

Param Poojya Dr. Babasaheb Ambedkar Smarak Samiti's



Dr. Ambedkar College

Deeksha Bhoomi, Nagpur



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RECOGNIZED AS "COLLEGE WITH POTENTIAL FOR EXCELLENCE" BY UGC

3.3.1

Number of research papers per teachers in the Journals notified on UGC website
during the last five years

Academic Year: 2020-21

Criterion 3

3.3.1. Number of research papers per teachers in the Journals notified on UGC website during the last five years

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51	‘Ambedkari Chalvalit Dadasaheb Gawai Yanche Yogdan’	Dr. Mohan D. Wankhade	PERSPECTIVES A National Interdisciplinary Annual Research Journal Vol. I Issue-VIII	Pali-Prakrit	No	338-343
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Machine Translation in Natural Language Processing

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The principal aim of the Natural Language Processing is to build a machine translation system that automatically learns translation mappings from bilingual lexemes. The Machine Translation (MT) focused on creating MT systems and technologies that cater to the multitude of translation. Data driven systems, with a statistical core engine, have proven to be the most efficient, due to the ability to adapt to broad domain coverage and being trained in new language pairs. This team works closely with research and development partners worldwide, making the system accessible to a variety of products and services.

Machine Translation has been a major focus of the NATURAL LANGUAGE PROCESSING group since 1999. This approach to Machine Translation has been “data-driven”. Rather than writing unambiguous rules to translate natural language, these algorithms on human-translated parallel texts, allows automatically learn for translation. First generation Logical Form based system learned translation patterns at the level of abstract parsed tree structures, and used to translate the entire Microsoft support knowledge base system into several languages. These recent research has focused on Statistical Machine Translation (SMT).

Syntax-Based SMT. Translating content from English language into as many foreign languages as possible is a big challenge for Multinational company’s not to mention the billions of people around the world who do not aware about English Language. The Treelet Translation System leverages an English natural language parser to help forguiding this process. This new technology is currently used in several location across Multinational company’s, including the Live translation system for computer-related texts and the Microsoft Support sytem site. Ongoing research has produced major improvements in the choice of wordinflections and word ordering in this system.

Phrase-Based SMT: Many leading STATISTICAL MACHINE TRANSLATION systems do not use any linguistic resources, such as

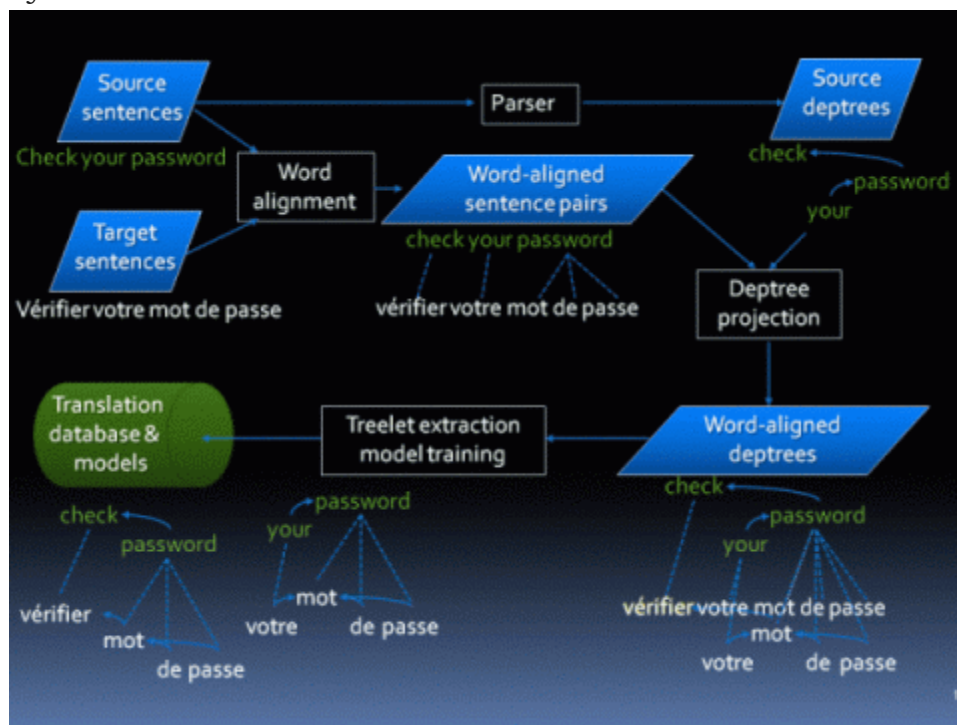
dictionaries, grammars, or parsers. These so called “phrase-based” systems on the way to learn translations of arbitrary word sequences of words directly from parallel texts. By improving the methods used to reduce the search for the best translation in this type of system, we try to find better translations in less time than previous systems.

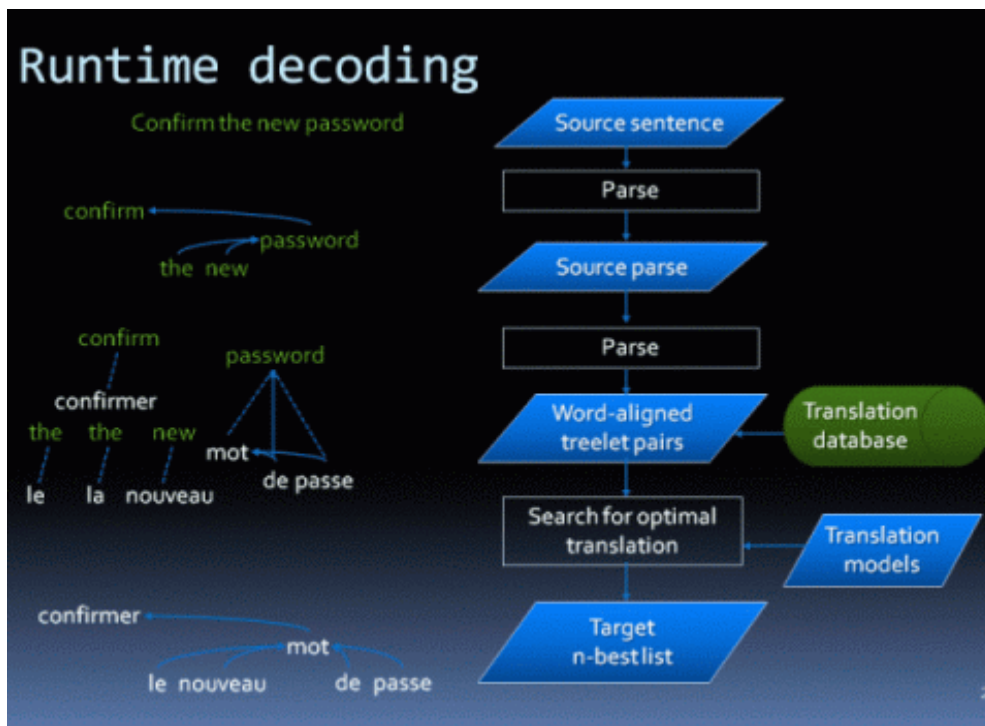
Word Alignment:- SMT systems find out translations from existing bodies of translated data. For most modern systems, identifying the word correspondences or word alignments in this translated data is a decisive step in training systems. We produced revolutionary work in both discriminative and generative approaches to word alignment, resulting in faster alignment algorithms with state-of-the-art quality.

Language Modeling:-

Large n-gram language models are a crucial component in high-quality SMT systems. Trained on only target language data, they help translation systems select fluent and readable output. MSRLM is a publicly-available language modeling toolkit developed at MSR. The toolkit is both fast and scalable, training a 5-gram model from more than one billion pre-tokenized words in about 3 hours on a single machine.

MSR MT System





Other research areas:

Some languages have their own special challenges; for instance, word boundaries are not indicated in normal Chinese texts. MSRSeg can both segment Chinese words and identify names of entities such as people and organizations, capabilities that are very useful in machine translation. More detail on our Japanese MT work can be found here.

Currently our systems are trained on parallel texts that supply sentence-for-sentence translations of the original information. We have developed accurate methods of finding parallel sentences among mostly parallel documents. We have also begun research in extracting parallel data from pairs of “comparable” documents, which contain some information in common, but are not direct translations of each other.

Products and Integration Scenarios:

Microsoft Translator, a free translation portal, and a web service that powers many other translation scenarios, is the latest result of the work done by our research and product teams. The goal is to create the simplest, most intuitively integrated and useful translation services available to end users—while making ongoing improvements to translation quality. This service allows Live Search users to translate foreign language search results by clicking

on “Translate this Page”. Users can also translate words, search queries, paragraphs or entire web pages through the Microsoft Translator portal. The Bilingual Viewer interface features a unique, side-by-side web page viewer that translates entire Web pages with blinding speed between 25 sets of language pairs. In addition, there is a Windows Live Toolbar Button , an add-in that puts a button on users’ websites, allowing their visitors to translate their web page using our service, and a Windows Live Messenger Translator Bot prototype that lets users translate IM conversations in a number of popular languages. Portions of the technology behind MSR-MT, including parsing, LFs, MindNet, have been used in the grammar checkers in Word, in the natural language query function of Encarta, and in other MS products.

The system already has proven its value within Microsoft, having been used in 2003 to translate nearly 140,000 customer- support Knowledge Base articles into Spanish (If you go to the web site, click on International Support and choose Spain as your country. You can then enter Spanish queries for the KB and receive back machine-translated hits.) The effort was extended to Japanese the next year and to French and German in 2005. Now, Microsoft’s Knowledge Base materials have been translated into nine languages by MSR-MT. This approach lowered the cost barrier to obtaining customized, higher-quality MT and Microsoft's support group is now able to provide usable translations for its entire online KB. It can also keep current with updates and additions on a weekly basis - something that was previously unthinkable both in terms of time and expense.

You can also visit the [MSR Machine Translation blog](#) to keep track of our ongoing product and scenario related work. This Research work is mostly used in comparative study of different Statistical techniques used in Machine Translation.

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Detection of 3243 A/G and 3316 G/A mitochondrial DNA mutations in Nagpur population

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ABSTRACT

The present study aims to detect 3243 A/G and 3316 G/A mitochondrial DNA (mtDNA) mutations in Nagpur population. Total of 142 patients of type 2 diabetes mellitus and 142 healthy control individuals were selected for the study from Nagpur city. Selected mutations studied using restriction fragment length polymorphism method and confirmed by DNA sequencing. Results showed that 3316 G/A mtDNA mutation found in seven patients of type 2 diabetes mellitus with a 4.92% prevalence, however, found absent in healthy control individuals. Chi-Square and Fisher's exact test showed a significant association between healthy control individuals and type 2 diabetes mellitus patients detected with 3316 G/A mutation ($p \leq 0.01$). ODDS ratio found significant (for 95% CI; $p = 0.05$) for 3316 G/A mutation. Furthermore, we did not find 3243 A/G mtDNA mutation in the studied population. Among studied mutations, 3316 G/A mutation in the ND1 gene is a pathogenic mutation that may responsible for type 2 diabetes mellitus in the Nagpur population.

1. INTRODUCTION

Worldwide, diabetes mellitus is a major health problem, often accompanied by polyuria, polydipsia, and glycosuria [1]. In the year 2000, the prevalence of diabetes mellitus was 171 million, which may increase to 366 million by the year 2030 [2] and about 70% of this burden will be shared by the developing countries. In India, epidemiological studies revealed a 1-4% prevalence of diabetes mellitus in the urban population, while 1%-2% prevalence in the rural population. This critical situation may be due to the change in life style, consumption of non-traditional food, and a genetic predisposition to various diseases [3,4].

Mitochondria are the main sites for respiration and inherit maternally [5,6]. Hitherto, prodigious work on mitochondria revealed that mtDNA mutations may cause type 2 diabetes mellitus. mtDNA is double stranded, measuring 16,569 bps in length, code 22 genes for transfer RNA (tRNA), 2 genes for ribosomal RNA (rRNA), and 13 polypeptides of the electron transport chain (ETC). Furthermore, the paucity of histone proteins and DNA repair enzymes make

mtDNA more susceptible to oxidative damages, which may result in homoplasmic (either mutated DNA or wild DNA) or heteroplasmic (both mutant and wild DNA) type of mutations [7]. However, maternal inheritance [8] and lack of recombination are considered the unique properties of mitochondria often use to identify maternal ancestors in a population [9].

For the present study, Authors selected 3243 A/G and 3316 G/A mtDNA mutations, the reason being their high prevalence rate worldwide. The 3316 G/A mtDNA mutation is responsible for the replacement of tyrosine by histidine in ND 1 gene [codes complex 1 (Nicotinamide adenine dinucleotide Dehydrogenase) of ETC] of the mitochondrial genome [10,11]. Also, 3243 A/G mutation results in an abnormal tRNA, which incorporates leucine amino acid in the growing polypeptide chain of the ETC [8].

Nagpur is a big city of central India and the vice-capital of Maharashtra state. This city is located near the boundaries of three states namely Madhya Pradesh, Chhattisgarh, and Andhra Pradesh and provides a varied range of populations with different dietary habits and living standards. These features make the Nagpur population a better model to study mtDNA polymorphism. Therefore, we have undertaken this study to know the status of mtDNA mutations and type 2 diabetes mellitus in the Nagpur population.

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2. MATERIALS AND METHODS

2.1. Family History and Sample Collection

For the present study, a total of 142 patients of type 2 diabetes mellitus was selected, who had a history of maternal inheritance in their family. To compare, 142 healthy control individuals were also selected (ages ranged from 18 to 75 years). All of them were selected from the Nagpur population. Blood samples were collected after taking signed consent. Family history was recorded meticulously.

2.2. Inclusion Criteria

Patients having a history of maternally inherited type 2 diabetes mellitus.

2.3. Exclusion Criteria

Any kind of history of paternal inheritance of type 2 diabetes mellitus, type 1 diabetes mellitus, juvenile diabetes mellitus, alcoholic individuals, smokers and surgery.

2.4. Isolation of mtDNA

mtDNA was isolated using a commercially available Abcam kit (ab65321) as per the manufacturer's instruction.

2.5. Detection of 3243 A/G Mutation

Total 422 nucleotides containing DNA was amplified by polymerase chain reaction (PCR), using ready to use master mix (Promega M7122). The forward primer was taken from nucleotide sequence 3035 to 3054 as 5'-CGTTTGTTC AACGATTAAG-3' and the reverse primer was taken from nucleotide sequence 3437 to 3456 as 5'-AGCGAAGGGTTGTAGTAGCC -3' [12]. The specificity of the primers was confirmed by primer BLAST using the national centre for biotechnology information (NCBI) database. The amplified PCR products were digested by Apa I restriction endonuclease (Promega: R6361). After electrophoresis, the presence of the mutation generates two bands (212 and 210 bp) and the absence of the mutation generates a single band (422 bp).

2.6. Detection of 3316 G/A Mutation

To identify 3316 G/A mutation authors used a new set of primers from the revised Cambridge reference sequence of human mtDNA (MITOMAP). A total 261 nucleotides containing DNA was amplified by PCR, using ready to use master mix (Promega M7122). The forward primer was taken from 3150 to 3175 as 5'TACTTCACAAAGCGCCTTCCCCCGTA 3' and the reverse primer was taken from 3388 to 3410 as 5' TTGCGTAGTTGTATATAGCCTAG 3'. The specificity of the primers was confirmed by primer BLAST using the NCBI database. The amplified PCR products were digested by Hae III restriction endonuclease (Promega: R6041). After electrophoresis, the presence of the mutation generates a single band (261 bp), while the absence of the mutation generates two bands (167 and 94 bp).

2.7. PCR Reaction Conditions and the Detection of Amplified DNA Bands

Primers were synthesized by integrated DNA technologies. A 12 μ l PCR reaction cocktail consisted of 1 μ l DNA as a template (100 ng), 2 μ l of forward primer (100 ng), 2 μ l of reverse primer (100 ng), and 7 μ l of the Promega master mix. PCR condition consisted: incubation for 3 minutes at 94°C, forwarded by 30 seconds at 94°C, 30 seconds at 55°C, 45 seconds for 72°C, and a final incubation for 5 minutes at 72°C, in Bio Rad thermal cyclar. The resultant amplicons of both mutations were identified using 2% agarose gel containing ethidium bromide, in the Gel Doc system (Bio Rad) and compared with 100 to 1,000 bp DNA ladder. The identified mutation was further confirmed by DNA sequencing.

2.8. Statistical Analysis

All statistical analyses were done using Med Calc statistical software (version 10.2.1.0). The Chi-Square test and Fisher's exact test were used to show an association between type 2 diabetes patients and healthy control individuals. The prevalence of the mutation was observed by the number of mutated samples over the total number of samples analyzed. ODDS ratio was used to define exposure of mutation and its probable outcome. $p \leq 0.05$ was considered as a level of significance.

3. RESULTS

Authors screened 142 patients of type 2 diabetes mellitus and 142 healthy control individuals to detect 3243 A/G and 3316 G/A mtDNA mutations. The restriction fragment length polymorphism analysis showed that seven patients of type 2 diabetes mellitus found positive for 3316 G/A mutation with 4.92 % of prevalence, while this mutation found absent in the healthy control individuals (Fig. 1). Furthermore, the presence of this mutation was confirmed by DNA sequencing (Fig. 2).

For the prevalence of 3316 G/A mutation, Chi-Square and Fisher's exact test showed a significant association between type 2 diabetic patients and healthy control individuals ($p \leq 0.01$). Moreover, for this mutation ODDS ratio demonstrated a significant association



Figure 1: Identification of 3316 G/A mitochondrial DNA mutation. Well 1 shows DNA ladder. Well 2 to 8 represents mutation (diabetic patients); however well 9 and 10 show the absence of the mutation (healthy individuals).

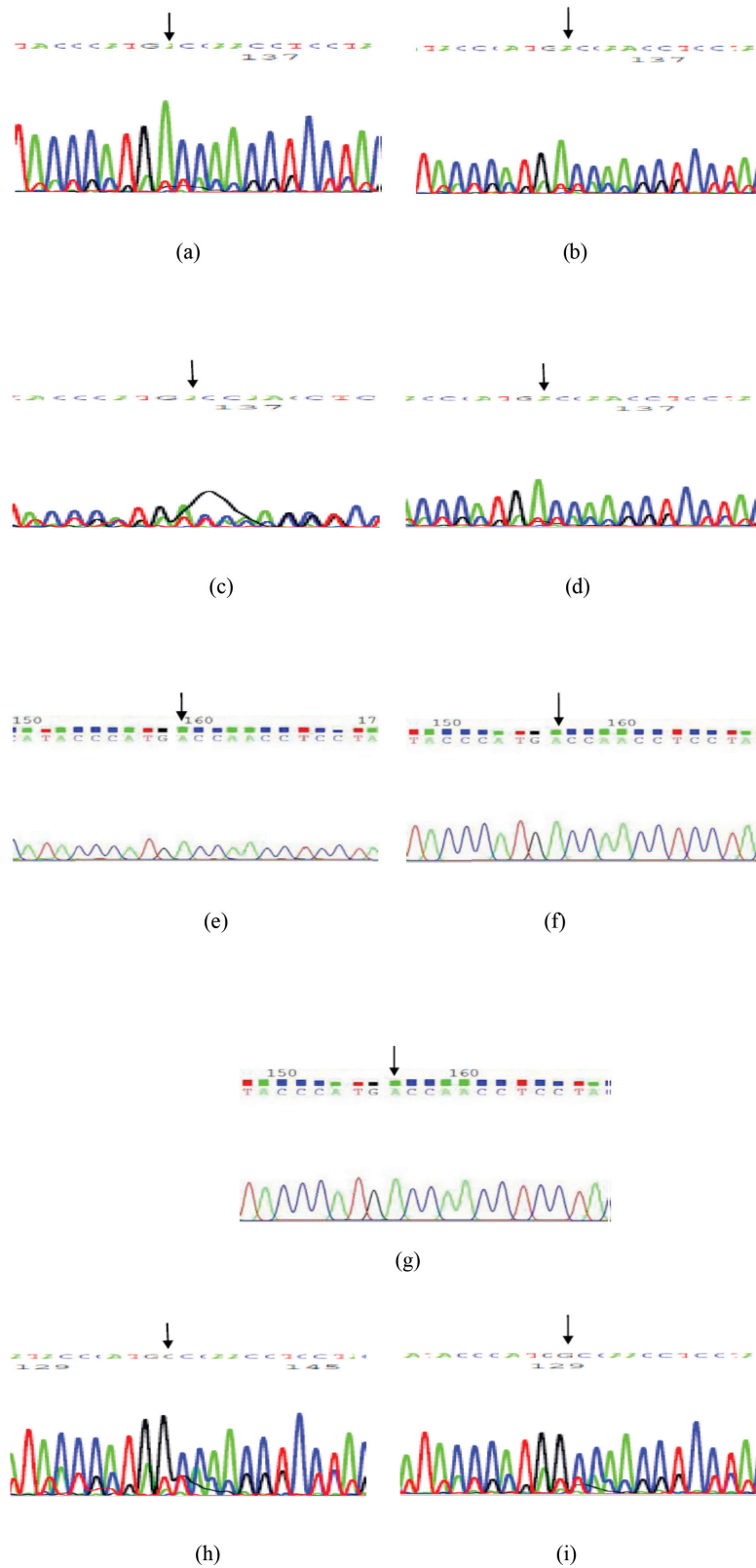


Figure 2: DNA sequencing result shows the presence of 3316 G/A mutation in seven patients of type 2 diabetes mellitus (a–g) and absence of the mutation in healthy control individuals (h and i).

between diabetic patients and healthy control individuals ($p = 0.05$). 3243 A/G mutation found absent in type 2 diabetes patients and healthy control individuals.

Table 1 represents the clinical characterization of seven patients of type 2 diabetes mellitus found positive for 3316 G/A mutation. The ages of the patients were ranged from 36 to 64 years, however,

the ages of the onset for type 2 diabetes mellitus varied from 34 to 52 years. The levels of fasting and postprandial glucose indicate severe hyperglycemia, resulted in high glycosylation of hemoglobin (HbA1C). Patient 2 (represented by I3 in the pedigree; Figure 3) was mentally retarded and the level of urea (48 mg/dl) and creatinine (1.9 mg/dl) were found elevated, which showed kidney dysfunction, however, rest of the family members exhibited these values in the normal range.

The mtDNA sequences were deposited in the NCBI gene bank with following accession numbers: LC064880, LC064881, LC064882, LC064883, LC064884, LC064300, LC064711, LC064712, and LC064713.

4. DISCUSSION

Due to its non Mendelian inheritance, mtDNA polymorphism can be used as a marker for the genetic elucidation of the world population; hence the detection of single nucleotide polymorphism in mtDNA has attended much prominence. In the last few decades, the extensive body of literature has reported the role of mtDNA

in type 2 diabetes mellitus [13–15]. Approximately, 40 different mtDNA mutations have been reported yet for the pathogenesis of type 2 diabetes mellitus [7].

Moreover, in the year 1992, Van Den Ouweland [12] had described the role of mtDNA mutation A/G at position 3243 as a causative factor for type 2 diabetes mellitus in a large pedigree. Since then, huge work has been done globally to know about the frequency of mtDNA mutations in different populations. Among these, 3243 A/G and 3316 G/A detection were more common.

This study did not report 3243 A/G mtDNA mutation in type 2 diabetes mellitus patients and healthy control individuals, indicating this mutation is not a major cause of maternally inherited type 2 diabetes mellitus in Nagpur population. The absence of the mutation is because of the higher level of 3243 A/G mutation is detected in muscles rather than the rapidly dividing tissue like blood [16]. However, for heteroplasmic mtDNA mutation, the development of physiological and clinical consequences depends on the threshold of the mutation. Furthermore, thousands of copies of mtDNA are present in each cell; hence the level of heteroplasmy may vary from 1% to 99% among different cells and tissues [17,18]. Therefore a female carrying mtDNA mutation may transmit the different amounts of the mutated mitochondria to her offsprings, within the same family; makes prenatal and postnatal genetic testing in maternally inherited mitochondrial abnormalities more complicated and problematic [19,20].

In this study, seven patients of type 2 diabetes mellitus showed 3316 G/A mutation in the mitochondrial genome and Chi-Square and Fisher's exact test also showed a significant association between type 2 diabetes patients and healthy control individuals ($p \leq 0.01$). These results represent that, mtDNA polymorphism due to 3316 G/A mutation is related to type 2 diabetes mellitus in the Nagpur population, instead of a neutral polymorphism. Furthermore, we found a significant ODDS ratio for 3316 G/A mutation and type 2 diabetes mellitus (for 95% CI; $p = 0.05$). Also, 4.6% of prevalence

Table 1. Clinical Characterization of patients identified with 3316 G/A mutation.

Parameters	P1	P2	P3	P4	P5	P6	P7	Normal range
Age (years)	64	62	59	57	41	36	37	–
M/F	F	M	F	F	F	M	M	–
Onset (years)	48	52	45	39	38	34	34	–
Fasting Glucose	180	213	185	199	156	162	192	60–105 mg/dl
PP Glucose	298	345	276	299	289	302	280	<126 mg/dl
HbA1C	10.3	11.4	10.2	9.4	8.8	9.8	10.1	4–6 %
Urea	21	48	20	19	18	19	21	7–22 mg/dl
Creatinine	0.8	1.9	1.2	1.4	0.9	1.1	1.1	0.8–1.5 mg/dl

P = Patient; PP = Post Prandial; HbA1C = Glycosylated Hemoglobin. M/F = Male/ Female Position of patients in the pedigree analysis was represented as: P1 (I2), P2 (I3), P3 (I6), P4 (I7), P5 (II2), P6 (II9), P7 (III2).

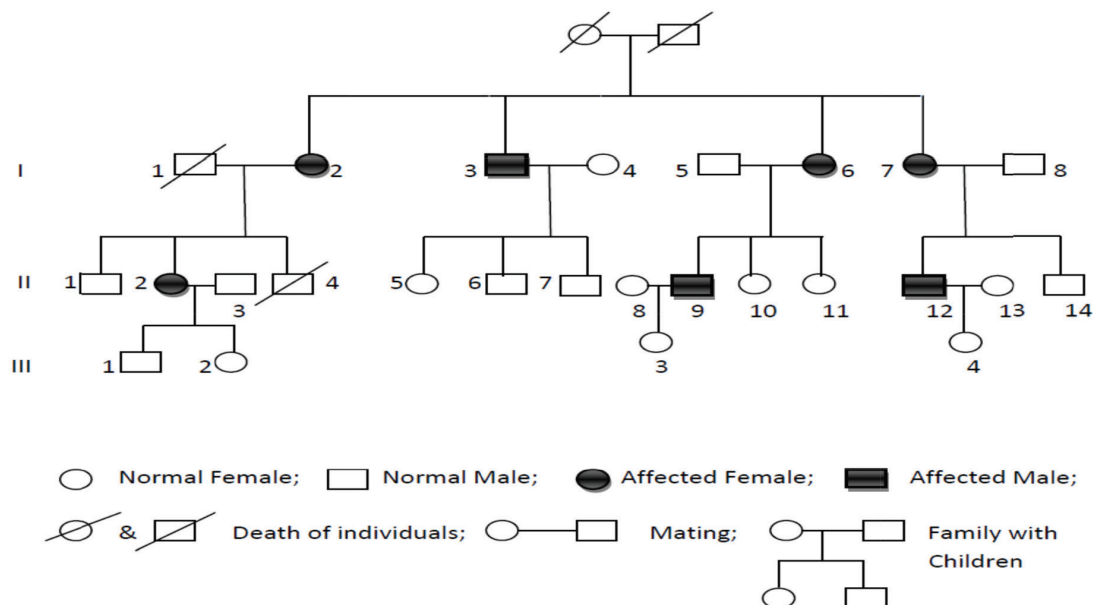


Figure 3: Pedigree analysis of the individuals affected by 3316 G/A mutation. I, II, and III represent generations.

has been reported for this mutation, which is similar to the different prevalence rates observed in other populations worldwide [21].

3243 A/G mutation has been reported for muscle stiffness and mental retards [11], however, in the studied population mental retard was found associated with 3316 G/A mutation (patient 2). This is possible since the position of 3316 G/A mutation exists nearer to the 3243 A/G mutation. Hence, we could predict that 3316 G/A mutation may also be involved in the etiology of mental retardation as similar to 3243 A/G mutation.

Clinical characterization of patients detected with 3316 G/A mtDNA mutation has been recorded in Table 1. Increased level of urea and creatinine in patient 2 (Fig. 3: I3) clearly shows the diabetic nephropathy, while it is not noted in the other family members. The higher range of fasting, postprandial glucose, and HbA1C values was reported in all patients, indicating that these patients are more prone to micro and macro-vascular complications. Kidney dysfunction was recorded for a single male candidate, which is possibly due to prolonged increased exposure of hyperglycemia.

5. CONCLUSION

The 4.92% prevalence of 3316 G/A mutation and its significant association between type 2 diabetic patients and healthy individuals concluded that this mutation may be associated with maternally inherited type 2 diabetes mellitus as a pathogenic mutation in Nagpur population. However, further studies are required to know about the possible role of 3316 G/A mutation as a causative agent for mental retardation. The absence of 3243 A/G mutation concludes that this mutation is not responsible for the type 2 diabetes mellitus in the studied population. This study provides a new genetic predisposition for maternal inheritance of type 2 diabetes mellitus in the studied population. This study will be useful for a large cohort and meta-analysis studies.

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CONFLICT OF INTEREST

Authors declare that they do not have any conflicts of interest.

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Screening of Selected Ethno-Medicinal Plants for Anti-Cancer Activity

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Abstract Cancer is an epidemic worldwide. As per the report of the National Centre for Health Statistics in 2019, approximately 606,880 patients were died due to cancer and 1,762,450 new cases were detected. To overcome this scenario, worldwide research is going on to combat this disease. Among these, treatment of cancer through plant phytochemical has attended much prominence in the last few decades. Phytochemicals are produced by plants for their defense mechanism. However, these can also be used to treat many deadly diseases, among them cancer is most common. In the present study, we selected three Ethno-medicinal plants namely *Careya arborea* (leaf), *Ficus religiosa* (leaf) and *Amorphophallus campanulatus* (tuber) to evaluate their efficacy against A549 human lung cancer cells. MTT assay is widely used to assess cell viability. Human lung adenocarcinoma cell lines were purchased from NCCS, Pune and maintained in the laboratory under all standard conditions. Cells were grown, using ready to use media containing 4.5 grams of glucose, L-glutamine and sodium pyruvate. Growth factors were made available to the cells through the fetal bovine serum. We treated the cells with different concentrations of methanol and distilled water extracts of the selected plants and investigate the cell viability using a statistical test. We found varied significant differences between control cells and the cells treated with plant extracts.

Keywords Ethno-Medicinal Plants, A459 Lung Cancer, Phytochemicals, Cancer

1. Introduction

Lung cancer is most common in men and the third most common cancer in women. In low and middle income countries 50% deaths are due to lung cancer [1]. Today, despite worldwide cancer eradication and awareness programmes, cancer established itself a killer disease around the globe.

When normal cells lose their regulatory mechanisms and halt apoptosis leads to abnormal growth of cells and tissue, called as cancer. These mechanisms make cell resistant to chemotherapeutic drugs [2]. Indeed, it took more than five decades to establish a systematic drug discovery on cancer what we have today. However, chemotherapeutics as a treatment in cancer do not devoid their intrinsic problems. Use of these agents for cancer treatment often creates more secondary complications in patient. For example, use of a chemotherapeutic agent, called as 5-fluorouracil is known to cause myelotoxicity, cardiotoxicity and often thought to act as a vasospastic agent in few documented cases [3, 4]. Drug doxorubicin has been reported to cause renal toxicity, cardiac toxicity and myelotoxicity. Another widely used drug named bleomycin is known to cause pulmonary toxicity and cutaneous toxicity. Similarly, cyclophosphamide drug is used to treat many malignant conditions, has been reported for bladder toxicity in the

form of alopecia, immune suppression and hemorrhagic cystitis. Meaning, modern and advanced chemotherapeutic drugs are failed to fulfil the lung cancer treatment [4-8].

Therefore, there is regular and constant demand to develop new therapeutics against cancer to meet the safety and costing strategies. Hence development of new anti-cancer therapeutics using traditional natural products and plants has attracted much attention of scientific communities in the last 3 decades [9, 10]. At present, about 60% anticancer drugs are derived from the plants due to its affordability and lower side effects (except few plants). Plants like *Vinca alkaloids*, *Taxus diterpenes*, *Podophyllum lignans* and *Camptotheca alkaloids* have been found most effective against cancer. Moreover, flavopiridol isolates from the Indian tree *Dysoxylum binectariferum* and compound like meisoindigo isolated from the Chinese plant *Indigo feratinctoria* have been reported for their potential anti-cancer activities than conventional drugs [2-4]. Approximately more than 3000 plant varieties worldwide have been known and used to treat cancer. In Asia, about 50% people use these plants and its derived compounds to treat cancer [1]. India, bestowed with a large biodiversity. From ancient time Indians have been using plant derived compounds to treat various ailments. Indeed, plants produces different kind of phytochemicals for their protection and development in different habitats, perhaps, hence selection of a same plant from different habitat and region may give different results [11]. Therefore, in present study we selected aforesaid three ethno-medicinal plants to check their efficacy against anti-cancer activities.

2. Materials and Methods

Plant Selection and Authentication

The selected plants are collected from Umred forest during July to November 2018. Plant authentication was done with the help of herbariums at the department of Botany, Dr Ambedkar College, Deekshabhoomi Nagpur.

Plant Extract Preparation

Selected plants were dried in a shed and then subjected to Soxhlet apparatus and Rotary evaporator for their methanol and distilled water extracts. Suitable concentrations of the extracts were prepared using 1% Dimethyl Sulphoxide.

Cell Line

Human lung adenocarcinoma A549 cells were purchased from the National Centre for Cell Science (NCCS) Pune and maintained in Ham's F12 nutrient mixture (Himedia), with 10% Fetal Bovine Serum (FBS) (Hyclone) and 1% streptomycin and penicilin antibiotic

(Hyclone) at 37 °C at 5% CO₂. Experiments were done on fourth passaged cells.

Cell Viability Assay

Cell viability was assessed using MTT assay. 2×10⁴ cells were seeded in required wells of 96 well plate. Cells with media were incubated at 37 °C in CO₂ incubator (Sartorius) for 24 hours with and without plant extracts. After 24 hours, media was removed and MTT (Himedia) was added at a concentration 5 mg/ml and again incubated for 4 hours. After 4 hours MTT was removed and purple coloured farmazon crystals dissolved in 100µl DMSO solution. Absorbance was measured at 570 nm using ELISA plate reader (Bio-Rad). Results were expressed in percentage using following formula:

$$\text{Cell Viability} = \text{OD of Sample} / \text{OD of Control} \times 100.$$

Statistical Analysis

Statistical analyses were done using Medcalc statistical software. Student "t" test assuming unequal variance was used to assess the significant differences between studied groups. Data was presented in Mean±SEM. P<0.05 was considered as a significant level.

3. Results

We found varied significant differences when selected plants with different extracts at different concentrations compared with control. For *Careya arborea*, we found significant decreased cell viability for 10 µg/ml (p<0.0001) and 20 µg/ml (p<0.001) methanol extract. However, we found non-significant difference for 40 µg/ml methanol extract when compared with control. However, for distilled water extract, we found significantly increased cell viability for 20 µg/ml (p<0.05) and 40 µg/ml (p<0.01) concentrations. A non-significant difference was found when 10 µg/ml extract compared with control (Table 1; Figure 1: a and b). For *Ficus religiosa*, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 40 µg/ml (p<0.001) methanol extract.

However, we found non-significant difference between control and 20 µg/ml methanol extract. For distilled water extract, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 20 µg/ml (p<0.01) and 40 µg/ml (p<0.001) concentrations (Table 1; Figure 1: c and d). For *Amorphophallus campanulatus*, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 40 µg/ml (p<0.001) methanol extract, while a non-significant difference was found between control and 20 µg/ml extract. For distilled water extract, we found significant increased cell viability for 10 µg/ml (p<0.001) and 20 µg/ml (p<0.01) and 40 µg/ml (p<0.001) concentrations (Table 1; Figure 1: e and f).

Table 1. Data showing cell viability assay of selected plants with different plant extracts at different concentrations.

PLANTS	EXTRACT	Percentage of Cell Viability at		
		10 µg/ml Mean ±SEM	20 µg/ml Mean ±SEM	40 µg/ml Mean ±SEM
Control		100.003 ±0	100.003 ±0	100.003 ±0
<i>Careya arborea</i>	Methanol	20.18 ±0.41****	48.90 ±1.52***	94.01 ±21.98
	Distilled Water	98.13 ±1.66	234.64 ±19.48*	137.96 ±3.53**
<i>Ficus religiosa</i>	Methanol	218.33 ±1.13****	101.84 ±2.17	331.55 ±0.001***
	Distilled Water	193.53 ±1.85****	126.12 ±1.73**	350.74 ±6.22***
<i>Amorphophallus campanulatus</i>	Methanol	218.33 ±1.13****	101.84 ±2.17	331.55 ±7.87***
	Distilled Water	193.53 ±1.85****	126.12 ±1.73**	350.74 ±6.22***

*p<0.05; **p<0.01; ***p<0.001; ****p<0.0001. SEM: Standard Error Mean. Different concentrations of plant extracts were compared with control.

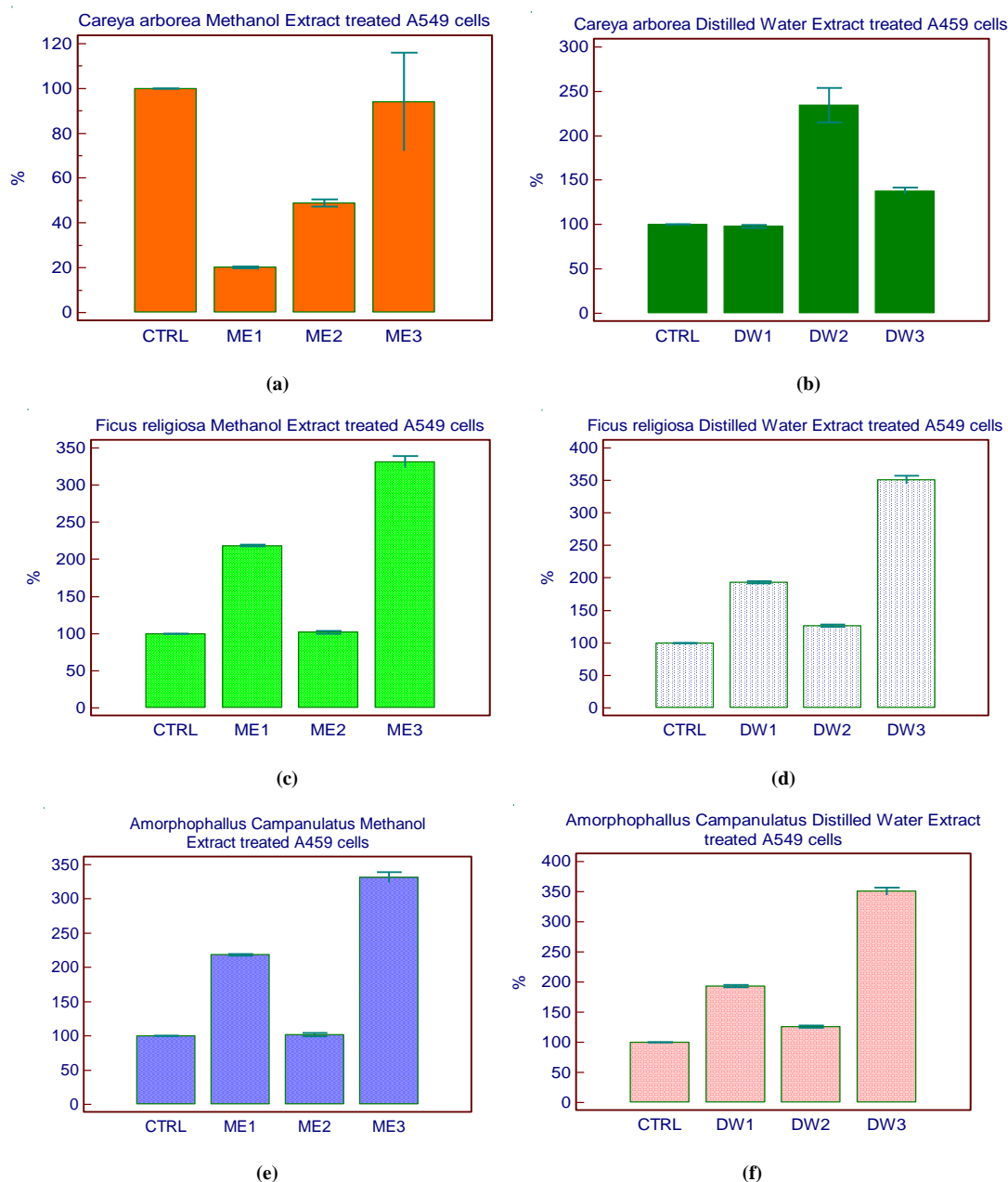


Figure 1. Figures representing cell viability percentage of A549 cells when treated with different plant extracts at different concentrations. Figure (a) and (b) representing cell viability of *Careya arborea* plant methanol and distilled water extract respectively. Figure (c) and (d) represents cell viability of *Ficus religiosa* plant methanol and distilled water extract respectively and figure (e) and (f) represents cell viability of *Amorphophallus campanulatus* plant methanol and distilled water extract respectively. CTRL: Control; ME1: Methanol Extract (10 µg/ml), ME2: Methanol Extract (20 µg/ml), ME3: Methanol Extract (40 µg/ml), DW1: Distilled water (10 µg/ml), DW2: Distilled Water (20 µg/ml), DW3: Distilled Water (40 µg/ml).

4. Discussion

Screening of plants for anti-cancer activities urge to search for more reliable and potent drugs. Worldwide research is going to derive natural product-based therapeutics not only for cancer but also to treat other ailments. So, being one of the greatest and diverse biodiversity, India should lead the world. Hence through this work, we drive to focus the plants of central India for deriving such novel therapeutics. Prodigious work done on plants has already explored publications on plant-derived compounds as novel drug molecules.

Moreover, to determine active biological compounds from the plants we need to explore our traditional knowledge about plants and natural product that we have gathered since ancient time against various diseases; by providing a scientific shred of evidence. Plants have various phytochemicals which may lead to in-vitro cell survival or cell death. By isolating such bio-active compound from plants we may treat various diseases [12, 13]. Cancer is a condition where there is continuous cell growth with a lost apoptosis mechanism. This may lead to tumour formation resulting disrupt cellular mechanism and death. To suppress tumour growth numerous medications and the treatments are available, but a question is always posed for their reliability and safety [14]. Therapeutics derived from natural products may oppose this question and hence plant derived bioactive compounds have attended much importance in the field of cancer research [15]. Therefore, the present study aimed to screen three ethno-medicinal plants for anti-lung cancer activity using A549 human adenocarcinoma cells. In the present study, among all three selected ethno medicinal plants methanolic extract of *Careya arborea* exhibited the decreased cell viability as compared to the control. Result showed that this plant may have a property to treat human lung cancer. Methanolic extract of *Careya arborea* at the concentration of 10 ug/ml and 20 ug/ml exhibited the decreased cell viability, however with a concentration at 40ug/ml showed a non- significant difference. This is possibly due to the fact that, we used a crude methanolic extract of the plant, which contains numerous useful and unusual bioactive compounds [16]. Distilled water extract of the plant showed increased cell viability, suggesting its non-potential to treat A549 cells. Methanolic and distilled water extracts of *Ficus religiosa* and *Amorphophallus campanulatus* also showed significant increased cell viability suggesting their non-anti-cancerous activities. Of note, the possible reason for the non-linear relationship between dose and effects for all studies plants could be the crude extracts. Further, the phytochemicals or plants secondary metabolites synthesised by plants may promote cell growth and differentiation. Cancer is modulated by a variety of cellular signalling pathways, albeit, to inhibit cancer via modulating such signalling pathways plant must possess special kind of biochemical compounds that can

modulate such cancer leading mechanisms. Although *Ficus religiosa* and *Amorphophallus campanulatus* did not show anti-cancer activities, their phytochemicals might use for other ailments; as each plant may synthesise different phytochemicals at different climatic conditions. Thus, one can predict that *Careya arborea* from different geographical locations and habitat conditions may exert different results.

Worldwide research on medicinal plants suggested their complete phytochemical and biochemical analysis, required to derive their best possible biological outcomes. *Tinospora cardiofolia* also is known as giloya in Hindi and heartleaf plant in English is a smooth climbing shrub often abundant in India, Myanmar, China and Shri Lanka. In Ayurveda, this plant is considered to be "amrita" for its longevity, youthfulness and vitality. This plant is also well known for its anti-inflammatory, anti-arthritis and anti-allergic properties often use against general debility, dyspepsia, fever, urinary diseases and jaundice. Stem extract found to be active against various skin diseases. This plant is also reported for high anti-oxidant content and immune-modulatory activities. Methanolic extract of *Tinospora cardiofolia* contains alkaloid like choline, isocolumbin, tinosporin, columbine, palmatine, magnoflorine and tetrahydropalmatine as active components. Dose dependant increased concentration of methanolic extract of this plant found effective against HeLa cancer cell lines. However, it's anti-cancer activity also found in rats where it reported for rapid tumour suppression at a dose of 50 mg/Kg [4, 17-24].

Another example is related to *Ziziphus nummularia*, also known as beri in Hindi and jujube in English, is a shrub, with purplish stem, found abundant in India, Pakistan, Afganistan, Egypt etc. Different plant parts like root, bark, stem, flowers and seeds have been reported for different biological activities. The bark and the stem of this plant found rich in two phytochemicals called betulin and betulinic acid. Both compounds exhibited anti-cancer activities. Betulinic acid has been reported to induce apoptosis in cancer cells by increasing reactive oxygen species concentration, topoisomerase inhibition, mitogen-activated protein kinase (AMP kinase) cascade activation, and angiogenesis inhibition and by modulating pro-growth transcriptional activators. Moreover, betulinic acid has been reported to induce apoptosis by p53 and CD95 independent mechanism. It has been revealed that the combined treatment of betulinic acid and other anti-cancer drugs induces loss of mitochondrial membrane potential and releases cytochrome-c and thereby induce apoptosis [4, 25-32].

From above cited examples it has been assumed that the selected plants of this study might possess properties against not only for cancer but also for other ailments and hence, demand in detail study to elucidated their phytochemicals rather active biochemical structures, to open a new window for researchers in central India.

5. Conclusions

Among selected three ethno-medicinal plants crude methanolic extract of *Careya arborea* might have a potential to treat human lung adenocarcinoma. Other two plants may have different types of potentials to treat varied diseases and ailments. Although this is a basic study providing first superficial inference; finding bioactive compounds using high-end techniques like high-performance liquid chromatography (HPLC) and Gas chromatography-mass spectrophotometry (GC-MS) analysis are required. Further, the bioactive guided assay may use as a track to elucidate enormous biological functions of these plants.

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Obesity, Cardiovascular Diseases and COVID-19

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ABSTRACT

Obesity is a metabolic disorder which is emerging as a worldwide epidemic. It is often associated with diabetes, hypertension and Cardiovascular Diseases (CVDs). High calorie intake/nutrition causes excess deposition of Free Fatty Acids (FFA) in adipose tissue, which later transports those FFA to the liver for further metabolic activities, resulting in dyslipidemia. However, altered secretion of adipokines plays an important role in the pathophysiology of obesity related complications via low grade chronic inflammation. Adipokine like Interleukin-6 (IL-6) favour endothelial dysfunction by stimulating monocyte to macrophage differentiation using adhesion molecules. Secretion of the Renin Angiotensin System (RAS) components and angiotensin-II activity promotion are considered the additional functions of adipose tissue. Indeed, all these aspects of adipose tissues have been evidenced for the development and the progression of CVDs. Coronavirus Disease (COVID-19) is a worldwide pandemic affecting millions of people. Pre-existing obesity and CVDs have been suggested as a potential risk factor for increased severity of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection in patients. Therefore, this review focuses on the possible role of obesity related CVDs as a significant risk factor for COVID-19 severity.

Keywords: Adipose tissue, Free fatty acid, Severe acute respiratory syndrome coronavirus 2 severity

INTRODUCTION

The World Health Organisation (WHO) has declared the COVID-19 as a global pandemic. The International Committee on Taxonomy of Viruses renamed the virus as SARS-CoV-2 due to the aetiology and the symptoms. The SARS-CoV-2 is a positive-sense single stranded Ribonucleic Acid (RNA) (30 kb) enveloped virus which belongs to the β coronavirus family with a diameter of 50-220 nm. The spike glycoprotein (S1 and S2 heterodimers) is a key structural protein of this virus, which make it more pathogenic [1,2]. However, this is not the first time when coronavirus has infected humans. With common cold like symptoms, coronavirus was first reported in the year 1966 by Tyrell and Bynoe. Later in the year 2003, SARS-CoV-1 and the year 2012, the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) had infected people of many countries [3]. Interestingly, the genome of SARS-CoV-2 reported being associated with the genome of SARS-CoV-1 and MERS-CoV [1]. Worldwide, more than 3,000,000 people were infected and more than 2,00,000 people were killed by COVID-19, suggesting the severity of SARS-CoV-2 [4].

Meta-analysis on patients with COVID-19 elucidated CVDs as a major risk factor for severe COVID-19 infection. A meta-analysis of 76993 patients with COVID-19 reported that the prevalence of CVD was 12.11%, and hypertension was 16.37% [5]. Another study on 44672 patients reported that the prevalence of CVD was 10.5%, and hypertension was 6% [6]. Other studies show similar findings suggesting that pre-existing CVDs may be a risk factor for elevated mortality rate in COVID-19 disease [7-10]. Moreover, obesity has been considered as a prominent risk factor for the development and the progression of cardiovascular complications clustering myocardial infarction, dysrhythmias, carditis, heart failure venous thrombosis and thromboembolic disease [11]. Therefore, this review focuses on the functional, biochemical and pathophysiological aspects of the obesity mediated CVDs and their effects on the COVID-19 severity.

ADIPOSE TISSUE PHYSIOLOGY AND COVID-19

Adipose tissue is a vital organ typically involved in energy homeostasis of the body. In mammals, adipose tissues are classified as Brown

Adipose Tissue (BAT) and White Adipose Tissue (WAT). BAT is enriched with mitochondria and active uncoupling proteins, hence appear brown and generate heat via non-shivering thermogenesis respectively. Conversely, WAT is subdivided as visceral and subcutaneous fat depots and is principally involved in altered lipid metabolism (dyslipidemia) and obesity [12]. However, to store excess energy preadipocytes potentially differentiate in mature adipocyte, under the strict control of CCAAT/Enhancer-Binding Proteins (C/EBPs) and Peroxisome Proliferator Activated Receptor gamma (PPAR γ) transcription factors. This leads to adipose tissue expansion through hyperplasia (increase in adipocyte number) and hypertrophy (increase in adipocyte volume/size), responsible for obesity and its associated co-morbidities [13]. Further, adipose tissue acts as an endocrine organ that secretes various hormones/adipocytokines/enzymes called "adipokines". Elevated dyslipidemia and altered secretion of adipokines such as adiponectin, leptin, Plasminogen Activator Inhibitor-1 (PAI-1), IL-6 and visfatin have been reported as a major risk of CVDs in patients with obesity [14] and thus might be involved in the severity of COVID-19.

At present, there is no direct evidence explaining SARS-CoV-2 infection in adipose tissue, except Angiotensin Converting Enzyme-2 (ACE-2) receptor expression on several cells within this tissue, including mature adipocyte, macrophages, stromal vascular cells and endothelial cells [15,16]. Thus, the analysis of these cells may provide a possible interlinked mechanism between adipose tissue and the severity of COVID-19. Visceral adipose tissue is distributed specifically throughout the body. Hence, adipose tissue associated with lung might act as a SARS-CoV-2 reservoir and can modulate inflammatory responses, vascular wall dysfunction (atherosclerosis), CVDs and thereby, the severity of COVID-19 disease [17].

DISLIPIDEMIA, CVD AND COVID-19

Excess dietary FFA deposit in adipose tissue which is later transported to the liver. The Triglyceride (TG) rich lipoproteins (chylomicrons) derived from dietary FFA and cholesterol promote fat storage in the adipose tissue, while catabolism of TG promotes mobilisation of FFA as a fuel to the tissues and organs; therefore,

lipogenesis and the lipolysis are considered as the chief functions of the adipose tissue [18]. In the liver, FFA generates Very Low Density Lipoproteins (VLDL) consist of TG, cholesterol and apolipoprotein, suggesting hypertriglyceridemia. This lowers the amount of High Density Lipoproteins cholesterol (HDL-c) and increases the amount of Low Density Lipoproteins cholesterol (LDL-c) in serum, leading to dyslipidemia [19]. Conventionally, this altered lipid status has been reported for the diagnosis and the prognosis of the CVDs, atherosclerosis and hypertension [20]. Thus, determining dyslipidemia in patients with COVID-19 might give a link between CVDs and severity of this disease.

Almost all studies performed to determine dyslipidemia in patients with COVID-19 have shown the decreased levels of Total Cholesterol (TC), HDL-c and LDL-c [21-24]. These levels further decrease in critical and severe patients compared to mild patients, while putatively increases with the recovery of patients [25]. Also, higher monocyte/HDL-c ratio and the lower HDL-c levels in the primary infection cases than the secondary infection cases have also been reported [21]. Decreased LDL-c, HDL-c, and TC have been reported in many viral infections, including Hepatitis B Virus (HBV) and chronic illness such as cancer [26]. However, the role of cholesterol in the progression of viral infections has been well studied in Human Immunodeficiency Virus (HIV) and Hepatitis C Virus (HCV). The mechanism of the disease involves Scavenger Receptor B type 1 (SR-B1) binding site, HDL-c, free cholesterol and TG [27]. Further, membrane bound cholesterol has been reported to facilitate the entry of the virus in the host cell [28]. As far as SARS-Cov-2 is concerned, cholesterol facilitates the binding of SARS "S" protein with ACE-2, which allow the entry of the virus into the target cell (tongue/bronchi/lung). Also, a recent study showed that cholesterol metabolism regulating protein/enzyme decrease in human colon epithelial carcinoma cells infected with the SARS-CoV-2, which suggests the cholesterol modulatory effects of this virus [26]. Hence, a cholesterol lowering and ACE-2 upregulating drug like statin could be recommended as a therapeutic to prevent host cell infection and lung injury in patients with COVID-19 [29]. Conversely, Shrestha SK argued that the use of statin causes very low or no synthesis of endogenous cholesterol, resulting in the upregulation of LDL-c in the cell membrane [30]. Thus, the use of statin may increase the risk of COVID-19 by promoting host cell infection.

As per the standard lipid profile, decreased HDL-c and increased LDL-c is responsible for CVDs. However, in contrast to this, the patients with COVID-19 exhibit hypolipidemia. Decreased HDL-c favours CVD, while decreased LDL-c creates an enigma as it correlates with the increased severity of COVID-19 [26,31]. Further, as decreased level of cholesterol reduces the severity of host cell infection by SARS-CoV-2; however, patients with COVID-19 shows hypolipidemia, which warrants further investigations about the COVID-19 disease progression.

ADIPOKINES, CVDs AND COVID-19

Adipokines secreted by adipose tissue are reported for the pathophysiology of diabetes mellitus, non-alcoholic fatty liver diseases and CVDs [32]. Among various adipokines leptin, PAI-1, resistin, visfatin, hepcidin and chemerin have been reported for increased risk of CVDs via peripheral and central mechanisms, whereas adiponectin, omentin and IL-10 have been reported for their cardioprotective roles [33,34]. Therefore, altered secretion of adipokines during obesity could be used to correlate CVDs with the severity of COVID-19 and their possible pathophysiological mechanisms, of which adiponectin and leptin have received more importance [35]. Adiponectin exhibit an anti-inflammatory role by promoting secretion of anti-inflammatory cytokines like IL-10 and IL-1 receptor antagonist and by regulating pro-inflammatory cytokines like IL-6 and Tumour Necrosis Factor alpha (TNF- α). On the contrary, leptin acts as a pro-inflammatory cytokine and thus modulates cellular immune responses by favouring synthesis of

pro-inflammatory cytokines like TNF α , IL-2 as well as interferon- γ and by attenuating the synthesis of anti-inflammatory cytokines like IL-4 and IL-5 [36,37]. Hence, low grade chronic inflammation is a typical characteristic of obesity that affects the vessel wall and cardiovascular homeostasis. Also, leptin/adiponectin ratio has been proposed for adipose tissue dysfunction, lung injury and the progression of CVD [38]. Adiponectin helps in determining the mortality of patients with COVID-19 [39]. Thus, it could be predicted that CVD related COVID-19 severity may be due to the abnormal secretion of adipokines.

ADHESION MOLECULES, CVDs AND COVID-19

Elevated expression of adhesion molecules like Vascular Cell Adhesion Molecule (VCAM), Intracellular Cell Adhesion Molecule (ICAM) and E-selectin are evidenced for progression and diagnosis of CVDs [40]. During chronic inflammation, adhesion molecules and pro-inflammatory cytokines guide circulating monocytes for their endothelial migration and differentiation into the macrophages [41]. Accumulation of macrophages increases the further burden of inflammation in endothelial cells leading to CVDs and atherosclerosis lesions [42]. As stated before, obesity exhibit low grade chronic inflammation and contribute to the pro-inflammatory cytokines like IL-6 as well as TNF- α , and, therefore, promote atherosclerosis, hypertension and CVDs via aforesaid adhesion molecule mediated mechanism [43]. However, the severity of obesity mediated endothelial dysfunction and CVDs are significantly increased by IL-6 and an adipocytokine Monocyte Chemoattractant Protein-1 (MCP-1). IL-6 stimulates monocyte to macrophage differentiation [43,44], while MCP-1 regulates cytokine and adhesion molecule expression [45]. IL-1 and IL-6 blockers may reduce inflammation [46].

Adipokines are also reported for their effects on adhesion molecule targeted vascular wall disease and CVDs. Among them, adiponectin has been documented for the decreased production of adhesion molecules, while resistin and ghrelin stimulate VCAM-1 expression and ghrelin alone can increase the ICAM expression [47,48]. Also, Lung marginated monocytes have been reported for acute lung injury [49]. This discussion suggests that obesity induced altered expression of cell adhesion molecules are responsible for chronic endothelial dysfunction, CVDs and lung injury. Interestingly, it has been revealed that the Influenza virus infection in alveolar epithelial cells facilitates monocyte migration and macrophage differentiation. This transepithelial migration of monocyte is favoured by binding of monocyte β 1, and β 2 integrins and integrin associated protein with adhesion molecules (VCAM-1, ICAM-1, Cluster of Differentiation (CD47) and junctional adhesion molecule-c) expressed on the epithelial cells. The severity of this transepithelial monocyte infiltration is further accelerated by TNF- α [50,51]. Recently, Tong M et al., reported the elevated levels of VCAM-1, ICAM-1 and Vascular Adhesion Protein-1 (VAP-1) in patients with COVID-19 signifies the role of CVDs as a major risk of COVID-19 [52]. Although the authors did not explain the leading cause of higher adhesion molecules or inclusion/exclusion criteria related to obesity in the study, hence, a predicted cause associated with obesity might be postulated based on the above arguments.

RAS MEDIATED CVDs AND COVID-19

The Rennin Angiotensin System (RAS) is a crucial mechanism operating in the body that regulates cardiovascular functions and contributes to a series of CVDs [53]. As ACE-1 works actively with the RAS system and a potent source for cellular SARS-CoV-2 invasion, discussing it could be another pathway that can contribute to the high COVID-19 severity via CVDs [54]. Usually, the RAS system is composed of Angiotensinogen (AGT), rennin, angiotensin-I (Ang-I), angiotensin-II (Ang-II), ACE I and II (ACE-I and ACE-II) and two Ang II receptors namely angiotensin type 1 receptor (AT-1) and Angiotensin Type 1 receptor (AT-2) [55,56]. The rennin is an enzyme which acts on a 1,2 AGT (a 452 amino

acid-containing protein) to produce Ang-I. Ang-I (a decapeptide) acts as a substrate for ACE and produce Ang-II. Ang-II (an octapeptide) plays a pivotal role in distinct pathophysiological functions via AT-1 and AT-2 receptors [57,58].

Among these two receptors, binding of Ang-II to AT-1 receptor promotes vascular proliferation, growth, endothelial dysfunction and vasoconstriction, which are responsible for hypertension and atherosclerotic CVDs [59]. AT-2 acts reversely and favour tissue growth and repair mechanisms [60]. ACE-II inhibitors prevent the conversion of Ang-I into Ang-II and therefore can suppress the deleterious effects of Ang-II. Also, Ang-II inhibition stimulates the release of bradykinin, which shows vasodilatory and tissue protective effects [61,62]. Thus, attenuation of AT-1 and use of ACE inhibitors are considered as a potential therapeutic line for the treatment of RAS related disorders [60]. Further, both AT-I and AT-II receptors have been located in adipose tissue; suggesting local RAS [61]. Adipocytes are reported as a source for the synthesis of RAS components; however, synthesis is regulated with respect to the status of obesity and hypertension [62]. Ang-II exerts a crucial role in adipose tissue, including adipocyte growth and differentiation, adipokine release, lipid metabolism and different local RAS component production in the visceral and subcutaneous fat depot [63]. Hence, targeting a RAS might provide a link between obesity-related CVDs and severe SARS CoV-2 infection in patients.

CONCLUSION(S)

In summary, obesity is a chronic metabolic disorder responsible for CVDs via low state chronic inflammation. Studies on current COVID-19 pandemic shows various major risk factors that are associated with increased severity of SARS-CoV-2 infection in patients. Obesity makes favourable conditions for the development of the CVDs, however, these favourable conditions may contribute in the progression of COVID-19 severity through dyslipidemia, altered secretion of adipokines and adhesion molecules, endothelial dysfunction and the RAS. Therefore, targeting these aspects might provide new opportunities for developing novel therapeutic approaches to decrease the severity of SARS-CoV-2 infection in patients.

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OBESITY, ADIPOSE TISSUE DYSFUNCTION AND ATHEROSCLEROSIS

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ABSTRACT

Obesity is becoming a major health problem around the globe and reported as a severe risk factor for insulin resistance, diabetes, hypertension and atherosclerosis. Organ-specific distribution and the pattern of gene expression make visceral fat more atherogenic than subcutaneous fat. Adipose tissue expansion due to a high-calorie diet adversely affects the vessel wall by modulating blood pressure, systemic inflammation and glucose as well as lipid metabolism (dyslipidemia). Adipose tissue acts as an endocrine and paracrine organ that secretes various adipokines. In patients with obesity, altered secretion of adipokines leads to a chronic low-grade inflammatory state, which exerts detrimental effects on vascular endothelial cells, trigger atherosclerosis. This review focuses on the role of obesity in the pathophysiology of atherosclerosis. In the current scenario, obesity has been considered as a potential risk factor for the progression of Coronavirus disease-2019 (COVID-19). Thus, this review gives a brief idea about a possible link between obesity, atherosclerosis and COVID-19.

Keywords: Obesity, Adipose tissue, Atherosclerosis, Adipokines, Dyslipidaemia, COVID-19

1. INTRODUCTION

Obesity is often considered as a lifestyle disease and emerging as a worldwide pandemic. As per the recent statistics, in the United States, among adult men and women, the prevalence of obesity was 42.4%; however, adults aged 40 to 59 years showed severe obesity [1]. It is estimated that one in every two people by the year 2030 would have obesity and associated complications [2]. In a developing country like India, the situation will be worst if early preventive measures not taken. It is forecasted that up to the year 2040, the prevalence of overweight and obesity in Indian adults will increase to 30.5% from the prevailing percentage [3]. These statistics suggest the upcoming burden of obesity and its related diseases.

Obesity pathogenesis is mainly governed by organ-specific white adipose tissues (WAT), which originated from mesoderm and mesenchymal stem cells during embryonic development. Adipose tissue comprises of progenitor adipocyte (pre-adipocyte) cells, which have differentiation and de-differentiation potentials, therefore, maintain adipocyte pool within the body [4]. During metabolic disturbances, progenitor cells differentiate into mature adipocytes and store extra energy, which triggers obesity-related comorbidities. Further, adipose tissue secretes many bioactive factors/ hormones termed as "adipokines" which not only regulate meta-

bolic pathways but also involve in the pathogenesis of cardiovascular disease like atherosclerosis [5]. This is a concise review of the current update on the functional and the pathophysiological aspects of obesity mediated dysfunctional adipose tissue in atherosclerosis.

2. ADIPOSE TISSUE, DYSLIPIDAEMIA AND ATHEROSCLEROSIS

2.1. Adipose tissue physiology

Adipose tissue is a vital organ not only involved in lipolysis and lipogenesis but also modulates various physiological functions including body weight, food intake, inflammation, vascular functions and insulin sensitivity [6]. Adipose tissue comprises of various cells such as preadipocyte, mature adipocyte, stromal vascular cells, macrophages and endothelial cells, which facilitates modulation of other tissue growth, innate immunity (bacteria sensing, phagocytosis, antimicrobial peptides), shock absorbance, sonar (echolocation) and nutritional support during energy deprivation. In mammals, adipose tissues are classified as brown adipose tissue (BAT) and white adipose tissue. During embryonic development, Myf5 and Pax7 expressing precursor cells from the mesoderm develop BAT, which contains a prodigious amount of mitochondria, hence brown in appearance. Due to high mitochondria and active uncoupling proteins

BAT predominantly produces heat [7].

Conversely, WAT is mostly distributed throughout the body, including visceral depot (omental, retroperitoneal, pericardial and mesenteric) and subcutaneous depot (beneath the skin) and thus associated with overweight and severe obesity [8]. In lean subjects, adipose tissue exhibit preadipocytes howbeit to store excess energy these preadipocytes can differentiate into mature adipocyte through strict transcriptional regulation of CCAAT/enhancer-binding proteins (C/EBPs), peroxisome proliferator-activated receptor-gamma (PPAR γ) and sterol regulatory element-binding protein-1C (SREBP-1C) [9].

2.2. Adipose tissue expansion and obesity

C/EBPs and PPAR γ arbitrate transcriptional regulation of gene expression in adipocytes, which determines the adipose tissue mass expansion in response to excess calorie intake. This event plays a pivotal role in metabolic syndrome and cardiovascular disease like atherosclerosis [10]. Both visceral and subcutaneous WAT expands and contracts dynamically to satisfy an organism's metabolic demand. The expansion of WAT evokes through a rise in adipocyte number (hyperplasia) and/or by increasing adipocyte size/volume (hypertrophy) [11]. Hyperplasia is related to severe obesity, while hypertrophy is related to overweight, obesity and might diabetes. Maintenance of adipocyte numbers depends on a pool of progenitor cells; therefore, hyperplasia maintains a healthy expansion of adipose tissue. To the contrary, hypertrophy results in necrosis like adipocyte death and releases cellular debris in the extracellular space, triggering inflammatory responses (macrophages surrounds adipocyte). In adults, adipocyte number stays constant; however, weight alterations are related to adipocyte size; thus, hypertrophy may cause serious complications [12]. Studies on rodent showed the various origins of pre-adipocyte and so contribute differently to adipose tissue expansion. Visceral adipose tissues exhibit greater expandability as compared to subcutaneous adipose tissues. Another crucial factor that expands WAT and favours energy storage is hypoxia, which induces hypoxia-inducible factor 1 (HIF1) liable to inflammation, insulin resistance and adipocyte hypertrophy [11]. Differentiation of pre-adipocyte into mature adipocyte and de-differentiation of mature adipocyte back to pre-adipocyte is additionally significant for fat mass expansion. A recent study on mice and 3T3L1 preadipocyte cell line highlighted adipocyte expansion capacity. This study reported that repeated exposure of the high-fat diet to

epididymal WAT of formerly obese mice halt WAT expansion, at the same time, immune cells like macrophages and T cells are retained. The weight loss cycle studied for six months in mice reported long lasting changes in the physiological response to regain weight [13].

2.3. Dyslipidemia in adipose tissue

In mammals, a rise in adipocyte number and volume due to altered metabolic activities promotes obesity. Primary dyslipidemia in obese patients is associated with modified lipid storage and mobilisation, which favour atherosclerosis. In adipose tissue, fat storage is promoted by chylomicrons (triglyceride-rich lipoprotein) derived from dietary fatty acids and cholesterol and are stored in adipose tissue as triglyceride (TG), while fat mobilisation is promoted by lipolysis of TG which supplies free fatty acid as fuel to tissues and organs [14]. In the presence of insulin, the liver plays a significant role in the processing of those free fatty acids and generate very-low-density lipoproteins (VLDL). Both visceral and subcutaneous fat depots transport a pool of free fatty acids to the liver. Hence, during obesity, dyslipidemia is characterised by hypertriglyceridemia, a well-known risk factor of atherosclerosis. Of note, the visceral fat depot is highly associated with hypertriglyceridemia than subcutaneous fat depot. Further, VLDL consists of TG, cholesterol and apolipoproteins, which suggests hypertriglyceridemia elevation. Hypertriglyceridemia promotes the TG enrichment of high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein (LDL), resulting in a lower concentration of HDL and a higher level of LDL. This dyslipidemic condition in obesity promotes atherosclerotic plaque formation [15]. As per the early studies decrease of 5mg/dL in HDL cholesterol increases cardiovascular diseases (CVD) risk by 14%, whereas an increase of 1mg/dL HDL cholesterol decreases CVD risk by 3%. Besides this, reverse cholesterol transport (RCT) has been reported for anti-atherogenic effects and thus reduces CVD risk [16, 17] (Fig. 1).

Apolipoproteins facilitate the transport of lipids (TG) throughout the body and maintain the amount of LDL, VLDL and chylomicron remnants, which have been reported as potential markers for atherosclerosis. It has been reported that angiopoietin-like 3 (ANGPTL3) regulates LDL, VLDL and TG and hence considered as a target to decrease atherosclerosis risk. Higher plasma levels of ANGPTL3, apoC-III and apoB48 and decreased LPL activity have been reported for dysfunctional visceral fat in adolescents obesity. Decreased LPL activity

debilitates chylomicron and VLDL catabolism leading to atherogenic remnants [18]. Further, various exchangeable apolipoprotein such as apolipoprotein A1 (ApoA1), apolipoprotein A5 (ApoA5), apolipoprotein C3 (ApoC3) and apolipoprotein E (ApoE) have been reported for altered lipid metabolism in both plasma and adipocytic as well as hepatocytic cells, resulting in dyslipidemia [19]. Activated microRNA-378a-3p modulates ApoB100-sortilin-1, while the patatin-like phospholipase domain containing protein 7 (PNPLA7) modulates ApoE stability, which stimulates hepatic VLDL synthesis and thereby promote hyperlipidemia [20, 21]. Stabilisation of the LDL receptor and statin lowers the plasma TG rich lipoproteins and LDL subclasses respectively and reduces the risk of atherosclerosis [22, 23]. Also, there is evidenced that fatty liver index (FLI) detects nuclear magnetic resonance atherogenic changes in patients with obesity, a breakthrough to standard lipid profile, as VLDL particle number and size elevate with FLI, while HDL particles and size are inversely related with FLI [24, 25].

3. ADIPOSE TISSUE WORKS AS AN ENDOCRINE ORGAN

Adipose tissue secretes many adipokines, which work as hormones, enzymes, cytokines as well as growth factors and modulates metabolic energy homeostasis. Adipokines act in an autocrine, paracrine and endocrine ways that

not only maintain adipose tissue development and enlargement but also modulate many functions of metabolism, reproduction, CVDs and immunity [26]. To explore the endocrinology of adipose tissue, colossal work has been done in the last two decades. During this time not only varieties of adipokines have been discovered, but also their biochemical and physiological functions have been studied extensively. Amid them, the critical adipokines include: leptin, which is one of the first discoveries of an adipocyte-derived adipokine, regulates food intake capacity and energy expenditure [27], adiponectin imparts its crucial role in the regulation of obesity and its consequences [28], resistin and TNF- α modulates insulin resistance [29], complement factor-D (adipsin) and acylation stimulation protein (ASP) promotes TG storage [30], apelin promote fatty acid oxidation and glucose uptake in skeletal muscles [31], visfatin and omentin helpsin glucose homeostasis [32,33], monobutyryn acts as a vasodilator [34], macrophage inflammatory protein-1 α (MIP1- α) and monocyte chemoattractant protein-1 (MCP-1) promote inflammation, transforming growth factor- β (TGF- β), hepatic growth factor (HGF) and insulin-like growth factor-1 (IGF-1) stimulates adipocyte differentiation and development [35,36], while vaspin is employed as a biomarker of inflammation [37] (Fig.1).

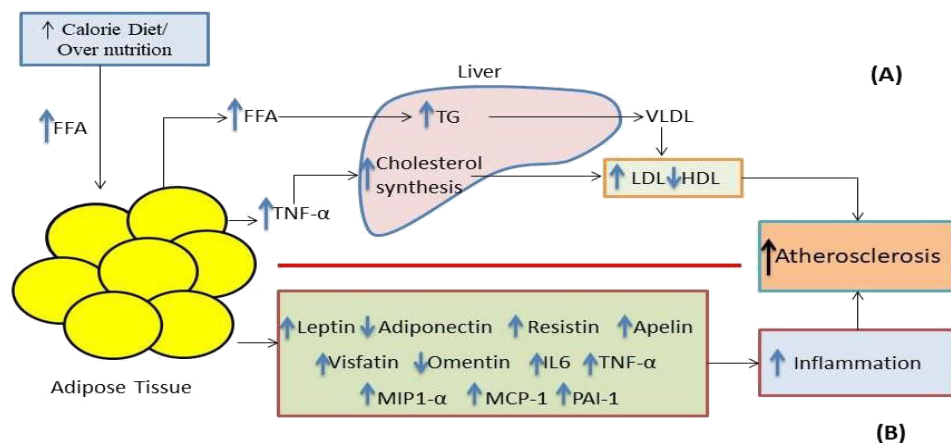


Fig. 1: (A) Dyslipidemia in adipose tissue: High-calorie diet leads to adipose tissue dysfunction, resulting in higher TNF- α expression and FFA mobilisation to the liver. Elevated FFA synthesis increases TG concentration (hypertriglyceridemia) and later converts into VLDL, while TNF- α increases the cholesterol synthesis. Finally, both FFA and TNF- α increases the amount of LDL, while decreases the amount of HDL. This altered lipid metabolism promotes atherosclerosis. **(B) Adipokines and cytokines in atherosclerosis:** Dysfunctional adipose tissue secretes various adipokines/cytokines, which modulates inflammatory responses in vascular endothelial cells via macrophages and thus contribute to atherosclerosis. Of note, adiponectin reverses the effect of dysfunctional adipocytes. FFA: Free fatty acid, TG: Triglyceride, VLDL: Very low-density lipoprotein, TNF- α : Tumour necrosis factor- α , LDL: Low-density lipoproteins, HDL: High-density lipoproteins, IL: Interleukin, MIP1- α : Macrophage inflammatory protein-1 α , MCP-1: Monocyte chemoattractant protein-1 (MCP-1), PAI-1: Plasminogen activator inhibitor-1.

4. ROLE OF ADIPOKINES IN ATHEROSCLEROSIS

Moreover, leptin, plasminogen activator inhibitor -1 (PAI-1), resistin, visfatin, hepcidin, TNF- α , and IL-6 promote atherosclerosis, whereas adiponectin, omentin

and IL10 exhibit anti-atherosclerotic properties [26]. Due to space limitations, two atherogenic and two anti-atherogenic adipokines have been discussed, whereas other adipokines involved in atherosclerosis have been mentioned in table 1.

Table 1: Role of adipokines in the pathophysiology of atherosclerosis

Adipokine	Study model	Action	References
Leptin	ApoE-/-mice	↓ Hypercholesterolemia ↓Atherosclerosis	[46]
PAI-1	Human/Mouse	PAI-1 inhibitor ↓Thrombus formation	[47]
Resistin	HUVECs	↑ICAM-1, ↑VCAM-1, ↑Monocyte adhesion	[48]
	Mice	↑Cardiac homing	[49]
Visfatin	Human cells	↑ICAM-1, ↑VCAM-1, ↑Monocyte adhesion	[50]
	Human	↑miR21 ↑Inflammation and ACS	[51]
Hepcidine	ApoE-/-mice	↓Atherosclerosis after erythrophagocytosis	[52]
TNF- α	Human cells	↑Oxidative stress and endothelial dysfunction	[53]
	Human cells	KLF-4 regulates NOS expression	[54]
IL-6	Mouse	↑Endothelial dysfunction in diabetes	[55]
Adiponectin	HUVECs	↓Endothelial inflammation ↓Insulin resistance	[56]
Omentin	HUVECs	↓Adhesion molecule expression	[57]
IL-10	Mice	↓Arterial lesion formation	[58]
	Human/HAECs	↓mtROS mediated innate immune activation	[59]

ApoE: Apolipoprotein-E, PAI-1: Plasminogen Activator Inhibitor-1, HUVEC: Human Umbilical Vein Endothelial Cells, ICAM: Intracellular Adhesion Molecule-1, VCAM: Vascular Adhesion Molecule-1, miR21: Micro-RNA21, ACS: Acute Coronary Syndrome, TNF- α : Tumour Necrosis Factor- α , KLF-4: Kruppel Like Factor, NOS: Nitric Oxide Synthase, IL: Interleukine, HAEC: Human Aortic Endothelial Cells, mtROS: Mitochondrial Reactive Oxygen Species.

4.1. Leptin

Leptin (16 kDa) is a 167 amino acid containing nonglycosylated hormone, encoded by the "ob" gene, which is the murine homologue of the human gene LEP. Mutational studies on leptin in the animal model (ob/ob mice) revealed hyperphagia and morbid obesity. Leptin composed of four alpha-helices and belongs to a class-I cytokine superfamily [38]. It regulates adipose tissue mass by energy expenditure, food intake and hormones under the strict control of the hypothalamus [27]. Leptin has six different isoform receptors; however, only the long isoform is functional and expressed in many cells and organs, including the CVD system. It has been reported that hyperleptinemia in obesity is associated with atherosclerosis [38]. Apart from this, leptin exerts many atherogenic effects such as hypertrophy, the proliferation of vascular smooth muscle cells, platelets aggregation and migration, oxidative stress, the release of monocyte colony-stimulating factor from macrophages, cholesterol accumulation in macrophage, stimulate angiogenesis,

hypertension and most importantly the induction of endothelial dysfunctions [26, 39].

Notwithstanding, leptin stimulates initial phases of atheroma formation by activating inflammatory factors like TNF α , IL-6, monocyte chemoattractant protein (MCP-1) and adhesion molecules like vascular cell adhesion molecule 1 (VCAM-1), intercellular adhesion molecule 1 (ICAM-1) and E-selectin. This causes circulating monocyte attraction and migration through endothelial cells, leading to plaque formation [40,41]. In women with obesity, the elevated leptin levels are positively associated with C-reactive protein, white blood cells (WBCs), neutrophils and monocytes [42], while in women with polycystic ovary syndrome (PCOS) adiposity, leptin increases by body fat percentage [43]. In-vivo study on dose dependant effect of leptin in leptin-deficient low-density lipoprotein receptor (LDLR-/-;ob/ob) female knockout mice demonstrate decreased mRNA expression of IL-6 and MCP-1, resulting in decrease macrophage infiltration in adipose tissue and thus regulates atherosclerotic plaque

formation [44]. The role of matrix metallo-proteinases (MMPs) in rupturing the atherosclerotic plaque through the extracellular matrix (ECM) protein degradation is documented. Leptin increases the production of MMP-9 and lowers atherosclerotic plaque by the leptin receptor/MAPK/ERK signalling pathways which facilitate the binding of activator protein-1 transcription factor (AP-1) to the MMP-9 promoter, in-vivo and in-vitro [45].

4.2. Plasminogen activator inhibitor-1

Plasmin is an enzyme act on fibrin, which eliminates blood clot. Plasmin is synthesised from its inactive precursor called plasminogen. Plasminogen activator inhibitor -1 (PAI-1) is a physiological inhibitor of plasminogen activator in plasma, thereby, promote vascular thrombosis and atherosclerosis [60]. Moreover, in human endothelial cells, leptin upregulatesthe expression of PAI-1 [61]. Due to inflammatory factors and loss of cellular replicative capacity, cell senescence is responsible for atherosclerosis. In vivo study demonstrated that PAI-1 promotes cell senescence in smooth muscle, while its inhibition attenuates vascular senescence and atherogenesis [62]. The TGF- β 1/p53/ PAI-1 and caveolin-1 signalling pathways also regulate vascular senescence and modulates atherosclerosis [63]. Tiplaxtinin, an inhibitor of PAI-1, reveals its role in smooth muscle cell migration (*in-vitro*) and fibrosis (*in-vivo*) [64].

It has been shown that in familial combined hyperlipidemia PAI-1 is elevated with insulin resistance and carotid atherosclerosis [65], of note, serum bilirubin level shows the inverse relation with PAI-1 [66]. Using Apo^{-/-} and LDLR^{-/-} double knockout mice, it has been evidenced that a decrease in thrombolytic activity increases the risk of atherosclerosis progression [67]. In contrast, PAI-1-knockout mice exhibit reduced adhesion of monocytes to aortic intima and thus, atherosclerosis prevention [68]. Further, PAI-1 target anti-atherogenic therapeutic approaches include hesperetin sulfate and glucuronide metabolites [69], mitochondria-targeted esculetin [70] and crocin [71].

4.3. Adiponectin

Adiponectin is a 30 kDa protein highly expressed in subcutaneous adipose tissue than visceral adipose tissue. Decreased level of adiponectin is associated with obesity, type 2 diabetes mellitus and atherosclerosis [72]. Albeit, the exact mechanism of action by which

adiponectin acts on vascular endothelial cells is still not fully resolved. Recent in-vivo studies have been evidenced that adiponectin reverses vascular injuries. T-cadherin (a cell-cell adhesion molecule) triggers the accumulation of adiponectin in the tunica intima where proliferation and migration of the vascular smooth muscle cells occur (neointima). This association of T-cadherin and adiponectin prevents vascular injury and thereby neointima and atherosclerotic plaque formation [73]. The nuclear factor kappa-light-chain-enhancer of activated B cells (NF-kB) is an essential transcription factor that modulates inflammatory gene expression responsible for vascular injury and atherosclerosis. Adiponectin inhibits the synthesis of "nuclear protein p65" a necessary subunit of NF-kB and avert its effect [74]. Fibroblast growth factor 21 (FGF-21) is another protein that suppresses atherosclerotic plaque formation via inhibiting SREBP-2 and by promoting adiponectin expression [75]. Nitric oxide synthase and oxidised LDL (ox-LDL) induce vascular endothelial cell proliferation (*in-vitro*) [76] and carotid atherosclerotic plaque formation (*in-vivo*) [77], is regulated by adiponectin. However, elevated macrophage autophagy by perivascular adipose tissue-derived adiponectin suppresses carotid atherosclerosis, suggesting an anti-inflammatory role of adiponectin [78]. Further anti-inflammatory and anti-atherogenic role of adiponectin include decreased inflammation and vascular calcification in human vascular smooth muscle cells [79], promote reverse cholesterol transport (RCT) and cholesterol efflux [80], modulation of NLRP3 inflammasome via Foxo-4 [81] and suppression of glucolipototoxicity-induced inflammation [82].

4.4. Omentin-1

Omentin is 313 amino acid containing (35 kDa) hydrophilic adipokine. It is also called as intellectin-1 and highly expressed in visceral adipose tissue than subcutaneous adipose tissue. Similar to adiponectin omentin-1 regulates insulin resistance, obesity, diabetes mellitus and metabolic syndromes. Omentin-1 increases glucose uptake and transport; however, its lower concentration is positively related to arterial stiffness and atherosclerosis in diabetic patients [83]. In mouse, omentin is a key adipokine which regulates high glucose-induced endothelial dysfunction by increasing AMP-activated protein kinase (AMPK) phosphorylation and PPAR- δ expression [84]. In patients with the atherosclerotic lesion, the concentration of omentin-1 has

reported 7.53 ng/ml, while in healthy individuals, the reported concentration is 12.56ng/ml. Thus, decreased omentin level in diseased condition establishes a link between atherosclerosis and this adipokine [85]. Elevated oxidative stress causes oxidation of LDL, resulting in overexpression of VCAM-1 and E-selectin stimulated endothelial dysfunction. Omentin-1 attenuates this effect by increasing glutathione peroxidase (GPX) activity [86,87]. Further, Ox-LDL reduces kruppel like factor-2 (KLF-2) dependant gene expression, which promotes adipocyte maturation by upregulating C/EBP α and PPAR γ . Omentin -1 reverses this effect, thereby reduces obesity arbitrate atherosclerosis [86,88]. Omentin-1 suppresses atherosclerosis by modulating inflammatory effects, including tanshinone IIA action on macrophages in apoE-/- mice [89], inhibition of TLR4/MyD88/NF- κ B signalling pathway as well as macrophages [90] and TXNIP/ NLRP3 signalling pathway [91].

5. OBESITY, ATHEROSCLEROSIS AND COVID-19

Obesity, atherosclerosis and other CVDs have been reported as a major risk factor for the development and the progression of Coronavirus disease-2019 (COVID-19); a worldwide pandemic as per the World Health Organisation (WHO). Severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), a positive sense RNA enveloped virus is responsible for this disease, preferentially affects the human respiratory tract and characterised by mild to lethal clinical complications [92,93]. Besides this, a robust association between obesity-related atherosclerosis and influenza/previous coronaviruses have also been demonstrated, suggesting a crucial link between obesity-related complications and viral load development. Interestingly, adiponectin helps in predicting the mortality rate in patients with COVID-19 [94], while elevated leptin can regulate inflammation via “Treg” cells [95]. Thus, targeting adipose tissue can be essential to determine the progression of COVID-19 in patients with obesity. Adipose tissue secretes many inflammatory cytokines that modulate the immune response via chemotaxis and monocyte differentiation, which may increase the severity of SARS-CoV-2 in patients. Moreover, previously the role of IL6 (a pro-inflammatory cytokine) is reported for influenza-related respiratory disorders. Adipokines secreted from thoracic visceral adipose tissue (epicardial and mediastinal) are thought to be

essential in the pathophysiology of this disease [94,96-98]. However, adipose tissue imparts its direct role in the COVID-19 through the angiotensin-converting enzyme 2 (ACE2). The SARS-CoV-2 spike protein binds with the ACE-2 and infects the cells of the tongue, bronchi, and lungs [99]. Moreover, ACE-2 expression increases in obesity, diabetes and atherosclerosis and actively involved in the renin-angiotensin-aldosterone system (RAAS). Thus, suppression of RAAS might be a potential therapeutic for COVID-19 in patients with obesity [100].

6. CONCLUSION

In conclusion, obesity-associated adipose tissue dysfunction promotes dyslipidaemia, hypertension, inflammatory responses and impaired glucose metabolism, which provokes atherosclerosis. Obesity-induced dyslipidaemia is regulated by angiopoietin-like 3 factors suggesting its therapeutic role. Various adipokines have been reported for direct impact on the atherogenic micro-environment of the vascular wall by regulating gene expression, functions of endothelial cell, higher expression of adhesion molecules, arterial smooth muscles and monocyte to macrophage conversion. Moreover, adiponectin governs the progression of atherosclerosis. Obesity-related adipose tissue dysfunction and cardiovascular diseases have been reported as a serious risk factor for increased clinical complications of COVID-19 patients, which suggest more studies about the role of adipokines in COVID-19 disease progression. Succinctly, obesity-induced dyslipidaemia and adipokines might provide new opportunities for developing novel therapeutic approaches for atherosclerosis and COVID-19.

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STUDY THE PREVALENCE OF HEPATITIS B SURFACE ANTIGEN AND ITS ASSOCIATED FACTORS IN THE POPULATION OF KACHIPURA (INDIA)

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Authors TW and PH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SP managed the analyses of the study. Author VU managed the literature searches and helped in revision of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Hepatitis B virus infection (HBV) is a global public health problem. Nearly two billion people in the world have been acutely infected by HBV and there are nearly 350 million people chronically infected with HBV. In this research study Population based hepatitis survey was carried out to estimate sero-prevalence of hepatitis B virus (HBV) infection for the Kachipura population which is located in Nagpur Dharampeth area (India). Random sampling of population has been done. Oral consent was taken before taking blood sample. The selected population could answer the questionnaire. All age group people are selected for sampling. Prevalence of hepatitis B surface antigen and its associated factors in Kachipura population has been studied. Also study the relation between hepatitis B positive and various symptomatic characteristics. Effect of various risk factor like drug abuse, food habits have been studied. Blood samples were taken and serological analysis of collected blood samples has been done using HBsAg kit. Data were analyzed using standard biostatistician tool and software SPSS. 1.86% of prevalence rate of hepatitis B viral infection has been found in the population of Kachipura. Relation between blood groups and HBsAg positive has been found that the people with ORh+ve blood group are very prone to Hepatitis B infection.

Keywords: Kachipura; hepatitis; serotyping; HBV; liver disease.

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1. INTRODUCTION

Hepatitis B virus (HBV) infection is still a major public health problem worldwide [1]. HBV is small DNA virus belonging to family Hepadnaviridae [2]. Hepatitis B virus is a hepatotropic deoxyribonucleic acid (DNA) virus which occurs through immune mediated killing of infected liver cell. It is also recognized as oncogenic virus that can cause a higher risk of developing hepatocellular carcinoma [3]. It is 50 -100 times more infectious than HIV [3]. Hepatitis B virus infection is life long, causing cirrhosis, liver cancer, liver failure and death. It can be acute with discrete onset of symptoms and jaundice or elevated serum ALT > 100 IU/L or chronic with no symptoms [3]. HBV is transmitted via permucosal or percutaneous exposure to infected body fluids or blood products and it replicates vial an RNA intermediate that can integrate itself into host genome [2]. Around 90% of infants infected prenatally become chronic carriers, unless vaccinated at birth. Approximately 25% of person who becomes chronically infected during childhood and 15% of person chronically infected after childhood die of cirrhosis of liver cancer [4]. Rate of chronicity is approximately 5% in adult infection, but it reaches 90% in neonatal infection. More than 300 million people have chronic liver infection globally and 600,000 people die annually from acute or chronic complication of hepatitis B infection [3].

HBV infection during pregnancy is closely related to high risk of maternal complication including pre-eclampsia, placenta pravia, preterm delivery, placental separation, ante partum hemorrhage, preterm labour, increased incidence of intraventricular hemorrhage, gestational diabetes mellitus and mortality with high rate of vertical transmission leading to fetal and neonatal hepatitis. Transmission from mother to infant take place in uterine, during delivery and after birth. Children born to HBs Ag + and hepatitis e antigen (HBeAg+) mother have 70-90% chance of prenatal acquisition of HBV infection and over 85-90% of them will eventually become chronic carries of the disease. They are main reservoirs for continued transmission of HBV and have high risk of hepatocellular carcinoma and liver cirrhosis [3].

Hepatitis B can be transmitted vertically from mother to child or horizontally by infected blood or by sexual intercourse [5]. High risk of transmission by infected blood is associated with the following medical and non-medical procedure:-

1. Blood products and whole blood transmission.
2. Surgical and microsurgical procedures.
3. Hemodialysis.

4. Intravenous drug application.
5. Accidental puncture with infected blood.
6. Accidental contact with infected blood.
7. Tattoo or piercing cosmetic procedures.
8. Manicure and pedicure.
9. Shared use of razor or toothbrush or nail cutter [6].

India is mesoendemic for HBV. Hepatitis B surface antigen (HBsAg) positivity in the general population ranges from 2.4% (2.2–2.7) and among tribal population 15.9% (11.42-20.4). Although predominate mode of transmission is horizontal, vertical transmission also placed a significant role in India [7]. Based on the prevalence of Hepatitis B surface antigen, different areas of the world are classified as high ($\geq 8\%$), intermediate (2-7%) or low HBV endemicity. India falls under the category of intermediate endemicity zone (average of 4%). Since India has one-fifth of the world's population, it accounts for a large proportion of the worldwide HBV burden. India harbours 10-15% of the entire pool of HBV carriers of the world. It has been estimated that India has around 40 million HBV carriers. About 15-25% of HBsAg carriers are likely to suffer from cirrhosis and liver cancer and may die prematurely. Chronic HBV infection accounts for 40-50% of hepatocellular carcinoma (HCC) and 20-30% cases of cirrhosis and chronic HCV infection accounts for 12-32% of HCC and 12-20% of cirrhosis in the country [8].

India falls into the category of intermediate endemicity for HBV and the common genotypes reported from India are A followed by D. In a population-based study conducted by Chowdhury et al., 7653 subjects were screened and 2.97% tested positive for HBsAg, of whom majority (90%) were Hepatitis B e antigen (HBeAg) negative and Hepatitis B e antibody (anti-HBe)- positive. A study by Lodha et al. from New Delhi depicted the prevalence of HBV infection in India to be 1–2% [9].

A well designed meta-analysis by Batham et al. noted a high prevalence of HBV infection in the tribal population of India (15.9%) when compared to the non-tribal population (2.4%). However, in order to overcome the fallacy of publication bias which can distort the results drawn in systematic reviews, the authors used population-weights and estimated a prevalence of HBV infection to be 3.07% in the non-tribal population when compared to 11.85% in the tribal population. Few other studies have assessed the prevalence of HBV infection in the tribal population of India and have noted prevalence ranging from 4.4% in the Baiga tribal population of Madhya Pradesh to 37.8% in the Shompen tribe and 65% in

the Jarawa tribe of Andaman and Nicobar islands. Due to the bias of self-selection, screening blood donors usually underestimates the real prevalence of HBV in a community and most of the blood bank data from India depict a prevalence of HBV infection of about 0.2–4% [10].

The predominant mode of transmission of HBV in India is horizontal [11], although a recent study by Dwivedi et al. has shown 56.8% of pregnant women with HBV infection to be in the high replicative phase and having HBeAg positivity, suggesting vertical transmission to play a significant role in India as well. The prevalence of HBsAg positivity in antenatal women was noted to be 0.9% in this study [12].

2. MATERIALS AND METHODS

Present research study carried out with the prior permission of ethical committee of the Dr. Ambedkar College, Deekshabhoomi. Nagpur. Laboratory analysis completed in the Department of Biochemistry and Biotechnology, Dr. Ambedkar College, Deekshabhoomi Nagpur during the Month of February 2020.

2.1 Study Area and Period

A cross sectional sero-epidemiologic study of hepatitis B surface antigen and its associated factor in population of Kachipura in Nagpur city, India was conducted in the month of February 2020. Kachipura comes under Dharampeth area ward 82 area is 3.6 hectares, household 400, slum code 104, population is 2000, located in major part of Nagpur the nearby areas consist of hospitals like KRIMS and sunflower, parks-Kachipura park, lendhra park, kotak Mahindra bank, lendhra market etc.

2.2 Selection of Population

Source population were of all age group stays in Kachipura during the period of survey fulfil the selection criteria all people who can be test by the HBsAg kit are inclusion criteria and the people who drinks alcohol and other drug abuse and the people who are present with symptomatic characteristics and who are unable to answer the question were excluded from the study.

2.3 Sample Size and the Sampling

Total 322 individuals were considered by simple random sampling method for this research study and the sample size determine by the single population proportional formula with the assumption of 95% confidence interval, finally calculated sample size was 322 from total population 2000[13-14].

2.4 Data Collection

A self-administered English Version Questionnaire was used to collect data related to Socio-demographic characteristics and associated risk factors and symptomatic characteristics for HBV infection were collected using structured questionnaire by trained health care professionals the study variables included in the study were age, sex, education, occupation, food habits, medical facilities in Kachipura, regular hospital visits, water facilities, any drug abuse, blood donation, blood transfusion, ever suffered from jaundice, dark urine, pale stool, abdomen pain, liver check-up, immunity, cold cough fever, acidity, lose motion, constipation, pregnancy, hepatitis B status and blood group. Data collection from participants was facilitate by laboratory professional for blood collection [15-17].

2.5 Detection of HBsAg

Two milliliter of venous blood was collected from study participants by trained laboratory technologist serum was separated by centrifugation at 4000 rpm for 10 minutes. Each serum was subjected to HBsAg antibody rapid test (Oscar Medicare Private Limited, India). OSCAR rapid test kit is qualitative, solid phase, two-site sandwich immunoassay for detection of HBsAg in serum HBV infection status was defined by positive and negative result for HBsAg using HBsAg test strip[18].

2.6 Data Quality Assurance

To ensure the quality of data, questionnaire was prepared in English language and translated it into Hindi and Marathi language as per the convenience of participants. To make sure that the questionnaire is appropriate and understandable. It was pretested and training was given for supervisor and data collectors for 1 day. The data collection process was supervised and collected data were reviewed and completeness by the principal investigator. Then the collected data were checked for consistency and accuracy. Standard operating procedures were strictly followed during blood sample collection, storage and analytical process. Storage conditions and expired date of reagents were checked. Positive and negative control sera were run following the manufacturer recommendation of the kit [19-20].

2.7 Data Analysis

Collected data were checked for the completeness and consistency and coded manually. Then data were entered into Epidata version 3.1 and cleaned data were exported to SPSS version 21 windows to recode, compute and do other statistical analysis. In the univariate analysis a descriptive statistical was

conducted to explore frequency distribution, central tendency, variability (dispersion) and overall distribution of independent variables [21].

Bivariate logistic regression analysis was conducted to select candidate variable for multivariable analysis. All explanatory variable associated with the outcome variable in bivariate analysis with p-value of <0.25 were included in logistic models of multivariable analysis using backward stepwise method. Adjusted odd ratio along with 95% confidence interval was used to check the strength of association. Multicollinearity between the independent variable was checked using variance inflation factor. Finally model fitness was done using Hosmer and Lemeshow statistics, chi-square ($\chi^2=1.82$) and p-value was 0.61. Variable with p value < 0.05 were considered as statistically significant. Confidence interval of outcome variable was (95% CI: 4.7-11.9) [22-23].

3. RESULTS

Quantitative data of Hbsag prevalence with respect to age, affecting factors and blood group presented in Table 1A and Table 1B, Age group-wise prevalence of HbsAg in the population of Kachipura shown in Fig. 1.

4. DISCUSSION

The result of study shows that prevalence of HBsAg among Kachipura population was 1.86%. According to WHO criteria which classifies endemicity of HBV infection: low endemicity area (less than 2% seropositive), intermediate endemicity area (2% to 7%

seropositive) and high endemicity area (more than 8% seropositive), the result showed low endemicity area [24]. Kachipura is representative of Nagpur city in general because of most of inhabitant's earnings in middle of income range, sex and the age distribution, and the level of economic and cultural developments in province.

HBV infection is consider as major public health problem in India. According to the study among below 20 age group prevalence rate is 1%, among 20 to 60 age group prevalence rate is 2.26% and more than 60 prevalence rate is 2% (Fig. 1). Prevalence rate in particular blood group is found to be 22% in A +ve and 21% in AB +ve and 57% in O +ve. Prevalence rate found to be 0% in blood group in O -ve.

Rate of prevalence among symptomatic characteristics study found to be 2.89% among male, 1.08% in female. 1.61% prevalence rate found in educated people 0.88% among employed population 2.49% among fast food eaters, 2.05% among non-vegetarian, 1.97% among NMC water drinkers, 3.08% among population who does drug abuse, 5% found in jaundice suffered population, 3.92% among population who has abdomen pain, 1.28% among strong immunity people whereas 3.41% among weak immunity people, 1.86% among the people who has indigestion issues (Table 1). In Kachipura there is no medical facilities available people does not visit hospital for regular checkup. People rarely go for blood transfusion and blood donation. Only one family among the population is aware of hepatitis B and other does not know about the disease, its risk factor and symptomatic characteristics.

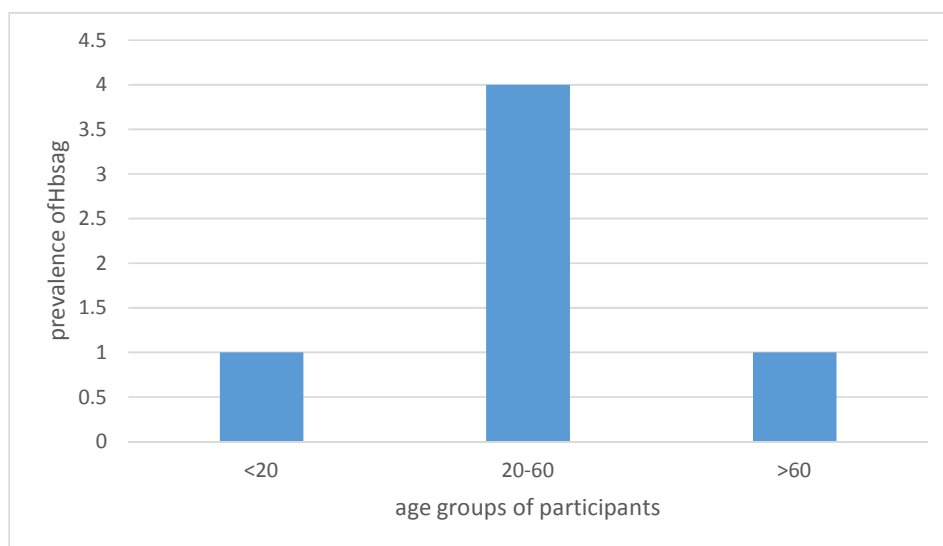


Fig. 1. Age group-wise prevalence of HbsAg in the population of Kachipura (Nagpur)

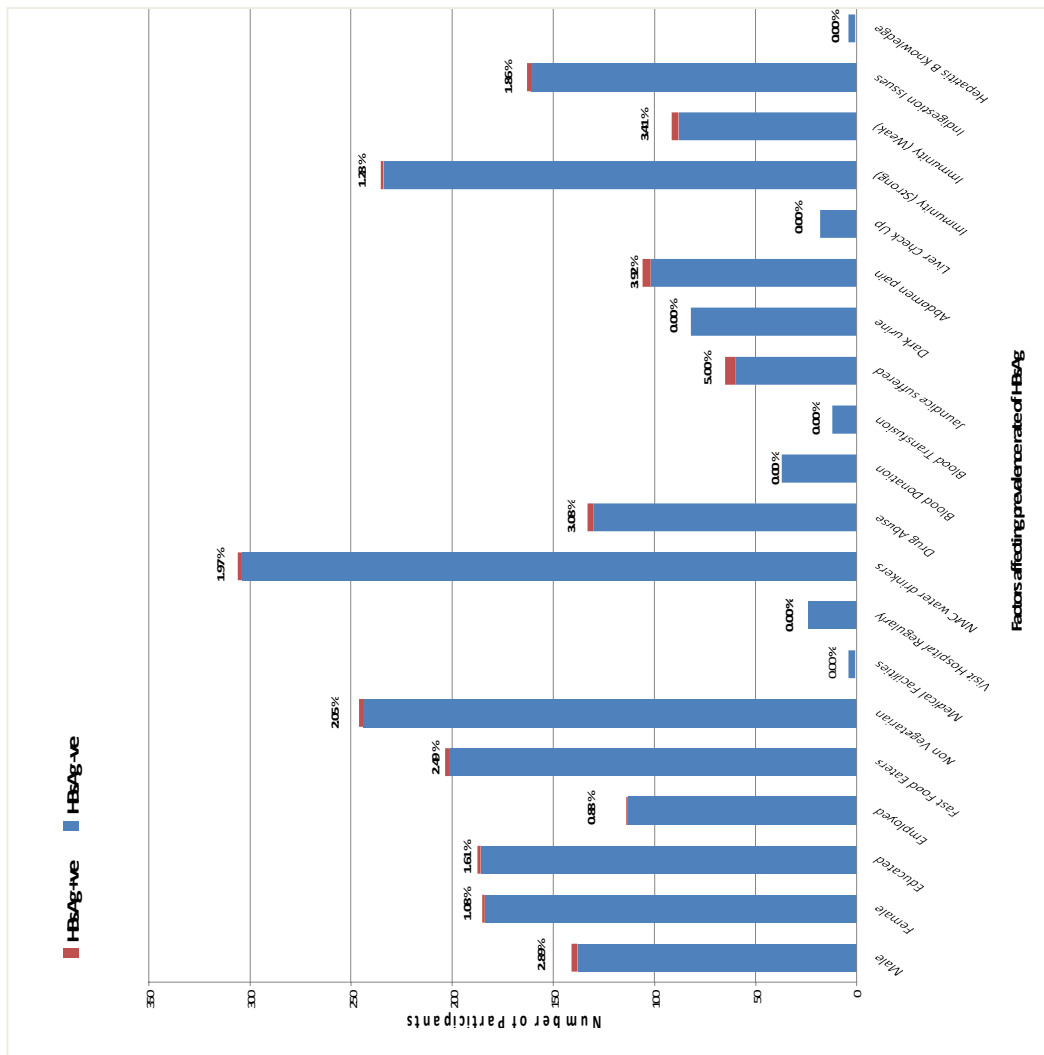


Fig. 2. Distribution of participants according to factors affecting prevalence of HBsAg

The knowledge of region and age specific prevalence of hepatitis B infection is important for evaluating vaccination program and national disease prevention and control efforts are finding classify the region as having low HBV endemicity rather than intermediate high endemicity defined by previous study in the last century and past decade. Introduction of vaccination in this regions happened in different year and in different age group [25].

Vaccination program for all new borns should be continued susceptible adult whose HBV markers are all negative should have repeat checkup immunization, especially those individuals who have risk factors of having poor sleep quality, being private small businessmen, having a family history of HBV,

having no personal history of vaccination and being a young male adult. HBV carries need to be closely monitor or treated. The finding of current study at to the knowledge of hepatitis B epidemiology in the area with a sizable high risk group, demonstrating the importance of screening programs for hepatitis B. mass screening permits base line estimates of prevalence and provide insight into the appropriate vaccination strategy. Furthermore because of India's high incident of hepatitis B related hepato-cellular carcinoma, screening programs are clinically significant for facilitating referral of newly diagnose cases to appropriate medical care [26]. Presently, In India there is COVID Pandemic spread globally and mainly in India affecting socio-economic and health of the global population [27, 28].

Table 1A. Quantitative data of Hbsag prevalance with respect to age, affecting factors and blood group

Characteristic	Frequency	Male						Female				
		Male	Female	Hbsag +ve	Symptomatic	Non Symptomatic	Hbsag -ve	Hbsag +ve	Symptomatic	Non Symptomatic	Hbsag -ve	
Age Group												
< 20	96	46	50	1	1	0	45	0	0	0	0	50
20-60	177	70	107	3	2	1	67	1	1	0	0	106
60 +	49	22	27	0	0	0	22	1	1	0	0	26
Personal Information Parameters related to prevalence of Hepatitis B												
Educated	186	83	103	2	1	1	81	1	1	0	0	102
Employed	113	79	34	0	0	0	79	1	1	0	0	33
Fast Food Eaters	201	93	108	4	3	1	89	1	1	0	0	107
Non Vegetarian	244	121	123	3	3	0	118	2	2	0	0	121
Medical Facilities	5	5	0	0	0	0	5	0	0	0	0	0
Visit Hospital Regularly	24	5	19	0	0	0	5	0	0	0	0	19
NMC water drinkers	304	126	178	4	3	1	122	2	2	0	0	176
Drug Abuse	130	89	41	2	2	0	87	2	2	0	0	39
Blood Donation	37	29	8	0	0	0	29	0	0	0	0	8
Blood Transfusion	12	3	9	0	0	0	3	0	0	0	0	9
Jaundice suffered	60	24	36	2	1	1	22	1	1	0	0	35
Dark urine	82	31	51	0	0	0	31	0	0	0	0	51
Abdomen pain	102	48	54	3	3	0	45	1	1	0	0	53
Liver Check Up	18	7	11	0	0	0	7	0	0	0	0	11
Immunity (Strong)	234	92	142	1	0	1	91	2	2	0	0	140
Immunity (Weak)	88	46	42	3	3	0	43	0	0	0	0	42
Indigestion Issues	161	59	102	2	2	0	57	1	1	0	0	101
Hepatitis B Knowledge	5	5	0	0	0	0	5	0	0	0	0	0
Blood Group												
A +ve	53	23	30	1	0	1	22	0	0	0	0	30
B +ve	125	58	67	0	0	0	58	0	0	0	0	67
AB +ve	54	26	28	0	0	0	26	1	1	0	0	27
O +ve	82	29	53	3	3	0	26	1	1	0	0	52
A -ve	0	0	0	0	0	0	0	0	0	0	0	0
B -ve	6	2	4	0	0	0	2	0	0	0	0	4
AB -ve	0	0	0	0	0	0	0	0	0	0	0	0
O -ve	2	0	2	0	0	0	0	0	0	0	0	2

Table 1B. Quantitative data of Hbsag prevalence with respect to age, affecting factors and blood group

	Characteristic	Frequency			Total		Symptomatic	%	Non Symptomatic	%	Hbsag -ve
			Male	Female	Hbsag +ve	%					
Age Group	< 20	96	46	50	1	1.04	1	1.04	0	0	95
	20-60	177	70	107	4	2.26	3	1.69	1	0.56	173
	60 +	49	22	27	1	2.04	1	2.04	0	0	48
Personal Information	Educated	186	83	103	3	1.61	2	1.08	1	0.54	183
	Employed	113	79	34	1	0.88	1	0.88	0	0	112
Parameters related to prevalence of Hepatitis B	Fast Food Eaters	201	93	108	5	2.49	4	1.99	1	0.50	196
	Non Vegetarian	244	121	123	5	2.05	5	2.05	0	0	239
	Medical Facilities	5	5	0	0	0.00	0	0.00	0	0	5
	Visit Hospital Regularly	24	5	19	0	0.00	0	0.00	0	0	24
	NMC water drinkers	304	126	178	6	1.97	5	1.64	1	0.33	298
	Drug Abuse	130	89	41	4	3.08	4	3.08	0	0	126
	Blood Donation	37	29	8	0	0.00	0	0.00	0	0	37
	Blood Transfusion	12	3	9	0	0.00	0	0.00	0	0	12
	Jaundice suffered	60	24	36	3	5.00	2	3.33	1	1.67	57
	Dark urine	82	31	51	0	0.00	0	0.00	0	0	82
	Abdomen pain	102	48	54	4	3.92	4	3.92	0	0	98
	Liver Check Up	18	7	11	0	0.00	0	0.00	0	0	18
Immunity (Strong)	234	92	142	3	1.28	2	0.85	1	0.43	231	
Immunity (Weak)	88	46	42	3	3.41	3	3.41	0	0	85	
Indigestion Issues	161	59	102	3	1.86	3	1.86	0	0	158	
Hepatitis B Knowledge	5	5	0	0	0.00	0	0.00	0	0	5	
Blood Group	A +ve	53	23	30	1	1.89	0	0.00	1	1.89	52
	B +ve	125	58	67	0	0.00	0	0.00	0	0	125
	AB +ve	54	26	28	1	1.85	1	1.85	0	0	53
	O +ve	82	29	53	4	4.88	4	4.88	0	0	78
	A -ve	0	0	0	0	0.00	0	0.00	0	0	0
	B -ve	6	2	4	0	0.00	0	0.00	0	0	6
	AB -ve	0	0	0	0	0.00	0	0.00	0	0	0
	O -ve	2	0	2	0	0.00	0	0.00	0	0	2

5. CONCLUSION

Study of socio demographic characteristics, risk factor and symptomatic characteristics associated with HBV infection done thoroughly. Strong association between HBV infection and ABO blood grouping was found and also association with immunity was observed regarding the gender, occupation, personal history of vaccination and age in adults. There has been decrease in prevalence of HBV infection since the national expanded program of immunization. Mother to fetal vertical transmission of HBV is well controlled. Transmission between adult has become most common mode of HBV spread. While survey focus on Kachipura region of Nagpur but it is likely that similar results were found else were in the country. Identifying groups at risk for susceptibility can assist in the development of national strategies to target specific group for cost effective salvage vaccination program for adulating the future.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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REPOSITIONING OF NSAIDS FOR LUNG CANCER TREATMENT AND AUGMENTATION BY QUERCETIN

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ABSTRACT

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are widely used analgesics. NSAIDs can inhibit cyclooxygenase (COX) enzyme, thereby targeting the prostaglandin (PG) pathway resulting in the prevention and treatment of cancer. Five NSAIDs were selected belonging to different classes based on the literature survey. The study aims to investigate the cytotoxic effect of NSAIDs and its synergism with quercetin, on lung cancer cell line A549 for repositioning. Cytotoxic assay and *in-silico* screening of NSAIDs was the methodology employed to attain the objective. The significance of repositioning of NSAIDs is cost-effectiveness and non-invasive cancer management.

KEYWORDS; Repositioning, NSAIDs, Cyclooxygenase enzyme, *In-silico* Docking, Synergistic effect.

INTRODUCTION

Lung cancer is bronchial (airway) cancer. The etiological cause of lung cancer is the inhalation of carcinogens through the air into the lungs. Lung cancer is responsible for a huge number of deaths in Asia, and a total of 160,068 lung cancer cases were reported in Asian countries in 2018.^[1] The two main types of lung cancer are small cell and non-small cell lung carcinoma (NSCLC)^{[3][4]}, a majority (85%) being the cases of NSCLC.^[5] Adenocarcinoma is a common subtype of NSCLC (around 40% of the total NSCLC), and it originates in peripheral lung tissue.^{[6],[7]} Drug repositioning is the application of already approved drugs and compounds for the treatment of another indication. Generally, it takes around 7 to 12

years for the de novo manufacture and marketing of any drug. However, drug repositioning can minimize the time and cost of development.^[22,12,13,16,21]

The present study tried to demonstrate a drug repositioning strategy for lung cancer using NSAIDs and augmentation by quercetin. Most lung cancer patients become immunosuppressed due to radiotherapy and chemotherapy, which leads to serious complications in lung cancer patients.^[21] In such situations, a drug repositioning regime can prove to be beneficial in the management of lung cancer. One of the pharmacological actions of NSAIDs is to inhibit cyclooxygenase (COX). Cyclooxygenase enzyme catalyzes the formation of prostaglandins H₂ (precursor for the synthesis of prostaglandins).^[12,13] NSAIDs reduce COX-2 catalyzed formation of specific prostaglandins (particularly PGE-2), which promote key cellular processes in cancer development including mitogenesis, mutagenesis, angiogenesis, deregulation of apoptosis, immune-suppression and metastasis, thereby acting as chemopreventive agents.^[13,15] The goal of this study was to find evidence of antiproliferative activity of selected NSAIDs (Diclofenac, Naproxen, Tolfenamic acid, Ibuprofen, and Celecoxib), determine an effective dosage and study synergism with quercetin on lung cancer cell line A549. The selection criteria of NSAIDs were based on previous literature. Also, NSAIDs of five different classes were incorporated, which were as follows.

NSAID Class	Compound used in the Study
anthranilic acid derivatives	Tolfenamic Acid
phenylacetic acid derivative	Diclofenac
propionic acid derivative	Naproxen
pyrazole derivative	Celecoxib
monocarboxylic acid	Ibuprofen

Diclofenac is a potent inhibitor of COX₂, resulting in a decrease of prostaglandins E₂ synthesis, thus having antiproliferative activity.^[15] Naproxen inhibits PGE₂ synthesis and therefore reducing the COX activity in colorectal cancer.^[16,19] Tolfenamic acid activates the p38 mitogen-activated protein kinase (MAPK) pathway in pancreatic and colorectal cancer.^[23,20] Celecoxib can suppress tumor growth, lung metastasis, and angiogenesis at high doses.^[19] Ibuprofen is found to inhibit COX 1 and COX 2.^[12] The selected phytochemical quercetin (3,30,40,5,7- pentahydroxyflavone (30,40,5,7 tetrahydroxyflavonol or 3,30,40,5,7-pentahydroxy-2- phenylchromen-4-one) exhibits antiproliferation in cancer cells by induction of growth arrest in G₁ or G₂ phase, apoptosis and inhibition of angiogenesis.^[18,19] Also, molecular docking on cyclooxygenase enzyme was investigated in this study. Computer-based simulation of the binding interactions of the protein-ligand complex was

performed to understand binding affinities of drugs and compounds (ligand) and COX1 and COX2 enzyme (protein). Autodock was employed to compute energetically stable conformation(s) that model(s) the structure of the complex^[27,28] as ligands for docking studies.

MATERIALS AND METHODS

Cell Culture and Media

The A549 lung cancer cell line was procured from NCCS, Pune. Cells were maintained in Dulbecco's Modified Eagle Medium (DMEM) with 10% FBS and 1% penicillin/streptomycin. The cells were maintained in T25 vented type of adherent tissue culture flasks at 37°C in CO₂ incubator with 5% CO₂ concentration. Cells were harvested by trypsinization when the culture reached confluency.

TREATMENT IN CELL CULTURE

1. Single Compound study

NSAIDs and quercetin were prepared with suitable solvents for the treatment of the cell culture. According to the solubility, Tolfenamic acid and Diclofenac were dissolved in distilled water, Naproxen and Celecoxib were dissolved in DMSO (50%), Ibuprofen and Quercetin were dissolved in Ethanol (100%). On the other hand, cells were seeded onto 96 titer well plate, after counting the cells using a hemocytometer (improved Neubauer chamber). The seeded cells were treated with NSAIDs and quercetin in amounts ranging from 25 micromoles to 100 micromoles and 10 micromoles to 100 micromoles respectively.^[29]

2. Synergistic Study with varied combinations of drugs

A novel approach to study the synergistic potential of drugs was employed in this study. A cocktail of two, three, and four NSAIDs were prepared. The dose of NSAIDs to study synergism was as follows, 100 micromoles of Tolfenamic acid, Celecoxib, Diclofenac and Quercetin, 75 micromoles of Ibuprofen and, 60 micromoles Naproxen.

Cell viability assay (MTT assay)

Cytotoxic assessment of A549 cell line post-treatment was performed by MTT assay. MTT assay was based on the reduction of tetrazolium dye (MTT) by metabolically active cells turning the dye purple. Therefore, the viable and unviable cells were differentiated based on purple color, which was assessed using a spectrophotometer.

Cell viability was determined post-treatment at regular 24-hour time intervals for 96 hours. This was done by adding 100 microliters media with MTT dye to each well in the plate. The plate was wrapped in an aluminum foil and incubated for 4 hours in a humidified atmosphere at 37°C to allow the formation of the formazone crystals (purple product). After the incubation period, the media and MTT were carefully removed. DMSO was added to each well. Absorbance was recorded immediately in a 96 well-plate reader at 570 nanometers.

Statistical analysis

The cell viability results were statistically analyzed using one- way ANOVA method. $P < 0.05$ was considered to be significant. The statistically significant concentrations of NSAIDs and quercetin were shortlisted for further studies.

***In-silico* study**

In-silico study was done using the *Autodock Software* to corroborate with the findings of *in-vitro* demonstration of repositioning efficiency. A computer-generated representation of the five NSAIDs (Tolfenamic acid, Naproxen, Celecoxib, Ibuprofen, and Diclofenac) and Quercetin were used as ligands, to study binding affinities with the target proteins i.e., Cyclooxygenase 1 and Cyclooxygenase 2 (prostaglandin-endoperoxide synthase) (PTGS) enzyme.

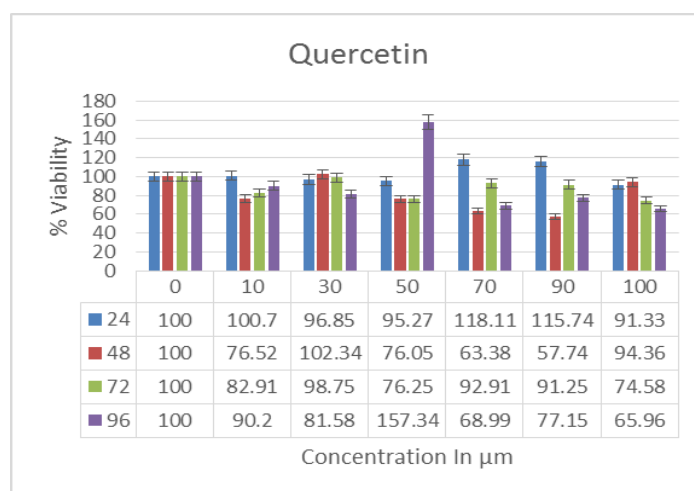
Protein structure and ligand preparation for Docking.

The biological macromolecular protein structure of COX2 (PDB Id: 5F19) was obtained by sequences from the RCSB protein databank. Ligplots were obtained from PDBSum-Generate. Protein structure server SWISS-MODEL was used for homology- based modeling of COX1 (PDB Id-a147) because the PDB structure was not available in the RCSB protein databank. Ligand structure drugs and phytochemicals were obtained from PubChem

RESULT AND DISCUSSION

The present study investigated the synergistic and augmented effects of selected non-steroidal anti-inflammatory drugs (NSAIDs) viz., Tolfenamic acid, Celecoxib, Diclofenac, Naproxen and Ibuprofen and Quercetin on Lung cancer A549 cell line. MTT assay was performed to gauge the cytotoxicity of each treatment. Finally, the *in-vitro* results were corroborated with the molecular interaction of COX-1 and COX-2. The molecular interactions were studied using *in-silico* molecular docking.

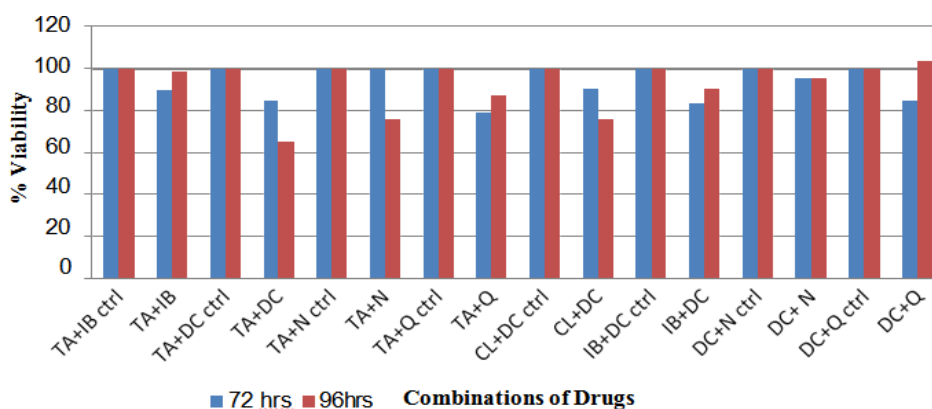
Our findings indicate that tolfenamic acid was most cytotoxic to cells at a dose of 25 micromoles and 100 micromoles at all time-points until 96 hours. Naproxen was found to be most cytotoxic at 25 micromoles, 50 micromoles, 60 micromoles, and 75 micromoles. Ibuprofen and diclofenac were most cytotoxic at 75 micromoles, 60 micromoles, 100 micromoles, and 50 micromoles, respectively, at all-time points. Celecoxib was cytotoxic to cells at 25 micromoles, 75 micromoles, and 100 micromoles at all time-points.^[29] Quercetin has indicated cytotoxicity at 100 micromoles, 90 micromoles, 70 micromoles, 50 micromoles and 10 micromoles at all the time-points as indicated in Graph 1.



Graph 1: % viability against Quercetin.

The results of cell cytotoxicity of the cocktail preparation of the drugs to study the synergistic potential of drug repositioning of NSAIDs are shown in graphs 2-5. Amongst the two-drug combinations, the cocktail of Tolfenamic acid and Diclofenac was most cytotoxic, reducing the cell viability to 65 % at 96 hours.

Synergistic cytotoxicity: 2 Drug Combination

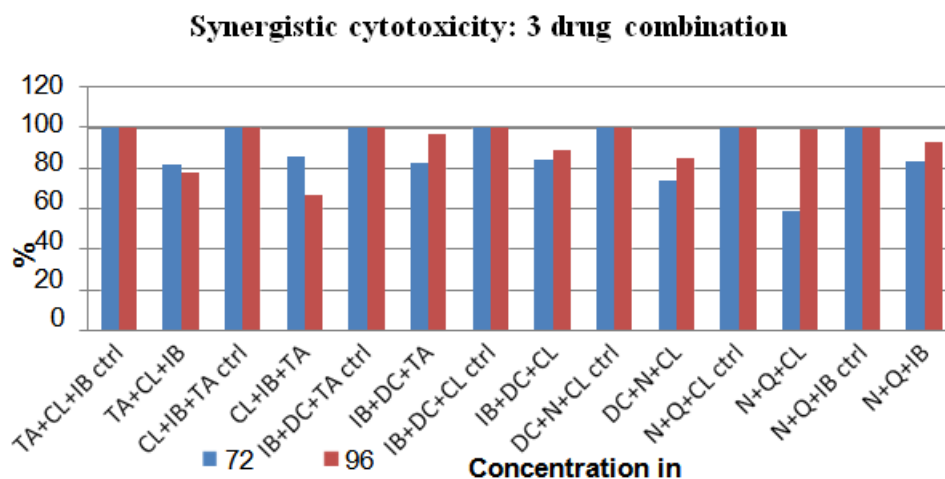


Graph 2: MTT assay combination of 2 drugs.

TA: (Tofenamic Acid); IB: (Ibuprofen); CL: (Celecoxib); N: (Naproxen); DC: (Diclofenac)
 CU: (Curcumin)

Amongst the three-compound combinations, a cocktail of Naproxen, Quercetin and Celecoxib was most cytotoxic, reducing the cell viability to 59% after 72 hours of treatment.

Synergistic cytotoxicity: 3 drug combination

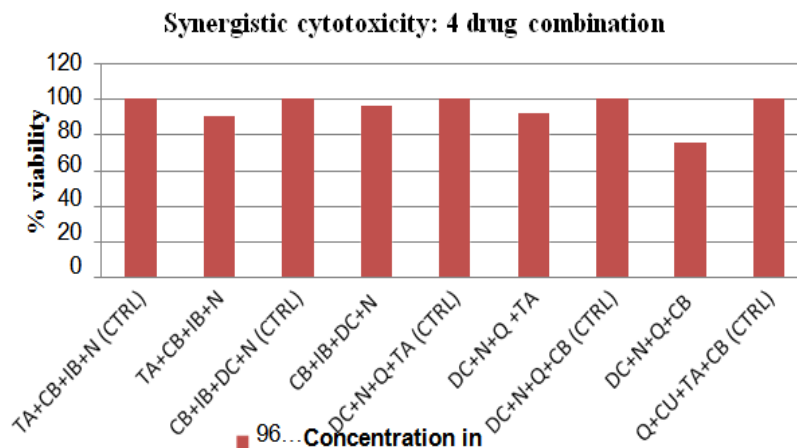


Graph 3: MTT assay combination of 3 drugs.

TA: (Tofenamic Acid); IB: (Ibuprofen); CL: (Celecoxib); N: (Naproxen); DC: (Diclofenac)
 CU: (Curcumin)

A preparation of diclofenac, naproxen, quercetin and celecoxib was found to exhibit the highest synergistic effect in case of four-drug combinations. Diclofenac, naproxen, quercetin and celecoxib reduced the cell viability to 76%.

Synergistic cytotoxicity: 4 drug combination

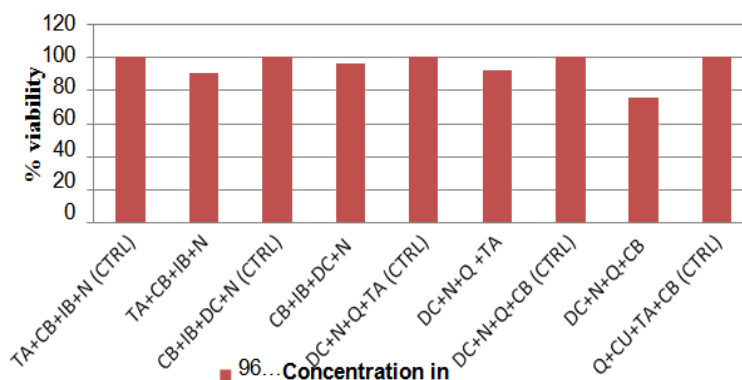


Graph 4: MTT assay combination of 4 drugs at 96 hour.

TA: (Tofenamic Acid); IB: (Ibuprofen); CB: (Celecoxib); N: (Naproxen); DC: (Diclofenac)
CU: (Curcumin).

The five-compound synergistic effect of tofenamic acid, celecoxib, diclofenac, naproxen and quercetin was found to be most potent, thereby reducing the cell viability to 52.4% at 96-hour time-point.

Synergistic cytotoxicity: 5 drugz combination



Graph 5: MTT assay combination of 5 drugs.

T: (Tofenamic Acid); I: (Ibuprofen); C: (Celecoxib); N: (Naproxen); D: (Diclofenac) CU: (Curcumin).

Table 1: Synergistic potential of repositioning.

Time of Incubation	% Viability		Best outcome
	72 hours	96 hours	
Two NSAIDs Combination Treatment			
TA+Q	79%	87%	TA+DC
TA+IB	90%	98%	
TA+DC	84%	66%	
TA+N	100%	76%	
CL+DC	90%	76%	
IB+DC	83%	91%	
DC+N	95%	95%	
DC+Q	85%	104%	
TA+CL	175%	78%	
CL+IB	109%	83%	
Three NSAIDs Combination Treatment			
TA+CL+IB	82%	78%	N+Q+CL
TA+CL+N	105%	67%	
CL+IB+TA	85%	66%	
CL+IB+N	111%	89%	
IB+DC+TA	83%	97%	
IB+DC+CL	84%	89%	

IB+DC+Q	115%	98%	
DC+N+TA	90%	145%	
DC+N+CL	74%	85%	
DC+N+IB	148%	78%	
N+Q+TA	125%	95%	
N+Q+CL	59%	99%	
N+Q+IB	84%	93%	
N+Q+DC	142%	83%	
TA+CL+Q	97%	114%	
Four NSAIDs Combination Treatment			
DC+N+Q+CL	-	76%	DC+N+Q+CL
TA+CB+IB+N	-	91%	
CL+IB+DC+N	-	96%	
DC+N+Q+TA	-	92%	
Five NSAIDs Combination Treatment			
TA+CL+IB+DC+Q	150%	83.2%	TA+CL+DC+N+Q
CL+IB+DC+N+Q	106%	90.3%	
IB+DC+N+Q+TA	71.9%	116%	
TA+CL+DC+N+Q	52.4%	105%	

T: (Tolfeenamc Acid); IB: (Ibuprofen); CL: (Celecoxib); N: (Naproxen); D: (Diclofenac); Q: (Quercetin)

Table 2: Comparison of Dock Score of Standard Chemotherapeutic Drugs, With Nsaids and Quercetin For Cox-1 And Cox-2 Binding.

Ligand	Cycloxygenase 1		Cycloxygenase 2	
	Binding Energy	Interacting Sites	Binding Energy	Interacting Sites
Tolfenamic acid	-8.82	Asn 381, His 385 Tyr 384	-8.56	Asn 375, Asn 376
Ibuprofen	-7.56	Trp 386	-6.96	Asn 537, Val 228 Gly 533
Diclofenac	-7.78	Asn 381, Tyr 384 His 206	-8.08	Gly 225, His226 Val 228, Asn375
Naproxen	-8.23	Met 390, Trp 386 Asn 381	-7.96	Val 228, Asn 537
Celecoxib	-6.94	Tyr 403,His 387	-8.44	Gln 374,Arg 376
Quercetin	-9.57	His 387, Thr 205, Asn 381	-9.19	Arg 376, Asn 375 Val 228, Asn 537 Gln 374, Tyr 37, Gly 533
Standard Chemotherapeutic Agents	Binding energy		Binding Energy	
Etoposide	-10.35		-12.45	
Irinotecan	-13.23		-13.73	
Paclitaxel	-7.39		-11.45	

The interactions of NSAIDs and quercetin with cyclooxygenase 1 and 2 was considered to be based on the binding of ligand with the proteins COX 1 and 2. The binding energy was assigned with a docking score. Dock score is a function of the binding energy of ligands-proteins. Table 2 represents the *in silico* analysis represented by a docking score as a mathematical function and putative interacting amino acids in the binding site. The NSAIDs and phytochemicals were compared with standard chemotherapeutic drugs, Etoposide, Irinotecan, and Paclitaxel. A ligand's lower negative dock score indicates a higher binding affinity with the protein.

Tolefenamic acid had the highest *in silico* binding potential with three interacting amino acids asparagines, histidine, and tyrosine for COX 1 and two interacting amino acids, both asparagines for COX 2. A slightly higher binding potential of tolefenamic acid for COX 1 complies with the presence of three interaction units in COX 1. The phytochemical quercetin had higher binding potential than NSAIDs, and quercetin has three interacting amino acids (histidine, threonine, and asparagines) with COX 1 and seven interacting amino acids (valine, glycine, glutamine, tyrosine, arginine, and two asparagine) with COX 2. Naturally, the NSAIDs, and phytochemical had a lower binding potential as compared to standard chemotherapeutic drugs. However, a few like tolefenamic acid and quercetin hold potential. Also, the chemotherapeutic drugs have multiple cellular targets to inhibit cell division or induce cell death, although, the NSAIDs solely target the prostaglandin pathway. Therefore, the chemopreventive action of NSAIDs should be seen as a potential for further development, which holds future promise, and the *in silico* findings surely suggest the NSAIDs to be an active specific binding agent.

CONCLUSION

Lung cancer is the result of an aggressively proliferating group of lung cells. The study has demonstrated an effective repositioning strategy for lung cancer. The repositioning of NSAIDs and quercetin has been able to induce cytotoxicity in A549 lung cancer cells. Thus, it can be concluded that a combination of NSAIDs works better than single NSAIDs in inducing cytotoxicity. Previous repositioning strategies focused on using a single compound for treating an indication, yet the present study was focused on creating a regime of compounds for better success in repositioning. Therefore, a study to find out the synergistic potential of the NSAIDs was performed. It was found that synergism was effective against A549 cells. In The synergistic study, this two-drug, three-drug, four-drug, and five-drug

cocktails showed potential cytotoxic effects. Furthermore, the results show that the augmentation of NSAIDs by phytochemical quercetin always works better than a non-augmented combination. The results of synergistic potential and augmentation demonstrate a promising novel repositioning strategy that has never been done before. The results of *in silico* studies for the binding of compounds proved the interaction NSAIDs and quercetin with cyclooxygenase enzyme. Tolefenamic acid had the highest *in silico* binding affinity. Also, quercetin, a proven antiproliferative agent, had a high binding affinity with cyclooxygenase. Lung cancer is a complex phenomenon. Thus, the present study was focused on helping find a non-invasive management strategy, rather than to claim a replacement of conventional cancer therapies. The study demonstrated the potential of repositioning NSAIDs for lung cancer management augmented with quercetin.

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CRISPR/CAS9 TECHNOLOGY FOR CROP IMPROVEMENT: A NEW WEAPON FOR INDIAN AGRICULTURAL THREATS

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ABSTRACT

Agriculture is the primary source of livelihood for about 58 per cent of India's population. Agriculture is important in India for the obvious reason of its centrality, given that it accounts for a large share in GDP (gross domestic product) (16%), and an even larger share in employment (49%). Perhaps it is even more important because, as the experience of the last few years illustrates, it has the potential to hold back Indian development. Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes adversely affect the growth of crop plants, yield and quality of agriculture products. Pest outbreak and increased abiotic stresses due to climate change pose a high risk to tropical crop production. Although conventional breeding techniques have significantly increased crop production and yield but new approaches are required to further improve crop production in order to meet the global growing demand for food. Genome editing technologies such as Zinc Finger Nucleases (ZFNs), Transcription Activator like Effector Nucleases (TALENs) helps to target gene of interest but these methods are expensive and time consuming. CRISPR(Clustered Regularly Interspaced Short Palindromic Repeats) proves as a powerful tool in this aspect, it is versatile, easy to design and cost effective tool for development of non-transgenic genome edited crop plants to overcome abiotic stress due to drastic climate change and to ensure food security as well as to enhance the Indian agriculture based economy in future. This review article discusses the molecular mechanism of CRISPR/Cas9 technology and its application in crop improvement.

Keywords: CRISPR/Cas9; biotic/abiotic stress tolerance; crop improvement.

INTRODUCTION

In today's world, almost one billion people suffer from chronic malnourishment, while at the same time our agriculture systems are degrading, exacerbated by the loss of biodiversity and uncertainties of climate change [1]. With increase in population, demand for food has also increased and hence to meet the global demand for food, it is necessary to increase agricultural productivity. There are many genetically modified crops since the procedure is time consuming and expensive it is not applicable on large scale. Also many genetically modified crops are not acceptable due to health issues. Government regulatory frameworks that aim to safeguard human and environmental biosafety have led to significant cost barriers to the rapid widespread adoption of new GM traits [2]. As a result, the advantages of GM traits have been restricted to a small number of cultivated crops [3]. The risk involved in altering genomes through the use of genome editing technology are significantly lower than those associated with GM crops because most edits alter only a few nucleotides producing changes that are not unlike those found throughout naturally occurring population [4]. Population growth, climate change, and food shortage are some of the threatening current issues for the world community. World population is growing rapidly and is projected to reach 9.7 billion by 2050. Besides this, increase in biotic/abiotic stress such as salinity, soil infertility, drought, flood, etc. leads to decrease in agricultural productivity resulting in the low crop yield. To overcome such problem CRISPR serves as an important tool. The CRISPR/Cas9 system is a plant breeding innovation that uses site-directed nucleases to target and modify DNA with great accuracy [5,6] Developed in 2012 by scientists from the university of California, Berkeley, CRISPR/Cas9 has received a lot of attention in recent years due to its range of applications including biological research, breeding and development of agricultural crops and animals and human health applications [7] these includes gene silencing, DNA free CRISPR-Cas9 gene editing, homology-directed repair(HDR), and transient gene silencing or transcriptional repression(CRISPRi). CRISPR is an enzyme found in bacterial defence system which requires

guide RNA (gRNA) for its activity. The CRISPR/Cas9 system is basically 'micro scissors' that cuts the DNA in more precise and directed manner than the conventional techniques. Once the DNA is cut, scientists rely on the cells' natural DNA repair mechanism to adjust the DNA as desired.

The CRISPR system is a sophisticated adaptive immune mechanism present in archaea or defence against invading bacteriophages and exogenous plasmids [8]. A complete CRISPR-Cas9 locus comprises a CRISPR array that harbors short repetitive elements intercalated with invader DNA-targeting spacers, an AT rich leader sequence and an operon of cas genes encoding the Cas proteins [9]. It is site specific genome editing technology for multiple sites. Fewer inputs are required for greater results.

MECHANISM OF ACTION OF CRISPR/CAS9

Workers across the world have described three types of CRISPR mechanism. Type II of CRISPR is the most studied type [10]. The types I and III system involves specific Cas endonuclease which make the pre-crRNA (Pre CRISPR RNA) and after attaining maturity, this crRNA assembles into Cas protein complex. This complex possess ability to recognize and cleave nucleic bases complementary to crRNA [11]. The CRISPR/Cas9 type II is characterized as a small RNA based immune system of archaea and bacteria [12] Type II CRISPR/Cas9 system from *Streptococcus pyrogenes*, have been developed as versatile genome editing tools for a wide variety of potential application [13] The CRISPR/Cas9 system requires two components, single guided RNA (sgRNA) and Cas9, to recognize and cleave the target DNA, thereby instigating the DNA repair mechanism and leading to gene mutation [14]. The Cas9 nuclease-mediated cleavage is guided by a single guide RNA (sgRNA) which recognizes the target DNA via standard Watson-Crick base pairing [15]. sgRNAs are 20-22 nucleotides (nt) in length, which can be easily designed and synthesized as oligonucleotides. Thus Cas9 nuclease can be targeted to any DNA sequence with 5'N(20-22)–NGG by changing the 20-22 nt guide sequence [16]. Cas9 contains 2

domains: (1) an H.NH domain, and (2) a Ruc-V-like domain. The first domain cleaves the complementary strand of CRISPR RNA (crRNA) and the second domain breaks the opposite strand of the double stranded DNA. The sgRNA consists of the seed sequence and nonseed sequence adjacent to the protospacer adjacent motif (PAM) sequence, and is the most important part of the guide RNA (gRNA) sequence in the CRISPR/Cas9 system [17].

The CRISPR molecule is made up of short palindromic DNA sequences that are repeated along the molecule and are regularly spaced. Between these sequences are “spacers”, foreign DNA sequences from organisms that are previously attacked the bacteria [7]. The CRISPR molecule also includes CRISPR associated gene or Cas gene. These encode proteins that unwind DNA and cut DNA, called helicases and nucleases respectively [18]. In general, the action of the CRISPR/Cas9 system can be divided into three

stages in response to invading foreign DNA [19,20]: (i) acquisition stage- the invading DNA is identified and a spacer sequence derived from the target DNA is inserted into the host CRISPR array to establish immunological memory; (ii) expression stage- the Cas9 protein is expressed, and the CRISPR array is transcribed into a precursor RNA transcript (pre-crRNA). A non-coding trans-activating CRISPR RNA (crRNA) then hybridizes to the pre-crRNA and Cas9 protein and processes then into mature RNA units known as crRNAs ; and (iii) interference stage- the mature crRNA guides the Cas9 protein to recognize the appropriate DNA target, leading to the cleavage and degradation of the invading foreign DNA [21] Scientists make use of CRISPR-Cas9 systems’ recognition of specific DNA sequence and apply it in the process of development of improved crops. Instead of viral DNA as spacers, scientists design their own sequences, based on their specific gene of interest (Fig. 1).

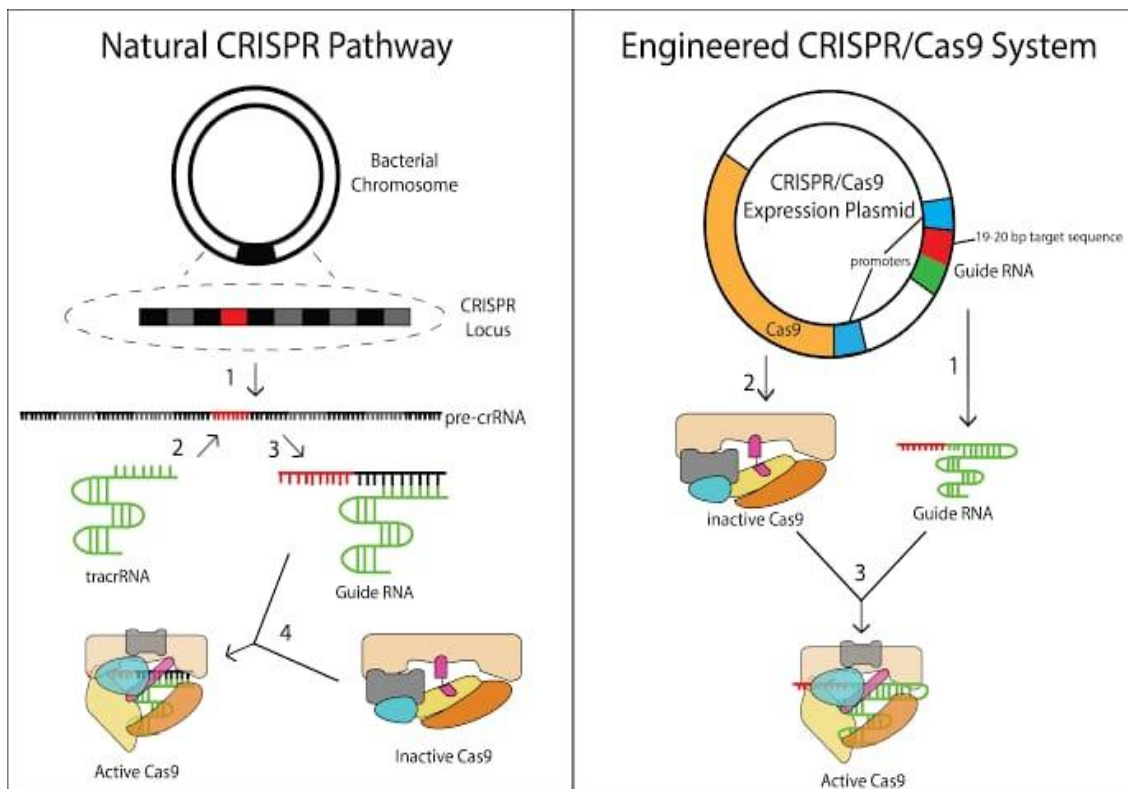


Fig. 1. Schematic representation of mechanism CRISPR/Cas9 in prokaryotes and in engineered CRISPR/Cas9 system

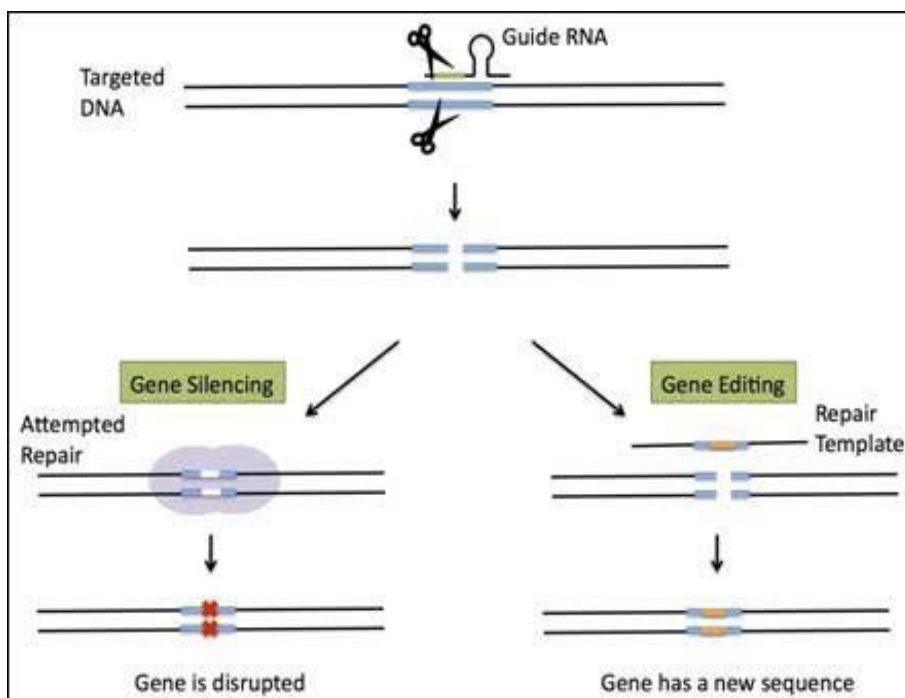


Fig. 2. Mechanism of CRISPR/Cas9

If a gene's sequence is known, it can be easily used in CRISPR. It will then act just like a spacer for the system and guide the Cas9 protein to a DNA matching sequence [5,18]. Plant cells can repair double-stranded breaks either by untemplated annealing of the DNA ends (known as SDN-1 editing), which often causes small sequence changes and generates gene knockouts or by integrating a different piece of DNA at the DSB to generate short sequence replacements of less than 20 nucleotides (SDN-2 editing) or longer sequence replacements or insertions (SDN-3 editing) [22].

STEPS INVOLVED IN CRISPR/CAS9 IS AS FOLLOWS

Step 1 describes the selection of gene and designing of gRNA, step 2 describes the cloning of the gRNA in a suitable binary vector, step 3 shows the availability of single and multiplex editing, step 4 describes methods of transformation, step 5 explains screening methods of edited crops and step 6 demonstrates the evaluation and selection of the desirable transgene-free plant for the target trait [23].

CROP TRAITS THAT ARE IMPROVED BY CRISPR/CAS9 TECHNOLOGY

There are many crops that are improved through the use of CRISPR/Cas9 technology. In rice, when the LAZY1 gene was knocked out by CRISPR/Cas9, a tiller spreading phenotype was generated, which could increase crop yield under certain circumstances [24]. *Grain Weight 2 (GW2)* is a key gene in cereal crops, which when disrupted increases grain weight and protein content in wheat [25]. Li et al. [26] used the CRISPR/Cas9 system to mutate the *Gn1a*, *DEP1* and *GS3* genes of the rice cultivar Zhonghua11, producing mutants with enhanced grain number, dense erect panicles, and larger grain size, respectively. CRISPR/Cas9 technology has been used to target *FAD2* to improve oleic acid content while decreasing polyunsaturated fatty acids in the emerging oil seed plant *Camelina sativa* [27]. DuPont Pioneer (now Corteva AgriScience) knocked out the maize waxy gene *Wx1*, which encodes the granule-bound starch synthase (GBSS) gene that is responsible for making amylose [3]. In the absence of GBSS expression in the endosperm, amylase was not synthesized, and thus

created a high amylopectin (waxy) maize with improved digestibility and the potential for bio-industrial application. The release of commercial hybrids with this trait is planned for 2020. The same gene has also been targeted in the potato by researchers at the Swedish Agricultural University to produce waxy potatoes, with improved cultivars aimed predominantly at the industrial starch market to be released in the next few years [28] In rice, Sun et al. [29] used CRISPR/Cas9 technology to generate targeted mutations in *SBEIIIb*, leading to a higher proportion of long chains in amylopectin, which improved the fine structure and nutritional properties of the starch.

Tashkandi et al. [30] used the CRISPR-Cas9 system to engineer tomato plants resistant to the tomato yellow leaf curl virus by targeting the coat protein and replicase loci of the genome. *Tomato dicer-like 2 (DCL2)* genes were targeted and the *dcl2* mutants displayed viral symptoms when infected by potato virus, suggesting the *DCL2* is involved in the defense mechanism against RNA viruses [31,32]. The *Solyc08g075770* gene has been identified to the function in *Fusarium* wilt

tolerance, and CRISPR-Cas9 knockout transgenic plants exhibited disease susceptibility [33]. Mitogen activated protein kinase 3 (MAPK3) has been shown to confer resistance to *B. cinerea* by using CRISPR-Cas9 technology [34]. Ortigosa et al. used CRISPR/Cas9 to target *JAZ2* gene in tomato to raise resistance against bacterial speck disease [35]. CRISPR-Cas9 technology was also used to develop resistance against banana streak virus by targeting ORF region of virus [36].

Zhang et al. [37] used CRISPR/Cas9 technology to generate *Taedr1* wheat plants by simultaneous modification of three homologs of *EDR1*. The resulting plants were resistant to powdery mildew and did not show mildew-induced cell death. In rice, enhanced rice blast resistance and bacterial blight resistance were separately obtained by mutagenesis of OsERF922 and OaSWEET13 [38,39]. Furthermore, powdery mildew – resistance tomatoes were generated by editing *SIMLO1* [40], and the bacterial speck-resistant tomatoes were created by disrupting *SIJAZ2* [41]. In this way many crop's and fruit crop's gene were edited successfully (Table no. 1).

Table 1. Crops and fruit crops that are improved by CRISPR/Cas9 technology

Crop species	Target gene	Target trait	Reference
Rice	<i>LAZY1</i>	Tiller-spreading	[24]
Wheat	<i>GW2</i>	Increased grain weight and protein content.	[25]
Rice	<i>Gn1a,GS3,DEP1</i>	Enhanced grain number, larger in size and dense erect panicles	[26]
<i>Camelina sativa</i>	<i>FAD2</i>	Decreased polyunsaturated fatty acid	[27]
Potato	<i>Wx1</i>	High amylopectin content	[3]
Rice	<i>SBEIIIb</i>	High amylase content	[29]
Tomato	<i>CP and Rep of virus</i>	Resistance against tomato yellow leaf curl virus	[30]
Tomato	<i>DCL2</i>	Susceptibility of potato virus X, tobacco mosaic virus, and tomato	[31,32]
Tomato	<i>Solyc08g075770</i>	Susceptibility of <i>Fusarium</i> wilt disease	[33]
Tomato	<i>MAPK3</i>	Susceptibility to gray and mold disease	[34]
Tomato	<i>JAZ2</i>	Resistance against bacterial speck disease	[35]
Banana	ORF region of virus	Resistance against banana streak virus	[36]
Wheat	<i>EDR1</i>	Powdery mildew resistance	[37]
Grape	<i>MLO7</i>	Resistance against powdery mildew	[42]
Grape	<i>WRKY52</i>	Resistance against gray mold disease	[43]
Cacao	<i>NPR3</i>	Resistance against <i>Phytophthora tropicalis</i>	[44]
Papaya	<i>aIEPIC8</i>	<i>Phytophthora palmivora</i>	[45]
Citrus	<i>LOB1 promoter</i>	Resistance against citrus canker	[21]
Apple	<i>DIPM1, 2, 4</i>	Resistance against fire blight disease	[42]
Watermelon	<i>ALS</i>	Resistance against herbicide	[46]
Cucumber	<i>WIP1</i>	Generation of gynoeious plant	[47]
Ground cherry	<i>SP, SP5G, CLV1</i>	Introduction of traits associated with morphology, flower production, and fruit size	[48]
Kiwifruit	<i>CEN4, CEN</i>	Generation of a compact plant with rapid terminal flower and fruit development	[49]

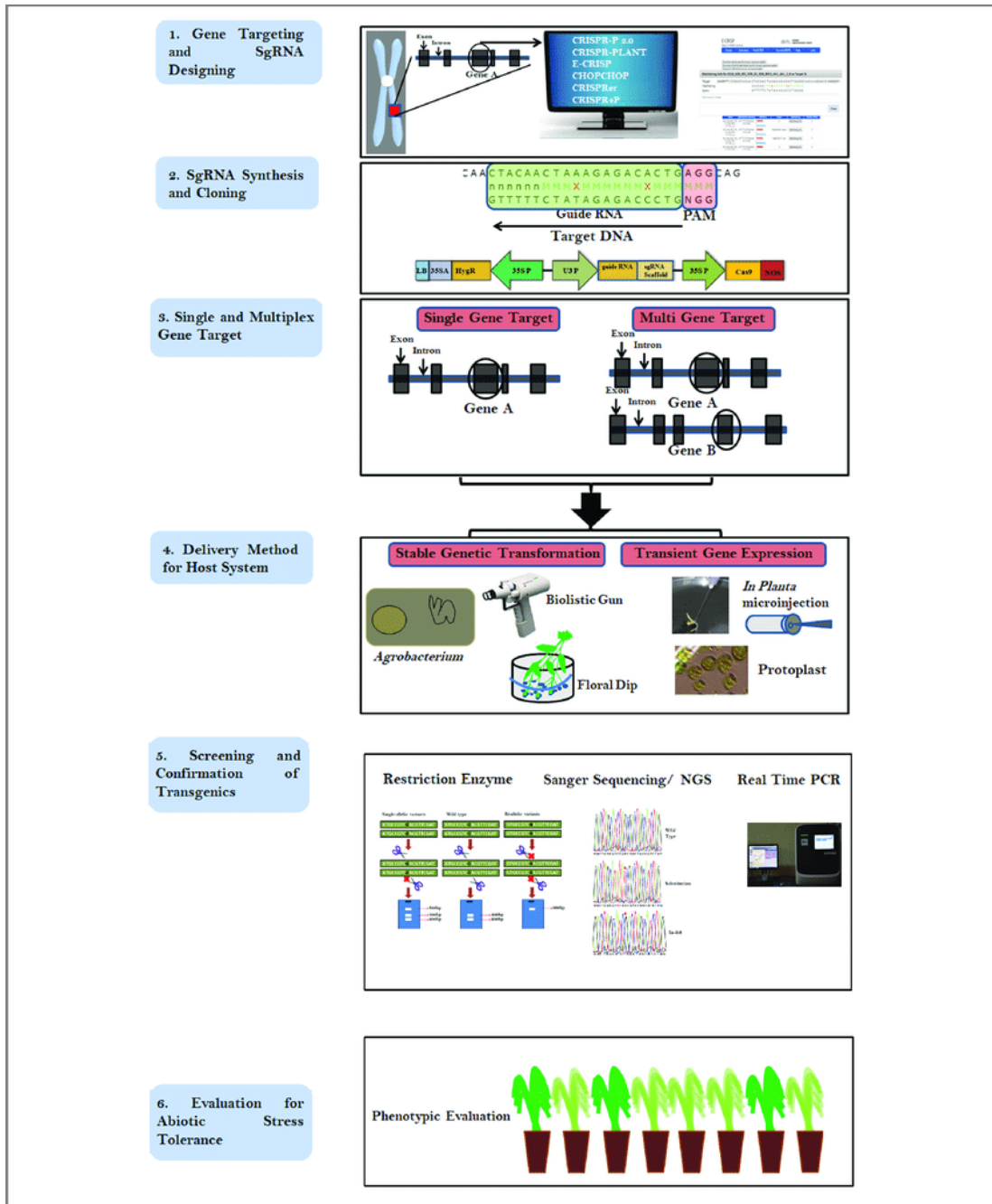


Fig. 3. Flowchart describing the steps involved in CRISPR/Cas9 based genome editing

CONCLUSION

Increased agricultural production and sustainable food security is of paramount importance for a growing population, both globally and in India

[50]. Rice is one of the major staple food crops, on which over half of the world’s population and 80% of Asians are dependent for meeting their daily energy needs. India is the second largest consumer (around 100 million tones) as well as

producer (115 million tone's) of milled rice after China. Rice, like other crops, is exposed to various biotic and abiotic stresses during its life cycle. Several diseases such as bacterial leaf blight and blast, and insect pests like the brown plant hopper, cause significant damage that result in devastating yield reductions. The crop losses from some of these biotic stresses can be as high as 50% and even reach 90% in epidemic conditions. Agriculture has remained as a centerpiece of Indian economy. Though it is a main source of livelihood for a majority of Indian population, it still stands as a technologically backward sector. Despite its importance to the economy, little has been done to revive the sector. From production challenges to financing inefficiencies, Indian agriculture is plagued by several issues in which climate change is a big threat for Indian agriculture. To overcome these problems need to crop modification. New breeding techniques provide scientists the ability to precisely and quickly insert the desired traits than conventional breeding. CRISPR/Cas9 based genome editing is a fundamental breakthrough technique. Application of genome editing tools in crop improvement to enhance yield, nutritional value, disease resistance and other traits will be a prominent areas of work in the future. In the last 5 years, it is being applied vigorously in many plant systems for functional studies and combating biotic and abiotic stresses as well as to improve other important agronomic traits. Though several modifications to this technology have to lead to increasing on-target efficiency, most work carried is preliminary and needs further improvement. Nevertheless, CRISPR/Cas9 based genome editing will gain popularity and be an essential technique to obtain 'suitably edited' plants that will help achieve the zero hunger goal and maintain feed the growing human population.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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DIGITAL AGRICULTURE: CONTEMPORARY WAYS FOR PRECISION FARMING PRACTICES IN INDIA

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Short Communication

ABSTRACT

Agriculture is the back bone of India, with majority of them depending on it for adequate livelihood. However, Indian farmers are not getting expected income from this sector owing to many problems relating to pest and disease, pesticides, fertilizer and processing, among others. Notably, digital agriculture has potential to make agriculture more productive and consistent, as well as using of time and resources more efficiently. This brings critical advantages for farmers and wider social benefits around the world. Digital devices Brings something valuable to farming from data collection, through to management and processing, as well as guidance and direction. This paper is an attempt to get an insight into digital technologies and applications of sensors, communication networks, Unmanned Aviation Systems (UAS), Artificial Intelligence (AI), robotics and other advanced machinery based on the principles of the internet in agricultural sector and potential of digital technology in India.

Keywords: Artificial intelligence; digital agriculture; precision farming; robotics.

INTRODUCTION

India is already large population is expected to become the world's largest in the next 20 years, while its economy will soon overtake Japan's to become the world's third largest. The resulting increase in the demand for food will need to be

met through higher agricultural productivity or by increasing food demand [1]. Agriculture is the most important sector of Indian Economy. 70% rural household depend on agriculture, where, Indian agriculture sector accounts for 18 percent of India's Gross Domestic Product (GDP) and provides employment to 60 percent of population

[2]. Digital agriculture is the use of new and advanced technologies, integrated into one system, to enable farmers and other stakeholders within the agriculture value chain to improve food production. Most of today's farmers make decision such as how much fertiliser to apply based on a combination of rough measurements, experience and recommendations. Once a course of action is decided, it is implemented but the results are normally not seen until harvest time [3]. Digital agriculture is Information and communications technology (ICT) and data ecosystems to support the development and delivery of timely, targeted information and services to make farming profitable and sustainable while delivering safe nutritious and affordable food for all [4]. A digital system gathers data more frequently and accurately, often combined with external sources (such as weather information). The resulting combined data is analysed and interpreted so the farmer can make more informed and appropriate decisions. These decisions can then be quickly implemented with greater accuracy through robotics and advanced machinery, and farmers can get real-time feedback on the impact their actions [3]. Precision Agriculture (PA), satellite farming or Site Specific Crop Management (SSCM) is a farming management concept based on observing,

measuring and responding to inter and intra-field variability in crops [5].

PROBLEM STATEMENT

Digital technology has significantly transformed all sectors of economic development. It has changed our way of living to the extent that it is difficult to imagine life without it. Digital agriculture has the potential to make agriculture more productive, more consistent and to use time and resources more efficiently. This brings critical advantages for farmers and wider social benefits around the world. It also enables organisations to share information across traditional industry boundaries to open up new, disruptive opportunities. In developed countries, digital technologies and analytics are already transforming agriculture, making farm operations more insight-driven and efficient. However, agricultural productivity in developing countries, but in many countries including India people remains unaware about the various digital technologies and the application of digital technologies still very limited. So this review research paper provides the information about the various application of digital devices and technologies in the field of agriculture.



Fig. 1. Role of agriculture in Indian economy

Source: <https://www.slideshare.net/Ravimeha/role-of-agriculture-in-indian-economy>

The Technology

Today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems allow businesses to be more profitable, efficient, safer, and more environmentally friendly [6]. Technologies used include sensors, GPS, communication networks, UAS, Artificial Intelligence (AI), robotics and other advanced machinery and often draws on the principles of the Internet of Things. Each one of these brings something valuable to farming from data collection, through to management and processing, as well as guidance and direction. This integrated system offers new insights that enhance the ability to make decision and subsequently implement them [3].

Global Positioning System

The GPS is a navigation system based on a network of satellites that helps users to record positional information with accuracy. This allows farmers to locate the exact position of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions. There is an automatic controlling system, with light or sound guiding panel (DGPS), antenna and receiver to calculate their position. The system allows farmers to reliably identify field locations so that inputs (seeds, fertilizers, pesticides, herbicides, and irrigation water) can be applied to an individual field, based on performance criteria and previous input applications [7].

Remote Sensing

Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. Remote sensors collect data by detecting the energy that is reflected from earth. These sensors can be on

satellites or mounted on aircraft. Remote sensors can be either passive or active. Passive sensors respond to external stimuli. They record natural energy that is reflected or emitted from the Earth's surface. The most common source of radiation detected by passive sensors is reflected sunlight. In contrast, active sensors use internal stimuli to collect data about earth. For example, a laser-beam remote sensing system projects a laser onto the surface of Earth and measures the time that it takes for the laser to reflect back to its sensor.

Robotics in Agriculture

Agriculture is quickly becoming an exciting high-tech industry, drawing new professionals, new companies and new investors [8]. One of the major advantages of robots is their flexibility to perform a variety of tasks and applications in any environment. They are more precise and consistent than people. They increase production and profit margin, as they can accomplish tasks more quickly. As the heart of this phenomenon is the need for significantly increased production yields. The United Nations estimates the world population will rise from 7.3 billion today to 9.7 billion in 2050. The world will need a lot more food, and farmers will face serious pressure to keep up with demand. Some of the most common robots in agriculture are used for harvesting and picking, weed control, autonomous mowing, pruning, seedling, spraying and thinning, sorting and packing. Harvesting and picking is one of the most popular robotic applications in agriculture due to the accuracy and speed that robots can achieve to improve the size of yields and reduce waste from crops being left in the field [9].

Sensors Technologies

Various technologies such as electromagnetic, conductivity, photo electricity and ultra sound are used to measure humidity, vegetation, temperature, texture, structure, physical character, humidity, nutrient level, vapour and air, among

Table 1. Application of digital tools and equipment's in agriculture

Digital tools and equipment	Uses
GPS	Allows farmers to locate the exact position of field information
Remote sensing	Obtaining information about objects or areas from distance typically from aircraft or satellite
Robotics	Increasing production yields for farmers in various ways
Sensors	Used to measure humidity, temperature, nutrient level, etc.

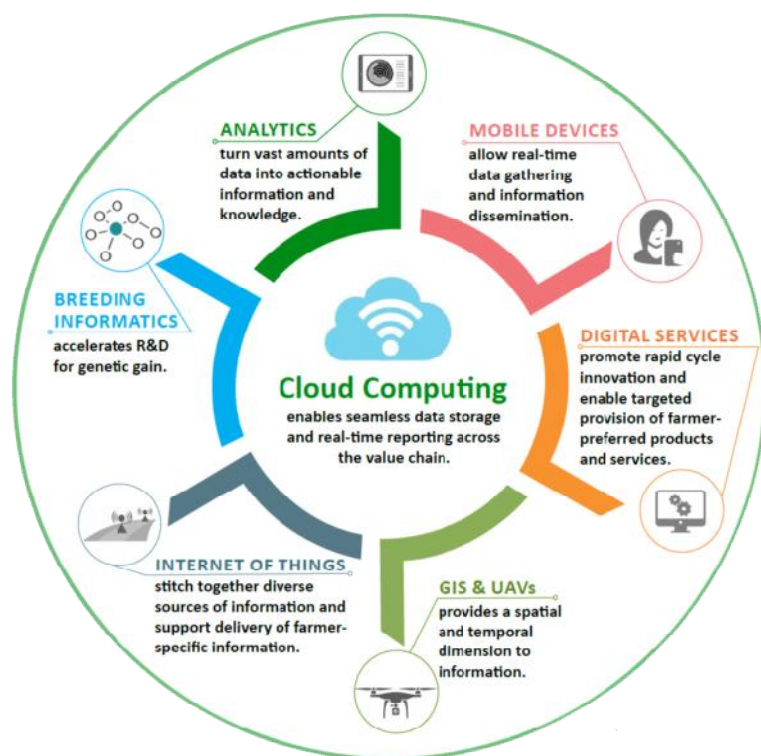


Fig. 2. Various aspect of cloud computing sensor technology

Source: Case Study Report of ICRISAT on Digitizing the Science of Discovery

others. Remote sensing data are used to distinguish crop species, locate stress conditions, identify pests and weeds, and monitor drought, soil and plant conditions. Sensors enable the collection of immense quantities of data without laboratory analysis [10].

APPLICATIONS USED TO MAKE AGRICULTURAL SECTOR DIGITAL

Agri App

Agri app is one of the most liked apps by farmers. It has a rating of 4.3 out of 5. It is an online farming marketplace bringing Kisan, farming input/output, government service on an online platform. It also provides chat option for farmers. Kisan can easily chat with an expert of agriculture using this app. This mobile application provides diversified videos of agriculture work. Approximately 0.1 million users downloaded this farming app [11].

Iffco Kisan App

Iffco Kisan is the best app in out of almost agri apps for Kisan. It is a small Android App in terms of memory with an easy interface to use. This android application provides information about the latest agriculture advice, latest mandi prices, and various farming tips. It also provides weather forecast information. It also provides agriculture alerts to farmers in 10 Indian languages. The farmers can easily take help of agriculture experts using this app. Approximately 50 thousand users downloaded this app [11].

Agri Media Video App

Agri Media Video App is one of the most popular in mobile apps for farmers in the video category. It has a rating of 4.8 out of 5. It is an online marketplace bringing farmers, agriculture input/output, farming retail and fulfilment service on an online platform. It also provides chat service for

farmers to solve their query related to agriculture with the option of upload images of infected crops .Farmers can easily chat with agriculture expert and discuss their problems. This smartphones application also provides various videos related to agriculture practice, new technologies, successful farmers, rural development, agriculture news, new government. Schemes related to agriculture. Approximately 10 thousand users downloaded this app.

FarmBee-RML Farmer

It is marvellous in the list of agriculture android apps which has a rating of 4.3 out of 5. It is a small app in terms of memory with an easy user

interface. It is available in 10 different Indian languages. It provides fertile agriculture content and information at every stage of the crop life cycle. A farmer can choose from 450 crop varieties, 1300 markets, 35000 weather locations .It also provides mandi price and weather forecast based on a user location. Approximately 0.5 million users downloaded this app [12].

Kisan Yojana

Kisan Yojana is another popular Android agriculture apps available for free. It provides information about all Govt schemes to Kisan. It commutes the information gap between the rural people and Govt. It also provides the schemes of

Table 2. Digital applications and their use in agriculture

App	Feature	No. of users
AgriApp	Online farming marketplace bringing Kisan, farming input/output, government service on an online platform, also provides chat option [11]	App 0.1 million users downloaded this farming app.
Iffco Kisan App	Provides information about the latest agriculture advice, latest mandi prices, and various farming tips. Provides weather forecast information [11]	App. 50 thousand users downloaded this app [11]
Agri Media Video App	Online marketplace Provides videos related to new tech., rural development, agriculture news, etc.	App.10 thousand users downloaded this app.
FarmBee-RML Farmer	Provides fertile agriculture content and information at every stage of the crop life cycle.	App. 0.5 million users downloaded this app.
Kisan Yojana	Provides information about all Government Schemes to Kisan. It commutes the information gap between the rural people and Govt.	App. 50 thousand users downloaded this app.
Sowing App	Deliver targeted and timely SMS to farmer about sowing. And other farm management practices [14]	Piloted in 2016 in seven villages in Devanakonda mandal, Kurnool district including Andhra Pradesh.
iHub	Provides mentorship for agricultural technology start-ups to improve research programme & accelerate the science of delivery	Working with state govt. Local NGOs, CGIAR research programme and technology.
Plantix	Help extension officers automatically diagnose and respond to disease and pest [15].	In November 2016, International Crops Research Institute for the Semi-Arid Tropics(ICRISAT) and the government of Andhra Pradesh signed Memorandum Of Understanding with People for the Ethical Treatment of Animals (PEAT) to pilot Plantix
LeasyScan	To rapidly measure leaf surface area characteristics and water stress	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) 2016
HarvestMaster	Records highly accurate measurements of grain weight and moisture characteristics for development of new varieties.	In 2017, under the phenotyping module of the Consultative Group on International Agricultural Research (CGIAR) , Excellence in Breeding Platform (EIB), ICRISAT

Source:<https://yourstory.com/mystory/e374fa4df7-top-5-best-android-app>, <https://plantix.net/en/>

the different relative states Government. This mobile application also saves the time and travel expense of Kisan to reach te state Govt office is saved. Approximately 50 thousand users downloaded this app [12].

Sowing App

The Sowing App uses cloud-based predictive analytics tools on Microsoft Azure including Cortana artificial intelligence and machine learning to predict an optimal sowing period and other farm management practices [12]. The Intelligent Agricultural Systems Advisory Tool (ISAT) integrates historical climate data, seasonal and short-term weather forecasts, soil information, and crop models to create decision trees with recommended actions for farmers. Both tools address these challenges by delivering SMS messages to farmers about when to sow and what management practices to adopt personalized to their village soil profile and weather forecast. The sowing app is a partnership between the

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Microsoft India, and the Government of Andhra Pradesh. It was piloted in 2016 in seven villages in Devankonda Mandal, Kurnool district and targeted 175 groundnut farmers working with local Non-Government Organization “Chaithanya Youth Association”. The Sowing App is currently being scaled up in 13 districts of Andhra Pradesh [13].

iHub

The iHub is an incubator program at International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) that provides mentorship for agricultural technology start-ups to improve research programs and accelerate the science of delivery. The Digital Agriculture team launched the iHub in February 2017. It connects entrepreneurs with mentors to help improve and iterate on innovations to meet needs across value chains and lead to social and economic impacts for farmers.

Table 3. Agricultural mobile apps and their operating systems [16]

Category	Android	iOS
Business and financial data	121	123
Animal production	65	65
Farm management –Crops	69	91
Pests and diseases	20	24
Agricultural technology and innovation	73	88
Agricultural machinery	39	35
Spraying related activities	30	31
Weather forecast	18	17
Training	41	39
Agricultural news	41	46
Other	44	30

Source: Article from IOSR Journal of Mobile Computing & Application , vol. 3, no. 6, pp. 44-99

Table 4. Countries with digital strategies affecting the agriculture food sector [17]

Country	Strategy	Phase	Impact on agrifood
Mexico	National Digital Strategy	Implementation	Partly (education and tax)
Columbia	Online Government Strategy	Implementation	Partly (data and ICT services)
Brazil	Digital Governance Strategy	Implementation	2016–2019 Partly
Bulgaria	Strategy for Digitization of Agriculture	Drafted	High
Hungary	Digital Agriculture Strategy	Drafted	High
Australia (Victoria)	Digital Agriculture Strategy	Implementation	High
Greece	Digital transformation of Greek agriculture	Implementation	High
United Kingdom	Agricultural technologies (agritech) strategy	Implementation	High
Ireland	National Digital Strategy	Under Elaboration	Moderate
Spain	Agenda for the Digitization of the agrifood and forestry sectors and rural areas	Planned implementation 2019	High

Source: Article of Nikola et.al "Digital technologies in agriculture and rural area

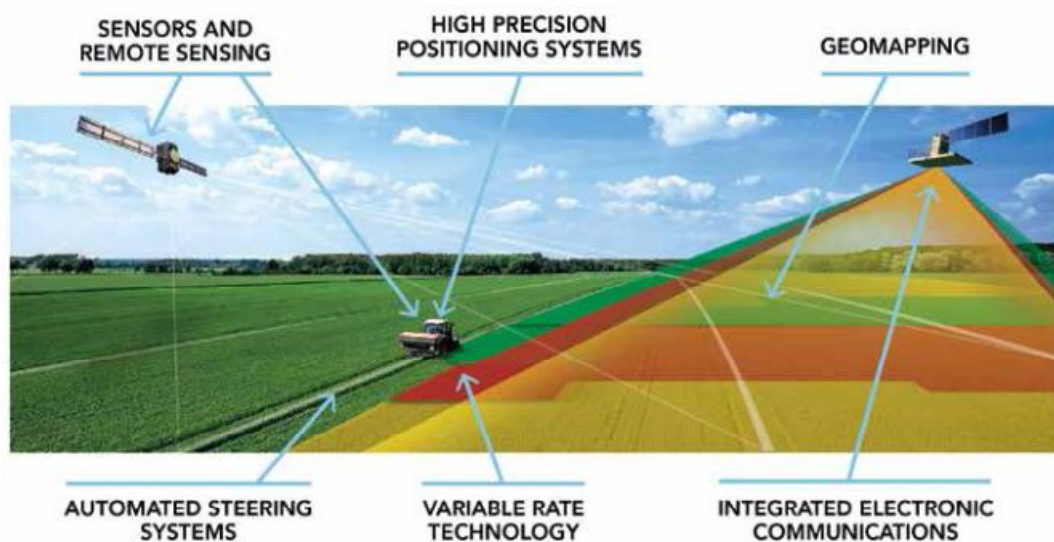


Fig. 3. Application of digital technology in agriculture

Source: CEMA (European Agricultural Machinery Industry)



Fig. 4. Plant specific sensor technology

Source: <https://www.onitsciences.com/products/>

Plantix

Plantix is a free mobile crop advisory app developed by German start-up Progressive

Environmental and Agricultural Technologies (PEAT). The app uses machine learning for automated image recognition that diagnoses over 240 plant diseases, pests, and nutrient deficiencies.

An offline library details 400 total types of crop damage, it returns simple information no systems, triggers, controls, and preventative measures in English, Hindi, Telugu, or five other languages.

LeasyScan

The Leasyscan phenotyping platform automatically measures important characteristics related to leaf surface area and water stress for large quantities of plants.

HarvestMaster

The HarvestMaster is a grain gauge originally developed for use on combines in the 1980s. The device measures plot weight, test weight, and harvest moisture. In 2017, under the phenotyping module of the Consultative Group on International Agricultural Research (CGIAR), Excellence in Breeding Platform (EIB), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) began using a standalone HarvestMaster for digital data collection to accelerate the breeding pipeline.

CONCLUSION AND RECOMMENDATIONS

The Prime Minister Narendra Modi launched Digital India on July 1, 2015 to create digital infrastructure for empowering rural communities, enabling digital delivery of services and promoting digital literacy. Given that 68 per cent of India's population is rural and agriculture is the main source of livelihood for 58 per cent of the population, one must consider the role of Digital Agriculture within Digital India. Digital Agriculture can be defined as ICT and data ecosystems to support the development and delivery of timely, targeted (Localised) information and services to make farming profitable and sustainable (Socially, economically and environmentally) while delivering safe, nutritious and affordable food for all. With the digital transformation ongoing, the agriculture environment is constantly evolving and may ultimately transmute into digital and smart agriculture. Understanding the major changes, we will be able to identify gaps, risk and opportunities and how they are driving new business models, adopting technologies and finally changing the

economic, social and environmental elements in the digital age. Today, we see a booming agriculture that is advancing by leaps and bounds in the process of digital transformation, but at the same time we see how small farmers are not included in this transforming process, increasing the digital divide, not only from the point of view access or electronic-literacy, but even more worryingly, from the point of view of production and economic and social integration.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Evaluation of Cytotoxicity and Genotoxicity of Water from Nag River, Nagpur, India

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ABSTRACT

The pollution of the river by man-made sewage and waste disposal is not only harmful to animals and plants in it but also for animals higher in the food chain including those close to the food chain. Water is the most vital natural substance, as it plays a role in nearly every aspect of human life. Therefore, there is a great need to ensure that the water used by humans should not contain hazardous substances. Water quality is directly linked to biological life. The Nag River flows from the Lava village of north Ambazari Lake and flows into the center of Nagpur city. As a result of rapid and unstoppable development, significant changes have taken place in the water quality of the Nag River. Because the Nag River's water is frequently used for irrigation, it should be tested for cytotoxicity and genotoxicity. Since the rate of cancer and genetic disorders has recently increased in the Nagpur region, the Nag River's water could be a source of carcinogens in the food chain, affecting the population. This study was conducted to analyze the impact of water collected from various points of the Nag River using *Allium cepa* as a model organism. The results of this study showed that all water samples from the Nag River cause a cytotoxic effect (20-23%) and genotoxic effects (23-28%) in *Allium cepa* cells. Therefore, before the use of Nag River water, it must be treated to diminish its harmful effect.

INTRODUCTION

Nagpur is the third biggest city in Maharashtra after Mumbai and Pune and it is one of India's quickest developing cosmopolitan cities. It is the winter capital of the province of Maharashtra and the second greenest city in India. Nagpur is home to a number of natural and man-made lakes, the largest of which being Ambazari Lake. This lake is where Nagpur's waterway begins. India has a vast and changing topography, which includes a large number of water bodies. Lakes and streams are now widely used for domestic purposes (Patil et al. 2017). Nagpur is fed by the Nag river, which gives the city its name. Originating from the Ambazari lake, the Nag river takes a winding path for approximately 16 km through the city before it joins another stream called Pili Nadi, which originates at another lake. This stream then merges into the Kanhan river on the outskirts of the city. Because Nagpur has experienced fast urbanization and migration to the city in the last five to six decades, there is increased use of water for domestic purposes, as well as, industrial production has increased, causing a sudden surge in sewage quantity (a meager grimy stream of water (Kalyani et al. 2017). Because of the value and importance of freshwater resources, they must be closely monitored biologically to meet water quality stand-

ards (Puri et al. 2010). An enormous amount of wastewater from the Nagpur metropolitan region and numerous enterprises surrounding the urban areas is dumped into streams, such as the Nag river and its tributaries, contaminating both ground and surface water (Manzar et al. 2010). Because this river runs through a city with a population of around 50 lakh people, it is quite dirty. The Nag river was once a lifeline of the city. But today, the river's rich history has got buried in deep silt beneath the millions of litres of sewage flowing in it (Anparthi 2013). The Ambazari Lake which was the prime source of water to Nagpur city is filled with waste and sewage (which gives it an unnatural dark gray color and a foul smell), and despite receiving rainwater during monsoon it is not fit for consumption. Since such contaminated waste affects all metabolic and physiological activities, it is necessary to analyze the physiochemical attributes of water and propose measures to reduce contamination. All said and done, the sewage-water-flooded soils had higher pH, natural carbon, and CaCO₃. Surface skylines of soils (flooded/non-flooded) had higher groupings of DTPA-extractable Fe, Mn, Cu, and Zn, which decreased with depth. When compared to non-flooded soils, sewage-water-flooded soils are associated with moderately higher concentrations of DTPA-Fe, Mn, Cu, Zn, Pb, Cr, and Album (Tayawade et al. 2010).

Exposure to organic and inorganic chemicals over a long period of time can cause ecological health impairment of aquatic ecosystems causing considerable effects on aquatic biota including bioaccumulation of chemicals in organisms and biomagnification in higher trophic levels. Further, these can result in cytotoxic and genotoxic effects in the organisms (Daniels et al. 1989, Kannangara & Pathiratne 2015). Therefore, many ecotoxicological studies focus on the assessment of physical and chemical environmental parameters and biological responses of organisms. However, recent ecotoxicological studies are paying more attention to using bioassays to assess the mutagenic and genotoxic effects of aquatic pollution (Kannangara & Pathiratne 2015). These mutagenic and genotoxic studies have focused on assessing genotoxicity and mutagenic effects of fish species (Alimba et al. 2015, Carrasco et al. 1990) [12, 14], microorganisms (Buschini et al. 2001, Guan et al. 2017), mammals (Chiu et al. 2009, Kim et al. 2010), and higher plants (Iqbal et al. 2019) in relation to variation of chemical parameters in aquatic ecosystems

However, compared to other organisms *Allium cepa* is considered an efficient bioindicator in genotoxicity testing, because of the rapid root growth rate and reduced number of large chromosomes. *A. cepa* assay is commonly utilized as a short-term and cost-effective indicator of toxicity in monitoring water pollution in many parts of the world. This bioassay can provide valuable information on the presence of genotoxic and/or mutagenic compounds in surface waters and sediments of aquatic ecosystems. However, in Nagpur, a few tests have been carried out to analyze the physiochemical parameters of Bother stream water at various locations (Patil 2017, Manzar 2010, Tayawade et al. 2010) yet till today nobody evaluated the cytotoxicity and genotoxicity of the Bother Waterway Water. Therefore, the current study will use an *A. cepa* bioassay to assess the cytogenotoxic effects of water collected from several locations along the Bother Stream of the Nag River in Nagpur. By proving the ability of such substances to cause chromosomal changes in *A. cepa* root cells, the testing would provide important information concerning the presence of cytogenotoxic or potentially mutagenic substances in surface waters of the Bother stream.

MATERIALS AND METHODS

All the experimental work was completed at the Department of Biochemistry and Biotechnology, Dr. Ambedkar School, Deekshabhoomi, Nagpur during the period of October 2019 to Jun 2020. All the chemicals utilized in this investigation were bought from Hi-media Pvt. Ltd and (The basic purple onion, *A. cepa*) bulbs (2.5-2.8 cm in diameter) used in this study were purchased from a local market in Nagpur, Maharashtra (India).

Sample collection: The collection of water samples of Nag River which is spread over Nagpur city. Five different locations were randomly selected to collect the water sample which is given in Table 1. Water samples were collected in clean glass bottles and GPS values of that site were noted down.

Allium cepa Test

A commercial variety of common onions (*Allium cepa*) was used for the determination of different toxicity end points of meristematic cells. Equal sized healthy onion bulbs were chosen and the outer scales of bulbs were removed by gently scraping to make the apices of root primordia exposed. Scarped onion bulbs were germinated in glass test tubes containing distilled water for 24 hours in the dark. The *Allium cepa* bioassay in accordance with Grant (1982) with some modifications was conducted using water samples collected from the study sites. After 24 hours, onion bulbs were exposed to the exposure media (70 mL, Nag River sample taken from each site) in the glass tubes at the time of processing. For each exposure media 10 onion bulbs were tested. Bulbs with exposure media were kept in dark to avoid the direct sunlight.

After 48 hours of exposure, root lengths of randomly selected five onion bulbs from each exposure media were measured in millimeters. Root tips (5-6 from each onion bulb) of 1-2 mm length were processed for microscopic studies of toxicity end points. Root tips were fixed in ethanol: glacial acetic acid (3:1, v/v) solution for overnight at 4°C. Root tips were transferred into 70% alcohol and stored at 4°C until the time of processing.

Table 1: River Water was collected from five different locations of Nag River, Nagpur.

Samples ID	Water collected from different area	GPS Location
Sample 1	Rashimbagh Darsa Road	21°08'19.9"N 79°06'31.3"E
Sample 2	Gangabai Ghat Road	21°08'26.2"N 79°07'13.0"E
Sample 3	Near Airtel express	21°08'30.0"N 79°07'32.5"E
Sample 4	Near RajatSankul apartment	21°08'14.3"N 79°05'43.0"E
Sample 5	Rashimbagh road (Plant growing side)	21°08'18.4"N 79°06'21.0"E

When processing the root tips, they were hydrolyzed in hydrochloric acid (1N) solution for 5 minutes at 60°C and washed with distilled water. Root tips were then placed in watch glasses containing acetocarmine for 30 minutes to allow the stain to penetrate to the primordial cells. After staining, root tips were placed on glass slides and a slight pressure was applied on the cover slip to squash the tip cells over the slide. Prepared slides for each exposure medium were observed under the light microscope at 400x magnification to score mitotic stages, occurrence of micronuclei, and nuclear abnormalities in the interphase cells (Fiskesjo 1985, 1988).

Mitotic index was calculated as the number of dividing meristematic cells into 100 total meristematic cells by counting 1000 meristematic cells in each slide

Mitotic index = Number of dividing meristematic cells / total meristematic cells (500) × 100

RESULTS AND DISCUSSION

Effect of water samples on cell division process, cytological and chromosomal characteristics were assessed by *A. cepa* test and results given in Tables 2, 3 and 4, and Figs. 1 and 2.

Table 2: Effect of water sample collected from different sites of Nag river on cell division.

	No. of dividing cells	Prophase	Pro-metaphase	Metaphase	Anaphase	Telophase	MI in %
Control	163±3.05	78±1.02	24±2.08	21±1.52	29±2.51	11±1.15	32.6
Sample 1	50±2.05	20±1.03	6±0.33	8±2.52	9±1.15	7±0.57	10
Sample 2	48±1.05	18±1.52	8±0.12	7±1.52	10±2.51	5±1.15	9.6
Sample 3	43±1.06	17±0.50	6±0.60	6±0.57	8±1.15	6±0.72	8.6
Sample 4	49±1.52	19±0.8	7±1.01	8±1.15	9±1.15	6±2.51	9.8
Sample 5	40±2.51	17±1.01	5±0.91	7±0.57	6±0.57	5±0.72	8.0

Data are presented as mean ± standard deviation (SD), MI – mitotic index

Table 3: Chromosomal aberrations in *Allium cepa* root tip cells exposed to the Nag river water samples.

	Bridges	Breaks	lagging	Stickiness	Abnormal spiralisation	Multipolarity	Abnormal Ki- netics	Total No. of Aberrant cells (%)
Control	00±00	00±00	01±0.57	01±0.02	00±00	01±0.57	01±0.57	04 (0.8)
Sample 1	09±0.57	17±2.52	00±00	78±2.52	13±0.57	11±2.52	13±1	141 (28.00)
Sample 2	07±1.15	11±1.15	02±0.57	67±1.51	12±2.15	09±0.57	12±2.51	120 (24)
Sample 3	09±2.15	10±1.52	01±0.02	71±0.57	9±1.15	07±1.52	11±2	118 (23.6)
Sample 4	09±0.57	09±1.15	00±00	74±2.52	16±1.52	13±2.51	15±1.52	136 (26.2)
Sample 5	10±0.51	12±2.08	03±0.57	64±3.15	14±2.52	09±1.15	12±2.51	124 (24.8)

Data are presented as mean ± standard deviation (SD)

Table 4: Cytotoxic effects of different collected Nag River water on root tips of *Allium cepa*.

	Cells without nu- cleus	Morphological alter- ations	Plasmolysed cells	BNC	MNC	Total no. of aberrant cells (%)
Control	00±00	01±0.57	01±0.5	01±0.57	00±00	03 (0.6)
Sample 1	07±0.57	20±2.52	34±2.52	07±1.51	50±3.02	118 (23.06)
Sample 2	08±1.15	15±3.08	40±1.52	04±1.52	44±2.52	110(22.00)
Sample 3	07±0.57	24±2.15	30±2.52	06±0.57	40±2.52	107(21.4)
Sample 4	07±1.52	22±1.52	25±2.15	04±1.15	37±0.57	100 (20.00)
Sample 5	08±1.00	19±1.02	29±3.08	07±1.52	49±1.15	112 (22.4)

Data are presented as mean ± standard deviation (SD); BNC-nucleated cells, MNC- micronucleated cells.

The mitotic index of the *A. cepa* root tip cells in the present study ranged from 8% to 10% in Nag River water samples which were low compared to control (32%)

(Fig. 3). A mitotic index of less than 22% is considered fatal to organisms (Antonise-Wiez 1990) As a result, the mitotic indices measured in this study are frequently regarded

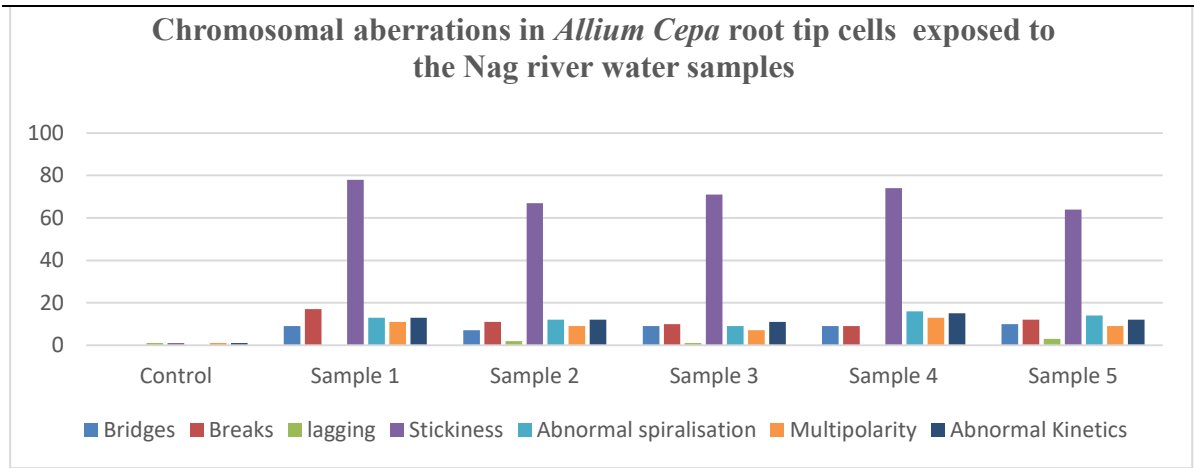


Fig. 1: Chromosomal aberrations in *Allium cepa* root tip cells exposed to the Nag river water samples.

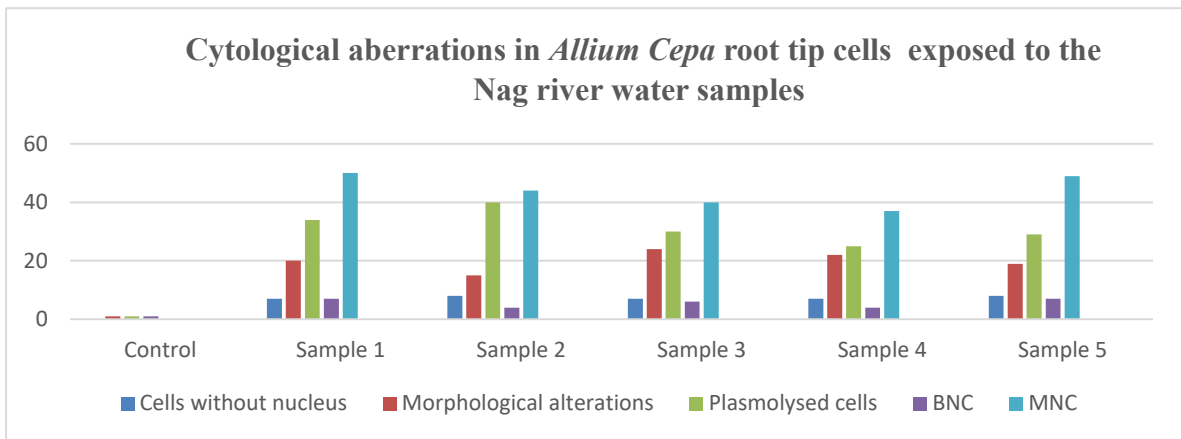


Fig. 2: Cytological aberrations in *Allium cepa* root tip cells exposed to the Nag river water samples.

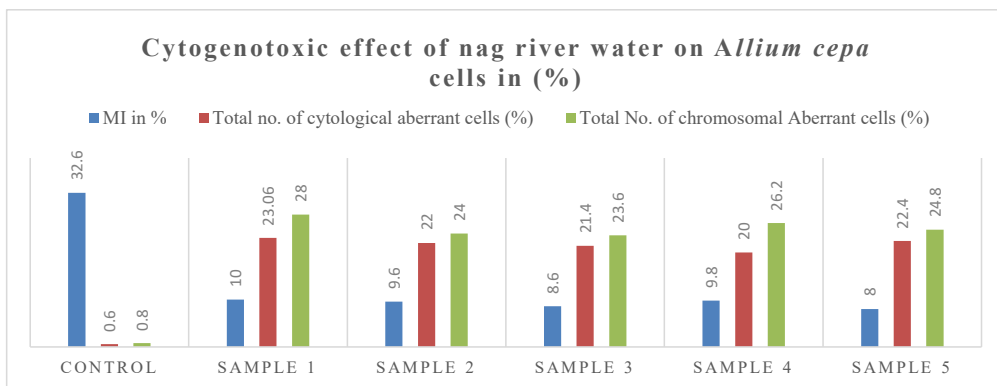


Fig. 3: Cytogenotoxic effect of nag river water on *Allium cepa* cells in (%).

as harmful and indicate high cytotoxic effects within the environment.

The presence of chromosomal abnormalities in *A. cepa* root tip cells indicates that genotoxic compounds may be present in the exposed medium (Kannangara & Pathiratne 2015, Boumaza et al. 2016).

After exposure to the Nag river water sample, chromosomal abnormalities in *A. cepa* root tip cells were observed. Anaphase bridges, breaks, chromosomal lagging and stickiness, aberrant spiraliation of chromosomes, multipolarity, and polyploidy were all observed, as shown in Fig. 4.

After treatment with Nag river water, cytological abnormalities were identified during the cell cycle. In all water samples except the control, anomalies such as cells without nucleus, bi-nucleated cells, and morphological alterations were observed. Fig. 5 shows a few examples of cytological changes.

Studies have proven that compounds such as poly aromatic hydrocarbons, copper, arsenic, and other industrial effluents have been shown to have cytotoxic and genotoxic effects in *A. cepa* root tip cells (Kannangara & Pathiratne 2015, Samuel et al. 2010, Da Costa et al. 2012, Olorunfemi 2011)

The *A. cepa* assay is a vital in-vivo assay in which the roots develop in direct contact with the substance of interest, allowing for the prediction of possible DNA damage in humans (Nefic et al. 2013). The test used in this study allows for the evaluation of several genetic endpoints that arise as a result of exposure to various water samples collected from the Nag River in Nagpur, Maharashtra. All 5 samples caused significant inhibition of MI in *Allium cepa* meristem cells and induced chromosomal aberrations, nuclear abnormalities and micro nucleated cells (MNCs).

The mitotic index decreased in all five experimental water samples when compared to the control. The cytotoxic and

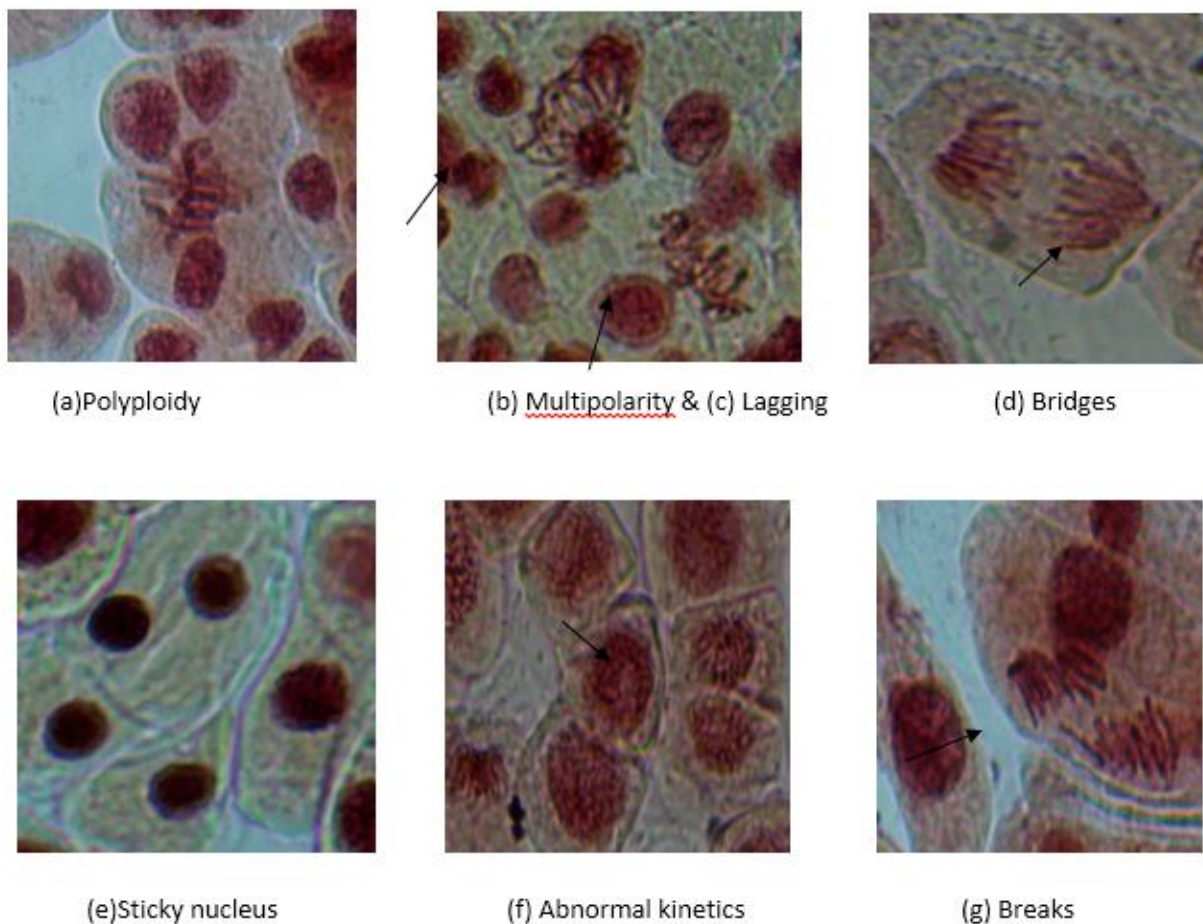


Fig. 4: Photomicrographs of CAs induced by Nag River water in root cells of *Allium cepa*.

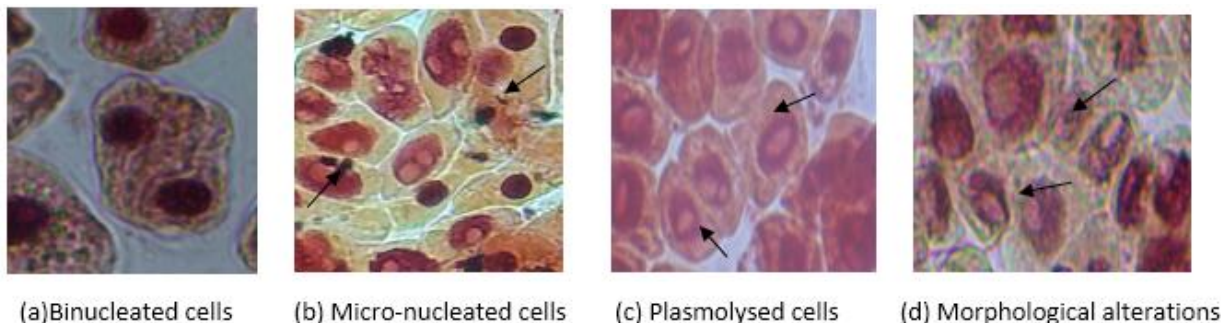


Fig. 5: Cytological aberrations in *Allium cepa* meristem cells exposed to Nag River water

genotoxic potential of Nag river water samples is determined by changes in MI of *Allium cepa* cells. The sample with the most chromosomal abnormalities was no. 1. (28%). The examination of various chromosomal abnormalities types at various stages of the cell cycle allows for a more thorough investigation of the impacts of the Nag river water sample. Breakages may occur and subsequent inhibition of repair mechanisms may lead to base mismatch, mutation and CAs such as fragmented chromosomes and DNA breaks (Nefic et al 2013).

All water samples tested from different points along the Nag River had bridges, breaks, lags, multi-polar anaphase chromosomes, and aberrant spiralization. The findings revealed that all Nag river water samples were capable of inhibiting normal cell division and causing deadly chromosomal abnormalities. Stickiness is due to inter-chromosomal linkages of sub-chromatid strands coupled with excessive formation of nucleoproteins and inappropriate protein-protein interaction (Nefic et al. 2013).

Cytological aberrations are characterized by BNC, plasmolyzed cells, and micronucleus formation as a result of exposure to Nag river Water samples. Also, we observed alterations in the shape and size of cells in all collected Nag river water samples.

CONCLUSION

Domestic as well as industrial activities are important sources of pollution during the flow of these rivers. Domestic sources as compared to industrial sources exceed substantially in terms of organic load addition into the River. The predominant source is untreated sewage discharged by Nagpur Municipal Corporation into Nag and Pili Rivers.

The findings of this study revealed that the water of the Nag River is highly cytotoxic and genotoxic, making it unsafe for drinking and irrigation. No one should grow any vegetables or crops near the Nag River because toxic substances

could enter the food chain and cause diseases due to the phenomenon of biomagnification and bioaccumulation. It's critical to identify the composition and speciation of those cytogenotoxic compounds in the tropical climate, as well as to provide cleanup or treatment options to address this environmental and public health risk. Furthermore, continual water quality monitoring and management are critical for maintaining the ecosystem's ecological health.

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Screening of Selected Ethno-Medicinal Plants for Anti-Cancer Activity

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Abstract Cancer is an epidemic worldwide. As per the report of the National Centre for Health Statistics in 2019, approximately 606,880 patients were died due to cancer and 1,762,450 new cases were detected. To overcome this scenario, worldwide research is going on to combat this disease. Among these, treatment of cancer through plant phytochemical has attended much prominence in the last few decades. Phytochemicals are produced by plants for their defense mechanism. However, these can also be used to treat many deadly diseases, among them cancer is most common. In the present study, we selected three Ethno-medicinal plants namely *Careya arborea* (leaf), *Ficus religiosa* (leaf) and *Amorphophallus campanulatus* (tuber) to evaluate their efficacy against A549 human lung cancer cells. MTT assay is widely used to assess cell viability. Human lung adenocarcinoma cell lines were purchased from NCCS, Pune and maintained in the laboratory under all standard conditions. Cells were grown, using ready to use media containing 4.5 grams of glucose, L-glutamine and sodium pyruvate. Growth factors were made available to the cells through the fetal bovine serum. We treated the cells with different concentrations of methanol and distilled water extracts of the selected plants and investigate the cell viability using a statistical test. We found varied significant differences between control cells and the cells treated with plant extracts.

Keywords Ethno-Medicinal Plants, A459 Lung Cancer, Phytochemicals, Cancer

1. Introduction

Lung cancer is most common in men and the third most common cancer in women. In low and middle income countries 50% deaths are due to lung cancer [1]. Today, despite worldwide cancer eradication and awareness programmes, cancer established itself a killer disease around the globe.

When normal cells lose their regulatory mechanisms and halt apoptosis leads to abnormal growth of cells and tissue, called as cancer. These mechanisms make cell resistant to chemotherapeutic drugs [2]. Indeed, it took more than five decades to establish a systematic drug discovery on cancer what we have today. However, chemotherapeutics as a treatment in cancer do not devoid their intrinsic problems. Use of these agents for cancer treatment often creates more secondary complications in patient. For example, use of a chemotherapeutic agent, called as 5-fluorouracil is known to cause myelotoxicity, cardiotoxicity and often thought to act as a vasospastic agent in few documented cases [3, 4]. Drug doxorubicin has been reported to cause renal toxicity, cardiac toxicity and myelotoxicity. Another widely used drug named bleomycin is known to cause pulmonary toxicity and cutaneous toxicity. Similarly, cyclophosphamide drug is used to treat many malignant conditions, has been reported for bladder toxicity in the

form of alopecia, immune suppression and hemorrhagic cystitis. Meaning, modern and advanced chemotherapeutic drugs are failed to fulfil the lung cancer treatment [4-8].

Therefore, there is regular and constant demand to develop new therapeutics against cancer to meet the safety and costing strategies. Hence development of new anti-cancer therapeutics using traditional natural products and plants has attracted much attention of scientific communities in the last 3 decades [9, 10]. At present, about 60% anticancer drugs are derived from the plants due to its affordability and lower side effects (except few plants). Plants like *Vinca alkaloids*, *Taxus diterpenes*, *Podophyllum lignans* and *Camptotheca alkaloids* have been found most effective against cancer. Moreover, flavopiridol isolates from the Indian tree *Dysoxylum binectariferum* and compound like meisoindigo isolated from the Chinese plant *Indigo feratinctoria* have been reported for their potential anti-cancer activities than conventional drugs [2-4]. Approximately more than 3000 plant varieties worldwide have been known and used to treat cancer. In Asia, about 50% people use these plants and its derived compounds to treat cancer [1]. India, bestowed with a large biodiversity. From ancient time Indians have been using plant derived compounds to treat various ailments. Indeed, plants produces different kind of phytochemicals for their protection and development in different habitats, perhaps, hence selection of a same plant from different habitat and region may give different results [11]. Therefore, in present study we selected aforesaid three ethno-medicinal plants to check their efficacy against anti-cancer activities.

2. Materials and Methods

Plant Selection and Authentication

The selected plants are collected from Umred forest during July to November 2018. Plant authentication was done with the help of herbariums at the department of Botany, Dr Ambedkar College, Deekshabhoomi Nagpur.

Plant Extract Preparation

Selected plants were dried in a shed and then subjected to Soxhlet apparatus and Rotary evaporator for their methanol and distilled water extracts. Suitable concentrations of the extracts were prepared using 1% Dimethyl Sulphoxide.

Cell Line

Human lung adenocarcinoma A549 cells were purchased from the National Centre for Cell Science (NCCS) Pune and maintained in Ham's F12 nutrient mixture (Himedia), with 10% Fetal Bovine Serum (FBS) (Hyclone) and 1% streptomycin and penicillin antibiotic

(Hyclone) at 37 °C at 5% CO₂. Experiments were done on fourth passaged cells.

Cell Viability Assay

Cell viability was assessed using MTT assay. 2×10⁴ cells were seeded in required wells of 96 well plate. Cells with media were incubated at 37 °C in CO₂ incubator (Sartorius) for 24 hours with and without plant extracts. After 24 hours, media was removed and MTT (Himedia) was added at a concentration 5 mg/ml and again incubated for 4 hours. After 4 hours MTT was removed and purple coloured farmazon crystals dissolved in 100µl DMSO solution. Absorbance was measured at 570 nm using ELISA plate reader (Bio-Rad). Results were expressed in percentage using following formula:

$$\text{Cell Viability} = \text{OD of Sample} / \text{OD of Control} \times 100.$$

Statistical Analysis

Statistical analyses were done using Medcalc statistical software. Student 't' test assuming unequal variance was used to assess the significant differences between studied groups. Data was presented in Mean±SEM. P<0.05 was considered as a significant level.

3. Results

We found varied significant differences when selected plants with different extracts at different concentrations compared with control. For *Careya arborea*, we found significant decreased cell viability for 10 µg/ml (p<0.0001) and 20 µg/ml (p<0.001) methanol extract. However, we found non-significant difference for 40 µg/ml methanol extract when compared with control. However, for distilled water extract, we found significantly increased cell viability for 20 µg/ml (p<0.05) and 40 µg/ml (p<0.01) concentrations. A non-significant difference was found when 10 µg/ml extract compared with control (Table 1; Figure 1: a and b). For *Ficus religiosa*, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 40 µg/ml (p<0.001) methanol extract.

However, we found non-significant difference between control and 20 µg/ml methanol extract. For distilled water extract, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 20 µg/ml (p<0.01) and 40 µg/ml (p<0.001) concentrations (Table 1; Figure 1: c and d). For *Amorphophallus campanulatus*, we found significant increased cell viability for 10 µg/ml (p<0.0001) and 40 µg/ml (p<0.001) methanol extract, while a non-significant difference was found between control and 20 µg/ml extract. For distilled water extract, we found significant increased cell viability for 10 µg/ml (p<0.001) and 20 µg/ml (p<0.01) and 40 µg/ml (p<0.001) concentrations (Table 1; Figure 1: e and f).

Table 1. Data showing cell viability assay of selected plants with different plant extracts at different concentrations.

PLANTS	EXTRACT	Percentage of Cell Viability at		
		10 µg/ml Mean ±SEM	20 µg/ml Mean ±SEM	40 µg/ml Mean ±SEM
Control		100.003 ±0	100.003 ±0	100.003 ±0
<i>Careya arborea</i>	Methanol	20.18 ±0.41****	48.90 ±1.52***	94.01 ±21.98
	Distilled Water	98.13 ±1.66	234.64 ±19.48*	137.96 ±3.53**
<i>Ficus religiosa</i>	Methanol	218.33 ±1.13****	101.84 ±2.17	331.55 ±0.001***
	Distilled Water	193.53 ±1.85****	126.12 ±1.73**	350.74 ±6.22***
<i>Amorphophallus campanulatus</i>	Methanol	218.33 ±1.13****	101.84 ±2.17	331.55 ±7.87***
	Distilled Water	193.53 ±1.85****	126.12 ±1.73**	350.74 ±6.22***

*p<0.05; **p<0.01; ***p<0.001; ****p<0.0001. SEM: Standard Error Mean. Different concentrations of plant extracts were compared with control.

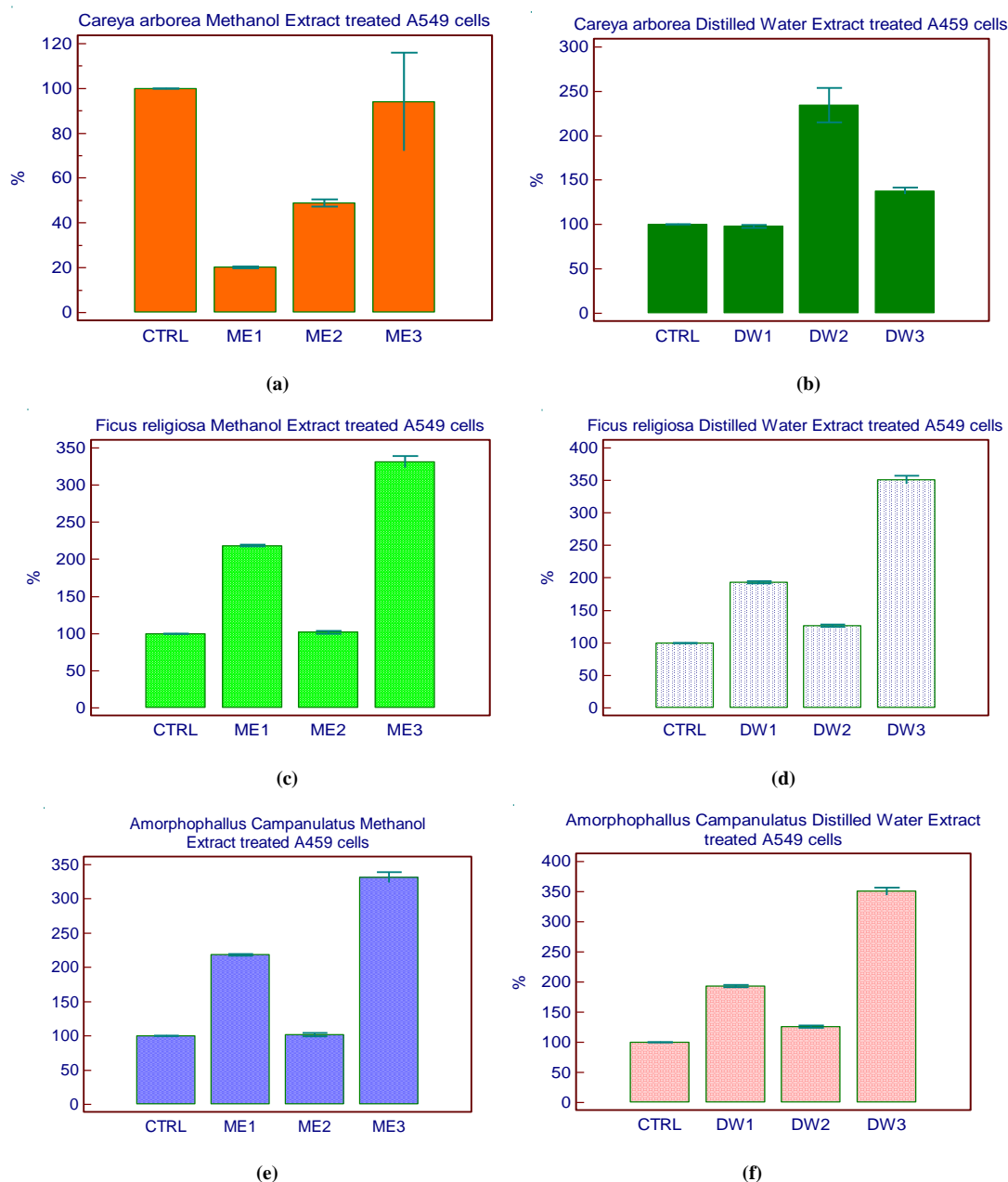


Figure 1. Figures representing cell viability percentage of A549 cells when treated with different plant extracts at different concentrations. Figure (a) and (b) representing cell viability of *Careya arborea* plant methanol and distilled water extract respectively. Figure (c) and (d) represents cell viability of *Ficus religiosa* plant methanol and distilled water extract respectively and figure (e) and (f) represents cell viability of *Amorphophallus campanulatus* plant methanol and distilled water extract respectively. CTRL: Control; ME1: Methanol Extract (10 µg/ml), ME2: Methanol Extract (20 µg/ml), ME3: Methanol Extract (40 µg/ml), DW1: Distilled water (10 µg/ml), DW2: Distilled Water (20 µg/ml), DW3: Distilled Water (40 µg/ml).

4. Discussion

Screening of plants for anti-cancer activities urge to search for more reliable and potent drugs. Worldwide research is going to derive natural product-based therapeutics not only for cancer but also to treat other ailments. So, being one of the greatest and diverse biodiversity, India should lead the world. Hence through this work, we drive to focus the plants of central India for deriving such novel therapeutics. Prodigious work done on plants has already explored publications on plant-derived compounds as novel drug molecules.

Moreover, to determine active biological compounds from the plants we need to explore our traditional knowledge about plants and natural product that we have gathered since ancient time against various diseases; by providing a scientific shred of evidence. Plants have various phytochemicals which may lead to in-vitro cell survival or cell death. By isolating such bio-active compound from plants we may treat various diseases [12, 13]. Cancer is a condition where there is continuous cell growth with a lost apoptosis mechanism. This may lead to tumour formation resulting disrupt cellular mechanism and death. To suppress tumour growth numerous medications and the treatments are available, but a question is always posed for their reliability and safety [14]. Therapeutics derived from natural products may oppose this question and hence plant derived bioactive compounds have attended much importance in the field of cancer research [15]. Therefore, the present study aimed to screen three ethno-medicinal plants for anti-lung cancer activity using A549 human adenocarcinoma cells. In the present study, among all three selected ethno medicinal plants methanolic extract of *Careya arborea* exhibited the decreased cell viability as compared to the control. Result showed that this plant may have a property to treat human lung cancer. Methanolic extract of *Careya arborea* at the concentration of 10 ug/ml and 20 ug/ml exhibited the decreased cell viability, however with a concentration at 40ug/ml showed a non- significant difference. This is possibly due to the fact that, we used a crude methanolic extract of the plant, which contains numerous useful and unusual bioactive compounds [16]. Distilled water extract of the plant showed increased cell viability, suggesting its non-potential to treat A549 cells. Methanolic and distilled water extracts of *Ficus religiosa* and *Amorphophallus campanulatus* also showed significant increased cell viability suggesting their non-anti-cancerous activities. Of note, the possible reason for the non-linear relationship between dose and effects for all studies plants could be the crude extracts. Further, the phytochemicals or plants secondary metabolites synthesised by plants may promote cell growth and differentiation. Cancer is modulated by a variety of cellular signalling pathways, albeit, to inhibit cancer via modulating such signalling pathways plant must possess special kind of biochemical compounds that can

modulate such cancer leading mechanisms. Although *Ficus religiosa* and *Amorphophallus campanulatus* did not show anti-cancer activities, their phytochemicals might use for other ailments; as each plant may synthesise different phytochemicals at different climatic conditions. Thus, one can predict that *Careya arborea* from different geographical locations and habitat conditions may exert different results.

Worldwide research on medicinal plants suggested their complete phytochemical and biochemical analysis, required to derive their best possible biological outcomes. *Tinospora cardiofolia* also is known as giloya in Hindi and heartleaf plant in English is a smooth climbing shrub often abundant in India, Myanmar, China and Shri Lanka. In Ayurveda, this plant is considered to be "amrita" for its longevity, youthfulness and vitality. This plant is also well known for its anti-inflammatory, anti-arthritis and anti-allergic properties often use against general debility, dyspepsia, fever, urinary diseases and jaundice. Stem extract found to be active against various skin diseases. This plant is also reported for high anti-oxidant content and immune-modulatory activities. Methanolic extract of *Tinospora cardiofolia* contains alkaloid like choline, isocolumbin, tinosporin, columbine, palmatine, magnoflorine and tetrahydropalmatine as active components. Dose dependant increased concentration of methanolic extract of this plant found effective against HeLa cancer cell lines. However, it's anti-cancer activity also found in rats where it reported for rapid tumour suppression at a dose of 50 mg/Kg [4, 17-24].

Another example is related to *Ziziphus nummularia*, also known as beri in Hindi and jujube in English, is a shrub, with purplish stem, found abundant in India, Pakistan, Afganistan, Egypt etc. Different plant parts like root, bark, stem, flowers and seeds have been reported for different biological activities. The bark and the stem of this plant found rich in two phytochemicals called betulin and betulinic acid. Both compounds exhibited anti-cancer activities. Betulinic acid has been reported to induce apoptosis in cancer cells by increasing reactive oxygen species concentration, topoisomerase inhibition, mitogen-activated protein kinase (AMP kinase) cascade activation, and angiogenesis inhibition and by modulating pro-growth transcriptional activators. Moreover, betulinic acid has been reported to induce apoptosis by p53 and CD95 independent mechanism. It has been revealed that the combined treatment of betulinic acid and other anti-cancer drugs induces loss of mitochondrial membrane potential and releases cytochrome-c and thereby induce apoptosis [4, 25-32].

From above cited examples it has been assumed that the selected plants of this study might possess properties against not only for cancer but also for other ailments and hence, demand in detail study to elucidated their phytochemicals rather active biochemical structures, to open a new window for researchers in central India.

5. Conclusions

Among selected three ethno-medicinal plants crude methanolic extract of *Careya arborea* might have a potential to treat human lung adenocarcinoma. Other two plants may have different types of potentials to treat varied diseases and ailments. Although this is a basic study providing first superficial inference; finding bioactive compounds using high-end techniques like high-performance liquid chromatography (HPLC) and Gas chromatography-mass spectrophotometry (GC-MS) analysis are required. Further, the bioactive guided assay may use as a track to elucidate enormous biological functions of these plants.

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ANOTE ON THE GENUS *AMORPHOPHALLUS* FROM MAHARASHTRA

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Key Words: *Amorphophallus*, Ethnobotany, Ecology, Maharashtra

The *Amorphophallus* Blume ex Decaisne (1834: 366) is one of largest genus of family *Araceae* Juss. with 214 known species (Hettterscheid 1996, 2013, Mayo *et al.* 1997, Magtoto *et al.* 2013, Nguyen Van Du *et al.* 2016 and Gadpayale *et al.* 2017). Sharma *et al.* (1996) reported three species of *Amorphophallus* from Maharashtra state e.g. *A. bulbifer* (Roxb.) Blume, *A. commutatus* (Schott) England *A. paeonifolius* var. *campanulatus*. Jaleel, *et al.* (2011) reported three species and 1 variety of *Amorphophallus* as *A. konkanensis*, *A. margaritifera* (Roxb.) Kunth, *A. sylvaticus* (Roxb.) Kunth and *A. mysorensis* var. *bhandarensis* from Maharashtra during revisionary work. Gadpayale *et al.* (2016, 2017) reported *A. longiconnectivus* as a new addition to the flora of Maharashtra State and described *Amorphophallus shyamsalilianum* from Bhandara District (MS) as a new species. A comprehensive ethno-botanical information on *Amorphophallus* species in Maharashtra State, has been given in present communication

Amorphophallus bulbifer (Roxb.) Blume: **Leaf**, young petiole and Corm are used as vegetable.

Amorphophallus commutatus (Schott) **Engl.:** Paste of tuber is externally applied to cure scabies, stomachic, obesity, piles, cysts, snake bite, tumors and post delivery problems.

Amorphophallus longiconnectivus Bogner: Corm is used to treat hemorrhoids, inflammations, and rheumatoid arthritis.

Amorphophallus bhandarensis S.R. Yadav, Kahalkar & Bhuskute: Corm is used for the treatment of piles, asthma, and general debility.

Amorphophallus margaritifera (Roxb.) Kunth: Corms are eaten to relieve body pain and its paste is externally applied against arthritis.

Amorphophallus paeonifolius (Dennst.) Nicolson: Dried tubers are used as vegetable. Fresh petiole and bulbs are used to treat gout. Pieces of fresh corm are used to relieve digestive problems, pile, dysentery, bronchitis and an astringent, expectorant, appetizer, liver tonic, constipation. However, it has to be used carefully on consultation with experts.

Amorphophallus shyamsalilianum J.V. Gadpayale, S.R. Somkuwar & A.A. Chaturvedi: Corms are used for the treatment of abdominal pain, obesity, enlargement of spleen, seminal weakness, fatigue, anemia, asthma and rheumatism.

Amorphophallus sylvaticus (Roxb.) Kunth: Corms are used to cure stomachache; amenorrhea; anorexia; bronchitis; cancer; dysentery; fistula; general debility; hepatopathy; inflammation; piles; rheumatoid arthritis; sexual weakness; toothache and urinary troubles.

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DIENIA OPHRYDIS (J. KONIG) SEIDENF. (ORCHIDACEAE) NEW RECORD TO THE FLORA OF MAHARASHTRA STATE, INDIA.

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Key words: *Dienia ophrydis* (J. Konig) Seidenf., Orchidaceae, new record, Maharashtra State.

During field explorations in Eastern region of Maharashtra State, the author came across a specimen of orchid, which was identified as *Dienia ophrydis*, after following the available literature (Lindley, 1830; Clemens and Jones, 1996; Seidenfaden, 1992 and Govaerts *et al.*, 2001). Earlier literature on the distribution of this species (Almeida, 2009; Sharma *et al.*, 1996 and Jalal and Jayanthi, 2018) suggested that it was a new record for Maharashtra State, India. Details of the collected specimen have been given as under.

***Dienia ophrydis* (J. Koenig) Seidenf. Contr. Orchid Fl. Thailand 13: 18. 1997.**

Plants terrestrial, pseudo bulbs, cylindrical, 12 cm, fleshy, with several nodes, enclosed in membranous sheaths. Leaves 4 to 5, obliquely ovate-elliptic, ovate, or narrowly elliptic-lanceolate, 716 × 49 cm, base contracted into a sheath like, amplexicaul petiole 35 cm, apex acuminate. Inflorescence erect, racemose, peduncle erect, 1560 cm long, very narrowly winged, rachis 515 cm long, many flowered, floral bracts more or less reflexed, persistent narrowly lanceolate, 2.55 mm. Flowers purplish red to greenish yellow, relatively small, pedicel and ovary 23 mm long. Dorsal sepal narrowly oblong, 33.5 × 1.11.2 mm, apex obtuse, lateral sepals obliquely ovate, 22.5 × 1.2 1.4 mm. Petals linear, 2.53.2 × ca. 0.7 mm, apex obtuse, lip broadly ovate, ca. 2 × 2.5 mm, concave, sub-cordate to truncate at base, apex 3-lobed; mid-lobe narrowly ovate, 0.71.1

mm, much longer than lateral lobes, apex obtuse. Column ca. 1.2 mm, stout, pollinia 4 in pairs. Capsule erect, obovoid-ellipsoid, 67 × 34 mm, fruiting pedicel 23 mm.

Habitat: Terrestrial moist

Distribution: Chaukul road, Amboli, Maharashtra, India

Distribution : Assam, Manipur, Meghalaya, Mizoram, Nagaland, Arunachal Pradesh, Sikkim, West Bengal, Uttarakhand, Odisha, Kerala, Tamil Nadu, Chhattisgarh, Jharkhand, Andaman & Nicobar Islands.

Accession No. DACN-1161

Flowering: July-December

Dienia ophrydis (J. Konig) Seidenf., is known only from Amboli Forest of Maharashtra state. Twenty three individual plants were observed in a small area of ca. 0.002 km² during three years (2015 to 2018). The major threat to this species in the study area is the construction of road and hotels, due to which fragmentation of natural habitat is taking place and most of the bulbs of this taxon are getting destroyed.

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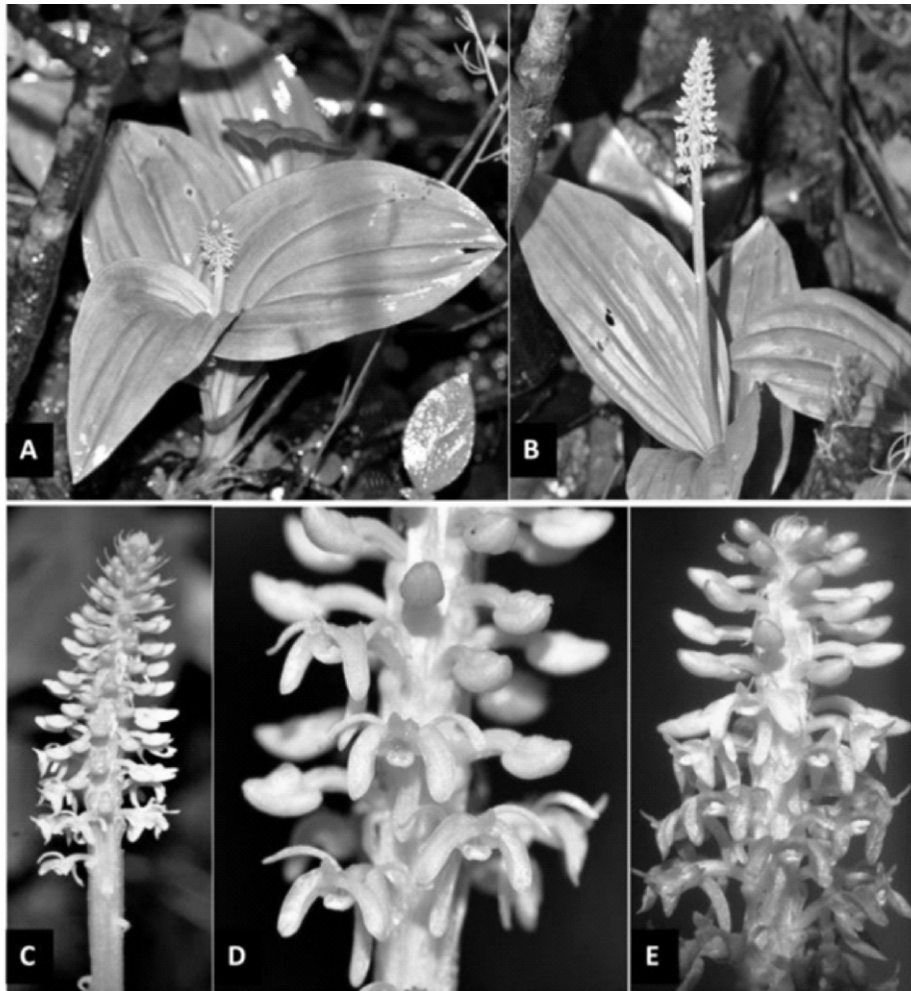


Figure 1. A) Natural habitat of *Dienia ophrydis* (J. Koenig) Seidenf. B) Habit having inflorescence C) Inflorescence-early view D) Close-up of the lips & petals E) Inflorescence with an open & close flowers

Nanopolymer: Overview, Innovation and Applications

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Abstract

In this review, we have tried to highlight some nano polymers innovations in the recent time frame. We have mentioned various approaches for novel nano polymeric materials and their new age applications in the context of industries, biomedical research and environmental sustainability.

Keywords: Nanopolymers; Environment; Nanocellulose; Fabrication; Composites

Background

Over the years, continuous innovative advancement has been observed in the field of polymer technology. Lot many researchers have gained a wide attraction in recent years to characterized, designed, and fabricates number of novel polymer, biopolymer and nano biopolymer sophisticated materials mainly due to the benefits related to environmental sustainability which is need of hours in the green planet earth. The current review article highlights recent development and innovations in the area of polymer, biopolymer and nano biopolymer composites, such as synthesis, characterization, and application of such sophisticated novel composites in the polymer and related industries. Living organisms produced nano biopolymers (nanocellulose, nano starch, nano chitin, nano silk, etc.) and microbial nano biopolymers, having received widely scientific and engineering interests in recent decades due to their extensive availability, sustainability as well as biocompatibility and biodegradability. Compare with petroleum-based polymers, biopolymers are sustainable and biodegradable. Chemical, mechanical, and microbial methods are generally used to fabricate nano biopolymers from nature. Nano biopolymers can be processed via solution casting, vacuum filtration and freeze drying [1-4] while most microbial nano biopolymers, polyesters can be processed using polymer processing equipment, like extruder, injection molding, etc. [5]. Nanopolymers have been synthesized using various methods. Eco-friendly, fully biodegradable microstructured polymeric nanoparticles systems are widely in demand, as biomedicine specially in tissue engineering and regenerative medicine [6-9], targeted controlled delivery to particular organs/tissues, carriers of DNA in gene therapy and in their ability to deliver proteins, peptides and genes through an oral route of administration [10,11], biocompatibility with tissue and cells [12,13], to improve bioavailability, and bioactivity of various pharmaceutically active compound used in various ailments [14,15] biodegradable and smart packaging [16-19], environment protection such as global spill accidents, water quality [20,21] etc. To improve the current growth of the bio-economy and green chemistry, the use of bio-derived polymers and chemicals could also be considered [22].

In recent years, the use of polymeric nanofibers has gained great importance in biomedical and biotechnological applications such as tissue engineering, controlled release

systems, wound dressings, medical implants, composites for dental applications and biosensors. The electrospinning method is the most preferred production method because it allows the production of nanofibers with different materials. Polymeric nanofibers are promising drug delivery systems, especially in terms of their applications as controlled release systems to achieve localized drug delivery [23]. Biologically active dendrimers can be useful for combination therapy for conjugated drugs, and for improvement of the therapeutic index, and 'personalized nanomedicine' [24-27]. The delivery of sncRNAs molecules by biodegradable, biocompatible and nontoxic biopolymers including chitosan, cyclodextrins, poly-l-lysine, dextran, poly (lactic co-glycolic acid), polyglutamic acid, hyaluronic acid and gelatin [28]. Nanocellulose polymers have played a vital role in biomedical applications and biomedical engineering as a whole and made possible with 3D bio-ink printing. This achievement has made it easy for skin grafting, organ transplants and cancer screening and treatment. The many available thermoplastics are being replaced with cellulose from wood, pulp and plants, some of the cellulose polymers covered in this paper are Nanocellulose (CNF), nanofibers (CNC), Bacterial cellulose and many more cellulose polymers. 3D structures of numerous advantages like flexibility, improved mechanical strength, controlled biodegradability and user-specific have made it possible to transplant, regenerate and cushion any loopholes in the medical field. The materials are also unique. Its ability to produce and regenerate tissues and organ structures has opened further studies in this field [29-43].

Fabrication and Characterization of Eco-Friendly Microstructured Polymeric Nanoparticles Systems in the Recent Times

Kustiyah et al. [44] made an attempt to create transparent conductive high cellulose-based paper by a facile process using chemicals and sonication methods to obtain cellulose nanofibril from sorghum stems waste which are eco-friendly and can be used as a substitute for glass coating in the display industry. Meindrawan et al. [45] explored an edible coating based polymeric bio nanocomposite of gelatin and ZnO nanoparticles to improve the quality of the broiler chicken fillet during storage. Saragih et al. [46] studies, cellulose nanofiber has been isolated using the steam explosion method from lignin and hemicellulose of pseudo-stem of abaca (*Musa textilis*). Oktaviani et al. [47] synthesized the bacterial cellulose-co-polyacrylamide by radiation-induced graft polymerization using gamma rays with the simultaneous technique. Nano biopolymers and nanomaterials such as SFNPs, SFNCs, POSS, ZCPs, and nickel hydroxide nanosheet have shown their roles in NF-transport. There are many different techniques for the fabrication of nanoparticle-containing NF membranes, including electrospun membranes, nanosheet membranes, layer by layer assembly and hollow fiber spinning which are used in combination with these techniques [48]. Novel nano polymers has many forensic applications such as drug detection, toxicology, fingerprints, document examination, DNA analysis, sensors, and trackers have benefitted by utilizing these novel polymers. It integrates the use of

nanoparticles, quantum dots, nanochips, nanotubes, nanofibers, and nanorods to multiply the results of tracing, detection, and analysis in forensic investigation. Nanomaterials are widely utilized for commercial purposes such as fabrics, cosmetics, sunscreen, dental fillers, semiconductors, smart packaging materials, actuators, and target nutrient and drug delivery, 3D nano systems, self-assembled structures, and more complex heterogeneous nanostructures will be seen in the near future [49]. Advancements in the material science have emerged as an extraordinary area that combines various analytical techniques like TEM, SEM, XRD, AFM, NMR, FTIR, LC/MS, GC/MS, MS/MS to detect and analyze nano evidence [50].

At present nano polymer degradation possesses a great challenge of high societal importance for which an experimental lacking exists. A closed graphene liquid cells in combination with fluorescent dyes can be used to detect the release of particular contents, with efficient screening of events, utilizing atomic force microscopy followed by electron microscopy. Such approaches can be used including chemical and physical triggers for the controlled break down of polymeric materials into primary building blocks to facilitate the transition towards a circular economy [51,52]. Qiang et al. [53] prepared a novel polymeric precursor with Zr-C-Si-N main chain structure was synthesized through a two-step method which shows an excellent moldable property, oxygen-free compositions and high Zr content of PZCS make it an ideal precursor for the preparation of UHTCs matrixes and fibers. Zhang X, et al. [54] were successfully prepared high-temperature resistant polycarbonates with different BHPF contents by a melt-polycondensation method with BPA, DPC, and BHPF. This discovery has tremendous application potential in high temperature resistant plastic industry. Zhang et al. [55] worked on bio-based N-heterocyclic poly (aryl ether ketone) with a high biomass content and superior properties prepared from two derivatives of guaiacol and 2,5-furandicarboxylic acid. Curcuma longa (Turmeric) embedded super macroporous cryogel discs used as a natural ligand for hazardous metal ions removal from aqueous and synthetic wastewater [56]. Godiya et al. [57] recently reported the cost-effective techniques for removal of bisphenol-A, with reasonably advanced efficiencies to address existing problems of bisphenol A-contaminated wastewater treatment.

Zhai et al. [58] rapidly prepared silica gel composite corks (Cosiae-SP and Cosiae-VP) by immersing corks of different tree species in silicone mucilage via the respiration impregnation method. Silica aerogel was immobilized in the cork cells to form a layered network structure with holes. Kalali et al. [59] developed a novel Wood Polymer Composite (WPC) flame retardant system using APP and Phytic Acid-Modified Layered Double Hydroxides (Ph-LDH) as raw materials. Cinausero et al. [60] studied the synergistic effect of nano-oxide and Ammonium Polyphosphate (APP) with polymers such as Polystyrene (PS) and Polymethylmethacrylate (PMMA). Manfredi's group [61] fabricated some composites with mod-acrylic acid and UPR as substrates, and jute, flax, sisal and glass as reinforcements, and compared the FR of these composites. Laoutid et al. [62] summarized the flame retardant properties of polymer composites obtained by adding nano-fillers to a polymer

matrix and accounted for the flame-retardant mechanisms of various nano-fillers. Baysal's group [63] prepared vinyl monomer-wood composites by treating sapwood with a mixture of 1 wt% borax and boric acid (1:1). The vinyl monomer-wood composites were prepared by using styrene, methyl methacrylate and a mixture of styrene and methyl methacrylate (50:50). The FR of the composite was evaluated using the combustion weight loss method. Fernandes et al. [64] introduced decabromodiphenyl combined with antimony trioxide as an additive to UPR to improve the FR of Sisal-Polyester (SSP) composites. Jones et al. [65] compared extruded polystyrene foam with rice husk/mycelium biological plate and found that the biomass system is expected to have better flame retardancy due to the presence of carbonaceous coke and embedded silica in the combustion process [65, 66]. For myoglobin recognition from aqueous solutions and human plasma with high adsorption capacity and selectivity in binding capacity the molecular imprinted supermacroporous cryogels technique can be used [67]. Functional 3-D nanofibrous scaffolds produced by electrospinning have immense prospective in a wide spectrum of biomedical research, viz. drug/gene delivery, tissue engineering and wound dressing [68]. Tolnaftate and tolnaftate- graphene composite loaded polyacrylate nanofibers can be potential used as dressing materials/scaffolds for efficient care of dermatophytosis [69,70]. Ying et al. [71] also studied the preparation of Straw Magnesium Cement (SMC) from rice straw, another bio-based isolation material.

Future Outlook

The integration and development of lignin processing, deconstruction, and synthetic polymer chemistry could prove crucial to yield commercial, biobased products such as adhesives, packaging plastics, biomedical devices, and stimuli-responsive materials [64]. Fabrication and characterization of eco-friendly microstructured polymeric nanoparticles systems becomes more demanding and complex. It finds applications in various field including Environment and biomedical research. A viable and promising strategy for the use of biodegradable polymeric nanoparticulate drug delivery systems in biopharmaceutical industry and green chemistry with ecofriendly biological entities can help in minimizing harmful impacts on human health. Polymeric Nanoparticulate Drug Delivery Systems (PNDDS) can increase the bioavailability, solubility and permeability of many potent drugs and also reduce the drug dosage frequency. PNDDS can be used to exploit for many biological drugs that have poor aqueous solubility, permeability and less bioavailability in future to overcome these problems.

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Diversity and Distribution of Order Fabales in Nagpur City, Maharashtra

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Abstract Order Fabales is one of the largest orders of flowering plants. This order is distributed worldwide and exhibits the greatest diversity of morphological types in tropical and subtropical regions of the world. Order Fabales comprises the major families such as Caesalpiniaceae, Mimosaceae and Fabaceae. To explore the diversity of this order in Nagpur City, regular field visits were made. Present study enumerated the order Fabales with total 59 genera, 126 species, 4 sub-species and 4 varieties of which Family Mimosaceae with 11 genera, 24 species and 2 sub-species. Family Caesalpiniaceae observed with 8 genera, 27 species while the largest family Fabaceae covered most of the diversity in this order with 40 genera, 75 species, 2 sub-species and 4 varieties. The study was documented with flowering and fruiting seasons and distribution in the Nagpur localities.

Keywords Order Fabales, Caesalpiniaceae, Mimosaceae, Fabaceae, Nagpur

1. Introduction

Biodiversity is the entire diversity of life on the earth. It includes all genes, species and ecosystems. The studies of biodiversity have now assumed greater significance as ecologist and taxonomist try seriously to document the global biodiversity. For this, the exhaustive exploration

and taxonomic study i.e. floristic surveys of flora and forest areas have great importance. It is essential to prepare local floras of urban areas where there is severe threat to natural vegetation due to identification of species that are in different stages of vulnerability [1] as well as the various factors that influence the existing vegetation in any region [2].

Nagpur, one of the greenest cities of India, it is also called the 'Garden City of Maharashtra' and is appropriate to and worthy of being the 'Gateway to the Centre Indian Forest. It is also called 'Orange city of India'. One of the most basic tools needs to confront the loss of biodiversity on our planet is lack of floristic information. Floristic studies have acquired increasing importance in recent years in response to the need of developing countries to assess their plant wealth. In the recent years there has been growing interest in plant diversity studies in general and floristic studies in particular. In this connection, regional floristic studies are much importance. It can be achieved by intensive exploration of smaller areas [3].

The Nagpur city is quite rich and varied in its plants composition. In addition to the natural flora of the district, there are large numbers of plants found either in cultivation or introduced for various purposes at one time or other which have now been naturalized in the area [4].

Order Fabales are a climax order achieving the success, which very few other plants groups could reach. Both morphological and chemical features contributed to the success of this group. Of these three families, the

Mimosaceae evidently are primitive, the Fabaceae, the most advanced and the Caesalpiniaceae, the intermediate taxon. According to Hutchinson [5], order Leguminales is best split into three separate families: Caesalpiniaceae, Mimosaceae and Papilionaceae and treated the 3-subfamilies under the order Leguminales. Engler and Prantl [6], Bentham and Hooker [7] and some other taxonomists have considered Caesalpinoideae, Mimosoideae and Papilionoideae as sub-families of the family leguminosae under the order Rosales. These three sub-families are treated as distinct families by many botanists [8,9] except those who cling to tradition. Authors accepting them as separate families treat diversity of fruits and certain other characters. According to Takhtajan [8] and Cronquist [9] order Leguminales changed into order Fabales containing 3 families Mimosaceae, Caesalpiniaceae and Fabaceae.

The Mimosaceae, a tropical or subtropical family mostly of and regions are a comparatively small family of 50 genera containing 3000 or more species. Caesalpiniaceae is a tropical family of about 150 genera and 2200 species. The plants are mostly trees and shrubs and a few herbs. Fabaceae is a large family of 440 genera and about 12000 species. Plants are mostly herbs, undershrubs, shrubs though few trees are also there.

2. Materials and Methods

Extensive visits to different parts of Nagpur City categorizing into East Zone, West Zone, North Zone, South Zone and Central Zone including prominent localities like University Campus, Ambazari, Ramnagar, Dharampeth, Laxminagar, NEERI colony, Ganesh tekdi, Pannase Lay-out, Railway station, LIT, Dabha, Ravinagar, Maharajbag, PDKV, Seminary hills, Satpuda Botanical Garden, Telangkheri, Futala, Ramdaspath, Wardhaman Nagar, Wardha Road, Amravati road, Mahal, Anmol Nagar, Kamptee road, Civil lines etc. During every visit, the specimens were collected for laboratory analysis. All the specimens collected were serially numbered, field notes were recorded in field books with data like habit, habitat, height of the plant, colour of the flowers scent if any, number of individuals and other pertinent features for the purpose of precise identification of the specimens. Each specimen was observed in respect of vegetative, flowering and fruiting condition. Specimens were described; identified and authenticated with help of standard literatures, different floras, research papers and reports viz. Flora of Nagpur District [10], Flora of Maharashtra State [11], Flora of Marathwada [12]. The voucher specimens of the collections have been deposited at the Herbarium, PGTD Botany, RTM Nagpur University, Nagpur.

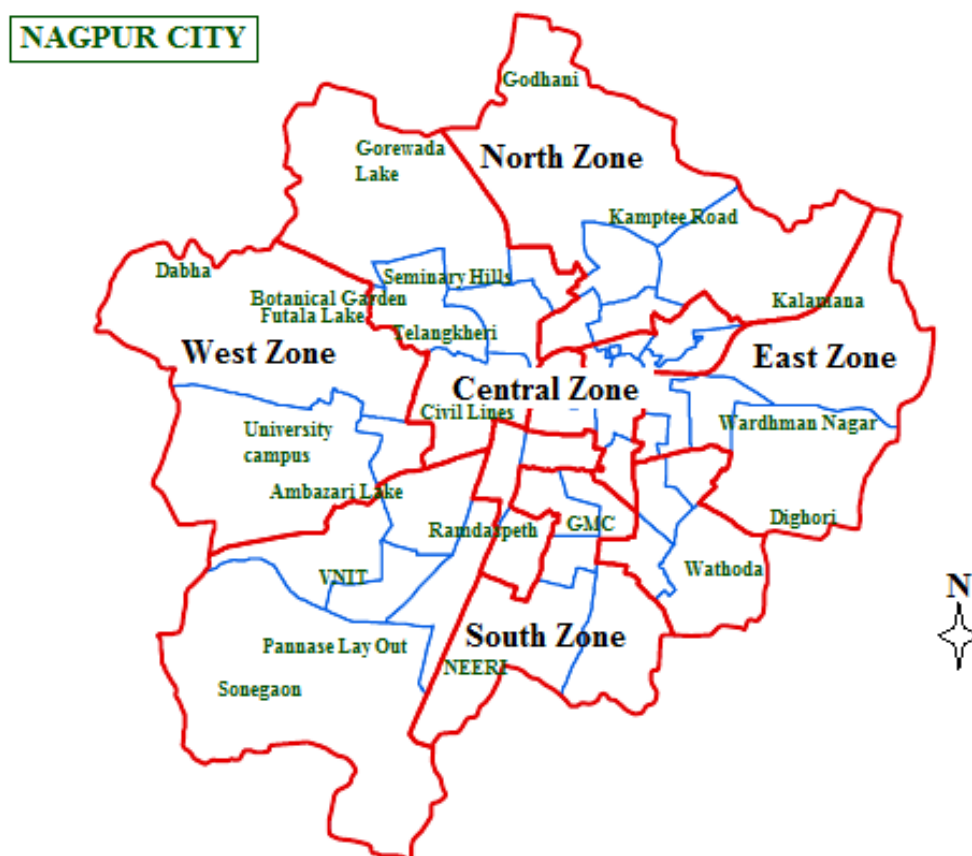


Figure 1. Nagpur City Map showing working zones

3. Results and Discussion

3.1. Analysis of the Diversity of Order Fabales in Nagpur City

Present investigation enumerated plants of order Fabales i.e. Family Mimosaceae, Caesalpiniaceae and Fabaceae of Nagpur city with total numbers of 59 genera with 126 species, 4 subspecies and 4 varieties. From which, Mimosaceae comprises 11 genera with 24 species and 2 subspecies (Table No. 2.1). Caesalpiniaceae have an account of 8 genera with 27 species (Table No. 2.2) while Family Fabaceae contributed with maximum numbers of 40 genera with 75 species, 2 subspecies and 4 varieties (Table No. 2.3). Of the three families of order Fabales, the

family Fabaceae is dominant and widely distributed in different localities of the city. The present work have compared with the earlier work of Ugemuge [10] and Graham [13]. The frequency percentage in the form of occurrence and distribution of all three families also calculated in co relation with present work's output i.e. genera 59 and species 126 (Table No. 1).

Graham [13] recorded 71 species of order Fabales from Nagpur and Telangkheri farm while Ugemuge [10] documented 105 species belonging to 53 genera from Nagpur city. Panda [14] have recorded the 35 native species of the order Fabales from the Bhadrak District of Odisha, India while our study documented with 126 species.

Table 1. A comparison between status of order Fabales of Nagpur city as per Graham [11] and Ugemuge [8] with present work

Comparative Analysis	Present Work		Ugemuge (1986)		Graham (1911)		
	No.	%	No.	%	No.	%	
Mimosaceae	Genera	11	18.64	11	18.64	6	10.17
	species	24	19.05	19	15.08	10	7.94
Caesalpiniaceae	Genera	8	13.55	8	13.55	3	5.08
	species	27	21.43	27	21.43	8	6.35
Fabaceae	Genera	40	67.80	34	57.63	20	33.90
	species	75	59.52	59	46.83	53	42.06
Total Genera(as per present work)		59		Total Species (as per present work)		126	

Table 2. Elements observed in Order Fabales

Table 2.1. Family: Mimosaceae

Sr.No	Scientific Names	Vernacular name	Flowering & Fruiting	Location
1	<i>Acacia auriculiformis</i> A. Cunn.	Australian babul	June-Jan	Nandanvan, Buildi
2	<i>Acacia campbelli</i> Arn.		June-March	University Campus
3	<i>Acacia catechu</i> (L.F.) Willd.	Khair	July-Dec	Ambazari, Seminary hills
4	<i>Acacia farnesiana</i> (L.) Willd.	Devbabul	Aug-July	Ambazari, Seminary hills
5	<i>Acacia ferruginea</i> DC.	Pandharakhair	May-Oct	Campus, Seminary hills
6	<i>Acacia leucophloea</i> (Roxb.) Willd	Hivar	Aug-Feb	Campus, Seminary hills
7	<i>Acacia modesta</i> Wall.	--	Feb.- May	Opposite Veterinary College
8	<i>Acacia nilotica</i> (L.) Willd. ssp. <i>astringens</i> (Schum. & Thonn) Roberty.	Vedibabhul	Aug-Dec	Umrer road, Campus
9	<i>Acacia nilotica</i> (L.) Willd. ssp. <i>indica</i> (Bth.) Brenan.	Babhul	June-April	Campus, Telangkheri, Ambazari
10	<i>Acacia pennata</i> (L.) Willd.	Jari, Chilar	Aug-Jan	Ambazari, Seminary hills
11	<i>Acacia tomentosa</i> Willd.	Anjar	Dec-Mar	Campus, Seminary hills
12	<i>Adenantha pavonina</i> L.	Thorla Gunj	Mar-May	Maharajbag
13	<i>Albizia lebeck</i> (L.) Willd. var. <i>lebeck</i>	Shirish	Feb-Dec	Campus, Ambazari, Seminary hills
14	<i>Albizia procera</i> (Roxb.) Bth.	Pandhara Shirish	May-Dec	Campus, Wardha road
15	<i>Dichrostachys cinera</i> (L.) var. <i>indica</i> Brenan & Brumit.	Sagunkati	Sept-Jan	Kalmeshwar road, Vayusena Nagar
16	<i>Leucaena latiliqua</i> (L.) Gills.	Subabhul	Throughout the year	Campus, Telangkheri, Umrer road
17	<i>Mimosa hamata</i> Willd.	Chilati	June-Oct	Campus, Seminary hills
18	<i>Mimosa pudica</i> L.	Lajalu	June-Jan	PG Boys hostel RTMNU, Maharajbag
19	<i>Mimosa rubicaulis</i> Lam.	Arai	June-Dec	Kalmeshwarroad, Campus
20	<i>Neptunia triquetra</i> (Vahl.) Btm.	Lajalu	June-Nov	Campus
21	<i>Parkia biglandulosa</i> Wight & Arn.	Chenduphal	Dec-Apr	Boys hostel RTMNU, Campus
22	<i>Pithecellobium dulce</i> (Roxb.) Btm.	Vilayti Chinch	Jan-June	Campus, Vayusena Nagar
23	<i>Prosopis cineraria</i> (L.) Druce.	Shami	Dec-June	Mahal, Bharat Nagar
24	<i>Prosopis juliflora</i> (Swartz.) DC.	--	Feb-Oct	Amravati road, Kamptee road
25	<i>Samanea saman</i> (Jacq.) Merr.	Rain tree	Mar-Sept	Bharat Nagar, Wathoda, Campus

Table 2.2. Family: Caesalpiniaceae

26	<i>Bauhinia malabarica</i> Roxb.	-	Sept-Feb	VC Bungalow RTMNU
27	<i>Bauhinia purpurea</i> L.	RaktaKanchan	Sept-Feb	Telangkheri, Cultivated in gardens
28	<i>Bauhinia racemosa</i> Lam.	Apta	Apr-Oct	Seminary hills, Ambazari
29	<i>Bauhinia vahlii</i> Wight & Arn.	-	Apr-Mar	Campus
30	<i>Bauhinia variegata</i> L.	Kachnar	Dec-May	Telangkheri
31	<i>Caesalpinia bonduc</i> (L.) Roxb.	Sagargota	July-Jan	Futala, Umrer road
32	<i>Caesalpinia corearia</i> (Jacq.) Willd.	Libi-dibi	Sept-Dec	Ambazari
33	<i>Caesalpinia pulcherrima</i> (L.) Swartz.	Shankasur	Throughout the year	Ambazari, Wardhaman Nagar
34	<i>Cassia absus</i> L.	Kankuti	Aug-Nov	Amravati road, Campus
35	<i>C. alata</i> L.	-	Sept-Jan	Amravati road, Itwari Rail. Station, Ambazari
36	<i>Cassia bicipularis</i> L.	-	Sept-Dec	Futala, Telangkheri
37	<i>Cassia fistula</i> L.	Amaltas	Mar-Oct	Telangkheri, campus, Shankar Nagar
38	<i>Cassia javanica</i> L.	-	July-Sept	Maharajbag, Sakkardara
39	<i>Cassia occidentalis</i> L.	Rantarota	Aug-Mar	Seminary hills
40	<i>Cassia pumila</i> Lam.	-	Aug-Dec	Campus
41	<i>Cassia renigera</i> Wall.	-	Apr-June	Sakkardara
42	<i>Cassia senna</i> L.	Sonamukhi	Throughout the year	Planted in gardens, Maharajbag
43	<i>Cassia siamea</i> Lam.	-	Aug-Feb	Campus, Bharat Nagar
44	<i>Cassia sophera</i> L.	-	Aug-Jan	Telangkheri, Shri. Ayurvedic College
45	<i>Cassia tora</i> L.	Tarota	July-Nov	Ambazari, Campus
46	<i>Cassia uniflora</i> Mill.	-	Aug-Dec	Campus, LIT
47	<i>Delonix elata</i> (L.) Gamble.	Gulmohar	June-Dec	Amravati Road
48	<i>Delonix regia</i> (Boj. ex Hook) Raf.	Gulmohar	Apr-Oct	Bharat Nagar, Buildi
49	<i>Hardwickia binata</i> Roxb.	Anjan	July-Mar	Seminary hills, Amravati road
50	<i>Peltophorum pterocarpum</i> (D.C.) Baker	-	Aug-Feb	Campus, Amravati road
51	<i>Saraca asoca</i> (Roxb.) de Wilde.	Seeta Ashok	Jan-Apr	Maharajbag
52	<i>Tamarindus indica</i> L.	Chinch, Imli	Feb-Nov	Telangkheri, Campus, VNIT

Table 2.3. Family: Fabaceae

53	<i>Abrus precatoreus</i> L.	Gunj	Sep-Dec	Futala, Campus
54	<i>Aeschynomene aspera</i> L.	-	Sep-Dec	Campus
55	<i>Alysicarpus bupleurifolius</i> (L.) DC.	-	Aug-Sep	Campus
56	<i>Alysicarpus hamosus</i> Edgew.	-	Aug-Oct	Campus, Ambazari.
57	<i>Alysicarpus heyneanus</i> Wight & Arn. var. <i>heyneanus</i>	-	July-Oct	Campus
58	<i>Alysicarpus longifolius</i> (Rottl. ex Spreng.) Wight & Arn.	-	Oct-Feb	Campus, Seminary hills.
59	<i>Alysicarpus monilifer</i> (L.) DC.	-	July-Oct	Campus
60	<i>Alysicarpus ovalifolius</i> (Schum.) J.Leon.	-	Aug-Oct	Campus, LIT
61	<i>Alysicarpus scariosus</i> (Rottl. ex Spreng.) Grah.	-	Aug-Dec	Campus
62	<i>Alysicarpus tetragonolobus</i> Edgew. var. <i>tetragonolobus</i>	-	Aug-Dec	Campus, LIT, NRCC.
63	<i>Alysicarpus vaginalis</i> (L.) DC. var. <i>nummularifolius</i> Miq.	-	Aug-Oct	Campus
64	<i>Arachis hypogaea</i> L.	Bhuingung	Aug-Nov	Campus
65	<i>Butea monosperma</i> (Lam.) Taub. var. <i>monosperma</i> .	Palas	Feb-Apr	Campus, Ambazari
66	<i>Butea superba</i> Roxb.	Palasvel	Feb-Apr	Campus, Ramnagar
67	<i>Cajanus cajan</i> (L.) Millsp.	Tur	Oct-Feb	Campus, Ambazari.
68	<i>Cajanus platycarpus</i> (Bth.) Van der Maesen.	Gophanvel	Sep-Dec	Campus
69	<i>Cajanus scarabaeoides</i> (L.) du-Petit-Thours.	Rantur	Jun-Dec	Campus
70	<i>Canavalia gladiata</i> (Jacq.) Dc.	-	Oct-Mar	NEERI, Seminary hills.
71	<i>Cicer arietinum</i> L.	Chana	Oct-Mar	Ambazari road, Umrer road
72	<i>Clitoria ternatea</i> L. var. <i>pilosula</i> Wall	-	July-Oct	Satpuda Botanical Garden, Campus

73	<i>Clitoria ternatea</i> L. var. <i>ternatea</i>	Gokarni	July-Dec	Campus, LIT.
74	<i>Crotalaria calycina</i> Schrank.	-	Aug-Nov	Campus
75	<i>Crotalaria juncea</i> L.	Boru	Aug-Jan	Campus
76	<i>Crotalaria linifolia</i> L.	-	Sep-Feb	Campus
77	<i>Cullen corylifolia</i> (L.) Medik.	Bawachi	Aug-Jan	Campus, Umrer road
78	<i>Cyamopsis tetragonolobus</i> (L.) Taub.	Gawar	July-Dec	Kamptee road garden
79	<i>Dalbergia latifolia</i> Roxb.	PahariSheesham	Sep-Feb	Campus, Seminary hills
80	<i>Dalbergia sissoo</i> Roxb.	Sheesham	Mar-Feb	Campus, Seminary hills
81	<i>Derris scandens</i> (Roxb.) Btm.	Tupbel	Aug-Oct	Sitabuldi
82	<i>Desmodium dichotomum</i> (Willd.) DC.	Chikta	Oct-Dec	Telangkheri garden, Campus
83	<i>Desmodium gangeticum</i> (L.) DC.	Salwan	Aug-Nov	Seminary hills, Campus
84	<i>Desmodium scorpiurus</i> (Sw.) Desv.	-	Oct-Mar	Telangkherigarden, Campus
85	<i>Desmodium triflorum</i> (L.) DC.	Ranmethi	Aug-Jan	Telangkherigarden, Campus
86	<i>Erythrina suberosa</i> Roxb.	Pangara	Mar-Sep	Campus, Seminary hills
87	<i>Erythrina variegata</i> L.	Pangara	Feb-Apr	Laxminagar square, Pandharabodi.
88	<i>Gliricidia sepium</i> (Jacq.) Kunth.	-	Feb-Apr	Ambazari, Pandhrabodi, Ganeshpeth
89	<i>Glycine max</i> (L.)	Soyabean	Sep-Nov	Umrer road, PDKV.
90	<i>Goniogyna hirta</i> (Willd.) Ali	-	Sep- Aug-Jan Nov	Ambazari, Pardi
91	<i>Indigofera astragalina</i> DC.	-	Aug-Oct	Ambazari, Pardi
92	<i>Indigofera cordifolia</i> Heyne.	-	Aug-Jan	Campus, LIT
93	<i>Indigofera linifolia</i> (L.) Retz.	-	Aug-Jan	Campus, LIT
94	<i>Indigofera linnaei</i> Ali.	Bhuiguli	Aug-Jan	Campus, LIT, Wardha road
95	<i>Indigofera trifoliata</i> L. var. <i>duthiei</i> (Drumm. Ex Naik.) Sanj.	Sarpot	Aug-Dec	Campus, Amravati Road
96	<i>Indigofera trita</i> L. var. <i>trita</i> .	-	Aug-Jan	Campus
97	<i>Lablab purpureus</i> (L.) Sweet.	Popat	Oct-Feb	Cultivated in garden, Ravinagar, Telangkheri.
98	<i>Lablab purpureus</i> (L.) Sweet. var. <i>lignosus</i> (L.) King.	Waal	Oct-Feb	Cultivated in garden, Home
99	<i>Lathyrus aphaca</i> L.	Ranwatana	Jan-Mar	Seminary hills, Marajbagh
100	<i>Lathyrus sativus</i> L.	Lakh	Jan-Mar	Umrer road
101	<i>Lens culinaris</i> Medik.	Masur	Dec-Feb	Mahal, Ambazari
102	<i>Melilotus alba</i> Medik.	Ranmethi	Feb-Mar	Campus, Sakkardara
103	<i>Melilotus indica</i> (L.) All.	Ranmethi	Jan-Mar	Campus
104	<i>Milletia peguensis</i> Ali.	Ranmethi	Feb-Oct	Rare, Campus, Maharajbagh
105	<i>Mucuna pruriens</i> (L.)DC.	Khajkuiri	Sep-Feb	Campus, Seminary hills
106	<i>Ougeinia oojeinensis</i> (Roxb.) Hochr.	Kalapals, Tiwas	Feb-Apr	Seminary hills
107	<i>Phaseolus vulgaris</i> L.	Vilaytiseem	Dec-Mar	Seminary hills, Campus
108	<i>Pisum sativum</i> L.	Watana	Dec-Mar	Campus, Seminary hills.
109	<i>Pongamia pinnata</i> (L.) Pierre.	Karanj	Feb-May	Campus, Seminary hills
110	<i>Pseudarthria viscida</i> (L.) Wt. & Arn.	Chikta	Aug-Nov	Satpuda Botanical Garden, Seminary hills
111	<i>Pterocarpus marsupium</i> Roxb. var. <i>marsupium</i> .	Bijja	Dec-Mar	Seminary hills.
112	<i>Rhynchosia bracteata</i> Bth.	-	Oct-Nov	Seminary hills
113	<i>Rhynchosia minima</i> (L.) DC.	Turel	July-Dec	Campus, Saoner road
114	<i>Sesbania bispinosa</i> (Jacq.) W. F. Wight.	Ran-Shevra	Sep-Jan	Campus
115	<i>Sesbania grandiflora</i> (L.) Poir.	Heti	Nov-Mar	LIT, Mahal.
116	<i>Tephrosia pumila</i> (Lamk.) Pers	-	Aug-Jan	Campus, LIT
117	<i>Tephrosia purpurea</i> (L.) Pers.	Unhali, Diwali	July-Jan	Campus, Kamptee road
118	<i>Tephrosia strigosa</i> (Dalz.) Sant	-	Aug-Oct	Ambazari
119	<i>Tephrosia villosa</i> (L.) Pers.	-	Aug-Oct	Campus, Ambazari
120	<i>Teramnus labialis</i> (L. f.) Spreng.	Tipani	Aug-Dec	Campus, LIT.
121	<i>Trigonella foenum-graecum</i> L.	Methi	Feb-Mar	Ambazari, Telangkheri

122	<i>Uraria picta</i> (Jacq.) Desv.	Pitwan	Sep-Oct	Rare, Gorewada
123	<i>Vigna angularis</i> (Willd.) Ohwi & Ohashi.	Udid	Sep-Nov	Telangkheri
124	<i>Vigna mungo</i> (L.) Hepper.	Moong	Aug-Nov	Campus, Telangkheri.
125	<i>Vigna radiata</i> (L.) R.	JangliMoong	Aug-Oct	Telangkheri
126	<i>Vigna trilobata</i> (L.) Verdc. var. <i>trilobata</i> .	Jangli Math	Aug-Oct	Campus, Telangkheri.
127	<i>Vigna unguiculata</i> (L.) Walp. ssp. <i>cylindrica</i> (L.) van- Eseltin.	Chavli	Feb-Oct	Seminary hills, Umrer road
128	<i>Vigna unguiculata</i> (L.) Walp. ssp. <i>unguiculata</i> .	Barbati	June-Oct	Telangkheri, Umrer road
129	<i>Zornia diphylla</i> (L.) Pers.	-	Aug-Oct	Campus, Dabha road
130	<i>Zornia gibbosa</i> Span.	Thipri	Aug-Oct	Campus, LIT.

*Dichrostachys cinera* (L.) var. *indica*.*Parkia biglandulosa* Wight. & Arn.*Peltophorum pterocarpum* (D.C.) Baker.*Cassia alata* L.*Cassia fistula* L.*Delonix regia* (Boj. ex Hook.) Raf.



Clitoria ternatea L. var. *ternatea*.



Uraria picta (Jacq.) Desv.



Butea monosperma (Lam.) Taub.



Gliricidia sepium (Jacq.) Kunth.

4. Conclusions

Present investigation enumerated plants of order Fabales in Nagpur city with potentialities of 59 genera with 125 species, 4 subspecies, 4 varieties belonging to 3 families. From the present study it is concluded that the number of taxa of order Fabales has increased sufficiently to earlier record of Graham [13], Ugemuge [10], Kamble [15,16] and Thakre [17]. It is also pointed out that earlier reported taxa such as *Acacia modesta*, *Uraria picta* are found with a single individual in the area, and needs further thorough investigations. So that it can be conserved in the area. Revision of floristic diversity is very important because these studies are considered as the backbone of the assessment of phytodiversity, conservation management and sustainable utilization of natural resources, habit loss and extinction rates of threatened taxa.

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Wetland Flora of Gorewada International Biopark, Nagpur, India

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Abstract Gorewada reservoir and adjacent area (1885 Ha) now converted into International Biopark abodes a variety of plant community to its credit. A study has been carried out to elucidate the aquatic flora with diverse plant wealth, indicator plants and their ecological status in wetlands of Gorewada catchment area. 114 plants species with 33 families have been identified from the Gorewada wet land area. 67 species belong to dicotyledons and 47 are monocotyledons.

Keywords Gorewada International Biopark, Nagpur, Wetland Flora, Indicator Categories

1. Introduction

Biodiversity accomplishes all vital requirements of organisms to complete their life cycle and amongst humans indirectly or directly dependent on both terrestrial as well as aquatic biodiversity, as both biodiversities provides natural resources in all ways to humans like cultural, economic, aesthetic, educational and scientific etc. Biodiversity covers all organisms like microorganism, plants and animals along with its all diverse genetic variations in species, varieties and populations in different habitats, ecosystems and in their natural areas, and its groups increases richness in natural environment [1].

Wetlands are vital parts of the hydrological cycle, highly productive, support exceptionally large biological diversity and provide a wide range of ecosystem services, such as food and fibre; waste assimilation; water purification; flood mitigation; erosion control; groundwater recharge; microclimate regulation; enhance aesthetics of the landscape; support many significant recreational, social and cultural activities, besides being a part of our cultural heritage [2].

The composition of a plant community is determined by a complex interaction of several biotic as well as abiotic factors including climate, soil type, position in the landscape and competition between plant species. Amongst which wetlands are the very important aquatic ecosystem, which maintains the balance in environment. Wetlands have seasonal variation in its floristic composition. Consequently, botanical explorations of wetland plants are necessary to gain more knowledge on species richness as well as their geographical distribution. Works on floristic studies of documentation of diversity of aquatic plants and wetlands flora in various water reservoirs and wetland areas of different states of India were carried out by many workers [3,4,5,6,7,8,9,10]. Besides these there are several researchers from Maharashtra state and its various districts and regions, explored the aquatic and wet lands plants diversity [11,12,13,14,15,16,17,18,19,20,21, 22].

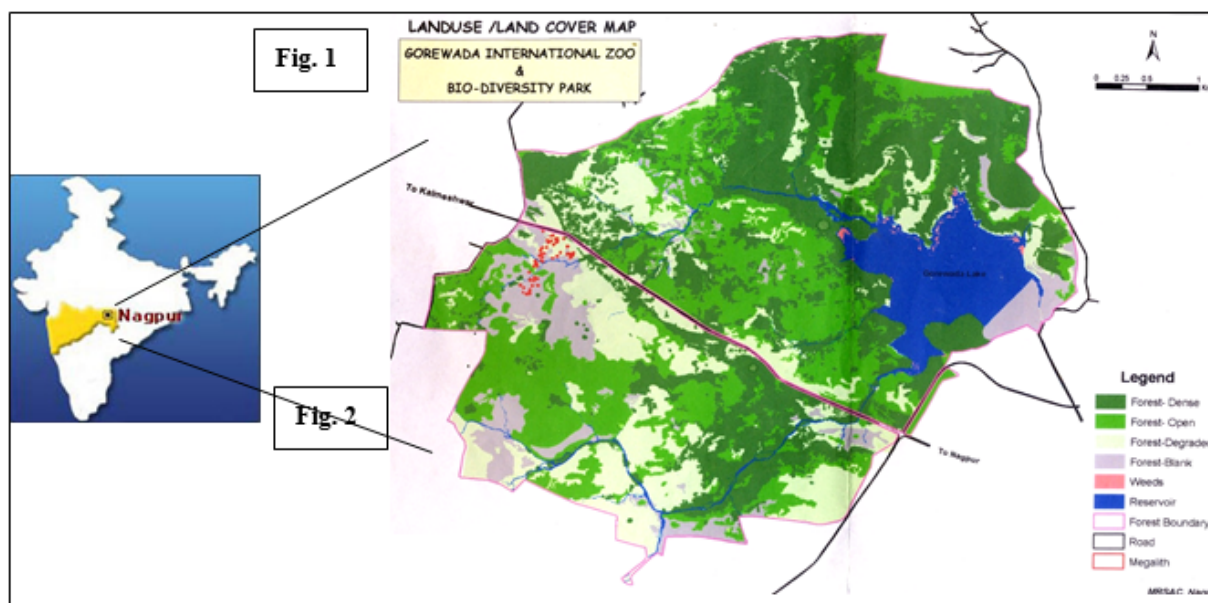


Figure 1. Map of Gorewada International Biopark

Nagpur is one of the greenest cities of India with 18 per cent of its area under forests and plantations, 17 per cent under cultivation and 2 per cent under water bodies [23]. To maintain ecological equilibrium, there is a need of documentation of floristic composition of wetlands, which plays a crucial role as pollution indicator. From this the assessment of conservation of threatened taxa which are associated with wetland habitats also carried out. In view of this fact, the present study is meant to prepare the documentation of the phytodiversity of wetland of Gorewada International Biopark (Proposed), Nagpur, the first exploration of the kind in this area.

2. Material and Methods

2.1. Study Area

Proposed Gorewada International Biopark lies between latitudes $20^{\circ} 35'$ and $21^{\circ} 44'$ North and longitudes $78^{\circ} 15'$ and $79^{\circ} 40'$ East. It extends over to 1885 ha of reserved forests, in outskirts of Nagpur city. All area is divided into 7 beats (Compartments) viz. 790, 791, 792, 793, 794, 795, 796 and one water catchment area. Land is well drained and form catchment area of Gorewada Lake, known for its scenic beauty. Gorewada water reservoir, an area of around 57.93 sq. Hectare is situated on the eastern side of the proposed zoo and bio-park. Northern bank of the lake is made by beat number 796 and western side by beat number 795. Almost all compartments have well drainage system in the form of ponds and streams towards the water reservoir. The annual average rainfall of the area is 900 mm and the annual mean temperature varies from 10° C minimum to 45° C maximum [24].

2.2. Methods

For the study of wetland flora, the survey in and around ponds, lakes, streams with extensive field visits have been done in various time of the year to cover all the wetlands of the area in different seasons during 2008 to 2013. The different wetland of each 7 compartments along with water reservoir often visited are shown in map. The methodology adopted for the data on taxa distribution within the forest range were collected particularly with the help of two sources- field observations and identification with pertinent literatures [25,26,27]. Besides that the information on habit, habitat and flowering was carried out in the both dry and wet seasons. The identification of

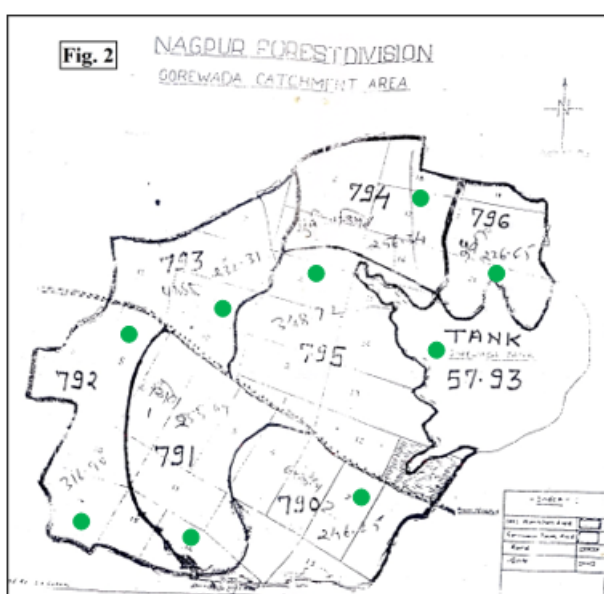


Figure 2. Compartments wise Map showing wetlands

specimens was carried out by consulting relevant literature and regional floras [28,29,30,31] and morpho-ecological classification viz. I) Submerged anchored, II) Free Floating, III) Floating leaved anchored, IV) Floating shoot anchored, V) Emergent anchored and VI) Helophytes [32].

3. Results and Discussion

Exhaustive field visits to the all wetland areas in 7 compartments and area adjoining the water reservoir carried out in all seasons of the year and documented all floral components. The statistical analysis of the floristic components also carried out. A total of 114 species from 33 families were identified from the Gorewada wet land area. 67 species belong to dicot and 47 are monocots

(Table No.2). Some of the major dominant wetland phyto-diversity are *Hydrilla*, *Utricularia*, *Vallisneria*, *Ceratophyllum*, *Azolla*, *Eichhornia*, *Ipomea*, *Lemna*, *Trapa*, *Nymphoides indica*, *Spigelia anthelmia* L. [33] etc. According to ecological classification, majority of the taxa belong to category V, i.e. muddy elements. Category I, submerged species are represented by *Vallisneria*, *Nechandra*, *Naias*, *Ceratophyllum* and *Hydrilla*, While *Ottelia*, *Aponogeton* and *Limnophyllum* forms the floating leaves category, II. *Typha* and *Ipomea fistulosa* are the most frequent taxa of category IV. (Table. No.1& Figure. 3). besides these, algae, aquatic fungi, bryophytes and peridophytes are also major parts of the wetland ecosystem. The detailed list of floral components according to its habits and ecological class occurred in Gorewada International Biopark given below. (Table No. 1).

Table 1. Floristic diversity of wetland belonging to different morpho-ecological classes and plant indicators from the study area are given as below

Sr. No	Botanical Name	Family	Habit	Ecological class
1.	<i>Justicia diffusa</i> Willd.	Acanthaceae	Wet Patches	VI
2.	<i>Justicia simplex</i> D.Don.	Acanthaceae	Wet Patches	VI
3.	<i>Rungia pectinata</i> (L.) Nees.	Acanthaceae	Moist Places	VI
4.	<i>Hygrophila auriculata</i> (K. Schum.) Heine	Acanthaceae	Wet Patches	VI
5.	<i>Justicia procumbens</i> L.	Acanthaceae	Margin of lake	VI
6.	<i>Justicia quinqueangularis</i> Koen.	Acanthaceae	Margin of lake	VI
7.	<i>Alternanthera sessilis</i> (L.) R.Br.	Amaranthaceae	Wet mud	VI
8.	<i>Celosia argentea</i> L.	Amaranthaceae	Moist Region	VI
9.	<i>Amaranthus viridis</i> L.	Amaranthaceae	Moist Places	VI
10.	<i>Aponogeton natans</i> (L.) Engl. & Krause	Aponogetonaceae	Submerged	VI
11.	<i>Gnaphalium polycaulon</i> Pers.	Asteraceae	Moist Places	VI
12.	<i>Blumea lacera</i> (Burm.f.) DC.	Asteraceae	Margin of Lake	VI
13.	<i>Caesulia axillaris</i> Roxb.	Asteraceae	Margin of Lake	VI
14.	<i>Cyathocline purpurea</i> (D.Don.) O.Ktze.	Asteraceae	Dry Mud Patches	VI
15.	<i>Glossocardia bosvallea</i> (L.f.) DC.	Asteraceae	Sandy / Moist	VI
16.	<i>Sonchus brachyotus</i> DC.	Asteraceae	Moist Region	VI
17.	<i>Vernonia cinerea</i> (L.) Less	Asteraceae	Moist Region	VI
18.	<i>Trichodesma sedgwickianum</i> Banerjee	Boraginaceae	Margin of Lake	VI
19.	<i>Heliotropium supinum</i> L.	Boraginaceae	Margin of Lake	VI
20.	<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	Submerged	I
21.	<i>Cleome chelidonii</i> L.f.	Cleomaceae	Wet Patches	VI
22.	<i>Terminalia arjuna</i> (Roxb.) Wt. & Arn.	Combretaceae	Margin of Lake	VI
23.	<i>Commelina benghalensis</i> L.	Commelinaceae	Wet mud patches	VI
24.	<i>Cyanotis axillaris</i> (L.) D.Don ex Sweet	Commelinaceae	Wet mud patches	VI
25.	<i>Merremia emarginata</i> (Burm.f.) Hall.f.	Convolvulaceae	Moist Region	VI
26.	<i>Evolvulus alsinoides</i> (L.) L.	Convolvulaceae	Wet Patches	VI
27.	<i>Ipomoea fistulosa</i> Mart. ex Choisy	Convolvulaceae	Wet mud patches	III
28.	<i>Eleocharis atropurpurea</i> (Retz.) K.B. Presl.	Cyperaceae	Wet Patches	VI
29.	<i>Cyperus iria</i> L.	Cyperaceae	Wet Patches	VI
30.	<i>Cyperus corymbosus</i> Rottb.	Cyperaceae	Wet Patches	VI

Table 1 Continued

31.	<i>Fuirena glomerata</i> Lamk.	Cyperaceae	Dry Mud patches	VI
32.	<i>Kyllinga brevifolia</i> Rottb.	Cyperaceae	Wet Patches	VI
33.	<i>Cyperus compressus</i> L.	Cyperaceae	Moist Region	VI
34.	<i>Cyperus niveus</i> Retz.	Cyperaceae	Moist Region	VI
35.	<i>Fimbristylis aphylla</i> Steud.	Cyperaceae	Moist Region	VI
36.	<i>Fimbristylis dichotoma</i> (L.) Vahl.	Cyperaceae	Moist Region	VI
37.	<i>Fimbristylis ferruginea</i> (L.) Vahl.	Cyperaceae	Margin of lake	VI
38.	<i>Fimbristylis spathacea</i> Roth.	Cyperaceae	Margin of lake	VI
39.	<i>Kyllinga nemoralis</i> (Forst.) Dandy	Cyperaceae	Moist Region	VI
40.	<i>Eriocaulon cinereum</i> R.Br.	Eriocauliaceae	Wetland	VI
41.	<i>Eriocaulon quinqueangulare</i> L.	Eriocauliaceae	Wetland	VI
42.	<i>Eriocaulon luzulaefolium</i> Mast.	Eriocaulaceae	Wet Patches	VI
43.	<i>Phyllanthus amarus</i> Schum. & Thonn.	Euphorbiaceae	Dry Mud patches	VI
44.	<i>Euphorbia rosea</i> Retz.	Euphorbiaceae	Dry Mud patches	VI
45.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Margin of lake	VI
46.	<i>Chrozophora prostrata</i> Dalz.	Euphorbiaceae	Dry Mud patches	VI
47.	<i>Crotalaria albida</i> Heyne ex Roth	Fabaceae	Dry Mud patches	VI
48.	<i>Crotalaria sericea</i> Retz.	Fabaceae	Dry Mud patches	VI
49.	<i>Indigofera cordifolia</i> Heyne ex Roth	Fabaceae	Dry Mud patches	VI
50.	<i>Indigofera trifoliata</i> L.	Fabaceae	Dry Mud patches	VI
51.	<i>Smithia conferta</i> J.E. Sm.	Fabaceae	Dry Mud patches	VI
52.	<i>Aeschynomene indica</i> L.	Fabaceae	Wet Patches	VI
53.	<i>Zornia gibbosa</i> Spanoghe	Fabaceae	Dry Mud patches	VI
54.	<i>Zornia diphylla</i> (L.) Pers.	Fabaceae	Dry Mud patches	VI
55.	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	Wet patches	VI
56.	<i>Alysicarpus vaginalis</i> (L.) DC.	Fabaceae	Wetland	VI
57.	<i>Centaurium centaurioides</i> (Roxb.) Rao & Hemadri	Gentianaceae	Wetland	VI
58.	<i>Canscora decurrens</i> Dalz.	Gentianaceae	Margin of lake	VI
59.	<i>Exacum pedunculatum</i> L.	Gentianaceae	Margin Region	VI
60.	<i>Hoppea dichotoma</i> Willd.	Gentianaceae	Wetland	VI
61.	<i>Nymphoides cristata</i> (Roxb.) O. Ktze.	Gentianaceae	Surface of Lake	II
62.	<i>Hydrilla verticillata</i> (L.f.) Royle.	Hydrocharitaceae	Submerged	I
63.	<i>Otelia alismoides</i> (L.) Pers.	Hydrocharitaceae	Submerged	III
64.	<i>Vallisneria spiralis</i> L.	Hydrocharitaceae	Submerged	I
65.	<i>Nechamandra alternifolia</i> (Roxb.) Thw.	Hydrocharitaceae	Submerged	I
66.	<i>Leucas aspera</i> (Willd.) Spreng.	Lamiaceae	Moist Places	VI
67.	<i>Ocimum basilicum</i> L.	Lamiaceae	Margin of Lake	VI
68.	<i>Lemna paucicostata</i> Hagelm	Lemnaceae	Surface of Lake	II
69.	<i>Scilla hyacinthina</i> (Roth.) Macbr.	Liliaceae	Dry Mud patches	VI
70.	<i>Curculigo orchioides</i> Gaertn.	Liliaceae	Moist places	VI
71.	<i>Gloriosa superba</i> L.	Liliaceae	Moist places	VI
72.	<i>Mitreola petiolata</i> (J.F. Gmel.) Torr. & Gray.	Loganiaceae	Wet Patches	VI
73.	<i>Spigelia anthelmia</i> L.	Loganiaceae	Wet Patches	VI
74.	<i>Rumex dentatus</i> L.	Lythraceae	Margin of Lake	VI
75.	<i>Ammannia multiflora</i> Roxb.	Lythraceae	Dry Mud	VI

Table 1 Continued

76.	<i>Rotala indica</i> (Willd.) Koehne.	Lythraceae	Wet patches	VI
77.	<i>Woodfordia fruticosa</i> (L.) Kurz.	Lythraceae	Margin of Lake	VI
78.	<i>Najas minor</i> All.	Najadaceae	Submerged	IV
79.	<i>Ludwigia octovalvis</i> (Jacq.) Raven.	Onagraceae	Wet mud	VI
80.	<i>Biophytum sensitivum</i> (L.) DC.	Oxalidaceae	Wet Mud	VI
81.	<i>Aristida funiculata</i> Trin.	Poaceae	Dry Mud patches	VI
82.	<i>Chrysopogon fulvus</i> (Spreng.) Chiov.	Poaceae	Dry Mud patches	VI
83.	<i>Coix lacryma-jobi</i> L.	Poaceae	Wet Patches	V
84.	<i>Dichanthium aristatum</i> (Poir.) C.E. Hubb.	Poaceae	Wet Patches	VI
85.	<i>Digitaria ciliaris</i> (Retz.) Koeler	Poaceae	Dry Mud patches	VI
86.	<i>Eragrostiella brachyphylla</i> (Stapf.) Bor.	Poaceae	Dry Mud patches	VI
87.	<i>Heteropogon contortus</i> (L.) Pal.-Beauv.	Poaceae	Dry Mud patches	VI
88.	<i>Oplismenus compositus</i> (L.) Pal.-Beauv.	Poaceae	Dry Mud patches	VI
89.	<i>Paspalidium flavidum</i> (Retz.) A.	Poaceae	Wet Patches	VI
90.	<i>Paspalidium geminatum</i> (Forssk.) Stapf.	Poaceae	Wet Patches	VI
91.	<i>Pennisetum pedicellatum</i> Trin.	Poaceae	Dry Mud patches	VI
92.	<i>Panicum miliare</i> Lamk.	Poaceae	Dry Mud patches	VI
93.	<i>Setaria verticillata</i> (L.) Pal.-Beauv.	Poaceae	Dry Mud patches	VI
94.	<i>Themeda triandra</i> Forssk.	Poaceae	Dry Mud patches	VI
95.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Margin of Lake	VI
96.	<i>Eragrostis gangetica</i> (Roxb.) Steud.	Poaceae	Margin of Lake	VI
97.	<i>Eragrostis aspera</i> (Jacq.) Nees.	Poaceae	Margin of Lake	VI
98.	<i>Setaria intermedia</i> Roem. &Schult.	Poaceae	Margin of Lake	VI
99.	<i>Polygala arvensis</i> Willd.	Polygalaceae	Moist Places	VI
100.	<i>Polygonum glabrum</i> Willd.	Polygonaceae	Dry Mud	V
101.	<i>Potamogeton nodosus</i> Poir.	Potamogetonaceae	Submerged	I
102.	<i>Potentilla supine</i> L.	Rosaceae	Dry Mud patches	VI
103.	<i>Dentella repens</i> (L.) Forst.	Rubiaceae	Moist Places	VI
104.	<i>Oldenlandia corymbosa</i> L.	Rubiaceae	Margin of Lake	VI
105.	<i>Striga densiflora</i> (Benth.) Benth.	Scrophulariaceae	Wet Patches	VI
106.	<i>Sopubia delphiniifolia</i> (L.) G.Don.	Scrophulariaceae	Moist Places	VI
107.	<i>Lindernia crustacea</i> (L.) F.V. Muell.	Scrophulariaceae	Moist Places	VI
108.	<i>Limnophila heterophylla</i> (Roxb.) Benth.	Scrophulariaceae	Wet mud	IV
109.	<i>Buchnera hispida</i> Buch.-Ham.	Scrophulariaceae	Moist Places	VI
110.	<i>Bacopa monnieri</i> (L.) Wettstein	Scrophulariaceae	Wet mud.	VI
111.	<i>Verbascum chinense</i> (L.) Santapau	Scrophulariaceae	Margin of Lake.	VI
112.	<i>Trapa natans</i> L.	Trapaceae	Surface of Lake	III
113.	<i>Typha angustata</i> Chaubard & Bory	Typhaceae	Wet mud.	V
114.	<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	Moist Places	VI

Note: I) Submerged anchored, II) Free Floating, III) Floating leaved anchored, IV) Floating shoot anchored, V) Emergent anchored and VI) Helophytes

Table 2. Statistical analysis showing percentage of Dicotyledonous and Monocotyledonous families, genera and species

	Dicots.		Monocots.	
	No.	%	No.	%
Families	23	69.70	10	30.30
Genera	59	62.76	35	37.23
Species	67	58.77	47	41.22
Total			114	

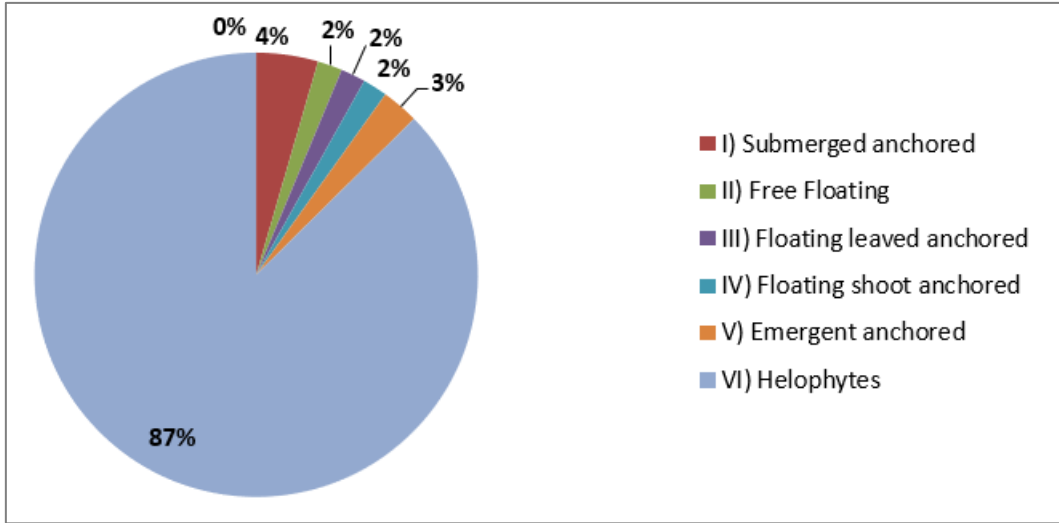


Figure 3. Pi diagram showing the composition of life form of aquatic macrophytes of the wetlands of the study area

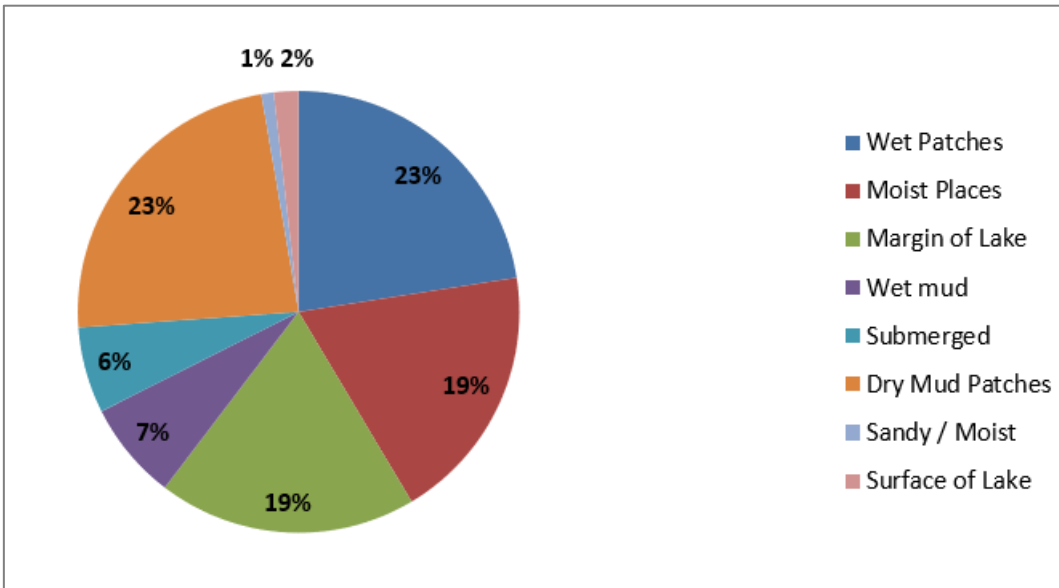


Figure 4. Habit Sharing of flora in Gorewada Wetland

Table3. List of Dominating Wetland Plants with Indicator Category

Sr. No.	Scientific Names	Indicator Category
1.	<i>Bacopa monnieri</i> (L.) Wettstein	OBL
2.	<i>Eriocaulon cinereum</i> R.Br.	OBL
3.	<i>Phyla nodiflora</i> (L.) Greene	FACW
4.	<i>Typha angustata</i> Chaubard & Bory	OBL
5.	<i>Ipomoea fistulosa</i> Mart. ex Choisy	FAC
6.	<i>Vallisneria spiralis</i> L.	OBL
7.	<i>Hydrilla verticillata</i> (L.f.) Royle	OBL
8.	<i>Ottelia alismoides</i> (L.) Pers.	OBL
9.	<i>Najas minor</i> All.	OBL
10.	<i>Phoenix sylvestris</i> (L.) Roxb	UPL
11.	<i>Terminalia arjuna</i> (Roxb.) Wt. & Arn.	FACU
12.	<i>Aponogeton natans</i> (L.) Engl. & Kr.	OBL
13.	<i>Cleome chelidonii</i> L.f.	OBL
14.	<i>Crotalaria sericea</i> Retz.	FACW
15.	<i>Phyllanthus amarus</i> Schum. & Thn.	FAC
16.	<i>Nymphoides cristata</i> (Roxb.) O.Ktze	OBL
17.	<i>Lindernia crustacea</i> (L.) F.V. Muell.	OBL
18.	<i>Oldenlandia corymbosa</i> L.	OBL
19.	<i>Coix lacryma-jobi</i> L.	OBL
20.	<i>Smithia conferta</i> J.E. Sm.	UPL
21.	<i>Ludwigia octovalvis</i> (Jacq.) Raven.	FACU

Wetland Indicator Categories based on differences in expected frequency of occurrence of wetland plant species [34], probability of occurrence in wetlands as opposed to upland habitats, with obligate wetland species having a percentage probability of occurrence in wetlands (OBL) > 99%; facultative wetland species (FACW), 67% – 99%; facultative species (FAC), 34% – 66%; facultative upland species (FACU), 1% – 33%; and obligate upland species (UPL), < 1%. According to this, the dominant wetland plants were categorized. The OBL indicator category comprises *Bacopa monnieri* (L.) Wettstein, *Eriocaulon cinereum* R.Br., *Typha angustata* Chaubard & Bory, *Vallisneria spiralis* L., *Hydrilla verticillata* (L.f.) Royle, *Ottelia alismoides* (L.) Pers., *Najas minor* All., *Aponogeton natans* (L.) Engl. & Kr., *Cleome chelidonii* L. f., *Nymphoides cristata* (Roxb.) O. Ktze, *Lindernia crustacea* (L.) F.V. Muell., *Oldenlandia corymbosa* L.,

Coix lacryma-jobi L. Facultative wetland species (FACW) are *Phyla nodiflora* (L.) Greene and *Crotalaria sericea* Retz.; facultative species (FAC) with *Ipomoea fistulosa* Mart. ex Choisy and *Phyllanthus amarus* Schum. & Thn.; facultative upland species (FACU) are *Terminalia arjuna* (Roxb.) Wt.&Arn. and *Ludwigia octovalvis* (Jacq.) Raven. and obligate upland species (UPL) represented with *Phoenix sylvestris* (L.) Roxb. and *Smithia conferta* J.E. Sm. (Table.3).

Gorewada Lake is one of the important water reservoirs of the Nagpur, from where supply of the drinking water to the different parts of the city takes place. At the same time its expanded marshy land provides suitable habitats for breeding of number of water animals. Large population of macrophytes of wetlands is provider of not only habitat but also the much needed food for number of organisms.

4. Conclusions

Wetlands have a great diversity of plants needing wetness of diverging extents. These plants are accordingly adapted to the local availability of water and many show transitions between annual and perennial forms and also their type of growth forms. Weed, a controversial class of plants, its invasion is a major problem in wetlands resulting in increased competition for resources such as water, light, nutrients and space [34]. Wetland plants can be threatened by changes in both surface water and groundwater levels as a result of human activities. Wetland plants are sensitive to changes in hydrology which result in a wetland having too much or too little water. The anthropogenic activities like deforestation; overgrazing and developmental activities etc. are causative factors for the acceleration of soil erosion and consequent siltation of wetlands. For successful implementation of conservation, involvement of people and nongovernmental organizations is crucial. People can be involved in de-siltation of lake, afforestation in the catchment area and generating awareness

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Appendix



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Adsorption Isotherm Mechanism for Removal of Fluoride by Using Microwave Assisted and Acid-Base Impregnated Biomaterial Prepared from *Tamarindus Indica* Seed

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ABSTRACT

The acid-base impregnated activated carbon derived from *Tamarindus indica* seed waste was used in the present study to remove fluoride ions from water. The adsorbent were prepared by activating the selected biomass in muffle furnace and then in microwave and subsequently with sodium hydroxide and sulphuric acid. The developed carbon material was assigned as MACTIS. The effects of different operating parameters including adsorbent dose, initial concentration of fluoride, contact time, solution pH and temperature on the removal of the fluoride ions, have been studied. Optimum conditions were observed for the prepared carbon content, such as pH 5, adsorbent dosage of 3.0 g/L, and agitation rate of 120 strokes/min and contact time of 180 min at a temperature of 303 K. The isotherms of Langmuir, Freundlich, Temkin and Dubinin-Radushkevich have been studied to explain the adsorption mechanism on the adsorbent surface. The Langmuir isothermal model agreed to a greater extent with the equilibrium results, suggesting monolayer adsorption of fluoride ions on MACTIS. The fluoride uptake potential for MACTIS by the Langmuir isotherm was found to be 1.222 mg/g. Thermodynamic experimentation found that the mechanism of adsorption in nature was feasible, exothermic and spontaneous. With a rise in temperature from 303 K to 333 K, the elimination efficacy of the defluoridation process was reduced. These results provide insights to further explore the adsorption method for fluoride ion removal using impregnated acid-base and microwave-assisted carbon materials derived from other plant based bio waste.

Keywords: Adsorption, Fluoride, Equilibrium, isotherm, *Tamarindus indica* Seed

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INTRODUCTION

Pure drinking water is inadequate and not readily accessible to everyone. Natural sources or industrial effluents can contaminate the water. Fluoride, found in groundwater and surface water, is one such contaminant. The main source of fluoride in the groundwater is geological formation. Fluoride, the 13th most common element on Earth, is a naturally occurring compound derived from fluorine. It can be found in rocks, soil, fresh water and ocean water. Fluoride occurs naturally as a consequence of runoff from weathering of rocks and soils containing fluoride and leaching from soil into groundwater in public water systems. In addition, the atmospheric deposition of fluoride-containing pollutants from coal-fired power plants and other industrial sources leads to the high fluoride concentrations in water, either by direct deposition or through soil deposition and subsequent water runoff [1].

The discharge of fluoride into groundwater and surface water is also involved in various industries such as semiconductor production plants, pharmaceutical firms, beryllium extraction units, smelters, aluminium, fertiliser manufacturing plants and mining industries are the sectors in question [2]. In several countries, including Benin, Algeria, Cameroon, Ethiopia, Egypt, Ghana, Kenya, Malawi, Libya, Nigeria, Morocco, Rwanda, South Africa, Tanzania, Sudan, Togo, Uganda, Tunisia, Zimbabwe, India, China, Indonesia, Pakistan, , Iran, Saudi Arabia, Turkey, South Korea, Yemen, Mexico, Canada, Argentina, USA, etc. the fluoride contamination and its associated diseases have been reported [3]. In different states of India, such as Andhra Pradesh, Haryana, Punjab, Rajasthan, Uttar Pradesh, Gujarat, Tamil Nadu, Maharashtra and Karnataka [4], the problems associated with fluoride contamination are more severe. If the level of fluoride in drinking water reaches 1.5 mg/L, then osteoporosis, skeletal fluorosis, dental fluorosis, Alzheimer's disease, neurological damage, male and kidney infertility, thyroid disorders, liver damage [5] are induced.

The use of groundwater has increased as a result of rapid growth and industrial demand among the global population, resulting in low water quality supply and a decrease in groundwater levels. Inorganic toxins, such as fluoride, heavy metals, etc., play a major role in groundwater pollution. Fluoride is such a contaminant that human beings face an extreme danger. Since drinking water is the primary source of fluoride ingestion, the Bureau of Indian Standards BIS, 2012 [6] has therefore placed a permissible value of 1 mg/L of fluoride in drinking water that, as suggested by WHO, is less than 1.5 mg/L [7].

Different analytical techniques have been used to extract residual fluoride from the fluoride contaminated water until it is released into the public water system. Coagulation-precipitation, ion-exchange, adsorption, nano-filtration, electro-dialysis, reverse osmosis and electrocoagulation are used in these techniques [8, 9, 10]. The adsorption process is a highly encouraging procedure, which usually uses natural or synthetic solid adsorbents, among all these techniques. This technique is highly appropriate because of its favourable economical cost, high removal efficiency, ease of use, and the reuse of the adsorbent used after its regeneration [11].

Several plant-based biomass products have also been used to extract fluoride from drinking water, such as leaves, seeds, eggs, peels, bark, etc., as illustrated in our previous review articles [12, 13, 14, 15]. Due to highly microporous composition, wide surface area, excellent surface reactivity and adequate availability of functional groups, activated carbon (AC) developed from plant based biomass is reflected as a versatile adsorbent material. Many researchers have used activated carbon extensively for the removal of fluoride from water.

Tamarindus indica has a place with the family Leguminosae (Fabaceae), commonly known as Tamarind tree, is one of the fruit tree species that is utilized as conventional medicine [16]. *Tamarindus indica* (T. indica) is evergreen tree that can achieve 24 m height and 7 m size that has light yellow and pink flowers [17]. Tamarind tree is found particularly in the Indian subcontinent, Africa, Nigeria and largely in the tropical countries. All part of *Tamarindus indica* plant (root, fruit, body and leaves) has high nutritional value and wide medicinal usage. It moreover has industrial and economic importance. World Health Organization report determines, tamarind fruit is an ideal source of all vital amino acids except tryptophan (82%) [18] and it also contains phenolic compounds like, mucilage, procyanidin B₂, catenin, arabinose, tartaric acid, xylose, galactose, epicatechin, pectin, glucose, uronic acid and triterpen [19].

Many works have been recently published with the primary goal being the investigation of removal of different pollutants using seed based adsorbent materials [20, 21]. Seed based materials are of low economic value, so inexpensive and abundantly available and composed different chemical compositions which make them effective adsorbents for a wide range of pollutants due to the presence variety of functional groups that participates in binding with the pollutants [22]. Thus, this article aimed at studying the adsorption behaviour of chemically activated *Tamarindus indica* seed for the removal of fluoride from aqueous solution.

MATERIAL AND METHOD

Materials used

All chemicals used were of analytical reagent grade and these chemicals obtained from S-D Fine Chemicals Ltd or Merck India limited. All glassware used in the study were delivered using Borosil glass. Batch adsorption experiments were performed using double distilled water.

Preparation of Adsorbent

Tamarindus indica seeds were collected from the local area and washed several times with water to remove dust and other impurities and kept for sun dry. The procedure of preparation of material was followed as that reported in previous work [23]. The carbon obtained from the seed of *Tamarindus indica* was hereafter referred as microwave assisted *Tamarindus indica* seed (MACTIS).

Batch adsorption experiments

The developed MACTIS carbon material was used for the defluoridation of water by batch adsorption experiments at different initial fluoride concentrations (2 mg/L to 10 mg/L). The 50 ml of known synthetic fluoride concentration solutions were taken for a batch test in 100 ml of Erlenmeyer flask and were shaken at 120 strokes/min for prearranged contact time, adsorbent dose, temperature and pH. The fluoride concentrations before and after adsorption were estimated by utilizing fluoride ion-selective electrode (HANNA Model No. H I 4110) and ion-selective meter (HANNA Model No. HI 4522). The adsorption capacities of fluoride were determined by the equation (1):

$$q_e = \frac{(C_0 - C_e) V}{m} \quad (1)$$

Where m, V, C₀, C_e and q_e are the mass of adsorbent (g), the volume of the solution (L), the initial fluoride concentration (mg/L), equilibrium fluoride concentration (mg/L) and fluoride adsorbed at equilibrium (mg/g), respectively. The fluoride removal efficiency from the water was evaluated by equation (2):

$$\% \text{ Removal of fluoride} = \frac{(C_0 - C_e)}{C_0} \times 100 \quad (2)$$

The impacts of agitation speed, adsorbent dose, contact time, pH, temperature and initial fluoride concentration have been considered for fluoride removal from the aqueous solutions by utilizing MACTIS material. The fluoride adsorption isotherm mechanism was discussed by using well-known models e.g., Langmuir, Freundlich, Temkin, and Dubinin–Radushkevich isotherms (**Table 1**).

Table 1: Empirical adsorption isotherm equations.

Isotherm Models	Isotherm Equations	Ref.
Langmuir isotherm	$\frac{C_e}{q_e} = \frac{1}{K_L q_m} + \frac{C_e}{q_m}$	[24]
Freundlich isotherm	$\ln q_e = \ln K_F + (1/n) \ln C_e$	[24]
Temkin Isotherm	$q_e = B \ln A_T + B \ln C_e$	[24]
Dubinin-Radushkevich isotherm	$\ln q_e = \ln q_D - (K_D) \varepsilon^2$	[24]

RESULT AND DISCUSSION

Fluoride batch adsorption experiments:

Effect of pH

In order to study the impact of pH on fluoride removal from aqueous solution, batch experiment was performed with changing initial pH value from 2 to 10 at 303 K (**Fig. 1(a)**). The initial concentration of fluoride and agitation speed was fixed at 2 mg/L and 120 strokes/min, respectively. The amount of the adsorbent dose was taken as 3 g/L and contact time was maintained as 180 min. It could be observed that the removal of fluoride increases with increment of initial pH from 2 to 5 and it nearly achieves a highest removal around pH 5. Therefore, the optimum fluoride removal consider at pH 5. At low pH, the concentrations of hydrogen ions are high, so adsorbent surface sites become positively charged and then hydrogen and fluoride ions compete for binding sites of the adsorbent which results the decrease in fluoride removal efficiency [25]. As pH increases in the ranges from 4 to 7, the fluoride removal efficiency are high and their after as pH increases removal efficiency diminishes. From above discussion, it is indicate that optimum pH 5 is required for later experiments for the successful removal of fluoride.

Effect of agitation speed

The impact of agitation speed on fluoride removal efficiency onto the MACTIS material was examined by changing the agitation speed from 20 to 180 strokes/min, while keeping the alternate parameters constant. As indicated by **Fig. 1(b)**, the removal of fluoride efficiency by and large increased besides increasing agitation speed. The fluoride removal efficiency of MACTIS adsorbent material increased from 53.00 % to 88.50 % when the speed of agitation of shaker increased from 60 to 120 strokes/min and the adsorption removal capacity shows up generally steady for agitation rates greater than 120 strokes/min. This outcome can be related to the fact that the expansion of the agitation speed enhances the diffusion of fluoride towards the adsorbent surface [26]. This additionally shows an agitation speed of 120 strokes/min is adequate to ensure that all the binding sites of adsorbent surface are made readily accessible for adsorption of fluoride.

Effect of adsorbent dose

The impact of adsorbent dosage on the removal of fluoride from aqueous solution are appeared in **Fig. 1(c)**, by varying the amount of adsorbent dosage from 1 g/L to 6 g/L, by keeping 2 mg/L of initial fluoride concentration and equilibrium contact time for 180 min at 303 K. The agitation speed kept up at 120 strokes/min. The outcomes indicated that the fluoride removal capacity increases with increase of amount of adsorbent dose because of the more prominent accessibility of adsorption sites of adsorbent [27]. On the other hand, the percentage removal of fluoride was more at 3 g/L and the optimum was obtained at this dose and changes slightly with respect to adsorbent dose. Therefore 3 g/L was taken reasonably as the adsorbent dose for further experimental investigations.

Effect of initial fluoride concentration

The effect of initial concentration of fluoride was considered by ideal adsorbent dose of 3g/L onto distinctive initial concentration of fluoride arrangements (2 - 10 mg/L) at four unique temperatures (303K to 333K) by keeping other optimum parameters steady. The impact of initial fluoride concentration on the percent fluoride removal efficiency is shown in **Fig. 1(d)**. The results laid out that percent fluoride removal efficiency diminished with rising initial fluoride concentration at studied unique temperatures. This was might be because of the capacity of the adsorbent carbon material gets exhausted sharply with the rise in the concentration of fluoride [28]. Furthermore, it is probably due to the fact that for a predetermined adsorbent dosage, the entire active adsorption surface sites of the carbon material

were constrained at higher initial fluoride concentration. Similar pattern has been reported for adsorption of fluoride by utilizing the various adsorbents [28, 29].

Effect of contact time

The investigation of impact of contact time for the adsorption of fluoride onto the MACTIS adsorbent material at different fluoride concentrations (2, 4, 6, 8 and 10 mg/L) with changing contact time from 30 to 300 min keeping every other parameters constant are appeared in Fig 1(e). It was seen that, fluoride adsorption by MACTIS carbon material was increased with time. In the beginning, fluoride adsorption on MACTIS material occurred rapid followed by slower fluoride adsorption up to the equilibrium. For MACTIS adsorbent, 88.50% of adsorption occurred for fluoride within 180 min contact time and equilibrium reached in 300 min, therefore contact time of 180 min was considered for further studies. It was observed that the adsorption efficiency of fluoride steadily increased with the increase in contact time. The steady rise shows the accessibility of adsorbent sites for adsorption of fluoride during the initial lower contact times [30]. On the other hand, adsorption site saturation arises after 180 min of contact time for MACTIS adsorbent material.

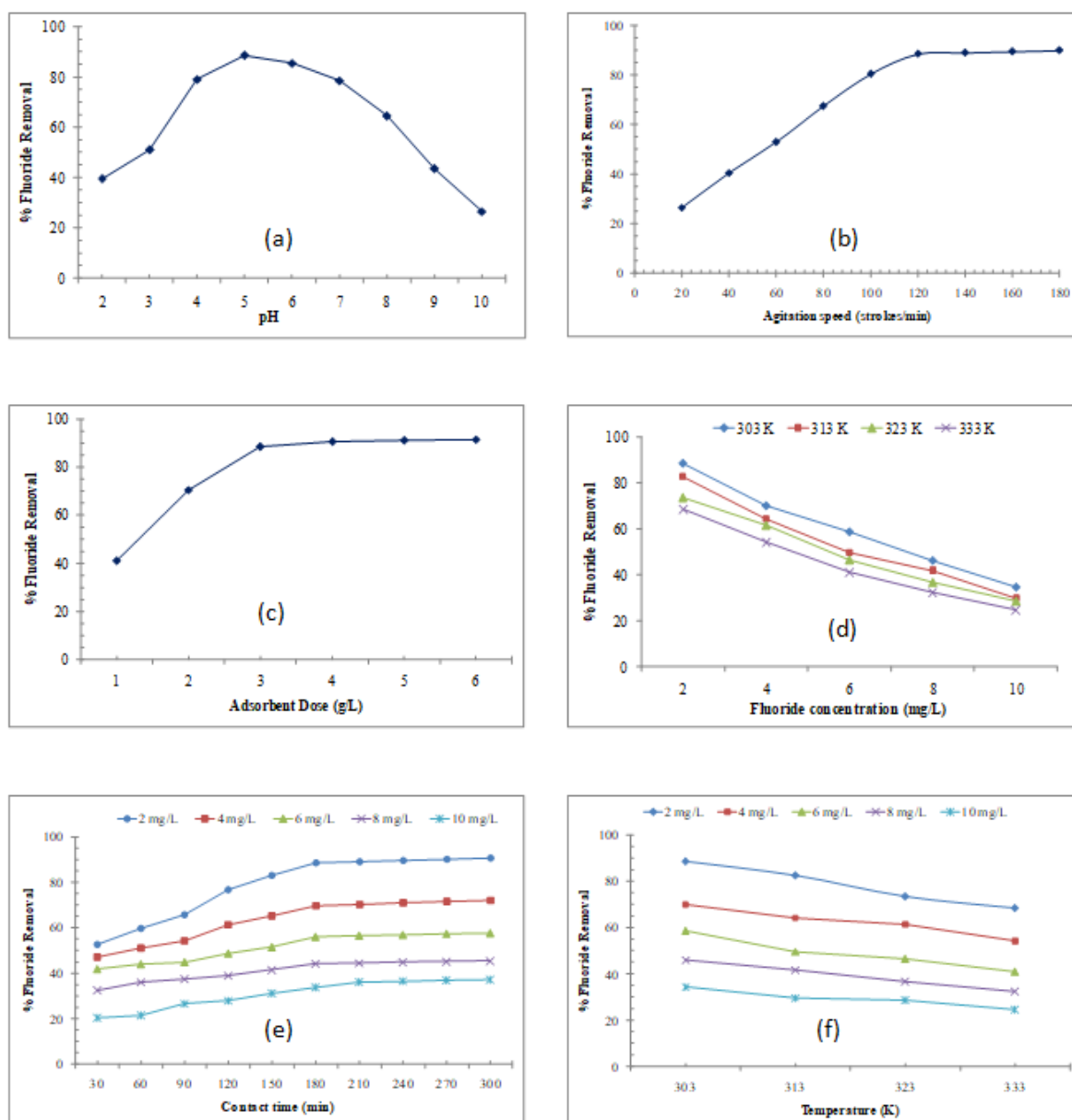


Fig. 1: Effect of (a) pH, (b) agitation speed, (c) adsorbent dose, (d) initial fluoride concentration (e) contact time and (f) temperature on the fluoride adsorption by MACTIS

Effect of temperature

It is well known that temperature is a supplementary factor significantly impacts the adsorption process. The impact of temperature on fluoride adsorption onto MACTIS from aqueous solution was investigated at 303, 313, 323 and 333 K for the initial fluoride concentration of 2–10 mg/L at optimized pH, agitation speed, adsorbent dose, and contact time. The plot presented in **Fig. 1(f)**, signifying the fluoride adsorption efficiency diminished with increase in temperature. Highest efficiency for fluoride removal (88.50 %) obtained at 303 K temperature for 2 mg/L fluoride concentration. This outcome shows low temperature supports the expulsion of fluoride and the adsorption process is exothermic in nature. The diminishing of expulsion of fluoride might be due to that at elevated temperature the thickness of the limit layer diminishes because of increased inclination of the adsorbate particles to escape from the adsorbent carbon surface to the aqueous phase, which results in a decrease in the fluoride adsorption efficiency as temperature is increased [31]. Comparative outcomes were previously reported by researchers [30, 31].

Adsorption isotherms study of fluoride onto MACTIS

The adsorption techniques are one of the significant processes for representing the fluoride adsorption capacity of the adsorbent material and it also demonstrates the mechanism of the fluoride adsorption process which communicates the specific relation between the concentration of the fluoride and its extent of accumulation onto the surface of the adsorbent material. The equilibrium data of fluoride adsorption onto MACTIS material at four unique temperatures has been examined by four well-known isotherms models, viz. Freundlich, Langmuir, Dubinin–Radushkevich (D-R) and Temkin (**Table 2**).

Langmuir isotherm

The Langmuir adsorption isotherm plot of C_e/q_e versus C_e suggests the applicability of this isotherm model (**Fig. 2(a)**). Estimations of Langmuir parameters q_m (fluoride adsorption capacity) and K_L (Langmuir parameter) were calculated from the intercepts and slope of the plot and the data are exhibited in the **Table 2**. From the **Table 2**, it indicates that the value of adsorption efficiency q_m and K_L of the MACTIS carbon material decreases on increasing the temperature from 303 K to 333 K. From the Langmuir parameters, it is noted that the most elevated fluoride adsorption communicates to a monolayer of fluoride particles on the adsorbent material surface with constant energy. Also, there is no spread of adsorbate in the plane of the adsorbent surface [30, 31]. The pattern demonstrates that the adsorbent likes to bind fluoride particles and that condition prevails on adsorbent characteristics, when ion exchange is the prime mechanism. Besides, it confirms the exothermic nature of the adsorption processes in the system. The calculated values of the separation factor (R_L) was seen to be somewhere in the range of 0 and 1 confirm that the Langmuir adsorption process is favourable [30, 31]. The correlation coefficient (R^2) values show a decent agreement between the parameters and confirm the monolayer adsorption of fluoride onto the adsorbent surface.

Freundlich isotherm

The Freundlich isotherm model was also utilized to investigate the adsorption of fluoride on the MACTIS adsorbent. Straight plot of $\log q_e$ versus $\log C_e$ appeared in **Fig. 2(b)**. The Freundlich isotherm parameters, K_F and N were determined by using slope and intercept. The experimental data obtained was presented in the **Table 2**. The outcomes demonstrate that the reduction in K_F values from 0.863 mg/g to 0.558 mg/g as temperature increases from 303 K to 333 K. This is a result of the adsorbent surface that diminishes the electrostatic force among the carbon surface of adsorbent and fluoride ions, which decreases the adsorption of fluoride with increase in temperature [32, 33]. The estimated values of $N > 1$ show that the adsorption process is much favourable for fluoride removal [34]. But, the values of the correlation coefficient, R^2 , obtained in this case show that the Freundlich isotherm model gave a poor fit to the experimental data than the Langmuir model.

Temkin isotherm

Temkin isotherm model was applied to assess the adsorption potential of MACTIS adsorbent material for fluoride removal. The Temkin constants b_T , B and K_T are determined from the slopes and intercepts of the Temkin plot of q_e versus $\log C_e$ (**Fig. 2(c)**). From the **Table 2**, the values of heat of adsorption and the equilibrium binding constant are appeared to the minimum during the adsorption of fluoride on MACTIS. The heat of fluoride adsorption (B) is decreased with increasing temperature from 0.191 to 0.158 J/mol. This demonstrates that the heat of adsorption of fluoride onto the surface of MACTIS decreases with increasing temperature from 303 to 333 K and the adsorption isotherm process is exothermic [28, 35]. Also, the b_T values is lower than 30 KJ/mol which indicating a physical adsorption process and dominating the chemisorptions and ion exchange. The correlation coefficients (R^2) are found to be the poor fit of all experimental data.

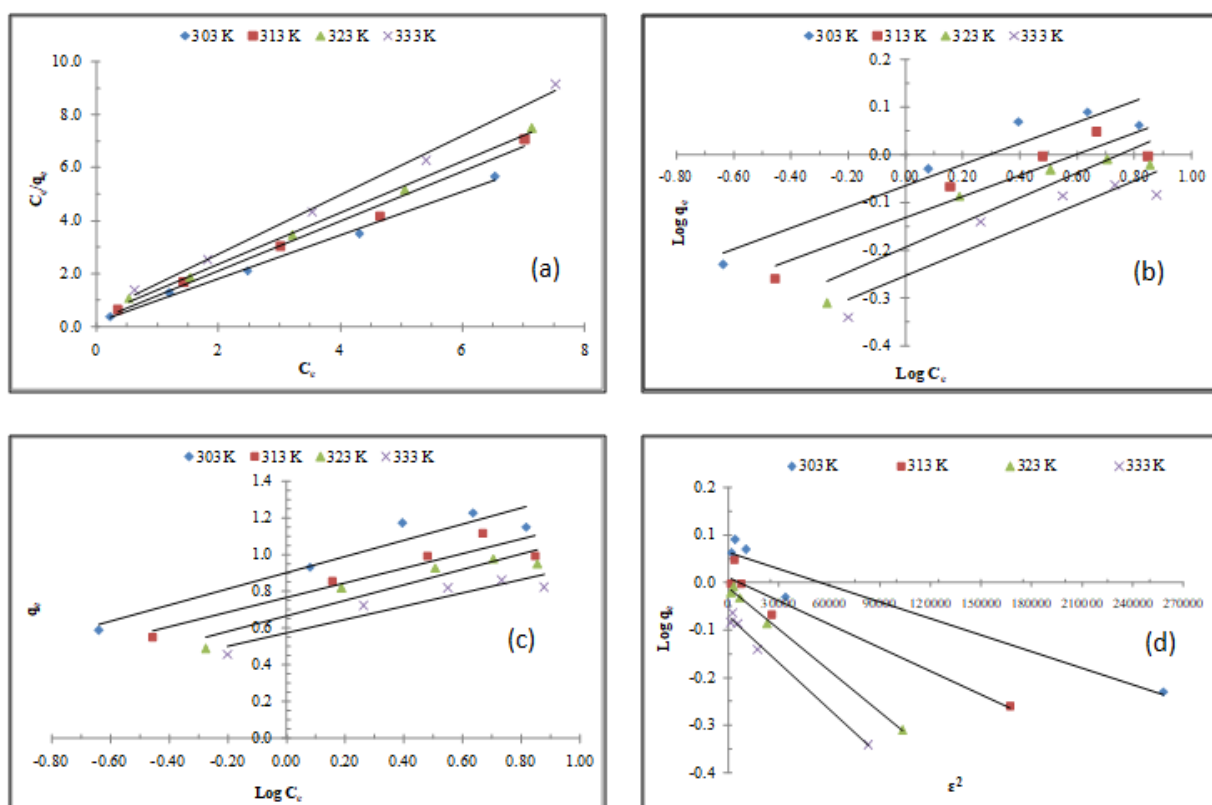


Fig. 2: (a) Langmuir, (b) Freundlich, (c) Temkin and (d) Dubinin-Radushkevich isotherm models for adsorption of fluoride by MACTIS at 303, 313, 323, 333 K.

Dubinin-Radushkevich (D-R) isotherm

Dubinin–Radushkevich isotherm model [344] was selected to study the adsorption potential of MACTIS adsorbent material for fluoride removal (**Fig. 2(d)**). It is an adsorption isotherm model that is commonly connected to express adsorption system with Gaussian energy distribution onto heterogeneous surfaces [35, 36]. The model has often effectively fitted for high solute actions and the intermediate concentration range, but has unacceptable asymptotic properties and does not anticipate the Henry's law at low concentration [346]. The D-R isotherm was generally applied to make a distinction between the Chemical and physical adsorption of adsorbate [36]. From the results mentioned in **Table 2**, the values of q_D and the mean free energy (E) decreased with increase in temperature. The values of E reveals the adsorption process follows physical adsorption process. The correlation coefficients for the D-R isotherm are highest for all temperature range (**Table 2**) proposes that the fluoride adsorption onto MACTIS is a physical process.

It is observed that fluoride equilibrium isotherm data fitted nicely to a majority of these isotherm models for MACTIS material. The correlation coefficients (R^2) values demonstrated that Langmuir adsorption isotherm gives a decent model for the adsorption of fluoride on MACTIS material, which depends on monolayer adsorption on to the surface limiting a finite number of identical adsorption sites. The appropriateness of the adsorption information to the Langmuir isotherm model suggests that the binding energy on the whole surface of the MACTIS adsorbent material was uniform and that adsorbate-adsorbate interaction was small. The values of various constants of four adsorption isotherm models were determined and were presented in the **Table 2**.

Table 2: Adsorption parameters for the removal of fluoride on MACTIS

Isotherm model	Adsorption Parameters	Temperature			
		303 K	313 K	323 K	333 K
Langmuir	q_m (mg/g)	1.222	1.068	1.034	0.898
	K_L (L/mg)	4.596	4.052	2.244	2.210
	R_L	0.098	0.110	0.182	0.184
	R^2	0.995	0.989	0.996	0.995
Freundlich	K_F (mg/g)	0.863	0.740	0.641	0.558
	$1/n$	0.220	0.221	0.258	0.247
	N	4.545	4.525	3.876	4.049
	R^2	0.912	0.886	0.861	0.863
Temkin	K_T (L/mg)	112.202	85.505	37.421	38.373
	B (J/mol)	0.191	0.172	0.184	0.158
	b_T (kJ/mol)	13.185	14.613	13.682	15.982
	R^2	0.911	0.881	0.894	0.887
Dubinin-Radushkevich	q_D (mg/g)	1.158	1.025	0.974	0.849
	K_D (mol ² /kJ ²)	2.66E-06	3.78E-06	6.69E-06	7.53E-06
	E (kJ/mol)	0.433	0.363	0.273	0.258
	R^2	0.938	0.944	0.996	0.995

Comparison of fluoride removal effectiveness of different leaf-based adsorbents:

The fluoride expulsion effectiveness of the adsorbent prepared from *Tamarindus indica* seed investigated in this present work has been matched up with other seed-based adsorbent material that was accounted by researchers in the literature and the values of fluoride removal efficiency (**Table 3**). The experimental data of the present research work were compared with reported values for the removal of fluoride. Results of this research work revealed that the adsorbent MACTIS has comparable fluoride adsorption efficiency with other reported values. (Table 3).

Table 3: Comparative reported details of different seed-based adsorbents for the removal of fluoride.

Adsorbents	Maximum % removal of fluoride	Ref.
Activated carbon of <i>Phyllanthus emblica</i> seed	82.1	[38,39]
Seed extracts of <i>Moringa Oleifera</i> (Drum stick)	88	[21]
Activated carbon of <i>Punica granatum</i> seed	78.1	[40]
CaCl ₂ treated activated carbon of <i>Phoenix Dactylifera</i> (Date Plum) seeds (Impregnation ratio's = 0.25)	88	[41]
CaCl ₂ treated activated carbon of <i>Phoenix Dactylifera</i> (Date Plum) seeds (Impregnation ratio's = 0.50)	91	[41]
CaCl ₂ treated activated carbon of <i>Phoenix Dactylifera</i> (Date Plum) seeds (Impregnation ratio's = 0.75)	93	[41]
Restructured lignite of <i>Cuminum cyminum</i> (Cumin) seeds	60	[42]
<i>Tamarindus indica</i> Seed (MACTIS)	88.5	This Work

CONCLUSION

A new acid-base impregnated and microwave treated carbonized material from the seed of *Tamarindus indica* (MACTIS) has been prepared for removal of fluoride from aqueous solution. The association of fluoride adsorption and fluoride removal efficiency both were investigated by changing process parameters responsible for effective adsorption such as pH, initial fluoride concentration, contact time, adsorbent dose, temperature and agitation speed. The maximum removal of fluoride was achieved by MACTIS up to 88.50 % for initial fluoride concentration was 2 mg/L. The investigation was assessed with four different adsorption isotherm models among them; the Langmuir isotherm described the experimental outcomes better than other isotherm models. The maximum fluoride adsorption capacity (q_m) obtained from Langmuir plot was found to be 1.222 mg/g and moreover correlation coefficients values greater than 0.989. The thermodynamic study indicates the fluoride adsorption process is exothermic, feasible and favour at lower temperature. All the above observations show that the MACTIS carbon material prepared from seed of *Tamarindus indica* is a highly efficient adsorbent for the removal of fluoride from aqueous solution.

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ADSORPTION STUDY OF METHYL RED DYE ON ACTIVATED FICUS BENGHALENSIS BIO-ADSORBENT BY SPECTROPHOTOMETRIC METHOD

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ABSTRACT

Banyan tree leaves as adsorbents were used for removal of excess of methyl red from aqueous solution were performed at room temperature by laboratory method. Adsorbent of activated carbon of Ficus Benghalensis leaves (Banyan tree leaves) was used with aqueous solution of methyl red Dyes of fabric. The effect of various parameters such as amount of adsorbents (in 1-5gm/250 ml), contact time (2 hours), temperature (20° C to 100° C). The result showed that the dye removal increased with increase in temperature and adsorbent amount. This is then checked by measuring absorption using Spectrophotometer. From absorption method, percentage removal of dye from aqueous solution with the help of above bio adsorbent can be determined.

Keywords:

Methyl Red Dyes, Ficus Benghalensis leaves, Adsorption, Spectrophotometer. Absorptions

INTRODUCTION

Nowadays, most of the food materials, textiles, leathers, cosmetics are polluted by large number of organic dyes¹. Dyes become the integral part of the day to day life. Water pollution can be identified as one of the major problems of the world. Dye industry causes major part of the water pollution.

Textile industry is the largest consumer of dye stuff. Waste of the textile industry contains unused dyes. They cause water pollution, which affect environment which is highly toxic to humans as well as aquatic life². Thereafter, purification of waste material is necessary before it emerges in the main stream of river³.

Decolonization or removal of the dye stuff is the important aspect of waste water treatment before discharge⁴.

Earlier, Activated Carbon (AC) was used commonly for dye removal. Activated Carbon as an adsorbent is an expensive process as well as its waste disposal has several problems⁵.

Among large number of physico-chemical methods, adsorption is widely used for dye removal from waste water of textile industry⁶.

Research starts with the use of low cost adsorbent materials. Methyl Red (MR) is selected as standard of dye contamination in the water. It is also used for coloring cotton, wood etc⁷. In our research method, we have used Banyan tree leaves (Ficus Benghalensis) as Bio-adsorbents for removal of various dyes from waste waters⁸.

Low cost Banyan tree leaves material as adsorbent was studied for removal of methyl red dyes from aqueous solution⁹. Various factors were studied like initial concentration, contact time, amount of adsorbents, temperature of adsorption and spectrophotometric absorption¹⁰.

MATERIALS AND METHODS

Batch adsorption process was used for the removal of methyl red from the aqueous solution. Parameters were studied like concentration, contact time, adsorbent amount, effect of temperature etc. The standard solution of methyl red was prepared by dissolving 1 gm in 1L of distilled water.

Preparation of adsorbent: Banyan tree leaves were collected from local area, washed with distilled water to remove the impurity, dried at low temperature for 48 hours to remove the moisture contents. After drying, banyan tree leaves were grind to fine powder and sieved through 600 μ . Adsorbent washed with distilled water to remove acid and dried at 80° for 10 hours.



Preparation of dye solution: The stock solution of methyl red of 0.1 % was prepared by dissolving 1 mg/L in distilled water. The experimental solutions were prepared by dissolving 0.2g, 0.4g, 0.6g, 0.8g in 1L of distilled water.

Batch Adsorption Experiment: Initial dye concentration 1g adsorbent in 100 ml of dye solution was kept constant for batch experiment. Initial methyl red solution concentrations of 200, 400, 600, 800, 1000 mg/L were performed at 25° C on rotator shaker operated at 120 rpm for 2 hours⁹. After carrying out adsorption, having contact time 2 hours for different adsorbent doses, different dye concentration and at different temperature followed by measuring absorptions by photoelectric colorimeter. The following absorption values were observed.

Table 1: Effect of adsorbent doses on adsorption

Adsorbent Concentration	Absorbance (nm)
1 g/L	0.76
2 g/L	0.68
3 g/L	0.55
4 g/L	0.52
5 g/L	0.50

Table 2: Effect of Dye concentration on adsorption

Dye Concentration	Absorbance (nm)
0.2 mg/L	0.07
0.4 mg/L	0.09
0.6 mg/L	0.28
0.8 mg/L	0.64
1.0 mg/L	0.76

Table 3: Effect of Temperature on adsorption

Temperature (°C)	Absorbance (nm)
20	1.05
40	1.02
60	1.00
80	0.99
100	0.96

Table 4: Effect of contact time on adsorption

Time in Minutes	Absorbance (nm)
10	0.98
20	0.74
30	0.56
40	0.43
50	0.36

Effect of Adsorbent dose: Ficus Benghalensis adsorbent 1 gm, 2 gm, 3 gm, 4 gm, and 5 gm were added into a 250 ml of conical flask containing a definite volume of fixed initial concentration 100 mg/l of stock solution of dye at 25° C. The mixtures were agitated at 120 rpm for 2 hours. The filtrate containing the residual concentration of dye was determined spectrophotometrically and dye concentration was measured.

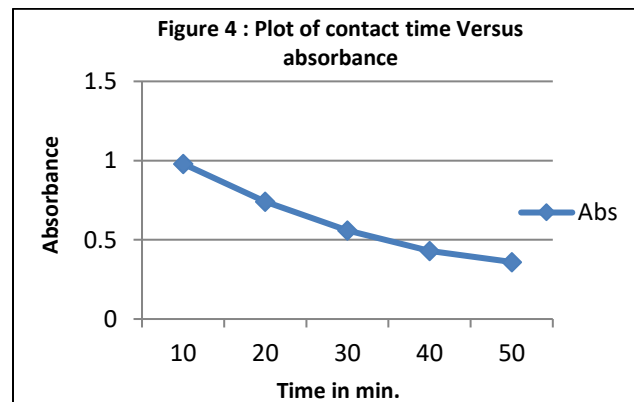
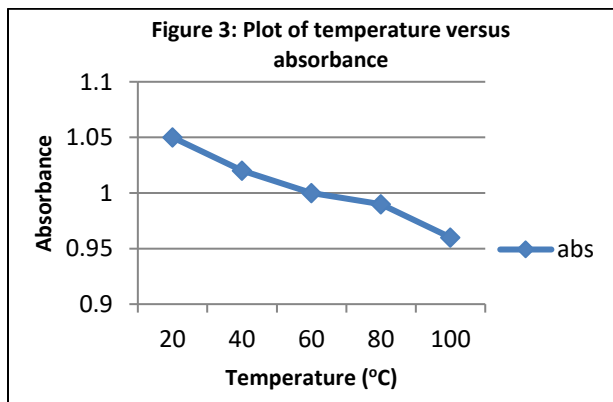
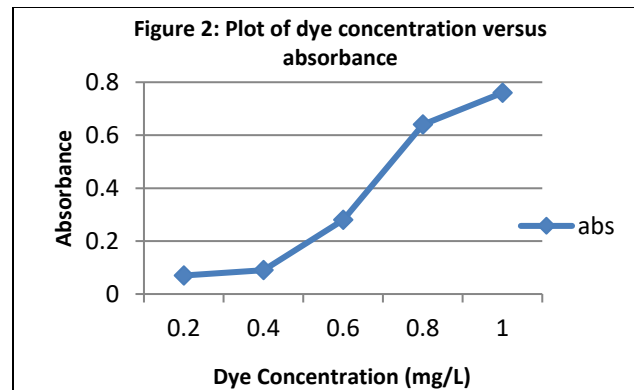
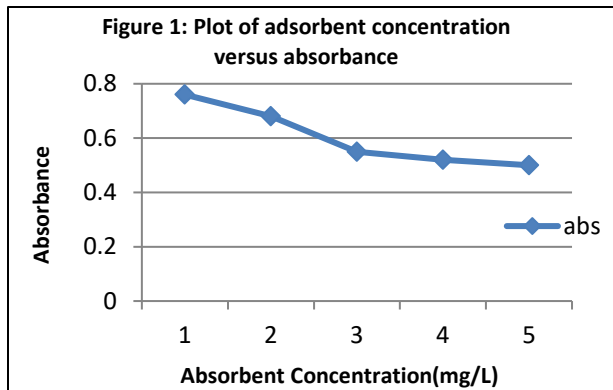
Effect of Temperature: Adsorption experiment were performed at different temperature at 20° C, 40° C, 60° C, 80° C, 100° C for initial dye concentration of stock solution 1 g/l. The mixtures were agitated for 2 hours at 120 rpm.

Effects of adsorption were carried out at different temperature. The contact time was kept constant for 2 hours. Removal of methyl red was determined by using Spectrophotometer.

Effect of Dye Concentrations: Effect of different amount of adsorbents 0.1 gm, 0.2 gm, 0.3 gm, 0.4 gm, 0.5 gm were used for the adsorption of methyl red from the aqueous solution. The different concentration solutions of methyl red dye were prepared. After adsorptions with 1g adsorbent of activated carbon of *Ficus Benghalensis* for fixed time. The absorption was recorded.

Effect of contact Time: 1 g solution of methyl red kept in contact with 5 g of adsorbent at different time for 10, 20, 30, 40 and 50 minutes. After that filter the solution and recorded absorption by spectrophotometer. It was found that as the contact time increases absorption values decreases. This indicates more the value of absorption less the adsorption on adsorbents. Hence with the increase in contact time adsorption of methyl red increases. As absorption decreases.

P^H Effect: All solutions were prepared in the acidic condition; for that P^H was maintained below 7. Good adsorption effect was observed in lower P^H conditions. At higher P^H adsorption found decreases, means on proper adsorption was done with this adsorbent.



RESULT AND DISCUSSION

The effect of adsorbent doses on removal of methyl red was observed from the table 1 that as adsorbent doses was increased from 1g to 5g, the percentage of MR adsorbed on the modified banyan tree leaves adsorbent increased. The waste removal percentage rises from 30% to 60%. As increase in the adsorbent amount increases the percentage of the dyes removed. This is also shown by the Fig.1 of adsorbent dosage versus percentage of dye removed i.e. lower the value of absorption means greater the adsorption of dyes on the adsorbent.

From table 2, it is observed that an increase in initial dye concentration or doses from 0.1 mg/L to 1 mg/L leads to decrease in percentage of adsorption. Lower the value of absorbance, greater the removal of dye methyl red by using adsorbent. It is also shown by the Fig.2 of dye concentration versus absorbance.

Adsorption of methyl red dyes increased with an increase in temperature from 20⁰ to 100⁰ C of adsorption. The decrease in spectrophotometric absorption of the solution means more amount of MR dye removed with increase in temperature of adsorptions. Fig.3 indicates that adsorption is exothermic. The solubility of dye increases with an increase in temperature. At high temperature the adsorbent's active sites are activated thereby increasing the concentration of dye removal. This may be due to enhancement of the adsorptive interaction between the active sites and the adsorbate ions. This is also shown by the plot of temperature versus percentage of dyes removed. As the temperature increases, the value of absorbance decreases i.e. the adsorbent banyan tree leaves has removed more amounts of methyl red dyes from the aqueous solution. Also it was observed that as the contact time increases absorption decreases hence indicate more the absorption of methyl red occur with contact time. Absorption was found good at lower P^H of the solutions.

CONCLUSION

The present study shows that natural bio-adsorbent obtained from banyan tree leaves which is an important low cost material non toxic easily available, can be used as good adsorbent for the removal of methyl red dye from the industrial waste like textile industry, waste water solutions. This adsorbent can also be used for the removal of other type of dyes from the food materials, waste of textile industries and from waste waters.

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Characterization of nanostructured spinel $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ obtained by sol gel auto combustion method

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Characterization of nanostructured spinel $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ obtained by sol gel auto combustion method

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Abstract: The samples of Cr^{3+} substituted Nickel ferrite with composition $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ were synthesized by employing sol gel auto combustion method. The ferrite powder materials were subjected to X-ray diffraction spectroscopy (XRD) analysis and Transmission electron microscopy (TEM) analysis for the study of structural as well as morphological characteristics. The X-ray diffraction pattern at the room temperature showed the formation of a cubic spinel ferrite having a single phase. Moreover, the values of lattice parameters (a) counter verified the same. TEM imaging demonstrated the formation of nanosize particles and the presence of all constituent elements were confirmed by energy dispersive X-ray (EDAX) analysis. Vibrating Sample Magnetometer (VSM) was used to study the magnetic properties of the samples. The magnetic properties showed low saturation magnetization (Ms), Remnance (Mr) as well as Coercivity (Hc). This confirmed the viability of such materials in the various applications of such as water treatment, microwave device materials, permanent magnets and storage recording devices.

Key words: cubic spinel ferrite, XRD, TEM, VSM, sol gel auto combustion etc.

1. Introduction

Nanotechnology is often referred to as the technology of the century and deals with the design, fabrication and application of nanostructures or nano materials. It also embraces the fundamental knowledge of the relationship between different physico-chemical properties and size of the material. Nanotechnology is often considered as an evolving interdisciplinary technology that has contributions in many fields, including physics, materials science, optics, electronics, electricity, mechanics, aerospace, plastics and medicine, over the past decade. Its strong social influence has been seen as the tremendous momentum to begin another industrial revolution [1-5].

Various magnetic materials have fascinated mankind for over centuries. Later, they have found their way into almost every part of our civilization. Every day we are using magnetic materials in computer HDD, credit ID cards, loudspeaker, permanent magnet motors, refrigerator door seals and a lot more. In the last 50 years, the production of new materials on a smaller and smaller scale has been at the centre of advances in material science [6-9].

2. Synthesis

In this method, a conventional heating element is replaced by a coherent microwave producing magnetron. It releases the required amount of heat in less time and in a more focused way. To some



better extent, this method is being improvised by controlling the operation of magnetron by incorporating digital circuits including frequency modulator, time counter, etc. Because of the additional circuits supported with the basic circuit of microwave oven, it is observed that the entire set up operates in a more suitable way to synthesize samples having particle size in the nano scale. The earlier demerit of fluctuating frequency around 2.45 GHz of magnetron is overcome in this method. The additional digital set up cares to maintain the frequency of the magnetron constant throughout the cycle of synthesis of a sample.

The sol gel method of synthesis comprise of various steps as given below;

Step I – A homogeneous solution is prepared in the deionized water by dissolution of the precursor metal ions in an organic solvent. In the given synthesis method, during the initial stages of preparation, blending of metal ions on an atomic scale in solution state helps to obtain homogeneous mixtures. For example; Nickel nitrate ($\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$), Chromium nitrate ($\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$) and iron nitrate ($\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$), in their respective molar ratios have been dissolved in 40 ml deionized water to prepare a homogeneous solution.

Step II – The solution so prepared is transformed to a sol if it is not already a sol. A colloid in which solid particles are suspended in a liquid is referred to as a sol. The resultant sol is generally stabilized by adjusting the pH, or else, the particles would expand into agglomerates which can further precipitate and thus don't allow for the acquisition of specific powder chemistry.

Step III – Gel formation is the most important step in the process and essentially aimed at the removal of the majority of the deionized water (solvent) so that a formation of rigid body with a well defined chemistry takes place. This aqueous sol of metal ions is steadily heated for 2 hours at around 80°C by using a magnetic stirrer hot plate to convert it into a gel which is kept in plastic or highly viscous form by maintaining processing variables like temperature, pH and time.

Step IV – The gel is transformed into the correct morphology, may be in the form of spheres, fibers or coatings. The gel is fired in the microwave oven at power 800 watt for three minutes which results in the formation of dry ash. These ash forming compounds are grounded by a using a mortar pestle or ball-milling process to obtain fine nano size powder.

Step V – Traditional grinding is performed for a powder calcined in muffle furnace for 4 hours at around 800°C in order to obtain a spinel ferrite material $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ for the intended application, in which x varies as 0.2, 0.4, 0.6, 0.8 and 1.0 [9-14].

3. Characterization

3.1. Powder XRD analysis

The use of XRD analysis is done to calculate the grain size of the material prepared. Debye Scherer formula is employed to determine the grain size of all the synthesized compounds from the most intense peak as; $D = 0.9\lambda / \beta \cos\theta$, where, λ is the wavelength of used X-ray beam, β is the full width at half maxima (FWHM) and θ is the corresponding angle.

Table 1 summarizes the Lattice parameters, x-ray and bulk density and the porosity of these samples [15-17]. Similarly, Figure 1 explains the XRD pattern of chromium substituted nickel spinel ferrite samples. The study of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ samples reveals the formation of cubic crystal structure with space group $Fd\bar{3}m$. PowderX software was used to index the miller planes indices [18-20].

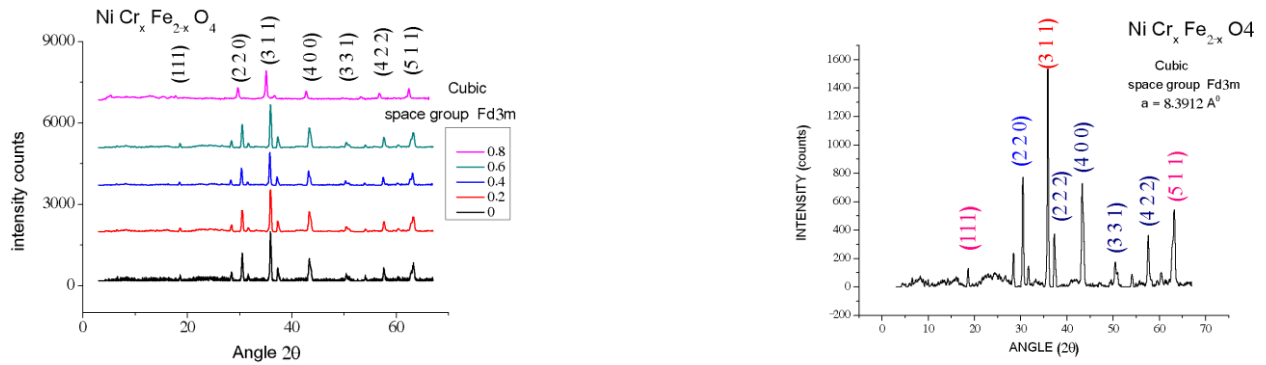


Figure 1. Powder XRD of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ spinel ferrite

Table 1. Lattice parameter of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$

Series	Conc (x)	Fe_{2-x}	Molecular wt	Lattice parameter (Å^0)	X ray density (gm/cm^3)	Bulk density (gm/cm^3)	Porosity (%)
$\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$	0.2	1.8	233.6	8.2950	5.44	3.897	28
	0.4	1.6	232.83	8.3123	5.38	3.797	29
	0.6	1.4	232.06	8.3545	5.29	3.697	30
	0.8	1.2	231.29	8.3712	5.24	3.573	31
	1	1	230.52	8.3912	5.18	3.457	33

3.2. EDAX analysis

The energy dispersive X-ray (EDAX) study was also carried out for the synthesized samples and is shown in figure 2. The EDAX spectrum of Nickel ferrite nanoparticles, calcined at 800°C divulged the information about presence of Ni, Cr, Fe and O peaks. EDAX analysis confirmed that all the constituent elements are present in the synthesized ferrite samples in the desired ratio. The pattern that is obtained also validate that the crystal structure of Cr^{3+} spinel ferrite was reduced after being doped with Nickel ferrite [18-21]. Powder XRD analysis.

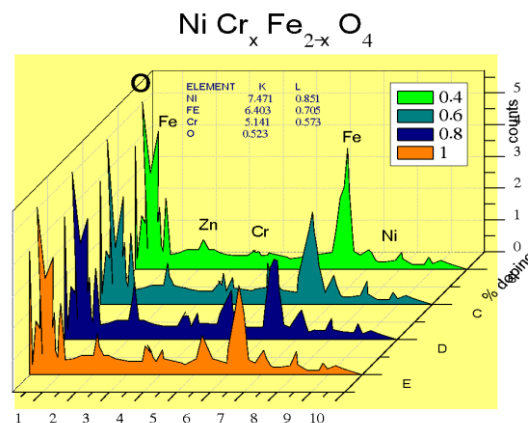


Figure 2. EDAX analysis of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$

3.3. VSM analysis

The Vibrating sample magnetometer (VSM) study was done to study the magnetic properties ferrite samples at room temperature. Magnetic hysteresis (M-H) loops of measurements of synthesized $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ samples with different concentrations were carried out and the observed values of saturation magnetization (M_s), remanent magnetization (M_r) as well as coercivity (H_c) were noted and plotted as seen in figure 3 and reported in Table 2 [21-22].

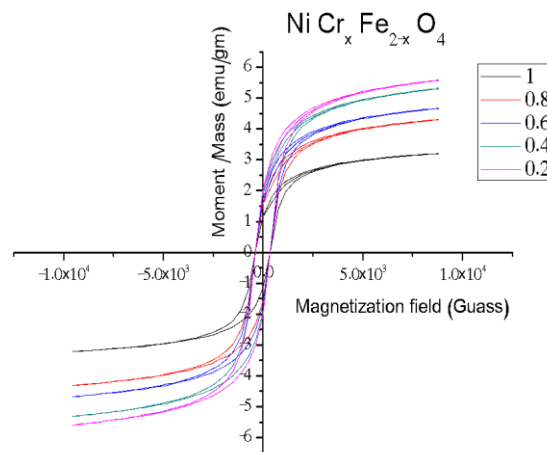


Figure 3. VSM of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ spinel ferrite

Table 2. Magnetic properties VSM of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$

Series	Conc. (x)	Fe_{2-x}	Magnetization (M_s) emu/gm	Retentivity (M_r) emu/gm	Coersivity (H_c) Gauss	Squareness ratio (M_r/M_s)
$\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$	0.2	1.8	5.7	2.11	435.35	0.37
	0.4	1.6	5.26	2.05	432.75	0.39
	0.6	1.4	4.68	1.87	429.60	0.40
	0.8	1.2	4.29	1.59	426.80	0.37
	1	1	3.15	1.40	423.15	0.45

3.4. TEM analysis

The Transmission Electron Microscopy (TEM) analysis was done to confirm the particulate size of the materials. The TEM pictures revealed that the particle size of the mechanically milled and annealed samples is well consistent with the grain size (crystallite size). Debye-Scherer formula was applied to calculate the grain size by using prominent XRD peaks corresponding to the cubic spinel phase. The grain size was found to be in the range of 22- 60 nm approximately for the synthesized samples and is shown in figure 4 [23-26].

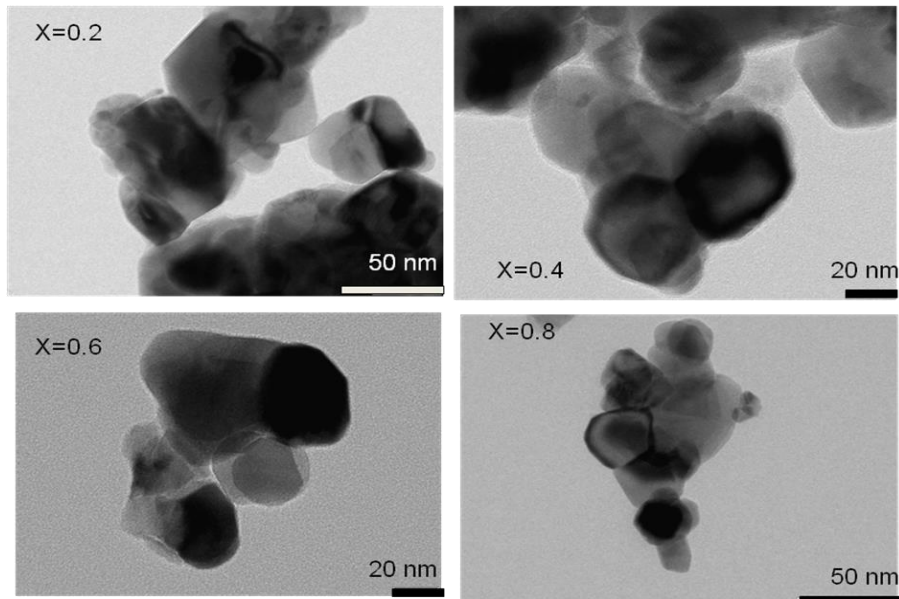


Figure 4. TEM of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ spinel ferrite

3.5. Electrical Properties

In case of ferrites, which are mostly low mobility semiconductors it is observed that rather than the concentration, it is the activation energy of the charge carriers, which is normally associated with the mobility of these charge carriers. Figure 5 illustrates the relation of the temperature with DC electrical conductivity. In case of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ ferrite samples it is also observed that the DC electrical conductivity attains a peak value at a particular temperature, which is termed as the transition temperature. Metallic character of the materials can be indicated by the initial increasing trend of conductivity with temperature and the subsequent increase of the same represents a semiconductor nature. A graph between conductivity and temperature with temperature was used to calculate the activation energy of synthesized nickel ferrite samples and is tabulated in the table 3 [27-33].

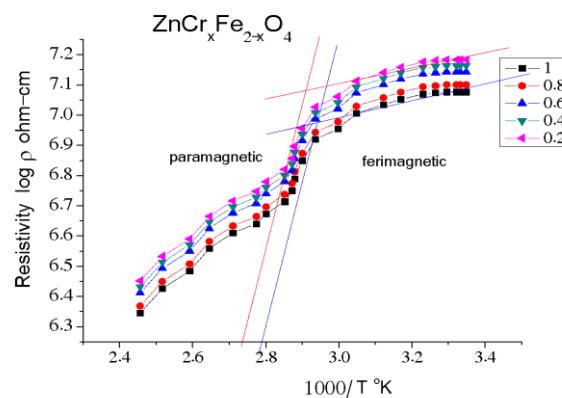


Figure 5. Electrical study of $\text{NiCr}_x\text{Fe}_{2-x}\text{O}_4$ spinel ferrite

Table 3. Transition temperature of NiCr_xFe_{2-x}O₄

Series	Conc (x)	Resistivity ($\times 10^{-7}$) ohm /cm	Activation energy para eV	Activation energy ferri eV	Transition Temp. T _c °K	GOUY' S Balance T _c °K
NiCr _x Fe _{2-x} O ₄	0.2	3.95	1.754	0.154	637	640
	0.4	3.37	2.245	0.134	621	632
	0.6	2.63	1.934	0.193	614	625
	0.8	2.22	1.034	0.134	609	612
	1	1.35	1.132	0.124	602	603

4. Conclusion

In summary, spinel NiCr_xFe_{2-x}O₄ nanoparticles were successfully synthesized by sol gel auto combustion route by using urea as a fuel. The formation of single phase, well crystallized cubic spinel ferrite powder with general formula NiCr_xFe_{2-x}O₄ was confirmed by XRD, Rietveld refinement XRD as well as EDAX analysis. The size of the synthesized nanocrystals calculated by the Debye-Sherrer formula was in the range of 22 to 60 nm. HR-TEM images of the samples also confirmed the size in the nanometer range confirming to the particle morphology with slight agglomeration.

The ferromagnetic behavior was confirmed by VSM technique as it is observed that the Ms values of the undoped sample is 66.93 emu/g, which shows a decreasing trend with the increase in Cr³⁺ content. The inclusion of Cr ion in the NiCr_xFe_{2-x}O₄ lattices plays a crucial role in electrical behavior and result in proportionate increase in electrical conductivity. Size dependence of electrical properties was well established and it is found that grain and grain boundary kinetics regulate these properties in the material. It is assumed that the interchange of cations from their respective tetrahedral (A) and octahedral (B) sites along with hopping of holes (Cr³⁺ → Cr²⁺) and electrons (Fe²⁺ → Fe³⁺) among cations of B site affect the electrical properties to a larger extent. Activation energy was decreased with increasing Cr ion concentration which confirmed the transition from ferromagnetic region to paramagnetic. The decrease in transition temperature with the increase in concentration of Cr ion was supported by Gouy's balance data.

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Investigation of structural and dielectric properties of Co-Zr doped Barium M-type Hexaferrites

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Abstract: The Samples of Cobalt- Zirconium doped Barium nano-hexagonal ferrites of chemical formula $BaFe_{12-2x}(Zr-Co)_xO_{19}$ ($x = 0.5, 0.9$) are prepared employing Microwave assisted Sol-gel auto-combustion Route, in which the ferrite materials were generated by providing continuous heat in microwave oven. The precursors in the form of nitrates are taken accompanied with urea as a fuel, supply energy to initiate exothermic reaction during the formation of materials. Uniform heating in the microwave leads to the ultrafast morphological transformations giving rise to a nano-scale particle size of the synthesized samples. The derived ferrites powders being analyzed for their structural and morphological characteristics with the help of X-ray diffraction techniques (XRD) and Transmission Electron Microscopy (TEM). Lattice constants 'a' and 'c', porosity (p) of the prepared materials were determined. Their d-values are counter checked and (h k l) planes were specified. TEM analysis confirmed the nano-scale particle size of the synthesized samples. The materials have been assessed with Impedance Analyzer for electrical resistivity (ρ). The obtained results suggest that the synthesized samples belong to the family of hexagonal M-type ferrites. A structural observation has verified that the space group symmetry of the prepared materials is $P6_3/mmc$. The ferrites samples show high resistivity of the order 10^7 ($\Omega\cdot m$). Such types of nano-sized ferrite materials with high resistivity are helpful especially for various microwave absorbing applications.

Key words: Ba-hexaferrites, Microwave induced synthesis, Nanocrystalline, Porosity, Resistivity, XRD, and TEM, etc.

1. Introduction

Magnetic ions in ferrites, which are a part of a magnetic oxide, are arranged to achieve spontaneous magnetization even as preserving strong electrical and magnetic properties in ferrite. The most important feature of the hexaferrites is the prospect of tailoring the magneto- electric behavior depending upon the application, which can be achieved by the biased replacement of trivalent, simultaneous substitution of divalent-tetravalent metal ion, and other compatible combinations for Iron (Fe) in the parent hexaferrite matrix [1,2]. Cost effectiveness, simple processing and fascinating electrical and magnetic properties make hexagonal ferrite one of the most significant materials that have drawn tremendous exposure within an area of technical purposes [3, 4]. The process of synthesis, sintering temperature, etc. shall, in



particular, specify the particle size upon which electrical and magnetic characteristics of the substance rely. [5]. In present research module, the novel method of Microwave assisted Sol-Gel Auto-Combustion process is utilized to fabricate zirconium-cobalt substituted barium nano-hexaferrite samples with the general formula $\text{BaFe}_{12-2x}(\text{Zr}_x\text{Co}_x)\text{O}_{19}$ ($x=0.5, 0.9$) [6, 7]. This section aims to characterize the structural and Electrical behavior of the synthesized substituted barium nano-hexaferrites materials. The structural and morphological characteristics of the synthesized ferrites powder are studied by X-ray diffraction (XRD) and transmission electron microscopy (TEM). Impedance analyzer is employed to study for the electrical measurements of synthesized hexaferrite powder.

2. Experimental Procedure

For the synthesis of ferrites, a significant number of preparatory methods like Solid-state reaction, Coprecipitation, Hydrothermal synthesis, Glass crystallization, etc. had previously been documented. The documented Sol-gel assisted auto combustion route had several benefits to prepared doped M-type hexagonal ferrites owing to its high degree of simplicity in the process, lower anneal or calcine temperature, and, short reaction time [6]. Besides, the Sol-Gel auto-combustion method produces an ultra-fine nano powder with a substantial distribution of particle sizes, outstanding chemical uniformity and the probability of creating a unified single domain structure.

The Co-Zr doped BaM nano-hexagonal ferrites materials are processed by 'Microwave induced Sol-gel auto combustion route, where the microwave is replaced in the place of conventional furnace, to assure the continual heating of the materials through the combustion method. AR grade nitrates like $\text{Ba}(\text{NO}_3)_2$, Ferric Nitrates, Cobalt Nitrates, Zirconyl Nitrates and Urea in proper stoichiometric proportion were liquefy with double filtered distilled water at 50°C temperature and kept for 20 minutes. Initiate an exothermic reaction with adequate energy available from the fuel as Urea. The generated gel is then stored at room temperature for an hour and then put inside the digitally operated 2.54GHz microwave for 10 min for thermal decomposition. The gel is thermally decomposed and eventually transformed into a loose, foamy, uniform nanocrystalline ash powder. After that the synthesized hexaferrite powder was grinded in pestle mortar for four hour with gradually slow cooling rate maintained at 50°C / minute, with further grinding for four hours.

3. Results and Discussions.

3.1. Structural Properties

The XRD diffract graph of fabricated materials were obtained by using Philips X'pert Diffractometer, with $\text{CuK}\alpha$ radiation of wavelength $\lambda=1.542(\text{\AA})$. Fig. 1.(a and b) present the x ray intensity graphs of synthesized materials for $x=0.5$ and $x=0.9$ respectively. After matching the diffraction patterns with the JCPDS standard files, leveraging 2θ values, the observed d-values and intensity differences, the d-value is being determined and the (h k l) planes were specified. With the help of interplaner spacing d (h k l) corresponding to finalized planes the values of lattice parameters can be calculate employing relation

$$d_{hkl}^2 = \frac{3a^2}{h^2 + hk + k^2} + \frac{c^2}{l^2}$$

The percentage Porosity is being calculated by

$$P = \left(1 - \frac{D_{Bulk}}{D_{Xray}}\right)\%$$

Where, P is porosity, D_B is bulk density and D_{xray} is x-ray density of formulated materials

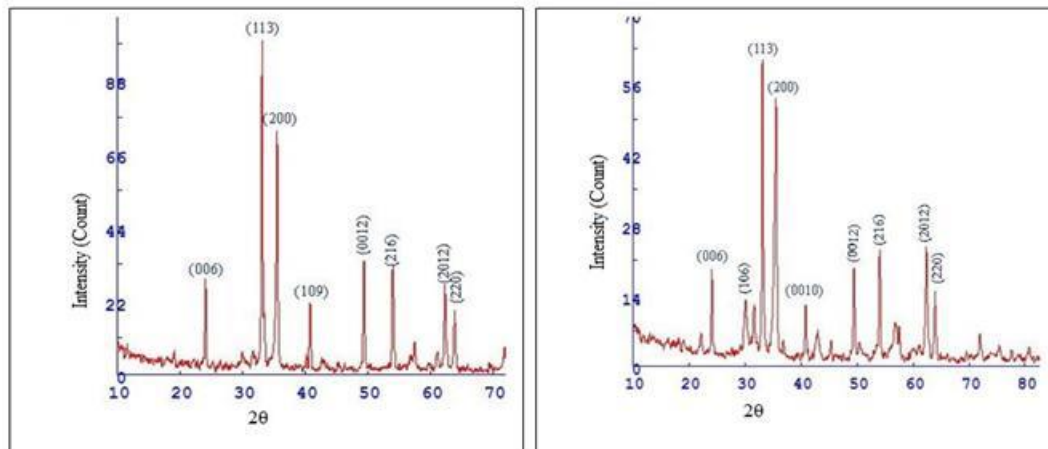


Fig a(x=0.5)

Fig b (x=0.9)

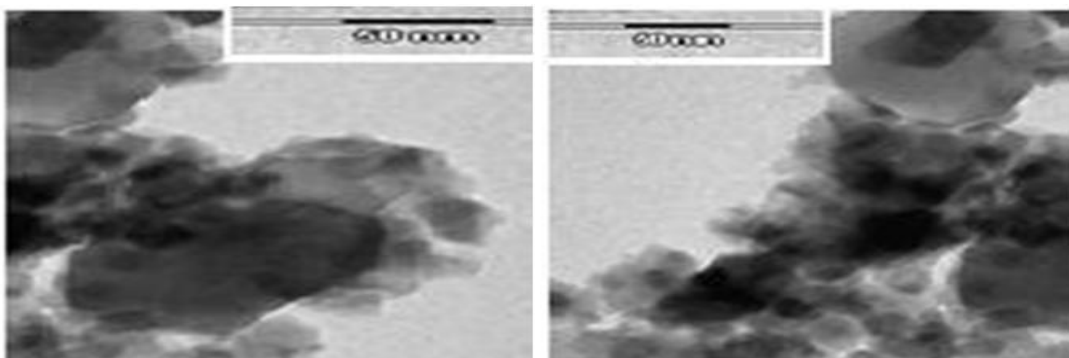
Figure 1. Powder XRD of Ba (Co-Zr)_xFe_{12-2x}O₁₉ Hexaferrite for x=0.5 and x=0.9

The value of lattice parameters affirms that the hexagonal ferrites with a single - phase is formed. Lattice constants 'a' and 'c' were observed to be 5.8256 (Å) and 23.124 (Å) independently for x=0.5 and 5.8239 (Å) and 23.127 (Å) for x=0.9 respectively. The space group symmetry of the formulated hexaferrites powder is found to P6₃/mmc.

Table 1 summarizes the Lattice parameters, x-ray and bulk density, porosity and the electrical Resistivity of these hexaferrites samples [15-17] at concentrations x = 0.5 and x = 0.9.

Table 1. Structural and Electrical Parameters

Conc.(x)	a (Å)	c (Å)	D _x (Å) ³	D _B (Å) ³	P (%)	ρ at 373K (Ω-m)
X= 0.5	5.8256	23.124	5.39	2.72	49.54%	1.229*10 ⁵
X= 0.9	5.8239	23.134	5.60	2.81	49.86%	1.788*10 ⁴

**Figure 2.** Transmission Electron Micrographs of the prepared Ba(Co-Zr)_xFe_{12-2x}O₁₉ materials, for x=0.5 and x=0.9.

3.2 Morphological Analysis.

Figure 2 displays TEM pictures of the prepared hexaferrites samples taken by TEM Philips Model CM 200. Micrographs showing hexagonal platelet structure with morphological homogeneity. Prominent grain boundaries are also observed.

TEM images of the samples are taken at nano-scale about 50nm, gives an idea about the particle size, which indicates the formation of the zirconium-cobalt substituted Barium nano- hexaferrite particles.

3.3 Electrical properties.

Precision impedance Analyser 6500B, Wayne kerr Electronics is used to study the electrical properties of synthesized materials. For regulated thermal variations, the material is housed inside the electric furnace operated digitally. Four probes techniques were utilized to calculate the electrical characteristics of prepared materials in palletized form. The electrical properties of ferrites termed phonon-assisted electron tunnelling can also be interpreted by the tunnelling of electrons among Fe^{2+} and Fe^{3+} . It is being noted that the electrons are closely bound to the lattice that participates in the $Fe^{2+} \leftrightarrow Fe^{3+} + e^-$ exchange mechanism and migrate from one lattice sites to other sites owing to the phonon-induced transfer process [8,9].

Table 1 indicates that with a rise in Co^{2+} and Zr^{4+} ions doped concentrations, the values of electrical resistivity at a normal temperature decreased from $1.229 \times 10^5 \Omega m$ to $1.788 \times 10^4 \Omega m$, while the percentage porosity (P) increased from 49.54 % to 49.86 %. This might be attributed to the evidence that, as a result of a increase in porosity, the driving pathways are made harder for charge carriers to travel from grain to grain. A number of reasons, along with the development of other secondary phases and significantly larger porosity values, may be accountable for the comparatively high resistivity value of the order of $10^5 \Omega m$. Separations in between grains are mostly attributed to increased porosity. And this separation can lead to difficulties in driving free electrons across grain boundaries [10].

4. Conclusion.

The series of Co^{2+} and Zr^{4+} doped Barium nano-hexaferrite of composition $BaFe_{12-2x}(Zr-Co)_xO_{19}$ via “Microwave Assisted Sol-gel auto- combustion technique” synthesized successfully. The formation of hexaferrites is confirmed by XRD results and the values of lattice constant ‘a’ and ‘c’ of the processed materials support such assertion. The prepared materials have hexagonal symmetry with space group $P6_3/mmc$ (No.194) which is confirmed by the structural study. From TEM analysis, the size of crystallites is being noticed in nano scale.

With high values of electrical resistivity of such synthesized nano-scale barium hexaferrite doped with Zr^{4+} and Co^{2+} can prove to be a promising material in the microwave absorbing, EMI shielding applications. Also, the nanosize of the particles helps to reduce the noise produced in magnetic data storage devices which occur due to the displacement of domain boundaries. The lowering of hexaferrites crystallite size to nano scale range allow us to enhance improve the previously described electrical properties.

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EFFECT OF CAUSTICIZING TEMPERATURE AND RETENTION TIME ON DESILICATION OF GREEN LIQUOR

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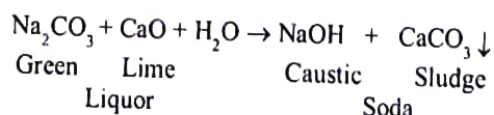
ABSTRACT: In two stage causticizing process for desilication of green liquor purpose, effect of causticizing temperature and retention time plays an important role. At higher causticizing temperature results in better silica removal efficiency in both the stages whereas retention time does have minimal effect on the silica removal efficiency. Study indicates that kinetic of reaction depends on the temperature of the causticizing reaction for the silica removal efficiency

KEYWORDS: Causticizing, desilication, lime sludge etc.

I. INTRODUCTION

Lime sludge from Pulp and Paper industries are disposed off wet in the form of slurry or filter cake into lagoons / settling tanks and are considered potential health and environmental hazards [1]. Although it can be reburned but the presence of high amount of silica in lime sludge is the major constraint in reburning lime mud. Higher silica content of the lime mud prevents the conversion of CaCO₃ to available CaO. This may be due the formation of tricalcium silicate. It also induces uneven burning of the lime and increases furnace oil consumption.

In paper industries, the chemical pulp is produced with the Kraft process; In Kraft pulping process the fibrous raw material is treated with sodium hydroxide and sodium sulphide to extract out the lignin and other unwanted materials in the form of weak black liquor. The weak black liquor is separated through washing treatment and then sent to recovery section to reuse further [2]. In this section, calcined lime is used for regeneration of caustic soda by conversion of soda ash (green liquor) leaving behind calcium carbonate sludge as a waste.



Calcium carbonate thus produced is washed with water and filtered to recover alkalis. The objective of causticizing process is to convert inactive sodium carbonate into active cooking chemical i.e. sodium hydroxide. The entire process involves, green liquor clarification, slaking, causticizing and white liquor clarification. Hence the clarified green liquor is reacted with reburned lime which results white liquor production [3-6]. The slaking and causticizing process conditions play a major role for the separation of lime mud. The critical factors which affects the causticizing system is the quality of lime, lime dosage, green liquor concentration, temperature, time and stirring conditions in the reactors [7-8]. In other prospects the main objective of recovery system is to minimize efficiently the loss and subsequent makeup of the chemicals used as cooking chemicals (white liquor preparation) [9]. Lime mud is converted back into the lime using a lime kiln. The lime kiln is a long cylindrical rotary kiln of about 50-120 m with a diameter of 2-4 m [10-11]. Lime mud as a byproduct of the recovery section is generally used as a land filling applications. Silica is the main culprit which restricts its usage in lime kiln for reburning. The silica present in the green liquor reacts with calcium oxide and form calcium silicate that creates several problems in lime cycle. It has been found that the calcium silicate makes the lime mud harder to dewater which results lower dry content of the feed lime in lime kiln [12]. It is well known that 1% of silicon reduces lime availability by 6%. This is because the formation of calcium silicates [13]. Silica concentration in the system reduces the lime reactivity significantly. It was studied by the researchers that available calcium carbonate for decomposition was reduced from 98 to 69% on increasing silica content from 0 to 5.5% [14].

Besides calcium silicate, silicon also reacts in the formation of various other impurities such sodium aluminosilicates [15-19].

The sources of silica are the fibrous raw material, quality of limestone, water and the makeup salt cake [20]. As per Panda et al, in case of using bamboo as a raw material about 70-80% of silica comes from bamboo, 5% from salt cake and 20% from lime [21]. An extensive work has been studied by Kulkarni et al for the removal of silica from wheat straw black liquor through carbonation process [22].

This paper presents the study for the removal of silica through two stage causticizing process by varying retention time and temperature levels.

II. EXPERIMENTAL

Material and methods:

Green liquor from an integrated pulp and paper industry is used for this study to evaluate the effect of reaction time and temperature on the silica removal in one or two stages.

Causticizing:

Causticizing experiments were carried out in stainless steel container using a geared stirrer paddle at 150 rpm at varying temperatures and retention time in constant temperature water bath. After the reaction, the mixture was settled for 30 min in an oven at 80°C. The supernatant liquid was thereafter decanted. The remaining mud slurry was then filtered through leaf filter and mud cake formed on the leaf filter was subsequently washed with hot water. Filtration and washing were carried out under vacuum of 360 mm of Hg. Leaf filter was used to simulate the plant condition with the drum filter at the rate of 2 rpm. (Leaf filter was immersed in the mud slurry for 10 sec, drained for 3 sec and after that, dipped in hot water for 7 sec and again drained for 3 sec.) Hot water (80°C) was used for the washing of mud cake to get displacement ratio of 1.2 during washing through the leaf filter.

In laboratory desilication study, the first stage causticizing experiments were carried out with clarified green liquor. All the experimental conditions were maintained in the laboratory as shown in the Tables.

Lime Quality Used:

Lime used for the desilication experiments was analyzed for the available CaO and silica. Detailed analysis is given in Tables below. The whole lime (composite) was crushed to coarse powder of ~10 mesh and added. Lime was at room temperature at the time of adding to hot green liquor.

III. RESULTS AND DISCUSSION

In two stage causticizing process for desilication purpose, effect of causticizing temperature plays an important role. At higher causticizing temperature results in better silica removal efficiency in both the stages. Desilication efficiency is increasing by about 5 to 7% above 80°C as compared to 60°C. The optimum temperature is in between 80 to 90 °C.

Retention time does have minimal effect on the silica removal efficiency. The reaction is quick and does not have significant impact on the desilication efficiency with respect to time beyond 10 min. Study indicates that kinetic of reaction depends on the temperature of the causticizing reaction for the silica removal efficiency.

Table: 4 Green liquor analysis

Description	Unit	Trial – 1
Na ₂ S	gpl as Na ₂ O	20.8
NaOH	gpl as Na ₂ O	21.2
Na ₂ CO ₃	gpl as Na ₂ O	69.7
TTA	gpl as Na ₂ O	111.7
Silica	gpl as SiO ₂	4.6
Causticizing Eff.	%	80

Table: 5 Green liquor desilication at different retention time

Retention time, min	10	20	30
	Desilication, %		
Single stage	83.68	83.26	83.48
First stage , 30%	52.17	50.21	50.21
Second stage , 70%	90.21	90.0	89.78

Table: 6 Silica content in lime mud at different retention time

Retention time	10 min	20 min	30 min
	Silica%		
Single stage	5.01	5.04	5.05
First stage , 30%	9.15	9.12	9.01
Second stage , 70%	3.31	3.34	3.33

Fig: 1 Effect of causticizing temperature on desilication efficiency of causticized liquor after first stage

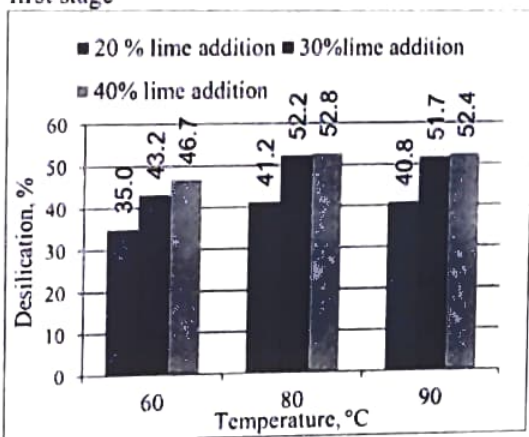


Fig: 2 Effect of causticizing temperature : Silica in lime mud after first stage

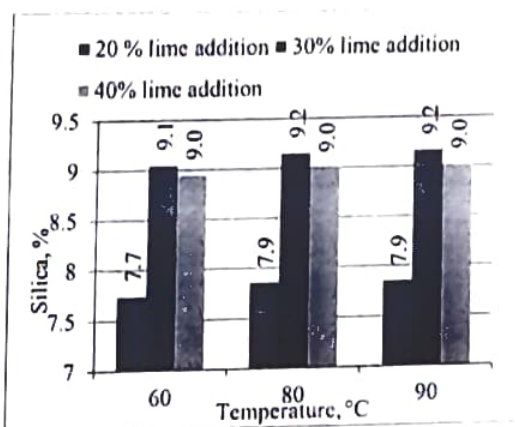


Fig: 3 Effect of causticizing temperature on desilication efficiency of causticized liquor after second stage

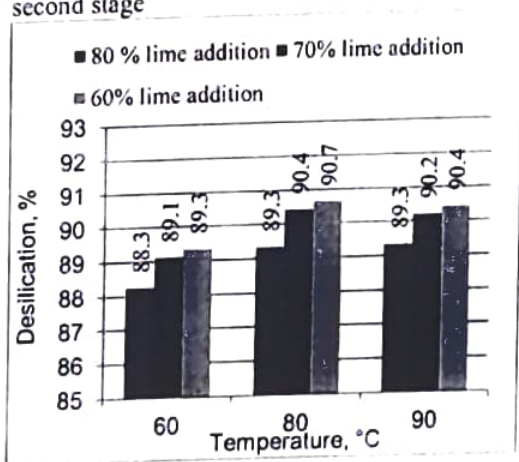


Fig: 4 Silica in lime mud after second stage (effect of causticizing temperature)

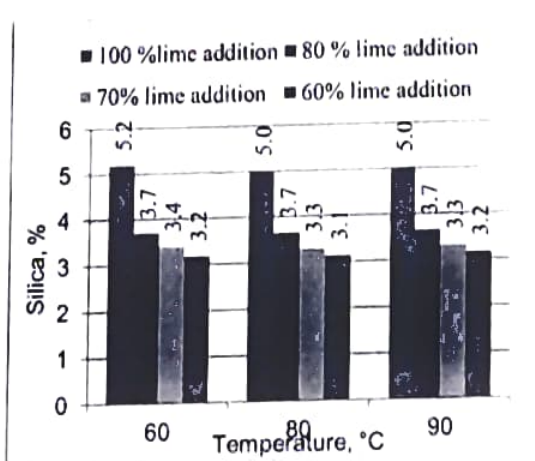


Fig: 5 Effect of retention time on desilication efficiency of causticized liquor after single stage

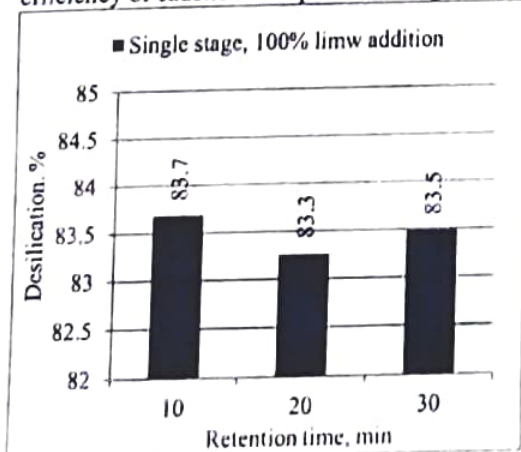


Fig: 6 Effect of retention time on desilication efficiency of causticized liquor after first stage

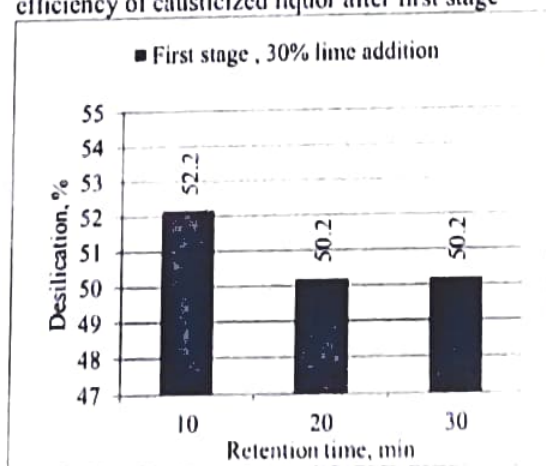


Fig: 7 Effect of retention time on desilication efficiency of causticized liquor after second stage

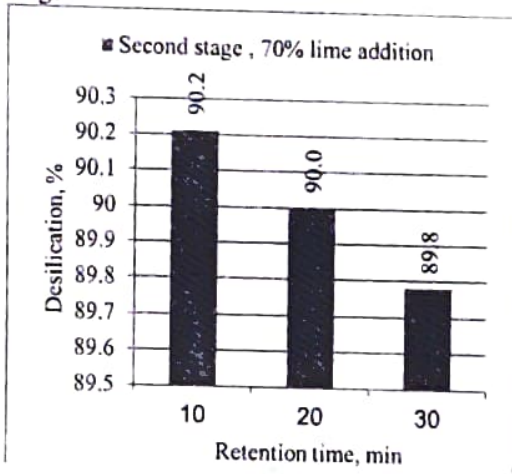


Fig: 8 Silica removal after single stage (effect of retention time)

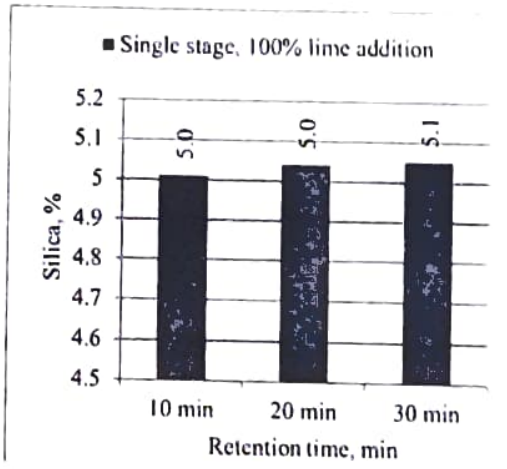


Fig: 9 Silica removal after stage (effect of retention time)

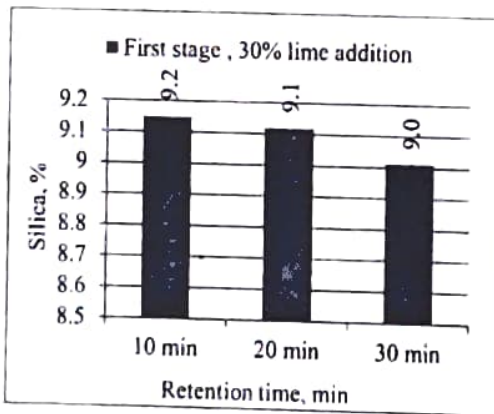
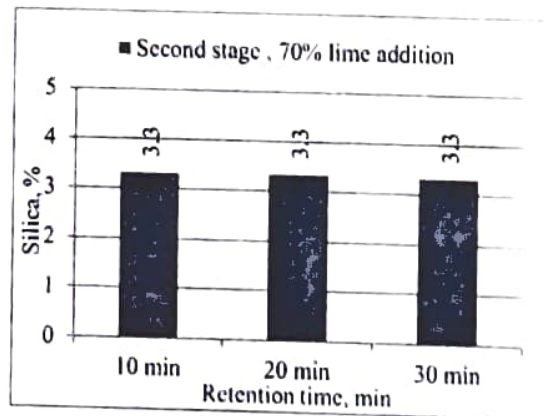


Fig: 10 Silica removal after second stage (effect of retention time)



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Study of Economic Implications of Reverse Migration on Small Scale Industries

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Abstract :

Movement of workers happens from impoverished rural regions to the more affluent urban and industrial pockets. Migration is a complex phenomenon influenced by many factors including economic, social, political, geographical and environmental factors. Migration is an vital element of human history, where people have been moving from one place to another in search of bread and butter. With the surge of COVID-19 pandemic situation in India and entire world; the economy slows down with the declining growth rates of GDP and growing unemployment rates. Majority of workers migrated towards their home town. Due to this reverse migration majority of industries have to face numerous problems. This paper focuses on the economic implications of this reverse migration on Small Scale industries.

Keywords :reverse migration, industries, economy, pandemic

Introduction :

The initiation of the lockdown generated widespread panic among migrants across India's major cities and states of destination, kicking off intensive attempts to return predominantly to rural hometowns in the states of origin. From the scale of the tried migration, it is evident that the government did not account for India's enormous magnitude of internal migrants, with the four-hour notice preceding the first lockdown taking migrant workers by surprise. The shutdown of commercial activities effectually cut off the primary source of income for many of these labour migrants, leaving them with little or no resources to ride out a twenty-one-day lockdown period which was likely to be the first among a number of successive nationwide lockdowns.

According to the 2011 Census, there were 450 million internal migrants in India by the 'Place of Last Residence' metric, thus accounting 37.7 per cent of the total population. Based on census trends, it is estimated about 600 million internal migrants in 2020. Among this, one-third are interstate and inter-district migrants which accounts to 200 million, and within this 200 million, two-thirds are



projected to be migrant workers that roughly constitute 140 million.

In all, these numbers are enormous. If we have do micro analysis, we find that most internal migrants in India are short-distance intra-district migrants, with almost 62 per cent according to the 2011 Census.

Significant numbers of migrant workers are temporary or seasonal migrants, with 21 out of every 1000 migrants confidential as a temporary or seasonal migrants in 2007–08. They show that the bulk of these migrants also hail from marginalised sections of the country and from among the lower-income lower groups. A number of these migrants are also intricate in employment in the informal sector, making them some of the most vulnerable working groups, which more exclude them from social security benefits and even basic rights at the workplace.

Pandemic Situation

The coronavirus outbreak came to light on December 31, 2019 when China informed the World Health Organisation of a cluster of cases of pneumonia of an unknown cause in Wuhan City in Hubei Province. Subsequently the disease spread to more Provinces in China, and to the rest of the world. The WHO has now declared it a pandemic. The virus has been named SARS-CoV-2 and the disease is now called COVID-19.

More than 1.7 million people died. Around 80 million people are known to have contracted the virus, though the actual number is likely much higher. Children became orphans, grandparents were lost and partners bereaved as loved ones died alone in hospital, bedside visits considered too dangerous to risk.

This is a pandemic experience that's unique in the lifetime of every single person on Earth," says Sten Vermund, infectious disease epidemiologist and dean of Yale School of Public Health. "Hardly any of us haven't been touched by it."

Businesses closed. Schools and colleges shut. Live sport was cancelled. Commercial airline travel saw its most violent contraction in history. Shops, clubs, bars and restaurants closed. Spain's lockdown was so severe that children couldn't leave home. People were suddenly trapped, cheek by jowl in tiny apartments for weeks on end.



Those who could, worked from home. Zoom calls replaced meetings, business travel and parties. Those whose jobs were not transferrable were often sacked or forced to risk their health and work regardless.

Reverse Migration

The imposition of the lockdown as a measure to contain the exponential development of the COVID-19 pandemic has hit the unskilled and semi-skilled migratory labourers the most. In the last few weeks, we have all been witness to harrowing, nerve-wrenching and bone chilling images of the migration of these marginal and “invisible” drivers of the informal economy of urban India. Indian highways deflated of most vehicles were lined with bedraggled, poor pedestrians, many carrying all their worldly belongings in bundles on top of their heads walking to their home villages, hundreds or thousands of miles away across states.

Migrant workers returning to native places in COVID-19 times were the host for urban to rural show of cases as the migrant-receiving states witnessed over five times increase in the number of districts having a more noteworthy concentration of COVID-19 cases from 1 May to 31 May 2020. There is an urgent need for the skill mapping of the migrant workforce and making social security schemes to protect them under any socio-economic or health emergency.

Impact of Reverse Migration on the Different Industries

Over three-fourths of small businesses in the country have shown an adverse impact on their businesses during the Covid-19 pandemic, with those in the small scale industries reporting more troubles.

It is found that 82 per cent of businesses have experienced a negative impact during the pandemic year.

An unparalleled large-scale reverse migration of labour triggered by the nationwide lockdown, that saw millions of workers travel across state borders, has put some of the Indian economy’s major sectors at risk. Manufacturing, mining, retail and wholesale trade and friendliness have some of the highest dependence on migrant workers from other states, according to an analysis by India Ratings



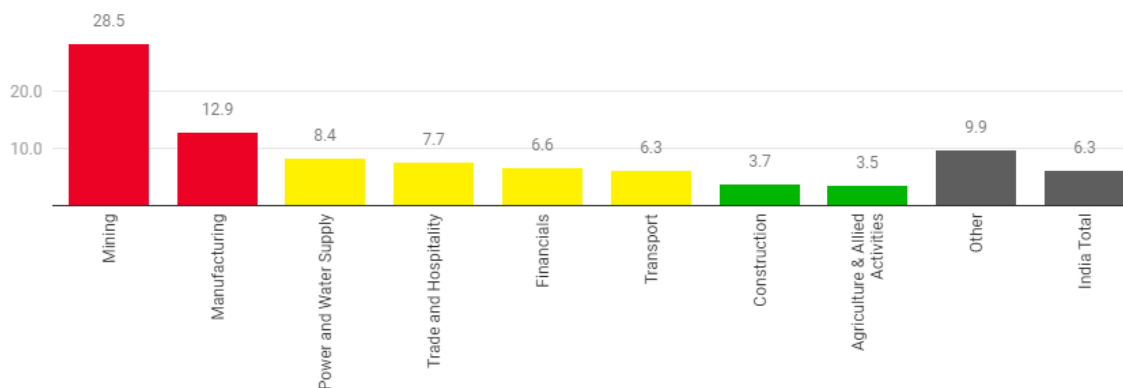
& Research. The impact will be further aggravated for medium and small enterprises that rely more on migrant workers than large corporates.

India imposed a sudden nationwide lockdown to curb the spread of Covid-19 that brought economic activities to a grinding halt. The lockdown, which was then extended twice, hit number of daily wage earners and migrant labourers who were left without jobs and income. Penniless and stranded, workers left cities for their villages on foot or bicycles, cramped in trucks and later by trains.

The result: a labour crisis which might hit capacity utilisation for several firms, India Ratings said. Manufacturing is the clear victim with its high reliance on migrants. The industry employs over 60 lakh migrant workers from other states more than any other sector, India Ratings said. Also, almost half of the manufacturing sector's output comes from MSMEs and contributes 8% to the country to the country's GDP.

“The sector might keep opposite labour shortage in the near term if labourers do not return to their workplace by Q2 FY21,” India Ratings said. “This will lead to an increase in labour wages in the near term, which may erode MSMEs’ profits.”

Sectors where migrant workers from other states form most of the labour force.



Another sector impacted severely due to reverse migration, according to India Ratings, is logistics. The shortage of trucks and workers for warehouses has led to lower capacity utilisation of ports affecting India’s external trade, it said.

Construction sector widely expected to be impacted severely from reverse migration. And while, construction activity has been hit due to local limitations, India Ratings said the sector’s dependency



on workers from other states is relatively lower. The sector depends on more on intra-state migrants.

Most Impacted States

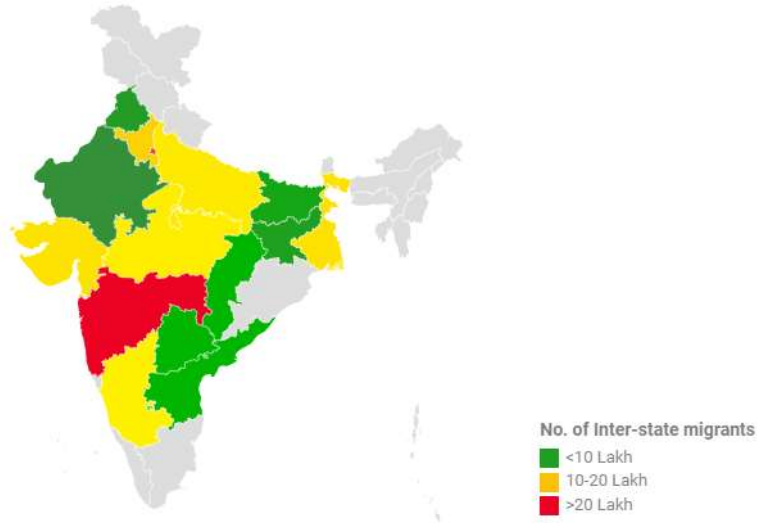
In addition to its impact on public health, coronavirus disease 2019 (COVID-19) has caused a major economic shock.

Maharashtra, Delhi and Gujarat has receive the largest number of migrant workers in India—most of them from Uttar Pradesh and Bihar. Companies in these regions are probably suffer more than the likes of Andhra Pradesh or Chhattisgarh where only a small portion of the work force is from outside the state, India Ratings estimated.

The impact of reverse migration is more pronounced in Maharashtra and Gujarat due to the huge presence of heavy labour-dependent sectors such as manufacturing and construction.

A quarter of Maharashtra's uncultured value-added product comes from manufacturing. The figure is much higher at over 48% for Gujarat. Manufacturing units in these states employment a total of over 22 lakh migrant workers, highlighting the challenge firms face due to reverse migration.

States with Biggest Invasion of Migrant Workers



Telangana and Andhra Pradesh have been considered one state for this analysis.

Source: India Ratings and Research - Map data: © OSM

Bloomberg | Quint

Impact on Corporates India Ratings has estimated that in the near term, corporates with manufacturing facilities concentrated in states with a high-migrant dependency will face higher costs and face pressure on its operating margins. Employers may also choose to offer incentives beyond just wages to woo labour back, leading to further costs.

Companies that have manufacturing facilities in multiple states are better hedged against the labour scarcity, India Ratings said. The impact on such companies will be limited to the share of revenue they get from facilities in states that depend more on migrant labour.

Impact on Small Scale Industries

The impact of COVID-19 on business operations and employment toward the beginning of the crisis. Second, we report our results on the financial fragility of those businesses, as captured by their cash on hand and ongoing expenses. Third, we turn to their expectations about the duration of the crisis and their own economic survival, as measured at a particularly sensitive point for understanding the impact of future policies.

Across the sample, 41.3% of businesses reported that they were temporarily closed because of COVID-19. A far smaller number—1.8%—reported that they were permanently closed because of the pandemic. By contrast, only 1.3% reported that they were temporarily closed for other reasons; 55.5% reported that



they were still operational.

On average, firms rated the disruptions resulting from supply chain challenges to be 35 on the 100-point scale (which is in the “slightly disruptive” part of the scale). Concerns about employee health were more prominent, with firms rating it as 57 out of 100 (which maps to “somewhat disruptive”). Reductions in demand were even more disruptive, with firms rating the importance of this to be 79 out of 100 (extremely disruptive). While closed firms noted worse disruptions due to demand, the basic ranking of the different disruptions was consistent across different types of firms. These findings suggest, thus far, that supply chain problems have been less pronounced, relative to disruptions resulting from demand shocks and concerns about employee health.

Conclusion

The recent surge in COVID-19 positive cases and succeeding lockdown imposed by numerous states are preventing the return of migrant labourers to their workplace, though such measures are necessary to control the eruption. Moreover, a protracted disruption will even diminish migrant labourers’ sentiments. The manufacturing sector will be at the forefront of the disruption mainly micro, small & medium enterprises in Maharashtra and Delhi.

India is presently witnessing a rapid surge in the number of COVID-19 cases. Although the nationwide lockdown has been able to decelerate the spread, the country’s ever-increasing population, remarkably high population density and poor socioeconomic conditions are major barriers in India’s battle against COVID-19.

The current migrant crisis due to COVID-19 pandemic requires accurate data on internal migrants which would render visibility to the invisible yet pervasive categories of labourers. Numerous migrants remain omitted from various governmental schemes due to their ‘neither here, nor there’ status. This should be done in preparation to the intent–impact gap analysis of such schemes. At this juncture, it is grave to revisit NCEUS references and effectively implement them without diluting the specificities. It is also vital to form a migrant collective for better voice and political agency of migrants.

The majority of small scale industries have workers from the nearby town or state. As these labours migrated to their home town. With the reverse migration of labours, these small scale industries are



suffering lot due to staff crunch.

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Caste System in India and its impact on Socio Economic Condition

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Abstract

The caste system has significant social system in India. One's caste affects their options regarding marriage, employment, education, economies, mobility, housing and politics, among others. The caste has significant on the socio-economic condition of person. This paper focuses on the impact of caste system on socio-economic condition.

Keywords : caste system, socio economic condition, economic mobility

Introduction

The Indian Caste System is historically one of the main dimensions where people in India are socially differentiated through class, religion, region, tribe, gender, and language. Although this or other forms of differentiation exist in all human societies, it becomes a problem when one or more of these dimensions overlap each other and become the sole basis of systematic ranking and unequal access to valued resources like wealth, income, power and prestige. The Indian Caste System is considered a closed system of stratification, which means that a person's social status is obligated to which caste they were born into. There are limits on interaction and behaviour with people from another social status. Its history is massively related to one of the prominent religions in India, Hinduism, and has been altered in many ways during the Buddhist revolution and under British rule. This paper will be exploring the various aspects of the Indian caste system related to its hierarchy, its history, and its effects on India today.

The caste system is debatably the most distinctive feature of Indian society. The Indian population is divided into four hierarchical classes, or varnas, with a large sub-population of untouchables excluded entirely from the system. Within each of these classes, and among the untouchables, are thousands of castes, or jatis. The central rule in Hindu society is that individuals must marry within their own caste. Recent genetic evidence indicates that this rule has been followed for over 2,000 years. Spatial segregation on caste lines within the village results in a high degree of local social connectedness, with caste clusters in distant villages and select urban locations linked to each other through ties of marriage over many generations. This unique social structure has remained in place 70 years after Independence, in one of the world's most dynamic economies.

Caste System in India

Defining the word "caste" itself is harder than thought to be. It is defined as "a collection of families or groups of families bearing a common name; claiming a common descent from a mythical ancestor, human or divine; professing to follow the same hereditary calling; and regarded by those who are competent to give an opinion as forming a single homogeneous community". It can also be defined as an endogamous and hereditary subdivision of an ethnic unit occupying a position of superior or inferior rank of social esteem in comparison with other such subdivisions. Caste name is generally associated with a specific occupation and, as mentioned before, is a closed stratification, which makes it endogamous. The Indian caste system is a classification of people into four hierarchically ranked castes called varnas. They are classified according to occupation and determine access to wealth, power, and privilege. Leadership positions in society are monopolized by a few dominant castes. The two upper castes are ritually considered as superior to the lower castes. The



Brahmans, usually priests and scholars, are at the top. Brian K. Smith, the author of *Classifying the Universe*, explains his definition of the Brahman caste:

The Brahmin class is essentially defined by its supposed priority (as the class created first by the creator god), by knowledge of the Veda, and by the monopoly this class holds on the operation of sacrifice. These traits justify the social position of the class vis-à-vis others: they are predominant because they are prior, and they claim to stand outside of the power relations that govern social life for others because of their superior knowledge and sole possession of the ultimate “weapons,” sacrificial techniques .

There are, however, varying “degrees” of Brahmans, such as Kanya-Kubja, Tamil, Tanjore, and others who are part of numerous villages (Pintane). These sub-castes, called jatis, are very specifically endogamous, so that a Brahman is not only restricted to marrying another Brahman, but to marrying a woman of the same subdivision of Brahmans. Each jati is composed of a group deriving its livelihood primarily from a specific occupation. People are born into a certain caste and become members. They then acquire the appropriate occupation according to their jati. Separation of these Brahmans from others is one of several indications of social status, which include material goods, social power or influence, and social skills .

In modern India, economic competition and education are predominate, and the Brahmans occupy this position in both aspects Following the Brahmans are the Kshatriyas, or political rulers and soldiers. They were the ruling class and often times collaborated with the Brahmans as they reigned over their kingdom. In ancient India, the rulers were bound by Holy Scriptures to govern their kingdoms with justice. A Hindu ruler was the protector of his subjects, and in order to protect his subjects the king needed to be an expert warrior. A Kshatriya is characterized by physical and martial strength. These qualities determined his relations with others: “the Kshatriya is charged with the protection of the higher Brahmin class with rule over (and unrestricted exploitation of) the lower Vaishyas”. The word ‘kshatra’ in Sanskrit means government, power, and dominion . Kshatriyas are considered to be bold, alert and full of fortitude, generosity, discipline and modesty. Priests and warriors were said to be “better” than or “superior” to the other castes, and in general the Brahmans and Kshatriyas were regarded as united into a ruling class according to the populace at large. But although the Brahmans and Kshatriyas together proclaimed to be superior to the commoners, the Brahmans never hesitated to declare their own caste as higher than the Kshatriyas. The reason of this, according to the Vedas, is that Brahmans have been characterized as being self-sufficient, whereas the Kshatriyas are dependent on priests. Thus, it is said that Brahmans can live without rulers, but rulers cannot sufficiently execute their tasks without the aid of Brahmans.

Next are the Vaishyas, or merchants. A Vaishya's duty was to ensure the community's prosperity through agriculture, cattle rearing and trade. The Vaishyas were considered and expected to be weak in comparison to their rulers, and were infinitely exploitable and regenerative. These oppressions however, were usually not boycotted because this was presented as a natural state of affairs in the social realm. Later, the Shudras took over agriculture and cattle rearing while the Vaishyas became traders and merchants. However, though they were “twice-born” and economically strong because they controlled commerce, Vaishyas were denied a high social status, for which they resented the upper castes. One expression of this resentment was their support of the anti-Brahminical sects that developed around the 6th century BC, like Buddhism and Jainism (Gurjari). Then come the Shudras, who are usually laborers, peasants, artisans, and servants. Shudras were thought to not have any special abilities and were considered only capable of serving as slaves to the upper three classes. Shudras enjoyed no rights or privileges, and were not permitted to perform any sacrifices or homa, read or learn the Vedas or recite the mantras (prayer rituals). They were also not allowed to enter temples and could only serve the upper three castes as a slave, barber, blacksmith or cobbler (Gurjari). They too supported the anti-Brahminical groups that came about.



Caste includes three elements: repulsion, hierarchy, and hereditary specialization. According to Velassery, "a society is characterized by such a system if it is divided into a large number of hereditarily specialized groups, which are hierarchically superposed and mutually opposed. It does not tolerate the principle of rising in the status of groups' mixture and of changing occupation". There are many rules in the Indian caste system which caste members must adhere to in order to avoid being shunned from their caste members or, according to Hinduism, being born less fortunate in their next life. The two most important characteristics of the Indian caste system have to do with endogamy and occupational restriction. Every member of a caste or sub-caste is required to marry within their own caste. Any violation of this results in excommunication from one's family and caste. When it comes to occupation, every caste is associated with a particular one to which its members are required to follow. Another characteristic is that every caste imposes restrictions on its members with regards to diet and has its own laws which govern the food habit of the members. There are two types of food: Pacca, which is food prepared with ghee (melted butter), and Kachcha, which is food prepared with water (Pyakurel). According to the castes, only certain kinds of foods can be exchanged between certain castes. For example, a Brahman can accept only Pacca food from a Shudra, but Kachcha food can only be accepted from a person of one's own caste or of a higher caste. Another is the social interaction between castes. There are strict barriers when it comes to the mixing of a superior caste with an inferior caste. Hence, under the caste system every caste abides by well established customs and well defined norms of interactions.

Origins and History

The origin of the Indian caste system has many theories behind it. Some of them are religious, while others are biological. The religious theories explain that according to the Rig Veda, which is the ancient Hindu book, the primal man, Purush, destroyed himself to create a human society and the different parts of his body created the four different varnas. The Brahmins were from his head, the Kshatriyas from his hands, the Vaishyas from his thighs, and the Shudras from his feet. The Varna hierarchy is determined by the descending order of the different organs from which the Varnas were created (Daniel). For example, Brahmins, who were derived from the head of Purush, are considered the intelligent and most powerful varna because of their wisdom and education and are a representation of the brain. In the same way, Kshatriyas, considered the warrior caste, were created by arms, which represent strength. Another religious theory claims that the Varnas were created from the body organs of Brahma, who is the creator of the world in Hinduism

Historically, however, it is believed that the caste system began with the arrival of the Aryans in India around 1500 BC. Of the many cultures that flourished in India, the literary records of the Indo-Aryan culture are not the earliest. They do, however, contain the first mention and a continuous history of the factors that make up the caste system. The Aryans came from southern Europe and northern Asia with fair skin that contrasted with the indigenous natives in India. When they arrived, their main contact was with the Dravidians. The only other culture whose records are dependable about the origins of the caste system are the Dravidians, but when that culture's documents were put forwards, it had already been largely influenced by the Indo-Aryan tradition. Unfortunately, the Aryans completely disregarded their local cultures and began conquering regions all over north India (Daniel). At the same time, the local people were pushed south towards jungles of mountains in north India.

Religion, Culture, and Caste

The division of castes constitutes one of the most fundamental features of India's social structure. In Hindu society, caste divisions play a part in both actual social interactions and in the ideal scheme of values. Members of different castes are expected to behave differently and to have different values and ideals. These differences are sanctioned by the Hindu religion.



One of the main beliefs in Hinduism is that the consequences of your past decisions have determined your present state, reincarnation plays a huge role in the prevention of people revolting against the caste system. Reincarnation was created by the Aryans in order to justify the oppressive behavior they were imposing on the natives and to keep the people from rising up against the system. Reincarnation bolsters caste oppression in two ways.

Modern India

Relationships between castes have become more relaxed today. There is more food sharing between castes and a lot more eating done at local restaurants where caste distinctions are less likely to be made. One of the biggest changes that took place in India was occupational pursuits among men (and women later on). Earlier, most men did not veer away from their caste-linked occupations, such as blacksmithing and pottery making. Many have now taken up newer occupations that do not relate to their caste, such as government jobs, teaching, retail and services, and machine repair. Wealth and power in the village is now less associated with caste than before, and landownership has become more diversified. Also, the idea that purity and pollution is caused by the lower castes has diminished a good amount. It has, however, only somewhat diminished in the public, whereas behind closed doors and on ceremonial occasions, purification rituals related to caste status are still observed. Endogamy is still enforced among families, but not as strict as before.

Socio Economic Impact of Caste

Socio-Economic mobility is a prerequisite for development. Given the continuing importance of caste in Indian society, an obvious question to ask is how occupational and spatial mobility in the Indian economy has been shaped by the caste system. The first thought is that the exploitation, prejudice, and discrimination that are associated with the hierarchical aspect of the caste system would have stifled mobility among the lower castes. It is certainly true that the lower castes remained locked in unskilled, low-paying occupations for centuries in the traditional economy. There is also evidence of continuing discrimination in the labour market, although this appears to be statistical—that is, employers use caste as a proxy for unobserved socioeconomic characteristics—rather than prejudice. Despite these obstacles, evidence from surveys of nationally representative samples indicates that there has been convergence between the upper castes and the lower castes on education and occupations over the past decades.

Some of this convergence may be due to the affirmative action policy that has been in place since Independence, reserving seats in institutions of higher education and the central government for former untouchables and other disadvantaged groups. Another force driving convergence could be the caste-based networks that facilitate economic activity and support the mobility of their members in an economy where markets function imperfectly. Individual members of a caste can be severely sanctioned if they renege on their obligations because information flows smoothly within the caste and because they are tied to their community in many different ways. This allows high levels of cooperation to be sustained. Numerous historical accounts document the important role played by castes in supporting the rural-urban migration that accompanied British rule and the growth of cities in the 19th century. Particular castes found particular niches in the urban labour market, and once networks in the city were established, they supported the movement of fresh migrants from the hinterland, often over the course of many generations.

The picture I have painted of the caste networks up to this point is entirely positive. However, these informal institutions have limitations of their own. The same networks that can be so effective in supporting the movement of groups of individuals across space and occupations can also restrict the mobility of individual members once they are established. Particular castes historically occupied niches in Mumbai's mills and factories with the support of their networks. When the Indian economy restructured in the early 1990s, shifting economic activity in Mumbai from manufacturing to services, these networks had been in place for over a century. We provide evidence, based on the schooling



choices of the children, that these blue-collar networks turned out to be a hindrance in this economy, keeping their members in the traditional (now less remunerative) occupations and preventing them from taking advantage of the new opportunities that became available.

A household with migrants will be less insured by its rural network for two reasons. First, it cannot credibly commit to reciprocate at the same level as households based entirely in the village because social sanctions against it will be less effective; it can always fall back on its new base in the city. The urban component of its income is also unobserved by the rural network. If the consequent loss in insurance is sufficiently large, then rural households could forego substantial gains in income from migration and keep all their members in the village. We use this argument to explain why rural-urban migration is unusually low in India, despite the presence of large rural-urban wage gaps. The restriction on mobility that we document, which leads to inefficiency in the labour market, arises because of inefficiency in another market; that is, because formal substitutes for the rural insurance network, such as private credit or government safety nets, are unavailable.

Conclusion

The Indian caste system has played a significant role in shaping the occupations and roles as well as values of Indian society. Religion has been the constant push towards this stratification system for centuries, beginning with the Aryans and continuing down a long road of unfortunate discrimination, segregation, violence, and inequality. Hinduism was the backbone of the puritypollution complex, and it was the religion that influenced the daily lives and beliefs of the Indian people. Even after sixty-three years of independence, Indians continue to be in the grip of caste consciousness. Historically, India has been surviving as a nation for millennia with closed groups divided by caste, creed and language. The present Indian society is moving from its closed systems towards a state of change and progression marked by the assertion of the human spirit irrespective of castes and creeds (Velassery, xii). Numerous movements challenging the injustices associated with the caste system have encouraged individuals in India to be more civil towards other caste members. Many of the lower castes have gained a lot from the partial elimination of the caste system, and India should be applauded for its constant effort to eradicate this system of stratification from its culture. It is, however, important to look at the importance of how caste status has affected the quality of life and social mobility in India today.

Caste systems are still active in India after independence where markets are functioning imperfectly. However, this casteism is exceptional with respect to their size and scope in India, because of the special caste-based structure of its society. Caste system thus plays an unusually important role in shaping economic mobility in the Indian economy. The economic mobility has impact on the socio-economic status of the citizen.

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प्रस्तावना :

आत्मनिर्भर भारत का अर्थ है स्वयं पर निर्भर होना, यानि खुद को किसी और पर आश्रित न करना। कोरोना महामारी के दौरान लाकडाउन मे सारे विश्व मे हर किसी के लिए खाने, पीने और रहने मे परेशानी पैदा कर दी है। महामारी की इस संकट को देखते हुए भारत को आत्मनिर्भर होने की जरूरत है। भारत प्राचीन काल से ही आत्मनिर्भर रहा है, और इस कड़ी मे आत्मनिर्भर बनकर आप खुद के परिवार के साथ-साथ आप अपने देश को फिर से प्रगति के मार्ग पर खड़ा करने मे मदद कर सकते है। यहां नीचे आत्मनिर्भरता और आत्मनिर्भर भारत के कुछ महत्वपूर्ण बातों पर उनपर नजर डालते है। महामारी के चलते लॉकडाउन के कारण देश आर्थिक संकट में आ गया था। इस आर्थिक संकट से देश को निकालने के लिए सरकार द्वारा आत्मनिर्भर भारत अभियान आरंभ किया गया था। आत्मनिर्भर भारत अभियान की सफलता के बाद भारत सरकार द्वारा आत्मनिर्भर भारत अभियान तथा आत्मनिर्भर भारत अभियान लॉन्च किया गया है। आत्मनिर्भर भारत जैसे कि आत्मनिर्भर भारत अभियान क्या है?, प्रधानमंत्री नरेंद्र मोदी ने कोरोना संकट के इस दौर में भारत की अर्थव्यवस्था को सुधारने के लिए 20 लाख करोड़ रुपये के राहत पैकेज का ऐलान किया था. इस पैकेज को आत्मनिर्भर भारत अभियान का नाम दिया गया है. इस हिसाब से अभियान का नाम आत्मनिर्भर भारत अभियान रखा गया है. प्रधानमंत्री नरेंद्र मोदी ने कोरोना संकट के इस दौर में भारत की अर्थव्यवस्था को सुधारने के लिए 20 लाख करोड़ रुपये के राहत पैकेज का ऐलान किया था. इस पैकेज को आत्मनिर्भर भारत अभियान का नाम दिया गया है. प्रधानमंत्री नरेंद्र मोदी का कहना है कि इस बड़े राहत पैकेज से भारत में लोगों को कामकाज करने की सुविधा उपलब्ध कराई जाएगी और यह कोशिश की जाएगी कि अगले कुछ सालों में भारत अपनी जरूरत की अधिकतर चीजों के लिए खुद पर निर्भर हो जाए. इस हिसाब से अभियान का नाम आत्मनिर्भर भारत अभियान रखा गया है. आत्मनिर्भर भारत अभियान में मोदी सरकार ने किसानों और ग्रामीण अर्थव्यवस्था के हाथ में अधिक पैसे पहुंचाने की कोशिश की है. सरकार ने बताया है कि मार्च और अप्रैल के बीच ₹86,600 करोड़ रुपये के 63 लाख लोन कृषि क्षेत्र में दिए गए हैं. इसके साथ ही सहकारी बैंक और क्षेत्रीय ग्रामीण बैंक की रिफाइनेंसिंग के लिए नाबार्ड ने ₹29,500 करोड़ दिए हैं. इसके साथ ही राज्यों को रूरल इन्फ्रास्ट्रक्चर डेवलपमेंट फंड के लिए ₹4200 करोड़ की मदद दी गई है. भारत सरकार ने बताया है कि पिछले 2 महीने के दौरान प्रवासी मजदूर और शहरी गरीब लोगों के लिए कई उपाय किए गए हैं जिससे उन्हें कोरोना के बाद के दौर में जीने में आसानी हो. इसमें प्रवासी मजदूर के रहने के लिए स्टेट डिजास्टर रिस्पांस फंड के रकम के उपयोग की इजाजत दी गई है जिससे कि उनके लिए खाने और पानी की व्यवस्था की जा सके. केंद्र सरकार ने राज्यों को ₹11000 करोड़ दिए हैं जिससे कि वह स्टेट

Design and development of an automatic smoke suction unit for diathermy machines

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Abstract

In this research paper, high frequency a.c. of the order of 1-3 MHz frequency is generated using crystal oscillator and other low frequency of 30 KHz is generated using astable multivibrator designed using IC 555. HF, high current with low voltage is used for precise skin dissection and blended effect of HF, LF, low current and high voltage is used for coagulation purpose. One of the important modifications done in this diathermy machine is the smoke suction unit used to evacuate the harmful smoke generated during diathermy. This smoke suction unit is fully automatic, its suction power changes according to the amount of smoke generated during surgical diathermy. Smoke Sensor MQ2 is interfaced with microcontroller for this process. Microcontroller 89S52 is used in this research work to control the smoke suction unit. Embedded C language is used for the programming and circuit is implemented using Proteus Simulator.

Keywords: high frequency, low frequency, blended effect, surgical diathermy, smoke sensor MQ2.

Introduction

Electrosurgical Surgical Diathermy (ESD) machine has evolved to become the modern-day scalpel being used for cutting and coagulating tissues. The Surgical diathermy machine involves the use of high frequency AC of the order of 1-3 MHz for the purpose of precise cutting or else to freeze tissue or seal blood vessels to cease bleeding [1].

This application of electrosurgery causes burning or many times damage to the tissues if safety precautions are not followed. Such hazards can be controlled by controlling the frequency and power of the device at the time of electrosurgery. In electrosurgery, voltages are provided by the generator, and current is delivered to the tissue through the electrode tip of the instrument [2]. The amount of thermal energy delivered and the time rate of delivery will dictate the observed tissue effects. In general, below 45°C, thermal damage to tissue is reversible. As tissue temperatures exceed 45°C, the proteins in the tissue become denatured, losing their structural integrity. Above 90°C, the liquid in the tissue evaporates, resulting in desiccation, if the tissue is heated slowly or vaporization if the heat is delivered rapidly. Once the tissue temperatures reach 200°C, the remaining solid components of the tissue are reduced to carbon [3].

Operating doctors, staff and patients regularly comes in contact with surgical smoke generated during surgical procedures while dissecting skin or tissues. During such procedure it is found that heat is produced and as a result smoke or haze is generated. Such smoke or haze puts great health hazards. It is also found that such smoke creates major biochemical hazard and is as hazardous as cigarette smoke [4][11].

MQ-2 is a smoke sensor that has high sensitivity to type of gases such as LPG, Propane, Hydrogen, smoke and carbon monoxide. Besides having high sensitivity, MQ-2 is low cost and suitable for different applications. In this work the smoke sensor will be interfaced with microcontroller so that it will automatically vary the power of suction unit so that suction power is directly proportional to the amount of smoke produced during surgical diathermy procedures [5].

MQ-2 is a gas sensor that has a high sensitivity to types of flammable gases such as LPG, Propane, and Hydrogen. Besides having high sensitivity, MQ-2 was chosen because of its low cost and suitable for different

applications. The gas sensor will be configured via OpenCR which is like Arduino.

Methodology

ESD machine is operated in two modes Monopolar and Bipolar

A. Monopolar mode

In this type of diathermy electrical current follows the path from Electrosurgical unit to active electrode. The active electrode comes in contact with the skin of the patient. The current generated from electrosurgical unit passes through this active electrode through the body of the patient. This current then returns through the return electrode connected to the buttock or to the leg. Thus, the direction of current is from electrosurgical generator through the active electrode, through the patient, through the return electrode and back to electrosurgical generator from where it originated.

B. Bipolar mode

In this type of diathermy, the active electrode and return electrode both are fitted on the forceps like structure. The electrical current passes only through the part or portion of the tissue we want to treat and then returns back to electrosurgical unit. Important point is that surgical current does not travel through the patient's body but instead is confined only to the part or tissue between the bipolar electrodes. Bipolar electrosurgery thus restricts passage of current through the body of patient and thus it is found that this type of electrosurgery offers very less amount of unintended dispersal of current. Another significant feature of this type of diathermy is that the surgical current does not flow through other parts of the body but remains concentrated only on the tissues in contact. The result is that surgery becomes safe and accurate and damage to the tissues is also less. Apart from this bipolar electrosurgery faces one drawback which is, due to use of low power sometimes it is not useful for cutting application [6].

To detect the smoke produced during surgical diathermy and control the suction power of suction unit

MQ2 smoke sensor is used in this work. MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas are measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm [7].

Experimental Work

A surgical diathermy machine consists of a high frequency power oscillator [9]. The RF generator provides an undamped high frequency current (typically 1-3 MHz) which is suitable for making clean cuttings. The function generator produces low frequency current (typically 30 KHz)[10]. Modulator is used for blending the current of radio frequency oscillator and function generator. By blending the current of RF oscillator and function generator, the degree of coagulation of wound edges may be chosen according to the requirement. The waveform selection and signal generating stage present in modulator provides the desired waveform for cutting or coagulation. The mode selector block is used for selecting the type of mode such as Electrotomy, Coagulation, Fulguration, or Desiccation. The power output stage employs power transistors such as MOSFETs to amplify the waveforms and output them

though an output isolation. This is then applied through a system of electrodes, where the current usually takes the path from the active electrode and back through the return electrode in case of monopolar mode, or alternatively flows through both the active electrodes in case of bipolar mode. Hand switch or foot switch is used to control the amount of current applied to the power amplifier circuit which controls the current flowing through the electrodes.

The smoke generated from the surgical electrodes is detected by MQ2 sensor. It contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element; the other four are used for output signals. Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow. When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.

These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high [8]. The gas sensor and smoke suction unit are interfaced with Microcontroller 89S52, so that if the concentration of gas increases the suction power of suction unit also increases.

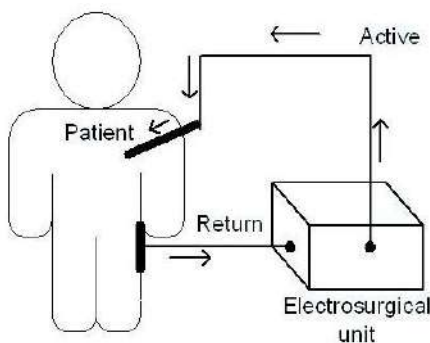


Fig. 1 Monopolar mode

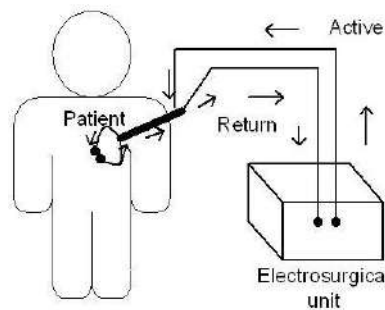


Fig. 2 Bipolar mode



Fig. 3. MQ-2 Gas Sensor

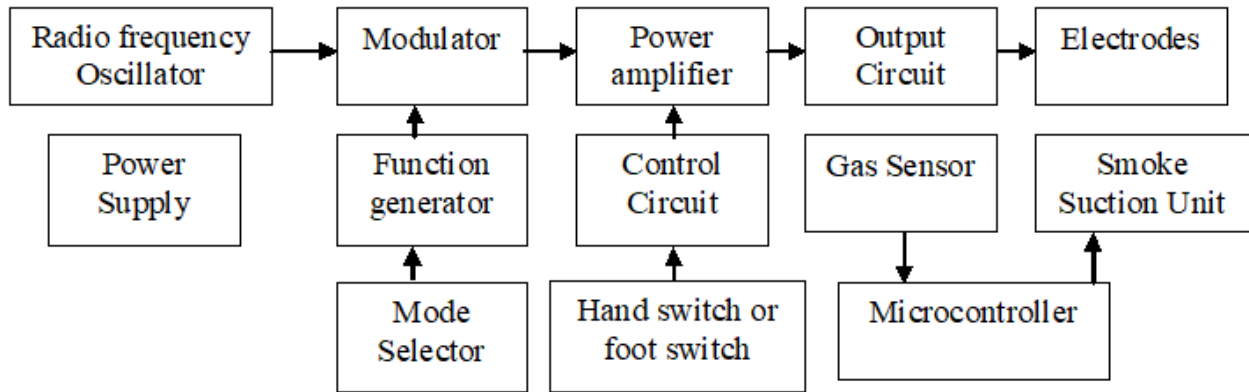


Fig. 4. Block diagram of ESD machine

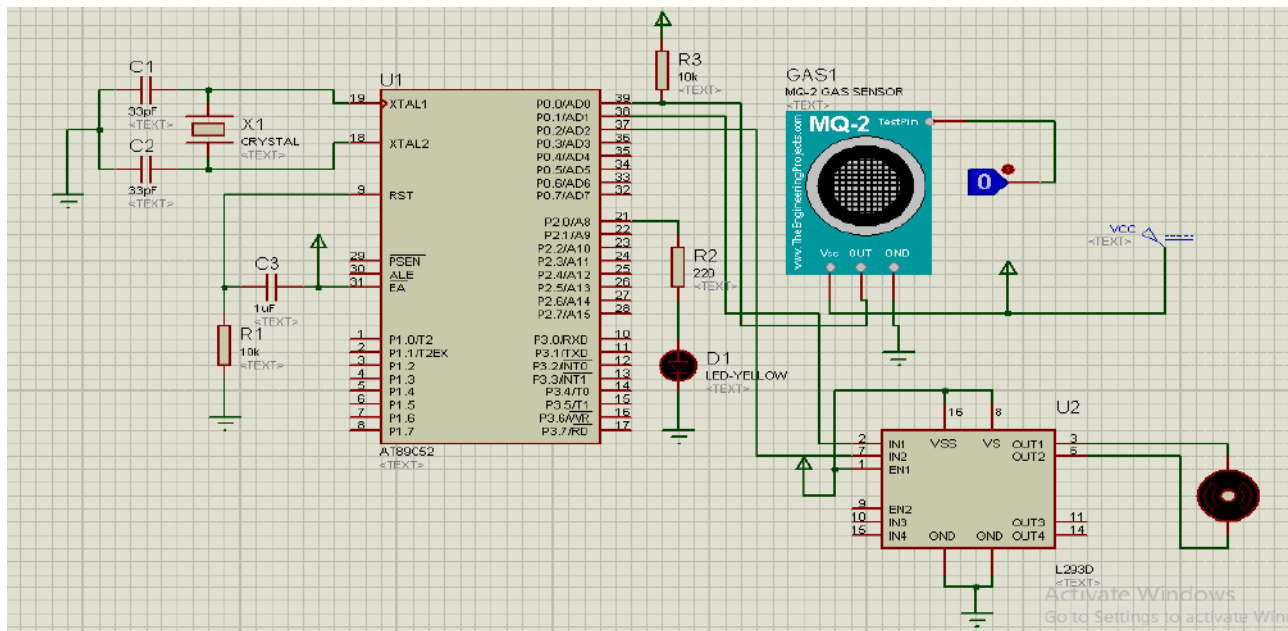


Fig. 5 Circuit diagram of automatic surgical smoke suction unit

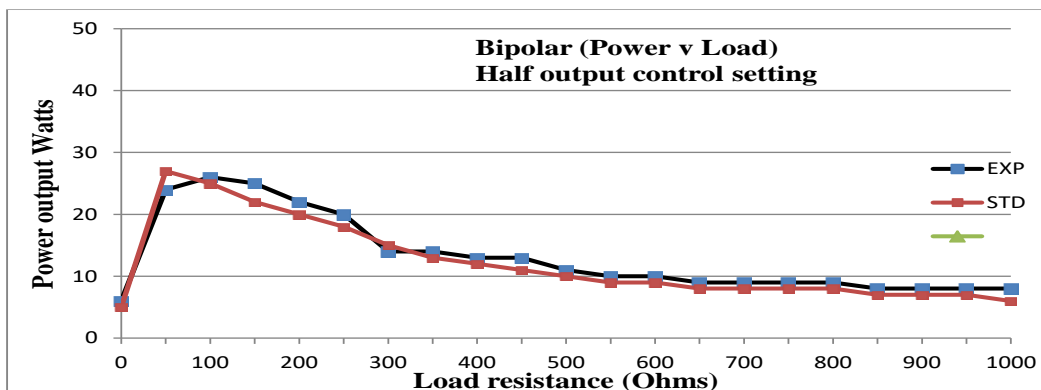


Fig. 6: Variation of Output power for various values of load resistance

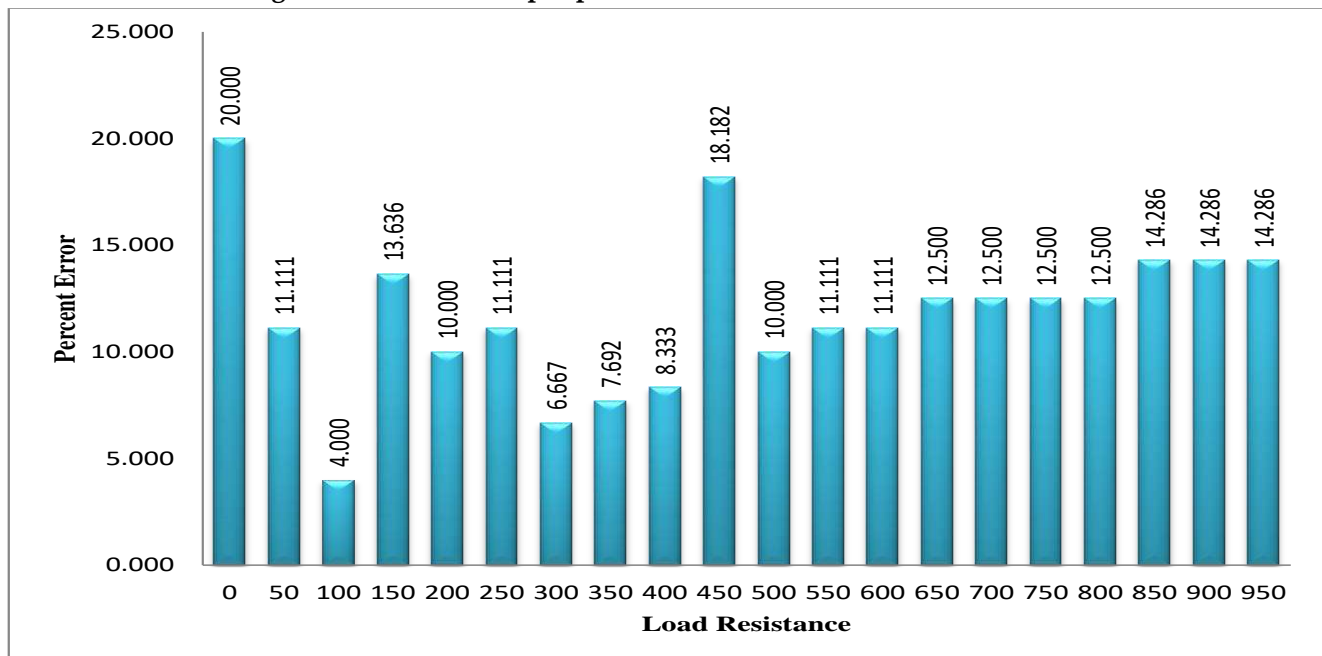


Fig. 7: Variation in Percent error for measured Power output.

Table 1: Output power recorded for various values of load resistance using bipolar electrode for half output control setting

Sr.	Load Resistance	Experimental Value	Standard Value	% Error
1.	0	6	5	20.000
2.	50	24	27	11.111
3.	100	26	25	4.000
4.	150	25	22	13.636
5.	200	22	20	10.000
6.	250	20	18	11.111
7.	300	14	15	6.667
8.	350	14	13	7.692
9.	400	13	12	8.333
10.	450	13	11	18.182
11.	500	11	10	10.000
12.	550	10	9	11.111
13.	600	10	9	11.111
14.	650	9	8	12.500
15.	700	9	8	12.500
16.	750	9	8	12.500
17.	800	9	8	12.500
18.	850	8	7	14.286
19.	900	8	7	14.286
20.	950	8	7	14.286

21.	1000	8	6	33.333
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Table 2. Power output recorded for various values of load resistance using bipolar electrode for full output control setting

Sr. No	Load Resistance (Ohms)	Experimental Value Power output (Watts)	Standard Value Power output (Watts)	% Error
1.	0	10	12	16.667
2.	50	28	30	6.667
3.	100	47	50	6.000
4.	150	45	44	2.273
5.	200	36	38	5.263
6.	250	32	34	5.882
7.	300	28	30	6.667
8.	350	26	27	3.704
9.	400	24	25	4.000
10.	450	22	23	4.348
11.	500	19	20	5.000
12.	550	17	19	10.526
13.	600	16	18	11.111
14.	650	15	16	6.250
15.	700	15	15	0.000
16.	750	14	14	0.000
17.	800	14	13	7.692
18.	850	13	12	8.333
19.	900	12	12	0.000
20.	950	11	11	0.000
21.	1000	10	11	9.091

Results & Discussions

Observations obtained for various physiological parameters are given below. Data for all the subjects were recorded in the same environmental conditions like room temperature, atmospheric pressure, humidity etc. The data obtained by standard device were compared with that obtained through experimental measures, by the current setup.

$$\% \text{ Error} = \frac{\text{Experimental value} - \text{Standard value}}{\text{Standard Value}} \times 100$$

The peak output voltage % error is ranging from 4.000 to 33.333. The lowest power recorded was 6 W and the highest power recorded was 26 W.

The peak output voltage % error is ranging from 0.000 to 16.667. The lowest power recorded was 10 W and the highest power recorded was 47 W.

Conclusion

The designed ESD machine have ensured the safety of patients using output transformer, smoke suction pump designed with a low cost with high quality performance. ESD machine provides the electrosurgeon

with lots of flexibility to perform various types of surgical procedures efficiently, greater safety, less health hazard and less tissue trauma.

With this kind of work an advanced and cost-effective surgical diathermy machine is designed which will be very useful in hospitals and operating theatres where accurate cutting and coagulation without blood loss, not letting the life of electrosurgeon and operating staff at any sort of risk. Advanced research in the field of biomedical instrumentation will definitely produce efficient, hazard free, accurate diathermy equipments that will lead to large scale use of diathermy equipments in various sections of surgery.

Conflicts of interest: The authors stated that no conflicts of interest.

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**SHASHI THAROOR'S THE GREAT INDIAN NOVEL: A CRITIC OF MODERN CENTURY****DR. SHAILESH BAHADURE**Associate Professor,
Dr. Ambedkar College,
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Nagpur-10**ABSTRACT:**

The seed of Indian Writing in English was planted during the time of the British standard in India. Presently the seed has bloomed into an ever green tree with fragrance being felt everywhere. The first phase occurred simply after the consistent minding, pruning and encouraging writings by Tagore, Sri Aurobindo, R. K. Narayan, Raja Rao to give some examples. These writers have really cared for the delicate plant night and day. Indian English Literature is a fair appearance to show that it is unique from being a solitary and extraordinary. Indian writing has ended up being another type of Indian culture and voice in which India banters consistently. Indian Writers – artists, authors, writers, and playwrights have been making significant commitments to global writings since pre – Independence period and now it is uncomparable. The authors of new age have intervened on various other topics of interest excluding the routine and tried delving deeper into the rich mythological traditions of the country. It not only provided them with the exhilarating concepts on which they could write but also represented them with the current happenings of the nation. Gains and losses, modifications and rigidity of people and facts, situations and deliberations of the newly born democratic nation was more than a digest of subjects for everyone.

Keywords: Indian English Novelists, Shashi Tharoor, The Great Indian Novel, Mythology, Criticism.

Indian English Literature has accomplished an autonomous status in the domain of world Literature. Wide scopes of topics are managed under the banner of Indian writing in English. While this writing keeps on reflecting Indian culture, convention, social qualities and even Indian history through the delineation of life in India and Indians living somewhere else, ongoing Indian English fiction has been attempting to offer articulation to the Indian experience of the severe difficulties.

India's generous commitment to world writing is to a great extent due to the bountifully imaginative abstract works created by Indian authors in English. Their works pondered and thought on diverse scope of issues like patriotism, ear of independence, social fabric and so forth. It is to the credit of these authors that they have defeated the obstacles of writing in an unknown dialect and have developed an unmistakable style for themselves by acing the complexities of the language and absorbing in it the tones and kinds of the Indian – sub mainland. It is important to note here that “Indian-English literature written by those Indians who claim that they think, feel and even dream in English has nowadays attracted a wide and

deep attention both in India and abroad” (Akira, 01). This gives us an impression that the Indian writings have surely made their presence felt and with a greater impact also that can be recorded in every walk of life and class of readers too.

It is known that not all kinds of writing create an appeal to all readers but it is equally true that Indian writings in English have their own and separate class of readers who have additionally helped to enhance the sublimity of issues and subjects on which new creations can be made. Additionally, these writings have helped the budding writers even to search for new themes which they can explore and sustain in the field of writing and publishing.

A cursory glance over a few Indian English writers substantiates the impression of worthiness these writings have earned not on the Indian soil but at the global level.

To begin with a fine example of how this global impact has been created, Vikram Seth’s ‘A Suitable Boy’ (1993) is appropriate. It was on the highest readership of the Indian Literary scene in the mid nineties. The plan of this novel was charmingly basic and it made itself as the novel of the day. It was also said that the novel was compared with Leo Tolstoy’s ‘War and Peace’ in case of size and he was also hailed as the ‘new Tolstoy’. The book took him eight years to compose, and his work has been sufficiently compensated. Seth additionally won the Thomas Cook grant for the best travel guide for From Heaven Lake. Seth’s ‘A Suitable Boy’ appears to propose a significant pattern in fiction today, and this isn’t really kept to Indian–English type.

Upamanyu Chatterjee’s ‘English, August’, distributed in 1981, was an extraordinary achievement. In this novel, Chatterjee portrayed one part of India. in light of metropolitan, world class and anglicized foundation. In 1993, Chatterjee came up with his second novel ‘The Last Burden’. It gives us an interesting picture of an Indian working class family toward the finish of the 20th century. Chatterjee brings to the Indian epic a style and feel, a conviction and development all its own.

Shashi Tharoor is another extraordinary Indian writer. His ‘The Great Indian Novel (1989) is perhaps the best accomplishment of Indian English fiction. A concerning critic on the Political history of Modern India, the novel has been viewed as a work of art of post – modernism. To Khushwant Singh, it is “perhaps a best work of fiction by an Indian in recent Years.” (Venkateswarlu, 3). Writes P. Lal, “...and should be said, is that this novel is an astonishing accomplishment, deserving unreserved kudos.” (Venkateswarlu, 3) While treating the 20th century political history of India as far as the story and characters of the Mahabharata, Tharoor’s epic targets introducing plentiful real factors and a range of translations of the real world. that is India. He clarifies: The novel is an attempt to retell the political history of 20th century India through a fictional recasting of events, episodes and characters from the Mahabharata (Venkateswarlu, 3).

The beginning pages give us a clear idea about how the modern century shall remain akin to the Mahabharata. In The Twice Born tale (Book One) it is mentioned, “They tell me India is an underdeveloped country. They attend seminars, appear on television.... I tell them that if they would only read the Mahbharata and the Ramayana...they would realize that india is not



an underdeveloped country but a highly developed one in an advanced state of decay” (Tharoor, 3). Comparable to extraordinary Indian writers, the commitment of women writers is hugely important. A number of women authors have debut in the nineties. Their first books hush up powerful in uncovering the genuine province of Indian Society with regards to the treatment of women. Every one of these authors was brought into the world after Indian Independence, and English doesn't have any pioneer relationship for them. Their work is set apart by a noteworthy feel for language and totally real introduction of contemporary India, with all its territorial varieties. They by and large expounded on the metropolitan center class, the layer of society they know the best.

Numerous Indian writers have utilized legend and history in their innovative compositions to bring out more noteworthy facts and hidden meanings. Where fantasy fortifies the functionality of an abstract harmony, history legitimizes its credibility. The truth of an artistic work which exists in the creative mind of the peruser should likewise have the extent of rising above its verifiable position. Here emerges the need for re-composing the sagas as far as contemporary history.

Presently numerous contemporary essayists compose with an educated mindfulness and focus on re-characterizing their personality, assessing their present, repositioning their past while declaring pictures of legend and history. 20th century several Indian writers deliberately utilized legend and history as an abstract gadget in their innovative compositions. They utilized an antiquated legend in a contemporary milieu also, reconsider regarding chronicled criticalness. This fanciful technique for epitomizing contemporary result in an old legend is additionally used in postmodern Indian English Fiction. It begun with Salman Rushdie's 'Midnight's Children' and enhanced with Shashi Tharoor's 'The Great Indian Novel'.

In 'The Great Indian Novel', Tharoor recasts Indian history as legendary and popular government as caricature. Tharoor has accepted the Mahabharata as a diagram and filled it with a contemporary cast for his clever send-up of independent India. A sort of India returned to with the performers of the epic. The novel challenges the fantasies of Indian freedom and a story of vote based system. He notices in various accounts different translations of the real world. Tharoor's innovativeness lies in uncovering how the procedure of the antiquated epic can replay the political arrangement of present day India. This involves that the cycles of history are not separate from writing.

Tharoor consolidates the imagination of fiction and the grant of real information to recognize the authentic figures like Gandhi, Nehru and Jinnah with their legendary partners. In using such a procedure, Tharoor confers the objectivity of real history with potential for anecdotal likelihood. He compares the two accounts to frontal area history as exceptionally talk actually open to re-evaluation. Tharoor's story re-opens the stories of the fiction and history and the figurative depiction confirms the perpetual outcomes of importance. The genuine worth and guidelines are taken from legend and history. 'The Great Indian Novel' is a recreated text mixing fantasy and history. Tharoor's joke to the public leaders is a section of his new method and advancement of new political supremacy example.

The incredible pioneers like Gandhi and Nehru got here a complete negligence on account of Shashi Tharoor. He dismissed the extraordinary leader being backstabbing to themselves, who caught in the nearby governmental issues and fail to remember the moral standards from their ethical responsibility. He discloses to India's account of unpleasant colonization experience and proceeds to the battles of Indians to decolonize it. The tale is profoundly established in Indian legend what's more, history.

The Mahabharata is an epic story depicting the successional battle over the seat of the Kingdom of Hastinapur among Pandava's and the Kaurava's, two parts of the beneficiaries of the ruler Shantanu. In this novel, Tharoor redesigns the narrative of the creating Indian democratic system as battle among gatherings and people, firmly related by their own and political careers. Along these lines Tharoor has accomplished two aspiring undertakings in a single stroke, reproducing the epic Indian story just as portraying the historical backdrop of 20th century India. The retelling of the equivalent story with extemporized growth and termination offers a quality of sentiments and newness to it. He utilizes the digressional strategy for narrating as used in the extraordinary legends successfully and by using legendary occurrences and circumstances to improve the impact of the contemporary situation.

The novel is an comprehensive examination of the influence of the Mahabharata, regarding the Indian freedom struggle, which leads to the partition of the India and correlating the two, Tharoor himself confesses, “Both are stories that at different levels are told and retold in Indian culture. In my intermixing the two, I was able to cast a perhaps cynical modern sensibility upon the great legends of the past, but equally was able to casts some of the values of that passed onto the experiences of the more recent present.” (Tharoor, http://shashitharoor.in/interviews_details/12). He not only juxtaposes the atmospherics of the Mahabharata with modern history. The organization of the chapters, the novel imitates the organization of the Mahabharata. The novel has eighteen ‘books’, just as the Mahabharata has eighteen books, corresponding with the war between Pandava’s and Kaurava’s which lasted for eighteen days. In the opening chapter, entitled ‘The Twice-Born Tale’ the narrator declares his intention to have ‘The Song of Modern India’ transcribed in his very own words.

To seek some comparisons and establish how ‘The Great Indian Novel’ is a critic on the modern 20th century India, we can go for some of the best characters and events in the novel. The unparalleled Bhishma of the Mahabharata is the Ganga Datta of the novel, Gangaji as he is to be depicted in the account. The recorded parallels are not very far to look for. The iconic Bhishma or Gangaji is no other than Mahatma Gandhi who in political adroitness, proficient methodologies, and the acts of grimness merits an unobtrusive correlation with the Bhishma Pitamaha of the Mahabharata.

The personality of Dhritrashtra then again is likened to Pandit Nehru’s, depicted as a communist. Portraying the story in modern terms, Tharoor substitutes the Sun God of Indian folklore with his Greek namesake Hyperion or Helios as he calls him and an outsider of tremendous presence and warmth. Modernizing the legend in his brand element, Tharoor sees that ‘it was simple to imagine how a naive and unpracticed youthful psyche could be taken in

by the blandishments of this conceivable outsider'(Tharoor, http://shashitharoor.in/interviews_details/12)

Tharoor's portrayal of the Ambassador vehicle is an exceptional bit of humour. He depicts that awkward machine of very fabulous offensiveness. Speaking about the call for races by Indira Gandhi in the outcome of the crisis, the author sees that it was generally accepted that Indira counseled an astrologer prior to taking the choice, and adds with a qualities a funny note as an Indian without a horoscope resembles an American without a Mastercard, and he is subject to many of similar inconveniences in life. The inevitable addition of Hastinapur gets representative of the beginning of the imperialist burden. The Jallianwallah Bagh massacre calls the sort of response. Tharoor's remarks are harmful and destructive, coloured with severe incongruity.

Different modernizations incorporate Mohammed Ali Jinnah as Mohammad Ali Karna. A genuine deviation from the Mahabharata epic is the narrative of Ekalavya. Ekalavya of the novel will not compensate Gurudakshina, the pay-back the teacher Drona demands from Ekalavya for his having tuned in to him furtively remaining outside the room where Drona showed the Pandavas and the Kauravas.

Keeping in view the circumstance before the Emergency by Indira Gandhi, the writer looks at Indira to Frankenstein's beast, as at the same time more and more laws went on to the rule press engaging Priya Duryodhani to prohibit, indict all the opportunities the national movement had battled to achieve. Remarking about it, Tharoor says, "There are no victors in such a fight, and advertisements, this political decision isn't Kurukshetra; life is Kurukshetra and History of Kurukshetra. The battle among dharma and adharma is a battle the country, and every one of them in it. That battle, that fight took place before this political race; it will proceed after it"(Tharoor http://shashitharoor.in/interviews_details/12)

Tharoor draws a possible symbolic between the legend and history by introducing Priya Duryodhanithat as Indira Gandhi who plots to dispose off Pandavas in each possible way. The different occasions of the novel can basically be seen with a binary vision and symbolism, present day and legendary, genuine and ironical eventually mirroring the procedures of genuine portrayals and dreams. Despite its critique, 'The Great Indian Novel' resembles Mahabharata, a changed, re-composed, re-read text. Shashi Tharoor has accepted the Mahabharata as a diagram and filled it with a contemporary cast for his clever send-up of pre-and post-autonomy India. He has reconstructed the significant strands of current Indian history as an epic with farce.

The historical backdrop of India's battle contrary to provincial rule and her postcolonial rendezvous with vote based system is introduced in an epic way. Like the epic of Vyasa, the novel is divided into eighteen books and its account is introduced in a multi shaded style and in a digressive way. The epic genuinely incorporates the nation. Tharoor has no dithering in seeking parallels from the incomparable Indian epic. Acknowledging the extraordinary indebtedness to the Mahabharata, the creator says that many of the characters, occurrences, and issues in the novel depend on individuals and occasions depicted in the incredible epic the



Mahabharata. Tharoor has changed the old legend of the Mahabharata by utilizing it to reproduce history and governmental issues of current Indian.

The Mahabharata has been a wellspring of creative mind to all masterful classes down the ages. It can't be considered as similarly as a book yet it is a convention. The perplexing and numerous celebrated plot of this huge epic, to a great extent in oral custom have been passed on age to age. The focal subject of the epic is the clash between two parts of a similar family, the Kauravas and the Pandavas, over a contested patrimony yet the story and its characters greatly affect the minds of the individuals that they have become a necessary piece of their lives. The chief characters of Mahabharata have been considered as a significant establishment of India. Bhima spoke to as a military, Arjuna as a press and Draupadi as majority rules system.

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Beginning with the Benchmarking Process: Inner Processing for HEIs

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The paper is an analytical discussion on the basis of information and data collected from various online resources. An in-depth and comprehensive discussion in the simplest way has been maintained in order to outline and get everyone introduced to the process of benchmarking in HEIs in India.

The concept of 'benchmark' in higher education has been drawing the attention of everyone around the globe during the last few decades. Since quality improvement has been one of the most important features of higher education institutions, it is of equal importance to understand the role of benchmarking as a means to continually improving and staying competitive. In case of India, it becomes even more pertinent as there has been a constant surge in colleges and universities all around. There are pure issues of the concept of benchmarking and develop transformational methods and practices to improve educational institutions. The profound changes in the higher education context emphasize the necessity of a quality culture realized in the terms of Continuous Quality Improvement (CQI) philosophy. Higher education institutions strive to improve academic excellence, through country and institution specific processes. In particular, promoting excellence is essential for creating and establishing a knowledge-based society and economy, and for accomplishing the goals of economic growth and job creation as the issues are interconnected. Excellence can be: (a) a description of current provision and also a goal or aspiration for institutions, academics and students; (b) describing something that is exceptional, meritocratic, outstanding and exceeding normal expectations; and, (c) a relative and an absolute concept. One of the most important topics rises above the issue of academic quality in terms of leadership, academic faculty and human resources in general and has to be regulated in order for excellence to be achieved in higher education institutions. Quality assurance processes are actually models of quality assessment, which models provide institutions with possibilities of putting the theory of quality into practice. Academic excellence reveals the linkage of quality assurance to benchmarking, while changes in the academic scene call for substantial transformations due to business and industry demands. Benchmarking is established as one of the most 3 successful processes of assessment and improvement. It can be viewed as a methodology of study or improvement and as an opportunity to learn best practices, identify, establish and achieve exceptional standards, as long as top management is committed to it and views the process of comparing and competing as an ongoing one. Moreover, benchmarking is highly related to what is called 'good performance' which is determined by levels of expertise including basic, standard, good and excellent performance.

There are three important issues in case of benchmarking:

1. What is the level of benchmarking used by academic institutions for the enhancement and improvement of quality?
2. What are the major outcomes of benchmarking in higher education institutions and what are the bottlenecks in achieving them?
3. How can benchmarking achieve excellence in higher education institutions?

Thus, quality in higher education can be defined as "a multi-dimensional, multi-level, and dynamic concept that relates to the contextual settings of an educational model, to the institutional mission and 4 objectives, as well as to specific standards within a given system, institution, programme, or discipline". The rapidly changing forces that call for quality improvement and the ongoing upheaval in the higher education sector requires institutions recommence their strategic planning and implement effective practices for quality. In all respects, quality is relative to "whether one educational context has more or less quality than another, not whether it meets an absolute threshold standard so that it can be seen to be of adequate quality, nor whether it reaches a high threshold and can be viewed as outstanding and of exceptional quality, nor whether a context is perfect, with no defects". According to many experts, there are considerable barriers in the applicability of the concept of Total Quality Management (TQM) in higher education institutions, though this philosophy has been transferred from industry to higher education due to rapidly changing forces that call for quality improvement in the higher education sector. Quality in the business of education is in need of change in the educational processes, as it is becoming important in the world of competitive environment. Many researchers have compared industry to education and have pointed out conceptual and substantial obstacles in the implementation of TQM in tertiary institutions. Newby (1999) claims that barriers fall into three broad 5 categories:

(a) the nature of the management culture in some institutions, regarding the inability to respond creatively to the pace of change which eventually leads to institutional atrophy and decline;

(b) the traditional culture of higher education, as the barriers to introducing total quality approaches are more likely to lie in the prevailing culture of higher education and the tendency for organizations to ‘regress’ to the long standing and traditional; and,

(c) The heritage of past quality initiatives, meaning that total quality introduces nothing new and that the responsibility for developing and delivering a curriculum is always devolved to course teams. Across the world, academic excellence is a much discussed topic among higher education organizations. According to various authors, excellence, like quality, is a rather vague term. In the European Union, promoting excellence is essential for creating and establishing a knowledge-based society and economy, and for accomplishing the goals of economic growth and job creation (Joosten, 2014).

Adding up to the concept of excellence, academic research is another essential element that impacts on the continuous improvement and establishment of excellence in higher education institutions. In the UK, the Research Assessment Exercises (RAE), established by the UK University Grants Committee in 1985, constitutes an essential means for rationalising the stratification of universities and the concentration of research resources, and of maximising research output (Henkel, 1999). Arthur and Cox (2014) suggest the Research Excellence Framework (REF), which is in effect “a renewed version of judging research, notwithstanding the introduction of impact to the assessment criteria”.

A multitude of educational institutions have acquired internal mechanisms for quality assurance and implement self-evaluation procedures for quality enhancement. However, a large number of them around the globe turn to quality assurance agencies to receive external assessment. In this case, the agencies determine the particular quality procedures to be practiced and prepare the guidelines and practicalities of any site visit (Ossiannilsson, 2012).

Quality assurance agencies play an operative and effective role in the Bologna Process, specializing in quality assurance and accreditation (Unit, 2005). Except for the changing needs of the higher education environment, understanding the criteria and sticking to the best practices calls for the implementation of the following widespread framework of the way quality can be assured (Harman, 1998): •

Self-evaluation; 6 •

Peer review by a panel of experts, usually including at least some external panel members in one or more site visits; •

Analysis of statistical information and/or use of performance indicators or the best practices benchmarking; •

Surveys of students, graduates, employers, professional bodies; •

Testing the knowledge, skills, and competencies of students. All processes require the use of specific tools and mechanisms, so that appropriateness for purpose is accomplished. Benchmarking is established as one of the most successful processes of assessment and improvement. Blackstock et al. (2012) define benchmarking as “the process of self-evaluation and self-improvement through the systematic and collaborative comparison of practice and performance with similar organizations in order to identify strengths and weaknesses, to learn to adapt and to set new targets to improve performance”. In the UNESCO-CEPES Glossary for Basic Terms and Definitions, benchmarking is identified as “a standardized method for collecting and reporting critical operational data in a way that enables relevant comparisons among the performances of different organizations or programmes, usually with a view to establishing good practice, diagnosing problems in performance, and identifying areas of strength” (Vlăsceanu et al., 2004). According to the contributing authors, benchmarking can also be defined as: (a) a diagnostic instrument; (b) a self-improvement tool (a quality assurance tool) allowing organizations and programmes to compare themselves with others regarding some aspects of performance, with a view to finding ways to improve current performance; (c) an open and collaborative evaluation of services and processes with the aim of learning from good practices; (d) a method of teaching an institution how to improve; and, (e) an on-going, systematically oriented process of continuously comparing and measuring the work processes of one organization with those of others by bringing an external focus on internal activities (Vlăsceanu et al., 2004). Vlăsceanu et al. (2004) refer to the historical development of benchmarking in the higher education sector. They identify the United States as the first country to introduce benchmarking processes in the early 1990’s and, also, establish NACUBO (National Association of Colleges and University Business Officers) Benchmarking Project for a long period of time. They also mention that benchmarking came to the forefront as a quality assurance tool in the UK, after the 1997 Dearing Committee 7 Report which included: (a) The History 2000 Project, led by Paul Hyland (School of Historical and Cultural Studies, Bath College of Higher Education); (b) The RMCS (Royal Military College of Science) Programme at Cranfield University (example of benchmarking in libraries); (c) The Higher Education Funding Council for Higher Education (HEFCE) Value for Money Studies (VfM), launched in 1993; and, (d) The Commonwealth University International Benchmarking Club, launched in 1996, by CHEMS (Commonwealth Higher Education Management Service), as an example of international benchmarking (Vlăsceanu et al., 2004).

The logic of benchmarking is sound and easy to follow as stability cannot bring improvement. Various authors suggest that continuous improvement and excellence can be achieved by higher education institutions that are empowered to take deliberate

steps by using the benchmarking tool for optimization of their processes and programmes. One basic step is to choose a benchmark and the type of benchmarking that is going to be practiced. Typifying the concept of benchmarking in four broad categories, various literature recognize internal, competitive, functional and generic as the most common types. Jackson and Lund (2000) categorize benchmarking types with regard to processes that are implicit or explicit, independent or collaborative, internal or external, vertical or horizontal, quantitative and qualitative approach, and input-output focused. Achtemeier and Simpson (2005) recognize: (a) process benchmarking, which is about identifying the problem area within one's institution, identifying another institution with impeccable performance in the same area, and sending a team of experts of the area to learn from the exemplar institution their success formula that brings outstanding results; (b) metric benchmarking, which means comparing data of selected performance indicators among several institutions (Smith et al., 1999); and, (c) goals and milestones, which represent another way to understand benchmarking by identifying internal targets to establish a process, without any external point of reference for measurement (Zairi, 1996). Yarrow and Prabu (1999) add up to the variety of benchmarking types by recognizing diagnostic benchmarking, which is more akin to the examination of an institution's well-being in that it helps to identify the practices that need change and the nature and extend of performance improvements to be followed. The Consortium for Excellence in Higher Education (2003) identifies international benchmarking along with strategic, performance or competitive, process, functional and generic, external, and internal good practice 8 benchmarking. International benchmarking can be determined nationally and internationally and includes "a mix of all these approaches and organizational learning that is best done when it is carried out within a spirit or partnership and collaboration that enable both parties to learn from each other" (Lutfullayev, 2007). However, those who compete for excellence must make sure that they meet the criteria of powerful and progressive strategic management and governance, high standards of academic achievement, a strong track record with students destinations, an exceptional student experience, positive stakeholder satisfaction, high levels of student satisfaction, commitment to research and academic development, support for socio-economic and cultural development, recognition of the social benefit of education, commitment to internationalisation, promotion of equity and academic freedom (Brusoni et al., 2014). Considering the popularity of rankings worldwide, the main idea is linked to benchmarking and the acceptance of being compared to others in the sector. Ranking contributes to the improvement of institutions and programmes as universities are alerted to get better and better through processes of assessment and evaluation in order to elevate in the global ranking and gain reputation in the international scene. All universities that aspire to become renowned and attract more customers should be conscious of rankings and thus, establish benchmarking processes.

This discussion study explores quality in higher education as enhancement and improvement, and focuses on the use of benchmarking as a self-improvement tool. The aim of this research paper is to point out the structure and applications of quality assurance, by providing evidence for understanding the implementation of benchmarking as a competing tool for quality in higher education institutions. The gathering of data aims to provide: (a) findings on the dissemination of benchmarking; and (b) exemplar attitudes towards the particular types of benchmarking and the verified methods and tools for practicing it.

The formation and pursuance of benchmarking involves the use of some practical and functional tools in order for institutions to be able to diagnose, improve, collaborate, continuously compare and measure their work processes.

Thus, internal benchmarking is mostly outlined in this process of evaluation, probably due to the encumbrance of costly external evaluation, bureaucracy and the tendency of preserving university autonomy. It is common knowledge that institutional processes may be evaluated either continuously or periodically. In the area of process evaluation, the findings derived from research analysis were attributed in a statistical manner with permanent evaluation possessing a 25%, periodical evaluation holding a 65%, and evaluation that varies due to process content owning a 5%. The unfolding of this analysis regards the most critical challenge in the idea of benchmarking: continuous improvement through evaluation. Interestingly, the majority of the participants seem to be totally engaged with periodical evaluation, rather than permanent evaluation.

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MELTING BOUNDARIES

MEETING CULTURES

PRITI SINGH
SHAILESH BAHADURE

EURO WORLD PUBLICATIONS

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Multilingualism and Translation in Amitav Ghosh's Ibis Trilogy

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Amitav Ghosh is a writer of historical novels. India is a country of many historical events. Amitav Ghosh as a diaspora writer has depicted many incidences of history in his novels including his Ibis trilogy based on British colonialism. Amitav Ghosh's Ibis trilogy consists of multitudes of themes as social, political, cultural and economic. His trilogy is based on history of opium war between British and China in the mid nineteenth century, British colonialism, opium trade, transportation, slave trade and communication. Language plays a distinct role in the history of India as it is the medium of communication among people from different religion, caste and class. It is a medium of expression of one thought which the writer uses to show the readers the world around them and Amitav Ghosh is no exception in giving language an important place in his novels.

We see the use of different languages by his characters like Hindi, Bhojpuri, Bengali, Bihari, Chinese, slangs, pidgins, English etc. Ghosh has used these languages in his novels many times without translating them with the aim of giving the native language more importance than the Imperial language. Amitav Ghosh has travelled throughout the world and he came across many languages and has borrowed many words from different languages in his novels. The present paper emphasizes on how translation plays a great importance in the works of Amitav Ghosh, his borrowing of several words from different languages and giving translation where there is necessity.

Translation is a very old concept. In the earlier times, writers used to write in their native languages. The drawbacks of it was that different language speakers were unable to understand it. So their works were translated from one language to another with the intention of communicating different cultures, views, customs, etc. So, translation is the process of translating words or sentences from one language to another. The task of translation is not easy as the translator has to convey the message of the writer.

Walter Benjamin says, “It is the task of the translator to release in his own language that pure language that is under the spell of another, to liberate the language imprisoned in a work in his recreation of that work.”

Translation and its importance in literary field:

Translation is a means of communication. It makes association between different languages and their culture. The process of translation began in late 1970. It was considered a very important for the comparative studies. In 1980, it holds a grip and grew fast keeping the aim of globalization. With the passing of time, invention of electronic media in 1990 helped in the process of globalization. It helped giving information about the whole world, about different cultures, new technologies, different languages, and many more. Translation studies basically stresses on cultural aspects of translation. It is a sub-branch of linguistics. It is an interdisciplinary field of study which connects language with other social sciences studies. Many scholars have worked on translation studies like Roger Bell, Wolfran Wilos, Eugene Nida. With the increasing popularity of translation studies, numbers of translators increased and so the historical data was easily available and it gave rise to several new researches and the role of translator became foremost in the literary field. Many writers used translation to show the past history. Translation became a tool for representing the colonial dominance.

Mahasweta Sengupta says, “Translation can become submission to the hegemonic power of image created by the target culture, a cursory review of what sells in the west as representation of India and its culture provides ample proof of the binding power of representation. We remain trapped in the cultural stereotypes created and nurtured through translated texts”

Now translation is seen as a creativity of writers. It is not only translating the text from one language to another but also describing the world, past and present, the condition of the migrants, settlers, their negotiation between space and culture. With the passing of time, there was new advent of post colonialism in the world of translation studies. It is a link between translation studies and linguistics. The Indian Authors like Khushwant Singh, Edward Said, V.S. Naipaul, Salman Rushdie, Amitav Ghosh, Shashi Tharooretc wrote their novels on post colonialism. They focused on the situation of the migrants, their psychological conditions, their suffering and nostalgia, their struggle to settle in new places, their mode of communication, and their identity crisis. Gender studies also found place in the translation studies. Female writers like Nayantara Sehgal, Kamala Markandaya, Anita Desai, Arundhati Roy,

Gayatri Spivak etc. has very well uncovered the conditions of female in their novels.

Amitav Ghosh has written Ibis Trilogy with a thoughtful aim to reveal the condition of people of India during the British colonialism in the mid nineteenth century. His trilogy consists of three novels as *Sea of Poppies*, *River of Smoke* and *Flood of Fire*. All these three novels are associated with each other. The title of the novel consists of the word 'Ibis', it is a name of the ship carrying indentured labours from different parts of the world like India, China, Africa, Malay, Burma, etc to Mauritius for the sugar plantation for British mercenary purpose. It also consists of convicts, workers and slaves or the indentured labours are called as *girmityas* who have to sign an agreement called *asami* to work aboard. These people speak diverse languages. Amitav Ghosh has used various characters of different religious speaking their native language in his novels. The protagonist Deeti, is a north India woman from Bihar who speaks only her native language. Her lover is from lower caste *kolwer* who also speaks the same language. There are slaves from different parts of the world communicating with each other, two convicts *Raja Neel Rattan*, a prisoner who was earlier a *Raja* of *Rakshali State*, speaks English, Bengali. He also knows Persian and Urdu and *Ah Fatt* a half Chinese who speaks English, *Paulette Lambert* a French girl brought up by a Muslim woman, her caretaker. *Paulette* speaks Bengali with the French accent. Her half-brother *Jodu* who speaks Bengali, The head of Slave, *Sarang Ali* from *Arakan*, who knows many languages. He is from *Rohingya* and learnt South China pidgin language in the slave trade. An American Mulatto *Zachary Reid* who speaks English. All these people use different languages while on board and able to interconnect with each other. *Neel* uses code switching while taking with different class of people on the board.

Amitav Ghosh has very well borrowed several words from different languages in his novels. He tried to give translation of those words with the aim to understand the foreign readers. But there are certain words readers must be aware what the writer exactly wanted to say like in the *Sea of Poppies*, "Deeti is preoccupied with the lateness of her motion of her daily routine, laying out a freshly washed *dhoti* and *kameez* for *hokum Singh*, her husband and preparing *throtis* and *achar* he would eat at midday." (SOP, 3)

Here we see the words like *dhoti* and *kamaaz* borrowed from Hindi. The writer has not given the English words as he knows the readers can very well understand that *dhoti* and *kameez* are the clothes to wear and *achar* and *rotis* are the food items commonly eaten by Indian people. So he has not given the

translation of these words. The River of Smoke, the second novel of Ibis trilogy, the protagonist of the novel Bahram Modi while communicating with Allow says, 'No Allow,' he snapped. 'No wanchi sing-song girlie. Mh man Fa! HeuiseiLaa!'(ROS,298)

Here Braham Modi is saying to allow that he doesn't need any prostitute girl. He is not that kind of man. Here we see Bahram is using a Pidgin Language which was a business language used by many traders in Canton for the purpose of communication.

Amitav Ghosh's usage of translation in Ibis Trilogy

In an interview with Ilaria Rigoli, Amitav Ghosh's translator Anna Nadottisays about Amitav writing on multifacitious "White noise";

"I think there are two different levels one level understands as translators, I think we had to research a lot with the author's help, because he gave us a lot of help in this. You as a translator, have to understand. I don't say everything because it is not possible, but most of it as much as you can. Then there is another problem: now I have to write and what do the readers have to understand? I agreed with Amitav Ghosh when yesterday he said that you can't postulate and Indian reader; there are a lot of readers and everyone will understand something different, because everyone has his or her kind of culture that is different from that of another person. Then someone will go on the net and they will research something. Some other will not do it. So I think we had to maintain a certain degree of white noise and I think we did it."

Amitav Ghosh has very well use the codeswitching, pidgin language and slangs words in his novels. The characters in his novel use these according to their need. They use these languages according to the social class of people. Like Neel uses code switching. While talking to his servant Primal, he uses Hindi, and when talking to Major Hall, he uses Standard English. One such reason for using this kinds of language is British Colonialism. British with the aim of domination ruled several countries and forcibly applied their language on the people keeping English as a dominant language and the native language as inferior. This gave rise to codeswitching in India. We see such example in the novels of ibis trilogy.

Codeswitching

In linguistics, code switching or language alternation occurs when a speaker alternates between two or more languages, or language varieties, in the context of a single conversation. (Wikipedia)

Amitav Ghosh has very well used codeswitching in his novel, *Ibis* trilogy. During the British Imperialism, Britishers use to converse with colonized people in a mixed language. In *Sea of Poppies*, there are various characters who use codeswitching while communicating on board. Amitav Ghosh has used codeswitching in his novel to show the social status of his characters. He was of the opinion that codeswitching is evolved due to the social status of the speakers. Mr. Doughty, a pilot on the ship while talking to the lascars talk in a codeswitching language

‘Do none of you halacores have any wit at all? ‘The veins stood out on the pilot’s forehead as he shouted at the unbudging crew: ‘where’s the mate? Has he been given the kubber that my bunder boat has lagowed? Don’t just stand there: jaws! Hop to it, before I give your ganders a taste of my lattee. Have you saying your bysmelas before you know it.’(*Sea of poppies*, 25)

Here we see lots of words in Hindi used by Mr. Doughty while communicating with the lascars on the ship. He has used several words like halacores means haramkhor in Hindi which means a man who does not work at all or an idle, kubber which means new in English; lagowed means to give whip etc.

Amitav Ghosh has used these Hindi words and has not given the translation and made the readers to understand the abusive words used by the white for the inferior lascars. Mr. Doughty then suddenly switches to a formal language when he sees Zachary Reid, an American, a second mate on the ship and says, “And I’m James Doughty. The Burra Sahib. Ben Burnham that is asked me to take charge of the ship”(SOP, 25-26)

At the same time, these are the Hindi words which he uses while talking to the lascars who are of inferior ranks. Amitav Ghosh has used this codeswitching to show the use of language according to the social status of people. This is a very good example of codeswitching which Amitav Ghosh has shown in his novel *Sea of Poppies*.

Another example is of Neel, a Raja of Rakshali. He uses Standard English when he is with English man and automatically switches to native language

while dealing with the local people. While talking to his servant Parimal he says 'Yehkya bat hai? 'And when he saw Captain Hall he immediately switches to say "Ah, major Hall! What can I do for you?"

Here words Yehkya bat hai are Hindi words meaning what is the matter. Serang Ali while talking to Zachary Reid talks in pidgin but when he talks to local like Jodu a lascar on ship says "Teranamkya?(Sea of poppies, 142)

In the novel Flood of Fire, Mr. Doughty while advising Zachary uses Codeswitching as 'Now bunnow that corner into a little flap and lagow it with a pin- yes just like that. Shahbash!'(FOF, 84) Bunnow is a Hindi word means make, lagow means to join

Use of Pidgin

Pidgin is a language that has developed from a mixture of two languages. It is used as a way of communicating by people who do not speak each other languages.(Cambridge Dictionary)

Amitav Ghosh has very well used the pidgin language as a source of communication on the board among the lascars. These lascars are from different places like Arabs, Malays, Tamil, China, Bengal, and Arakanese. They have been separated from their family when they were children. They even don't know their country name. Sea is the only nation for them. While communicating they use hybrids of words, phrases and slangs which they have learnt from different places.

The best example of it is Serang Ali, the head of the lascaron the ship Ibis. While communicating with Zachary Reid, he says, 'Malumhabcutee he head? He said, "what for wanchee this piece boy? He blongi boat-bugger- no can learn ship pijjin. Better he wailo chop chop"(SOP, 151)

Here Serang Ali says to Zachary Reid that Sir, have you lost your mind? Why you want to keep this boy? He is a boat beggar. He will never learn pidgin.It is better that you leave him quickly. In the River of Smoke, the conversation between Punhyqua and Bahram Modi; 'That timi Lin Zexu, he Governor Kiangsi.He Savvy allo this thing. May be he thinkee, English-fellow speakee too muchi lie, allo' (ROS,291)We see the use of pidgin language in the conversation of Bahram Modi and Punhyqua where the words like pidgin words timi represents time, allo stands for all, thinkee as think, speakee as speaks etc

Use of Slang

A Slang is a very informal language that is usually spoken rather than written used especially by particular groups of people.(Cambridge dictionary). We see the use of slangs in the novels of Amitav Ghosh. He has used it to show how the power full man like Mr. Doughty used it on the inferior to show his dominance on the inferior class of people.

‘Damn my eyes if I ever saw such a caffle of barnshootingbadmashes! A chowdering of your chutes is what you budzats need. What do you think you’re doing, toying with your tatters and luffing your laurels while I stand here in the sun?’(SOP,25) Here we see the use of slang words like barnshoot: it is slang word used by British troops when they were serving India also called as Banchoot in Hindi.Badmashes is borrowed from Urdu, Hindi which mean bad or evil. ‘Chowdering’ is a Hindi word which is an abusive word. This word is used in America which means a kind of soup or pottage.

Budzats is a Hindi word which means badmas. In the third novel, Flood of Fire, we see the use of Slang words. Here we see Bhyro Singh using abusive words Haramzada! Bahenchod. ‘Bastard, you think you can get away from me? Chootiya, Haven’t I loaned you money and fed you for a month? You cunt, you think I’m kind of man you steal from and get away..?’ (FOF,111)

Translation has a very important place in the novels of Amitav Ghosh. He is very much fascinated towards the practice of translation with the intention to understand the other cultures. The writer has very well borrowed several words from different languages. He has used codeswitching, pidgin language, and slang words in his novels of ibis trilogy. We see his mastery over the use of words from diverse languages to suit his purpose in all his three novels of ibis trilogy. He has not translated many of words in his novels to make the reader understand the importance of native language rather than the imperial language. He has given the translation of words where ever it was necessary.

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Virtual Learning Environment in Higher Education

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Abstract:

E-learning is a type of education that is gaining prominence and being used increasingly across the world, since we are living in an era of information explosion. Education and Internet technology has impacted perspectives of teaching and learning. A VLE is a computer program that facilitates computerized learning or e-learning dealing with synergism of computer technology and content management sites like DRUPAL, MOODLE, WebCT (Course Tools), Interactive learning sites. Virtual Learning Environment (VLE) is a software system designed to support teaching and learning in an educational setting. It also aims to provide students with more flexibility, convenience and opportunity to work closely with teachers and peer groups. Its outcome can bring a paradigm shift in the way things are taught and will be taught. It emphasizes that learners and not just teachers can contribute to the educational experience.

Key words: E- learning, Virtual Learning Education (VLE), Computer, Internet, technology, teaching, learning.

Introduction:

“Teachers open the door, but you must enter by yourself,” a Chinese proverb says. The same can be said about technology in the field of Higher Education. If used properly, technology opens the door to a whole new range of possibilities. We live in an era of information explosion. Once upon a time there used to be a famine of information but today we are drowned in the deluge of information.

Information and Communication Technology (ICT) has become a catalytic agent. A Virtual Learning Environment (VLE) is a multi - user environment where developers may create, store, reuse, manage and deliver digital learning content from a central object repository. The marriage between education and Internet technology has made a deep impact on perspectives about teaching and learning. The role of the teacher, the nature and context of



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learning, as well as the function and relative importance of course content have all been challenged and redefined. Techno phobic teachers have no place in this new world order. Efforts can be made to harvest newer possibilities of revitalising and empowering universities and colleges through network, e-resources, online learning, archiving of contents. Several programs like Digital Repository, Network of colleges and universities, course wise e-content development, CEC, audio-video centres, etc. launched by the UGC are proving to be very helpful in furthering e-education. The thrust area of UGC XIIth plan relates to the same five goals of access to higher education (reflected in enrolment ratio), equal access to socially and economically disadvantaged groups or inclusiveness, and quality and excellence, relevance and value oriented education. More students need to be enrolled. This is possible only through web- based learning because it is difficult to increase infrastructure, man-power, etc. at such a pace and it will also require more monetary investment, which may not be afforded by the State Government. The easiest solution is to do investigative work on how E-Content Development can help in teaching – learning, and if effective implementation of such network is possible, it can help in more intake with less investment on manpower and infrastructure. Virtual Learning Environment will also provide students with benefits such as flexibility, convenience and the opportunity to work closely and collaboratively with lecturers and other learners from different universities and across the world. It deems to make the learning environment more interactive.

Today there is a great deal of research teaching through the use of e-learning. What can be said to characterise e-learning is that it does not require the student and the teacher to be in the same physical environment, in the so called face to face situation (Hiltz & Turoff 59).

According to Clark and Mayer, “ e-learning is defined as instruction delivered on a digital device such as a computer or mobile device that is intended to support learning”(8). Quality and Excellence is of great relevance in education: it can be seen that (a) VLE can deal with promotion and empowering the students and (b) it can also increase employability of students. This paper presents an estimation, possibilities and outcome of VLE in higher education.

What is VLE ?

A Virtual Learning Environment (VLE) is a software system designed to support teaching and learning in an educational setting, as distinct from a Manage Learning Environment (MLE) where the focus is on management. A VLE will normally work over the Internet and provide a collection of tools such as those for assessment, communication, uploading of content, return of students’ work, peer assessment of student groups, collecting and organizing student grades, questionnaires, tracking tools etc.



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Technologies in Open Source Course Management Systems (CMS) allow even non technical teachers to set up and maintain a Web site. The students can log in, access course information, interact, share and teach others in an open Course Management System (CMS). It is also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). It has become very popular among educators around the world as a tool for creating online dynamic web sites for their students. To work, it needs to be installed on a web server somewhere, either on one of your own computers or one at a web hosting company.

There are a number of free software packages that allow an individual or a community of users to easily publish, manage and organize a wide variety of content on a website. These are open source software distributed under the GPL ("General Public Licence"). A VLE is a computer program that facilitates computerized learning or e-learning. It deals with synergism of computer technology and content management sites like DRUPAL, MOODLE, WebCT (Course Tools), INTERACTIVE LEARNING sites. Creating online dynamic web sites for students will have profound relevance for interdisciplinary teaching and learning. Its outcome can bring a paradigm shift in the way things are taught and will be taught.

In addition, the VLE will be capable of supporting numerous courses, so that the students and instructors in a given institution or across institutions experience a consistent interface when moving from one course to another. At the heart of any learning platform is the concept of a personalized online learning space for the pupil. This space should offer teacher and pupil access to stored work, e-learning resources, communication and collaboration with peers, and the facility to track progress.

Possibilities of VLE:

The extensive use of web components like Internet, Blogs, E- groups, SMSes, Emails, Socializing portals, E-dictionaries, Encyclopaedia, Power Point presentations, Web –casting, Audio- video etc. are used now a days to make the classrooms more interesting. The teacher-student community will be motivated to make use of cyber cafes and GPRS mobiles. Here again, use of ICT in form of DVDs of Encyclopaedia, Internet resources, Graphical presentations, audio books, movie clips etc. can be of tremendous help.

Use of VLE can help in teaching for it deals with synergism of computer technology and content management sites even hosts discussion forum, chat, quiz, etc. The built –in functionality, combined with dozens of freely available add-on modules of the VLE has features such as Blogs, collaborative authoring environments, Forums. Peer to peer networking, Newsletters, File uploads and Downloads and much more.

The open source licence of VLE and its modular design allows a developer to create additional modules and features. It is very similar to a learning management system, but it



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has many more standard features. It can be used in many types of environments such as in education, training and development, and business settings. Developers can extend its modular construction by creating plug-ins for specific new functionality. Many VLEs that are being used support many types of plug-ins for various activities (including word and math games), questions types (multiple choice, true and false, fill in the blanks, etc.), data field types (for the database activity), its graphical themes and its resource types.

It has its unique system for its authentication methods (can require username and password accessibility), or even for enrolment methods or as content filters. The VLE users can use PHP to author and contribute new modules. It must be admitted that the development of VLE has been assisted by the work of open source programmers. This has contributed towards its rapid development and rapid bug fixes. E-learning systems can have many dimensions of interoperability. VLE provides various types of questions – Calculated, Description, Essay, Short Answer, Numerical, Random Short Answer Matching, True/False. In colleges students are beginning to mix virtual courses in their schedules. The trend toward using digital contents and online elements to enhance traditional courses in all fields is also strengthening. An increasing number of institutions are now offering a blend of virtual and in-classroom teaching with some components available in person in the classroom and other pieces available online.

Outcome of VLE:

The Virtual Learning Environment (VLE) includes a constructivist and social constructionist approach to education, emphasizing that learners (and not just teachers) can contribute to the educational experience. The basic objective of VLE would be to communicate to the youth population of the country the excitements of creative pursuit of knowledge and attract talent at the ripe stage and build the required critical human resource pool for strengthening and expanding the Humanities of Science & Technology system and R&D base. It relies on the efficacy of the existing educational structure. The strength of the innovative infrastructure of a nation has enormous significance in the competition between emerging knowledge economies. The realization of VLE calls for action and a well designed innovation infrastructure.

VLE shall expose teacher and students to e-libraries, e-resources, e-information and make them free from close-minded outlook towards education and life and to share and extend experience of using the Internet in teaching in order to increase the effectiveness of the teaching/learning process. It shall facilitate the exchange of information and networking among teachers and trainers interested in using information technologies in their teaching and to exploit the potentials of teachers and develop their training skills with the help of web resources.



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Generation of nurturing of a human talent pool and developing first principles in science, humanities or any stream is both a pre-condition and integral part of such an innovation infrastructure. VLE can add talent to the excitement and study of science at an early age, and to help the country build the required critical resource pool for strengthening and expanding the S&T system and R&D base. These are programs with long term foresight.

The advantage of VLE in the long run is that it can establish a common platform at various content management sites to develop more e-resources which can be used by teachers and students. This may be made accessible by the mediating Teachers. This is a great step towards further complementing of our educational system. We can, then, take a step in the direction of copyright to free access realm, which is of great importance to Third World countries. The VLE and higher education are highly relevant to decision makers and professionals who are involved in the design, implementation and evaluation of online learning to serve the higher education community.

Conclusion:

Information and communication technology has changed the way people look at education. We live in an era of information and knowledge society. This new society, to fulfil its needs requires innovativeness in teaching and learning. Of all the disciplines of education, Social Sciences and Humanities make least use of new technologies. It is the urgent need of the hour to make them aware of the importance of the use of E-content Development. A VLE should make it possible for a course designer to present to students, through a single, consistent, and intuitive interface, all the components required for a course of education or training. Although logically it is not a requirement, in practice VLEs always make extensive use of computers and the Internet.

Traditional teaching methods have become obsolete. They are no longer yielding expected results. It is the urgent need of the hour to find out better ways to use E-content Development and make teaching-learning more effective. Thus the problem arises whether our teachers are equipped for this new wave and the question whether our infrastructure is suitable for extensive use of VLE. Beneficial aspects of e-learning must be promoted to those teachers who are sceptical towards and do not have enough knowledge or experience in working with learning technologies.

Internationally, all the renowned universities and educationists are engaged in research and development in how to make effective use of ICT for improving and empowering the education system. Worldwide research on the use of E-content Development for teaching-learning is going on. Indian Universities should not be left behind in this research and development. Indians have proved their mettle as an intellectually powerful nation of the world, thanks to IT technocrats and software engineers working in multinational



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IT companies. But still our education system is not coping with the current trend. Foreign universities are eyeing entry into India. They are well equipped with IT facilities to woo our students. If our universities/colleges need to stand the competition, they shall have to revolutionize their education system with the help of ICT.

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Theme of Protest in Toni Morrison's *The Bluest Eye*

Priti Singh

Abstract

Protest is the awareness that arises when man confronts an unjust and inhuman situation, and decides to get rid of it by way of raising his voice against it and acting to remove it. It has the quality of identifying itself with the downtrodden and the oppressed. The awareness of protest thus arises when man confronts an unjust and inhuman situation. It takes birth when man decides to get rid of his slave mentality. The novelist as a socio political being uses the medium of writing to transform the society to a large extent. Toni Morrison, in her debut novel *The Bluest Eye*, has voiced her protest against the racialized community very effectively and expressed various significant issues related to the life of the blacks, their psyche, society and plight through the character of Pecola.

Keywords: Protest, oppressed, downtrodden, unjust, inhuman, racialized, blacks.

Introduction

Protest means objection, complaint or revolt. Protest literature refers to works that address to real socio-political issues and express objection against them. The definition of protest literature is fluctuating and variable. It may have different connotations for different people. For the deconstructionists all literary writing is eventually a form of protest. In literary history

protest literature has continued to exist in diverse forms. In a society, protest provides human alternatives for safeguarding not only ones natural rights but also to ensure social change. The protest of an individual is often reflected as social protest. Protest is the awareness that arises when man confronts an unjust and inhuman situation, and decides to get rid of it by way of raising his voice against it and acting to remove it. According to Douglas O. Willium, "Protest is not ideological in its orientation, but is, essentially activist" (9). The basic ingredients of protest that naturally comes into conflict with the establishment are a consciousness regarding fundamental rights, a tendency to struggle, and a sense of independence and liberty. Protest is, thus, primarily the result of intense human consciousness, which involves values. It is both a manifestation of human concern and an endeavour to add meaning to human existence by strengthening the concepts of social justice, equality, and liberty. Protest has the quality of identifying itself with the downtrodden and the oppressed. We can say that it is a process of upholding human values as they cannot be taken as eternal and unchanging. Emmanual G. Mesthene states that "Most frequently we make rearrangements in our value hierarchy; values once considered crucial become less relevant and, therefore, less important while others, once relatively lower in our estimation take on new importance. Values do not have to be eternal and unchanging in order to be values" (47- 48). Protest as a value and as an effective medium will serve its purpose only if it is used with relevance to real situations obtained in actual life processes. Literature is a good medium to reflect such values through protest. A writer who while struggling or confronting the condition of his times and society, earns values in a new and fresh way and explores them in the context of real life situations. The result is that new values emerge when one is imbued with new consciousness, with an understanding of the prevailing social norms and belief structures of the individual and society. Some writers by rebelling try to bring in new forces of social change as Albert Camus commented 'Man, by rebelling, imposes in his turn a limit to history and at this limit the

promise of a limit is born'. Protest in literature is a kind of evolution. It is a course of change and the need for reform.

The awareness of protest arises when man confronts an unjust and inhuman situation. It takes birth when man decides to get rid of his slave mentality. Literature has always been suffused with vestiges of social realism in fiction which gained prominence in the writings of Charles Dickens (1812- 1870), Zora Neale Hurston (1891-1960), Richard Wright (1908-1960), Ralph Ellison (1913-1994), Attia Hosain (1913-1998), Kushwant Singh (1915-2014), Toni Morrison (1931-), Bapsi Sidhwa (1938-), etc., to mention a few. Social realism is suggestive of the acute awareness of the various social, political, economic and religious forces that the individual is entrenched in, and their power to affect the lives of men and women for better or for worse and the overall interaction of the individual. With the progress of civilization and development in technology, the scientific temper affected the human psyche to a large extent. The dawn of democracy brought in its wake a sense of individualism and protest became a means to voice the need for equality and reaction against injustice. The novelist as a socio political being uses the medium of writing to transform the society to a great extent. This paper analyses Pecola's protest against racial discrimination.

Toni Morrison, known to be one of the most inspiring writers of America, has voiced her protest against the racialized community. She has very effectively expressed various significant issues related to the life of the blacks, their psyche, society and plight. Her themes mainly determine her protest against the adverse effects of race, gender or class. She also explores the theme of sexism which is integrally connected with racism in the black society. Racism involves the belief in racial differences which acts as a destructive element for the members of the other race. The term is commonly used pessimistically and is usually associated with race-based prejudice. Therefore, racism may be defined, according to Hernton as: All of the learned behaviour and learned emotions on the part of a group of people towards another group; whose physical

characteristics are dissimilar to the former group behaviour and emotions that compel one group to... treat the other on the basis of its physical characteristics alone, as if, it did not belong to the to human race (Hernton 175).

The *Bluest Eye*, published in 1970, deals honestly and unflinchingly with the internalized pain and ruinous impacts of racism in the U.S. The seeds of racism were sown in America when the white masters started to bring the Africans in chains and used them as slaves. They also started treated these black people in a very dehumanizing and degrading manner and which ultimately resulted in the rise of racism in the United States. The white imposed their values on them robbing them of their African souls leaving them shattered and broken with feelings of inferiority. The plight of Toni Morrison was no different and she gave vent to her feelings of racism by way of protest writing against the idea of race, gender and class which were the three major forms of oppression of the blacks in America. The novels of Toni Morrison are predominant with the themes of oppression and exploitation revealing at the same time her grave concern of the inter relationship of race, gender and class, though the emphasis on these three elements of race, gender and class varies in each novel. The *Bluest Eye*, Morrison's first novel is a poignant story of the condition of a black girl's quest for white values. Pecola is black girl, an abandoned, ill-treated and hateful child who has a very poor opinion about herself. Along with others around her, she herself thinks, that she is repulsive and worthless. However, Pecola protests against her ugliness by finding the way to her happiness. Pecola yearns to have blue eyes because for her blue eyes symbolise beauty and being loved. Innocent as she is Pecola believes that the mere possession of blue eyes will replace all the cruelty in her life with affection and respect.

It had occurred to Pecola some time ago, that if her eyes, those Eyes that held the pictures and knew the sights – if those eyes of Her were different, that is to say beautiful, she herself would be Different (TBE 46).

In the blue eyes, the aspiration is for identity and selfhood. Pecola's aspiration of attaining the bluest eyes is in itself a kind of protest though she is condemned to be black by her birth and colour. It is her struggle to go beyond the existing condition and discover her identity and selfhood. "Pecola desires blue eyes, the symbol of white beauty; she feels that such eyes could make her beautiful, acceptable and admirable and she could restore her self-respect" (Pathak 43). The ideals of the country in which she is born, do not apply to her. Moreover, all the images on billboards are the images of white people. Pecola's conviction of becoming loveable by changing her eyes is altogether an evidence of racial self hatred. The girl believes that only blue eyes can alleviate her desperate situation. She is a very lonesome and rejected child and even her family does not support her. "Her parents treated her as an outcast and put her outdoors where neither her mother nor father ever bothered to enquire about her living conditions in the neighbouring family of Mc Teer where they had dumped her" (Kant 47). Her strong craving to possess blue eyes is because she wants to protest against the attitude of her family towards her. The discrimination on the basis of race from the society may be tolerated but there is no escape from the pain when the shock comes from one's own family. Pecola thinks,

"If she looked different, beautiful, maybe Cholly would be different, and Mrs. Breedlove too. Maybe they'd say, "Why, look at pretty-eyed Pecola. We mustn't do bad things in front of those pretty eyes" (TBE 44).

This indicates that her primary concern is to escape the abuse and neglect within the home. Pecola tries to acquire people's love and attention by getting blue eyes because she sees that little girls with blue eyes are accepted and respected. The choice of blue eyes is due to the racist society she has grown up in and to show her dissent against the racist society: Each night, without fail, she prayed for blue eyes. Fervently, for a year she had prayed. Although somewhat discouraged, she was not without hope. To have something as wonderful as that happen would take a long, long

time. Thrown, in this way, into the binding conviction that only a miracle could relieve her, she would never know her beauty. She would see only what there was to see: the eyes of other people (TBE 44). Since Pecola has not received love and affection at home, she has a somewhat hazy idea of what it would like to be loved, "What did love feel like? She wondered. How do grown-ups act when they love each other? Eat fish together?" (TBE 55). Unknown to the idea of love, Pecola can discuss about love only with the prostitutes living upstairs at Mrs. Mc Teer's. Since Pecola does not have any knowledge as to why people feel love and affection for each other, she decides that it certainly has to do with the colour of the eyes. Both the communities associate blue eyes with beauty, and the fact that Mrs. Breedlove, Pecola's mother, is so fond of the blue-eyed fisher girl, and showers her ultimate nurturing care to the little white girl leaves Pecola only with this choice. This reaction of Mrs. Breedlove is her protest as a victim of being black: When she bathed the little Fisher girl, it was in a porcelain tub with slivery taps running infinite quantity of hot, clear water. She dried her in fluffy white towels and put her in cuddly night clothes. Then she brushed the yellow hair, enjoying the roll and slip of it between her fingers. No zinc tub, no buckets of stove heated water, no flaky, stiff, grayish towels washed in the kitchen sink, dried in a dusty backyard, no tangled black puffs of rough wool to comb (TBE 125). This statement is proves that she likes the Fisher home with all its modern amenities and actually prefers the Fisher girl to her own. Pecola and the rest of the family appear to be insignificant to Pauline as they are "the early-morning and late-evening edges of her day, the dark edges that made the daily life with the Fishers lighter, more delicate, more lovely" (125). The white girl becomes superior in comparison to her own daughter that the black mother belittles her. The white girl can call her Polly while Pecola, her daughter, has to call her Mrs. Breedlove, may be considered as her remonstrance against her desperate and disgusted situation: Her attitude of discrimination in rejecting her own daughter in the face of the white girl may have another angle that could have been perceived not out

of the curse of poverty but as a natural reaction of a desperate, disgusted and dissatisfied mother-woman who has been consistently denounced, beaten and tortured by her husband (Kant 49). Pauline also ascribes society's love of white beauty to such a degree that she views herself as worthless unless she achieves that standard. She cannot relate to any of the women in the North hence Pauline frequently visits the movie theatre "along with the idea of romantic love, she was introduced to another----physical beauty. Probably, the most destructive ideas in the history of human thought. Both originated in envy, thrived in insecurity and ended in disillusion" (TBE 120). For this reason it can be believed that, "...black represents the shade of evil, the devil's aspect, night, separation, loneliness, sin, dirt, excrement, the inside of the body, and white represents the mark of good, the token of innocence, purity, cleanliness, spirituality, virtue and hope" (Kovel 232).

The ultimate act of deceit and betrayal that finally pushes Pecola over the edge comes when Cholly, her own father rapes her. According to some social psychologists, frustration is the only, or even the most important reason of aggression. Others believe that it is simply one of many factors that have led to aggression. In Cholly's case, frustration is manifested in the form of sexual aggression because when he was sixteen, he was caught by the two white hunters while experiencing his first sexual pleasure with a country girl named Darlene. At the time he was forced by those white hunters to repeat the same act while they watched. This repetition of the humiliation Cholly had experienced under the gaze of the two racist whites, caused hatred in him for the black girl. Hence, "The entire situation, however, culminates into a silent revolt that would sustain his soul till he finds a favourable occasion to wreak his revenge" (Kant 52). Later, in the novel, he demonstrated it through domestic violence toward his wife and the molestation of his daughter. In this way, Morrison condemns racism and shows that the person who is subjected to it, internalizes the shame and bitterness and when those feelings are let out, others get hurt.

Pecola's brother, Sammy, remains away from home most of the time to show his dissent against the racist society. So he is not there to protect Pecola when she is in need. The common feature in the Breedlove family seems to be that every member of the family feels hideous because "You looked at them and wondered why they were so ugly; you looked closely and could not find the source. Then you realized that it came from conviction, their conviction" (TBE 37). Pecola is made a scapegoat in the school. The children at school would taunt her primarily because she was dark skinned "Black e mo. Black e mo. Yadadd sleeps nekked. Black e mo black e mo ya dad sleeps nekked. Black e mo..." (TBE 63). The "Black e mo" part of the quotation means that Pecola was even blacker than they were. As a result, even those who were not particularly light-skinned themselves took the chance to mock and make fun of someone who was darker than they were: They had extemporized a verse made up of two insults about matters over which the victim had no control: the colour of her skin and speculations on the sleeping habits of an adult, wildly fitting in its incoherence... It was their contempt for their own blackness that gave the first insult its teeth. They seemed that taken all of their smoothly cultivated ignorance, their exquisitely learned self-hatred, their elaborately designed hopelessness and sucked it all up into a fiery cone of scorn that had burned for ages in the hollows of their minds---cooled---and spilled over lips of outrage, consuming whatever was in its path. They danced a macabre ballet around the victim, whom, for their own sake, they were prepared to sacrifice to the flaming pit (TBE 63). Claudia Mac.Teer, is the only character in *The Bluest Eye* who is not affected by the mainstream culture. Claudia is disgusted when Pecola and Frieda discuss about the beauty of the white movie star, Shirley Temple. The disgust and contempt is so pronounced that when she is gifted the present of a blue eyed and blond haired doll from her parents at Christmas, she destroys the doll by tearing holes in their eyes. Other than Pecola, it is Geraldine, the mother of Louis Junior, who is obsessed by the colour of her skin. Though she herself is light-skinned Geraldine hates darker- skinned black and tries

hard to be much like a middle class white woman. Geraldine and her peers are willing to do anything to differentiate themselves from darker-skinned blacks and to resist being with them. Geraldine serves as the best example in this regard, who, despite being a coloured woman, maintains distance from the entire nigger community. This sort of behaviour is the result of her own despair and anger. After becoming pregnant by her father, Pecola goes to Soaphead Church, to take help from a "faith healer." He asserts that he talks to God. Pecola pleads him to grant her blue eyes, but he was misconceived by the belief that the girl would be helped by living with the illusion that she had blue eyes. "I, I have caused a miracle. I gave her the eyes. I gave her the eyes. I gave her the blue, blue, two blue eyes. Cobalt blue. A streak of it right out of your own blue heaven. No one else will see her blue eyes. But she will. And she will live happily ever after. I, I have found it meet and right so to do" (TBE 180). Thus by helping Pecola, in getting the bluest eyes he applies balm on the injuries inflicted on him due to racism. The real reason for Soaphead Church's actions can be found in his own family background where members of his family have tried their best for generations to marry someone whiter to improve upon the family features like, nose, lips, etc; and become whiter with each generation. In the Soaphead Church family, every success is attributed to the white strain of the blood. All these instances show that blacks reject their own racial identity due to self loathing or hatred. Thus it can justly be said that: It was as though some mysterious all-knowing master had given each one a cloak of ugliness to wear, and they had each accepted it without question. The master had said, "you are ugly people." They had looked about themselves and saw nothing to contradict the statement; saw, in fact, support for it leaning at them from every movie, every glance. "Yes," they had said. "You are right." And they took the ugliness in their hands, threw it as mantle over them, and went about the world with it (TBE 37). In this manner, Pecola protests against all the acts of ill treatment by remaining mute and goes mad, believing that her long cherished dream of possessing blue eyes has been fulfilled. In

this novel other characters also protest against racism, such as, Mr. Breedlove who reacts against it by abusing and ill treating his wife and children. Claudia defies it by destroying the white dolls. Mrs. Breedlove speaks against it by humiliating her daughter and working in Fisher's home and Geraldine, by keeping away from the nigger community. In other words, it can be said that the novelist too expostulates against it by showing the repulsive effects of racism on the life of the Afro-Americans.

Conclusion:

Toni Morrison's singularity lies in protesting against the inhuman treatment on the blacks by the whites, and, at the same time, revealing the beauty and the hope beneath the surface of the Black America. In *The Bluest Eye*, Toni Morrison has tried to convince the readers to re-read the questions of racial identity, class and culture in order to rethink about the black identity in nationalist terms. Pecola the ugly black girl was humiliated and insulted because of her skin colour. She does not meet the society's standards is expunged from the human society even before realising the consciousness of self. Pecola stands for the triple indemnity in the female black child: children, blacks, females and the poor are devalued and pushed to the margins of an already marginalized society. Both male and female characters are victimised in the white society and they protest throughout the novel.

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DARK ROMANTICISM – A SHADOWY APPROACH TO THE FANTASTICAL**MANOJ ANDRASKAR**Assistant Professor
Department of English
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Deeksha Bhoomi, Nagpur-10**ABSTRACT**

Dark romanticism considered as one of the major literary sub-genre of the Romantic Movement in literature. It was a direct reaction to the transcendentalist's optimistic attitude towards life. Dark romanticism often deals with the sceptic and unknown facts of the individual's life. The writings of the dark romantics like, Edgar Allen Poe, Nathaniel Hawthorne, Herman Melville, and Emily Dickenson also come under shadowy elements where strange and untouched facts need to be studied. This paper aims to study the writings of the dark romantics to analyze the hidden and shadowy structure of the writings behind the famous works given by Dark Romantics which can be considered as a shadowy approach to the fantastical. It may be called the negative approach towards the text to unravel something unknown which cannot be understood by simply reading the surface. Dark romantics believe that sometimes the struggle of a human soul goes with pessimistic thinking which represents something unnatural and odd, and this becomes the subject for dark romantics to find out the hidden motives behind the same. It directly or indirectly gives affirmation to the evil and death which is nothing but the symbolic representation of the individual's life.

Keywords: Unravelling the Unknown, Unnatural and Odd Representation of the Characters, The struggle of Human Nature, Affirmation to Death and Evil, Individualism.

Dark Romanticism emerged in the eighteenth century and became the main area of study under the broad Romantic Literary Movement. It was a direct reaction to the Transcendentalist philosophy. Dark romantics emphasize the primitive, medieval, mysterious, horrifying and supernatural elements whereas Transcendentalists emphasize the inherent goodness of nature and the human soul and they embrace the free spirit of imagination to become self-reliant and independent. The Romanticism Movement in literature introduced many genres under which Gothic literature flourished. The gothic romance was a direct and influential genre as far as the themes like gloom, the grotesque and supernatural are concerned. At the same time, the more generalized concept was formed that was Dark romanticism but there is little difference between Gothic and Dark Romanticism. When it is about Gothic Romance it is more particular in sense but when it is about Dark Romanticism it is more general in sense.

Dark Romanticism often deals with the individual's life, suffering and personal losses. It is a fact that every Dark romantist have experienced something bad in their life. They may have lost someone so special; they may have suffered a lot because of society, personal health problem, or because of some addictions in their life. They struggle a lot, that is because the writings of the Dark romantics are sceptic, having mysterious nature and double meaning in them. There are several factors that are not touched upon yet. The Dark romantics like, Edgar Allan Poe, Herman Melville and Nathaniel Hawthorne often discussed personal losses and mysterious facts of their life which are still unfolded. Edgar Allen Poe was just three years old when he was orphaned and the reason for his death is still unknown. His wife died at the age of 24 and coincidentally it was the same age at which his mother and brother also died. (1) The life of Poe is full of grievances, depression and suffering which reflected in most of his writings like the poems 'Raven' and 'Ligeia'. Herman Melville also forced to leave because of the worsening financial condition after his father's death. After leaving home his four-month voyage to Liverpool established his connection with the seas. He also introduced the shabbier side of the materialistic society of England which can be seen in his famous work 'Moby Dick'. Nathaniel Hawthorne's writing also distinguished by the subject of human fallibility which allows thinking that good men and women can drift towards sin and self-destruction. His works '*The Scarlett letter*' and '*The House of Seven Gables*' is the best example for it.

The characters in the Dark romantic works always seems as the odd and unnatural, though the works or the characters in the dark romantic spirit were influenced by the transcendentalism philosophy, it does not hold up the entire ideas of the philosophy. Transcendentalism follows man's spiritual essence and his soul's ability to transcend the physical more optimistically, whereas dark romantic follows it in a more sinister light. It presents individual as inclined to sin and self-destruction not as innately possessing spirituality and wisdom. Dark romanticism also presents reality and nature as dark, decaying and mysterious which reveals the evil and hellish reality of the individual's life. For the dark romantics, evil and sin were everywhere so their symbols often represent evil entities like devils and spirit. The presentation of the characters are more sceptic in general which arises doubt in the minds of the readers, sometimes it also pretends the reality of how it should be and can be very dangerous to accept. Dark romantics found transcendental beliefs far too optimistic and egotistical and reacted by modifying them in the works that are the reasons dark romantics consider it as farce, away from reality, to correct it dark romantics frequently show the individuals failing in their attempt to make changes for the betterment of the society or its own sake. It turns his mind in a state to bring out the change where it sometimes would not be possible for any individual to present himself naturally as a normal human being. This is because the characters in dark romanticism are considered outcast. It believes that nature is evil and there is no positive aspect in the life of human being. They also believe that every individual is different and not perfect and there is no innate quality, they generally argue against the norms formed by society and that's why they stand different from the normal. It considered odd and unnatural sometimes in connection with the human psyche which sometimes attracted in a subtle way to fear, pain, tragedy and destruction. It is the suffering of the human soul to discover the dark side of the human mind which leads to the birth of dark perspective and unnatural representation of the characters. This kind of characterization aims to reveal dark mystery and scepticism hidden somewhere in the dark.

Moby –Dick by Herman Melville is one of the great examples of Dark Romanticism. The character, Captain Ahab is an archetype of human fallibility and attracts towards the Biblical allusions including his character name which observes and centred upon the theme of judgement, soul, guilt, sin, evil and the end of the world. It can be seen in Moby Dick, (Chapter 65)

"Cannibals? Who is not a cannibal? I tell you it will be more tolerable for the Fejee that salted down a lean missionary in his cellar against a coming famine; it will be more tolerable for that provident Fejee, I say, in the day of judgement, than for thee, civilized and enlightened gourmand, who nailest geese to the ground and featest on their bloated livers in thy pate de fois gras." (p. 285)

The great practitioner of Dark Romanticism, Edgar Allan Poe's famous work 'The Fall of the House of Usher' discuss Hypochondria and Hyperthesia which is about the mental state of the human being. 'The Scarlet Letter' by Nathaniel Hawthorne, deals with the punishment, imposed judgement, sinning which results in the alienation from society.

The typical symbols of dark romanticism are the individuals and their sufferings. They are filled with guilt, sin and despair this is the reason they often stand themselves alienated from society. They often seem as having committed some horrible blunder or terrible crime in the past. Dark romantics are outcast from the beliefs, divinity, godly things and the men in the society. Dark Romantic does not mean darkly romantic, it is an exploration of the inner working of the human minds. It has a struggle that leads to the shadowy element. It is about the struggle of human nature. Dark Romantics believed that human nature is less than good, so the evil state of mind can take a hold of a person. Their writing reflects the people often suffer, they see something mysterious is there. For instance the characters in 'Dr. Heidegger's Experiment' by Nathaniel Hawthorne, each have something they need to modify and change in their lives because they feel guilty and embarrassed about their past. Once upon a time, Widow Wycherly was a woman who was loved in the town but when people came to know about her past she lost her status and reputation and has guilt for it. People started rejecting her so she suffered a lot, she lived alone. Similarly one of the characters who wanted to be young and beautiful again drank the youth water. As she is guilty of her past mistakes and she looks miserable she seemed as she had never known the youth and pleasure. She looked like she had always been an unhappy and weak creature who was bent over the doctor's table. So the character struggles a lot in their personal life, sometimes they want to change everything which is happening with them in their lives so that they can at least survive or fight with the situation. Hawthorne here focuses mainly upon the sins and struggles of individuals in taking the journey of life to the next level.

The life of Edgar Allen Poe also was not easy. He also experienced ups and downs in his life. There are so many pages of his life that has to study thoroughly so that the pessimist writing and negative approach to unravel something which he has used in his writings can be understood properly. Lorine Pruetif writes in "A Psychoanalytical Study of Edgar Allan Poe (p. 370):

"The life of Edgar Allan Poe might be considered happy record of that "disaster" which "followed fast followed faster" this man of brilliant capacities till it drove him into opposition with most of the world, deprived the love he so inordinately craved,

paralyzed his creative abilities, seduced him to seek a vague nepenthe in the drugs and stimulants, and, its relentless purpose achieved, cast him aside, a helpless wreck, to die from the darkened tragedy of a Baltimore saloon. Without further following such an anthropomorphic conception of fate, we must be impressed that both environmental circumstances and natural inheritance seem to conspire to cast the young poet in a role that is both somber and wild, with a beauty that chills more than it saddens.” (3)

Overall the life he lived was not sorted enough. The writer is someone who enjoys every thought, ideas while putting it down on paper and presents a story as a lively picture. These writers make us alive with their writings and many of their writings are considered as clearly an escape from society or reality and this can be easily seen in the dark romantics' writings. That is exactly what Poe has incorporated in his writing. Poe went through a lot of things he was always feeling sad about the life he was leading and he expressed almost everything in his works. The poem 'Raven' is one of the famous literary models for dark romantic writings. This poem is about the narrator and the black raven. The theme and meaning of the poem have expressed the life and suffering of Poe's life. In the poem, he seems very sad and lonely and he found the expression to express it in words through this poem. The poem is about his love for his wife and he lost hope of ever seeing her again. Poe loved to reflect through his writings and it can be also seen in his poems like "Ligeia" and "Anabelle Lee".

The source of imagination is all about the limits of the great minds and Edgar Allen Poe is a writer of great imaginative power. He is especially known for his creepy imaginative, sad, depressing poems and stories. His life's incidents are very sad that can be seen in most of his works. The symbols he has used in the poem are mostly dealt with depression, death and lost love. It sometimes directs towards the affirmation to the evil or death. His poem 'The Raven' stands as an prototype of grief, sadness, despair, loneliness and separation. In the poem, Poe is yearning for his love Lenore out of despair. Somewhere Poe knows this and hard to believe that his beloved will never come to him. So it means here Raven stands as a symbol of evil and death it also stands as a symbol of Poe's grief as well as the wisdom that Poe gain through their exchange.

'The Night's Plutonian Shore' in the poem 'The Raven' symbolizes the border between the worlds of the living and the dead (4) These kinds of scary images descend from the eerie gloominess which brought through the unknown power of the midnight hour. The shadows, isolations, loneliness and eeriness all characterized the setting and create a scary atmosphere within the poem. Poe takes the symbol of 'The night's Plutonian shore' and allow the reader to the journey of pits of hell, which is a direct allusion to the Roman God of the underworld where at the shore the ferryman would be ready to take the dead through the gates of Hades. These symbols are not merely the hellish representation of night, but it is Poe inner willingness to see his beloved Lenore at any cost. Poe somewhere accepts the thing that she will never come again. Somewhere in the mind, to achieve something desired, the human mind gives affirmation to death and evil.

The symbol can have good and bad meanings. As an optimist one symbol might have just good meaning but also could have all bad meanings. In 'The Scarlett Letter' by Nathaniel

Hawthorne the “A” meant differently than it was intended to the people. The scarlet “A” in the book epitomize and happiness, churlishness along with sins and suffering. In Poe’s work “The Tell-Tale Heart” the narrator is getting mad. He thinks that the old man’s vulture eye is putting down vex on him. Here the narrator is getting obsessed with rid of the eye. The importance of this ‘eye’ symbol is taken as an essence of human identity and it cannot be separated from the human body. Here, Poe’s skill in using symbols makes connections throughout the book. Like in ‘The Raven’, the narrator is slowly going mad at Raven and ravens are known to be found on battlegrounds eating away at the dead.

In Dark Romanticism, individuals are the primary subject to study. They focus on the dark side of individualism and perceived the darkness of the human soul through the presentation of the characters. The fundamentals of the dark perspectives are nature and individuality. When dark romantics look at any individual, they, at the outset, depicts the potential evil of human beings. The dark romantic’s writings are focused on fear, greed, betrayal, mistrust and any kind of mental issues of the individuals. This kind of shades of writing can be easily found in Frankenstein, the individual soul tries to control the power that he has created. It asks the question which is more generalized in its sense ‘Can we really control what we create?’. Here, generally, the psychological and physical torment sometimes become an integral part of the dark romanticism when the inner torment of the soul unravel the dreary facts with the help of symbols like death, decay, madness and sin ‘Frankenstein’ is one of the great examples for presenting individuals aspects in its realistic way.

The importance of individuality in dark romanticism has highlighted the struggles, sufferings and dissatisfaction of the individuals with the society. Dark romantics like Edgar Allen Poe, Nathaniel Hawthorne, and Herman Melville found themselves in the characters and expressed individual anger and dissatisfaction with the society, their plea for taking what they wanted in their life, like lost beloved and death of someone who is very dearest to them can be easily depicted their works. Dark romantics observed every aspect of the individual where they find something abnormal, it becomes their area of study, For instance, Edgar Allan Poe explored dementia whereas Herman Melville talked about the obsession and Nathaniel Hawthorne analyzed the guilt in Puritan life. According to the dark romantics, the transcendentalist ignored to depict the darker reality and its existence in individuals life to become optimists. So here, in Dark Romanticism, an individual could be impure, insane, mad, and evil, not a pure soul as transcendentalist thought and that is why it is said that Individualism has great prominence in dark literature.

Conclusion

The Dark Romanticism in the nineteenth-century became a weapon for revolutionary ideas by which the unknown facts of the time had been studied. The shadowy approach to unravel the unknown facts is the primary motive of dark romanticism. It is less focused on the characters development and ideas. It is more about reality. It shares more characteristics of Realism also. In Dark Romanticism the representations of the character are not natural, they appeared unnatural and odd to show the human wickedness with their imperfections, self-destruction and hazard of social reform. Dark Romanticism draws attention towards the struggle of human nature, which is also a study of mental state or the human psyche. As transcendentalist believes in the optimism, dark romantists believe the evil side of spirituality, it is about the

rebellng against the norms formed by the society, it is a struggle against imposed judgment and punishment decided by the society which can be seen in the works of Edgar Allen Poe, Herman Melville, and Nathaniel Hawthorne.

The symbolism, used in the dark literature is much closed to the dark and evil. The representation of symbolic figure Like Raven, the river Hades are nothing but the description of tormented souls from one world to another. Many of the poems are nothing but the laments by the narrator for losing beloved ones. Somewhere writer himself gives affirmation to the evil and dead through the characters which nothing but the sudden inclination towards inner plea or the depression in which somebody lives. The notion behind this is, the individuals suffering, which focusses on the emotion, nature, ideals and reaction to established norms. An individual emotion and the natural world can create tumult in society to reform something. It can produce horrors, crime, insanity and irrationality in prevailing orders to get the desired outcome. So the shadowy approach to the fantastical in dark romanticism is considered as the reforming approach where reality can be understood under the dark and shadowy images.

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MELTING BOUNDARIES

MEETING CULTURES

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Melting Boundaries: Meeting Cultures

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EDITORIAL

MELTING BOUNDARIES: MEETING CULTURES

Literature, language and culture form an amazing trio in which civilizations of the world thrive. Language and culture are intertwined as their fusion gives rise to the rich literature of any region. In fact, as someone rightly said, *“Language is the road map of a culture. It tells you where its people come from and where they are going”*.

The concept of a boundary represents geographical, political, sociological, psychological or linguistic boundaries. It is only through translation which is interdisciplinary in nature that enables boundaries to merge and melt. In this context translation is inextricably linked with the idea of boundaries. When boundaries melt then the doors unlock themselves for cultures to meet and translators make this meeting of cultures possible.

The role that translation plays in overcoming social and political boundaries is significantly immense. Translation brings communities together fostering communication and dialogues. Machine aided translation is also gaining importance with rapid strides. It is with this perspective of interdisciplinarity that the present collection of research topics is strung together in this volume of ‘Melting Boundaries Meeting Cultures’.

In order to have a diverse outlook and formal attention on how translation is achieved keeping intact the issues and integral facets of culture and advancement of human life, research articles and papers from Marathi and Hindi language too have been amicably accommodated.

April, 2020

- Priti Singh
- Shailesh Bahadure

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Conflicts in Translating the Gothic: Revisiting Edgar Allan Poe

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“Translations are like women: when they are beautiful, they are unfaithful, and when they are faithful they are not beautiful.” (C. Bertrand)

The mainstream of gothic horror and macabre is attributed to Edgar Allan Poe. His works are the distinguished philosophy of the individuality, dark perspectives of the human minds and the psychology of the time. His works became the main source for Translation studies and interpretation. There is a belief that translations are used not only when some kind of information has to be transferred from one language to another but also when it comes to a better understanding of something in the same language it needs a basic and literal understanding of the source and targeted language.

This paper is a somehow an honest try to revisit Poe's works through the translations by depicting the actual tone and style of his writings. His translated poems and short stories like *“The Black Cat”*, *“The House of Fall of Usher”*; poems like *“The Raven”* and other works are taken into account for the consideration of conflicts in translating the actual mood and style from the original source.

Every translation is a study of the deep cultural prospect of its language and proper understanding of the linguistic structure. A translator must be the player while translating source language into his own or target language. While translating any language most of the experienced professionals come with the problems of confusion and frustration which is the reality because of the multiple meanings of the sentences, twofold meanings of the words, idioms and phrases and individual psychology in handling the objects are some of them. Translating Edgar Allan Poe's work is a quite difficult task to translate with its proper measures.

He is quite skeptical of his mood and presentation of the objects. His pessimistic attitudes towards the dark realities of his life are still unfolded, so it is very difficult to create meanings out of the objects which are against the ethics of translations. In the following points, it is discussed in detail.

Multiple Meanings :

Edgar Allan Poe is master of using symbols with assorted meaning. He uses symbols to link the contradictory aspects of life to his literary works. There are many symbols with multiple meanings are often found in his poems and short stories. Poe's short stories like "*The Tell-Tale Heart*", "*The Black Cat*" and the poem "*The Raven*", have multiple hidden meanings with dark realities, Usually, Poe's all works are considered Dark romances where the dark symbols are easily recognized. The symbols employed by Poe sometimes create distorted aiming to avoid death and end of something and lots of them include visuals and visual references which creates another meaning.

The master of using iconic meaning within the works, Poe makes the reader confused. Within the "*The Fall of House of Usher*" death may be a subject of the collapse of the house of Usher's family but Poe despises the account of reading in an emotional way. Later he emphasizes when the reader focused on the important meaning; the emotional reference to the text of family would automatically disappear.

This description clearly indicates the contradictory thoughts where readers can take their own meaning that Poe believes in each side of the story. Within the same way when readers encounter Poe's work "*The Black Cat*," it indicates the madness, aggressive emotions and guilt feelings of the narrator though how calm and humanistic attitude he has face to face. It creates difficulty that how the characters are handling the situation; in humanistic perspectives or animal perspective or it's just his individual feeling of resentment.

Literary translation isn't any doubt one of the foremost complex kinds of translation, particularly poetry translation. Many translators encounter difficulties while translating poems, like linguistic, cultural, and aesthetic problems. Thus, experts consider poetry translation to be a highly complicated process because the translator is responsible for preserving the form and content of a poem while transferring text from one language to a special.

According to Hariyanto (n.d.), literary translation is that the foremost difficult task a translator can face and translate poetry is that the foremost intricate genre in terms of translation since both the form and thus the meaning of a poem has got to be taken into consideration. Although translation theorists have made considerable endeavors to explore the various obstacles like religious, literal, pastoral and linguistic which is to be involved in translating one language into the target language. Only a couple of studies

have shown concern for the precise religious challenges a translator may face when rendering Omani poems.

Most of the translators accompany the difficulties while translating the literal ideas of the poems especially if the poet implies multiple meanings with figurative sense in regard to linguistic, cultural or aesthetic. The poem “*The Raven*” may be a story told in person which means a particular subjectivity; on the opposite side, the effect of this is often that narrator is rather unreliable which is Poe’s ambiguous way of structuring the patterns of sentences because it happens within the “*The Fall of the House of Usher*” also. The narrator sometimes assumes that he converses with the reader and also sometimes assumes that the narrator is died or completely collapsed from distress or attack. It’s literally unclear during which forms he tells the story. Sometimes a question arises “Is the narrator a ghost? or Is he merely saying someone about his dream? It is quite unclear but particularly it's not strange to possess nightmares about someone’s or one’s death without really dying.

Conflicts in Depicting Mood and Style:

Poe considered one of the finest writers who can delineate gothic and terror with its utmost impact on the readers. In literal translation, it is quite difficult to maintain the actual tone and dreary mood of the story or poem when it is a matter of translation into targeted language. In the literal translation of “*Arthur Gordon Pym*” followings, French lines are unable to depict the actual mood and style of the story

“My name is Arthur Gordon Pym. My father was a respectable trader in sea-stores at Nantucket, where I was born.”

“Mon nom est Arthur Gordon Pym. Mon père était un respectable commerçant dans les fournitures de la marine, à Nantucket, ou je suis né.”

In the above-translated text, several things are slightly awkward in French here. First, the construction “mon nom est” is not typically used to say, “my name is.” Second, in French, adjectives typically follow the word they describe, and articles such as ‘a’ or ‘an’ to describe a person’s occupation are not used. Baudelaire keeps reminding the reader that they are in fact reading a translation, and it is therefore not Baudelaire’s voice that shines, but Poe’s.

In translations, Poe’s Short stories and poems have twofold motives; first the influence of original source and second; impression of the translated text

on the reader. Most of the readers find interest in translated texts but the original source is a pleasure for readers. The Italian translation “*Racconti straordinari*” is a collection of various short stories of Edgar Allen Poe; of which the first impression was negative; at the outset, readers encounter difficulties in understanding syntactic and a lexical level of the sentences, which made some parts the stories arduous to understand. Readers, therefore, label up Poe’s writing as inflated and artificial, whereas; the actual source is far way better than the translated text despite of being rich in every aspect.

“*The Raven*’ is another best example of Poe’s mastery. The poem maps out the man’s emotions as he steps into the depths of psychosis or insanity. In the poem, man is lamenting over the loss of his beloved called ‘Lenore’ and a bird Raven is a mysterious bird who symbolizes death only utters the word ‘Nevermore’. The poem unfolds multiple symbolic images that cannot be explained and translated easily with its dreary and melancholy mood. The Romanian writer has few lines where he is saying original is a source of pleasure that cannot be unlocked with foreign keys....

“The language’s lock cannot be unlocked with foreign keys... Poetry cannot be translated. Poetry belongs to language more than prose, language’s secret soul: the playful iridescence from within poetry leaves vocabularies powerless.”

Baudelaire as Translator of Poe:

Charles Baudelaire is known as the most compelling poet, critic, and translator of the 19th century. Literary critics have already given the credit of popularizing Poe in France to Baudelaire only because of his choices of translations. His body of work mainly includes a novella which is an influential translation of Poe’s work. Baudelaire translated many of his works when he was already a renowned artist and literary critic. He translated Extraordinary Tales, Tales of the Grotesque and Arabesque as well as the Prose Tales by Edgar Allan Poe which was the most famous translation ever done by any translators.

Baudelaire was deeply influenced by Poe’s writing; that’s why Baudelaire decided to translate Poe. By taking a task of translation Baudelaire started to create a new way of writing was both aesthetic and personal. In most of Poe’s stories, he revealed a strange beauty which he liked most and which probably reminded him of his own views on beauty. There is no doubt that Baudelaire himself was possessed as a weird and twisted person, but unique in the vision of beauty. Baudelaire read Poe’s life and he was saddened and deeply moved by this difficult and varies tortured life, which was not very different from his own

besieged life. He himself was very much interested to write about Poe's life. In his first article in 1852, he showed his close affinity for Poe and published his text named "*Edgar Allan Poe, sa vie et ses ouvrages*" ("*Edgar Allan Poe, His life and his works*").

The syntax of the French language plays a most significant role in Baudelaire's literal translations, and allows for improvement in every translation's overall clarity and focus. In French, Baudelaire has translated several pieces by adapting Poe's style. This makes his literal translation of Poe more interesting. He read carefully all the original texts of Poe. When somebody asked why he translated Poe so literally, then he responded.

"Because he resembled me. The first time that I opened one of his books, I saw with delight and horror not only subjects about which I had dreamed, but sentences I had thought, and that he had written down, twenty years prior to me". (Baudelaire 362).

Charles Baudelaire's literal translation of Poe could, therefore, be staying true to his own voice, and not the revolutionary move scholars have suggested.

Translation has been used for a wide variety of reasons ranging from general communication to cultural and aesthetic ground. This paper is an attempt to focus on the translations of a work done by Edgar Allen Poe and the conflicts in translation to maintain the actual mood and style in translated work which exhibits how the translator demonstrates translations to its audience, whether it is for aesthetic purpose or a literary one. Poe is a writer and poet who can feel strongly about everything that makes a poem. He strongly believes that every translation must be filled with proper wordings which render the message and feeling naturally. Translation of any text can be written at length with proper shape and rhyme especially the rhythm. Poe said that "Music elevates the soul because it is placed in direct connection with Beauty. And Beauty is the purpose of a poem because it elevates the soul".

Poe's gothic works are the inspirations for the translators where Charles Baudelaire without any doubt can be called a translator of Poe because of his French translations like "*Mesmeric Revelation (La Liberté de penser)*" and he continued until his last translation of "*Histoires grotesques et sérieuses*" in 1865. His Gothic literary works are closely associated with word order and this paper aims at discussing the problems arising from the differences between English and other languages in the degree of reliance on thematic structure. The paper is an honest try to focus on possible problems of literary translation from Poe's Gothic to other targeted languages.

Literary translation is no doubt one of the most complex types of translation, particularly poetry translation. Many translators encounter difficulties while translating poems, such as linguistic, cultural, and aesthetic problems. Thus, experts consider poetry translation to be a highly complicated process, as the translator is responsible for preserving the form and content of a poem while transferring text from one language to another. According to Hariyanto (n.d.), for instance, literary translation is the most difficult task a translator can face and translating poetry is the most complicated genre in terms of translation since both the form and the meaning of a poem has to be taken into consideration. Although translation theorists have made considerable endeavors to explore the cultural, aesthetic, and linguistic obstacles involved in translating Arabic poems from Arabic into English, very few studies have shown concern for the specific religious challenges a translator may face when rendering Omani poems. Hence, the main concerns of this paper are to bring perspective to the religious problems encountered by translators from translation students' standpoints, identify their causes, and present solutions and recommendations to reduce these unknown translation difficulties.

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DARK ROMANTICISM – THE WISDOM OF PESSIMISM**MR. MANOJ ANDRASKAR**Assistant Professor
Department of English
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Nagpur-10**ABSTRACT**

Dark Romanticism, a subgenre of Romanticism and is considered as a dark side of Romanticism. The genre tries to unravel the truths behind the problem of evils, human imperfection, and human psyche which could only be found in Dark romanticism. All works of this genre are measured under complex emotions and expression of individualism where Dark Romantics believed that even good men and women can drift towards evil, sin and self-destruction. This article is about such Dark romantic's writers like Edgar Allen Poe, Nathaniel Hawthorne, and Herman Melville and their suspicious nature of writings, which the Transcendentalists ignored. Dark Romanticism comes with the preoccupations of the mind with the grotesque and morbid. It holds the tendency to reveal the pessimistic truth of humankind. It explores the human mind in extreme situations and so arrives at an essential truth. In literature, pessimistic narratives have become an integral part of Dark Romanticism. Literature is filled with the wisdom of such kind of pessimistic writings which considered as a reaction to the Transcendentalists philosophy which needs to be studied and analyzed.

Keywords: The Dark Side of Romanticism, The Question of Evil and Human Psyche,
The Importance of Individualism, Pessimism in Literature

The American Romantic literary movement emerged in the mid of the 18th century, gave us various academic topics to think about and discuss. It has its root in the movement called 'Strum and Drang' or 'Storm and Stress' which was focused on the extreme emotions oh the individuals. The Movement lighted up the thinker's mind of the time and nurtured the writings with an abundance of emotion and imagination by instilling their thoughts into text. In this particular era, Romanticism introduced the two opposing sub-genres, later known as Transcendental Movement and Dark Romanticism Movement. The former Movement believed in human goodness and spirituality, which follows optimism and the latter, follows the subjects of human fallibility and predisposition towards sin, which is pessimistic.

Dark romanticism is a branch of Romanticism which is characterized by the celebration of sublime and the instinct and the nature of Individualism. The theory of Individualism focusses on the emotional experience taken up by the individuals. They promote the ideas and desires of the individuals and give them a value which advocates independence and the self-reliance to achieve precedence over the opposing ideas constructed by the society or institution. Individualism is the study of the human mind; recognizing the individual as the

center of all social life and aims to establish that the society should keep hands off him to determine his destiny and the free development of his capacities and interests.

The writers of the Dark romanticism believe the dark and suspicious realities are the subjects of their writings, though they have the tone of pessimism, in reality, they are not totally pessimistic. Somewhere it is a base for optimism. Transcendentalism theorist advocates this idea and it proposed that 'Transcendentalism is a reaction against overpowering religious traditions and dogma. Both encouraged the individual to discover their own truth and be ruled by that rather than obey the constructs of the time' (1)

Dark Romanticism is a sub-genre of Romanticism and a significant part of the American Romantic Literary Movement. As the word implies, it is very closely related to Romantic perspectives and its attitude. Romanticism is a literary, intellectual and artistic wave originated in Europe. With the popularity of Romantics writings, Dark Romanticism flourished side by side where evil, darkness and gloomy atmosphere are characterized; which is also closely associated with the Gothic Romance.

In the history of American Romanticism, Gothic romance has created a unique place with its dark and shadowy characteristics. The themes of this particular genre share the darker side of humanity, dark tales of obsession, revenge, shame and madness, which are ignored by the Romantic writers in their writings. Romantics give importance to the emotions and freedom over intellectual thoughts and notions; it makes everyone believe that to dream of something, one needs to create images where the particular individual finds its place to roam around with his free will. It is about the strong motivational force which will take us into the realm of divinity and nature. It sometimes allows us to draw the inspiration far from the real world. This writing tendency is rejected by the writers like Edgar Allen Poe, Nathaniel Hawthorne, Herman Melville and Emily Dickenson in their writings. Their writings are filled with darker realities of life, and their perspective towards life is not that much happening. Their works are the results of increasingly, reclusive life, the loss of a beloved, imposed judgement and severe depression, resulting in self-destruction or alienation from society. Dark Romantics in particular drawn to the dark side of human nature, imperfection and hazards of social reforms; they also depict the evil side of divinity and spiritualism. Dark Romantic's writings sometimes considered as a rebel, struggle and reform against societal norms formed by the established authority. Nathaniel Hawthorne's 'The Scarlett Letter' and 'The Maypole of Merry Mount' are the examples of such kind of writings where issues like social reform, slavery and the rights of the minorities are the subject that grew into the Dark Romantics writings. Thus, it is said that this is a dark side of Romanticism.

Edgar Allen Poe, Herman Melville and Nathaniel Hawthorne are all Romantics as well as Dark Romantics. They introduced the question of evil as Dark romantics believe that the human gravitates to the evil and self-destruction in some way or the other way. These notions about evil or dark objects are hidden somewhere in the human mind, which involves sheer terror, supernatural, and personal torment. It is a human psyche which affects and creates the question of existence to revels secretes of the individual's life.

It sometimes presents "the darker side of awareness... guilt, fear and madness... the uncomfortable sense of being in a fantasy world which is about to reveal secrets of the human personality" (Howells 5).

It venerates the familiar even as it takes readers to a terrifying new world where evil is much more deceptive. The humans are powerfully influenced, even controlled by the unconscious forces of shadows, particularly in the form of strong instinctual emotional reaction that is repressed somewhere in the subconscious mind. Even everyone carries a dark cloud; being part of this materialistic world, the less it is embodied in the particular's individual life, the blacker and denser it is. The concept of evil develops in the individual's minds as they grow up, and society tells them what is and what is not acceptable. Dark Romantics, Edgar Allen Poe and Nathaniel Hawthorne also believed that evil existed and was inherent in human nature. From this, individuals learn what he or she should repress and hide from the others to appear and having an excellent and virtuous character. It is formed of those things that our ego deems unacceptable to portray the outside world as they threaten the concept developed by the individuals or the society.

Human psyche usually characterized by the firm and deep emotions. Individuals always pretend and deny the evil qualities within themselves while attributing it to the others; on the other hand, they see in other people their faults. The Dark romantics writing proposed such dark faculties of human minds through this genre where they often discuss mysteries of their life. Dark romantics often write about their individual life's mystery through the characters. One of the significant writers of Dark Romanticism, Edgar Allen Poe during his life was a controversial figure. His life was not that easy. His life's experience made him what he is known today. After the critical failure of his two early poems Al Aaraaf and Tamerlane, he never wrote a long poem.

In a few days later, Poe said to his editor: "I find myself entirely myself-dreadfully sick and depressed but still myself. I seem to have just awakened from a horrible dream in which all was confusion and suffering----- I really believe that I have been mad, but indeed I have had abundant reason to be so."(Biography of Edgar Allen Poe, 35).

The psychological term, 'Human Psyche' is a broader concept in literature in terms of successfully presenting characters, their moods, instincts and bringing the reader into the psychological sphere of human reality. Thus human psyche plays a vital role in creating its value as part of the analysis of the human mind in literature which directly focuses on the studies of phantasies, emotions and its impact on the human soul.

The American Literary Movement 'Strum and Drang' gave so much importance to the individual's emotional experience which later paved the way to for early Romanticism and later it became a vital segment for The Dark Romanticism Movement. In general, Romanticism holds the Individual as a primary unit of romantic's writings. Here, Individualism means an ethic of declaration about the pursuit of one's happiness where the individual himself takes seriously concerning with his self-expression and self-development. This system of Individualism is underlying in every theory like Capitalism or Romanticisms or Dark romanticism. It is a base of psychological analysis of human's conscious, unconscious and subconscious mind. Edgar Allen Poe stories and poems are notable for



understanding and exploring human psychology concerning the impulses whether it is conscious or unconscious. His stories like 'Ligeia' and 'The Fall of The House of Usher' and the poems, 'El Cuervo' and 'Ulalume' are the great examples of the individualistic writings. Nathaniel Hawthorne is an author of Dark romanticism. He showed up that his writings have a close connection with the Transcendentalism but later he disassociated himself from the movement. As a part of Dark Romanticism, he was later called as Anti-transcendentalist. His works 'The Black Veil of the Preacher' explains his tendency of the Individualism. His works are preoccupied with the extremes to which an individual's life can lead. His writings are abundance with the images of guilt and sin which are the inherent qualities of any individuals. One of the writers of Dark Romanticism, Herman Melville, he is known for his travel writings. Some of his works like 'Moby Dick' and 'Bartleby the Scrivener: A Story of a Wall Street' deals with the blind ambition of human kinds. His works create questions on the existence of God. It also discusses the themes of cruelty, madness and challenge to God where the triumph of evil over the good is mentioned which is none other than an individualistic approach.

The term pessimism derives from the Latin word 'pessimus' meaning 'the worst'. It was first used by Jesuit critics of Voltaire's 1759 novel *Candide, ou l'Optimisme*. Voltaire was satirizing the philosophy of Leibniz who maintained that this was the 'best (optimum) of all possible worlds'. In their attacks on Voltaire, the Jesuits of the *Revue de Trévoux* accused him of pessimism (3). Pessimism is a negative mental attitude in which an undesirable outcome is anticipated from a given situation. Pessimists tend to focus on the negatives of life in general.(4) Dark Romantic Writers like Edgar Allen Poe, Herman Melville and Nathaniel Hawthorne are the realists and not totally pessimistic. Their pessimism in literature has a faculty of correction. Pessimists see both bad and good thing in the past and future to correct the mistakes. They look ahead but they never trust the changes brought by the future or the society.

Pessimism in literature always comes with the mysteries, darkness, and scepticism. It means characters in literature can be found themselves anytime in Dark Romanticism. The heroes from Nathaniel Hawthorne's 'The Scarlet Letter' and Edgar Allen Poe's 'The Fall of House of Usher' are fully analyzed for their archetypal and realistic characteristics and they often embody the idea rather than to represent the humanity. Pessimism is a philosophy in literature dealing with the realities and imaginations having dark truths which are still unfolded. The authors like Poe, Melville and Hawthorne had been to a tragic life, pain and agony of which mirrors in their works. Their works reflect relation to the past realities which are also pessimistic in tone. In literature, pessimism contemplates on many problems which are facing by mankind. For the pessimist, they are concerned with the origin of evil, to fight with evil and to promote justice in an insecure world.

Pessimistic narratives in literature often tell the stories of life what life is like. Pessimistic writers believe that 'Work is a place to realize 'Yourself' and to become 'Yourself'. The pessimism in literature is a way of presenting aesthetic reactions and subverts it by arousing delight and misunderstanding. It is the sublime beauty of pessimistic narratives where the concept formed by the character captures the trauma and fear in its original state which is clearly distinguished from the mainstream of Romanticism. In addition to this pessimism in literature stands as a great factor in the moulding of the beliefs of the philosophers.



Everything that we see and experience in this world is merely a reflection of the ideas propounded by the predecessors which are far from the understanding of the poor mortals. So the pessimism is a philosophy to distinguish and scrutinize those ideas which are governed by the optimist's theories in the literature.

In a literary point of view, Dark Romanticism is an imperative and pessimistic way to look at Romanticism. It is a way of highlighting an individual's nature as a sublime source of aesthetic element emphasizing on the emotions like awe and terror. It is a reaction against Transcendentalist doctrine prevailing in human beings. The genre is also a study of realism and individualism which can be presented in the light of pessimistic narrative. The Dark Romantics like Edgar Allen Poe, Herman Melville and Nathaniel Hawthorne are the chief exponent of such kind of writings in literature. Their works have gain popularity because of their pessimistic and realistic narratives in literature. Though, their writings have the colouring of the Gothic Romance which is particular in the genre, whereas Dark Romanticism is more general in the sense where all these writers are excelled with hands on it. This is Dark side of Romanticism where the uncomfortable facts become the source of the conscious and unconscious mind and fascination with irrational, demonic and grotesque thoughts exchange the place of idealized romantic concepts. Because of this psychological and analytical element, Dark Romanticism attracts the reader and it changes the perspective to see an object for the critical study. This wisdom of pessimism nowadays became a source for the narratives to unfold the underlying truth.

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WAYS OF ECONOMIC UPLIFTMENT OF DALITS: THE PERSPECTIVE OF DR. B. R. AMBEDKAR

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Dalits had been jostled into the abyss of slavery for many years and they had also been denied the fundamental rights. So, there were no other means of earning livelihood. It compelled them to reel under the dominance of upper caste people. They were denied social, economic, and religious rights. Dalits had internalized this toxic attitude and led their life in miserable conditions for many years. Dr. Babasaheb Ambedkar strove hard to emancipate Dalits from this condition. For untouchables, the only way to earn livelihood was to serve for the upper caste people. Untouchables were denied the rights for other trades and businesses as per stated in the Vedic Bramhanical scriptures. Dr. Ambedkar meticulously studied the condition and appealed untouchables to leave traditional works and lead the life with dignity and self-esteem.

Twelve Balutedar system had control over routine life of people and their activities in economic, social and political sphere from ancient era. The occupation of various castes had been predetermined and regulated according to Balutedar system in the villages. These occupations were based on traditions, birth and caste. There was an undeclared law that every caste must follow the predetermined occupation.¹ This system was equally prevalent in most of the areas of Maharashtra. Mahar community didn't have a separate occupation in contemporary era. Their hereditary work was to serve the government and the people. These were the trivial and worthless works. So, there was the scarcity of food and clothes in their life.² This community's people were tagged as inappropriate and unholy by birth and it caused great economic harms to them. The prominent earning sources such as trade, service and agriculture were denied to them. They didn't get customers as they were considered as untouchables. So, there were no

scope for the trade and business to them.³ A person started the factory of beedi (a small cigarette) to improve his financial condition. But the upper caste decided not to purchase the beedi as it was wrapped with a thread which was considered as unholy to them. He had to close his factory bearing the loss of one thousand rupees.⁴ The same situation was imposed on other businesses. The selection of business was the major issue posed before Dalits. Dr. Ambedkar states that Dalits should select the business in which every community's people had freedom.⁵ He recommended them various prestigious and dignified business and trades. Therefore, it is legitimate to term it as the ways of economic upliftment of Dalit community's people.

Ways of Economic Upliftment Recommended By Dr. B. R. Ambedkar:

Agriculture:

A conference was organized under the leadership of Dr. Babasaheb Ambedkar at Mahad in March 1927 and passed some resolutions for the economic upliftment of the untouchable community. These resolutions were regarding to impart forest land for the economic welfare of the ostracized people, forceful implementation of independent occupation like agriculture by leaving Maharaki, co-operative societies should be established for the agricultural development, government treasuries should be established to face droughts, excessive rainfall and to emancipate untouchables from the clutches of moneylenders.⁶ This policy had been propagated in this conference which promoted agriculture as a means of earning.

Dr. Ambedkar recommended untouchables for agriculture as their profession. He opined, "...the motive behind recommending agriculture as their chief occupation is that

untouchables should lead their life having economic independence. Today, Mahar caste is regarded as the group of beggars which falls under untouchable community. This community has become habitual to lead their life by collecting stale pieces from door to door in the baskets. This community doesn't have respectful place in the society due to this trend. It marred the pride and dignity of this community...It is very shameful to sell one's dignity for the sake of stale pieces of food. They should leave begging for the pieces of stale food and start farming like other people. It would be tough task to purchase land but they can cultivate the barren land of forest department which can be easily gain from the forest department if an untouchable demands for it...⁷ But it is quiet tough task to provide large piece of land to earn livelihood on farming for Mahar community's people. So, they should start other business parallel to the agriculture. Mahar community is not business-minded caste. Therefore, it is better to opt any business for them. But, it is quiet tough task to retain the quality and affordability of that opted business due to the lack of money and experience. They should initiate their business from elementary level. They can do a business which is not undignified and is not recognized as a particular community's business. Perhaps it will make them venturesome.⁸ So, he recommended agriculture as it is a prestigious business for them.

Khadi business

Dr. Babasaheb Ambedkar presided over the conference of Mahar community at Solapur district in November 1927. He recommended to disseminate spinning and knitting in this conference.⁹ At that time, Khadi movement was rapidly flourishing in the country. But the biggest question posed before them was who would buy the Khadi made by Mahar community's people. Still he recommended to knit Khadi and opined, "...you should knit khadi. You will think that who will buy our Khadi? And what will be the use of knitting it if anyone don't purchase it? But it is not major issue to solve. Mahar community's people buy clothes for their use. If every Mahar community's people determine to use Khadi

and purchase it only from Mahar community's people, it will generate large amount of customers from their own society. If these two aspects implemented successfully, it will only need financial assistance. But it will be easy if they get it from somewhere."¹⁰ Thus, Dr. Babasaheb Ambedkar recommended a prestigious business. He stressed on creating own market for society's welfare.

Migration

Dr. Ambedkar thought that migration would solve the problem of untouchables. He advised untouchable people to abandon villages. MLA Nikalaje stressed the issue to increase the salary of Mahar Vatanarsupto 15 rupees in 1925 and propagated it in Mumbai Judiciary. Montfort, a representative of government, responded to it and his answer was based on the views of Dr. Ambedkar's thoughts. He opined, "...while studying the barriers in Mahar community's development, it is noticed that Mahar community's people who live in villages are not habitual to lead their life proudly and dignifiedly. The people who begged for the pieces of food from door to door would remain poverty-ridden throughout the life. He clearly propagated that it is not appropriate to reel under the set tradition of slavery and indulge in it. If Mahar community's people want to uplift themselves, they must not stick at the village instead they should abandon it."¹¹ Dr. Ambedkar was agreed with the opinion of Montfort. So, he propagated an example of a Muslim tradesman in a conference at Ratnagiri on 13th April 1929 who traded in South Africa and became rich by migrating from his homeland. He assured that he would strove hard to acquire land for them in Sindh and Indore region for the cultivation if they were ready to adopt this to enhance their social status by migrating from villages.¹² He had faith that migration would resulted into the social emancipation of the untouchables from various barriers.

Independent colonies

Majority always wins in the conflict between majority and minority. Mahar community comes under minority in the villages and it was not possible to fight against the atrocities

committed by majority of upper caste people. According to Dr. Ambedkar, it would be better to rehabilitate these people from many villages at a particular place and form various independent colonies for their betterment and emancipation from these atrocities.¹³ These types of colonies should be established on the forest land which has multiple benefits. Mahar community's people couldn't start other businesses as they live in prejudiced society. But various doors could be opened if independent colonies established for Mahar community's people. They would be free to opt any type of business after the establishment of independent colonies which were denied to them in the villages. This community's offspring would brought-up without any fear in these new colonies. It would give birth to the feeling that they are not inferior from others and others are not superior to them. Thus, future generation would not become weak by the mind. It will be the biggest benefit of it.¹⁴ Untouchability can't be eradicated until untouchables set free from the clutches of Hindus. Therefore, the demand of independent colonies of untouchables is the movement of renaissance in the life of untouchables which will be free from the discrimination like upper-lower class, sanctified-untouchables etc.¹⁵ Dr. Ambedkar suggested to the Central Government to establish a Settlement Commission by constitutional way to build independent colonies for the untouchables. He demanded to allocate five crore rupees per year to the concerned commission and entrust government's barren land to the commission to establish new colonies on it. It clearly indicates that Dr. Ambedkar endeavoured to solve the issues of untouchables through establishing independent colonies.

Service

Dr. Ambedkar always feel that untouchables should embrace service as a profession in their life. Because it gives a significant place in the administrative system. They should enter in this profession of government service for the personal and society's welfare. Otherwise, the conditions will be worst in the future. Therefore, untouchables should strive hard to achieve government jobs to elate their present

condition.¹⁶ He recommended to pay attention on higher education for it. He quoted an example of his ancestors in this regards, "...our ancestors were Subhedars and Jamdars. They didn't educate their children. They could have provided B.A. and M.A. level education. If these educated children could have secure collector and magistrate like posts, their patronage would be certainly grown-up."¹⁷ It doesn't happen accordingly, so we are in this situation. Dr. Ambedkar told untouchables that they should pursue higher education and secure good positions to come out of miserable situation. But higher education had been confined to the upper caste people in India. Untouchables never got the opportunity of education. They remained aloof from various government positions due to the lack of education. So, Dr. Ambedkar demanded representation in government jobs. He advised them to secure government positions by pursuing higher education. Therefore, Dalits have determined to work accordingly and secure government positions for their economic development.

Struggle for the Abolition of Mahar Vatan And Khoti System

Dr. Ambedkar suggested to dissolve Mahar Vatan for the upliftment of Mahar community's people. As far as the works and the benefits from the land of Vatan is concerned, Vatan was a prominent reason of their slavery. As generation passes, land inherited as Vatan was divided into pieces. Mahar community's people were levied with large amount of tax or dues though they didn't have enough land.¹⁸ Dr. Ambedkar proposed a Bill before Mumbai Council in 1928 for amending Mahar Vatan Act to emancipate Dalits from the clutches of Mahar Vatan. Mahar Vatan Council had been established during these years. Khoti like brutal system was also prevalent in Kankan region. He organized conferences to aware Mahar community's people regarding Khoti system and Mahar Vatan. Dr. Ambedkar expressed his views on Mahar Vatan Bill and said, "...Mahar community's people will organize strikes publically if Legislature disapproved this Bill and I will also resigned the membership of

Legislature...”¹⁹ He had taken this stern decision for their emancipation. But this problem persistently continued during post-independence era. Mahar community’s people later on abandoned MaharVatans. Afterward, this trend came to an end.

Collective farming

Dr. Ambedkar remarked on the land inherited in Vatan in 1920’s Mangaon conference and said that these lands had been divided into multiple pieces as generation passes. So, it gave very meagre amount of yield which made Dalits penniless. He recommended collective farming as the best solution to cope with this problem. He clarified his perspective about the farming in the declaration of Schedule Caste Federation. He also stressed on the use of modern technology or mechanization in the farming as agriculture is the backbone of Indian Economy. Mechanized farming needs large and extensive land which can be made by joining small pieces of lands. So, the problem of small pieces of land can be resolved by cooperative or collective farming.²⁰ He also stated that agriculture should be declared as government enterprise. He approved the method of cooperative farming implemented in France and Italy by integrating the pieces of lands. Accordingly, he recommended the centralization of agriculture on the basis of some Directive Principles.²¹ This policy of agricultural centralization was not only beneficial for welfare of Dalits but also for the other community’s people.

Passive resistance (Satyagraha) for land

Though agriculture was the path of prestigious living, the problem of land ownership was the biggest issue in the contemporary era. The possession of land was concentrated in the hands of very few people. Government had decided to implement the policy of cultivators’ right of possession. Dr. Ambedkar raised the issues of landless people in parliament in 1951 while delivering the speech on amendments in the Constitution as a member of Parliament.²² As per India’s contemporary geographical area, 93 million acre barren land was useful for farming.²³ He stressed the demand of allocating this land to the landless

Dalits. So, Schedule Caste Federation demanded to the government to allocate this land to solve the issue of livelihood of landless Dalit people. But government didn’t pay attention on this issue so Dr. Ambedkar started passive resistance of landless people in Marathwada region. Dalits started to encroach and possess barren land. This encroachment had the motive of availing permanent source of earning livelihood as well as enhancing Dalit community’s place and status in the society. Because the social place and status of the people were always associated with the possession of land in traditional rural Indian society. The status of the person who has many acres of land was considered as a prestigious person. His stature was totally different from others. So, it was legitimate for Dalits to aspire for the piece of land and to stand equal to the upper class farmers.²⁴ Thereof, passive resistance in Marathwada region of Hyderabad state has significant place. Nizam Government conferred barren lands to Dalits but Congress Government revoked those lands from untouchables when it came to the power.²⁵ This passive resistance was organized to regain that revoked land. This passive resistance commenced in Badanapur, Basatnagar, Latur, Beed, Aurangabad, Parbhani, Nanded, Udgir, and Usmanabad region in 1953. Many men and women participated in this protest and were jailed for their participation. Ambedkarite movement’s leaders spontaneously campaigned for the passive resistance which gave impetus to the passive resistance of landless people of Marathwada region. Many protestors participated in the protest without caring for home, children, wife, and their own life. They were imprisoned for it.²⁶ Police tried to suppress the spirit of protestors but it didn’t affect their courage. Law-suit had been filed against B. K. Gaikwad and B. S. More who were the leaders of this protest. They were imprisoned for one month.²⁷ The intensity of passive resistance had been increased rapidly in the upcoming years. So, Hyderabad government approved the demands of landless people. Dr. Ambedkar thanked Hyderabad government for it and said, “...State government has decided to return the land to untouchables. Government is brooding over to

confer the deforested area during communist movement to untouchables... Schedule Caste Federation will organize passive resistance against Government of India if needed...²⁸ He propagated his approach and took back his movement for the landless people. The main motive behind this passive resistance was to allocate land to Dalits to lead their life prestigiously who were reeling under acute poverty.

Conclusion

Dr. Babasaheb Ambedkar analysed the real condition of untouchables and asserted that their traditional profession was the prominent reason behind this condition. He propagated various new ways of their economic upliftment before them. Agriculture was an important occupation and it gave prestigious place in the society to untouchables. Untouchables strove hard to acquire the pieces of land as they were landless. Dr. Babasaheb Ambedkar motivated for other dignified works parallel to the agriculture. He incessantly stressed on the business of Khadi. As far as the structure of Indian society is concerned, Dalits had no dignified place in Indian society. Village life was so barricaded that Dalit could not lead their life with dignity and prestige. Dr. Ambedkar suggested migration as the best remedy over it. Hereafter, many people

inclined towards the cities for employment and migrated to the cities. This act of migration affected rural society and demolished the social structure based on the discrimination. Dr. Ambedkar championed independent colonies or localities of Dalits. He also suggested the profession of service. It proved milestone which brought metamorphic changes in the lives of Dalits. This suggestion ushered far-reaching transformations in Indian society. He strove hard to establish 'Governmental Socialism' in the nation through collective farming. It was a praiseworthy solution over the land divided into multiple small pieces. Dr. Ambedkar's passive resistance for the land played significant role in providing esteemed life to Dalits. He succeeded in drawing the attention of the nation on the issues of landless people. Thereafter, Ambedkarite movement organized passive resistance all-over in the country on the issues of landless people directed by Dr. Ambedkar. This passive resistance imprinted its own significance on the history of India. In short, the ways of economic upliftment of Dalits suggested by Dr. Ambedkar not only positively influenced Dalit community but also social and political life of the country. The path shown by him will certainly prove beneficial in resolving new challenges posed before the country.

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मराठी स्त्री लोकगीतों में प्रकट होती सामुदायिक सद्भावना

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सारांश

किसी भी संस्कृति की जड़े उस की लोक संस्कृति में होती हैं। लोक परंपरा के अनेक अवशेष संस्कृति के इस प्रगत अवस्था में भी विद्यमान होते हैं। लोक संस्कृति में जनसाधारणद्वारा लोकसाहित्य का निर्माण अनायसही किया जाता है। इस कारण यह अनौपचारिक रूप में नजर आता है। लोक संस्कृति में लोकसाहित्य की मौखिक परंपरा में रूढ़ी परंपरा, विधि संस्कार, धार्मिक परिस्थिति व प्रभाव, राजनितिक कालावधी, सामाजिक व्यवस्था इत्यादि विषयों की अध्ययन पूरक सामग्री उपलब्ध होती है। मराठी लोक साहित्य में स्त्री गीतों की परंपरा अति प्राचीन रही है। इस विपुल संपदा को मराठी साहित्यकारों द्वारा अपौरुषेय कहा जाता है। क्योंकि इसकी रचना स्त्रियों ने अपनी भाव भावना, इच्छा-आकांक्षा और सुख-दुःखों के निचोड़ के रूप में की है। यह स्त्रीवादी साहित्य सांस्कृतिक एवं सामाजिक इतिहास के संदर्भ में अति महत्वपूर्ण स्रोत हो सकते। संसारी जीवन के अनेक पहलुओं के साथ महिलाओं ने अपनी रचना में सामुदायिक संप्रदाय की भावना का प्रगल्भता से प्रदर्शन किया है, जो भारतीय गंगाजमनी संस्कृति का महत्व एवं सांस्कृतिक आदान-प्रदान को समझने में मदद करती है।

प्रमुख शब्द : मराठी लोकगीत, लोक साहित्य की परंपरा, सामाजिक एवं धार्मिक परिवेश, गंगाजमनी संस्कृति का मिलाफ, जनसाधारण कासहजीवन, सामुदायिक सद्भावना

संशोधन प्रविधि

ऐतिहासिक संशोधन प्रविधि का अवलंब कर उपलब्ध साहित्य का शास्त्रिय दृष्टि से परीक्षण करके निष्कर्ष प्राप्त किया गया है। मूल्यांकन किया गया है।

गृहित तत्व

मराठी लोकसाहित्य में स्त्रियों के गीत तत्कालीन ऐतिहासिक, राजकीय, सामाजिक एवं धार्मिक परिस्थिति के संदर्भ में महत्वपूर्ण स्थान रखते हैं। समाज इतिहास के दृष्टिकोण से यह मौखिक परंपरा उपयुक्त समझी जा सकती है।

प्रस्तावना

भारत में प्राचीन काल से लोक गीतों की समृद्ध और विविध तथा विभिन्न परम्पराएँ रही हैं। प्राचीन काल से प्रचलित गाथा यह लोकगीत का एक रूप है। ऐतरेय ब्राह्मण में बलिदान देने वाले राजाओं की प्रशंसा करने वाली भी कई गाथाएँ हैं। जैन और बौद्ध साहित्य में भी गाथा पाई जाती है। धम्मपद और थेरीगाथा को उदाहरण के रूप में उद्धृत किया जा सकता है। भारत

के विभिन्न राज्यों में लोकगीत आज भी गाए जाते हैं, जो प्रदेश की लोकसंस्कृति को दर्शाते हैं। हर राज्य के लोकगीतों में कई विशिष्ट प्रकारों की विशेषताएँ हैं। जन्म, विवाह और मृत्यु के अवसरों पर किए जाने वाले संस्कारों पर आधारित लोकगीतों की परंपरा भारत के विभिन्न हिस्सों में प्रचलित है। विभिन्न प्रकार के लोकगीत जैसे अनुष्ठान गीत, ऋतु गीत, श्रम गीत, नृत्य गीत, विभिन्न त्योहारों पर गाए जाने वाले गीत, जाति-व्यवसाय के गीत हर जगह बहुतायत में पाए जाते हैं। भारत के प्रत्येक राज्य के लोकगीतों में कुछ विशेषताएँ हैं, जो किसी विशेष क्षेत्र की क्षेत्रीय संस्कृति को दर्शाती हैं। जिस प्रकार असम का बिहूगीत, बिहार के सोहाग गीत, उत्तर प्रदेश के विवाहगीत, पंजाब की लोकगीतों में गाए जाने वाली प्रेम कथाएँ, आदिवासियों के प्रकृति पूजा गीत अपनी प्रादेशिक विशेषताओं के लिए प्रसिद्ध हैं। ऐसी ही कुछ विशेषताएँ महाराष्ट्र में गाये जाने वाले लोकगीतों में भी हैं।

मराठी लोकसाहित्य में लोकगीतों की एक लंबी और प्राचीन परंपरा में स्त्री गीतों की संख्या ज्यादा है। पत्थर की चक्की पर अनाज पीसने का कठिन काम

करने वाली सर्वसाधारण स्त्रियों ने इन गीतों की रचना की है। अपनी घर गृहस्थी के लिए दिनरात श्रम करने वाली मराठी संस्कृति की नारियों ने अपने सुखदुःख, अपनी इच्छाएं, रिश्तेनाते इसमें पिरोए हैं। इन सेतत्कालीन स्त्रियों का सामाजिक, सांस्कृतिक जीवन समझने में मदद होती है। साहित्यिक मूल्य रखने वाले इस लोक साहित्य का उपयोग समाज इतिहास के क्षेत्र में भी हो सकता है। इन लोकगीतों के माध्यम से तत्कालीन महाराष्ट्र का राजनितिक, धार्मिक एवं सांस्कृतिक परिवेश समझने में मदद होती है।

इसवी सन १५२६ में बाबरने पानिपत की पहिली लढाई में जीत हासिल की, जिसके कारण हिंदुस्तान में मुसलमान सत्ता स्थिर, दृढमूल हो गई। हिंदू और मुस्लिम संस्कृति के संबंधों में नजदीकी आ गई। विचारों का आदानप्रदान हुआ। एक तरह का सलोखा स्थापित हुआ। सांप्रदायिक सहिष्णुता का यह संबंध अंग्रेजों के आगमन तक कायम रहा। अंग्रेजों की बांटो और राज करो नीति के तहत इस भाईचारे को तोड़ने की कोशिश सर्वविदित है।

महाराष्ट्र की ऐतिहासिक पृष्ठभूमि/धरोहर

महाराष्ट्र की भूमि पर राज करनेवाले प्रसिद्ध शासकों की शृंखला में क्रमवार सम्राट अशोक, शालिवाहन, चालुक्य, राष्ट्रकूट, यादव इनका समावेश है। यादवराज्य अल्लाउद्दीन द्वारा नष्ट किया गया। जो १३४७ तक सुलतान राज्य कहलाया गया। उसके बाद बहामनी राज्य की स्थापना हुई। बहामनी राज्य के विघटन के बाद मुगलों का शासन शुरू हो गया। भारत में महाराष्ट्र की ऐसी ऐतिहासिक राजनितिक काल हिंदू संस्कृति और मुस्लिम संस्कृति को आमने-सामने ला खड़ा कर दिया। भारत में इस्लाम धर्म के आगमन के कारण जो परिणाम हुए थे। उनमें महत्वपूर्ण परिणाम यह था कि हिंदू और मुसलमानों ने एक दुसरे के धार्मिक विचारों को अपनाया, सम्मान दिया। मुसलमान शासकों के कारण साधारण जनता में सांस्कृतिक लेनदेन होना स्वाभाविक था।

मराठी लोकगीतों की रचना ग्राम संस्कृति की स्त्रियों ने अपने जीवन अनुभव के आधार पर की है। पुरानी ग्राम संस्कृति में गांव एक स्वयंसिद्ध संकाय के रूप में कार्य करते थे। भारतीय समाज जाति व्यवस्थापर आधारित था। मराठी संस्कृति भी इसका अपवाद नहीं

थी, स्तरीकृत व्यवस्था होने के बावजूद स्त्रियों ने अपने गीतों में सहज सहवास और सबधर्म समभाव को दर्शाया है। पुरुष प्रधान संस्कृति के बंधनों में रहकर भी स्त्रियों ने अपनी प्रगल्भता, सद्भावना और विचारों की उच्चता को अपने गीतों के माध्यमसे प्रदर्शित किया है।

विट्ठल भक्ति और वारकरी संप्रदाय मराठी संस्कृति की विशेषता है। मराठी लोकगीतों में इन पर आधारित अनेक लोकगीत प्रसिद्ध हैं। स्त्रियों के धार्मिक जीवन में पंढरीकी यात्रा, भजन कीर्तन, संत सहवास, व्रतउत्सव, इत्यादि का महत्व लोकगीतों में से प्रदर्शित होता है। इसके साथ साथ मराठी स्त्रियों के लोकगीतों में जैन, बौद्ध, पारसी और मुसलमान धर्म के उल्लेख भी आते हैं। उन्होंने अपने धार्मिक परंपराओं का प्रामाणिकता से पालन करते हुए भी मानवता का धर्म सबसे बड़ा है, यह अपने विचारों से साबित किया है और इसका प्रमाण इन गीतों में मिलता है।

लोकगीतों में प्रदर्शित हिंदूमुस्लिम सहजीवन

भारतीय संस्कृति में जन्म से जुड़े रिश्ते की तरह, मन से जुड़े रिश्ते को भी इमान के साथ निभाने की परंपरा रही है। हर पारिवारिक इकाई में इसकी शिक्षा भी दी जाती है। इतिहास में ऐसे कई रिश्ते के उदाहरण दिए जाते हैं। हिंदू रानी कर्मावती ने मुगल बादशाह अकबर को राखी भेजकर धर्मबंधु बनाया था, ऐसा कहा जाता है। इसी तरह का उदाहरण इन पंक्तियों में मिलता है।

मानियाला भाऊ, जातीचा मुसलमान
सख्या भावा परीस, त्याचं आहे ग इमान
दरसाल येतो, बहिणीला आठवून
जातीचा मुसलमान, प्रेमासाठी
मानीयला भाऊ, जातीचा मुसलमान
दिवाळी चोळी, घरी आला घेऊन
(सानेगुरुजी, २०११ पृ. ३६)

उपरोक्त पंक्तियों में अपनी हिंदूधर्मकी बहन के लिए मुसलमान भाई दिवाली पर साड़ीचोली लेकर आता है। हिंदू संस्कृति में विवाहिता बहन को दिवाली में भाई द्वारा साड़ीचोली उपहार में दी जाती है। यहां गाने वाली स्त्री, अपने मुसलमान भाई के इमान को, उसके अपनी बहन के प्रति प्रेम को गीतों में गा कर सम्मान दे रही है।

भाई—बहन के पवित्र रिश्ते की तरह ही मैत्री का संबंध सदा से सम्मानित रहा है। इस रिश्ते में ऊंच—नीच,जात—पात या धर्म की दीवार कभी आड़े नहीं आसकती। इसका सुंदर उदाहरण लोकगीतों में मिलता है। जिससे मराठी स्त्रियों ने अपने गीतों में गाया हुआ धार्मिक सद्भाव भी समझने को मदद होती है।

तुझा माझा भाऊपणा, हाय पराया जातीचा
तुझा माझा भोजनाला, हांय अंतर ईतीचा
(इंगोले क., २००४, पृ. २१४)

समाज में प्रचलित जाति व्यवस्था में जातियता का पालन किया जाता था। एक पंक्ति में उंचिजाति के लोगों के साथ निचले जाति के लोग नहीं बैठ सकते थे। सहभोजन के कार्यक्रम में अपनी प्रिय सखी के साथ एक पंक्ति में बैठने को नहीं मिलने का दुःख उपरोक्त पंक्तियों में दिखाई देता है। किंतु मित्रता का यह रिश्ता इन बंधनों से ज्यादा मजबूत है यह बताने के लिए गाने वाली कहती है। अपनी गहरी मित्रता के कारण मेरी मराठी भाषा पर तेरी हिंदी भाषा का असर इतना है कि अपनी भाषा भूलने लगी हूं।

तुझा माझा भाऊपणा,तु ग मुसलमानाची मैना
तुझ्या संगतीन,बोली मराठी येईना
(इंगोले क. , २००४, पृ. २१४)

स्त्रियों ने अपने गीतों में केवल रिश्ते में पनपती धार्मिक सद्भावना को ही नहीं दर्शाया है, उसके साथ साथ एक दूसरे के धर्म का सम्मान भी किया है। जो इन पंक्तियों में उजागर होता है।

सई बहिना जोडू मुसलमाननि सारजा
कपाळना कुंकू तीन्हा रामनि वरजा
(Foundation, २०२०)

हिंदू संस्कृति में विवाहित स्त्रियों के माथे पर लगने वाले कुमकुम का अतिशय महत्व होता है। किंतु मुसलमान धर्म में माथे पर तिलक नहीं लगाया जाता। दोनों ही धर्म के रिवाजों में अपनी अपनी श्रद्धा और मान्यताएं हैं। जिसका पालन करना व्यक्ति का कर्तव्य है। ऐसे तात्विक विचार मराठी स्त्रीगीतों में प्रदर्शित होते हैं। धर्म कोई भी हो, ईश्वर का रूप कोई भी हो श्रद्धा पवित्र होती है और उसका सम्मान करना चाहिए। ऐसी विचारों की प्रगल्भता इन अनपढ़ स्त्रियों की रचना में दिखाई देती है।उपरोक्त गीत में यह कहा गया है कि

मुसलमान होने के कारण उसके माथे पर तिलक नहीं है। क्योंकि वह उसके धर्म की मान्यता है। इससे मेरे और उसके अपने आराध्य के प्रति श्रद्धा में,भक्ति में कोई अंतर नहीं है।

लोकगीतों में प्रतिबोध होने वाला सांस्कृतिक प्रभाव

मराठी लोकगीतों में छलकने वाला यह धार्मिक सहिष्णुता का भाव मराठी प्रांत में रहने वाली मुस्लिम स्त्रियोंके गीत में भी दिखाई देता है। जिससे सांस्कृतिक लेनदेन समझने में मदद होती है। छोटे बच्चों को किसी की बुरी नजर नुकसान करती है, ऐसी धारणा महाराष्ट्र के हर प्रांत के लोकगीतों में मिलती है।छोटे बच्चों की बुरी नजर उतारने के लिए नारियल या नींबू का उतारा किया जाता है।यहा मुसलमान धर्म की माँ अपने मराठी पडोसन को कहती है।

शेजी का ताना मेरे ताने बराबर
नींबू—नारळ उतारिते दोनोपर
(जगदाळे क. , २००४, पृ.६३)

यहा ममता की सहज भावना दिखती है, जो हिंदू—मुसलमान भेद नहीं जानती। उपरोक्त पंक्तियाँ विभिन्न संस्कृती का आपस में होनेवाला मिलाफ दिखाती है। यह संस्कृतिसंगम महाराष्ट्र के रितीरिवाज को आपनाने वाले इन मार्मिक शब्दोंमें दिखाई देता है।

दसरा—दिवाली में भाई था पुणे में
बहना के लिए साड़ी चोली
लाया घोड़े को जिनमें (जगदाळे, पृ. १६१)

दसरा—दिवाली जैसे त्योहारों का महत्व जानते हुए गाने वाली कहती है, दिवाली के महीनों में भाई पुणे से अपनी बहन के लिए साड़ी—चोली घोड़े की जीन में रखकर लाया।शायद अपने हिंदू मित्रों को दसरा—दिवाली की त्योहारों में अपनी बहनों के लिए साड़ी खरीदते देख उसके भाई ने भी इस प्रथा का पालन किया हो।लोकगीतों में जहां मराठी मुस्लिम बहन भाई के दिवाली त्योहार में साड़ी लाने पर आनंदित है वही रूढ़ीवादी मराठी संस्कृति की नारी अपने आराध्य लोकदेव विठ्ठल से रोजे रखवाती है।

जेवू वाढीते रुक्मिना, जेव मनता जेवना
येड्या लोकानला कळना

याला रोजाचा महिना, विठ्ठल कोमट्यला
(भोसले(संपा.), २००५ पृ. २३०)

धर्म कोई भी हो, ग्राम संस्कृती मे रहनेवाली सर्वसाधारण स्त्री की जीवनकथा लोकगीतो मे एकसमान दिखायी देती है। जैसे की अपनी घर गृहस्थी के कार्य में सुरज उगने से पहले लग जाना, आधी रात तक जागकर कुटुंब के जरूरतों का ध्यान रखना। पुरुषप्रधान संस्कृती के अधीन हो कर रहना और पत्थर की चक्की पर अनाज पिसते हुए अपनी भावनाओं को गानों के जरिए प्रदर्शित करना लोकगीतपारंपारिक स्त्रियों के जीवन का चित्रण करते हैं। इन गानों से तत्कालीन लोकजीवन में हिंदू एवं मुसलमान धर्मियों द्वारा निर्भाई जाने वाली सहिष्णुता व सद्भावना समझने में मदद होती है। महाराष्ट्र में स्त्रियों के लोकगीतों में 'ओवी' सबसे ज्यादा प्रसिद्ध है। सुबह तड़के आटा पीसते हुए मराठी औरतें गाने की पहली पंक्तियाँ भगवान को समर्पित करते हुए कहती हैं, सारे संसार के रक्षक, पालक भगवान को मेरी पहली ओवी समर्पित है।

पहिली माझी ओवी जगाच्या पालका
रक्षिता बालका देवराया (साने, पृ. २९७)

वही मराठी— मुसलमान स्त्री कहती है, मुझे दुनिया में लाने वाले अल्लाह मेरी रक्षा तुझे ही करनी है।

पहली मेरी ववी गाती अल्लाह तुझे
दुनिया में डाला मुझे अब निभाने की फिख्त तुझे
(जगदाळे, पृ. ११२)

यहां दोनों की अपने अपने ईश्वर के प्रति भावना समान है। फर्क केवल शब्दों का है। मराठी संस्कृति में ओवी की अपनी एक सांस्कृतिक विशेषता है। यहां ओवी गानेवाली का धर्म, भाषा, ईश्वर का स्वरूप भी भिन्न है परंतु प्रादेशिक प्रभाव दिखाई देता है। जो सामुदायिक साहचर्य को दिखाता है। 'सर्वा भूति परमेश्वर' मानने वाली हिंदू संस्कृति में मराठी स्त्री का यह कहना उचित लगता है।

सकाळी उठूनी राम नाम घोकावा
धरणीमाते वरी मग पाऊल टाकावा
(जगदाळे, पृ. ११२)

पृथ्वी को माता का दर्जा देना और सुबह सबसे पहले भगवान का नाम लेकर दिन की सुरुवात करना भारतीय संस्कृती की सीख है। परंतु मराठी परिवेश मे जीवनव्यापन करने वाली मराठी—मुस्लिम नारी भी

अपने ईश्वर के साथ साथ धरती माँ का आदर करते हुए दिखाई देती है। जो दो संस्कृतीयोंके आपसी तालमेल को प्रदर्शित करता है।

सुबह के वक्त अल्लाह का नाम लेना

फिर पाऊं देना धरती मां पर (जगदाळे, पृ. ११३)

एक ही परिवेश मे रहने के कारण मित्रता, रिश्तो मे घनिष्ठता स्वाभाविक होती है। जहां जन्मे, परवरिश हुई उस प्रदेश को अपना मानना सहज होता है। यहां का रहनसहन, खानपान, पहनना ओढना, सणत्यौहार सब अपने से होते हैं। इसका उत्कृष्ट उदाहरण मराठी मुस्लिम स्त्रियों के गीतों में मिलता है। इस्लाम धर्म में सलवार कुर्ता और दुपट्टा या ओढनी ऐसी वेशभूषा स्त्रियों की होती है। महाराष्ट्र की पारंपरिक स्त्रियों के वस्त्रों में नववारी, साड़ी चोली का चलन सदियों से चलता आया है। आज भी यह कायम है। मराठा कालीन और पेशवेकालीन पुरुषों के वस्त्रोंपर मुगल वस्त्रों का प्रभाव सहज दिखाई देता है। वैसे ही मराठी मुस्लिम ओवी गाने वाली स्त्री ने इस सांस्कृतिक प्रभाव को अपने शब्दों से प्रदर्शित किया है। जो सांस्कृतिक आदान—प्रदान का उत्कृष्ट उदाहरण है।

सुबु को उठके खुला दरवाजा माडी का
बीबी फातिमा का लाल पदर साडी का
(जगदाळे, पृ. ११३)

सुबह के पवित्र वातावरण में पैगंबर की बेटी फातिमा बीबी को याद करने वाली यह साधारण स्त्री बीबी फातिमा की साड़ी का पदर लाल है, ऐसा सहजता से कह जाती है। सलवार कुर्ता पहनने वाली पैगंबर की लाडली इस संस्कृति समन्वय में साड़ी में नजर आती हैं। ऐसे ही बाहर से आई सभ्यताओं को अपना बनाकर साथ ले चलने की हिंदू संस्कृति की प्राचीन परंपरा का निर्वाह प्रामाणिकता से करने वाली मराठी स्त्रियों की सहज वृत्ति भी प्रकट होती है।

नागपंचमी का त्योहार महाराष्ट्र के हर प्रांत में मनाया जाता है। पुराने काल में लड़कियों की शादी छोटी उम्र में की जाती थी। उन्हें त्योहारों के बहाने मायके आने का मौका मिलता था। भाई अपनी बहनों को उनके ससुराल से माता पिता के घर लाते थे। सावन—भाद्रपद के महीने में नीम के पेड़ पर झूले टांग कर नवविवाहिता और कुमारीका कन्याएं झूलती थी, गाने गाती थी। पुरुष प्रधान संस्कृति में सामाजिक बंधनों के जोरखंडों में बंधी स्त्रियों के लिए यह कुछ पल

सुकून भरे होते थे। यहां नागपंचमी की पूजा के लिए अपनी सखियों को आवाज देते हुए मराठी स्त्री कहती है।

चल ग सये वारुळाला, नागोबाला पूजायाला
हळद—कुंकू वाहायला, ताज्या लाह्या वेचायाला
या ग या ग गडयिनी या ग या ग मैतरिणी
तेल्या तांबुळयाच्या बाई, वाण्या बामणाच्या बाई
(बाबर, मराठीतील स्त्री स्त्रीधन, १९७३ पृ.८१)

उपरोक्त पंक्तियों में गाना गाने वाली स्त्री अपनी अलग अलग जातिधर्म की सखियों को उनके जातिवाचक शब्दों से आवाज दे रही है। यहां उल्लेखित तंबोली यह शब्द पान का व्यवसाय करने वाली जमात के लिए प्रयोग किया जाता था। यह व्यवसायिक ज्यादातर मुसलमान धर्म के होते थे। इन पंक्तियों में धर्म कोई भी हो, खुशी के उत्सव मिलजुल कर मनाने की वृत्ति और सामुदायिक सहजीवन की भावना प्रकट होती है। इसी प्रकार नीचे दी गई पंक्तियों से यह कह सकते हैं की मराठी मुल्क में रहने वाली मुसलमान स्त्री को हिंदू पंचांग के मृग एवम् रोहिणी नक्षत्र का और नागपंचमी में पेड़ों पर बंधे जाने वाले झूलों का महत्व, दोनों ही का ज्ञान है।

ऐसा पानी पड़ता मिरुंग और रोहिणी का
झूला झूलता भाया और भयनों का (जगदाळे, पृ.१६१)
भारतीय संस्कृति में विद्वान पंडितों का स्थान ऊंचा होता है। उनके ज्ञान के विद्वता का सम्मान किया जाता है। इस संस्कृति विशेष को ध्यान में रखकर नीचे दी हुई पंक्तियों में कहा गया है,

मेरे अंगना में तांबे के रांजन, पानी पिण्गे काशी के
बम्मन

मेरे जन्नी मां के ला (जगदाळे, पृ. १५६)
इन पंक्तियों में अपने भाई की तारीफ करने के लिए काशी के पंडितों का उल्लेख किया है, जो तांबे के रांजन में पानी पीते हैं अर्थात् उनका स्थान ऊंचा है, वे पूजनीय होते हैं।

महाराष्ट्र में बेहतरीन कपड़ों की कला सातवाहन काल से ही प्रसिद्ध है। पैठण के कारीगरों द्वारा तैयार की गई सोनेचांदी के धागों की रेशमी पैठणी और कपास के उत्कृष्ट धागों से बुनी जाने वाली चंद्रकला महाराष्ट्र के सांस्कृतिक जीवन में अपना अलग स्थान रखती है। पूर्णतः भारतीय कहलाने वाले इन वस्त्रों पर बाहर से आई मुगल कला का प्रभाव हुआ है। अर्थात् हिंदू

और मुस्लिम कलाओं का संगम वस्त्रकला में दिखता है। इस तथ्य को ध्यान में रखकर अगली पंक्तियों में कहा गया है कि,

काली चंद्रकळा गंगा जमनी त्याची घडी
बंधूजी राजसा शेजारी मारवाडी
(बाबर, दसरा—दिवाळी , १९९० पृ. ७०६)

अर्थात् भाई ने दिलवाई हुई इस बेशकीमती साड़ी पर गंगा जमनी संस्कृति का असर है। और दोनों ही संस्कृति के कारीगरों की बेहतरीन कला का यह उदाहरण है। इस बात को जाने अनजाने में इन पंक्तियों में गाया है। दो धर्म संस्कृतिके आपसी मिलाप को सहजता से लेने वाली यह स्त्रियां गंगाजमनी शब्दों का उपयोग कर जीवन का बड़ा तत्वज्ञान समझा जाती है। मानवता का धर्म सबसे बड़ा है। मानव जीवन अनमोल होता है। उसे नफरतों में बहकर बर्बाद नहीं किया जा सकता। इसीलिए शायद गणपति की स्तुति में गाए जाने भजन में अष्ट भैरव, योगिनी, गण इनके साथ साथ पीर पैगंबरों को भी उल्लेखित किया गया है। पीर पैगंबर का इस्लाम धर्म में ऊंचा स्थान रखते हैं।

मोरया गणपती रे गणराजा किती विनवू तुला महाराजा
अष्टभैरव सिंधू सोळा, चौसष्ट योगिनीचा मेळा
गण शंभर कोटी जमले

माइया अंगणी येऊन गमले, पीर पैगंबर हे रमले
गाऊ नाम लावू ध्वजा, किती विनवू तुला महाराजा
(बाबर, श्रावण—भाद्रपद , १९८५ पृ. ७१९)
गंगाजमनी संस्कृति के संदर्भ में ऐसे ही कुछ विचार मराठी मुस्लिम ओवी में भी नजर आते हैं।

गंगा और जमुना दोनों है सग्या बहना
गंगाबाईउतावळी जमुना का धीरे जाना
(जगदाळे, पृ. ३६०)

गंगा और जमनी दोनों ही हिमालय से निकलती है, इसीलिए सगी बहनें है। फरक केवल दोनों के प्रवाह की गति में है। वैसे ही हिंदू और मुसलमान अलग—अलग धर्म संस्कृति है। उनके आराध्य, पूजा पाठ के तरीके, मान्यताएं, धारणा भिन्न—भिन्न है। किंतु मानवता का संबंध इन सबसे ऊपर है। जो इंसान को सामुदायिक साहचर्य की भावना सिखाता है। यही तात्विक विचार दोनों ही गीतों में प्रदर्शित होते हैं। इस गंगाजमनी संस्कृति के सांप्रदायिक सद्भाव को अपने गीतों में स्त्रियों ने श्रद्धा से गाया है। आने वाली पीढ़ियों के लिए इस मौखिक लोकसाहित्य की परंपरा को संजोया है। सहजता से मानवी जीवन के अनमोल

होने की शिक्षा देते हुए यह मराठी मिट्टी की बेटियां कहती है,

एकनाथ कुलकर्णी मौलाना देशपांडे
दोघांची वाणी एक गोदेचे पाणी एक
(ब्रम्हानंद देशपांडे संग्रह)

अर्थात् साधु संत हिंदू या मुसलमान किसी भी धर्म के हो उनकी वाणी से निकलने वाला सत्य एक ही होता है। मानव धर्म सबसे महान यह समझने वाला चाहे एकनाथ हो या कोई मौलाना हो। नाम, मजहब, भाषा भले ही भिन्न-भिन्न हो, उनके शब्दों का अर्थ एक समान ही होता है। जैसे हमारी पवित्र गोदामाई का पानी कहीं से भी देखो एक समान बहता नजर आता है। गंगाजमनी संस्कृति पर ऐसे मार्मिक विचार, स्त्रियों की केवल रचना की उंचिश्रेणी ही नहीं दिखाते हैं, उनके समग्र जीवन का सार भी समझने में मदद करते हैं। सर्वसाधारण जनों का आपस का भाईचारा, एक दूसरे के धर्म के प्रति आदर, सांस्कृतिक प्रभाव, प्रथा-परंपराओं का जाने अनजाने में एक दूसरे से मिलाना समझने में यह मौखिक परंपरा निश्चित ही उपयोगी है।

मूल्यांकन

महाराष्ट्र के लोकगीतों में स्त्रीगीतों का एक विशिष्ट स्थान है। इन गीतों में स्त्री जीवन के हर एक पहलू पर गीत रचना की गई है जिसमें स्त्रियों का पारिवारिक,

सामाजिक, धार्मिक, सांस्कृतिक जीवन समझने को मदद होती है। इन गीतों से कुछ अध्यात्मिक और ऐतिहासिक पहलू भी सामने आते हैं। इन स्त्री गीतों में दिखने वाली गंगाजमनी संस्कृति विशेष उल्लेखनीय है। इससे महाराष्ट्र में सदियों से चलती आ रही सामुदायिक सद्भावना और भाईचारे की मिसाल मिलती है। यह लोकसंस्कृति लोकगीतों द्वारा शांतिपूर्ण सहजीवन, धार्मिक सहिष्णुता की सीख देती है। मराठी लोक गीतों की रचना करने वाली अशिक्षित स्त्रियों की प्रगल्भ विचारधारा इस गंगाजमनी संस्कृति का मान रखती दिखाई देती है। शायद बड़े-बड़े विद्वान पंडितों को, मुल्ला-मौलवी को कठिन अध्ययन के बाद जिस ज्ञान की प्राप्ति होती है, उस ज्ञान को इन साधारण औरतों ने अपने अनुभव से ग्रहण किया और उसका उपयोग भी किया है। राजनितिक गलियारों में, ऊंचे घरानों में, शहरी बस्तियों में शायद धार्मिक भेदभाव, वैचारिक द्वंद्व आम हो सकते हैं किंतु लोकसंस्कृति में सर्वसाधारण जनता आपसी तालमेल और सांप्रदायिक सहिष्णुता पर जोर देती हुई दिखाई देती है। मराठी लोकगीतों में यह स्त्री गीत सामुदायिक सद्भावना और गंगाजमनी संस्कृति का बेमिसाल प्रमाण देते हैं। महाराष्ट्र की यह मौखिक परंपरा ऐतिहासिक, राजनितिक, सामाजिक, धार्मिक, सांस्कृतिक पार्श्वभूमि और दृष्टिकोण को समझने में मदद करती है।

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2018, “We know the port has to happen and the US is going to work with India to do that.”⁹”

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Mahatma Gandhi & Abolition of Untouchability

Dr. Avinash D. Fulzele*

[Mahatma Gandhi was a great champion of Hinduism but he never approved evil customs and traditions that were prevalent in Hinduism. He always endeavoured to refrain Hindus from these evil things by frequently rebuking or criticizing it. Mahatma Gandhi had faith on transformation of mind. So, he propagated the change in the hearts of the upper caste people and to wash out the sins of untouchability instead of laws. He didn't want to mar the glory of Indian freedom struggle by bringing social issues in it. Therefore, Gandhiji was not ready to give collective form to the entry of untouchables in temples because he thought that it would weaken the freedom struggle by hurting the religious sentiments of Hindu religious fundamentalist. This was the prominent reason behind not openly supporting the entry of untouchables in the temples. Mahatma Gandhi's thoughts and deeds about the abolition of untouchability created sympathy, compassion and awareness among Indian upper caste people. Upper caste people gradually realized about the injustices and atrocities meted out to untouchables due to untouchability. Many activists continuously strove hard for the abolition of untouchability which was initiated by Mahatma Gandhi. 'Harijan Sevak Sangh' was established to abolish untouchability as per the path shown by Mahatma Gandhi. It was the greatest instrument to materialize the Gandhiji's thoughts regarding the abolition of untouchability. But this instrument hadn't been used so effectively for the abolition of untouchability.]

Mahatma Gandhi started working for the abolition of untouchability since 1920. Untouchables were residing all over India. So, they were earning their livelihood as per the favour of mostly populous Hindus in the villages. Gandhi opined that untouchables were an integral

part of Hindu religion. But Dr Ambedkar's views were contrary to Mahatma Gandhi. Dr Ambedkar organized the movement of untouchables with great efforts for their emancipation. Dr. Ambedkar propagated that untouchables have no rights as Hindus so they can't be a part of Hindu religion and he organized independent movement for them.

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Mahatma Gandhiji worked hard to connect untouchables to Hinduism as well as tried to avail some social rights to them in Hindu religion till the end of life. But, his main role was based on the transformation of minds. He never adopted violent mode for the abolition of untouchability. The main reason behind it was that Mahatma Gandhi had always seen the issue of the abolition of untouchability from the perspective of Hindu scriptures. So, he tried to find out the remedies over this issue from this perspective. Present research sheds light on the review of Mahatma Gandhi's work regarding the abolition of untouchability and the means which he employed for it.

Gandhi's Perspective Regarding Abolition of Untouchability

Gandhi was the exponent of Varna system. He clearly opined, "There is no relation between the annihilation of caste and the issue of untouchability."¹ Gandhi approved that Varna system had great power and it is strong enough to prohibit heinous deeds in the religion. He strongly opined that everyone should carry forward the occupation of his father and forefathers. He also approved that Varna is formed by birth. But the expected meaning of the Varna is not appropriate from his perspective. According to him, Varna means duties; it also stands for the religion. The marriage of a Brahmin man to a Brahmin woman is not enough instead it is their duty to teach and inspire them for it. Gandhi proposed about the Veda's spiritual aspect is that religion is related with the duties of human beings.²

Lokmanya Tilak said that as per the history about the untouchables, so-called untouchables had carried water in the leather bags on the battlefield. So, the food from the plates of few untouchable people was strictly prohibited during contemporary era. It clearly indicates that the plates in the houses of untouchables can't be clean and pure as well as their touch also denied as it affected the food negatively.³ Like Lokmanya Tilak, Mahatma Gandhi had also believed that there is no reference of untouchability in Hindu religion. Indian National Congress organized a session in 1920 in Nagpur.

All India Untouchability Abolition Conference was organized on 25th December 1920 under the Presidency of Gandhiji. In his Presidential speech, he stated, "I am a Vaishnav. I am proud of Varna system. There is not a single reference about untouchability in Hindu religion. Untouchability is an unpardonable sin. Though I am proud of Varna system, I have adopted an untouchable girl and I am very affectionate to her. She is like my own daughter and I have quarrelled with my wife to call her as my own daughter. Though I have adopted this girl, I never insist others to do accordingly."⁴

It clearly indicates that Gandhiji's act of adopting an untouchable girl was his personal decision. It will not be superficial to say that something new could have come out if Gandhiji gave the message of adopting untouchable girls to the people instead of confining it to himself.

In 1921, Mahatma Gandhi clarified in 'Navjeevan' that the whole credit goes to Varna system for keeping Hinduism alive.⁵ Therefore, the annihilation of caste and abolition of Varna system is misconceived notions. If it stands for breaking various castes, I will be agreeing to it. Annihilation of castes and abolition of untouchability are two different things. If these two works are intermingled, it may culminate into chaos in the world.

He clearly stated that sharing food or allowing marriages with upper caste Hindus is not necessary part of the abolition of untouchability. But he also mentioned that it is not inappropriate to share food or allow inter-caste marriages with Harijans.

Gandhiji had stated about the untouchables, "...it is inappropriate to consider human beings untouchables by their birth. It is also wrong to consider that misfortune will happen if one touches the dead body. It is necessary to have compassion and reverence towards them. We take bath after touching dead body or after massaging oil or shaving to maintain good health. There shouldn't be any other motive. Amidst these circumstances, the person who hasn't taken bath will appear dirty but he should not be termed as sinner. If a mother fails to take bath or wash the hands after cleaning the dirt of his son, but a son touches her, he would not be polluted after touching his mother. But the

people like Bhangis, Dhedas and Chamars or blacksmiths are considered as degraded as they are untouchables. If these people have been bathing with soaps for many years, wear standard clothes, have the qualities of Vaishnavas, read Gita regularly and carry their own business and still they are termed as untouchables. It will be not only a part of Hindu religion but also considered as the agony of Hinduism. Every Hindu should fight against it. Every Hindu who has considered it as sin, he should maintain healthy relations with untouchables, build camaraderie and bonhomie relation, solve their grievances, and help them to gain victory over ignorance and purge himself by doing accordingly...'⁷

These changes have been continuously observed in his attitude. Broadening his perspective about untouchability, he said that castes have no scientific basis. These castes are responsible for the degradation of the nation. So, small castes should come together and assimilate with big castes or communities.⁸ Thereafter, Gandhiji started a weekly newsletter namely 'Harijan' in 1933 as a result of understanding the importance of abolishing untouchability or politically overlaying this issue.⁹ After thirteen years, metamorphic changes had been observed in the perspectives of Gandhiji in 1932. In 1946, he blessed the casteless community and stated that caste is the curse for human beings.¹⁰ He endeavoured to associate untouchability with the principle of non-violence. He opined, "...we worship ourselves while pretending to be praying to the God. So, people should establish bonhomie relations with untouchables and love ourselves through this deed. Abolishing untouchability stands for the spreading love and serving people in the world. Thus, this principle of abolishing untouchability assimilates with non-violence. ..."¹¹ In short, Gandhiji's perspective regarding abolishing untouchability had been changing as per the passage of time and he openly talked about the annihilation of the caste.

National Movement and Untouchables

The main motive behind Gandhi's political movement was to politically liberate India from the

shackles of slavery. Rashtrasabha was the leading organization which represented people of the country and cared for the grievances and expectations of the common people. Gandhiji expected that Congress should gain the faith of Dalits and oppressed people as well as it should also follow the path of social revolution while struggling for political freedom or power. He included various programs in his agenda which comprised Charkha, Hindu-Muslim unity, women's emancipation and upliftment of Dalits etc.¹² So, Mahatma Gandhi decided to know about whether to include untouchables in non-cooperation movement in 1920s Conference in Nagpur.

Depressed Class Mission also held All Indians' Conference in Nagpur. Vitthal Ramji Shinde was appointed on the Subject Regulatory Committee of National Congress as per recommended by Mahatma Gandhi.¹³ British Government spent large amount on the education of untouchables. If untouchables participate in the non-cooperation movement, British Government would stop granting fund for the education of untouchables. So, National Congress also brooded over the fund for untouchables' education. Finally, Gandhiji said that it is not an appropriate time to indulge untouchables in the tough task like non-cooperation movement. So, the government grant should be continued for the education of untouchables.¹⁴ So, untouchables were kept aside from this movement.

Thereafter, an independent movement of untouchables was started under the stout leadership of Dr. Ambedkar. Dr. Ambedkar demanded for Independent Constituency for the untouchable community in Round Table Conference. But Mahatma Gandhi opposed the idea of independent constituency for untouchables as it could split nationalist movement.¹⁵ Though it was true, the demand for independent constituency for untouchables was not anti-national and never supported British government. It was the demand for fundamental rights of human beings. This demand was denied to untouchables under the influence of Varna religious system.¹⁶ Therefore, it can't be denied that this community kept themselves far from the nationalist movement.

Political freedom was the prominent need of contemporary era. So, as a national leader, Gandhiji took the responsibility not to split national integrity as the process of awakening started among the various communities which could be resulted into the struggle for their rights. Though Gandhiji was willing for the abolition of untouchability, he left the personal issues like sharing food and inter-caste marriages to the conscious mind of the people.¹⁷ He never forced for it. In short, Mahatma Gandhi only focused on reinforcing national movement only for the political freedom.

Entry in Public Places

Mahatma Gandhi campaigned for the equal rights of the untouchables at public places through his speeches and writings. But he never motivated his disciples for public passive resistance in the crucial issues such as entry in the temples as it could be resulted into the severe discontent or hatred among untouchables and upper caste people.¹⁸ But he strove hard for slackening the clutches of untouchability among the conservative people about the inhuman nature of untouchability by spreading awareness among the common people. But Dr. Ambedkar clearly opined regarding the entry of untouchables in temples, "...there are many types of worship. It is not necessary to get entry to the untouchables in the temples to directly worship the God. They just want to prove that their entry in the temples never pollute the temples or the holiness of the statue doesn't diminish due to the touch of untouchables..."¹⁹ So, this is not only the question of entry in the temples but also it is the question of equality.

Dr. Ambedkar insisted for this equality to untouchables. But Mahatma Gandhi proposed that the insistence of bringing untouchables to hospitals or temples should be avoided where people are against their entry.²⁰ In this regard, Mahatma Gandhi said, "...you are very much aware that Hindu fundamentalists are against the entry of untouchables in the temples. They are ready for other things but they never allow the entry of untouchables in the temples. They are aware about the truth that the entry to untouchables in temples will give all rights to them. These people should not promote the

reasons of standard of living and cleanliness of untouchables because the living standard of Dr. Ambedkar is high and clean. We allow him in our houses. We share food with him. But we never bear the shadow of the poor untouchables because we are rustic minded people..."²¹

Because, Gandhiji had himself experienced the religious fundamentalism of upper caste people. No other person would be allowed except Brahmins in the Padmanabhan temple in Trivandrum. Mahatma Gandhi was also prohibited from entering in the temple.²² Gandhiji experienced another such incident in Wardha on 11th November 1933. Mahatma Gandhi was determined to enter the temple with Dalits in Deoli village of Wardha district. At that time, a pundit hailing from Banaras stood by the door of temple with his four-five companions to restrict the entry of Gandhiji with Dalits. They shouted, "They would not let them allow polluting the temple."²³ So, he avoided to enter in the temple. After observing such incidents, Gandhiji instructed his disciples to build new temples if conservative people are denying entry to untouchables in the temples.²⁴

Mahatma Gandhi clearly opined that untouchables should get entry in the hotels. Every community and religion's people stay in hotels. So, untouchables should be allowed to come in the hotels. Untouchables should also be allowed in the hotels like upper caste Hindus stay in the hotels without any conflict. They should be treated on par with the upper class Hindus.²⁵ He also stated that the untouchables must have the rights to freely communicate and roam in the public places.

Establishment of Harijan Sevak Sangh

Gandhiji determined to dedicate his life for the service of untouchables after Puna Pact. Establishment of 'Harijan Sevak Sangh' was one of the parts of this work. The organization's name was kept in Hindi instead of English as per the inclination of Mahatma Gandhi. So, they decided 'Harijan Sevak Sang' as the name of organization. He felt that the workers should prominently focus on the servitude. Gandhiji expected that Harijan Sevak Sangh should be a registered organization

like Charkha Sangh, Gramodyog Sangh, and Nayi Taaleem Sangh, it should be run on the charity-based funds and accounts should be meticulously managed as well as workers should spontaneously participate in the freedom struggle.²⁶

People had supported Harijan Sangh. Many foreigners also donated funds for it. Gandhiji received rupees forty thousand's fund from Japan for the work of Harijan Sangh during contemporary era.²⁷ Gandhiji stated that it is necessary to work for bestowing new status to the Harijans, abolition of untouchability from their life, imparting social and civil rights to them and their fast educational development. He advised laborers for huge constructive work throughout India as per the sentiments and willingness of Harijans to bring them in mainstream equal to the developed section of the society. Gandhiji replied to the question raised by renowned Harijan leader of Madras, "Abolition of untouchability is the toughest task and it should not be forgotten that our work is the most difficult task."²⁸ In a stone-laying ceremony of Harijan Hostel in Delhi, he said, "Untouchability should be died to keep Hinduism alive and Hinduism should be killed to keep untouchability alive."²⁹

Few students hailing from Pune had written an application to Harijan Sevak Sangh. This application attempted to bring into notice regarding low per capita income of the Indians and the income of untouchables couldn't be even measured. He got an opportunity to visit those three students of Pune on 3rd January 1933. He said during discussion, "...it is inexperienced statement of the per capita income. Upper caste people are dying of hunger while untouchables are dying due to less hunger. For example, Namshudras of Bengal region, Theonas of Malabar or the Bhangis of Mumbai. These people are more contented as compared to the upper caste people. Many men, women and children work in the Bungalows. There are many instances regarding it. The condition of Chamars is better than others. On the contrary, Odiya people's bones are clearly visible but they never do the works of Chamars and Bhangis. They are ready to die of

hunger but they never touch the work which they haven't done in their life. If we calculate the average income of untouchables and upper caste people, the average income of untouchables would not be lesser than upper caste people..."³⁰

Students immediately responded, "Untouchables are the slaves and they are working as laborers." Gandhiji replied, "I know that you are intelligent students. Collect the concerned information of a village. I could examine the economic condition of the villages in Gujarat if I have enough time for it."³¹ Gandhiji stated the real condition to the students. Though he hadn't enough time to work for it, he had Harijan Sevak Sangh to work for it on national level. Harijan Sevak Sangha's work was confined to the establishment of schools and hostels for untouchables, spreading awareness about sanitation, persuading the owners of the temples and wells to open it for untouchables.³² It would be appropriate to say that the students' question could have got justice if Gandhiji examined the economic condition of the upper caste people and untouchables through Harijan Sevak Sangh.

Evaluation

Mahatma Gandhi was a liberalist. He had faith on the values of social equality. He also approved that a person's conscious mind is the final criterion of the justice. He sternly believed that untouchability is a blot on Hindu religion and he was not suspicious about his opinion. Gandhiji's personal behaviour and his views in public never signified the concepts such as untouchability or caste discrimination. He equally treated untouchable families like upper caste people during his residence in Ashrama. He happily blessed those couples who spontaneously expressed their desire for inter-caste marriages. He never compromised his principles during his conjugal life though he was little afraid of people's discontent.

He strictly prohibited few things while working in social reformation movement. Political freedom was the first need of the nation during contemporary

era. So, as a national leader, Gandhiji took the responsibility not to split national integrity as the process of awakening started among the various communities which could be resulted into the struggle for their rights. It is observed that Gandhiji courageously completed his responsibility. Though Gandhiji was willing for the abolition of untouchability, he left the personal issues like sharing food and inter-caste marriages on the conscious mind of the people. It certainly helped to diminish the embitterment among untouchables and upper caste people.

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CHHATRAPATI SHAHU MAHARAJ: REVIEW OF THE WORKS OF EDUCATIONAL, SOCIAL, AND INTELLECTUAL AWARENESS OF UNTOUCHABLES

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ABSTRACT

Mahatma Phuley meticulously devised the path of emancipation of the untouchables by opening schools for them. Chhatrapati Shahu Maharaj continued this work of Mahatma Phuley. He pre-eminently rubbed elbows for the abolition of untouchability in Kolhapur province by establishing schools and hostels for the untouchables in his province. He had appointed Mahar community's people (an Untouchable Caste) on the positions of charters of lawyership and Talathi (Local Revenue Officer) and broken the shackles of social and economic slavery. He issued many resolutions and effectively executed it for the reformations among the lives of untouchables. He facilitated education for the untouchables to make them self-reliant. He also opened hostels at various places. He came forward to treat them equally. Moreover, he participated in various meetings and conferences to spread ideological awareness among them. This remarkable work gave impetus to the movements of untouchables. Untouchable community regarded him as Godly figure due to his deeds. So, present research article endeavours to bring forth the noteworthy works of Shahu Maharaja regarding educational, social, and ideological awareness of the untouchables from research perspective.

Keywords: Shahu Maharaja, Abolition of Untouchability, Hostels, Schools, Dr. Ambedkar, Social Equality.

Research Methodology

Historical research methodology has been used for the present research and available literature has been scientifically examined and evaluated in the light of concerned topic.

Hypothesis

Shahu Maharaja endeavoured to make untouchable self-reliant and establish social equality.

Introduction

Many barons ended up their lives to sustain their existence during British rule. Indian politics is going through the same situation. But, it has some exceptions. Kolhapur's Chhatrapati Shahu Maharaj is the foremost name among them. Shahu Maharaja executed the movement for the dignified life of untouchables till last breath of life. He provided educational facilities like mainstream people to the untouchables. He was concerned about the educational, social and ideological awareness of the untouchables as they were reliant on others. In short, present research shed light on these remarkable deeds of Shahu Maharaja.

Present research article is divided into three parts. First part deals with Shahu Maharaja's works for the educational development of

untouchables. Second part sheds light on his endeavours for flourishing social equality. Third part includes Shahu Maharaja's works for the ideological awareness among untouchables. Finally, the evaluation of all these aspects is provided in it.

Educational Works

Chhatrapati Shahu Maharaja paved the way for the development of untouchables by opening schools and hostels for them. While doing so, he strove hard to eradicate prejudices from untouchable community and insisted to provide equal opportunities in education. He adopted the policy of upliftment of the backward communities through education in his province. Many hostels were established for the students of various communities in Kolhapur. In 1908, he also opened hostels for untouchables by involving his colleagues namely Bhaskarrao Jadhao, Mahadeo Dongare, Bagal, Shinde etc. He established an organization namely 'Education Proliferating Board' (Vidya Prasarak Mandal) for this work (Pawar 72-73). These people strove hard to find out the children of untouchables for hostel as well as endeavoured to enhance their educational status equal to the mainstream people's children (Pawar). But, it was tough task to convince untouchables for education as they were apathetic about the education. So,

Shahu Maharaj worked hard to overcome these issues. Only five schools were existed for untouchables in his province at the time of his coronation and the number of students was 168. The number of schools for untouchables became 16 and the number of students was 416 during 1907-1908. The number of schools for the untouchables gradually increased due to the endless efforts of Maharaja. In 1912, the number of schools for the untouchables became 27 and the number of students was 636 during these four years(Pawar).He wholeheartedly supported for opening the schools for untouchables. He was personally observing the financial provisions of these schemes. Chhatrapati Shahu Maharaja and Bhaurao Patil devised a unique scheme of fund collection for the proliferation of education among educationally backward communities in Satara district. He was very interested in wrestling and many wrestlers were there under his patronage. He took the cost of 4-5 pairs of wrestlers and handed them over to an assigned committee. People were too interested in wrestling in Kolhapur province.He executed the scheme of selling tickets of wrestling matches in various villages and spent income on the proliferation of education(Prabodhan Monthly Magazine (Marathi) 64).

Chhatrapati Shahu Maharaja started building hostels for untouchables and appointing new teachers to proliferate and promote education among untouchables in his province (Warkhede 34).In 1907, he established a branch of Depressed Classes Mission in Kolhapur. 'Miss Clark Student Hostel' was established under this mission. Moreover, he opened a free hostel and mess for 50 untouchable students in his palace. Sometime, he personally taught to students (Shinde 243). He continued this work endlessly in his province. He also generously donated for those organizations which were dedicated for the upliftment of untouchables. He presided over All India Backward Classes Conference of 1920 in Nagpur. He munificently donated five thousand rupees to Chokhamela Boarding (N. R. Shende 41). He generously donated many times for various noble works.

Shahu Maharaja's efforts regarding the proliferation of education in untouchable

community reflect in his various issued orders. He issued most important order on 24th November 1911. As per stated in this order, all types of education were made free for the untouchables in his province (Pawar 74). Special scholarships were given to the meritorious students from untouchables from the court. He approved two thousand and five hundred rupees by issuing an order on 7th April 1919 to promote education among untouchables and offered books, slates, and pencils to them(Pawar 74).As per stated in his an order, 'Education department of province should treat everyone equally without any discrimination among untouchables and mainstream people like American Mission, Saint Xavier, Wilson College and Mission and Arya Society's schools, colleges, and residential schools in Banglore, Panchgani, Railway and government personnel. Government aided schools should respectfully treat untouchable students and enrol them in the schools' (Prabodhan Fortnightly (Marathi) 122).He conveyed this order to various branches of the organization. Shahu Maharaj was very serious about the education untouchables and it is clarified in an order. As per this order, government buildings are not for private works. It should be used for the sake of government. Everyone should be treated equally without any discrimination between untouchables and mainstream people. If untouchables pay the taxes levied on them, why should they be treated so badly? (Prabodhan Fortnightly (Marathi)). He hoped that the private and government organizations which avail grant under education department in the form of buildings and free ground, they should treat untouchables with more affection and respect as compared to upper-caste people. Mainstream people have many ways to educate themselves. But, untouchables don't have such mediums to achieve it. If the principals or teachers fail to treat untouchables equally, they will be punished. As well as, the grant of private institution will be revoked in that case (Prabodhan Fortnightly (Marathi)). As per another order issued by Shahu Maharaj, if any individuals from School department contravene this order, they should send their resignation letter within six weeks. He will not get pension. As well as, the court will revoke the

grant and other aids if the aided organization contravene to it (Prabodhan Fortnightly (Marathi)). Moreover, he expected that every teacher should help untouchable students whenever they come to school though he is very tired due to work (Prabodhan Fortnightly (Marathi)). Thus, Shahu Maharaja was an avant-garde whose movement developed interest among backward classes and made them aware about their human rights (Khairmode 260-261). Shahu Maharaja's educational works made untouchables aware about their condition and increased the proportion of untouchables' education in his province.

Elimination of Social Inequality

Shahu Maharaja everlastingly endeavoured to build new society based on equality by violating traditional caste system in Hindu society. He was motivated by the thoughts of annihilation of caste, abolition of untouchability, destroying the artificial walls between superior and inferior, upper and lower classes (Kharat 14). Shahu Maharaja issued an order stating no one will desecrate untouchables. Labourers of village, police assistant and local revenue personnel will be held responsible for it if this happen in the province (Prabodhan Fortnightly (Marathi) 122). He opened all public places for untouchables in the province. He bestowed equal rights to untouchables by opening public taps, wells, lakes, inns, hospitals, schools, and offices for them (Gore and Limaye 21). He remarked about untouchables, "I believe that true national service lies in breaking the shackles of inhuman oppression which completely enslaved untouchables. Lower caste people can't do it though they endlessly strive hard for it. Upper caste people should abandon the rights which they have been enjoying since ancient times in inheritance (Bagal 9-10). He issued an order stating that the children of untouchables should be enrolled in government schools like others and all the independent schools which were opened for them should be closed. As well as, the children of various castes and religions should be seated collectively without observing any desecration (Prabodhan Fortnightly (Marathi) 122). His motive behind providing religious education to

untouchables was to establish equality in the society. So, he organized thread ceremony (Upanayan ritual) for untouchable students before initiating their religious education. Shahu Maharaja was the first ever well-known King in the history who gave Veda's *santha* by organizing thread ceremony for the untouchables and brought them up equal to the so-called superior status of Brahmins (Pawar 75). The work executed by Shahu Maharaja in his province inevitably affected and shattered the very roots of Brahmanism. So, few Brahmins from Pune complained about Shahu Maharaja to British and tried to politically suppress him. At that time, he stated, "I don't care if I am dethroned while serving for the backward classes. He warned to the antagonists and contemporary British that I will everlastingly strive hard until the last breath of my life to eradicate the miseries of persecuted communities (Garud Weekly 2). He organized the movement of social equality. This movement had given constitutive form to the abolition of untouchability (Bansode 2). Shahu Maharaja prominently stressed on developing social equality by restraining detrimental customs and traditions prevalent in Hindu society.

Ideological Awareness

Shahu Maharaja endeavoured to provide equal opportunities of education and employment to untouchables in his province. Whole untouchable community was indebted forever for this historical work. The best example of this work was Mahar barons of Karveer of Bastwadpeta Raibaug area had submitted an application regarding Maharheirdom on 27th July 1921. While mentioning the works of Shahu Maharaj regarding the upliftment of untouchables, they stated, "The generous King has tried many ways for our upliftment and reformation. You opened boarding, schools, provided employment to many people, some entered in the profession of lawyer, and the King treat us like his own children with equal affection sidelining any type of discrimination. So, our community worships you like the God and will be indebted forever for this remarkable work" (Bahishkrit Bharat Fortnightly (Marathi) 11). It indicates that untouchables were bowed down to the works

of Shahu Maharaja. But, he unceasingly endeavoured to spread ideological awareness among untouchables. He said about the tradition of untouchability that, 'Dweej people were considering themselves superior by birth and inferior to Shudras (untouchables) when Vedic religion deteriorated after Mahabharata. So, the most of the population of India was deprived of education, religion, and prosperity. But, the atrocities meted out to untouchables stopped during Buddha's era. Thereafter, fanatic Hinduism was flourished based on Vedas which culminated into the growing casteism in the society. Its branches also flourished at large scale. Nowadays, the casteism and atrocities meted out to untouchables is considered as the commandment in Hinduism'(Prabodhan Fortnightly (Marathi) 122-123).Shahu Maharaja felt that mainstream people should come forward to overcome this problem. As well as, lower caste people should strive hard to uplift themselves and enhance their status, and upper caste people should also collectively work with lower caste people. It will help to annihilate casteism systematically and amicably(Mooknayak Fortnightly (Marathi) 5).As well as, Shahu Maharaja suggested that inter-caste relationship should be established to eradicate casteism from the society. Legal barriers should be resolved to increase inter-caste marriage which will be beneficial to overcome this issue. Legal provisions should be made for it(3-4).Shahu Maharaja chaired All India Backward Classes Conference in May 1920.He clarified in the conference that 'development of the nation depends upon the proportion of the abolition of casteism" (3-4).

In All India Backward Classes Conference at Delhi, Rajashree Shahu Maharaja said, "Emergence of British Empire lead towards the awareness and renaissance in our life. We shouldn't forget it. As well as, nation's political future depends upon the character of the citizen of respective nations. So, everyone should endeavour to improve his own character. Everyone should prove their capabilities to use given rights through their behaviour" (Bahishkrit Bharat Fortnightly (Marathi) 4).He never propagated himself as the leader of untouchables though he

significantly contributed in this work. He always worked merely as a servant of untouchables. Shahu Maharaja expressed his views in All India Backward Classes Conference in Nagpur saying, "If any calamity wrought upon you, I will hand over my empire to the prince to render the service for you" (Bahishkrit Bharat Fortnightly (Marathi) 3). Shahu Maharaj always felt that the path of the emancipation of untouchables will be more substantial if the leadership of the movement of untouchables emerge out of untouchable community. He wanted to suggest the same message from a letter written to Gawai. In this letter, he said, "You should not give the leadership of your community's movement to others. The credible and suitable leader should be appointed from own community. Otherwise, other community's leaders will play with your and movement's future" (N. R. Shende 39). So, he publically declared Dr.Ambedkar as the leader of untouchables in the Mangaon conference which was chaired by him. Thereafter, untouchable community resolutely stood with Dr.Ambedkar resulting into gradual decrease in the fame of other leaders. A movement for the emancipation of humans organized under the leadership of Dr.Ambedkar.

Conclusion

Shahu Maharaja ceaselessly extended Mahatma Phuley's Truth-Seeker (Satyashodhak) movement. He used his power to constitutively eliminate inequality from the society.The prominent role of an avant-garde is to bring metamorphic changes among the lives of people, lead them towards progress by making aware them about humanity. ChhatrapatiShahuMaharaj was an iconoclast as far as this perspective is concerned (Garud Weekly, (Marathi) 1).The era when Shahu Maharaja raised the issue of the abolition of untouchability was not as congenial and progressive as it is today.It is meticulously illustrated in the death article of Shahu Maharaja in Kesari newsletter.Author of Kesari said, "No one can surpass the expertise and intellectual capability of Shahu Maharaja in epistemology, politics, and sociology in today's era. People are witnessing the output of his massive and hard work" (Prabodhan

Fortnightly 117). Thakare, a campaigner and social reformer, had endeavoured to show how different community's people looked at the work of Chhatrapati Shahu Maharaja with wide-ranging perspectives. In this regards, he said, "He was a foe for Chitpawan community's people. He was a rebel in religious sphere for Deshasth community. He was a lovely friend to Mumbai and Indian Government, father to Non-Brahmins while an angel of God for untouchables" (Prabodhan Fortnightly (Marathi) 116). It clarifies different perspectives of the people towards Shahu Maharaja's works. In a tribute to Shahu Maharaja after his demise on 6th May 1922, it was written in 'Bahishkrut Bharat', "He was our Abraham Lincoln who has proven that if

you bore the seeds of love, it will never give you the fruits of hatred; he is our laurel; he has wiped out the blot of untouchability imprinted on the minds of Hindus. He was our God..." (Bahishkrit Bharat Fortnightly (Marathi) 3). Dr. Ambedkar remarked, "Shahu Maharaja endlessly strove hard to abolish social inequality and devastated the stronghold of Brahmins" (Moon 307). Thus, present study clarified that Chhatrapati Shahu Maharaj always took care of the development of untouchables. He strove hard for their educational, social, and ideological awareness of the untouchables. Shahu Maharaja's this massive work is inspirational for the forthcoming generation.

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V. R. SHINDE: ANALYSIS OF SOCIAL AND POLITICAL ALTERATIONS AMONG UNTOUCHABLES

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ABSTRACT

Untouchability had been prevalent from ancient era in Indian Society. The lives of this community's people became intolerable due to untouchability. Many efforts of reformation in the social milieu of India had been undertaken during British rule. Untouchables were relentlessly endeavouring for the upliftment of the society. Amidst these circumstances, V. R. Shinde promoted the organizational reformation of the untouchables. Ideologically he was an avant-garde. He was prominently associated with Bramho Society and Prarthana Samaj (Prayer Society) and endlessly worked for the upliftment of untouchables. He established 'Nirashrit Sahyakari Mandal' (Board for Assistance to Orphans) for the betterment of untouchables. He endeavoured to pave the way for social, religious and political development of the untouchables. His deeds helped to foreground the work of Dr.Ambedkar. V. R. Shinde and Dr.Ambedkar's paths regarding the betterment of untouchables were radically ununiformed as there was fundamental ideological difference in their modus operandi. But, V. R. Shinde stout-heartedly placed it on national level and dedicated his youth for humanizing the wretchedness of untouchables. His remarkable deeds are still buried in the graves of history. So, present research article is an attempt to unearth his deeds regarding untouchables.

Keywords: V.R. Shinde, PrarthanaSamaj, BramhoSamaj, Untouchability, Depressed Class Mission, Dr.Ambedkar.

Introduction

Contemporary society was so dumb and silent though they were witnessing how humans enslaved other humans. This community had been denied social, religious and political rights. Any efforts made for bringing untouchables into mainstream were considered as the violation of religious principles of Hinduism. So, no one had dared to educate and reform them due to the resistance from the orthodox people until the emergence of Mahatma Phuley. Mahatma Phuley opened first school for the untouchables and opened the frontiers of their all-pervasive development. Mahatma Phuley started the process of social dissemination by initiating Satyashodhak (Truth-seeker) movement in Maharashtra. Chhatrapati Shahu Maharaj continued the work after Mahatma Phuley in Maharashtra. Thereafter, V. R. Shinde executed organizational work for the upliftment of the untouchables. The leadership of Dr.Ambedkar was emerging from untouchables during the same era. Shinde belonged to Maratha community so he didn't bear the brunt of untouchability. He hadn't experienced the agonies of untouchability. But, Dr.Ambedkar's path of abolition of untouchability was

different from V. R. Shinde as he had personally experienced it. In short, present research paper shed light on the social and political works of V. R. Shinde for untouchables.

Early Life

Vitthal Ramji Shinde was born at Jamkhandi in Karnataka on 23rd April 1873. His ancestors were the heirs of Sinda of Mandali dynasty during Twelfth Century. They were the barons of Surapur province during the second half of Eighteenth Century in Vijapur district (Shinde V. R., p. 236). It was the land where Marathi and Kannada languages were flowing together in a stream. Vitthal Ramji Shinde's father was in lead in flourishing Bhajani Sect of Jamkhandi Pandharpur. As a result, hymns were regularly sung at their home. He approved that these hymns significantly contributed in his religious development (Shinde V. R., p. 17). Thereafter, their economic condition deteriorated gradually. Amidst this crucial time, his mother painstakingly sheltered their family and courageously handled the situation. She bore the brunt at mother's house which made her capable to endure and tackle all these circumstances (Pawar G. M., p. 83). They had

to reel under miserable familial condition due to father's joblessness and losing their agricultural land. Amidst this crucial condition, he got admission in Ferguson College, Pune for B. A. on the basis of scholarship (Paswan & Pramanshi, p. 116). His passage which was written in his diary dated 22nd May 1898 while educating in Pune shows his willingness for the betterment of untouchables. It was noted, "Today the Founder President of Maharashtra Village Education Society namely Kalaskar from Baramati has come to our hostel. I was listening to his remarkable deeds and selflessness. He has shown his solicitude for the extremely lower-castes like Mahar-Mang. Brooding over these facts, I heartily feel so ashamed of myself and repulsive too" (Shinde V. R., p. 265). It clarifies that he had fervour of the upliftment of untouchables since he had been a student. He admitted in Mumbai University for Law in 1899 after completing his graduation from Pune. Thereafter, he admitted in Manchester College after getting Unitarian Scholarship. Sayajirai Gaikwad Maharaj of Baroda Province financially assisted him in his decisive days. Prarthana Samaj appointed him as its campaigner when he returned to India in 1903. Afterward, he downrightly dedicated himself in social service. Shinde's participation in Prarthana Samaj disappointed Maratha community's people. According to Maratha community's people, Shinde had completed his education from the fund of Marathi community and foreign expenses were also funded by Baroda's King. So, it was inappropriate to participate in the service of Prarthana Samaj instead of serving for Maratha community's people. But, Shinde endeavoured to correct the misconceived notions in the mind of his community's people. If the King doesn't confine himself in the service of selective people, how could his disciple be ideologically different from him? (Shinde V. R., p. 179).

Advocators Of Prarthana And Bramho Samaj

Shinde was very devoted by nature as he had been influenced by the sacraments of Warkari sect. He got engaged with Prayer Society when he was educating in Pune. Shinde was copiously influenced by the speech of

Mr. Kashinath Balwant Marathe of Prayer Society (Shinde V. R., p. 110). He entered into Prayer Society in 1898 and he took ordination of this society. He endeavoured to get scholarship given by 'British and Foreign Association'. The prominent motive of this scholarship was to reciprocate ideas and religious principles of the generous institutions like Prayer and Bramho Societies in India (Kadam, p. 66). He admitted to Manchester College in Oxford for theological education in 1901. As per the norms of Unitarian Scholarship, it was mandatory to devote himself for religious preaching and campaigning till the end of life (Shinde V. R., p. 142). Shinde returned to homeland after concluding his foreign journey in 1903. Thereafter, he commenced his philanthropic work as one of the campaigner of Prayer Society (Shende, p. 52). As an able preacher and campaigner, he devoted himself by taking responsibility over himself to invigorate, functionalize and competently spread Prayer Society's principles among common people. The principles of Prayer Society and Bramho Society were analogous in nature. So, he also intermingled with Bramho Society. In this regard, he remarked, "I become a reformer not because of I have entered in Bramho Society. I was a reformer so I come to Bramho Society. I have observed that the structure and principles of Bramho Society is meticulously analogous with the pictures of human life that I have intermittently portrayed in my mind as per my generous nature. Moreover, I have assimilated with it too early and completely dedicated himself for its work as I am so enthusiastic" (Shinde V. R., p. 149).

Shinde initiated innovative policies for campaigning Prayer and Bramho Society. He established a significant association namely 'Young Bramho Association' in 1905. He precisely prepared the rules for the memorandum of the association to prepare the youths, who participated in the Prayer Society, for ardently observing the principles of the association (Shinde V. R., p. 161). The prominent motive behind the establishment of this association was to incline them for worship by uniting the youths of Bramho family to increase harmony among them and

campaigning for the religion, brotherhood and world peace (Kadam, p. 69). As well as, he started the reading of various scriptures by beginning 'Liberal Scripture Reading Classes' in temple. He had remarkably done the job of distribution of millions of posters and booklets among the people who weren't the members of this society through 'Postal Mission' and spread awareness among the people (Shinde, p. 52). 'Central Postal Mission' of London had taken cognizance of his remarkable work and British Foreign Unitarian Association's Secretary had passed a congratulatory resolution on 12th February 1904 for successfully running the work of Mission through Prayer Society (Shinde V. R., p. 175). Mr. Kisan Fagu Bansod, a youth from Mahar community, residing at Mohapa near Nagpur, inclined towards Prayer Society by reading some liberalistic books of Society's Postal Mission in Mumbai. He was present in Annual Festival of Prayer Society in 1905. Due to this participation and acquaintance, the movements regarding self-upliftment in Mahar community fascinated Prayer Society's campaigners and attracted them towards it (Shinde V. R., p. 210). Shinde endeavoured to inculcate the principles and values of Prayer and Bramho Society in Indian society. He strove hard to prohibit Bramhin religion by relentlessly endeavouring to ameliorate Prayer society (Kurkure, p. 7). Shinde travelled across India for three times during 1903 to 1906. He delivered a talk before 'Social Reform Association' at Mumbai in 1906. He systematically presented the issues of outcastes in India, region-wise population of outcastes etc. (Pawar D., p. 453). Thereafter, he established 'Depressed Class Mission' by focussing on the issues of outcastes. He emerged as an exponent of untouchables. But, he everlastingly left the work of Mission after Dr. Ambedkar dived into social work.

Shinde again inclined towards Bramho Society after abandoning Mission. He relentlessly travelled to Madras region during 1924-25 as an all India campaigner of Bramho Society. He refrained to the untouchables from converting to other religions. As well as, he performed ordination of the people who left Hinduism and had been converted to other religions (Shinde

V. R., pp. 247-248). The condition of Bengal was radically different from that of Madras during contemporary years. While rationalizing it, he remarked, "Untouchables opened and ran all the schools in Bengal from many years. The prominent reason behind this difference was the high-class standard of the untouchables in Bengal. Education department of Bengal province and Calcutta University's democratic policies are prominently responsible for the rapid development of untouchables in higher education (Shinde V. R., 1976, p. 251).

Shinde started studying Buddhism during 1925-26 because he wanted to experience Buddhist lifestyle by travelling in Myanmar. He also studied Pali language for it. Maghotsava (Festival of the Brahmos) of Bramho Society was held during 24th January to 6th February 1927 in Calcutta. In this meeting, Shinde said, "I am Buddhist." Missionaries were so flabbergasted by his assertion. Taking cognizance of the disputable situation, Mr. Gurudas Chakravorty, President of the Conference, tried to edify the members. He illustrated Shinde's opinion in following words, "Try to understand the spiritual sense of Shinde. Bramho Society is all-comprehensive and Shinde is an epitome of it. He is going to Myanmar to observe Buddhism. The people of Myanmar and Bramho Society will be certainly benefitted by the liberalistic nature of Bramho religion" (Shinde V. R., pp. 370-371).

Establishment Of Depressed Class Mission

V. R. Shinde perceived various severe issues of the untouchables when he was roaming across India. According to him, Indian untouchability is not only local or religious but also casteist or national and perpetual in its manner (Shinde V. R., p. 10). Shinde wrote on 'The Issue of Indian Untouchability' and elaborated five prominent causes of the origin of untouchability (Kshirsagar, p. 21). Untouchability is an independent human organization. Shinde believed that it had its origin at the very outset (primary stage) of the human species (Shinde V. R., p. 12). Three symptoms of Indian untouchability i.e. caste-based untouchability, communal boycott, and everlasting negligence of law are still prevalent in Indian society (Kshirsagar, 1994, p. 9).

Ordination during Muslim reign had abolished untouchability to some extent because Islamic principles never endorsed Hindu traditions and customs. But, British-Hindi government was so coward and insidious in this regard (Shinde V. R., p. 11) because Shinde alleged that British never enthusiastically came forth for the abolition of untouchability.

Untouchables came forward with the issue of untouchability and established mini organizations to confront with their issues at the outset of twentieth century. Ex. 'Somvanshiy Society' in Pune headed by Shivram Janaba Kamble; 'Lower Caste Organization' in Nagpur headed by Kisan Fagu; Shrimantrao Thorat led 'Somvanshiy Welfare Society' in Nagar etc. organizations were actively working for the betterment of untouchables. Shinde was brooding over to establish an organization for the comprehensive welfare of untouchables. His pragmatic and conscious role behind the establishment of the organization was that if every organization works individually and independently, gradually these organizations will wane according to the passage of time (Pawar D. , p. 453). So, he determined to establish all India level organization to collectively venture for humanizing the untouchables. As per the census of 1901, India's population was 29,43,61,056 out of which the population of untouchables was more than five crore. It means untouchables constituted one-sixth of India's population (Shinde V. R., p. 92). So, Shinde focussed on how Mahar (an untouchable caste) community's people are running the movement as untouchability is the major issue and how the awareness is spreading among them. At the same time, Mahar community's people ran a movement through 'Somvanshiy Society' for the upliftment of their community in Ahamadnagar. Shinde went to Ahamadnagar to know about the works, to get familiar with its activists, and to interact with them (Khairmode C. B., p. 226). Shinde organized a meeting at Bhangar village which was four miles away from Ahamadnagar in 1905. He read the content in a pamphlet issued by Kisan Fagu Bansode's 'Somvanshi Hitchintak Samaj' in the meeting. Shinde read the most ethical lines

in the pamphlet: "Though untouchables have tolerated the injustice and exploitation by upper-caste people, they should endeavour for their own upliftment without hurting the sentiments of upper-caste people." Shinde inspired for the work of upliftment and determined to dedicate himself to this work after reading that content in the meeting (Shinde V. R., pp. 215-216). Thereafter, Shinde decided to establish a mission to execute it systematically. But, he had to face financial crisis for that reason. Shivram Kamble, a person from Pune, visited Dr. Santuji Ramji Lad, an honest activist of 'Truth-Seeker's Society', to overcome the financial problem. Dr. Lad was well-acquainted with Damodhardas Sukhadwala who was a well-known shroff in Pune. He gave one thousand rupees on advance for the work. In 1906, Shinde established 'Association for Aid to Destitute' in Mumbai from that donation and commenced his work for the welfare of untouchables (Navalkar, pp. 31-32). The main motive of this association was to provide education, jobs, equal and benevolent treatment, preaching liberal perspective regarding religion, behaviour, health and citizenship to the impoverished and lower-caste communities like Mahar, Mang, Blacksmiths, Dhed, Pariya etc. as well as assisting them for self-upliftment and development through various means (Shinde V. R., p. 212).

Shinde endeavoured to associate Depressed Class Mission with Bramho religion's ideology. As per stated by him, Bramho religion is nothing but the incorporation of all religions. But, it stresses on the significance of sanctity of the mind and 'Association for Aid to Destitute' ran the work of social equality with same sanctity of mind (p. 9). Shinde believed that untouchability can be abolished on the basis of liberal religion and a program on the comprehensiveness of all factors of the society. If upper-caste and untouchables come together, it will help to eliminate prejudices about each other. Furthermore, it will help to civilize and cultivate the minds of lower-caste offspring in the vicinity of upper-caste people (Pawar D. , p. 455). These people came forward for executing home-sacrament for those untouchables who had adopted this

simplified ideology of the religion. In 1910, after four years of the establishment of 'Association for Aid to Destitute', Vitthal Ramji Shinde renamed this association as 'Depressed Classes Mission' (Shinde V. R., p. 218). Though Arya Society and Prayer Society had started the movement of untouchability abolition, the issue got more relevance after the establishment of Depressed Classes Mission (Bansode, p. 2). Dayaram Giddmal donated hundred rupees per month to start home for destitute at the beginning of the mission. This donation continued for only three years. But, the donation was stopped at the end of June, 1910. Vitthal Ramji Shinde somehow continued the work of Mission by initiating rupee fund, rice fund, clothes fund, Box fund to overcome the financial crisis (Shinde V. R., pp. 241-242). Rich people from Hindu, Christian, Parsi, Muslim etc. communities were coming out to financial aid the noble work of the organization. Government personnel were also compassionate with the organization. Miss Violet Clark, daughter of Sir George Clark, Governor of Mumbai, actively supported the work of organization (Khairmode C. B., p. 227).

Shinde studied the issues of untouchability. He considered that untouchables should be educated for the abolition of untouchability. The main motive of Mission behind opening of the schools was not only to teach reading and writing but also to civilize the minds of the students and their parents (p. 9). So, he stressed on the educational awareness among untouchables and the establishment of schools and hostels for their children (Kharat, p. 15). He started hostels for the students in Pune, Nagpur, Mumbai and Madras by opening an institution namely Depressed Class Student Mission (Gore & Limaye, p. 19). The association aimed at campaigning for the jobs for untouchables along with educational awareness, resolving their social problems, cultivation of universal religion, individual morals, and citizenship (Pandit, p. 19). With the same motive, Depressed Class Mission opened 24 schools and 5 hostels in the 14 branches at Mumbai, Pune, Satara, Mahabaleshwar, Dapoli, Thane, Malwan, Mangrul, Madras, Hubali, Akola, Amravati,

Bhawnagar, and Indur. As well as, total 55 teachers and 1100 students were taking education in twelve other institutions of the Mission. The expenditure of Mission increased upto 20,000 rupees per annum (Shinde V. R., p. 216). Many old organizations were merged with Depressed Classes Mission due to acute financial crisis. Out of which, one organization was from Southern-India. It was an organization established in 1896 by Rangrao at Mangrul for the upliftment of the untouchables. He endeavoured to establish schools and hostels for the untouchables. Moreover, he also strove hard to establish independent colonies. He got 75 acres of land from the government for the work. He reserved 35 acres of land for the colonies of untouchables and remaining land was used for farming. Thereafter, this organization was merged with the Depressed Classes Mission in 1922 as it was economically relegated (Moon, p. 97). In this way, the work of Shinde's Depressed Classes Mission work became comprehensive.

Shinde's many upper-caste colleagues were handling the administration of Depressed Classes Mission after Mission flourished widely. But, Shinde's colleagues lacked the fervency which Shinde had about the untouchables. It led towards the mobocracy in the administration of Mission. The anarchism in the administration of Shinde's Mission caused discordance between Shinde and Dr. Ambedkar (Moon, p. 101). Furthermore, Depressed Classes Mission failed in extensively promoting and proliferating education among untouchables. It led towards the disappointment among untouchables. In 1921, Shivram Kamble came forward and established 'Untouchable Upliftment Association' (Asprushya Sudharak Mandali) in Pune (Navalkar, p. 43). Various untouchable communities had discordance among them. These communities were envious with each other. Bramhin and Non-Bramhin allegedly criticized Shinde in their news papers for his discriminative nature among untouchable communities. It was said, "It is natural to be enraged with Mr. Vitthal. He strove hard for Mahar community's people. Why didn't he work hard for Matangs? Why didn't he appoint Matang community's maid instead of Mahar?"

(Naik, p. 87). This criticism caused dilemma in the minds of other community's people regarding his work. Furthermore, some of the untouchable leaders, involving in the executive body, were suspicious that Shinde's organization was working in favour of a particular community though Depressed Classes Mission worked hard for the betterment of untouchables. So, various communities' people including Mahar, Mang and Chamars protested in a meeting against the discriminative Shinde policy (Moon, p. 126). As per Shinde's open invitation on 29th March 1923, many leaders of ostracized community had participated with their disciples in a meeting held at Depressed Classes Mission, Bhokarwardi, Pune on 15th April 1923. But, Shinde's colleagues prohibited these people from entering in the meeting and the meeting was organized in a closed room. So, these people gathered in Sir Padamji ground for meeting. Mr. Gholap was the chair-person of this meeting. Mr. Tatya Narayan Shinde, a person from Chamar community, proposed a resolution that ostracized people wouldn't support any activities of Shinde and Patode, organized through Depressed Class Mission on the name of betterment of untouchables. As well as, government and well-wishers should understand that the meeting organized by Shinde is unlawful. Mr. K. K. Sakat, a person from Matang community, affirmed the resolution (Moon, p. 100). Thereafter, Shinde's colleagues and social activists from upper-caste severely criticized him. However, he continued his work till 1925-26. But, he was disappointed as there was no previous enthusiasm in the work and he gradually detached himself with the Mission (Khairmode C. B., pp. 45-46).

V. R. Shinde And Indian National Congress

Rashtrasabha (National Congress) was gradually shaping as the representative organization of all Indians in the political sphere of India. Shinde hoped that various classes in India should participate in the organization and make it more advanced and powerful. Shinde spread awareness among untouchables through Mission. During the same era, Bramhin-Non-Bramhins, mainstream-untouchables like groups were

emerging in the society. Shinde felt that this newly emerged Non-Bramhinism is detrimental for the national integration (Shinde V. R., p. 286). Majority of Maratha community resides in Maharashtra and it is the backbone of Maharashtra. Shinde expected that the awareness should be spread among Bramhins to untouchables. He consistently advised National Congress to deal with the issues of untouchables to assimilate and involve them in national movement. If the leaders of National Congress show sympathy about the abolition of untouchability, it will give impetus to the social reformation with their participation. As well as, untouchables will incline towards National Congress which will help to increase its strength. In 1917, Shinde passed a resolution in a session in Calcutta saying, 'Atrocities are meted out to untouchables since ages, it should be stopped immediately' (Pandit, pp. 23-24). Shinde was active in Congress. He started to organize a conference on various social issues in the same village where the Annual Session of Congress was held in. This move upheld the issues of untouchables in political sphere. Many people thought that Congress should not only focus on the political demands but also it should strive hard to eradicate social evils (Surana, p. 18). A district level conference of Congress was held at Lonawala. Mr. Shankarrao Lawate insisted to put forward the resolution of self-government in the conference. Shinde expressed his opinion that the conference should put forward the resolution of untouchability abolition first. Thereafter, they should pass the resolution of self-governance. Taking cognizance of the discordance, Lokmanya Tilak upheld the side of Shinde. Shinde felt that the work of untouchability abolition can be easier if national leaders support with similar spirit (Pawar D., p. 463). Shinde relentlessly strove hard for it.

Shinde stepped forward for All India Untouchability Abolition Conference which was held in Mumbai under the aegis of Sayajirao Gaikwad of Baroda on 23rd March 1918. In his presidential speech in the conference, Gaikwad highlighted that it is legitimate to give independent status and rights to the untouchables (Warkhede, p. 28). A draft

had been prepared of the declaration made in the conference. It was written in the declaration that, "I undersigned hereby declare that I will obey the conditions written in the declaration and also relentlessly endeavour to be obeyed by others too" (Shinde V. R., p. 294). More than 300 prominent leaders had signed the declaration. But, Lokmanya Tilak avoided signing on the declaration. Shinde wrote a letter to Tilak on 2nd June 1918 enquiring about his motive behind it. Tilak replied to the letter saying, "At the end of your manifesto, some responsibilities were assigned to the individuals to implement. So, I can't bear the new responsibilities due to increasing responsibilities. Therefore, I couldn't sign the declaration. Sorry for the inconvenience" (Khairmode C. B., p. 255). In spite of that Shinde compelled Tilak to say that untouchability doesn't exist in Hinduism (Shende, p. 56). It clearly indicates Shinde's strong determination regarding the abolition of untouchability.

In May, 1918, three subsequent conferences had been organized in an important meeting at Vijapur. Conference on Untouchability Abolition was decided to hold on 6th May 1918. But, Mahatma Gandhi would be there for the regional political conference which was held the day before of it. So, the organizers of the conference shifted social conference on 5th May 1918 at 10:00 p.m. as the people participated in social conference wanted to listen Mahatma Gandhi's address. In the Presidential address of the conference, Kamat praised Shinde's work of the upliftment of the untouchables and suggested every Hindus for financially supporting for this noble work. A resolution was to be put forward regarding the approval of untouchables to Lucknow Pact between Congress and Muslim League. Mahatma Gandhi stepped up to put forward the resolution and thrice asked, "Is there any untouchable? But, no one replied positively. Taking the cognizance of the situation, Gandhi said, "How can I term this conference as the conference of Depressed Classes? The resolution which I am going to present here says that the untouchables participated in the conference are in support of the pact signed between Congress and Muslim League. But, I

deny putting forward the resolution as there is no untouchable in the conference. At the same time, Kamat who was the President of Conference stated and clarified, "This conference not for the untouchables. It is for the upper-caste people regarding how to behave with untouchables." Thereafter, Mahatma Gandhi approved to put forward the resolution. Kamat proposed the resolution and Shinde gave consent to his move (Khairmode C. B., pp. 256-257). It clearly indicates that many resolutions were passed on the name of untouchables though very few untouchables were participated in such social conferences. The perspective of Congress towards the movement of untouchables has been clarified through the non-cooperation and boycott movement initiated by Gandhiji. Mahatma Gandhi's movement affected school-colleges and lawyer-ship in the court. National schools also stopped receiving government grants. Shinde upheld the question whether the National Congress or other organizations help the schools of Mission if it participate in the movement or give up government grant. Many people had advised him that it would be wise not to participate in non-cooperation movement as well as he should receive the grant for the schools (Shinde V. R., pp. 322-323). So, Shinde's Mission didn't participate in the movement. A resolution had been passed in the session of Indian National Congress on 31st December 1920 stating that 'Regional Legislature should immediately devise a program for backward community's people' (Mitra, p. 216). These types of resolutions had been regularly passed in the sessions of Congress.

Shinde came closer to Congress Party when Dr. Ambedkar participated in political sphere of India. Ramswami Naykar started passive resistance at Viacom in Travancore province. Mahatma Gandhi also backed this passive-resistance. Karmaveer Shinde also participated in this passive-resistance (Keer, p. 64). Shinde was actively participating in the agitations of Congress. He promoted and proliferated Civil Disobedience movement which was initiated by Congress in 1930. He was imprisoned with grievous labour for six months on 10th May 1930 (Shinde V. R., p. 401). Mahatma Gandhi's

influence on Shinde can be traced by an interview given to 'Hindu' newspaper. Shinde said, "There is no difference in spiritual religion, basic familial improvements and eminent politics. I know that Mahatma Gandhi is a prophet, sent by the God" (Parikh, p. 102).

Shinde never allied Mission with any political party from the beginning and only focused on the welfare of backward communities. He established All India Untouchability League in Pune to independently run Mission's educational activities which should be distinct from the politics (Shinde V. R., p. 291). Afterwards, Mahatma Gandhi focused on the untouchables after signing Pune-Pact with Dr. Ambedkar. He decided to establish 'All India Anti-Untouchability League' to run this work efficiently. But, Shinde opposed this move as he had already established an organization with the similar same before several years. Finally, an organization had been established in English and local languages namely 'All India Untouchable Service Association' (p. 58). In reality, Shinde's Mission had already done massive work regarding the abolition of untouchability. Thereafter, he abandoned the work and aligned with Congress Party. It is still a mystery that why Gandhi didn't run already existing Untouchability Abolition Association headed by Shinde instead of establishing new association for it? Abolition of untouchability became national program when Mahatma Gandhi dived into abolition of untouchability. Thereafter, Congress ruled regional governments passed various laws in the council in the guise of untouchability abolition. Reacting on the issue, Shinde said, "No matter how many resolutions and bills are passed by the Congress in the Council, the work on these problems cannot be said to be over unless the selfishness, sacrifice and affection of the untouchables and the tolerance and cooperation of the untouchables increase (Shinde V. R., p. 228).

V. R. Shinde and Dr. Babasaheb Ambedkar

V. R. Shinde had run the movement regarding the upliftment of untouchables through Depressed Classes Mission. He spread Mission across India after some of his successful

endeavours. He selflessly started painstaking journey of the betterment of untouchables. His efforts had been generously supported by many promoters of avant-garde. Shinde's selfless work deepened the faith of on him among untouchables. Moreover, the government consulted him regarding the betterment of the untouchables if it devised any plan of their welfare (Pagare, p. 22). Dr. Ambedkar's emergence in the social sphere played significant role during this era. He felt that the issues of untouchables couldn't be solved by their upliftment; it could be solved by the abolition of untouchability. The nature and path of Dr. Ambedkar's work was predetermined. So, Shinde was criticized by Dr. Ambedkar.

In the seventh session of 'Central Province Berar Mahar Conference' which was held on 19th March 1917 in Amravati, Shinde advised in his speech that 'untouchables shouldn't participate in political movement' (Moon, p. 116). But, he presented an application to the government through Depressed Class Mission to appoint political representatives of untouchables in legislature and they should not be selected by the governor or the organizations of the untouchables (Keer, p. 47). Moreover, a delegation under the leadership of Sir Narayan Chandawarkar and Vitthal Ramji Shinde had visited Montague for the political demands of the untouchables in 1917. Most of the social activists from untouchables worked as per suggested by Chandawarkar, President of Depressed Classes Mission and Shinde as they had dominance over them. As per their suggestion, Mr. Ganesh Aakaji Gawai and Kisan Fagu Bansode presented a memorandum to Montague through 'Depressed India Association' regarding the demands of untouchables (Moon, p. 8).

In 1918, Montague, the Secretary of State for India and Lord Chelmsford, Viceroy of India, travelled in various regions to discuss with the political leaders in India when British Government had positively signalled for the political reforms to India. Shinde's Depressed Classes Mission had taken advice from the King of Kolhapur Province regarding Mont-Ford Committee (Kavlekar, p. 64). Thereafter, a delegation of untouchables visited the committee under Shinde's leadership and

demanded the political rights for untouchables (Pandit, p. 16). In 1918, Mont-Ford report had been presented. As per the report, British Parliament sent a Franchise Committee under the presidency of Lord Southborough in India. Dr. Ambedkar painstakingly got an opportunity to uphold the political demands of the untouchables before Southborough Committee. Shinde and Dr. Ambedkar put forward the demands of untouchables before the committee from different perspectives (Moon, p. 8). Shinde demanded to the Southborough Commission to bestow the voting right to those untouchables who had passed fourth standard and had Rs. 144 annual income (Pawar J. V., pp. 40-41). Whereas, Dr. Ambedkar proposed for the voting rights for untouchables, right of contesting elections, independent constituency for untouchables, and representation as per the population of untouchables (Khairmode C. B., pp. 277-278). The ability which Shinde proposed before Southborough Committee regarding voting right couldn't be found among few untouchables. If it were found among several untouchables, they would elect the associates of Shinde. Untouchables would be politically enslaved like social, religious, and economic slavery of upper-caste people if the representatives of untouchables were not elected. In other quarters, upper-caste Hindus were trying to impose exploitation and national slavery on untouchables. Taking cognizance of the situation, Dr. Ambedkar declared that the statement given by Shinde through Depressed Classes Mission is detrimental for the untouchables (Moon, pp. 8-9). Thereafter, in 1920, first conference of untouchables was organized at Mangaon in Kolhapur province under the presidency of Shahu Maharaja. Shahu Maharaja declared that untouchables got their true leader while talking about Dr. Ambedkar in this conference (Pawar D., p. 462). All India Ostracized Conference was organized at Nagpur in May 1920. Shinde's Depressed Classes Mission was severely criticized in the conference and a resolution had been passed in the conference showing distrust of untouchables on Depressed Classes Mission (pp. 8-9). Thereafter, the importance of Shinde's Mission rapidly deteriorated. Untouchables accepted the leadership of

Dr. Ambedkar and commenced the movement under his leadership. Shinde's colleagues in Mission as well as social activists from mainstream society brutally criticized Shinde still he continued his work till 1925-26. But, he got disappointed when he didn't get response from the people. Thereafter, he gradually detached with the Mission and he started working in Bramho Society as the representative of Maharashtra (Khairmode C. B., pp. 45-46). But, it didn't affect his ideological base. On 23rd October 1928, Dr. Ambedkar, as a member of a Sub-Committee, clearly and responsibly stated before Simon Commission, "There is no relationship between untouchables and Hindus. They are independent minorities. So, everyone should treat them accordingly." Shinde opposed this move and demand of Dr. Ambedkar to some extent (Shinde V. R., p. 148). He believed that untouchables were a part of Hindu religion. So, he disapproved the minority status of untouchables. He also opposed independent constituency for untouchables given as per 'Communal Award'. He thought that untouchables should always live indiscreetly with Hindus. He never abandoned this stand regarding it. So, he had to everlastingly bear the enagement of the untouchables.

Shinde had no other means of earning livelihood so that his family had to lead miserable life for many days. Sayajirao Maharaja gave monthly compensation to Shinde when he came to know about his miserable condition (Khairmode C. B., pp. 45-46). He suffered from severe paralysis attack in 1935. Shinde dedicated his whole life for the betterment of untouchables. Moreover, he had to bore the enagement of his own Maratha community's people and led further life in the locality of untouchables. Finally, he died on 2nd January 1944 bearing disappointment, sorrows and miseries.

Conclusion

Mahatma Phuley's comprehensive and audacious struggle initially brought metamorphic changes in the social and political sphere of Maharashtra. Rajarshi Shahu Maharaja significantly contributed in Truth-

Seeker Society's movement. Thereafter, social and political struggle couldn't become comprehensive so far in Maharashtra. Shinde strove hard to sustain the comprehensiveness of Mahatma Phuley's movement. As far as the annihilation of caste is concerned, Shinde's perspective was radically different from that of Mahatma Phuley as Shinde was heuristic in approach (Kamble, 1909, p. 12). It was desirable and beneficial for Untouchables to lead life gently during contemporary era. Shinde frequently said, "The life of poor, untouchables and Dalits is burning and alighting. It is my duty to extinguish this fire by serving them with the love bore in my heart. Humanism lies in it" (Shende, 1981, p. 53). In 1903, when Shinde returned to India after completing his study of Comparative Religion and Sociology in Oxford University, he worked as a promoter of Bramho Society. He experienced the miseries of socially, educationally, and politically ostracized untouchables who were deserted by Indian society. Shinde rationalized this issue in his book entitled 'Issues of Indian Untouchability' and determined to dedicate himself for the welfare of untouchables. He prominently focussed on the education, sanitation of untouchables and other social reformations. He was never rebellious. But, he shrewdly gained the sympathy of upper-caste people with his conscious mind to solve the issues of outcastes (Shende, 1963, p. 56). He directed two night schools of untouchables while working as a promoter of Prayer Society. He suggested mainstream people to maintain harmonious relations with untouchables. He established 'Depressed Classes Mission' with the help of Narayanrao Chandawarkar amidst this crucial situation. It was the first organized effort of the upliftment of untouchables (Keer, 1989, p. 27). He opened schools and hostels across India for untouchables. Khairmode, biographer of

Dr.Ambekar, mentioned his as a first iconoclast who lived and worked with untouchables (Khairmode C. B., 1991, p. 39).

Shinde socially organized untouchables through Depressed Classes Mission. He put forward the issue of untouchables in National Congress. He compelled Congress to focus on the issue of untouchability in the country. Untouchables became socially and politically aware due to Shinde's social conferences with the Sessions of Congress. It indicates that Shinde's efforts foregrounded the work of Dr.Ambedkar (Pawar D. , 1993, p. 450).

The concept of social reformation through spirituality left behind and the struggle for dignity commenced after the emergence of Dr.Ambedkar in social sphere. It side-lined Shinde's focus from social and political spheres. Shinde ended-up his youth for the upliftment of untouchables. This sacrifice would certainly mould a generation. But, Dr.Ambedkar determined to mould thousand generations of untouchables. The perspective of Dr.Ambedkar and Shinde was radically different in the context of untouchability abolition, upliftment of untouchables and annihilation of caste. It led towards the conflict between them. Harmony would never prevail in Hindu religion and nation until untouchability is abolished. Dr.Ambedkar was damn sure about it. So, he determined the path of the emancipation from untouchability. Dr.Ambedkar's demand for the reserved constituency for the untouchables was a part of this move. But, Shinde opposed for the separate constituency for the untouchables. It culminated into gradual decrease in Shinde's fame among untouchables. It compelled him to abandon Mission. However, Shinde's sacrifice for the upliftment of the untouchables is inspirational for forthcoming generations.

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Dalit Movement in Vidarbha before Dr. Babasaheb Ambedkar

Dr. Avinash Digambar Fulzele*

[Dr. Babasaheb Ambedkar raised a massive movement for the social, political, economic and religious upliftment of Dalits. This movement is widely known as 'Ambedkarite Movement' in the present era. Dr. Babasaheb Ambedkar actively participated in the social movement since 1920. Thereafter, he fostered an organization by courageously agitating with discipline and organizational power. Dalits of Vidarbha region actively participated in the movement led by Dr. Ambedkar and gave impetus to the movement. Ambedkarite movement became more resistive for the justice and rights within short span in entire Vidarbha. The success of Ambedkarite movement in Vidarbha region lies in the movements that had taken place before Dr. Ambedkar. Some people strove hard to awaken the conscience of Dalits in Vidarbha region before Dr. Ambedkar. It can't be denied that the roots of Ambedkarite movement instantaneously strengthened in the Vidarbha prominently due to the consciousness about the rights and privileges during Pre-Ambedkarite era. So, it is necessary to creatively bring forth the local history by reviewing Dalit movement during Pre-Ambedkarite era in Vidarbha and it is the main motive behind present research paper.]

Some Mahar community's people strove hard for the upliftment of the untouchables since 1880. The hostels and schools for the untouchable girls and boys had been initiated by these people. Some people carried out this work at their own cost while few of them continued their work by collecting some contribution from the society and initiated the process of social upliftment. Some of them started newspapers and endeavored to aware the society. These all efforts were seen before Dr. Babasaheb Ambedkar's participation in the social movement in Vidarbha region. It had already provided background for the consciousness. So, Dr. Ambedkar's thoughts and active policies rapidly flourished in this region after his participation in the social movement. Vidarbha's Dalits cohesively stood with him. Present research paper endeavors to review the wave of consciousness before 1920.

British Government started the universalization of education after East India Company lost its administrative powers. Many Missionary schools were started in India. It benefitted untouchables

to some extent. Many untouchables were deprived from the education as there was lack of the residential and mess facility at the place of education. Januji Khandare came forward for it in Akola. Though Janoji was illiterate, he was aware about the importance of education. So, he established hostels for the untouchables students of rural areas who couldn't afford education in the cities like Akola.¹ In 1884, Mr. Janoji Kacharu Khandare established this institution with the help of many people from Akola and other areas.² He also demanded for the land to start a technical school near to the hostel. In this way, he strove hard to provide such facilities to the untouchable students and fortified the path of their education.

Nagpur was the center of movement during that era. Mahar community's people were prohibited from entering at the Ambala Lake in Ramtek which is near to Nagpur. Mr. Gopalrao Bhide lawyer, an activist from Gourakshan Sabha, instructed Mahar community's people not to eat the beef by organizing a meeting at Ambala in 1892. He allowed them to take bath in Ambala Lake after pledging not eat the flesh.³ Thereafter, Gourakshan Committee instructed its workers and peons to sit on the bank of the lake and they were

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extorting religious fund and money for shaving. Mahar community's devotees expected that the religious fund that had been collected by the committee members should be utilized for generating facilities for the devotees. But, these Gorakshan Committees never considered human beings superior than the cows.⁴ Moreover, no other facilities were provided at the Ambala Lake. In 1903-04, Gourakshan Committee's people prohibited Mahar community's people from taking bath at the Ambala Lake during pilgrimage. Mr. Vithoba Moon Pande strove hard to open Ambala Lake for the untouchables at that time. Mahar community's people were desecrated as they were eating beef and the flesh of died animals. So, Mr. Vithoba Moon Pande organized meetings of Mahar community's people at many villages and instructed them to promise they would not to eat the beef.⁵ In 1903, he obtained a verdict for Raghujji Bhosale Maharaj regarding not to prohibit Mahar community's people from taking bath at the lake. He also sought the permission for building the wharf in 1905.⁶ Thereafter, Mr. Vithoba started to build the wharf but the land near to the lake was not legally belonged to the committee. So, he purchased that land from Rajeshri Gopal Ganesh Fadanvis Malgujar, Ramtek. He established Shivapind and completed the work of wharf.⁷ In this way, Ambala Wharf opened for Mahar community's people for bathing and other religious rituals. The whole credit goes to the endless efforts of Mr. Vithoba Moon Pande.

Mr. Kisan F. Bansode was the second most important person in Nagpur. He established an institution namely 'Sanmarg Bodh Asprushya Samaj' at the age of 22 in 1901.⁸ He flourished this movement throughout Maharashtra. He incessantly worked for spreading awareness and education among the people for 20 years through this organization.⁹ Then, he became the part of Bramho Society in 1909.¹⁰ He was a journalist by blood. He gave voice to the plight of untouchables by starting 'Vital Vidhwansak' in

1910, 'Nirashrit Hind Nagarik' in 1910, 'Manjur Patrika' in 1918, and 'Chokhamela' in 1936.¹¹ He continued his movement of social awareness through these newsletters. In December 1921, a religious conference was organized in Nagpur. Mr. Kisan Fagu delivered an influential talk in this conference. In his speech, he said, "...our religion is Democratic. So, Dharmadhikari must behave as per people's inclination. Many public movements or agitations take place at many villages. Untouchables are absent in these movements. Yet, you people termed it as the public movement. Untouchables never stand with you because you never treat them with dignity. All the people fetch the water from public wells. The touch of beef eaters is allowed there. But, why are these people not allowing us to fetch water though we are still stick with Hinduism without adopting Christianity or Islam? You say we are untouchables. People will not forcibly share food with you if the tag of untouchables has been removed. Prohibiting entrance in the homes and not sharing the food are the matter of personal consent. Public places are for everyone. Every person has right over it. Is there any question about choices? God is one. What is detrimental in opening the doors of the temples for Mahar community's people? There is not a political motive in it. Religious power is the power of people. It is in your hands. Supreme Power should open the doors of temples for everyone. He should eradicate untouchability. Untouchability is detrimental in work of nation building. These things should not be neglected. So, you should prominently focus on the issue of eradication of untouchability by sidelining other factors..."¹² But these efforts were useless. In the public meeting of Mahar community's people at Warora, Dist. Chandrapur, he stoutheartedly said that untouchables should courageously fight for their right with so-called upper caste people.¹³ Mr. Kisan F. Bansode established 'Central Province and Warhad Mahar Council' with the help of his colleagues. This council's 9th Session was organized on 7th February 1920 at Chikhali of Buldhana district. Mr. Kisan F. Bansode was the Guest of Honour of this conference.¹⁴ He

elaborated the comprehensiveness of the Mahar Council in this conference and appealed the untouchables to unifiedly fight for their rights. In 1906, he established 'Mahar Sabha' in Nagpur. As per the printed report of Mahar Sabha, Mr. Vithoba Raoji Moonpande was the chairperson of the Mahar Sabha in 1913 while Mr. Rewaram Kawade was the Founding Member of Mahar Sabha.¹⁵

Mr. Rewaram Kawade's journey was started from the social inequality, untouchability, poverty and unemployment. Mill workers were surviving on the low wages during that period. Their service could be terminated any time. Amidst these circumstances, Mr. Rewaram Kawade organized first ever strike for the demands of the laborers in the Empress Mill in 1919.¹⁶ He played key role and successfully continued the strike for two days and he succeeded in fulfilling the demands of the laborers. It was his remarkable deed. Thereafter, he was widely known as the leader of laborers.

Mr. Kalicharan Nandagawali was a prominent leader from Gondia-Bhandara district. He was the foremost leader of the movement of untouchables in Vidarbha region. He was a key leader in this movement. He was less educated but was a landlord. He whole-heartedly helped for Dalit movement and paved the way for their upliftment. In 1911, he started 'Putri' school for Dalit girls in Gondia and spent 3000 rupees of it.¹⁷ This school was started with the help of his other companions in 1914, Mr. Nandagawali became the member of Gondia Municipal Corporation. Thereafter, he soon became the Chairperson of the Municipal Corporation in 1916. He established 'Bharatiya Mahar Panchayat' in 1914 and organized a huge conference for the abolition of the untouchability in 1916.¹⁹ He unceasingly endeavored to awaken the conscience in the untouchable community regarding their rights. In this way, Mr. Nandagawali was rich landlord who always financially helped untouchable community's movements and kept it burning.

Mr. V. D. Makesar was an important leader in Berar Province (Varhad). He took initiative for the betterment of Mahar community before the establishment of All India Depressed Classes Association and Depressed India Association. In 1910, 'Mahar Sudhar Mandal had been established in Amravati. Mr. Makesar became a member of this organization. This organization held meetings in the villages and passed various resolutions regarding ban on liquor, interpretation of sub-castes, and education to their children etc. These all passed resolutions were put forward to the government by this organization and tried to eradicate the miseries of Dalits.²⁰ Thereafter, he started his work in Yeotmal.

Mr. Ganesh Gawai was the resident of Thugaon in Amravati district. He started his social work from his village. He started 'Mahar Library' at Thugaon to create interest of reading among people. He strove hard to connect Mahar community's people with reading. Mr. Ganesh Gawai rendered his service to Prarthana Samaj by adhering to it in 1910 in Mumbai. Thereafter, Karmaveer Shinde handover the work of Depressed Classes Mission to Mr. Gawai to flourish it in Maharashtra and Karnataka.²¹ Though Mr. Gawai was the member of 'Depressed Classes Mission' established by Karmaveer Shinde, he established 'The Depressed India Association' means 'Bahishkrit Bharat Samaj' as a representative organization in Nagpur in 1918 and Mr. Ganesh Gawai was the real director of the organization at that time.²² Entire untouchable community was perplexed about the role of Depressed Classes Mission regarding the nominations of the representative of untouchables. In 1914, he started a fortnightly entitled 'Bahishkrit Bharat'.²³ Then this fortnightly closed but his efforts were significant. Dr. Ambedkar also started a fortnightly entitled 'Bahishkrit Bharat' but it was already started by Mr. Gawai to give the voice to the issues of Dalits. Apart from this, Mr. Gawai also established 'Bhajan Samaj' as a part of religious reformation movement.²⁴ Most of the youngsters were the participants in this Bhajan Samaj. Mr. Gawai

obtained government land for this community by incessantly following-up to the government. Many reformations had been taken place through it. Many villages were reformed deriving the inspiration from him. In this way, the work of Dalit consciousness had begun during Pre-Ambedkar era in Vidarbha.

Conclusion

Many Dalit people had undertaken the work of social consciousness among untouchable community before the emergence of Dr. Ambedkar. Their deeds spread awareness about the rights among Dalit people in Vidarbha region. The works of Dalit leaders had taken the form of organized movement for the rights of untouchables till 1920. Thereafter, Dr. Ambedkar started the movement for the rights and justice of Dalits. This movement gradually flourished in extensively. Vidarbha's Dalits people were working in organized form. Dr. Ambedkar led movement was the movement for the emancipation of human beings and it is reflected in the passive resistance of Mahad. So, Vidarbha's people participated in the struggle started by Dr. Ambedkar. Ambedkarite movement stood on the strong base in Vidarbha region. The whole credit should be given to the movements emerged during Pre-Ambedkar era.

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COTTON CULTIVATION AND TRADE IN VIDARBHA UP TO 1947**S. Meshram¹ and A. D. Fulzele^{2*}**¹Department of History, R.T.M. Nagpur University, Nagpur, Maharashtra (India)²Department of History, Dr.Ambedkar College, Deekshabhoomi, Nagpur, Maharashtra (India)
avi.fulzele@gmail.com**ABSTRACT**

Present research unveils various aspects of cotton cultivation and trade during British rule over India. British Government's motive behind the cotton cultivation is meticulously discussed in the present research. It illuminates East India Company's vested interest in encouraging cultivation and production of cotton in India. The company aimed at establishing their monopoly across the world in cotton production. Company's policies regarding cotton production and experiments carried out to improve the production level are also illustrated in the present research.

Keywords: Cotton, Vidarbha, Central Province & Berar, British, East India Company, Cotton Trade and Cultivation, Monopoly.

Introduction

One great staple for which India is famous since times immemorial is cotton. Even before India came into contact with western civilization, she was known to the outside world as a great cotton producing country, and her cotton fabrics of fine art, especially Decca muslins and Calico, had obtained worldwide reputation as products of excellent home spinning (Cotton Department, 1920,1). "...Its hundred millions of inhabitants are clothed in home-grown cotton, in the hot weather and in the rains, in calicoes and muslins, and in winter in an additional quantity, for their calico coats are padded with cotton. At night, they lie on beds and pillows stuffed with cotton and, instead of blankets, they cover themselves with quilts of calico padded with the same material. In place of doors and windows, they hang up curtains padded with cotton. Awnings and carpets, tents and tent ropes, the covering of carriages, the housings of elephants and the halters of horses, are all made of cotton..." (Royal, 1851,18). Thus, Mr. J. Forbes Royle wrote about the use of cotton in day to day life of the common Indian man.

The Vidarbha region consists of eight districts, namely, Akola, Amravati, Buldhana, Yeotmal, Wardha, Nagpur, Bhandara and Chandrapur. The first four districts were collectively known as Berar. These were under the dominion of the Nizam. At time, the other four were under the East India Company and were known as Central Provinces. In 1903, the Berar districts

also came under British rule and merged with the Central Provinces. This new province was called Central Provinces and Berar.

To Bombay must be assigned the credit of priority in attempts at agricultural improvement. Cotton, as the most important crop of the Presidency and one of special interest to East India Company, first came into prominence in 1788. The Directors of the Company felt that encouragement should be given to its production and improvement but the experiments to this end which were carried out during the next hundred years had little effect on the bulk of the crop. In 1839, the court of Directors sent out 12 American planters to teach the local cultivators how to grow and clean cotton (Royal Commission, 1928,21). It has been said that "Messrs Mercer and Blound, two of the American planters, have contributed so much to the improvement of cotton in India" (32), but Mr. Eugene C Schrottky wrote one another name, "...Mr. Login to whom we are deeply indebted for his trouble in introducing the Egyptian method of cotton cultivation into India..." (Schrottky, 1876, 276).

In 1793, the company sent to India the newly-invented Whitney Saw Gin to quicker and improves cotton ginning (Nanjundayya, et al., 1960, 279). The British did another thing to improve cotton cultivation in these districts. They distributed exotic seeds to the cultivators. At the end of 1857, four and half bags of Egyptian seed were sent from Government of

India to Colonel Davidson. This information is contained in Colonel Davidson's report of 18 May 1860. Another report dated 17 March 1860 was given by the Assistant Commissioner regarding experiments with exotic seeds in West Berar. He wrote: "...The following descriptions of cotton seed were received for experiment in this district: Brazilian, Egyptian – from Government of India; New Orleans – from Manchester Cotton Supply Association; New Orleans – from Dharwar. ...I have further satisfied myself by testing the seeds at different periods, the result being alike in every instance and I am, therefore, of the opinion that the whole supply had lost its germination quality and hence its complete failure in every part of the district." (Cassels, 1862, 212).

An agricultural survey of the cotton tracts by district agency began in 1861. A Cotton Commissioner was appointed for Central Provinces & Berar in 1866-67. He experimented both with exotic varieties of cotton and with the indigenous varieties and endeavored to introduce the cultivation of cotton in tracts in which it was then unknown (Royal Commission, 1928, 26-27). The record of these attempts is, however, that of a series of failures due to lack of knowledge of climatic conditions suitable to the growing of cotton, lack of skill on the part of the cultivators and lack of efficient supervision by government (26-27).

In 1888-89, an agriculture training program for land records and revenue staff was opened at Nagpur (27). With the advent of East India Company in India and the establishment of British rule, cotton growing and cotton industry got a real impetus.

The continuous efforts from Government of India were going on from time to time like, the model seed farm which was opened at Hinganghat was soon closed but another farm which was opened at Nagpur, an area commanded by tank irrigation (27). Before this, irrigation was not employed in the district for cotton cultivation. It was considered prejudicial to the plant and the natural rain is sufficient (Cassels, 1862, 197). In the period of 1922-23, in the region, ploughing matches were organized and the system of ploughing

land on contract was started. In these matches, some of which attracted thousands of people, the working of tractors and tractor ploughs was also demonstrated whenever possible. Many landholders were now convinced that without iron ploughs, a reasonably high standard of tillage was impossible (Central Province & Berar Government, 1924, xxix). It has been reported that the policy of extending popular knowledge of improved methods by practical demonstrations, by lantern lectures, by agricultural shows and distributing literature was being steadily pursued, meetings of agricultural associations and agricultural shows were well-attended, the number of books and leaflets, dealing with agricultural subjects, sold during the year 1922-23 was as great as in the previous year (xxix). The major impetus to cotton cultivation in India, however, came from the American Civil War. During the war, England and European countries did not get the supply of American cotton. Therefore, they focused on Indian cotton. Due to that '...within the last six decades, much improvement has been made in the systematic cultivation of Indian cotton...', had been said (Cotton Department, 1920, 1).

This sudden and unprecedented increase in demand resulted in an abnormal rise in prices of all cottons in India. In Vidarbha, for example, the average price of unginned cotton at the Wardha market during 1856-60 was about Rs 19 per *khandi* (784 lbs). During 1861-65, the price increased to an average of Rs 56 per *khandi*, that is, an increase of about three times over the price during 1856-60 (Khandewale, 1971, 7).

In former years, the price of Hinganghat cotton at Liverpool had been up to 25 dollars (Morris, 1867, ix). Now the Berar farmers began to import food grains from Chhattisgarh, Jabalapur, Khandesh and Malwa, so that all available land might be devoted to the profitable cotton crop (Govt. of CP & Berar, 1921-22, 44).

During the 18th century, the British textile industry was largely dependent upon long staple cotton but due to the civil war, the supply of raw cotton from USA was stopped. Therefore, the East India Company tried to

develop India as an alternative source. Thus, the trade in raw cotton between India and England began and increased gradually (Cotton Department, 1920, 1).

As the European countries' demand was mainly for short staple cotton, a significant change occurred in the varieties of cotton grown in Vidarbha. Within a decade (the 1870s), the region abandoned the cultivation of finer varieties like Hinganghat and came to specialize in the production of acclimatized inferior but high yielding varieties. Vidarbha became a principal producer of short staple cotton (Khandewale, 1971, 9).

The cotton markets in Berar were established and administered under the Berar Cotton & Grain Markets Law 1897, and the rules framed thereunder (Nanjundayya, et al., 1960, 271). This was the first attempt towards regulating the commodity markets in India. This legislation sought to regulate the market through notification of market areas, appointment of market committees, formation of rules for collection and disbursement of fees, and for licensing of traders, weightmen, etc (Khandewale, 1971, 75-76).

Before the opening of railways, cotton markets of this region were confined only to the town of Khamgaon, Akot, Amravati, Hinganghat and Arvi. Raw cotton was cleaned on hand-gins in the villages and the lint was brought to the markets in gunny cloth loads called Bojas. As a result of the opening of railways in the 1860s, some important towns on the railway routes developed into cotton markets in the 1870s (69). The extension of railway from the mainline to the interior started another phase of increase in the number of markets in the region. Thus, by the turn of the century, marketing in Vidarbha was spread over a large number of centers in contrast to the relatively centralized marketing of the pre-railway era (69).

Sir Richard Temple in 1862 initiated a vigorous road policy, which was supplemented by a rapid development of railway communications (Central Province & Berar Government, 1924, 43). At about the end of the first quarter of the 19th century, the export of cotton from India to other countries began to

be channelized through the port of Bombay. The foreign demand offered better opportunities to Vidarbha cotton. Since Vidarbha was occupying a prominent place among the regions supplying cotton to Bombay, it was natural for the government to give priority to Vidarbha in the construction of railway line for connecting it to Bombay. The emergency created by the American Civil War expedited the construction of railway. Thus, between 1863 and 1867, nearly all the important cotton markets in Vidarbha were connected by railway with the port of Bombay. Following the railway, many Indian and foreign cotton traders entered Vidarbha and directly exposed this region to international demand (Khandewale, 1971, 67-68).

The revolutionary change came with the setting up of hydraulic cotton pressing factories which made cotton transportation clean, compact and expeditious. Synchronisation of these two developments (i.e. railway and cotton pressing) in the small span of seven years from 1863 to 1870 had nothing short of an epoch-making effect on the organization of marketing of cotton in Vidarbha (67-68).

In India, Bombay has been the biggest centre for organized trading in cotton ever since 1875 when the first organized association for trade in cotton was started under the name of the Bombay Cotton Association. Around 1890, another association called the Bombay Cotton Exchange Limited was established. From 1893 to 1918, these two associations shared between themselves the control of the forward and ready trading in cotton.

In 1918, during the First World War, the price of cotton reached such an artificial high that some sections of the trade approached the government to fix the price of cotton. The government, however, did not intervene to this extent but framed the Cotton Contract Rules under the Defence of India Act and appointed Cotton Contracts Committee to regulate the cotton trade in Bombay. These temporary rules were replaced in 1919 by the Bombay Cotton Contracts Act (Nanjundayya, et al., 1960, 272). A new Cotton Contracts Board was set up. While it was functioning, the Indian Cotton Committee of 1917 recommended the

formation of one Central Association in place of the several distinct bodies. East India Cotton Association came into being on 1 May 1922. In June 1930, Wiles Committee was appointed and as per the recommendations of this committee, Bombay Cotton Contract Act was enacted which remained in force up to 31 March 1948. During the Second World War, the Government of Bombay realized the need for greater control of forward trading in cotton and appointed a Committee of the Cabinet in September 1946 to examine the question. Recommendations made by this committee led to the enactment of the Bombay Forward Contracts Act 1947. Under this Act, the East India Cotton Association Limited, Bombay, was appointed the only body for regulating dealings in forward contracts in cotton in Bombay state (272).

At this time, most of the cotton markets were ill organized, weights not uniform, trade allowances, and other practices unregulated, storage arrangements were unsatisfactory and market intelligence almost non-existent. ‘...During the exchange of huge produce between the farmer-sellers and the trader-buyers, the buyers did not leave any malpractice unused in the lure of profit ...Taking large free samples of raw cotton from farmers, imposing a large number of charities and using fraudulent weights were the most common malpractices...’ (Khandewale, 1971, 75).

In 1829, the Government of Bombay enacted the Bombay Regulation 1829 and Amending Act to check frauds committed in the packing and sale of cotton. This Act made the mixing of different varieties of cotton a penal offence (Nanjundayya, et al., 1960, 263). Another Act was passed in 1851. This act repeated most of the provisions of the 1829 regulation with minor alterations but added some clauses introducing a system of paid informers (264). In 1863, one more comprehensive Act was passed ‘...which not only penalized fraudulent adulteration and deterioration of cotton and the fraudulent sale or offer for sale of adulterated or deteriorated cotton but also prescribed a penalty...’ (264). This Act also provided for the appointment of Inspector of Cotton who was given powers of access at all times to

ginning and pressing factories and to seize and detain all cotton in respect of which any offence under the act appeared cognizable (264). Another Act was passed in 1878, an important feature of which was the abolition of all personal penalties, ie, imprisonment and fine (264). This Act was repealed in 1881 (265).

In the days of regional self-sufficiency, the marketing of cotton was simple. There were no cotton exchanges, no ginning and pressing factories and no railways. In 1923, the Government of India passed the Cotton Transport Act. This Act empowered the state government to prohibit the import of cotton, cotton waste, *kapas* and cotton seeds by rail, road, river and sea into specified areas unless required for a special purpose and covered by a license (265). Cotton Ginning & Pressing Factories Act was passed in 1925. Section 3 of the Act made it obligatory on the owner of every cotton ginning and pressing factory to maintain a register containing a record of all cotton ginned and pressed in the factory and of the names of persons for whom the cotton was ginned and pressed. Section 4 of the Act provided for marking in the prescribed manner every bale pressed in the factory with a serial number and with the mark assigned to the factory. This system enabled a bale to be traced to its source and served as a check on malpractices at the factories (266).

Agricultural Produce (Grading & Marketing) At was passed by the Government of India in 1937. In March 1939, the Government of India notified that this Act would be applicable to cotton. Specified varieties in some states are now, therefore, marked under a distinguishing ‘Agmark’ as a guarantee of purity (270).

From times immemorial, India has had a flourishing trade in cotton textiles. The import of cotton textiles into England in 17th and 18th centuries caused such a drain of wealth to India that propaganda was started against the use of Indian fabrics. Meanwhile, the industrial revolution had started in England. Improvements took place in the machinery used for spinning and weaving, as well as in the art of bleaching and calico printing, from the first introduction of Arkwright’s patented

spinning frame in 1769 to the establishment of the factory system in 1785. These created an insatiable hunger for raw cotton. However, England ceased to be an important buyer of Indian cotton. Meanwhile, the trade between India and the Continent had also been developing. By this time, direct dealing with India had started and the number of foreign mercantile houses in Bombay increased. A French trading house purchased land and set up full presses in the Berars. A French bank was established in Bombay to facilitate trade with the Continent. Indian cotton was also shipped regularly to Russia, Austria, Belgium, Germany and Italy. Between 1885 and 1891, Europe was the biggest consumer of Indian cotton. The trade with China started sometime about 1770. Japan came into the market in 1890 and, by 1897, was the biggest consumer of Indian cotton. Japan maintained this position for about 40 years thereafter (280).

With the advent of East India Company and the establishment of British rule in India, as well as the development of sea transport, cotton cultivation and industry got a huge boost. Cotton became one of the greatest item of export. Thousands of bales of Indian raw cotton went to the Continent and the Far East for a number of years. Before the 19th century, Vidarbha cotton was sent to Masulipattam in the South and to Cuttak in the South East. This route was abandoned early in the 19th century when Mirzapur, in Uttar Pradesh, became an emporium and the road was opened in that direction. Up to the end of the first quarter of 19th century, the main consumer of Vidarbha cotton was Bengal province.

Immediately after the First World War, India had also appreciably increased the production of cotton to cope with the boom that followed the war. However, when the great depression started in 1929 (282), the demand for cotton from the Continent also abruptly declined. This had an adverse effect on the cotton economy of Vidarbha. The price of cotton in the region declined sharply. The average annual price of raw cotton was about Rs 208 per *khandi* (784 lbs) in 1923-24 and Rs 112 in 1925-26. In 1933-34, it declined to Rs 55 and it came down to the all time low of Rs 50 in 1937-38.

However, between 1928 and 1931, the imports of Japan increased (282). In August 1932, the duty on non-British piecegoods was raised to 50 per cent and the Indo-Japanese Convention of 1909 was terminated in June 1933. Simultaneously, the duty on non-British imports was raised further to 75 per cent. These measures resulted in the Japanese boycott of Indian cotton. The impact of the boycott was felt in the following year and negotiations for a trade pact resulted in the Indo-Japanese Trade Agreement in 1934. It was valid for three years. Imports of cotton by Japan once again showed enormous increase in 1935-37 (283).

Within a year of the outbreak of the Second World War, the export of cotton from India declined sharply due to the loss of markets in Europe and the Far East. This led to a drastic reduction in acreage under cotton. The state government adopted a number of measures during 1942-46 to reduce the area under cotton and divert it to the production of food crops (Khandewale, 1971, 13). With the cessation of hostilities and the easing of shipping restrictions, the international demand for Indian cotton began to revive. The licensing system introduced during war was abolished in December 1945. The demand for Indian cotton from Europe increased. As a result, prices shot up in the first quarter of 1946. To arrest the inflationary trend in prices and to conserve stocks to meet the growing demand for cloth and yarn within the country, the licensing system was re-introduced in April 1946 (Nanjundayya, et al., 1960, 283).

Conclusion

It is true that due to British efforts, cotton cultivation in Vidarbha got a boost and resulted in increased prosperity of the local farmers. They also undertook vast peripheral and extension activities from seed research to spreading awareness. However, it must be realized that the British did not have purely altruistic objective in encouraging cotton cultivation. Their main objective was to ensure uninterrupted supply to their textile mills in Manchester and to strengthen their grip on the international trade in cotton. Thus, in the final reckoning, their principal aim was to increase their own wealth.

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RAYBHAN JADHAO: A DYNAMIC ACTIVIST IN AMBEDKARITE MOVEMENT**S. Meshram¹ and A. D. Fulzele^{2*}**¹Department of History, R.T.M. Nagpur University, Nagpur.²Department of History, Dr.Ambedkar College, Deekshabhoomi, Nagpur.²avi.fulzele@gmail.com**ABSTRACT**

In Maharashtra, many people significantly contributed for building and strengthening Ambedkarite movement in Maharashtra. These people strengthened the base of this movement with great efforts. The work of Raybhan Punaji Jadhav is significant among all. As an activist of Ambedkarite movement, he played significant role in disseminating the thoughts of Dr. Ambedkar among marginalized people. He belatedly participated in the social and political spheres. Despite of this belatedness, he left a due imprint on the people within short span of time and came into the limelight as an ardent activist in Ambedkarite movement. In 1942, Dr. Ambedkar established Schedule Caste Federation. Jadhav joined the party as the time of establishment. Thereafter, he journeyed through the remote areas and organized the Ambedkarite party. Taking the cognizance of Jadhav's work, Dr. Ambedkar offered the candidature of Schedule Caste Federation from C. P. & Berar Province in 1946 from Buldhana. In this election, he was the only candidate of S.C.F. who won the election from Maharashtra. Though he was the only candidate of SCF from Maharashtra in the C. P. & Berar legislature, he strongly raised the issues of Ambedkarite community in the House. This remarkable works of Jadhav is the reflection of an ideal activist. The new generation has completely forgotten his valuable works. Therefore, present research article endeavours to illuminate his works to forthcoming generation as well as to position his as an ardent activist in Ambedkarite movement.

Keywords: Satyashodhak Samaj (Truth-Seekers' Society), Puna Pact, Dalit Labourers, Untouchability, Dr. Ambedkar.

Early Life

In 19th century his father Mr. Punaji had allowed untouchables to fetch water from their two wells. In the year 1907, his father and elder brother had started Chokha Mela Boarding at Chikhlin Buldhana district with own expenses and without taking any help from others. They provided food grains to this boarding which was cultivated in their own farm. They ran that boarding till the year 1919(Jadhav, 10/8/1956, p. 1).Then they handed over that boarding to Mr. Ganesh Akkaji Gawai and Mr.L.S. Bhatkar and appointed them as the secretaries of that boarding. Mr. Raybhan was born on 1 January 1888 in the self-sacrificing farmer's family at Chikhli in Buldhana district. He was not highly educated. He took up the job in forest department. Initially, he was influenced by the work of Satya Shodhak Samaj (Truth-Seekers' Society) and started working for it while serving in the forest department. He tried to convince Dalits that they should not eat the meat of dead animals, they should pay attention to cleanliness and they should get educated. He had started hostel for untouchable students at Chikhli in 1938 with his own money(Paswan, 2002, p. 190).There were 15 to

20 students in the hostel. He ran that hostel for nearly five years on his own (p. 190). Mr.Raybhan retired from forest department service in 1941 and actively participated in the social work.

Contribution in Scheduled Caste Federation Party

He joined Scheduled Caste Federation Party in 1942. Later he became the President of the Buldhana district unit of the Party(Kshirsagar, 1994, p. 229).During the period of four years beginning in 1942 to1946, he took efforts to strengthen the party and for that he had travelled all over Buldhana district. That's why in the divisional election of C.P. & Berar, he was the candidate of Scheduled Caste Federation Party. He won that election by defeating veteran untouchable activist Mr.L.S. Bhatkar who was the candidate of Congress(p. 229).At that time in 1946, only two candidates of Scheduled Caste Federation Party won the election. Mr. Raybhan Punaji Jadhav was one of them(p. 229). He had put forth the problems of untouchables in C.P. & Berar divisional Assembly and tried to give them justice.

Contribution as a Member of C.P. & Berar Legislative Assembly

The Scheduled Caste Federation Party had started passive resistance at Nagpur in 1946 against Pune Pact. Raybhan told untouchables, '... The reason behind this passive resistance was that Mahatma Gandhi had opposed the separate constituency for untouchables but supported separate constituency for Sikh and Muslims. Afterwards untouchables got composite constituency but it proved unfavourable for them. Therefore, by the time it was proven that the demand for separate constituency was right. Hence this passive resistance started to oppose Congress policy of separate electorate'(C P & Berar Government, 1948, p. 538).The government had imposed section 144 and curfew at Nagpur Assembly. On 3 September 1946, Mr.Raybhan Punaji Jadhav had supported the passive resistance of Scheduled Caste Federation Party and said that though this passive resistance was on the right track and the government imposed section 144 and curfew as well. While tabling resolution of Legislature adjournment, Mr.Raybhan said, 'The government of Central Province and Vidarbha was taking action against the passive resistance though it was justified for untouchable community. By imposing Section 144 and Curfew, government tried to curb peoples' rights. Mr.Raybhan had strongly put forth his opinion that Legislature should be adjourned as it is a public work' (Government of C P & Berar, 1946, p. 54).While explaining the importance of the resolution, he said, 'The Congress had also done passive resistance for independence. The untouchables were fighting for their rights but Congress could not bear it. Though the Congress demanded independence, it was trying to obstruct those who were helping the untouchables to get their due rights. Congress had opposed Scheduled Caste Federation Party and fielded its candidates against it. So this protestors in passive resistance started to protest against the Congress'(p. 54). Mr.Raybhan had also expressed his grief as the board of three ministers didn't pay attention to the problems of untouchables. At that time, Mr. Ruikar had suggested that he should launch passive resistance at London. On this suggestion,

Mr.Jadhav responded spontaneously saying how he could demand independence in London when reign was here in India. Mr.Ruikar was nonplussed by this argument (pp. 54-56).

Though the passive resistance of untouchables at Nagpur was going peacefully, police tried to suppress it. On 18 September 1946, police resorted to cane charge on untouchables. Mr.Jadhav had called adjournment motion in the Assembly against the action taken by police(Government of C P & Berar, 1946, p. 538). While justifying the motion, he said, 'The Composite Constituency was proved harmful for untouchable community. When Mahatma Gandhi went to round table conference he put the resolution that untouchables should not get separate constituency because he felt if the untouchables got separate ward they won't be dominated by Hindus. According to Mr.Jadhav, Gandhi felt if untouchables left the Hindu community then who will do the degraded works and who will work as conservancy workers, who will skin the dead animals and who will work as cobbler, if they abandoned Hinduism. Who will dispose the dead animals if Mahar abandoned Hinduism? According to Mr.Raybhan, Mahatma Gandhi had opposed separate electorate for untouchables as he felt that there would be no one to take up those degraded jobs. Mr.Raybhan had tried to explain his role of adjournment saying that untouchables needed only for carrying out the degraded works and when the situation comes to appoint them on leading position they are being ignored by the mainstream leaders...' (p. 538).However, the Assembly rejected the demand unanimously (Shirke, 1946, p. 2).Mr.Jadhav had played an important role in the Assembly by conveying the demands of untouchables through the passive resistance of Scheduled Caste Federation Party at Nagpur. Though Mr.Raybhan Jadhav was not well educated, he had realised the importance of education. That's why he vehemently advocated that untouchables should concentrate on education. He strongly supported primary education. He requested the government to pay attention on the primary education of the children of Dalit, farmers and poor people as the educated people from these communities would be well settled (Government of C P &

Berar, 1947, p. 612). As the primary education was controlled by local board and district board, the teachers were transferred whenever deemed fit by these boards. Due to these abrupt transfers, students suffered a lot. So he demanded the government should make a law to regulate the transfers (p. 612). He alleged in the Assembly that it spends less funds on the students from untouchable and tribal community (p. 613). He continuously demanded in the Assembly that the government should spend more funds for these communities; the government should give them scholarships and concession in fees. There would be only few untouchables who earned Rs 1200. The government should charge fees to the rich among untouchable community and should give free education to children from poor families among untouchables, farmers and Muslims (Government of C P & Berar, 1946, pp. 372-373). At that time, the Congress government from C.P. & Berar spent Rs 10,000 on furniture at ministeries' residences. Mr. Jadhav had objected to it saying that the government could have spent the fund on the welfare of poor and on the education of their children (Government of C P & Berar Province, 1946, pp. 416-17). Mr. Raybhan believed that juveniles turn to criminal activities due to lack of education. Hence government should start livelihood or skill oriented schools for such children so that they could live happy life and would remain away from bad habits (Government of C P & Berar, 1947, p. 292). Mr. Raybhan always raised the issues of untouchables in the Assembly to get them facilities of education.

Agriculture and business were the backbone of Indian economy. There were many difficulties in agriculture. Cotton was the main crop during that time but its prices were varying. So the C.P. & Berar government presented the bill in the Assembly to regularise the prices. At that time, Mr. Raybhan Jadhav stood by the side of farmers. He had tried to convince the government that the production cost of cotton had gone up due to the inflation and if the government couldn't take the cognizance of such situation and control the rate of cotton which was not beneficial to the farmers, they might be ruined (Government of C P & Berar, 1946, p. 697). He also said that the farmers

were cheated in the weights and measures. Traders took advantage of the situation. They would purchase cotton at low rate due to which farmers suffered huge financial losses. Traders and moneylenders ruined the farmers. In such situation, if the government fixed the price then the farmers would have lost their remaining hopes also (pp. 697-698). While alerting the government about the gravity of the problem, Mr. Raybhan Jadhav said, 'Despite hard work, farmer had become penniless. Like the special attention paid to the working children in a family, it was the duty of the government to take care of farmers since they work hard round the year. The government should formulate schemes to support farmers. The world would be happy if farmers are happy...' (pp. 697-698). So Mr. Raybhan demanded in the House that the government should give the fair price to the farm produce and make their lives happy. At that time, the bill regarding landlords was tabled in the Assembly. Mr. Jadhav supported that bill. While speaking during the debate of the bill, Mr. Jadhav said, '... If the government spent 0.5% of landlord's earning spent on the welfare of other farmers or poor, it would be beneficial for us. But the companies bigger than landlords and well established people, big industrialist like Tata and Birla had earned lot of money from poor people. Mr. Jadhav felt that the government should force the industries to contribute the share of their profit for social cause... before passing the bill, then landlords would definitely follow the suit' (Government of C P & Berar, 1947, p. 208). He felt that the government should support the farmers along with the industries. In this regard, he expressed his views in the Assembly, 'In the past, the manufacturing industry was thriving in the country. Several artisans made various artefacts. However, they never got the due remuneration for it. The raw material like cotton, leather was exported from India and the readymade goods were imported. Hence the entire profit was earned by the foreign industries' (C P & Berar Government, 1946, pp. 425-426). Mr. Raybhan tried to convince the government in the Assembly that it should encourage the industries like shoe making and leather works etc. He also opposed increased tax on farmers and expected that the

government imposed heavy tax on black marketeers and take strong action against them. He requested that instead of imposing tax on poor farmers, the government should give them exemption from tax (Government of C P & Berar, 1946, pp. 452-453). Thus he had always tried to help farmers by raising their problems in the Assembly.

On 21 September 1946, a discussion was held on Grampanchayat Bill in the Assembly. Mr. Raybhan Jadhav had opposed the bill. He said, 'At the time of primary elections, Mahars from Belgaum had to face lot of trouble as they didn't vote for Congress candidate Mr. Jadhav had clearly told that if the Grampanchayat Bill was passed the poor people would be ruined for sure' (Government of C P & Berar, 1946, pp. 434-35). His fear came true later. There were many incidents of bullying untouchables by other communities. One of the incidents occurred at Katol in Nagpur district. When three people from untouchable community had gone to a hotel for tea, the hotel owner denied them entry. On 23 October 1950, Mr. Raybhan Jadhav raised this issue before the Assembly at Question Hour (C.P. and Berar Police Department, 1950, p. 8). But he didn't get satisfactory answer. Mr. Jadhav didn't give up and always tried to help untouchables by raising their issues in the House.

On 22 March 1947, a discussion was held on C.P. and Berar Home Guard Bill in the House. The core of the Bill appealed Mr. Jadhav, but at the same time, he also expressed his fear that there are many religious and caste differences in our country. 'There are many Sect. There is a rat race for one up-man ship among the parties, castes and religions. Mahatma Gandhi had good intentions when he thought of getting freedom for our nation and it had almost become a reality but our Dalits brethren had to face the ill effects of Gandhiji's good intention. Similarly, the intention of that bill was nice, but our Dalit brethren might have to face its ill effects' (Government of C P & Berar, 1947, pp. 10-11). He had requested in the Assembly that the government should think over the bill seriously and give chance to Dalits in Home guard.

The Maintenance of Public Order Bill, 1946 came up for discussion in the C.P. & Berar Assembly on 12 November 1946. There were

many tough sections applied on the provisions of that bill. While explaining on the provisions of that bill in detail, Jadhav said, 'Due to different sections in this bill there would be restrictions on processions, public meetings and fare. According to him, the weaker sections of the society could not be strengthened, unless they mastered in Indian martial arts such as lathi-kathi and other self-defence arts such as wrestling, and overpower their enemies. The proposed Bill could be a major hurdle for minorities who wished to learn this arts' (Government of C P & Berar, 1946, pp. 855-56). So, he insisted that the government doesn't pass this act without taking opinion of the people. Not only that but he had suggested the government to make hand bills of that act and seek the opinion of common man.

The workers from Mahar community faced many serious problems in C.P. & Berar region. These problems couldn't be solved for several years. Their wages were miniscule as compared to the work load. Since their duty hours were not fixed, many of them had to work 24 hours a day. Their wages were reduced from Rs 10 to Rs 8 (Government of C P & Berar, 1947, p. 506). When the discussion was held in the Assembly regarding their wages Mr. Raybhan said, 'Earlier the government had agreed for the wage hike in proportion with the inflation. But it never saw the day of light. At that time, workers from Mahar community earned Rs 8 as wages and Rs 4 as dearness allowance. Thus they got a monthly salary of Rs 12. It was difficult to make both ends meet in such a low salary... The government should consider the demand on humanitarian ground. The working hours for Mahar community should be fixed and the government should put an end to the bonded labour system. Mr. Jadhav had requested the House that the salary of Mahar labours was brought at par with government servants' (pp. 506-507).

The Specified Commodities Bill, 1947 was tabled in the C.P. & Berar Assembly and discussions on it were held on 26 February 1947. During that discussion, Mr. Jadhav raised the issue of black-marketing of grains and demanded that the government to take immediate action against it. He said,

‘...Though government’s decision to control the grains was beneficial to poor but the poor were not actual beneficiaries. He further pointed out that it was expected that the poor will be benefitted under Section 93 in Congress rule. But it also proved to be the same and poor people continued to suffer. He had demanded that the government should forfeit the properties of black marketeers. The government should confiscate their stock and should distribute it among the poor people...’(Government of C P & Berar, 1947, pp. 94-95).Mr.Raybhan stressed that poor people would actually get the benefit under the Bill, if the government took strong measures to curb black marketing. On next day, 27 February 1947, C.P. & Berar and Municipality Amendment Bill 1946 came for discussion in the Assembly. During the debate on that bill, Mr.Raybhan said, ‘... The Bill was not at all beneficial for the poor when it came to their upliftment. No matter whosoever was their elected representative. They are forced to dance to the tunes of upper caste people. Hence the Bill was not at all beneficial for the poor and untouchable community. Though there was provision to nominate untouchable people to the Assembly, it was subject to approval from higher authority or government officer. The person belonging to that reserved community won’t get nomination. Though projected to be

for the welfare of poor and untouchable community, according to Mr.Raybhan Jadhav, it was actually against the interest of the untouchable community as the election of the candidate was completely at the mercy of the upper caste people and government officers...’(Government of C P & Berar, 1947, pp. 149-150).

Conclusion

Raybhan Jadhav disseminated Ambedkarite movement in the remote areas of Buldhana and other areas also. He strove hard to achieve justice for the commoners by raising their issues. In 1946, he was the only candidate of Schedule Caste Federation who won the general election from C. P. & Berar Province. It clarifies his popularity among Dalits. Though he was the only member of Schedule Caste Federation in legislature, he always moved with the principles and ideology of the party. He had assimilated Ambedkarism and worked accordingly. Thus Mr.Raybhan Jadhav had always tried to raise the issues and questions of Dalits in the House and give them justice. In 1956, Mr.Raybhan had taken ordination of Buddhism and devoted his life to spread the Buddhism in Buldhana district. Mr.Raybhan passed away on 22 October 1969 at the age of 81.

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DYNAMICS AND DIALECTICS OF LEGAL REGULATION OF VIOLENCE AGAINST WOMEN IN INDIA

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ABSTRACT

The concept of violence against women is the meeting point of conflicting and competing approaches and implicates the relationship of law with culture, civilization, history, philosophy etc. Certain forms of violence masquerade as discipline or punishment. In the context of domestic relationship, it assumes subtle and obvious forms, thus reflecting the dynamic and dialectic character of violence, concept of violence and its competing and conflicting conceptions. This paper briefly traces the epistemological foundations of violence against women to demonstrate how subordination of women has been considered by the society to be natural and given. It also aims at pointing out the paradoxes of legal regulation dealing with violence against women in considering women as (victims) and perpetrators of violence. Lastly, the paper brings out the ambivalent approaches of the legislature and the judiciary in dealing with violence against women.

Keywords: Violence, women, victims, perpetrators, legal regulation

1. Introduction

The concept of violence against women is the meeting point of conflicting and competing approaches and implicates relationship of law with culture, civilization, history, philosophy etc. Certain forms of violence masquerade as discipline or punishment. In the context of domestic relationship, it assumes subtle and obvious forms, thus reflecting the dynamic and dialectic character of violence, concept of violence and its competing and conflicting conceptions. In order to map the journey of legal regulation of violence against women, this paper is divided into the following sections. Section I deals with the epistemological foundations of women's subordination and victimization. Section II discusses the International human rights law dealing with violence against women. Section III attempts to bring out the paradoxes of the legal regulation of violence perceiving women as (victims) and perpetrators of violence. This paper concludes by drawing attention to the emerging conflict of approaches towards violence against women between the legislature and the judiciary.

2. Epistemological Foundations of Women's Subordination and Victimization

In the history of development of ideas, freedom came first and equality of freedom came later. But this equality of freedom was predicated upon equality of 'man' as exemplified by abolition of the practice of slavery. Women continued to suffer discrimination in matters of property and franchise revealing their entrenched subordination vis-a-vis men. From times immemorial the processes of

formation of norms and paradigms has been controlled by man. Even the Western philosophical tradition has denigrated and sub-humanised women's separate and equal existence. This is reflected for example, in Aristotle's philosophy. Aristotle first defined "man" as a rational animal. Thus he identified 'rationality' as the identifying characteristic of humans but then also claimed that women's reason was defective in that it was "without the power to be effective."¹ This is a clear evidence of women being considered to be subordinate. Similarly, one sees this trend in the other Western philosophies too. Notice for example, the philosophy of Locke, who believed that "man" could transcend natural power relations by means of civil agreement. Despite this thought, he considered it somewhat obvious and natural that in case of conflict between husband and wife "the rule... naturally falls to the man's share, as the abler and the stronger."² He considered this to be rather obvious and given. Rousseau, who took freedom to be the distinguishing mark of humanity, held that it followed from the different natures of men ('active and strong') and women ('passive and weak') that "woman is made to please and be dominated" by man.³ The highest degree of this denigration can perhaps be noted in the philosophy of Kant, who observed, "I hardly believe that the fair sex is capable of principles"⁴. Reacting to these approaches by popular and influential philosophers of the West, Helen Longino makes an interesting point. She says that the problem with such philosophies is not really their maleness; the real problem rather is homogeneity; that is to say that when a large number of people begin to believe in the same thing then it is less likely for that ideology to be questioned. On the other hand, "diversity of viewpoint and interest generates the 'essential tensions' that promote the generation and testing of new ideas and that militate against premature convergence onto inadequate theories"⁵. Applying Longino's reasoning, it is not difficult to see why women objectification and subordination appear to be natural or given. In this context it would be relevant to draw attention to one aspect of Cartesian epistemology and Longino's response thereto. Cartesian epistemology assumes for example, that all knowing is essentially individualistic⁶. This means that it is to the individuals, their beliefs, and their thoughts to which, in the first instance, epistemic norms are applied in order to make their assessment as objective or non-objective, rational, or irrational etc. Longino very vehemently discards this assumption and puts forth a contrary theory that objectivity and justification are fundamentally 'social'. "Objectivity is not, and could not be, according to Longino, a property of individual knowers, for knowers isolated from the productive pressures of social intercourse cannot subject their beliefs to the kinds of testing that is necessary to overcome the limitations of any single epistemic location. Objectivity is thus a social, rather than an individual norm; objectivity is a feature of a properly constituted epistemic community. Longino's view, which essentially broadens general empiricist method to cover societies instead of individuals, is called *social empiricism*"⁷

The feminist movement began to deconstruct this social truth and exposed the deliberate nature of patriarchal power and domination. Therefore the phenomenon of violence against women masquerading as stronghold of culture, is inevitably linked with their objectification and subordination in a patriarchally determined division and hierarchy.

¹Louise M Anthony, *Embodiment and Epistemology* in Oxford Handbook of Epistemology (Paul K. Moser ed) 465, Oxford University Press, 2005

²Louise M Anthony, *Embodiment and Epistemology* in Oxford Handbook of Epistemology (Paul K. Moser ed) 465, Oxford University Press, 2005

³Id

⁴Id

⁵Id, 469,470

⁶Id, 470

⁷Id

The further consequence of objectification has been the denial of personhood and/or moral agency to women. Within this frame of reference, violence against women was perceived as a part of cultural discipline or legitimate forms of coercion exercised by man over the body and mind of a woman. Any disobedience or non-compliance with the patriarchally determined standards or norms of behaviour by women justified violence as a part of discipline or legitimate forms of coercion by men on women. It may be observed here that control over the movements of the body, especially in the context of military and in schools has been recognized as a certain mode of shaping the minds of soldiers and children. This has been graphically illustrated by Michel Foucault in his book "Discipline and Punish"⁸. He believes that the mode of being of power is secrecy. The power will be successfully exercised when the person over whom the power is exercised does not realize that he is subject to power. Hence concealment of exercise of power amounts to successful exercise of power. This is especially true in the context of patriarchal power sanctified by the patriarchally determined culture. Foucault observes, "In every society, the body was in the grip of very strict powers, which imposed on it constraints, prohibitions or obligations. However, there were several new things in these techniques. To begin with, there was the scale of the control: it was a question not of treating the body, (en masse) 'wholesale', as if it were an indissociable unity, but of working it 'retail', individually; of exercising upon it a subtle coercion, of obtaining holds upon it at the level of the mechanism itself - movements, gestures, attitudes, rapidity: an infinitesimal power over the active body. Then there was the object of the control: it was not or was no longer the signifying elements of behaviour or the language of the body, but the economy, the efficiency of movements, their internal organization; constraint bears upon the forces rather than upon the signs; the only truly important ceremony is that of exercise. Lastly, there is the modality: it implies an uninterrupted, constant coercion, supervising the processes of the activity rather than its result and it is exercised according to a codification that partitions as closely as possible time, space, movement. These methods, which made possible the meticulous control of the operations of the body, which assured the constant subjection of its forces and imposed upon them a relation of docility-utility, might be called 'disciplines'"⁹.

Man's power over woman both - her body and her mind has been legitimized by the culture and civilization of society. Thanks to the suffragette movement in the UK led by Emmeline and Christabel Pankhurst, which among other many reasons, presumably led to revision of the system of distribution of social and political powers and freedoms between men and women.

3. International Human Rights Law and Violence against Women

On a careful perusal of Article 1 of the Declaration on Elimination of Violence against Women, it reveals that violence against women has to be understood in its comprehensive dimensions. It includes all forms of violence - physical, sexual, psychological and so on. Article 2 then carries forward the spirit of Article 1 and states that the different manifestations of violence against women recognized in that article are merely illustrative and not exhaustive of the forms of violence that may be perpetrated against women. More importantly, violence inflicted on women is prohibited whether it be perpetrated by the officials of the state or in the privacy of the homes and in society. In other words, irrespective of the sources and causes, violence against women is totally forbidden. It is important to note that violence includes symbolic and psychological forms thereby casting obligation on the states to scrutinize all sources and causes of violence offered as justifications for infliction of violence on women. Article 4 obligates the states to revise its existing laws and customs and social practices followed by its population and to take preventive and curative measures including the use of criminal law and civil and administrative remedies. The article very clearly states that neither religion, nor culture and so on

⁸Michel Foucault, *Discipline and Punish*, Vintage Books (1995)

⁹Id 136,137

can furnish justification for infliction of violence against women. Thus it will be seen that violence against women is absolutely forbidden.

In addition to the above, the patriarchal culture together with caste based social division and hierarchy contributed to the phenomenon of double discrimination of women. Women may suffer discrimination not only on the ground of their gender but also on gender plus factors. This intersectionality is brought about by the Convention on Elimination of All Forms of Discrimination Against Women (CEDAW) in the context of gender, Convention on Elimination of All Forms of Racial Discrimination in the context of race and Convention on Rights of Persons with Disability in the context of persons with disability. These thematic conventions lay out the perspective within which the status of certain class of human beings, whether it is race, gender or disability has to be taken into account while evaluating possession and exercise of human rights by these classes of humans on the basis of equality. CEDAW has led to the rejection of essentialist conception of women by drawing attention to the social status of different classes of women for e.g. urban and rural women, educated and illiterate women and so on. Therefore while implementing CEDAW the legislative, administrative, social, economic and educational measures have to be suitably tailored, taking note of these different classes of women. These thematic conventions have fundamentally transformed the approach to the study of human rights of women, in that, it rejects the formal concept of equality and demands that human rights of women have to be considered in the defacto situation in which they are placed. Such an approach has a far-reaching implication of strengthening and perfecting the feminist method of deconstruction and gives us an accurate and reliable data for revising policies and devising measures to promote gender justice.

4. Paradox of Legal Regulation of Violence against Women

The reforms of the legal system took two distinct forms. Law recognized the right to formal equality between men and women leading to the norm of non-discrimination on the ground of sex¹⁰. Also, special provisions were enacted to protect women¹¹, taking note of their biological character and functions¹². This formal equality did not alter the defacto social reality for women. They remained subjected to the subordinate status and survived on the gracious protection granted by men through special provisions. This is the reflection of the limits of law since law depends for its effective operation on forces beyond its control. In the absence of any social reforms mere normative alterations will not secure the goal of equality in a substantive sense between men and women.

Legal regulation of violence reveals the paradox of the legal system towards the phenomenon of violence. On the one hand the legal regulation of violence against women perceives women as victims of violence perpetrated by man. The assumption on which this legal regulation is based can, at best be described as a charitable one, to say the least. The further assumption is that women are incapable of perpetrating violence thereby denying to them equal moral agency with man. The first assumption undergirds the Declaration on Elimination of Violence Against Women in international law and on the national level, legislation governing sexual harassment. Also, some of the provisions are justified on the ground of a paternalistic conception of protection of women as was section 497 of the Indian Penal Code (IPC) until it was recently declared unconstitutional by the Supreme Court.¹³ This section had granted women the exemption from criminal liability in the offence of adultery. The graphic illustration of women being perceived as victims of man's aggressive sexuality and therefore in need of protection

¹⁰ Constitution of India 1950, Articles 14 & 15. *See also* Constitution of United States of America, 14th Amendment.

¹¹ Indian Penal Code, 1860, Sec 497 furnished one such example.

¹² Maternity Benefit Act for example.

¹³ Joseph Shine vs Union of India Writ Petition (Criminal) No.194 of 2017; 2018 SCC OnLine SC 1676

has been furnished by the judgments of the Supreme Court in *Revathi*¹⁴ and *Saumitri Vishnu*¹⁵ cases. The immunity from criminal prosecution accorded to women in the matter of offence of adultery had been perceived as a protectionist measure considered as a 'special provision' authorized by Article 15(3) of the Constitution of India. The conception of a woman as a victim entails two far-reaching implications: (i) that women are always perceived as passive and inactive agents, reason being, the male counterpart, resulting in denial of equality under Article 14 & 15 of the Constitution. More fundamentally, it results in denial of equal moral agency in matters of sexuality. (ii) It is a systemic denial of personhood in that, she is not capable of making autonomous choices and being responsible for those choices. In other words, women have no freedom to make their own judgments and are denied the sense of responsibility in making these judgments. Another de-personalizing dimension of Section 497 offence was that the wives were considered to be the property of the husband, access to whose body could be a matter of negotiations on the part of the husband, as his consent could legitimize that access. Justice Chandrachud describes this as husband being the 'owner of wife's sexuality'¹⁶. It is this archaic and anachronistic perception of women that led the Supreme Court, in *Joseph Shine's* case to de-construct Section 497, IPC and hold it unconstitutional. After noting that in various jurisdictions in common law and in the United States the offence of adultery has been de-criminalized, the court also found that Section 497 runs afoul of the guarantee of equality before law and also denial of equal subjection to law. Furthermore it denies to women equal personhood thereby demeaning her in her own eyes in terms of individuality and dignity which is guaranteed by Article 21 of the Constitution. So any law which prescribes an unjust and an unfair procedure will be violative of right to life and personal liberty under Article 21. Hence insofar as Section 497 violates equality before law and equal subjection to law and undermines her right to equal autonomy and dignity under Article 21, it came to be declared unconstitutional. On the other hand, legal regulation recognizes that women are equally capable of perpetrating violence (sometimes individually and on many occasions by being party to the violent act with man either being abettor of the violence or in executing acts of violence with man, who happen to be her close relatives).

While analyzing violence against women this paradox of the legal regulation has to be kept in view. In addition to the above, in the measures adopted by the Indian legal system to deal with violence against, and by, women - both the strategies of criminal and civil liabilities have been employed. Section 498A of the IPC furnishes an example of criminal liability for violence perpetrated either individually or together with her male close relatives. The graphic illustration of violence by and against women which however is not based on gender is furnished by the on-going trial of Indrani Mukherjee and Peter Mukherjee in the killing of their daughter Sheena Bora.

The Vienna Accord of 1994 and the Beijing Declaration and Platform for Action 1995 have recognized that domestic violence is a serious human rights issue. The United Nations Committee on Convention for Elimination of All Forms of Discrimination Against Women in its General Recommendation No XII of 1989 had recommended that all State parties must take measures for protecting women from violence of all kinds, especially that which is inflicted within the four walls of her domestic house. Violence occurring within the family is a lived experience of many women, but is not very easily visible. The international declarations and conventions governing human rights of women thus obligate the state to adopt measures on a vertical level but more importantly to adopt measures on a horizontal level where discrimination and violence occurs in the domain of social relations in general and domestic relations in particular. The horizontal protection of women's human

¹⁴1988(2) SCC 72

¹⁵AIR 1985 SC 1618

¹⁶*Joseph Shine vs Union of India*, 2018 SCC OnLine SC 1676, See para 64 of Justice Chandrachud's judgment

rights is the toughest challenge confronting the state in the 21st century. The large part of power relations are determined by social and cultural norms and traditions which is at the heart of the religious liberty implicating the concerns for privacy of the home or domestic sphere. Due to the feminist movements the patriarchal nature of the legal regulation was de-constructed as a result of which domestic violence was regulated through a special enactment like the Domestic Violence Act in India. While cruelty by the husband or relatives of the husband is already made punishable under the Penal Code, the Domestic Violence Act was designed to provide some innovative remedies under civil law and to protect women from becoming the victims of domestic violence. The Preamble to the Act says that it is “An Act to provide for more effective protection of rights of women guaranteed under the Constitution who are victims of violence of any kind occurring within the family and for matters connected therewith or incidental thereto”. It also clarifies that the Act is broad enough to cover all forms of violence against women, whether it be physical, verbal, sexual, emotional or economic.

In *Harsora vs Harsora*¹⁷, the Constitutional validity of clause (q) of Section 2 was challenged before the Supreme Court. This clause defined the term ‘respondent’ for the purposes of the statute. The grounds on which the challenge to its validity was constructed were interesting. The word respondent was defined in section 2(q) as under:

“Respondent” means any adult male person who is, or has been, in a domestic relationship with the aggrieved person and against whom the aggrieved person has sought any relief under this Act:

Provided that an aggrieved wife or female living in a relationship in the nature of marriage may also file a complaint against a relative of the husband or the male partner.

The definition as worded in clause (q) clearly shows that the respondent against whom a complaint can be filed under the Domestic Violence Act must always be a male person unless the complainant is a wife or a female living in a relationship in the nature of marriage. The court evaluated the other definitions in the statute (especially that of domestic relationship, shared household etc) along with the scheme of remedies provided there under and observed that going by the object of the statute, the words ‘adult male person’ in the definition of ‘respondent’ is not in tune with, and will frustrate the object of the Act. It also observed that on one hand the amendment in Section 6 of the Hindu Succession Act 1965 has recognized female coparceners in a joint Hindu family, also a ‘shared household’ could include a household which may belong to a joint family of which the respondent is a member. In the face of all these provisions, the definition of respondent being restricted to an adult male person, the court said, results in a glaring anomaly. Also the court observed that Act is designed to protect women from any kind of domestic violence, irrespective of whether it is perpetrated by a man or a woman herself within the domestic house. This being the object of the statute, the court found that the inclusion of the words ‘adult male’ in the definition frustrate its object and hence read these words down. Likewise the court observed that the proviso to the definition is also rendered otiose and hence read that down too.

Now the most interesting aspect of Justice Nariman’s reasoning in the aforesaid judgment is that the statute enacted by the Parliament dealing with women’s rights and obligations should be read as furnishing an integrated perspective. More significantly, the acceptance of equal rights in the context of property would justify a conclusion in respect of civil liability in the context of domestic violence. The requirement of Section 2(q) that the female respondents could be impleaded only when there is a male respondent resulted in the frustration of the object of the Act. Therefore the commitment to equality in matters of property rights would justify equality in matters of subjection to civil liability. This mode of reasoning has the merit of bringing in coherence and consistency in making the laws by

¹⁷Hiral P Harsora vs KusumNarottamdasHarsora(2016) 10 SCC 165

the Parliament. On a deeper level inconsistency in the statutes will be perceived as discrimination grounded in the Constitutional commitment to equality.

5. Conclusion

After surveying response of the legislature and of the judiciary to violence against women it may be observed that in the first phase, there appears to be an agreement between the judiciary and the legislature that women are in need of protection from men's aggressive behaviour including sexual behaviour. Men were perceived as perpetrators of violence and women were perceived as only the victims of violence¹⁸. This is duly illustrated by *Saumitri Vishnu* and *Revathi* cases. Even where the legislature intended to rope in women as perpetrators of violence they were seen necessarily as associates of the husband or the "man" as perpetrating the act of violence. This is graphically reflected by the language of Section 498A of IPC or section 2(q) of the Domestic Violence Act. This unified perspective led the Supreme Court to prohibit sexual harassment of women at workplaces. Harassment has also been conceived as one form of violence by the United Nations in its Declaration on Violence Against Women. Verma J. in his judgment in *Vishakha's* case¹⁹ took a novel step of enforcing the international human rights law when it is not in conflict with the fundamental rights provisions in the Constitution, thereby giving subordinate status to the practice of dualism in the context of enforcement of human rights of women. More significantly, Verma J. adopted the recommendations of the CEDAW committee for the purpose of defining sexual harassment. Without going into the details of the definition it may be observed that it seeks to accord protection to women against harassment at any cost without leaving any room for defence for a man who is alleged to have committed sexual harassment. It may be described as a very passionate but not a measured response to violence against women. When in 2013, the Parliament enacted the law²⁰, it virtually reproduced the law laid down by Verma J. In other words, it is one of such instances where women's interests are protected with great passion and fervour²¹.

The second phase of response to violence against women essentially belongs to the judicial initiative working through the doctrine of transformative constitutionalism and the distinction between constitutional morality and popular morality. The Supreme Court perceived section 377 IPC punishing homosexual activity as invidious discrimination and lacking any socially redeeming feature. It was as if the state was advertising its unrestrained potential for violence against homosexual adults in privacy. It also perceived section 497 as an anachronistic or regressive law treating women as property and lacking in any moral agency, giving rise to a perception amongst women that denial of equal moral agency was an insult to her personhood and therefore a form of violence lacking in any rational basis, thereby confirming the thesis that coercive use of force by the state could be justified by at least minimum rationality. This is one such example. Therefore the Supreme Court's decision in *Joseph Shine* and *Harsora* cases clearly demonstrate that women are not perceived as near victims but they are equally responsible for criminal and civil liability vis-a-vis men. Thus it will be seen that perception of the legislature and the perception of the judiciary in the second phase in respect of the response to violence against women is incompatible with each other. The legislature continues to view women as

¹⁸ The same thinking is reflected in the Declaration on the Elimination of Violence Against Women

¹⁹ *Vishakha vs State of Rajasthan*, AIR 1997 SC 3011

²⁰ Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013

²¹ Other examples of law's passionate protection are that a statement made by a victim of rape is presumed to be true; Also Section 304B under which if death occurs within seven years of marriage under unnatural circumstances, it is presumed to be dowry death; Some other examples of law's passionate protection, though unrelated to gender are furnished by legislation protecting tenants against landlords or legislations protecting employees against employer.

victims and men as perpetrators of violence whereas the judiciary perceives women as having equal moral agency and as being equally responsible for their acts and omissions as are men.

It may finally be observed here that in the context of matrimonial relationship in general, and mental cruelty as a ground of divorce in particular, there is a very refreshing insight furnished by the reasoning of Chandrachud J. that there cannot be any objective basis on which mental cruelty can be defined. Hence in this context there is no oppressor or oppressed and while deciding the issue of mental cruelty the peculiarities of each matrimonial relationships will furnish a determinate guidance with regard to judgment about mental cruelty. As the Hon'ble Justice observes, "The parties are Hindus but we do not propose, as is commonly done and as has been done in this case, to describe the respondent as a "Hindu wife" in contrast to non-Hindu wives as if women professing this or that particular religion are exclusively privileged in the matter of good sense, loyalty and conjugal kindness. Nor shall we refer to the appellant as a "Hindu husband" as if that species unfailingly projects the image of tyrant husbands. We propose to consider the evidence on merits, remembering ofcourse the peculiar habits, ideas, susceptibilities, and expectations of persons belonging to the strata of society to which these two belong. All circumstances which constitute the occasion or setting for the conduct complained of have relevance but we think that no assumption can be made that the respondent is the oppressed and appellant the oppressor. The evidence in any case ought to bear a secular examination."²² Here the court is seen rejecting the stereotype image of "husband" (as oppressor) and "wife" (as oppressed) in any given culture and rather emphasises on a more secular examination for arriving at a finding of mental cruelty.

Thus it is clearly seen that the approaches of the legislature and the judiciary have been far from consistent in dealing with violence against women in India.

²²Narayan Ganesh Dastane vs Sucheta Narayan Dastane AIR 1975 SC 1534



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From E-governance to Good governance via Right to information.

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Abstract

Provision of efficient public services is the prime effort of the Government Departments. This digital age has proved to be the boon for the government for providing the basic facilities and services at the single click of mouse on computer or a click on mobile phone. With the advancement in information and communication technology, the various public departments have become online and are able to fulfil the variety of needs of individuals. This concept of interacting of the governmental department with the citizens through electronic medium is called e governance. Digital India programme is a leading programme of the Government of India with a target to renovate India into a digitally cultured society. The initiatives of E-governance in India made a wide-ranging application by providing public services through electronic government. In order to efficiently equip the citizens with the governmental information through Right to Information Act 2005 and using Information and Communication Technology (ICT), the Government of India has launched the Digital India programme. Central government along with numerous States started several E-governance schemes. However, these E-governance projects failed to deliver the desired results. In the year 2006, the enthusiastic plan of National E-governance (NeGP) was launched by Government of India, in which multiple projects covering various fields were introduced. Notwithstanding, the effective application of various E-governance projects through different public authorities, E-governance failed to attain all its objectives of providing electronic services to the citizens, due to numerous administrative as well as technical loopholes.

This paper aims at emphasising the significance of E-governance for effective application of Right to Information Act 2005 for achieving Good governance. The paper further gives insight into the conceptual understanding about E-governance, E-government and good governance. Its main focus is on the Sec.4 of the RTI Act 2005 which deals with the obligation of public authorities to make voluntary disclosure of Departmental information through electronic medium resulting in e governance. The paper also deals with the challenges before the Government for effective implementation of RTI Act 2005 through e governance and lays emphasis on certain recommendations.

Keywords: E-governance, Right to Information (RTI), Good governance, Information and Communication Technology (ICT).



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and surveys clearly demonstrate that increasing number of attacks and murder of RTI activists throughout the country. The objective of the RTI Act will be of no use if precaution is not taken to curb such types of activities and if strict punishments are not inflicted to the perpetrators.

Conclusion:

E-governance proves to be an effective tool for good governance as it is the most effective mode of propagating information to large public. E-governance is booming in our country by assisting the citizens in filing RTI application and appeals just by a click either through their personal computers or mobile phones. RTI can deliver a strong support to democracy. It further promotes good governance by empowering citizen's ability to partake efficiently and hold government officials accountable rather than just an information provider. However, there are challenges in the effective implementation of the Act but the same can be removed by taking suitable measures and the goal of good governance, i.e. transparency, accountability, greater participation etc. can be achieved through RTI. Section 4(1)(b) of RTI Act 2005 mandates the public authority to make voluntary disclosure of prescribed information using different medium like display board, newsprint, websites etc. Amongst these ways internet is the fastest and economical medium to publicize the information. However, there are numerous public authorities which have not fulfilled the said legal obligation. Only few public authorities have effected online system for filing of complaint/ appeals and availing video conferencing facilities for hearing of the same. Apart from this there is no co-ordinated strategy of various state governments for enhanced application of RTI Act 2005 with the assistance of E-governance.

Thus, it can be correctly said that RTI as a whole is a great step in a democratic set up like India. Currently, the RTI Act is passing through the crucial period, much more needs to be done to enable its growth and development leading to Good governance by efficiently using E-governance.

Suggestions:

1. There is an urgent need for wilful revelation of online information available with public Authorities for effective implementation of RTI Act. Section 4 of the RTI Act provides for a detailed manual for compulsory disclosure on various aspects of structure and functioning of Public Authorities and requires that they make voluntary disclosure in public interest. The said section also emphasizes the need for using electronic means for record management and dissemination of information.
2. It is also necessary to sensitize the Public Authorities about the Right to Information and incorporate training programmes in all government departments.
3. Single web portal should be created in the States covering all public authorities to make the process hassle-free because sometimes an applicant will not be able to understand that which department is involved in the particular matter.
4. All public authorities should compulsorily make full disclosure of information as per Section 4(1)(b) of RTI Act, 2005 and for its non-compliance some penalty should be inflicted on that particular public authority.



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The DNA technology (Use & application) regulation bill, 2019: A critical appraisal

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Abstract

DNA fingerprinting is a technology that has been proved to be a boon for the administration of the Criminal Justice System. To have a uniform procedure for the use of DNA Technology 'The DNA Technology (Use & Application) Regulation Bill, 2019' was placed in the Lok Sabha. The main purpose of the Bill is to apprehend repeat offenders for heinous crimes, to develop stringent standards, etc. The proposed legislation will empower the criminal justice delivery system by enabling the application of DNA evidence, which is considered the gold standard in crime investigations. However, there are many ethical and legal issues surrounding the Bill. This paper is an attempt to analyse the provisions of the bill and the gaps in the proposed Bill.

Keywords: DNA bill, DNA profile, DNA technology, criminal investigation, crime scene

Introduction

DNA (Deoxyribonucleic Acid) Forensic Technology has changed the face of evidence collection in the Criminal Justice System. It has saved many innocent individuals and had brought numerous criminals to justice. Doing the unthinkable, and solving the earlier thought unsolvable cases across the globe, DNA Forensic Science's Advancement has revamped the Criminal Justice System throughout the globe. Though 100% accuracy is not claimed it is substantially used due to its proven efficacy. For example, "the amendment of Cr. P. C. by the Cr. P. C. (amendment) Act, 2005 has brought two new sections which authorize the investigating officer to collect a DNA sample from the body of the accused and the victim with the help of medical practitioner. These sections allow examination of a person accused of rape by a medical practitioner and the medical examination of the rape victim respectively.

In India, there have been numerous instances when many 'mysterious' cases have been solved with the help of this modern technology. But taking into consideration the potential risks of the use of this technology, one must not overlook the gravity of privacy infiltration while putting into action this technology. While DNA testing, the State asks the concerned individual for his/her most private information. Rather, one can debate that they ask for the information that is interlinked with the concerned individual's very existence.

Yet, the pros of this technology clearly outweigh its cons. Still, we simply cannot overlook the potential threats, ergo rises the need for a law to regulate DNA Forensic Science. The DNA Technology Regulation Bill was placed in the Lok Sabha in July 2019. The Bill was then referred to Parliamentary Standing Committee on Science and Technology. The Parliamentary Standing Committee on Science and Technology recently issued a report, which points out the possibility of misuse of the provisions mentioned in the Bill. For example, the committee pointed that, the DNAs can be used for caste or community based profiling, or this can be a serious encroachment upon the right to privacy. There also has been considerable criticism, voicing for

the required changes. Some of the criticised sections of the Bill are: the data isn't being protected; and the potential misuse of this data is a threat to the right to privacy. Some Members feel that the "crime scene index" is unnecessary and is not a required feature to solve crimes. Thus there are many ethical and legal issues surrounding the Bill. Nonetheless, nobody will deny the need for legislation. The proposed legislation will empower the criminal justice delivery system by enabling the application of DNA evidence, which is considered the gold standard in crime investigations. Therefore, the paper will first analyse the provisions of the bill and the gaps in the proposed Bill. Secondly, it will discuss the possible impacts of this Bill on vulnerable communities. The paper will also analyse the suggestions forwarded by the Parliamentary Standing Committee recently on 1st February 2021.

Glimpses of DNA Technology (Use & Application) Regulation Bill, 2019

The purpose of DNA Bill is "to provide for the regulation of use and application of Deoxyribonucleic Acid (DNA) technology for the purposes of establishing the identity of certain categories of persons including the victims, offenders, suspects, under trials, missing persons and unknown deceased persons and for matters connected therewith or incidental thereto." The statement of objects and reason of the Bill contains that, "DNA technology has the potential of wide application in the justice delivery systems. In criminal cases, it helps in the investigation of crimes through biological evidence including semen evidence in rape cases, blood evidence in murder cases, saliva evidence in the identification of the source of anonymous threat letters, etc. In civil cases, it helps in investigations relating to identification of victims of disasters like cyclones, air crash, etc. Several crimes are committed by repeat offenders, whose apprehension and conviction will be aided by a comparison of biological evidence at the scene of crime with DNA profiles stored in a DNA Data Bank. At the same time, the DNA analysis offers substantial

information, which if misused or improperly used, can cause harm to individuals or society.”

It had been claimed in the Bill that, sufficient efforts has been taken in balancing the use of DNA profiling in the administration of criminal and civil proceedings and the protection of the right to privacy. This is evident from the functions of the DNA Regulatory Board. Section 12 of the proposed Bill, talks about the functions of the Board. It states that the Board shall recommend methods and ensure optimum use of DNA Technology in the administration of Civil and Criminal Proceedings. It further requires that Board shall take into consideration all ethical, social and human rights issues regarding use of DNA. It further states that it shall be inconsistent with International guidelines provided by the UN and Its specialised agencies in respect of the protection of right to privacy, civil liberties by abiding by professional ethics in DNA testing while collecting and using DNA sample and DNA techniques. It also requires maintenance of confidentiality of DNA information and removal and destruction of obsolete or inaccurate DNA information from data Base.

Section 21 of the Bill proposes to obtain valid consent from the person who is arrested or whose bodily substances are required for criminal investigation, except for the offences for which punishment is death or imprisonment for a term exceeding seven years. It further says that, if the investigating officer wants the bodily substances of the person, who refuses to give, may apply to the Magistrate for obtaining bodily substances. And if the Magistrate feels it appropriate to prove or disprove the case may issue an order for taking of substances from such person. It means proper procedure has been laid down to prohibit any kind of abuse of process by the officers concerned.

Chapter V of the proposed Bill talks about the establishment of the National and Regional Data Bank. And further requires that all data stored in Regional Data Bank need to be shared with National Data Bank. It also categorically requires bifurcation of data in different indexes, like a crime scene index, under trials index, offender's index, etc. so that there shall be a proper use of this data. Bill prescribes the procedure for sharing of DNA Profiles with even Foreign Government of International organisation, so that if required DNA profile may be matched with DNA profile received from International authority to facilitate criminal investigations at International Level. At the same time precautions are being taken by prescribing the due procedure for providing services to International bodies. It also prescribes the procedure for removal or detention of data from the Data Bank. Like if the criminal case is closed down or there is a written request from the person whose DNA data has been stored unnecessarily needs to be removed.

Chapter VI of the proposed Bill also talks about the security and confidentiality of the data received by data bank. The chapter further through section 34 of the Bill talks about the security of information relating to DNA profiles by specifying the purposes for which DNA profiles can be used. It states that the information can be utilised for facilitating the identification of persons in criminal cases by the law enforcement and investigating agencies, judicial proceedings, by following the rules of admissibility of evidence, facilitating prosecution and adjudication of criminal cases, taking defence by an accused, investigations relating to civil disputes or other civil matters, however in these matters information will be provided only after

the approval of the court, or the concerned authority to this effect. The bill also prohibits access to information in DNA data banks to protect the right to privacy and prohibit the misuse of data. Section 35 of the Bill states that information relating to DNA profiles, DNA samples and any other records thereof, in the custody of DNA Bank or the Regional DNA Bank or a DNA Laboratory need to be secured and kept confidential. Communication or access of information is restricted to the purposes specified under the Bill. This indicates that efforts are taken to regulate the use of data forwarded to and in the custody of Data Bank. Section 45 and 46 of the Bills provides a penalty for unauthorised disclosure or collection of DNA information from DNA Data Bank. The penalty has also been prescribed for destruction, alteration, and contamination or tampering with biological evidence. The Bill also listed down the list of matters for DNA testing through the Schedule attached to it. Matters relating to offences under the Indian Penal Code where DNA testing is useful for investigation of offences, offences under special laws, like, under the Immoral Traffic (Prevention), Act, 1956, The Medical Termination of Pregnancy Act, 1971, The PCPNDT Act, 1994, Domestic Violence Act, 2005, The protection of Civil Liberties Act, 1955, etc. and in respect of Civil matters like Parental disputes, Issues relating to ART, Human organ Transplantation, to establish individual identity etc. It also includes within its sphere the cases of medical negligence, unidentified human remains, identification of abandoned or disputed children.

Critical Analysis of the Bill

As stated earlier the present Bill has been criticised from various angles, let's discuss few important criticisms of the Bill.

Need for efficient, trained Police officers and Forensic scientists

This Bill mainly focuses on the collection of DNA data and on DNA Profile creation, and its application in the field of Criminal Justice. It empowers the investigating agencies for the above mentioned functions. But the infrastructural revamp that is needed, such as but not limited to: proper training of police officers in this field and abundance of forensic experts. If such conditions aren't met properly, this technology will prove ineffective, will be abused, and will then lead to injustice.

Use of Data from Different indexes for the purposes for which it has not been stored

Section 25 of the proposed Bill allows the creation of DNA banks at National and State levels. It further talks about the different kinds of indexes relating to the crime scene, offenders, suspects, including under trials, and missing and deceased people. However, the author would like to argue that there should be a separate database for criminal matters and missing persons. Or situations may occur where a missing person's DNA is being used in criminal matters!

Targeting of individuals from poor socio economic backgrounds

History stands witness to the fact that the Indian Criminal Justice system often preys on the socio economically marginalised sections of society. And this process is sadly still in continuation, and it will continue hitherto. And according to the Bill, the DNA

data of these individuals (under trials, suspects etc.) will be collected and stored, ergo strengthening this vicious cycle of social oppression and marginalisation.

Data protection and right to privacy

It is also argued that, "Right to Privacy has been included under Right to Life and Personal liberty or Article 21 of the Indian Constitution, and Article 20(3) provides Right against Self-Incrimination which protects an accused person in criminal cases from providing evidences against himself or evidence which can make him guilty. But it has been held by the Supreme Court on several occasions that the Right to Life and Personal Liberty is not an absolute Right. In *Govind Singh v. State of Madhya Pradesh*, Supreme Court held that a fundamental right must be subject to the restriction based on compelling public interest. In another case *Kharak Singh v. State of U. P.*, Supreme Court held that the Right to privacy is not a guaranteed right under our Constitution. It is clear from various decisions which have been delivered by the Supreme Court from time to time that the Right to Life and Personal Liberty which has been guaranteed under our Indian Constitutions not an absolute one and can be subject to some restriction. And it is on this basis that the constitutionality of the laws affecting the Right to Life and Personal Liberty are upheld by the Supreme Court which includes a medical examination. And it is on the basis that various courts in the country have allowed DNA technology to be used in the investigation and in producing evidence. To make sure that modern technologies can be used effectively, there is an urgent need for specific legislation that would provide the guidelines regulating DNA testing in India." Yet, two major issues – privacy violations and capacity – have not been adequately tackled in the report. The Parliamentary Standing Committee report comprises two dissent notes, both of which highlight the risks of privacy violation caused by this Bill. It would be prudent, at the least, to wait for the Personal Data Protection Bill to be passed before debating this Bill.

Immoral Trafficking (Prevention) Act, 1956 and DNA Profiling

In one of the articles, author argues that "In the Indian law, sex work in India is conflated with trafficking and no agency has been given to those who voluntarily carry out sex work as a means of livelihood. Sections 7 and 8 of ITPA criminalize 'carrying on prostitution by any person' and 'soliciting in a public place for the purpose of prostitution'. On a day to day basis, women and trans persons who practice sex work suffer sexual abuse and extortion at the hands of police personnel. The stigma attached to sex work and the daily abuse by police personnel pushes HIV prevention programmes underground and further deprives sex workers of their right to health."

Analysis of Standing Committee Report

The Parliamentary Standing Committee on Science and Technology, Environment, Forests and Climate Change has recommended that the government assuage concerns raised over the DNA Technology (Use and Application) Regulation Bill, 2019, including over creation of a national databank of crime scene DNA profiles and fears of communities being targeted. While recognising the importance of DNA technology in criminal investigation, the committee, in its report tabled in Parliament

Wednesday, says, "The risk with a national databank of crime scene DNA profiles is that it will likely include virtually everyone since DNA is left at the 'crime scene' before and after the crime by several persons who may have nothing to do with the crime being investigated." It adds, "These fears (regarding the Bill) are not entirely unfounded (and) have to be recognized and addressed by the government and by Parliament as well... The Committee is of the strong opinion that an enabling ecosystem must be created soon to ensure that DNA profiling is done in a manner that is fully consistent with the letter and spirit of various Supreme Court judgments and with the Constitution." The committee further observed that "While conviction rates have remained abysmally low, the majority of those arrested as under trials belonged to just three communities: Dalits, Muslims and Adivasis. Therefore, the committee recommended the deletion of all references to inclusion of DNA data about non-convicts, including suspects and under trials which are proposed to be held in an indexed data bank."

One of the articles states that, "The National Crime Records Bureau (NCRB) reports that there are over 36,000 unidentified bodies each year. A DNA databank can be useful in identifying these bodies. The other use of a databank would be in identifying and tracking down repeat offenders. A 2016 NRCB report claims that, of all criminals arrested in India in 2015, around 8 percent were repeat offenders. It is important to note that DNA evidence cannot be inculpatory i.e., it cannot be used as evidence that someone committed a crime. At best, it can show that a person may have been at a scene where the crime took place, and add suspects to a case. The Committee report addresses both these issues, and recommends purpose limitation for the Bill and a mechanism that purges data post closure of a case." The article further suggests that "The issue with capacity can be addressed by increasing investment towards infrastructure. As per a note submitted by the Department of Biotechnology to the Committee, DNA testing is currently being done on an extremely limited scale in India, with approximately 30-40 DNA experts in 15-18 laboratories undertaking fewer than 3,000 cases a year. In other words, 2-3 percent of the total need for DNA profiling is being met. The creation of a databank for all criminal offenders will go hand-in-hand with the increase in demand for DNA profiling. With the capacity deficit that follows, it is likely that the implementation of this Bill stalls judicial proceedings that demand DNA profiles. This can be resolved by staggering the implementation of the databank – use it primarily to identified deceased remains in the beginning, and later for specific crimes, where DNA evidence may be a useful piece of the puzzle. If the databank truly helps in expediting justice, the provisions of the Bill can be expanded to other crimes."

The committee also observed that "DNA is not only used for the detection of crime. It is a unique identifier of the person, & if not recorded or retained with appropriate safeguards, may allow for the identification of a person and critical information about them. This not only raises concerns about the privacy of individual citizens but also national security." The committee further states that "Therefore it is recommended that urgent steps are taken to incorporate substantive safeguards about the collection, transfer, contamination and matching of DNA. Furthermore, it must be ensured that the revised draft of the Bill prevents excessive & undue delegation of the powers and functions of the Board, as well as the purpose for which DNA information may be used. The

manner in which data is retained, shared & controlled must be a matter that Parliament must be concerned with. Within the framework of the Puttuswamy judgment, it is not possible to envisage a situation where the use of such critical data is managed & controlled by a mere statutory body.”

Regarding the absence of the Data Protection Law, the committee stated that “Government continues to collect citizen’s private data is critical because it provides a mechanism for enforcement of rights, grievance redressal and independent oversight. When the data being collected is sensitive as DNA, it requires additional protections.” Therefore, the committee recommended that the bill should not be introduced till the enactment of Private data protection Bill. For effective privacy protection, an autonomous and independent remedial process is paramount. This can only be achieved when there is an independent regulator such as Data Protection Authority as envisaged in the Data protection Bill.

The committee further suggested that “The absence of procedural and substantive safeguards makes the proposed legislation suspect. It must be noted that the indefinite retention of DNA profiles of persons without a straightforward process for its removal is a violation of a person’s right to privacy. Under section 31 of the Bill, data is effectively retained indefinitely because it is preconditioned on police reports or court orders. The indefinite retention of personal information, condition on court orders, violates the principle of privacy and control over personal information. Therefore, the database is likely to be lopsided and consist of people who are presumed to be innocent in the eyes of the law. In such a case, there is no constitutional justification to include their data in a database or index. Furthermore, removal of a DNA profile of someone who is not an offender or suspect or undertrial from the database would require an application.”

Conclusion and Suggestions

DNA Profiling is undoubtedly proven forensic technology for criminal investigation, disaster victim identification, identification of missing persons and human remains. However, the use of DNA Profile involves various legal and ethical issues. Therefore, it needs to be regulated through a piece of legislation. The present Bill on DNA Profiling is indeed a welcome step. From the standing Committee Report and after reviewing the existing literature on the subject it is very clear that DNA Profiling may reveal sensitive information about individuals, skin, colour, behaviour, illness, health status, etc., which may result in abuse of this information to target individuals and their families using their genetic data. It was also rightly observed by the committee that, it may be misused for caste/ community based profiling. So the process may result in a serious violation of the right to privacy and human rights. The whole process of DNA profiling, handling and controlling is vulnerable to manipulation, mislabelling and contamination by accident or design. Therefore the Bill must ensure an independent regulator of data as suggested in the Data Privacy Bill. So the government may reconsider the Bill in the light of the recommendations forwarded by the Standing Committee and the recent judicial practices in respect of the right to privacy. This is as far as reality has fared. The gravity with which the two houses of Parliament will weigh the recommendations of the committee is as of now, unknown to us all. The spine of the proposed DNA Bill requires concrete spine reinforcement if it is to come through on the hoped and claimed judicial delivery while protecting the rights of the Indian citizens.

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THREATS POSING TO BIODIVERSITY AND TRADITIONAL KNOWLEDGE: IN THE CURRENT INTELLECTUAL PROPERTY LAW REGIME IN INDIA

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INTRODUCTION:

India is one of the mega-biodiversity countries with different combinations of ecosystems. The loss of biodiversity and commercialization of bio resources and existing traditional knowledge have been causing great concern especially when the Intellectual Property Rights (IPR) applied to claim monopoly. In order to comply with the TRIPs (Trade Related Intellectual Property Rights) and CBD (convention on Biological Diversity) India has passed Indian Patent (Second Amendment) Act, 2002 and the Biological Diversity Bill, 2002 respectively. According to this Amendment Act, 2002 the duration of the term of patent has been extended to 20 years for all product and process (under the existing Act of section 53 as well as those included in the present bill) patents. Now microorganisms will be patentable subject in India.

The negotiations at international and national level for the protection of traditional knowledge and for the conservation of biological resources are now carried out on various issues of implementing the Convention on Biological Diversity (CBD), 1992. India being a party to the Convention is the first to implement it by enacting the Biological Diversity Act, 2002. However, the Act still needs more clarifications on the issues of implementation like benefit sharing, bio piracy etc. Therefore, it becomes pertinent to develop ways and means of protecting and nurturing traditional knowledge thereby ensuring sustainable development compatible with the interests of the traditional knowledge holders. Hence this article attempts to analyses and clarifies some of these issues and concerns and thus, suggests few actions for the effective implementation of the Act.

MEANING OF BIODIVERSITY AND TRADITIONAL KNOWLEDGE:

Biodiversity is the sum total of living things, with their associated ecological processes, and specifically refers to the variability and variety within species as well as among the ecological processes that connect them. The food, fiber, fuel, fodder, shelter, health and other needs of the growing world population are dependent on various components of biodiversity. In simple words, biodiversity is the variety of life; the different plants animals and microorganisms, their genes and the ecosystems of which they are a part. More specifically biodiversity means processes that create and maintain variation. There is no single answer to what exactly biodiversity means. It can refer to genetic diversity, species diversity or the diversity of environments or habitats. Biodiversity has provided many benefits.

Some of these benefits come in the form of goods that can be directly valued because they provide some crops that can be extracted and sold. These goods include everything - from all the domesticated agricultural make the clothes that we wear.

Traditional knowledge refers to the information, knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of the cultural and spiritual identity as well as to maintain the genetic resources necessary for the continued survival of the community. It continues to play a key role in the lives of people in ensuring food security and healthcare

For instance, traditional medicines provide affordable healthcare to more than 80 percent of the population in the developing world. The commercial value of TK in biodiversity lies in the fact that it provides useful leads for scientific research, particularly in pharmaceutical and agricultural sectors, and sales based on TK have touched billions of dollars annually.

Some examples of traditional knowledge are:

Use of the Ayahuasca vine by Western Amazonian tribes to prepare various medicines.

1. Use of Hoodia cactus by the San people to starve off hunger.

2. Turmeric mainly used as an antiseptic.

3. Neem has a medicinal value.

However, the source countries or communities, mostly from the Southern region, are rarely provided with any benefits arising out of the sale of these end products. Moreover, through IPRs, particularly patents, commercial interests are usurping control and ownership of TK, which has usually stayed in the public domain.

THREATS POSING TO TRADITIONAL KNOWLEDGE AND BIODIVERSITY:

1) Loss of Biodiversity:

In India, a significant part of the land, forests and habitat of tribal people is being affected by human intervention like deforestation, logging, road construction and dam projects, mining, urbanization and conversion of forests to land for agricultural plantations. Many Traditional Knowledge based agricultural systems have also declined. The traditional lifestyles of the indigenous communities have been urbanized with the migration of large chunks of indigenous and tribal people from rural areas to the urban areas.

Further due to the greater impact of modernization and westernization, commercialization of agriculture with the introduction of export crops which has introduced hybridization and spread of market economies, etc. have made international community's take the initiatives to protect and conserve biodiversity and knowledge related to the use of biological resources. A major snag of the CBD and the resultant Biological Diversity Act is a shift in focus from the ecological and scientific value of biodiversity to its mere commercial value. In actual sense, protection as provided by the provisions of CBD requires promotion of 'wider application' of TK. Some describe protection in this context as 'a tool for facilitating access to TK' and some say that preservation of TK is not only a key component of the right to self-identification and a condition for the continuous existence of indigenous and traditional people; it forms a central element of the cultural heritage of humanity.

2) Bio piracy:

Bio piracy is a violation of the rights of traditional communities over their biological resources and related knowledge. Once an IPR is acquired by the bio pirate, the original holders of a biological resource or related traditional knowledge are barred from making any commercial use of the IPR-protected knowledge or resource. This could lead to a situation where, for example, a community is not allowed to sell an indigenous product that is covered by an IPR. The IPR-holder dictates the terms of use of the IPR protected resource/knowledge, which could mean that traditional communities who are the original holder could lose access to, or control over, their resource/knowledge. In the traditional system of India, there has not been a system of private ownership of knowledge in relation to the use of biodiversity such as farming, fishing, animal rearing, healing and use of medicinal plants. It occurs when patents are wrongly granted on innovations that are not novel, since the knowledge has already existed as TK in the public domain. It can also occur when patents are incorrectly granted, but are based on pre-existing TK. Such grants are often made because the adequate benefit-sharing mechanism was not created. Correct patents also granted because of low standards in domestic IPR laws, such as patents granted to minor modifications in existing TK is also another form of bio piracy.

Many pharmaceutical corporations are misappropriating TK and making huge profits in the form of what

is popularly known as bio piracy. In most of the cases, developing countries were the victims of the appropriations by the researchers, scholars and institutions from outside the community with neither of the community nor agreements to share benefits arising from the use of the knowledge, made to counter the western 'protectionist' measures in the form of IPR for the knowledge that was already in this part of the world.

The presence of regressive domestic IPR laws also contributes to bio-piracy, such as those in the US do not recognize non-published TK unless it is originated in that country .

Instances on Bio-piracy:

- a) An US patent was granted to the University of Mississippi for the use of turmeric in wound healing. Government of India challenged the patent on the basis of ancient texts and research papers of non-contemporary nature of the knowledge held in the public domain. The US Patent, now rejected, have prevented Indian companies from marketing turmeric-based products .
- b) The European Patent Office granted a patent to W. R. Grace and Company for its 'discovery' of fennel effects of Neem oil. The Government of India challenged the patent on the ground of its being India's TK. The patent was rejected, due to lack of novelty and inventive step .
- c) Banaba, a well-known herbal medicine, is widely used in the Philippines to treat many ailments. A nese company, Itoen KK, has been granted a patent for its anti-diabetic property, even though many tional healers know it and is well documented in national literature .

Several Pharmaceutical companies were carried research on range of marine organisms including lusks, sharks, male toad fish, sea horse, tuna fish, jelly fish, snails, seaweeds, cyano-bacteria, turtles, coral and sponges. The extensive ongoing research for harnessing marine life for pharmaceutical, nutritional various other research purposes led to an incredible coverage by intellectual property in the form of pa being filed worldwide .

3) Problems in Access and Benefit Sharing (ABS):

Previously, the free exchange of biological and genetic resources and traditional knowledge by the enous and local communities to the outside world was viewed differently, but when the issue of access benefit sharing is discussed at the Convention on Bio Diversity negotiations, we are able to address the and conditions for access to genetic resources and benefit-sharing. It provide that access to genetic resou should be on the basis of mutually agreed terms that provide fair and equitable sharing of the results search and development and the benefits of commercialization and utilization. It also calls for the fair equitable sharing of benefits derived from the use of TK. In respect of intellectual property, the Convention states, that access and transfer of genetic resources should be consistent with the adequate and effective tion of IPRs. In this back drop the difference between biological resources and genetic resources needs clearly understood.

There is underlying indistinctness between biological and genetic resources among the policy makers the communities. Traditionally biological resources such as seed, or any parts of plants or animals are commercialized which contain genes . This means accessing biological resources naturally accessible resources. How genetic resources can be accessed separately from biological resources is not clear. Access and legislation in the region.

In the emerging Access and Benefit Sharing laws there is no legal certainty on who owns the genetic sources and who should be the rightful person to legally sign the contract if resources are under their management. In the countries, there are separate legislations governing the ownership of land, private

common property, intellectual property and other forms of intangible properties defining definite and specific rights and duties. In the emerging ABS laws, it is not clear on how genetic resources and traditional knowledge under such situation can be owned or accessed? Access to a sample of biological resources and access to one such gene/genes contained within the biological resource for commercialization or research. The fundamental uncertainty seems to be related to the ownership over genetic resources. Furthermore, Benefit sharing provision of the laws has caused many controversies and is debated at the provincial, district, local community, indigenous people, marginalized people and the government. The issue that affects both the users and providers is the legal certainty in tracing the rightful owner of the resource when it comes to bio prospecting.

There are a number of questions that arises among communities such as; the sale of farm or forest products in the market and uncertainty during proceedings. Will the implementation of ABS regime prevent their routine business as they are dealing with the collection and sale of their bio resources? Will this process be accessible to their genetic resources in disguise? The above factors have aroused a sense of suspicion amongst the local communities on the ownership over genetic resources and potential benefits that they hope to reap from bio prospecting. Furthermore, the question of who can be identified as indigenous has become an important issue when it comes to the use of biological resources.

4. Loopholes in Biological Diversity Act, 2002 (BD)

The process of formulating BD Act started only after India becoming a signatory to the Convention on Biological Diversity in 1992. Even then it took a good 10 years for the Act to be notified. There is no denying that the efforts of government officials, NGOs and academicians have also contributed to highlighting and pressing for the need for the conservation of biodiversity. The Act had practically sanctioned IPRs on biodiversity by outlining a process for accepting applications, screening them and thereafter approving such claims.

A major snag of the CBD and the resultant Biological Diversity Act is a shift in focus from the ecological and scientific value of biodiversity to its mere commercial value. The Act is quite vague in its treatment of traditional and local knowledge, merely requiring the central government to "endeavor to respect and protect" such knowledge, especially in the Indian context is important enough to not be left to the discretion of the executive and to require a definitive statement of law. It completely obliterates common property arrangements whose importance and extent in the context of the management of biological resources is still immense. The Act centralizes property rights either in the hands of the state through sovereign appropriation or in the hands of private inventors through monopoly intellectual property rights. It does not, however, provide a framework for the rights of all other holders of biological resources and related knowledge. The consequence is that resources and knowledge that are not allocated to private entities through intellectual property rights or to the state, can be deemed freely available.

The National Biodiversity Authority, whose main objective is equitable sharing of benefits, even after several years of its establishment, is neither known to have delivered any benefit to the stakeholders of biodiversity in the country nor have contributed to the conservation of biodiversity.

Further, the BD Act differentiates between domestic companies and the MNCs, although the provisions of TRIPS demand that MNCs be treated at par with domestic companies. The Act may also adversely affect research, because the researchers from abroad may need approval of NBA and the domestic researchers may need to register with SSB for using the biological resources for research purposes. Further, the Act does not seem to have an overall riding effect on the existing laws on wildlife and forests, and it is not clear which law will prevail, in case of a dispute.

Recommendations to Protect and Preserve Traditional Knowledge and Bio Diversity:

The issues raised in this paper would lead to the following suggestions to be followed by the countries in negotiations on IPRs and Traditional Knowledge:-

1. There is no separate statute to give legal protection for Traditional Knowledge, so Indian Parliament should bring separate statute and define TK which is pertinent for Indian System.
2. There is no common protection worldwide, so WIPO should develop a universally acceptable (sui generis) protection systems or any other viable system.
3. The terms "public interest" and "sui generis" need to be clearly defined.
4. There is a strong need for protecting and promoting the traditional knowledge related to biodiversity. Government shall allocate a significant budget to facilitate the effective implementation of Biodiversity Act, 2002 to protect biodiversity.
5. National Biodiversity Authority needs more support from Government.
6. The countries should push forward for an effective dispute resolution mechanism for CBD and for WIPO also consider CBD as a relevant international regulation important in international trade.
7. All technologies emanating from the access and use of biological diversity must be environment friendly.
8. Government should incorporate traditional knowledge as part of the curriculum for schools, colleges, universities and research centre.

Conclusion:

The IPR issues relating to Traditional knowledge and Biodiversity are very complex particularly in event of transfer of biological material from India to foreigner. The Benefit sharing issues are even more complex, when the material belongs to the local communities. It is clear that industries, with increased support from governments, are quickly establishing control over plant genetic resources and associated knowledge through the use of IPRs. Overall, communities are increasingly losing control over their own plants and being increasingly exploited for their knowledge. As awareness amongst groups, communities and even governments increases, and as those affected become more organized, the tide has begun to turn. There is a lot of strategic work to be done among NGOs and people's movements in order to build a stronger force against the growing influence of trade and IPR over genetic resources and traditional knowledge in the globe each and everyone have to take an effort to conserve our Biological Resources and Traditional Knowledge of Indigenous communities.

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JUDICIAL RESPONSE TO MARITAL RAPE IN INDIA

Prof.Dr.Mrs.Hema Menon¹

“ A murderer destroys the physical frame of the victim, a rapist degrades and defiles the soul of a helpless female.”- Justice Arjit Pasayat.

An eighteen-year-old girl, meets a stranger twice, and she is told by her parents that she is to get married to him. This innocent young girl has dreams of care and companionship and a rosy romantic married life. These are shattered on the very first night of the marriage when she is subjected to verbal and sexual assault from the man who had vowed to love and protect her in the rituals of marriage. Every night, she faces a new ordeal, from being forced to mimic pornographic videos to forcibly having a candle or flashlight inserted into her vagina. If she complains to her family, they advise her to “try and adjust.” If she complains to the police, they rebuke her and tell her to be grateful that her husband is coming home to her instead of visiting a brothel. And when she tries to take her woes to the Supreme Court, they tell her that she is bringing a personal claim, not a public concern and as such, they cannot change the law for one person. This is the unfortunate reality for countless Indian women living among the culture of arranged marriages and remaining legally unprotected from the realities of marital rape.² Marriage is viewed as a sacrament under the Hindu personal laws and the wife is still viewed as subservient to the husband. It is assumed by the society that, marriage refers to the wife giving consent to all the “matrimonial obligations” including sexual intercourse.

The concept that institution of marriage is “sacrosanct” is propagated in the Indian society and is further enforced by the mainstream Indian cinema in its portrayal of the Indian Bahu. This however is a myth and is contrary to the reality of women’s position today. Though marital rape is the most common and repugnant form of masochism in Indian society, it is hidden behind the iron curtain of marriage. Not only that it is hidden under strict tight-lipped secrecy within families, society and unfortunately protected by the Government and the Judicial reluctance to interfere. Dogmatic social practices and legal norms in India mutually enforce the denial of women’s sexual agency and bodily integrity, which lie at the heart of women’s human rights. Rape is rape. Be it stranger rape, date rape or marital rape. The law does not treat marital rape as a crime. Even if it does, the issue of penalty remains lost in a cloud of legal uncertainty. The legal system must be forced to accept

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² *Night After night, the torture grew’: A survivor of marital rape speaks up*, DAILY OPINION (May 12, 2016), <https://www.dailyo.in/voices/women-marital-rape-sexual-harassment-abuse-arranged-marriage-divorce/story/1/14390.html> [https://perma.cc/RTM8-A9M8]; see Chhavi Sachdev, *Rape Is A Crime In India – But There Are Exceptions*, NPR (Apr. 13, 2016), <https://www.npr.org/sections/goatsandsoda/2016/04/13/473966857/rape-is-a-crime-in-india-with-one-exception> [https://perma.cc/6VSH-ANJR]; see also Vimi, *Marital Rape – My Husband Rapes Me Everyday!*, PINKDOMBLOG (Aug. 1, 2017), <http://pinkdomblog.com/marital-rape/> [https://perma.cc/CZP2-HP9W]

rape within marriage as a crime. Further, women themselves must break free of societal shackles and fight for justice. They must refuse to comply with the standards applied to them as the weaker sex.³

marital rape has both Physical and psychological effects

There is a common myth that rape by one's partner is a relatively insignificant which causes little trauma and a woman eventually gets adjusted to it. However, research indicates that marital rape often has severe and long-lasting consequences for women. The physical effects of marital rape may include injuries to private organs, lacerations, soreness, bruising, torn muscles, fatigue and vomiting. Women who have been battered and raped by their husbands may suffer other physical consequences including broken bones, black eyes, bloody noses, and knife wounds that occur during the sexual violence. Specific gynaecological consequences of marital rape include miscarriages, stillbirths, bladder infections, infertility and the potential contraction of sexually transmitted diseases including HIV.⁴

It is well established through extensive scientific research that women who are raped by their partners are suffer severe psychological consequences and become emotional recluses. Short-term effects of marital rape like anxiety, shock, intense fear, depression, suicidal ideation, and post-traumatic stress are common while the long-term effects like disordered eating, sleep problems, depression, problems in establishing trusting relationships, and increased negative feelings about themselves resulting in blaming themselves for these acts have serious repercussions on the health of the woman concerned. Psychological effects are likely to be long-lasting and sometimes scar a woman for life disabling her from normal humanly functions not to speak of cornering her into a hole from which she is never able to pull herself out.

India as a nation is based on the theory of equity, but it is appalling to notice that even now in the 21st century it has still not recognised the right of a woman to include marital intercourse as a component of equality. There is a clear absence of legal provisions regarding marital rape and therefore, the victims have the only resort of going to court. Courts have time and again applied various methods to identify marital rape and have given strict punishments but the lack of legal provisions ties their hands and they are bound by the letter of law. They cannot hence describe "forceful intercourse by a man upon his wife" as marital rape. At this juncture it is necessary to examine the law of Rape in India.

Section 375 of the Indian Penal Code defines "Rape",

Operative part of the said section is reproduced herein below: 375. Rape.—A man is said to commit "rape" if he—

- a. Penetrates his penis, to any extent, into the vagina, mouth, urethra or anus of a woman or makes her to do so with him or any other person; or
- b. inserts, to any extent, any object or a part of the body, not being the penis, into the vagina, the urethra or anus of a woman or makes her to do so with him or any other person; or
- c. manipulates any part of the body of a woman so as to cause penetration into the vagina, urethra, anus or any of body of such woman or makes her to do so with him or any other person; or
- d. applies his mouth to the vagina, anus, urethra of a woman or makes her to do so with him or any other person,

under the circumstances falling under any of the following seven descriptions:

Firstly,— Against her will.

Secondly, — Without her consent.

Thirdly, — With her consent, when her consent has been obtained by putting her or any person in whom she is interested, in fear of death or of hurt.

Fourthly, — With her consent, when the man knows that he is not her husband and that her consent is given because she believes that he is another man to whom she is or believes herself to be lawfully married.

Fifthly, — With her consent when, at the time of giving such consent, by reason of unsoundness of mind or intoxication or the administration by him personally or through another of any stupefying or unwholesome substance, she is unable to understand the nature and consequences of that to which she gives consent.

Sixthly, — with or without her consent, when she is under eighteen years of age

Seventhly, — When she is unable to communicate consent.

³ Marital Rape — Myth, Reality and Need for Criminalization

by Saurabh Mishra & Sarvesh Singh²(2003) PL WebJour 12 <https://www.ebc-india.com/lawyer/articles/645.htm>

⁴ Thornhill, R. & Palmer, C.T., *A Natural History of Rape — Biological Bases of Sexual Coercion* (1st Edn., MIT Press Cambridge Mass., 2000.

Explanation I—For the purposes of this section, "vagina" shall also include labia majora.

Explanation 2—Consent means an unequivocal voluntary agreement when the woman by words, gestures or any form of verbal or non-verbal communication, communicates willingness to participate in the specific sexual act:

Provided that a woman who does not physically resist to the act of penetration shall not by the reason only of that fact, be regarded as consenting to the sexual activity.

Exception 1—A medical procedure or intervention shall not constitute rape.

Exception 2—Sexual intercourse or sexual acts by a man with his own wife, the wife not being under fifteen years of age, is not rape.

Nationwide protests erupted as a result of the horrendous crime in the NIRBHAYA case and consequently, the former Chief Justice of India, Late J.S. Verma established a committee to amend and enhance laws against rape and sexual assault. Among other recommendations, the committee suggested that the marital rape exception should be repealed as it originates from the notions of women being the property of their husbands. Several changes came about from the Criminal Law Amendment Act, 2013. Many changes made under The Criminal Law Amendment Act, 2013 were necessary and substantive, but the Act failed to criminalize marital rape with the exception of Section 376A where sexual intercourse by a man with his wife who is living separately shall be punishable with imprisonment and liable for a fine and where the girl is under the age of fifteen.⁵

That Article 21 of the Indian Constitution, incorporates the right to live with human dignity and is a standout amongst the most fundamental components of the right to life which perceives the independence of a person. The Supreme Court has held in a catena of cases that the offense of rape abuses the right to life and the right to live with human dignity of the victim of the crime of rape

In *Bodhisattwa Gautam v. Subhra Chakraborty*⁶ the court held that rape is a crime against the basic human right and violation of the right to life enshrined in Article 21 of the Constitution and provided certain guidelines for awarding compensation to the rape victim. In the landmark case of *The Chairman, Railway Board v. Chandrima Das*⁷, the Hon'ble Court held that rape is not a mere matter of violation of an ordinary right of a person but the violation of Fundamental Rights which is involved. Rape is a crime not only against the person of a woman, it is a crime against the entire society. It is a crime against basic human rights and is violative of the victims most cherished right, namely, right to life which includes right to live with human dignity contained in Article 21.⁸

The turning point of the judicial stance against marital rape can be seen in the case of *Independent Thought vs Union Of India*,⁹ The Division bench opined that "The issue before us is limited but one of considerable public importance – whether sexual intercourse between a man and his wife being a girl between 15 and 18 years of age is rape? Exception 2 to Section 375 of the Indian Penal Code, 1860 (the IPC) answers this in the negative, but in our opinion sexual intercourse with a girl below 18 years of age is rape regardless of whether she is married or not. The exception carved out in the IPC creates an unnecessary and artificial distinction between a

⁵ Criminal Law (Amendment) Act, No. 13 of 2013, PEN. CODE § 375, Exception 2; *India: Reject New Sexual Violence Ordinance*, HUM. RTS. WATCH (Feb. 11, 2009, 9:30 PM), <https://www.hrw.org/news/2013/02/11/india-reject-new-sexual-violence-ordinance> .See also *The Gap in Marital Rape Law in India: Advocating for Criminalization and Social Change* by Krina Patel* *Fordham International Law Journal* ; *Volume 42, Issue 5 2019 Article 7* .

⁶ AIR 1996 SC 922

⁷ JT 2001 SC 426.

⁸ India: Law On Marital Rape – A Much Needed Reform In Our Legal System

<http://www.mondaq.com/india/x/691482/Crime/Law+On+Marital+Rape+A+Much+Needed+Reform+In+Our+Legal+System>

⁹ 2017 SCC Online SC 1222; (2017) 382 SCC (India).

married girl child and an unmarried girl child and has no rational nexus with any objective sought to be achieved. The artificial distinction is arbitrary and discriminatory and is definitely not in the best interest of the girl child. The artificial distinction is contrary to the philosophy and ethos of Article 15(3) of the Constitution as well as contrary to Article 21 of the Constitution and our commitments in international conventions. It is also contrary to the philosophy behind some statutes, the bodily integrity of the girl child and her reproductive choice. What is equally dreadful, the artificial distinction turns a blind eye to trafficking of the girl child and surely each one of us must discourage trafficking which is such a horrible social evil.” However it cannot be overlooked that the court was clear “we have not at all dealt with the larger issue of marital rape of adult women since that issue was not raised before us by the petitioner or the intervener.”

In the case of *State of Maharashtra v. Madhkar Narayan*¹⁰ the Supreme Court has held that every woman is entitled to her sexual privacy and it is not open to for any and every person to violate her privacy as and whenever he wished. The court explicitly laid down that Even a woman of easy virtue is entitled to privacy and no one can invade her privacy as and when he likes. So also it is not open to any and every person to violate her person as and when he wishes. She is entitled to protect her person if there is an attempt to violate it against her wish. She is equally entitled to the protection of law.

Clause (2) of S.357 is violative of Article 14 and Article 21 of the Indian Constitution -

Article 14 of the Indian Constitution ensures that “[t]he State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India.” Although the Constitution guarantees equality to all, Indian criminal law discriminates against female victims who have been raped by their own husbands.

At the time the IPC was drafted in the 1860s, a married woman was not considered an independent legal entity. Rather, she was considered to be the chattel of her husband. As a result, she did not possess many of the rights now guaranteed to her as an independent legal entity, including the right to file a complaint against another under her own identity. Exception 2, which essentially exempts actions perpetrated by husbands against their wives from being considered acts of “rape,” is largely influenced by and derived from this already existing doctrine of merging the woman’s identity with that of her husband.

The roots of this doctrine can be traced to British colonial rule in the Victorian era. merged the identities of husband and wife under the “Doctrine of Coverture.”

But times have changed. Indian law now affords husbands and wives separate and independent legal identities, and much jurisprudence in the modern era is explicitly concerned with the protection of women. This concern is evident in the plethora of statutes intended to protect women from violence and harassment that have been passed since the turn of the century, including “The Protection of Women from Domestic Violence Act” and the “Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act.”¹¹

Article 21 states that “no person shall be denied of his life and personal liberty except according to the procedure established by law.” In recent years, courts have begun to acknowledge a right to abstain from sexual intercourse and to be free of unwanted sexual activity enshrined in these broader rights to life and personal liberty. In *The State of Karnataka v. Krishnappa*,¹² the Supreme Court held that “sexual violence apart from being a dehumanizing act is an unlawful intrusion of the right to privacy and sanctity of a female.” In the same judgment, it held that non-consensual sexual intercourse amounts to physical and sexual violence. Later, in *Suchita Srivastava v. Chandigarh Administration*,¹³ the Supreme Court equated the right to make choices related to sexual activity with rights to personal liberty, privacy, dignity, and bodily integrity under Article 21 of the Constitution.

Most recently, the Supreme Court has explicitly recognized in Article 21 a right to make choices regarding intimate relations. In *Justice K.S. Puttuswamy (Retd.) v. Union of India*,¹⁴ the Supreme Court recognized the right to privacy as a fundamental right of all citizens and held that the right to privacy includes “decisional privacy reflected by an ability to make intimate decisions primarily consisting of one’s sexual or procreative nature and decisions in respect of intimate relations.” Forced sexual cohabitation is a violation of that fundamental right. The above rulings do not distinguish between the rights of married women and unmarried

¹⁰ AIR1991SC207

¹¹ Marital Rape: A Non-criminalized Crime in India

<https://harvardhrj.com › 2019/01 › marital-rape-a-non-criminalized-crime->

JANUARY 1, 2019 By: Sarthak Makkar

¹² 2000) 4 SCC 75 (India).

¹³ 2008) 14 SCR 989 (India)

¹⁴ 2017) AIR 2017 SC 4161 (India).

women and there is no contrary ruling stating that the individual's right to a privacy is lost by marital association. Thus, the Supreme Court has recognized the right to abstain from sexual activity for all women, irrespective of their marital status, as a fundamental right conferred by Article 21 of the Constitution.¹⁵

A bench of Acting Chief Justice Gita Mittal and C Hari Shankar said RIT Foundation versus Union of India that in a relationship like marriage, both man and woman have a right to say 'no' to physical relations. The Delhi High Court, while hearing petitions on making marital rape an offence, has observed that physical force is not necessary for rape as a man could bring her wife under financial pressure to force her for sex. It also held that marriage doesn't mean that wife is always consenting for physical relation with her husband. "Force is not a pre-condition of rape. If a man puts his wife under financial constraint and says he will not give her money for household and kids expenses, unless she indulges in sex with him and she has to do it under this threat. Later, she filed a rape case against the husband, what will happen," the court said. The court rejected the arguments put forward by the NGO Men Welfare Trust which said that in a spousal relationship, use of force or threat of force are important elements to constitute as rape. The bench also observed that marriage gives the right to both man and woman to say no to physical relations. "Marriage does not mean that the woman is all time ready, willing and consenting (for establishing physical relations). The man will have to prove that she was a consenting party," the bench observed.¹⁶

The Government has taken a reactionary stand that condemning marital assault would destabilize the establishment of marriage" and could turn into a simple device to "hassle spouses" is disheartening, disillusioning and regressive to say the least. This patriarchal approach and misogynistic attitude of the government puts the position of women of our country in peril in the very so called safe havens of her own home.

"Marital rape is not a husband's privilege, but rather a violent act and an injustice that must be criminalized," said a Gujarat High Court judge presiding over a case involving a woman who'd accused her husband of sexually assaulting her. He repeatedly forced sex on her, she said. He also subjected her to "mental and physical torture," the woman claimed. Pardiwala.J. ruled that the husband could not be charged with rape in this case since the Indian Penal Code explicitly states that "sexual acts by a man with his own wife ... is not rape." The judge said the man could be charged with sexual harassment and spousal cruelty (which carry lesser punishments than rape). As he delivered his decision, however, Paridwala.J. expressed dismay at the limitations of the law. He advocated for the criminalization of marital rape, saying that outlawing non-consensual sex in a marriage is the "first necessary step in teaching societies that dehumanized treatment of women will not be tolerated." "Marital rape is not a husband's privilege, but rather a violent act and an injustice that must be criminalized," he added.¹⁷

Allowing spousal rape and not criminalizing it, effectively means that human dignity can be accorded lesser value in the case of a woman when she is married. It is inherently wrong and problematic to assure dignity and sexual autonomy to the husband and not the wife. The argument that the act cannot be criminalized to protect the stability of the institution of marriage is base and illogical. Only when two partners are given equal rights over their bodies can the "sacred" institution of marriage thrive.¹⁸

In the aftermath of the Delhi gang rape of 2012, the Justice Verma Committee was set up which recommends the need to remove the exception of marital rape and these were its recommendations

¹⁵ Ibid <https://harvardhrj.com › 2019/01 › marital-rape-a-non-criminalized-crime->
JANUARY 1, 2019 By: *Sarthak Makkar*

¹⁶ Read more at:

[//economictimes.indiatimes.com/articleshow/65034722.cms?from=mdr&utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst](http://economictimes.indiatimes.com/articleshow/65034722.cms?from=mdr&utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst)

¹⁷ WORLD NEWS 05/04/2018 8:29 AM IST

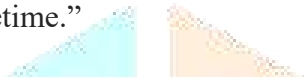
<https://www.huffingtonpost.in/entry/india-marital-rape-gujarat-high-court>

¹⁸ India's Marital Rape Problem; *Aahna Rajan*; 14 FEB 2019

<https://intpolicydigest.org/2019/02/14/india-s-marital-rape-problem/>

1. The exception for marital rape is to be removed.
2. The law ought to specify that:
 - (a). A marital or other relationship between the perpetrator and victim is not a valid defence against the crimes of rape or sexual violation;
 - (b). The relationship between the accused and the complainant is not relevant to the inquiry into whether the complainant consented to the sexual activity;
 - (c). The fact that the accused and victim are married or in another intimate relationship may not be regarded as a mitigating factor justifying lower sentences for rape.

It is pertinent to note that in India, one in every ten women was reported facing sexual violence by their husbands during their lifetime. “35.1% of the sample women reported to surveyors in 2005-06 (on which the UN Women 2011 figures for India are based) that they have experienced physical violence by their intimate partners in their lifetime.”



CONCLUSION :

The issue of violence against women is a sensitive issue as it brings the worms out of the cupboards of homes that have tightly closed door. It is therefore important to address the safety of women and prevention of violence against women from their very homes. It is a basic need to make the home a safe place in its true sense for women. This in turn entails an open and clear understanding and discussion about the issue of respect to women and their dignity within home which has to stand in stark contrast to the patriarchal notion of considering her as a chattel. Till the time society, government, legislature and judiciary all do not come together to take this initiative treating women as individuals within or without marriage, the situation of women is not going to improve. It There has to be an equal partnership. In a marriage it is of utmost necessity to include and imbibe the concept of consent within marital relation. Acknowledging the fact that women have a right over their bodies is essential to promote the concept of consensual sex. Challenging the deeply ingrained stereotypes, widespread entrenched mentality and questioning the biased values may provide the solutions to the issue of discrimination and violence within marriage.¹⁹

If the true essence of Equality of women at all levels is to be achieved in our country, the patriarchal and dogmatic attitude of oppressing system, women needs to be replaced by an inclusive structure that promotes women's equality to the level where women have sexual autonomy, right to self-determination in the home and outside, protection of their self-dignity and physical integrity. An amendment of the criminal laws should be so structured as to give a significant and symbolic recognition of women's equality and right to their bodily integrity. Once this step is effectively taken it will bring about a proper realisation of women's right of equality. All this can be achieved only when it is accompanied by a paradigm shift in the social mind set followed by a political transformations that brings about economic and social independence for women.

¹⁹ The Social And Legal Paradox Relating to Marital Rape in India: Addressing Structural Inequalities
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विद्येविना मति गेली, मतीविना नीति गेली
नीतिविना गति गेली, गतिविना वित्त गेले
वित्तविना शूद्र स्वचले, इतके अनर्थ एका अविद्येने केले

-महात्मा ज्योतीराव फुले

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प्रा. डॉ. मोहन दे. वानखडे

सहयोगी प्राध्यापक, पाली प्राकृत विभाग प्रमुख,
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सारांश:-

पाली भाषा ही प्राचीन भारतीय भाषा आहे. ही भाषा प्रामुख्याने मगध प्रदेशामध्ये व मगध प्रदेशाला लागून असलेल्या वेगवेगळ्या प्रदेशांमध्ये बोलली जाणारी लोकभाषा होती, म्हणून या भाषेला 'मागधी भाषा' सुद्धा म्हटल्या जात असे. या भाषेमध्येच तथागत बुद्धांनी आपल्या धम्माचा उपदेश दिला. या उपदेशांचे तथागतांच्या महापरिनिर्वाणानंतर वेगवेगळ्या संगतींच्या माध्यमातून संगायन, संकलन करून ते तीन पिटकांमध्ये संग्रहीत करण्यात आले. या साहित्या मधील उपदेशांना 'बुद्धवचन' सुद्धा म्हणतात.^१ 'पा पालेति रक्खती, ति पालि' जी या भाषेतील बुद्ध वचनांचे रक्षण करते, पालन करते ती पाली अशा पद्धतीने या भाषेला पाली म्हणून संबोधल्या गेले आणि त्यामधील साहित्याला 'पाली साहित्य'. या साहित्याचा उदय किंवा तथागत बुद्धाचा उदय ही भारतातील समाजासाठी अतिशय महत्त्वपूर्ण घटना होती. कारण यामुळे विषमतामूलक समाजव्यवस्थेला आव्हान देऊन समतामूलक मूल्यांचे बीजारोपण झाले. कोणत्याही परिवर्तनवादी, जीवनवादी, समतावादी व सामाजिक न्यायवादी, तत्त्वज्ञानाची विचारांची निर्मिती अंधातरी किंवा आपोआप होत नाही, त्याला काही ना काही कारण असावे लागते. बुद्ध धम्माच्या निर्मितीला सुद्धा बुद्धपूर्व काळातील वैदिक धर्माचे एकंदर यज्ञ-याग वादी कर्मकांड वादी व सामाजिक विषमतावादी तत्त्वज्ञान तर कारणीभूत आहेच परंतु त्याचबरोबर वैदिक धर्माला

तत्त्वज्ञानाला न मानणारे जे अवैदिक तत्त्वज्ञान होते ते सुद्धा बहुजन समाजाच्या दुःखाचे, शोषणाचे, उत्पीडनाचे व वैचारिक दाख्रियाचे समाधान करणारे नव्हते. तथागत बुद्धाच्या आधीचे जे धर्म आणि तत्त्वज्ञान तत्कालीन समाजात प्रचलित होते, त्यांचा समाजवास्तवाशी फारसा संबंध होता असे आढळून येत नाही. पुरोहितवाद, धार्मिक कर्मकांड, धार्मिक अंधश्रद्धा आणि समाजामध्ये फार मोठ्या प्रमाणात जी विषमता, हिंसा, अशांती पसरलेली होती तिला थांबविणे, समाजामध्ये नवचैतन्य निर्माण करणे ही त्या समाजाची अतिशय मूलभूत अशी आवश्यकता होती आणि याकरिताच तथागत बुद्धांनी आपल्या धम्माची स्थापना केली.^२ या धम्माचा मुख्य उद्देश व्यक्तीला, समाजाला दुःखमुक्त करणे हा होता, म्हणून पालीसाहित्यामध्ये जेवढ्या संकल्पना आल्या आहेत, त्या सर्व संकल्पना व्यक्तीला, समाजाला दुःखमुक्त करून त्याला सुगतीला नेणा-या आहेत. कोणत्याही व्यक्तीला, समाजाला दुःख मुक्त होण्याकरिता कुठल्याही धार्मिक कर्मकांडाचा, रूढी परंपरेचा, अंधश्रद्धेचा आधार घेण्याची आवश्यकता नाही. हे तथागतांनी आपल्या उपदेशातून पटवून दिले. तथागतांनी स्वतः पहिल्यांदा आपला बौद्धिक विकास केला, उच्चतम स्वरूपाचे ज्ञान प्राप्त केले, विशुद्ध आचरण केले, आपल्या मनातील सर्व विकारांचा नाश करून संपूर्ण मानवतेप्रती प्रेम, दया, करूणा, मैत्री, मुदिता, उपेक्षा, मानवी संवेदनशीलता निर्माण करून लोकांना दुःख मुक्तीच्या मार्गाचा संदेश दिला. म्हणून पाली साहित्य हे सामाजिक प्रेरणेचे साहित्य ठरले आहे, जे विशुद्ध समाज निर्मितीसाठी महत्त्वपूर्ण आहे.

की वर्ड्स:- पाली भाषा, तथागत, समता, बहुजन समाज, अंधश्रद्धा, दुःखमुक्ती
प्रस्तावना:-

पाली साहित्याचे स्थान हे भारतीय इतिहासा मध्ये अतिशय महत्त्वपूर्ण आहे. कारण या साहित्या मध्ये तथागत बुद्धाचा मानवतावादी विचार समाविष्ट आहे. पाली साहित्य हे कथा-कथन, नाटक, कादंबरी, पौराणिक कथा, राजा-राणीच्या कथा यासारखे साहित्य नाही, तर या साहित्याचा उद्देश दुःखमुक्त समाज निर्माण करणे हा आहे. पाली साहित्याची निर्मिती ही

अतिशय उच्च प्रतीची प्रज्ञा, बुद्धी, विवेक व मानवते बद्दल प्रेम असणा—या लोकांनी निर्माण केलेली आहे. बुद्धांच्या वेळी ब्राम्हण—पुरोहित वर्ग राजसत्तेने, धर्म सत्तेने लाभान्वित होता. राजसत्ता संचालनामध्ये त्यांचे विशेष स्थान होते. त्यामुळे बहुसंख्य लोक आपल्या हक्क आणि अधिकारांपासून वंचित होते. बहुजन समाजाला शिक्षणाचा अधिकार नाकारण्यात आला होता. शिक्षणाचा अभावामुळे समाजामध्ये चिकित्सक वृत्तीच नव्हती, जे काही घडत होते ते निमूटपणे सहन करीत आपल्या नशिबालाच दोष देत होते. तत्कालीन समाज व्यवस्थेमध्ये, जन्माला महत्त्व होते. त्याच्या कर्माला नव्हते. म्हणून तथागत बुद्धांनी या व्यवस्थेला आव्हान दिले आणि म्हटले— 'न जच्चा वसलो होती, न जच्चा होति ब्राह्मणो। कम्मनो वसलो होति, कम्मनो होति ब्रह्मणो।'² अर्थात जन्माने कोणीही वसल किंवा ब्राह्मण होत नाही तर तो त्याच्या कर्मानेच वसल किंवा ब्राह्मण होतो. तथागतांच्या या मानवतावादी विचाराने संपूर्ण चातुर्वर्ण्यव्यवस्था खिळखिळी झाली. मानवी समाज जीवनामध्ये चेतना निर्माण झाली, समाजमन जागृत व्हायला लागले.

बुद्धाचा उपदेश हा मानव जीवनाच्या कल्याणासाठी आहे. हा उपदेश मानवाला आतून बदलवितो, त्याच्या मनाला बदलवितो, अंतर्मनाचा विचार करायला लावतो. व्यक्तीचा स्वभाव आहे की, तो इतरांकडे दोषात्मक बोट दाखवितो परंतु स्वतःच्या अंतर्मनात कधीच डोकावून पाहत नाही. मनुष्य काहीही करत असो, त्याविषयी सर्वात आधी त्याच्यामनामध्ये त्या प्रकारच्या विचार येतो. विचार कुशल सुद्धा असतात आणि अकुशल सुद्धा असतात. मन मनन करून चिंतन करून चांगल्या विचाराला ग्रहण करण्याचा सल्ला देतो. मनाच्या सल्ल्याशिवाय कोणीच काम करू शकत नाही, म्हणून मनुष्याच्या शरीरामध्ये मनाची प्रधानता आहे आणि म्हणूनच तथागत बुद्ध मनुष्याच्या मनालाच सम्यक बनविण्यासाठी, बनविण्याची शिकवण देतात. कारण जे काही उत्पन्न होते ते मनातूनच उत्पन्न होते, याची शिकवण आपल्याला धम्मापदामधील यमकवगातून सुद्धा मिळते, ते म्हणजे— 'मन सर्व प्रवृत्तींचे अग्रणी आहे, जे काही उत्पन्न होते ते मनातूनच

उत्पन्न होते. जर का तुम्ही वाईट विचार केला किंवा वाईट कर्म केले तर दुःख तुमचा पाठलाग तसेच करते ज्याप्रमाणे बैलगाऱ्याच्या पायांचा बैलबंडीचे चाके करतात. याच्या उलट दुसरी गाथा त्यामध्ये आहे, ती म्हणजे जर का तुम्ही चांगला विचार केला किंवा चांगले कर्म केले तर सुख तुमचे अनुसरण तसेच करते ज्याप्रमाणे कधीही सोबत न सोडणारी सावली.³ ह्या दोन्ही गाथा मनुष्याचा मानसशास्त्रीय दृष्टिकोन स्पष्ट करणा—या आहेत. म्हणजेच असेही म्हणता येईल की, मनुष्य हा स्वताच स्वताचा भाग्यविधाता आहे, त्याच्या भाग्यविधाता इतर कोणीही होऊ शकत नाही. म्हणूनच तथागत म्हणतात—'अत्तहि अत्तनो नाथो, कोहि नाथो परोसिया। अत्तनाव सुदन्तेन नाथं लभति दुल्लभं।'⁴ अर्थात मनुष्य स्वताच स्वताचा मालक आहे, त्याचा दुसरा कोणीही मालक होऊ शकत नाही. त्याने जर स्वताला संयमित केले तर तो दुर्लभ यशाला प्राप्त होतो.

तथागत बुद्धांच्या तत्त्वज्ञानामध्ये संयमित जीवनाला फार महत्त्व दिले गेले आहे. संयमित जीवनच एक प्रकारचे सम्यक जीवन आहे. संयमित जीवनाने मनुष्य भोगवाद, धनवाद, पूंजीवाद यापासून दूर राहू शकतो. त्याचप्रमाणे मनुष्य वाईट विकृती पासून दूर राहू शकतो. भोगवादाचा, धनवादाचा कुठेच अंत नाही, मनुष्य याचा गुलाम बनतो, ज्यामुळे मनुष्य विनाशाच्या दिशेने पाऊल टाकतो. महानाम शाक्याला उपदेश देताना तथागत बुद्ध म्हणतात— 'महानाम! सील सदाचाराने युक्त, इंद्रियांमध्ये संयत, भोजनाची उचित मात्रा जाणणारा इत्यादींनी युक्त सुखाने विहार करून सुगतीला प्राप्त होऊ शकतो,⁵ म्हणून मनाला जर संयमित बनविले तर तृष्णेपासून सुद्धा मुक्ती मिळू शकते कारण धम्मचक्र प्रवर्तन सुत्तामध्ये सांगितल्याप्रमाणे तृष्णा ह्या दुःखाला कारणीभूत आहेत. यां तृष्णांना संयमित मनच आवर घालू शकते.

बौद्ध जीवन मार्गामध्ये सील सदाचाराला विशेष महत्त्व आहे. एवढेच नव्हे तर या जीवन मार्गाची आधारशिला आहे. हिंसा, चोरी, व्यभिचार, असत्य, क्रोध, लोभ, व्देश, मोह, मत्सर इत्यादी प्रमाद हे मनुष्याचा पावित्र्याला नष्ट करतात. प्रमादी व्यक्ती हा

लोभामुळे, अज्ञानामुळे, अविद्येमुळे, स्वार्थासाठी एक-दुस-यासोबत दुर्व्यवहार करतो. वैयक्तिक स्वार्थाने तो वशीभूत झालेला असतो. आपला प्रत्येक व्यवहार व कृती तो परिपूर्ण समजतो. स्वतःला ज्ञानी व अधिकारी समजूनच तो आपले दैनंदिन व्यवहार करित असतो. मला जे समजते ते इतरांना समजू शकत नाही म्हणून इतर सगळे मूर्ख व मीच एकटा समजूतदार, ज्ञानी अशी त्याची वागण्यातील दर्पोक्ती दिसून येत असते. त्याचा हा प्रमादी स्वभाव अप्रत्यक्ष रुपाने समाजालाही त्रस्त करित असतो. इतरांनी आपले दास व्हावे, इतरांनी नित्य आपल्या आज्ञेत राहावे, याकरिता तो आपल्या प्रभावी स्वभावाचा वापर करतो. जो प्रतिसाद देत नाही, त्याला तो आपल्या प्रमादाचा प्रसाद देतो. मनुष्याच्या प्रमादी स्वभावाच्या विषारी वेली समाजामध्ये वाढत असतात. अशा विषारी वेलींच्या जो संपर्कात येतो त्याचे संपूर्ण जीवनच विषमय बनण्याची शक्यता असते. याचाच अर्थ असा की, मनुष्य अकुशल विकारांपासून दूर राहून सुखी समाधानी जीवन जगू इच्छित असला तरी समाजामधील वाईट प्रवृत्ती त्याचा जीवनात अडथळे निर्माण करित असतात. म्हणून वैयक्तिक स्तरावर प्रत्येकाने सील सदाचारचे जर पालन केले तरच सामाजिक स्तरावर शांतता प्रस्थापित होऊन समाज दुःखमुक्त होऊ शकतो. म्हणूनच तथागत बुद्धांनी आपल्या अनुयायांना काया, वाचा व मनाने कुशल कर्म करण्याचा उपदेश दिला. तथागतांनी सांगितलेल्या एका गाथेच्या पालनातूनच आपण तथागतांचा धम्म आचरणात आणू शकतो, ती गाथा म्हणजे—'सब्व पापस्स अकरणं कुसलस्स उपसम्पदा। सचित्त परियोदपणं एतं बुद्धानसासनं॥' अर्थात कोणत्याही प्रकारचे पाप करू नका, कुशल कर्मांचे संपादन करा आणि चित्ताला परिशुद्ध करा हेच तथागतांचे अनुशासन आहे. कोणतीही वाईट कृत्ये जेव्हा मनुष्य करतो तेव्हा सर्वप्रथम त्याच्या मनात असा विचार चालू होतो. त्यानंतर तो मनातील विचार वाचेच्या माध्यमातून समोरच्या व्यक्तीवर तो व्यक्त होतो आणि त्यानंतर वादावादी वाढल्यानंतर कायेचा म्हणजेच शरीराद्वारे मारपीट करून दोषेही त्या प्रकरणांमध्ये गुंतून राहून दुर्गीतिला पोहोचतात, म्हणून मनात सर्वांच्या विषयी चांगली भावना ठेवली पाहिजे

कारण वैराने वैर शांत होत नाही तर ते अवैरानेच वैर शांत होते.' म्हणून व्यक्तींनी राग, लोभ, द्वेष, मोह, माया, मत्सर या सर्व विकारांपासून दूर राहून मनाला संयमित केले पाहिजे. कारण हे सर्व विकार मनुष्याचे सर्वात मोठे शत्रू आहेत. हे शत्रू जेवढे आपले नुकसान करतात तेवढे नुकसान इतर कोणते शत्रू करित नाहीत. पराभव सुत्तामध्ये तथागत बुद्धांनी पराभवगामी अवगुणांचे वर्णन केले आहे, ते याप्रमाणे आहे— 'धर्म द्वेष, सज्जनाशी घृणा, असत्य धर्मांचे आचरण करणे, मेहनत न करणे, आळस आणि क्रोध न करणे, आई-वडिलांची सेवा न करणे, खोटे बोलून फसविणे, घमेंड करणे, बंधू-बांधवांचा अपमान करणे, पर स्त्रीगमन करणे, मद्यपी आणि जुआरी असणे इत्यादी वाईट कामे केल्यामुळे मनुष्याचे आधीसुद्धा पतन होत होते, आजसुद्धा होत आहे आणि भविष्यात सुद्धा होणार आहे.' म्हणून ज्यांना सुख-शांती पाहिजे त्यांनी या दुर्गुणांपासून दूर राहिले पाहिजे.

मनुष्य अंतराला किलोमीटरने मोजतो, जडवस्तूला किलोग्राममध्ये तोलतो परंतु काय जगामध्ये अशी कोणती मोजपट्टी आहे, ज्याने मनुष्य दिन-प्रतिदिनच्या जीवनस्तराला मोजू शकेल, ज्यामुळे असा अनुभव करू शकेल की, कालच्या तुलनेत आज त्याने उन्नती केली आहे की अवनती. निश्चितच जर अशी कोणती मोजपट्टी असेल तर ती आहे बुद्धांचे पंचसील. सील म्हणजे सदाचार, योग्य आचरण करण्याची पद्धत, शिस्तीचे पालन करून नैतिक विकास साधणे: आपण एक सज्जन माणूस म्हणून कोणालाही उपद्रव न देता जीवन जगले पाहिजे.' बुद्धांचा अनुयायी, उपासक या पाच सीलांचे पालन करण्याचा प्रयत्न करतो आणि दुःखमुक्त, सुखी जीवनमार्गावर वाटचाल करतो.

तथागत बुद्धांचा धम्म हा दुःखमुक्तीचा धम्म आहे. मानवी समाज हा दुःखापासून मुक्त कसा होईल; तो सुखशांतीने जीवन कसे जगेल, याचाच विचार तथागत बुद्धांनी केलेला आहे. इतर निरर्थक प्रश्नांना त्यांनी महत्त्व दिले नाही. मज्झिम निकायाच्या चुलमालुक्य सुत्तामध्ये तथागत बुद्धांनी मालुक्यपुत्ताला उपदेश देताना म्हटले आहे की, हे मालुक्यपुत! हे

दुःख आहे, हे दुःखाचे कारण आहे, हा दुःख निरोध आहे आणि हा दुःख निरोधाचा मार्ग आहे हे मी सांगितले आहे.^{११} जग शाश्वत आहे की अशाश्वत या सारख्या निरर्थक प्रश्नांच्या भरीस मी पडलो नाही. कारण हा वादविवाद दुःखमुक्तीसाठी सहाय्यक होत नाही. परंतु ही चार आर्य सत्य जीवनाला स्थैर्य आणणारी आहेत, पापांचा निरोध करणारी आहेत, निब्बानाचा लाभ करून देणारी आहेत.

संसारमध्ये दुःख आहे हे पहिले श्रेष्ठ सत्य आहे, इथे सर्व काही नश्वर आहे, अनित्य आहे. ज्या इंद्रियजन्य सुखांवर आपण अभिमान करतो, ते सुद्धा नश्वर आहे. दुःखाचे वेगवेगळे रूप असू शकतात परंतु प्रत्येक दुःखाच्या उत्पत्तीमध्ये कोणते ना कोणते कारण अवश्य असते. या कारणांना दुःख समुदयाच्या रूपामध्ये जाणल्या जाते. दुःखाचा अनुभव आपल्या सर्वांना होतो, परंतु आपण दुःखाच्या कारणांचा शोध करित नाही. दुःखांच्या कारणांची एक श्रृंखला आहे, ज्याला पाली साहित्यामध्ये 'पटिच्चसमुत्पाद' म्हटल्या जाते. याचा अर्थ आहे, 'एकाच्या असल्याने दुस-याची उत्पत्ती.' अविद्या, संस्कार, विज्ञान, नामरूप इत्यादी दुःखाच्या उत्पत्तीचे कारणे आहेत.^{१२} या दुःखाचा नाश संभव आहे. याला दुःख निरोधाच्या रूपामध्ये तिसरे श्रेष्ठ सत्य म्हटले आहे. हे श्रेष्ठ सत्य आपले दुःख नेहमीसाठी दूर होऊ शकते, याचा विश्वास आपल्याला देते, म्हणून तृष्णा जर नष्ट केल्या तर आपले दुःख नष्ट होऊ शकते. तथागत बुद्धासमोर मोठा प्रश्न होता की, दुःखाला कसे दूर करता येईल? त्यांनी दहा अव्याकृत प्रश्नांना उत्तर देणे आवश्यक समजले नाही कारण की, दुःख निरोधा सोबत त्यांचा कोणताच संबंध नाही. मानवी जीवनासाठी दुःख निरोधाची उपयोगिता आहे म्हणून तथागत बुद्धांनी या सत्याचा साक्षात्कार केला की, दुःखाचा निरोध होऊ शकतो. मग ह्या दुःखाचा निरोध कसा होऊ शकतो? यासाठीच चवथ्या श्रेष्ठ सत्याचे प्रतिपादन केले, ज्याला दुःखनिरोध गामिनी पटिपदा म्हटल्या जाते.^{१३} जो 'अरियो अट्ठडिको मग्गो' म्हणून ओळखला जातो.

जे श्रेष्ठ सत्यांना जाणून अष्टांगिक मार्गावर चालतात ते दुःखाचा आत्यांतिक निरोध करण्यामध्ये

सक्षम होतात. यासाठी सर्वात प्रथम आपल्याला आपल्या आंतरिक दृष्टीला सम्यक बनविले पाहिजे, तेव्हाच जे संकल्प बनू शकतील ते सम्यक असतील; संकल्प सम्यक असतील तर वाचा तसेच आचरण सम्यक होईल, त्यामुळे आजीविकेचे साधन सम्यक होईल. आजीविका सम्यक असेल तर वासना व कुप्रवृत्तीचा नाश तसेच सम्यक विचारांच्या अभिवृत्तीमुळे सम्यक प्रयत्न होऊ शकतील, ज्याला अष्टांगिक मार्गामध्ये सम्यक व्यायाम म्हटल्या जाते. सम्यक व्यायाम असल्यावर सतत जागरूकता संभव आहे, ज्याला सम्यक स्मृती म्हटल्या गेले आहे. सम्यक स्मृती सम्यक समाधीमध्ये सहाय्यक आहे. सम्यक समाधी ही पूर्ण शांती, पूर्ण विराग व पूर्ण निरोधाची अवस्था आहे, शुद्धचित्त एकाग्रतेची अवस्था आहे.

मानवी जीवनाचा प्रवास हा सुख आणि दुःखाच्या दिवस-रात्र याप्रमाणे आहे. या पृथ्वीवर असा कोणीही नसेल ज्याला सुखच सुख मिळाले असेल, त्याच्या जीवनात दुःखाचा लवलेशही नसेल. तसेच असा कोणीही नसेल ज्याच्या जीवनात दुःखच दुःख असेल, सुखाचा किंचित ही लवलेश नसेल. सुख आणि दुःख मागे-पुढे एक दुस-यांशी जोडलेले असतात. तथागत बुद्धाचे तत्त्वज्ञानच आपल्याला सांगते की, कोणतीच गोष्ट ही नित्य नाही तर अनित्य आहे, परिवर्तनीय आहे. 'सब्बे संखार अनिच्चा' ति, यदा पञ्जाय पस्सति। अथ निब्बिन्दति दुक्खे, एस मग्गो विमुद्धिया।।^{१४} अर्थात सर्वच संस्कार अनित्य आहेत, असे जेव्हा आपण प्रज्ञेने पाहतो तेव्हा सर्वच दुःखातून निर्वेदास प्राप्त होतो, हाच विशुद्धीचा मार्ग आहे. अविद्यादी प्रतित्य समुत्पादाच्या श्रृंखलेमुळेच दुःखाची उत्पत्ती होते. परंतु अविद्यादी प्रतित्य समुत्पादाची श्रृंखला जर नष्ट झाली तर दुःख सुद्धा नष्ट होते, हाच तथागत बुद्धाच्या दुःखमुक्तीचा सिद्धांत आहे.

उपसंहारः तथागत बुद्धांनी 'दुःख आहे' हे सांगून ते थांबले नाहीत तर त्यांनी त्यावर उपाय काय आहे? बहुजन कल्याणाचा-हिताचा मार्ग काय आहे? बहुजन मुक्तीचा मार्ग काय आहे? एकंदरच मानवी समाजाच्या मुक्तीचा मार्ग काय आहे? उत्थानाचा मार्ग काय आहे? हे सुद्धा तथागतांनी सांगितले. म्हणूनच पाली साहित्याला

कुठेही अलौकिक साहित्य, अलौकिक वाणी, ईश्वर वाणी अशाप्रकारे म्हटल्या गेले नाही. संपूर्ण पाली साहित्याला बुद्धवचन, बुद्धवाणी या नावानेच संबोधल्या जाते आणि पाली भाषेला जन भाषा, लोक भाषा, तथागत बुद्धाच्या वचनांची भाषा या नावाने संबोधल्या जाते.

म्हणून आपल्याला असे म्हणता येईल की, उच्चतम नैतिकतेचे निदर्शन जेवढे पाली साहित्यात मिळते तेवढे इतर कुठेच पाहायला मिळत नाही. संपूर्ण साहित्यात दुःखमुक्ती देणारा केवळ आणि केवळ मानवतावादच दिसतो. मनुष्यच नाही तर संपूर्ण प्राणिमात्रांचा तथागतांनी प्रतिपादित केलेला विचार या साहित्यात दिसतो. जसा मी आहे तसे सर्व प्राणी आहेत. मला जर कोणी त्रास दिला तर मला वेदना होतात तसेच इतरांनाही होतात, म्हणून कुणालाही त्रास देऊ नये, म्हणूनच तथागत म्हणतात—'सब्बे तस्सन्ति दण्डस्स, सब्बेसं जीवितं पियं। अत्तानं उपमं कत्वा, न हनेय्य, न घातेय्य॥' अर्थात सर्वच शिष्येला घाबरतात, सर्वानाच आपले जीवन प्रिय आहे. म्हणून सर्वाना आपल्यासारखे समजून कुणालाही मारू नये, कोणाचाही घात करू नये. हा तथागतांचा विचार अंमलात आणला तर मनुष्य समाज दुःखमुक्त जीवन जगू शकतो.

उपरोक्त अध्ययनावरून हे स्पष्ट होते की, तथागतांनी संपूर्ण प्राणिमात्रांवर प्रेम करण्याची शिकवण दिली. तृष्णारहित, संयमित जीवन जगण्याची शिकवण दिली आहे. व्यक्तीचे व्यक्तिमत्व प्रज्ञेने, सीलाने, करुणेने युक्त असावे. जीवनाची सार्थकता यामध्येच आहे की, मनुष्याने सर्वप्रथम आपले आचरण शुद्ध ठेवावे. प्रत्येक प्राण्याप्रती प्रेम आणि मैत्रीभावना जोपासावी. हाच तथागत बुद्धांच्या धम्माचा दुःखमुक्तीचा मार्ग आहे.

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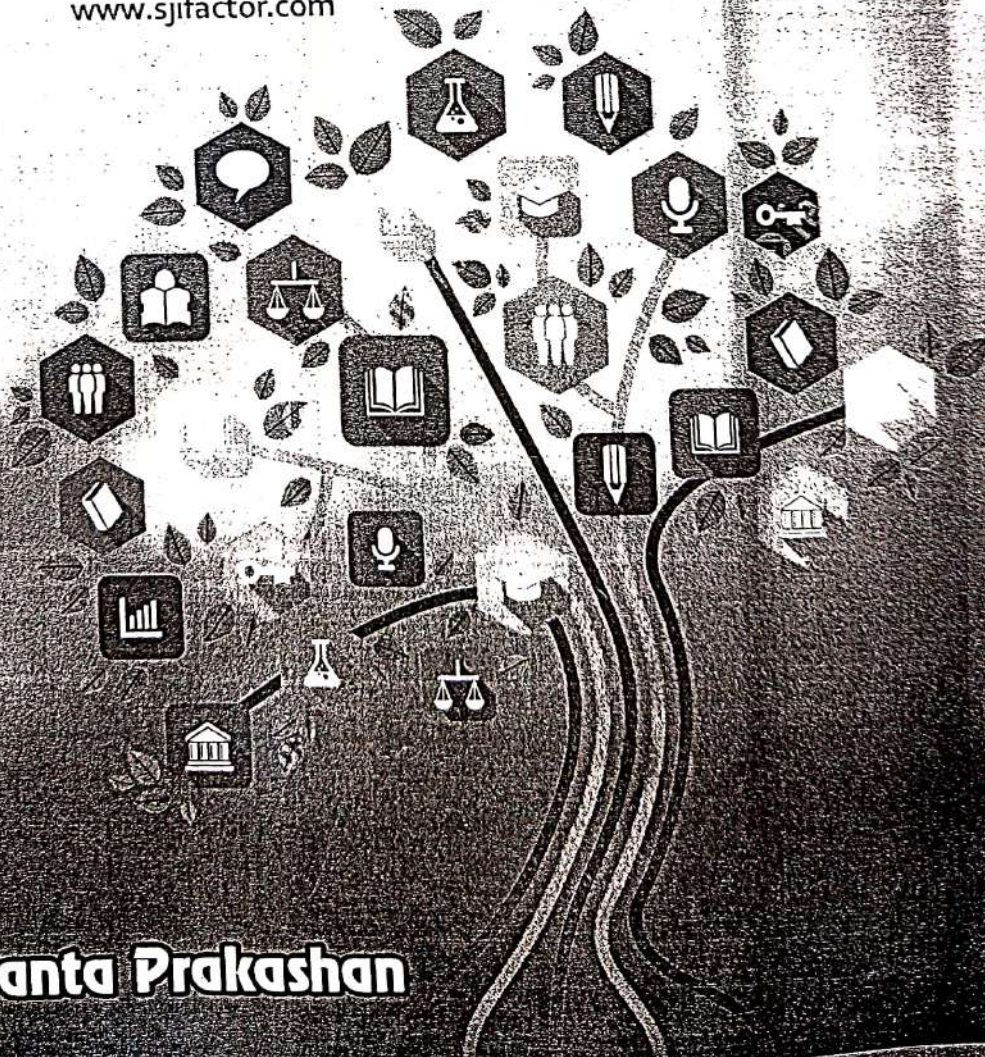
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सारांश

बुद्धपूर्व समाजाची स्थिती बंदिस्त स्वरूपाची होती. त्यावेळी भारतीय समाज वर्णामध्ये, जातीमध्ये बंदिस्त होता. प्रत्येकाला आपल्या वर्ण आणि जातीच्या सीमेबाहेर जाण्याची परवानगी नव्हती. बहुजन समाजातील मनुष्याचे कोणतेच मूल्य नव्हते. व्यक्तीची ओळख त्याच्या कर्मावरून, गुणावरून नव्हे तर त्याच्या वर्णावरून, जातीवरून होत होती. तत्कालीन समाज पूर्णपणे चातुर्वर्ण्य व्यवस्थेतील पहिला वर्ण असलेल्या ब्राह्मण पुरोहितांची नियंत्रित होता. समाजव्यवस्था सुद्धा ब्राह्मण केंद्रित होती. त्यांचा शब्द अंतिम आणि प्रमाण मानला जात होता. संपूर्ण बहुजन समाजाला विचार करण्याचा अधिकार नव्हता. तत्कालीन समाजामध्ये शूद्र आणि स्त्रियांचा सामाजिक दर्जा हा अतिशय हीन समजल्या जायचा. या वर्गाची स्थिती मुक्या प्राण्याप्रमाणे होती, एखाद्या गुलामाप्रमाणे होती. संपूर्ण मानवी चिंतन जणू थांबून गेले होते. बुद्धपूर्व चिंतन एक प्रकारे व्यक्ती भोवती फिरत होते, ज्याला बहुजन समाजाच्या समस्यांशी काहीच देणे घेणे नव्हते. धर्मशास्त्रांच्या नावावर आणि ही धर्मग्रंथ अपौरुषिय सांगून, ईश्वराची भीती दाखवून या संपूर्ण बहुजन समाजाला भ्रमित करण्यात आले होते.

सिद्धार्थ गौतमाचे मन हे लहानपणापासूनच समाजातील दुःख पाहून दुःखी होत असे. याची जाणीव आपल्याला त्यांच्या लहानपणातील उदाहरणावरून येते. एकदा सिद्धार्थ गौतम आपल्या मित्रांसोबत शेतात गेले होते. शेतात दास काम करीत होते. त्यांच्या अंगावर पुरेसे कपडे नव्हते, अतिशय कडक उन्हामुळे त्यांचे शरीर हे काळे पडले होते. त्यांना पाहून सिद्धार्थाने आपल्या मित्राला विचारले, 'हे काय आहे?' उत्तर मिळाले, 'हे दास आहेत आणि दासांसोबत अशाच प्रकारचा व्यवहार केल्या जातो. तेव्हा सिद्धार्थ तन्मयतेने म्हणाला, 'एका मनुष्याने दुस-या मनुष्याचे शोषण करावे, काय याला योग्य म्हणता येईल?' मजूराने मेहनत करावी आणि मालकांनी त्यावर मौज करावी हे कसे ठीक होऊ शकते? सांगण्याचे तात्पर्य असे की, सिद्धार्थ गौतमाचे मन हे सुरुवातीपासूनच करुणामय होते, त्यामुळेच त्यांनी नंतर शाक्य संघाचा सभासद बनल्यानंतर युद्धजन्य परिस्थिती निर्माण झाल्यावर त्याला विरोध केला आणि सांगितले युद्धाने प्रश्न सोडविता येत नाहीत, तर एका युद्धाने दुस-या युद्धाची बीजे रोवली जातात. परंतु सिद्धार्थ गौतमाच्या विरोधाला न जुमानता सेनापतीने युद्धाची घोषणा केली आणि सिद्धार्थ गौतमासमोर तीन पर्याय ठेवण्यात आले. एक तर युद्धामध्ये सहभागी व्हा, दुसरे युद्धमध्ये सहभागी होत नसला तर आई-वडिलांची संपत्ती जप्त करून त्यांच्यावर सामाजिक बहिष्कार टाकल्या जाईल आणि तिसरे म्हणजे देश सोडून जावे लागेल.¹ यापैकी तथागतांनी देश त्यागाचा निर्णय मान्य केला आणि अशा प्रकारे त्यांना कुठल्याही समाजावर अन्याय होऊ नये, यासाठी त्यांनी सुरुवातीपासूनच आपल्या सामाजिक कार्याला सुरुवात केली होती. तत्कालीन समाजामध्ये जी असमानता होती, जातीद्वेष, आर्थिक, धार्मिक आणि सामाजिक शोषण होते, त्याला त्यांनी चांगल्या प्रकारे जानले होते. यज्ञामध्ये पशुपक्षी

यांची तर हिंसा होत होतीच परंतु नरबळी सुद्धा दिल्या जात होता. म्हणून तथागत बुद्धांनी वैदिकांच्या या यज्ञ संस्थेला विरोध केला होता. तसेच विषमता मूलक जाती व्यवस्थेला विरोध करून त्या व्यवस्थेलाच त्यांनी आव्हान दिले की, 'जन्माने कोणीही ब्राह्मण किंवा वसल होत नाही तर तो त्यांच्या कर्मानेच ब्राह्मण किंवा वसल होतो.'² या सर्व अमानवीय व्यवस्थेला विरोध करणारे तथागत बुद्ध हे पहिले समाजसुधारक ठरतात, म्हणून त्यांच्या या कार्यातून समाजाला प्रेरणा मिळून तो सम्यक आचरण करू शकतो, असा निष्कर्ष या शोधनिबंधातून करण्यात आला आहे.

की-वर्षः- वर्ण, जाती, शूद्र, शाक्यसंघ, युद्ध, यज्ञ, तथागत बुद्ध

प्रस्तावना

इसवी सन पूर्व सहाव्या शतकात शाक्य परिवारामध्ये सिद्धार्थ गौतमाचा जन्म झाला. शाक्य गणराज्याची राजधानी कपिलवस्तू होती. सिद्धार्थ गौतमाने वयाच्या एकोणतिसाव्या वर्षी सांसारिक जीवनाचा त्याग केला आणि ते सत्याच्या शोधासाठी निघाले. जेव्हा ते घरून निघाले, तेव्हा त्यांच्यासमोर अनेक प्रश्न होते. ते आपल्या काळातील समाजापासून, समाज व्यवस्थेपासून आणि सामाजिक, सांस्कृतिक, धार्मिक आणि दार्शनिक मान्यता पासून संतुष्ट नव्हते, याचे प्रमाण आपल्याला पाली साहित्यामध्ये उपलब्ध होतात.

तथागत बुद्धाची शिकवण मनुष्य केंद्रित आहे, मनुष्याशी संबंधित आहे आणि मनुष्यासाठीच आहे. त्यांच्या शिकवणीचा मुख्य उद्देश आहे, मनुष्य जीवन सुंदर आणि सुखी बनविणे, मनुष्याला सर्वप्रकारच्या संकटापासून, दुःखापासून मुक्त करणे. म्हणून बुद्धांच्या शिकवणुकीची मूळ प्रेरणा आहे की, मनुष्याच्या आंतरिक प्रेरणेला जागविणे. तथागत बुद्धाने मानव समाजाला हा उपदेश दिला आहे की, 'अत्त दीपो भवो' अर्थात स्वयंप्रकाशित व्हा, स्वतःचा दीप स्वता व्हा. मनुष्याचे जीवन सुखी समाधानी व्हावे म्हणून तथागतांनी समाजाला दोन टोकांचा त्याग करायला सांगितले. मनुष्याच्या जीवनामध्ये भोगाचे अति होणे सुद्धा विनाशाचे कारण आहे आणि अतिशय दारिद्र, गरीबी, निर्धनता सुद्धा विनाशाचे कारण होते. ज्याप्रमाणे त्यांनी भोगवादाचे समर्थन केले नाही, त्याचप्रमाणे त्यांनी कधीही भयंकर दारिद्र, गरीबी, निर्धनता यांचे सुद्धा समर्थन केले नाही. अर्थात मनुष्याने दारिद्र, गरीबी, निर्धनता यापासून मुक्त होण्याचे सम्यक प्रयत्न केले पाहिजे. त्याचप्रमाणे धनवान व्यक्तीने सुद्धा आपल्या धनाचा उपयोग भोगविलासामध्ये लिप्त होऊन राहण्यासाठी करू नये, कारण यामुळे त्याचा विनाशच होतो. म्हणून तथागत बुद्ध म्हणाले की, 'समाजाने या दोन टोकांचे सेवन करू नये तर मध्यम मार्गाचा अवलंब करावा.'³

तथागत बुद्धांच्या तत्त्वज्ञानामध्ये संयमित जीवनाला अतिशय महत्त्व दिल्या गेले आहे. संयमित जीवनच सम्यक जीवन आहे. तथागत बुद्धांनी हे तत्त्व भिक्खू-भिक्खूणींसाठी सुद्धा सांगितले आणि सर्व लोकांसाठी सुद्धा सांगितले. संयमित जीवनामुळे मनुष्य भोगवादापासून, वाईट कृती पासून वाचू शकतो. कारण भोगवादाचा कुठेच अंत नाही, मनुष्य धनाचा गुलाम बनतो, ज्यामुळे मनुष्य विनाशाकडे वाटचाल करतो, म्हणून तथागत बुद्धांच्या उपदेशामध्ये संयमित जीवनाला फारच महत्त्व दिल्या गेले आहे. समाजामध्ये संयमित जीवनाचे मूल्य रुजवावित. यादृष्टीने तथागतांनी समाजाचे प्रबोधन केलेले आहे. यावर आधारित सेख सुत्तामध्ये तथागत बुद्धांनी जो उपदेश दिला आहे, तो महत्त्वपूर्ण आहे. महानाम शाक्याला उपदेश देताना तथागत बुद्ध म्हणतात, 'हे महानाम! शील सदाचाराने युक्त, इंद्रियांमध्ये संयत, भोजनाची मात्र जाणारा याच जीवनामध्ये सुखाने विहार करतो.'⁴ याप्रकारे तथागत बुद्धांनी संयमित जीवनाविषयी उपदेश दिलेला आहे.

तथागत बुद्धांनी मिथ्या आजीविका त्यागण्याविषयी आणि सम्यक आजीविका करण्याविषयी ही उपदेश दिला आहे. जो व्यवसाय किंवा रोजगार इतरांना त्रासदायक असेल, दुःख देणारे असेल असे व्यवसाय किंवा रोजगार करू नये. मझिम निकायाच्या समणमण्डिक सुत्तामध्ये मिथ्या आजिविकेला तथागत बुद्धाने अकुशल कर्म म्हणून त्यापासून अलिप्त राहण्याविषयी म्हटल्या गेले आहे.⁵ या सुत्ता मुळे सुकर्म काय आहेत? सुकर्मी पुरुष कोणाला म्हटले पाहिजे? या गोष्टीला सुद्धा स्पष्ट केल्या गेले आहे. सेवितव्व असेवितव्व सुत्तामध्ये तथागत बुद्धांनी सेवनिय व असेवनिय गोष्टींची व्याख्या केलेली आहे. ज्यामध्ये हिंसक होणे, मारपीटमध्ये लागून राहणे, सर्व प्राण्यांप्रती निर्दयी होणे, चोरी करणे, दारू पिणे इत्यादींना वाईट कर्म म्हटल्या गेले आहे आणि यापासून अलिप्त होण्याला कुशल कर्म म्हटल्या गेले आहे.

तथागत बुद्धांनी कुटदन्त ब्राह्मणाच्या हिंसामय यज्ञाची निंदा केली आणि त्यांनी 'महाविजित जातक' सांगून अहिंसामय कार्याला उचित सांगितले. महाविजित जातकात सांगितले गेले की, देश संकटाने ग्रस्त आहे, उत्पीडन भोगत आहे, ग्राम घातक (लुटणारे) दिसून येतात, वाटमारी करणारे दिसून येतात. अशा संकटग्रस्त देशात आपण बळीवर आधारित यज्ञ करण्याचे योजले आहे. अर्थात आपण या देशाचे अहितकारी आहात, विनाशकारी आहात, कदाचित आपला विचार असेल की, आपण या लूटमार करणा-यांचा उत्पादाला पूर्णपणे पिटाळून लावू परंतु यामुळे या लुटारूंना पूर्णपणे उखडून टाकल्या जाऊ शकत नाही, कारण की मृत्यूपासून वाचून राहिले, जिवीत राहिले तर ते नंतर राजाच्या जनपदाला त्रास देतील. म्हणून या उत्पादापासून राज्याला तेव्हाच वाचविल्या जाऊ शकते आणि समस्येला तेव्हाच समूळ नष्ट केल्या जाऊ शकते, जेव्हा हे राजन! आपल्या जनपदामध्ये जो कोणी शेती, पशुपालन करण्यामध्ये उत्साहित आहे, त्यांना आपण बीज आणि भोजनाची मदत करा, व्यापार करणा-यांना व्यापारामध्ये मदत करा, घनाची सहायता करा, जे राज्याची नोकरी करण्यामध्ये उत्साह ठेवतात, त्यांना आपण भत्ता वेतन द्या,⁶ याप्रकारे ते लोक आपल्या कामामध्ये लागून राहतील आणि राज्याच्या जनपदाला त्रास देणार नाहीत. त्यामुळे देशामध्ये घनाची उत्पत्ती होईल, धन आणि धान्याचे उत्पादन वाढेल, जनपद पीडेपासून, उत्पादापासून मुक्त होईल, दुःखापासून मुक्त होईल आणि लोक सुद्धा आपल्या मुलांना वाचवीत खुल्या घरातून विहार करतील. राजाने तसेच केले आणि राज्याला महा धनराशी प्राप्त झाली. जनपद संकटापासून मुक्त झाले. चारही बाजूने खुशी उत्पन्न झाली.⁷ इथे तथागत बुद्धांनी जनकल्याणकारी राज्यालाच चांगले राज्य म्हटले आहे. तथागत बुद्ध यज्ञाला विनाशाचे पीडेचे, अहिताचे, दुःखाचे कारण मानीत होते, ही गोष्ट या सुत्ता वरून स्पष्ट होते. या प्रकारे तथागत बुद्धांनी यज्ञामध्ये धन-संपत्तीच्या विनाशाचा विरोध करीत कल्याणकारी राज्याची कल्पना व्यक्त केली आहे.

याचाच अर्थ असा की, तथागत बुद्धांनी कुशल कर्मांना नाकारून, कुशल कर्मांना, नैतिक कर्मांना प्राधान्य दिले आहे. कारण व्यक्तीचा समाजाचा विकास हा अंधश्रद्धेतून, कर्मकांडातून होऊ शकत नाही तर तो त्याच्या सम्यक कर्मातून, कुशल कर्मातूनच होऊ शकतो हा उपदेश समाज हितासाठी तथागतांनी समाजाला दिला आहे. या सर्व उपदेशांचा केंद्रबिंदू नैतिकता आहे. नैतिकता एक सामाजिक संकल्प आहे. म्हणून डॉ. बाबासाहेब आंबेडकर यांनी म्हटले आहे की, 'एखाद्या पर्वतावरील गुफे मध्ये बसलेल्या एकांतसेवेसाठी नैतिकतेची काही आवश्यकता नाही, त्याच्यासाठी नैतिकता अप्रासांगिक आहे. कारण की स्वता एकट्याच्या संदर्भात नैतिकतेची ना आवश्यकता आहे, ना ते संभव आहे. नैतिकता नेहमी एकापेक्षा जास्त मनुष्यांच्या संदर्भात संभव आहे.'⁸ म्हणूनच डॉ. बाबासाहेब आंबेडकर

आपल्या 'बुद्धा अँड हिज धम्मा' या ग्रंथात याविषयी म्हणतात कि, 'नीती म्हणजेच धम्म आणि धम्म म्हणजेच नीती.'⁹ इतर धर्मांमध्ये जे स्थान ईश्वराला आहे ते स्थान बौद्ध धम्मात नीतीला आहे, नैतिकतेला आहे. व्यक्तीचा सामाजिक दर्जा उंचावण्यासाठी व्यक्तीचे नैतिक आचरण हे कुशल असले पाहिजे. काया, वाचा व मनाने व्यक्तीने कुशल कर्म केले पाहिजे. असा उपदेश तथागत बुद्ध समाजाचे प्रबोधन करताना देतात.¹⁰

सीलाचे महत्त्व सांगतांना तथागतांनी म्हटले आहे की शीलवान पुरुष सर्व दिशांना सुभाषित करतो जेव्हा की चंदन, कमळ, तगर इत्यादींचा सुगंध हवेच्या विरुद्ध दिशेने जात नाही आणि तो अल्पमात्र आहे परंतु सील सदाचारी व्यक्तीचा गंध हा सगळीकडेच दळवळतो आणि तो उत्तम असतो.¹⁰ म्हणजेच तथागतांनी येथे व्यक्तीच्या जन्माला महत्त्व दिलेले नसून त्याच्या कर्माला महत्त्व दिलेले आहे. तथागत बुद्ध यांचे स्पष्ट मत होते की, 'केवळ ब्राह्मण मातेच्या पोटी जन्म घेतल्याने कोणी ब्राह्मण होत नाही, अशा व्यक्तीला मी ब्राह्मण मानत नाही.'¹¹ तथागतांच्या नुसार ब्राह्मण होण्यासाठी अनेक गुण आहेत, ज्यांचे वर्णन धम्मपदाच्या ब्राह्मण वर्गामध्ये आलेले आहे. जो तृष्णारहित आहे, कामनारहित आहे, निर्भय, ध्यानी, अनासक्त, चित्त, मलरहित, तेजस्वी, पापाचे, अकुशल कर्माचे दमन करणारा, समतेचे आचरण करणारा, अहिंसक, संयत, क्रोधरहित, प्रज्ञावान, मेघावी, मार्ग-अमार्गाचा ज्ञाता, राग, द्वेष आणि रहित, अचौर्य, शोकरहित इत्यादी अनेक प्रकारच्या गुणांनी संपन्न असावा, त्यालाच ब्राह्मण म्हटल्या जाते. जटांनी, गोत्रांनी आणि जन्माने मनुष्य ब्राह्मण होत नाही.¹²

पाली साहित्याच्या अस्सलायन सुत्तामध्ये तथागत बुद्ध आणि अस्सलायन ब्राह्मण यांच्यामधील संवाद आलेला आहे, ज्यावरून आपल्याला मनुष्याचे श्रेष्ठत्व हे त्याच्या कर्मावरून असल्याचे स्पष्ट होते. तथागत बुद्धांनी अस्सलायन ब्राह्मण आणि त्याच्यासोबत असलेल्यांना त्यांच्या मतांचे खंडन करून अनेक उदाहरणांद्वारे सर्व वर्णांच्या समानतेला सांगितले.¹³ तथागतांनी त्या लोकांना संबोधित करताना म्हटले आहे की, सर्व वर्ण, वैररहित, द्वेषरहित, मैत्री, चित्ताची भावना करू शकतात. तथागतांनी लाकडापासून आग उत्पन्न करण्याचे उदाहरण देत सांगितले की, 'ज्या प्रकारे सर्व वर्ण लाकडापासून आग उत्पन्न करण्यामध्ये समर्थ आहेत, त्याच प्रकारे इतर कर्मांना करण्यामध्ये सुद्धा सर्व वर्ण समान रूपाने समर्थ आहेत.'

तथागत बुद्धांनी गृहस्थांसाठी अनेक प्रकारची आदर्श तत्त्वे सांगितली आहेत. मग ती व्यक्ती बौद्ध धम्माचा असो किंवा इतर कोणत्या धर्माचा. याविषयीचे विश्लेषण दीघनिकायाच्या सिगालोवाद सुत्तामध्ये केल्या गेले आहे. जे याप्रमाणे आहे- 'कोणताही धर्म मनुष्याचा सदधम्म तेव्हाच होऊ शकतो, जेव्हा तो त्या वाईट सवयींना त्यागण्याची शिकवण देत असेल. जसे चार वाईट सवयी याप्रमाणे- प्राणी हिंसा, चोरी, व्यभिचार आणि असत्य यांचा त्याग केला पाहिजे.' पाप कर्मांच्या कारणांविषयी तथागतांनी म्हटले की, 'हे पक्षपात, शत्रुता, मूर्खता तसेच भीतीमुळे केल्या जातात. जर मनुष्य या पापासून मुक्त झाला तरच तो पाप कर्मापासून मुक्त होईल.'¹⁴ यामधून तथागत बुद्धांनी सम्यक आचरण करण्याचा उपदेश दिलेला आहे, कारण समाजात शांतता आणि सुव्यवस्था प्रस्थापित जर करावयाची असेल तर तथागतांनी सांगितलेल्या धम्माप्रमाणे आचरण करण्याची आज आवश्यकता आहे.

निष्कर्ष

उपरोक्त अध्ययनानुसार या निष्कर्षावर येऊ शकतो की, वर्तमान भारतीय समाजात तथागत बुद्धांच्या सील सदाचारावर आधारित तत्वांची अत्यंत आवश्यकता आहे. कारण आज समाजामध्ये ईश्वरवाद, अंधश्रद्धा, कर्मकांड,

भ्रष्टाचार, हिंसाचार, धार्मिक कट्टरवाद, व्यभिचार, बलात्कार, मानसिक दास्यता आणि आतंकवाद याचे मोठ्या प्रमाणात प्रचलन आढळून येत आहे. हे निश्चितच समाजस्वास्थ्याच्या दृष्टीने योग्य नाही म्हणून निरपेक्ष भावनेने, कुठलीही व्देष भावना न ठेवता, जो विचार व्यक्तीच्या समाजाच्या आणि देशाच्या हिताच्या दृष्टीने आवश्यक आहे, अशा धम्म विचारांप्रमाणे आचरण करूनच आपण सम्यक वाटचाल करू शकतो.

अर्थ्यातू

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2. धर्मरक्षित, भिक्खू, सुत्तनिपात, वसल सूत्त
3. सांकृत्यायन, महापंडित राहुल, विनयपिटक, धम्मचक्कपवत्तन सूत्त
4. सांकृत्यायन, महापंडित राहुल, मज्झिमनिकाय, सेखसुत्त
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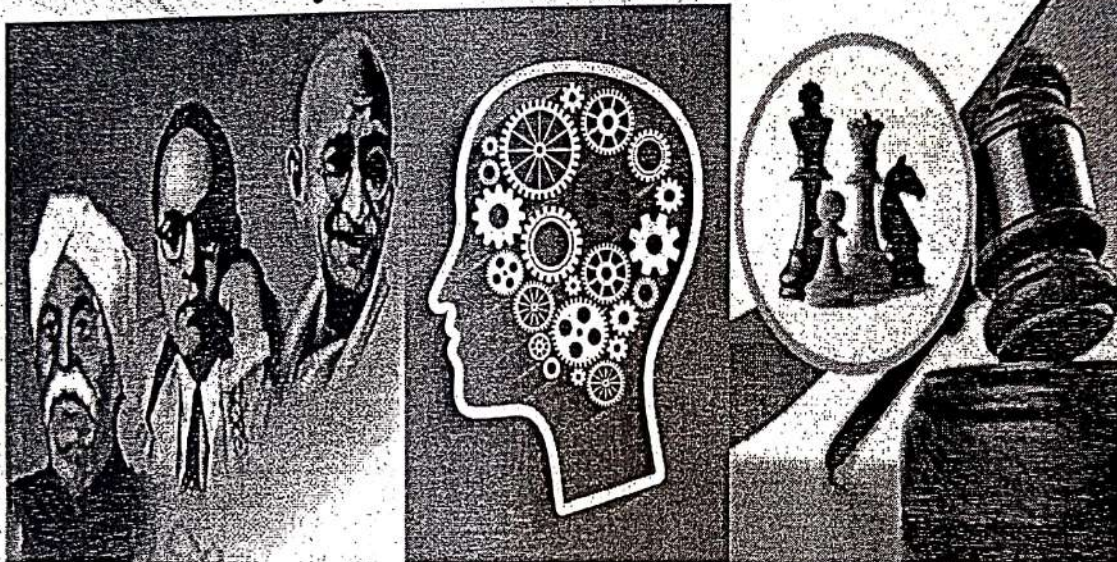
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भारतीय अर्थव्यवस्थेच्या सुदृढतेसाठी बुद्धाच्या आर्थिक विचारांची आवश्यकता

प्रा. डॉ. मोहन दे. वानखडे

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सारांश:

तथागत बुद्धाच्यावेळी भारतीय समाज शेतीप्रधान होत. पशुपालन सुद्धा त्यांच्यासाठी धन-संपत्तीप्रमाणे होते. प्राचीन अर्थव्यवस्थेमध्ये वर्णवर्चस्वाचे, विषम समाजव्यवस्थेचे विचार दिसून येतात. पाली तिपिटक साहित्यामध्ये वेदांचा उल्लेख मिळतो.^१ परंतु कौटिल्याच्या अर्थशास्त्राचा उल्लेख मिळत नाही. जर कौटिल्याचे अर्थशास्त्र बुद्धपूर्व असते तर पाली तिपिटकामध्ये कुठेना-कुठे उल्लेख असता. पाली तिपिटक साहित्यामधून आपल्याला याची माहिती मिळते की, प्राचीन भारतीय समाजामध्ये सामाजिक, आर्थिक विषमता, असमानता आणि सामाजिक आर्थिक शोषण होते. त्या समाजामध्ये शोषक आणि शोषित वर्ग होता. त्याचप्रकारे बुद्धाच्या वेळी ब्राह्मण पुरोहितवर्ग राजसत्ता, धर्मसत्ता इत्यादीपासून लाभान्वित सुद्धा होता आणि भूमीस्वामी, भूपती सुद्धा होता.^२ राजसत्ता संचालनामध्ये त्यांचे विशेष स्थान होते. वस्सकार ब्राम्हण राजा अजानशत्रुचा प्रधानमंत्री होता.^३ म्हणजेच तथागत बुद्धाच्या काळापर्यंत भारतीय समाजव्यवस्थेमध्ये ब्राह्मणांचे वर्चस्व ब-याच प्रमाणात वाढलेले होते. भारतीय समाजामध्ये धनवानांचा वर्ग सुद्धा निर्माण झाला होता आणि निर्धनांचा वर्ग सुद्धा निर्माण झाला होता. वर्णव्यवस्था आणि जातीव्यवस्था सुद्धा होती. त्यावेळच्या समाज व्यवस्थेमध्ये गुलाम, अस्पृश्य, चांडाळ सुद्धा होते. पाली तिपिटक साहित्यानुसार प्राचीन भारतामध्ये सामाजिक असमानता सुद्धा होती आणि आर्थिक असमानता सुद्धा होती. ही असमानता तथागत बुद्धांना त्यांच्या बालपणापासून जाणवली होती. त्यामुळे बुद्धत्व प्राप्तीनंतर तथागतांनी निरंतर ४५ वर्षे ही असमानता नष्ट करण्यासाठी आपल्या धम्म विचाराचा प्रचार आणि प्रसार केला. पहिल्याच धम्मचक्र प्रवर्तन त्यांनी सम्यक आजीविकेचा उपदेश दिला. ही सम्यक आजीविका तथागत बुद्धाच्या आर्थिक विचारांची आधारशिला आहे, असे म्हणता येईल. या विचारानुसार जर आपण प्रत्येक व्यक्तीने, समाजाने आचरण केले तर कुटुंबाचीच अर्थव्यवस्था नव्हे तर समाजाची व देशाची सुद्धा अर्थव्यवस्था सुधारू शकते, हाच विचार या शोध प्रबंधातून स्पष्ट करण्याचा प्रयत्न केलेला आहे. की वईस: तथागत बुद्ध, समाज, शेतीप्रधान, अर्थव्यवस्था, आर्थिक विषमता, असमानता प्रस्तावना:

तथागत बुद्धाच्या काळात भारतामध्ये जी सामाजिक, आर्थिक, राजकीय परिस्थिती होती त्यावर आधारीत तथागत बुद्धाचे सामाजिक, आर्थिक व राजकीय विचार आहेत. तथागत बुद्धांनी आपल्या जीवनामध्ये कोणत्याही प्रकारच्या अन्यायाचे, कोणत्याही प्रकारच्या गरीबाचे, कोणत्याही प्रकारच्या असमानतेचे समर्थन केलेले नाही, त्याचप्रमाणे त्यांनी कोणत्याही प्रकारच्या भोगवादाचे समर्थन केले नाही. तथागत बुद्धांनी आपल्या संपूर्ण जीवनात मध्यम मार्गाचा उपदेश दिला. त्यांचे आर्थिक विचार सुद्धा मध्यम मार्गाच्या सिद्धांतावर आधारित आहेत. मनुष्याच्या मनातील लोभ, द्वेष आणि मोह नष्ट करण्याच्यादृष्टीनेच तथागतांनी मध्यम मार्गाचा शोध लावला.

देशाची आर्थिक समृद्धी ही केवळ उत्पादनावर निर्भर राहत नाही, ती मनाच्या शुद्धतेवर आणि एकाग्रतेवर सुद्धा अवलंबून राहते. जर मन शुद्ध राहिले तर अधिक एकाग्रता आणि परिणामता अधिक चांगल्या दर्जाची उत्पादन निर्मिती अधिक प्रमाणात असते. मन एकाग्र राहिले नाही तर वस्तूच्या दर्जावर त्याचा निश्चितच परिणाम होईल. याप्रकारे उत्पादकता ही अप्रत्यक्षरूपाने मनाच्या अवस्थेवर अवलंबून राहते. उत्पादनासंबंधी बुद्धाचे कठोर आदेश आणि निर्देश असे आहेत की, एखादा व्यक्ती जर काहीही काम

न करता राष्ट्राचे अन्न खात असेल तर तो लोखंडाचा तप्त गोळा खात आहे, असे त्याने समजावे.^४ याप्रकारे तथागत बुद्धाने श्रमाचे महत्त्व समजावून देण्याचा प्रयत्न केला आहे.

दोन अंतांचा त्याग : तथागत बुद्धानी पंचवर्गिय भिक्खूंना प्रथम उपदेश देतांना सांगितले होते की, भिक्खूँनो! या दोन अंतांचा (टोकांचा) जीवनामध्ये कधीच स्वीकार करू नये. पहिले टोक म्हणजे खा, प्या, मौज-मजा करा म्हणजे भोगवादाचे टोक आणि दुसरे टोक म्हणजे गरीबी, दारिद्र्य, निर्धनता, आत्मक्लेश. या दोन्ही टोकांचा त्याग करून तुम्ही मध्यम मार्गाचा स्वीकार केला पाहिजे. तथागत बुद्धानी भोगवादाचे समर्थन केलेले नाही त्याचप्रकारे त्यांनी दारिद्र्य, गरीबी, निर्धनता याचे सुद्धा समर्थन केलेले नाही. याचाच अर्थ असा की, व्यक्तीने गरीबी, निर्धनता, दारिद्र्य यापासून मुक्त होण्याचा प्रयत्न केला पाहिजे. त्याचप्रकारे धनवान व्यक्तीने धानाचा उपयोग भोग विलासामध्ये लिप्त राहण्यासाठी करू नये, कारण त्यामुळे त्याच्या विनाशच होतो. तर या धनाचा उपयोग गरजूंना मदत करण्यासाठी, निराधारांना आधार देण्यासाठी करण्यात यावा असे तथागत बुद्धाना अभिप्रेत होते.

तथागत बुद्धानी आपल्या जीवनामध्ये नेहमी भोगवादाचा निषेध केला आहे. ते धन-संपत्तीच्या विरोधी नव्हते, संपत्ती मिळविण्याच्या विरुद्ध नव्हते, परंतु ती संपत्ती चुकीच्या मार्गाने मिळविण्यास येऊ नये, असे त्यांचे मत होते. तथागत बुद्धाना आर्थिक विचारधारेला स्पष्ट करण्यासाठी तथागतांच्या आर्य अष्टांगिक मार्ग पर्याय आहे. आर्य अष्टांगिक मार्गामध्ये जो सम्यक शब्द आहे, तो त्यांच्या जीवनदृष्टीला समजण्यासाठी महत्त्वपूर्ण आहे. त्यांनी मानवी जीवनाच्या प्रत्येक क्षेत्रामध्ये सम्यक जीविकेला फारच महत्त्व दिलेले आहे. तथागत बुद्धानी आपल्या पहिल्याच धम्मचक्र प्रवर्तनाच्या उपदेशामध्ये ही गोष्ट स्पष्ट केली आहे.^५ समाज जीवनामधील वास्तविकता अशी आहे की, जो श्रीमंत आहे तोही चिंतेत आहे, दुःखी आहे आणि जो गरीब आहे तोही चिंतेत आहे, दुःखी आहे. म्हणून यामधील जर मध्यम मार्ग अवलंबिला तर व्यक्ती समाधानी जीवन जगू शकतो. कारण धनवान व्यक्ती आपले धन सुरक्षित राहिल का नाही, कुणी चोरी तर करणार नाही, त्या काळजीत असतो. त्याला रात्रीला झोप सुद्धा लागत नाही तर गरीब व्यक्ती ही आपले दारिद्र्य केव्हा संपेल या विवेचनेत असते. तो ही भोगवादाच्या स्वप्नांनी व ते पूर्ण न होत असल्यामुळे दुःखी असतो, म्हणून या दोन्ही टोकांचा त्याग करून मध्यम मार्गावर आधारित सम्यक आचरण केल्यास त्याच्या जीवनात सुद्धा सम्यक बदल घडून येऊ शकतो.

संयमित जीवन:

संयमित जीवनाच एकप्रकारे सम्यक जीवन आहे. तथागत बुद्धानी ही गोष्ट भिक्खू आणि भिक्खूँणीसाठी सुद्धा म्हटली आणि सर्व लोकांसाठी सुद्धा म्हटली आहे. संयमित जीवनामुळे मनुष्य भोगवाद, धनवाद, पुंजीवाद, वाईट कर्म आणि विकृतीपासून आपले संरक्षण करू शकतो. मनुष्य धनाचा गुलाम बनतो, ज्यामुळे मनुष्य विनाशाच्या मार्गावर जातो, म्हणून तथागत बुद्धानाच्या उपदेशामध्ये संयमित जीवनाला फार महत्त्व दिले आहे. त्यांच्या संयमित जीवनाच्या सिध्दांताला त्यांच्या आर्थिक विचारांमध्ये सुद्धा फार महत्त्व आहे. याविषयी तथागत बुद्धाना सेखसुत्तामधील उपदेश विशेष महत्त्वपूर्ण आहे. तथागत बुद्ध महानाम शाक्याला उपदेश देतांना म्हणतात- 'हे महानाम! सील-सदाचाराने युक्त, इंद्रियांनी संयमित, भोजनाची मात्रा जाणणारा, सावधानतेमध्ये तत्पर व्यक्ती याच जीवनामध्ये सुखाने विहार करतो. याप्रकारे तथागत बुद्धानी संयमित जीवनाचा उपदेश दिला आहे. जो बौद्ध अर्थशास्त्राचा मोठा सिद्धांत आहे.

कल्याणकारी राज्याची संकल्पना:

कल्याणकारी राज्य शासनाची ती संकल्पना आहे, ज्यामध्ये राज्य नागरिकांच्या आर्थिक आणि सामाजिक उन्नतीमध्ये महत्त्वपूर्ण भूमिका निभाविते. कल्याणकारी राज्य संधीची समानता, धन-संपत्तीचे समान वितरण तसेच जे लोक चांगल्या जीवनाची न्युनतम आवश्यकतांना स्वता मिळविण्यामध्ये असमर्थ आहेत, त्यांची सहाय्यता करण्यासारख्या सिद्धांतावर आधारित आहे.^६ अशोक एक कल्याणकारी राजा होता. गिरनार अभिलेखानुसार त्याने पशु-पक्षांसाठी सुद्धा चिकित्सालये निर्माण केले होते.



मज्झिमनिकायाच्या कुटदन्त सुत्तामधून बुद्धा तथागत बुद्धाचे आर्थिक विचार स्पष्ट होतात. त्यावेळी कुटदन्त ब्राह्मणाला महायज्ञ करण्याची इच्छा झाली. त्या यज्ञासाठी त्याने ७०० बैल, ७०० बछडे, ७०० बक—या इत्यादी यशस्थळावर आणल्या होत्या. त्यावेळी तथागत बुद्धांनी कुटदन्त ब्राह्मणाच्या या हिंसामय यज्ञाची निंदा केली आणि त्यांनी 'महाविजित जातक' ला सांगून अहिंसामय कार्याला उचित सांगितले. महाविजित जातकामध्ये म्हटल्या गेले आहे की, 'आपला देश संकटांनी ग्रस्त आहे, उत्पीडन भोगीत आहे, ग्रामघातक गावाची लुट करताहेत, वाटमारी करणारे दिसून येतात. अशा संकटग्रस्त देशामध्ये आपण ग्रामघातक गावाची लुट करताहेत, वाटमारी करणारे दिसून येतात. अशा संकटग्रस्त देशामध्ये आपण बळीवर आधारित यश करायला निघाले आहात. म्हणजे आपण या देशाचे अहितकारी आहात, विनाशकारी आहात. कदाचित आपल्याला असे वाटत असेल की, आपण लुटेरूंच्या उत्पादाला उखडून टाकू, त्यांना पळवून लावू, परंतु यामुळे लुटेरूंच्या उत्पादाला पूर्णपणे संपविल्या जाऊ शकत नाही. कारण की, जे यामधून सुरक्षित राहिले असतील ते नंतर राजाच्या जनपदाला त्रास देतील. म्हणून या उत्पादापासून राज्याला तेव्हाच वाचविला जाऊ शकते, जेव्हा लुटेरूंच्या समस्यांना संपूर्णपणे नष्ट केल्या जाईल. जेव्हा हे राजन! आपल्या जनपदात जो कुणी शेती, पशुपालन करण्यामध्ये उत्साहित असेल, त्यांना आपण बी—बियाणे आणि भोजनाची मदत करा, व्यापार करणा—यांना व्यापारामध्ये मदत करा, धनाची सहाय्यता करा, जे राज्याची नोकरी करण्यामध्ये उत्साहित आहेत, त्यांना आपण उचित वेतन—भत्ते द्या. यामुळे लोक आपल्या कामामध्ये लागून राहतील आणि राजाच्या जनपदाला त्रास देणार नाहीत. त्यामुळे देशामध्ये धनाची उत्पत्ती होईल, धन आणि धान्याचे उत्पादन वाढेल, जनपद पिडा, उत्पादापासून मुक्त होईल, दुःखापासून मुक्त होईल आणि लोक आपल्या मुलाबाळांसहित निर्भयपणे, मोकळ्यापणाने विहार करतील. राजाने तसेच केले आणि राजाला महाधनराशी प्राप्त झाली. जनपद संकटापासून मुक्त झाले.' इथे तथागत बुद्धांनी जनकल्याणकारी राज्यालाच चांगले राज्य म्हटले आहे. तथागत बुद्ध यज्ञाला विनाशाचे, पीडेचे, अहिताचे, दुःखाचे कारण मानीत होते, हे या सुत्तावरून स्पष्ट होते. याप्रकारे तथागत बुद्धांनी यज्ञामध्ये धन संपत्तीच्या विनाशाचा विरोध करित कल्याणकारी राज्याची संकल्पना व्यक्त केली आहे. ते हिंसात्मक यज्ञाला विरोध करित पंचशील पालन, सील, समाधी, प्रज्ञाने मुक्त होण्यालाच महत्त्व देत होते.

आधुनिक काळामध्ये डॉ. बाबासाहेब आंबेडकर यांच्या अर्थशास्त्रासंबंधी लिखाणांवरून इतर विषयासंबंधी बुद्धा तथागत बुद्धाच्या विचारांचा प्रभाव मोठ्या प्रमाणात दिसून येतो. त्यांच्या 'द प्रॉब्लेम्स ऑफ रुपीस' (The Problems of Rupee) या ग्रंथाने जगातील अर्थशास्त्राच्या क्षेत्रात फार मोठी क्रांती केली आहे. त्याचप्रमाणे भारताचे प्रसिद्ध अर्थशास्त्रज्ञ आणि नोबेल पुरस्काराने सन्मानित डॉ. अमर्त्य सेन यांच्या आर्थिक सिद्धांतांमध्ये बुद्धा बुद्धांच्या आर्थिक विचारांचा प्रभाव दिसून येतो. डॉ. अमर्त्य सेन यांनी तथागत बुद्धांच्या समाजकल्याणकारी अर्थशास्त्राचे वैज्ञानिक पद्धतीने विश्लेषण केले व ते जगासमोर आणले. ज्या—ज्या देशांनी तथागत बुद्धांच्या धम्माचा स्वीकार केला. ते—ते देश प्रगतीच्या उच्च शिखरावर पोहोचले. आज जगात बौद्ध अर्थशास्त्राचे विशेष महत्त्व आहे. आर्थिक विकासामध्ये मानव विकास निर्देशांक महत्त्वाचे मानले जातात. बौद्ध अर्थशास्त्रात मानव विकास केंद्रभूत आहे, त्यामुळे बौद्ध अर्थशास्त्र हे मानवाच्या कल्याणचे शास्त्र आहे.

मूल्यांकन:

तथागत बुद्धांच्या विचारांचे जर आपण अध्ययन केले तर त्यावरून आपल्याला हे स्पष्ट होते की, त्यांनी प्रत्येक व्यक्तीला अनेक सम्यक पद्धतीने स्वावलंबी होण्याचा उपदेश दिला आहे. त्यांचा हा स्वावलंबनाचा सिद्धांत, आर्थिकदृष्टीने बुद्धा महत्त्वपूर्ण आहे आणि हीच त्यांची आर्थिक विचारांची बुद्धा महत्त्वपूर्ण शिकवण आहे. तथागत बुद्धांच्या शिकवणीप्रमाणे आचरण करून सम्राट अशोकाने आपल्या प्रजेला आपल्या संततीप्रमाणे समजले होते. ज्याप्रमाणे पिता आपल्या मुलाबाळांची संपूर्णपणे काळजी घेतो, त्यांच्या सुखा—समाधानासाठी, प्रगतीसाठी प्रयत्नशील असतो, त्याचप्रकारे सम्राट अशोकाने आपल्या साम्राज्याची संपूर्ण शक्ती प्रजेच्या हितामध्ये लावली. आपल्या कर्मचा—यांना ते आदेश देतात— 'प्रत्येकवेळी



मग मी जेवन करीत असेल, किंवा निवासामध्ये आराम करीत असेल किंवा वैयक्तिक कामामध्ये असेल गुप्तचरांनी मंला माझ्या प्रजेच्या विषयामध्ये सूचना द्यावी. प्रजेच्या सुखासाठी तर मला सतत प्रयत्नशील राहिलेच पाहिजे. यावरून सम्राट अशोकाच्या कल्याणकारी राज्याची कल्पना येते. राजाने जर कुशल कार्य केले तर प्रजा सुद्धा खुशहालीमध्ये राहते. म्हणून सम्राट अशोकांनी बुद्धाच्या विचारांप्रमाणे आचरण करून कल्याणकारी राज्य प्रस्थापित केले तसेच विदेशातील लोकांनी भारतातील तथागत बुद्धाचा स्वीकार करून, त्यांच्या विचारानुसार आचरण करून आपल्या देशांना सर्वांगीण प्रगतीच्या अतिउच्च शिखरावर नेले. परंतु आपण आपल्याच देशातील तथागत बुद्धांना, त्यांच्या आर्थिक विचारांना, त्यांच्या तत्वज्ञानाला समजून घेण्याकरिता आपली संकुचित मानसिकता आपल्या आड आली, म्हणूनच आपल्या डोळ्यादेखत विदेशातील देश तथागतांच्या धम्म विचाराला समजून, त्या विचारांना स्वीकारून आपली प्रगती करीत आहेत आणि आपण अजूनही जाती-धर्माच्या संकुचित डबक्यातून बाहेर निघायला तयार होऊ इच्छित नाही. कमीत कमी आजच्या परिस्थितीमध्ये तरी आर्थिक वृद्धीला धार्मिक बाबींपेक्षा जास्त महत्त्वपूर्ण मानण्याची आवश्यकता आहे, तसाही तथागत बुद्धाचा धम्म हा धर्म नाही, ती एक जीवन जगण्याची कला आहे, त्यामुळे ही कला भारतीयांनी निरपेक्ष भावनेने स्वीकारण्याची आवश्यकता आहे.

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विदर्भातील आंबेडकरी चळवळीचा इतिहास
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आंबेडकरी चळवळीत दादासाहेब गवई यांचे योगदान

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सारांश: 'माणूस शब्दाने दुखावल्या जातो त्याची वेदना शस्त्रापेक्षा भयंकर असते' आणि या प्रवृत्तीतून वैरभावना निरंतर वाढत राहते, म्हणूनच तथागत बुद्धांनी उपदेश दिला की, 'वैराने वैर शांत होत नाही तर अवैरानेच वैर शांत होतो.'¹ दुःखापासूनही मुक्त होता येते, आणि सदासर्वकाळ दुःखाचेच रडगाणे गात राहण्याची वेळ मनुष्यावर येत नाही. कारण सदासर्वकाळ दुःखाचे रडगाणे गात बसल्यास मार्ग मिळत नाही. यासाठी स्वतःच्या कार्याबद्दल बिनधारस्तपणे सम्यक विचाराने कार्यरत राहिल्यास 'प्रज्ञा, शील, करुणा, मैत्री' यागुणांनी युक्त व्यक्ती जीवनात कधीच पराभूत होत नाही. पण आपल्या कार्याबद्दल अढळ निष्ठा हवी. आज राग, लोभ, द्वेष, मोह, माया, मत्सर इत्यादींनी समाज लिप्त आहे परंतु कोणत्याही व्यक्तीला, समाजाला, देशाला कुशलपूर्वक जीवंत राहायचे असेल तर जीवनाकडे बघण्याचा दृष्टिकोन हा आनंददायक असला पाहिजे. रोज शेंकडो विमानांतून हजारो बॉम्बचा वर्षाव डोळ्यासमोर होत असतांना चर्चिले डोक्याने शांत राहून योग्य तो निर्णय घेत होता, याचे कारण त्याची विनोदी जीवनदृष्टी. याच जीवनदृष्टीने दादासाहेब गवई यांनी अगदी हसत-हसत अनेक प्रसंगावर मात केली. अनेक गंभीर आणि किचकट प्रश्न आपल्या मोहक आणि मनमिळावू स्वभावाने विरोधकांचे सुद्धा मन जिंकून सोडविण्याची कसब त्यांच्या व्यक्तिमत्वात होती. जनतेचे प्रश्न ते थंडी, ऊन, वारा, पाऊस याची पर्वा न करता घेयाने, हिंमतीने सोडवायचे,² हे करीत असतांना ते कधीच जात, धर्म, पंथ इत्यादींचा विचार करीत नसत. मग ते कार्य व्यक्तीचे असो, समाजाचे असो, त्यामध्ये ते कुठलाच भेदभाव करीत नसत.

त्यांनी आपल्या सामाजिक कार्याची सुरुवात वयाच्या 17 व्या, 18 व्या वर्षापासूनच केली होती. डॉ. बाबासाहेब आंबेडकरांच्या विचारांचा प्रचार-प्रसार खेडोपाडी फिरून ते करायचे, लोकांनी मेलेली गुरे-ढोरे ओढु नये, सामाजिक प्रश्नांना संघटीत होऊनच सोडविणे शक्य आहे याचे महत्त्व ते समाज प्रबोधनातून करीत असत. समाजामधून त्यांच्या सामाजिक कार्याला मोठ्या प्रमाणात प्रतिसाद मिळायचा. मग तो प्रश्न भूमीहिनांचा सत्याग्रह असो, रोजगार हमी योजनेचा असो, मंडल आयोगाचा असो, मराठवाडा विद्यापीठाच्या नामांतराचा असो, बौद्धांच्या सवलतीचा प्रश्न असो, राखीव जागांचा असो, डॉ. बाबासाहेब आंबेडकर रायटिंग अँड स्पीचेसच्या प्रकाशनाचा असो, दलितांवर होणा-या अत्याचारांचा असो, महार वतनाच्या जमीनीचा असो, मागासवर्गीय समाजाच्या बँकलॉगचा असो, मालेगाव, भिवंडी, ठाणे, कल्याण मुंबईत झालेल्या दंगलीचा असो, जातीवादाने त्रस्त झालेल्यांच्या असो, शेतमालाच्या भावविषयी असो, शेतमजुरांच्या प्रश्नांविषयी असो, आदिवासींचे प्रश्न असो, गिरणी कामगारांचे प्रश्न असो, रिडल्स प्रकरण असो इत्यादी अनेक सामाजिक कार्य त्यांनी जनतेच्या पाठिंब्याने यशस्वी करून दाखविले.

शब्द संकेत: माणूस, तथागत, दुःख, वैर, दृष्टिकोण, समाज, जातीवाद, भूमीहिन, सत्याग्रह
संशोधन पद्धती : ऐतिहासिक संशोधन पद्धतीचा स्वीकार करण्यात आलेला आहे.

प्रस्तावना : दादासाहेब गवईने विद्यार्थीदशेपासूनच अंगी प्रौढता अंगिकारली व स्वतःला विधायक कार्यात झोकून दिले. त्यावेळी कर्मयोगी संत गाडगेबाबा यांनी समाजातील अनिष्ट चालीरितींविरुद्ध तथा अंधश्रद्धे विरुद्ध मोहिम राबवून जनजागृती घडवून आणण्यास जीवनाभर प्रयत्न केला. या चळवळीत दादासाहेब गवई यांनीही विद्यार्थीदशेतच खारीचा वाटा उचलून अमरावती जिल्ह्यातच नव्हे तर संपूर्ण विदर्भभर अंधश्रद्धे विरुद्ध जनजागृती केली व सामान्य माणसाला आवर्जून सांगितले की, पुत्रप्राप्ती अथवा धनसंपत्ती ही ईश्वरासमोर बक-याचा बळी देऊन कदापिही होत नाही. तर कठोर परिश्रमाने व शिक्षणाच्या माध्यमातून मानवाचा सर्वांगीण विकास होतो. अनेक ठिकाणी दादासाहेबांनी संत गाडगेबाबा यांच्या समवेत फिरून व्याख्याने दिली. गाडगेबाबांच्या समवेत एका पात्रात जेवण्याचेही भाग्य दादासाहेबांना लाभले.³ हा दादासाहेबांच्या जीवनातील अतिशय महत्त्वाचा व दुर्मिळ योग होता. दादासाहेब गायकवाड यांच्या मार्गदर्शनाखाली जो अभूतपूर्व 'भूमीहिनांचा सत्याग्रह' झाला होता, त्यामध्ये दादासाहेब गवईचे योगदान उल्लेखनीय होते. संपूर्ण अमरावती जिल्हा जणू दादासाहेब गवईच्या नेतृत्वात या आंदोलनात उतरला होता. दादासाहेब गवई यांच्या नेतृत्वाखाली 25000 सत्याग्रहींनी एकाच दिवशी

स्वतःला अटक करवून घेऊन तुरुंगवास पत्करला. दादासाहेबांच्या नेतृत्वात मिळत असलेला अभूतपूर्व प्रतिसाद लक्षात घेऊन दादासाहेब गायकवाड यांनी आपल्या इतर कार्यकर्त्यांना सांगितले की, 'तुम्ही देखील त्यांचा किता गिरवून कार्यास लागा.'⁴ यावरून दादासाहेब गायकवाड हे दादासाहेब गवईच्या कार्यकर्तृत्वावर फार समाधानी होते, हे स्पष्ट होते.

महारांना त्यांच्या इमानदारीबाबत गावकुसातल्या जमीनी दिल्या होत्या. या कायदान्वये महारांनी करावयाची गुलामगिरीची कामे रद्द करून जमीनीचा ताबा महारांना द्यावा असे विधेयक 1900 साली खुदद बाबासाहेब आंबेडकरांनी मुंबई वरिष्ठ सभागृहात आणले होते आणि महारांची गुलामगिरी काही अंशी संपविली असली तरी कायद्यात काही पळवाटा राहिल्या, त्यामुळे पश्चिम महाराष्ट्रातील गावकुसा नजिकच्या जमीनी गावातल्या कुळांनी गडप केल्या. रा. सु. गवई यांनी त्यावेळचे मुख्यमंत्री शंकरराव चव्हाण यांच्याकडून एक प्रशासकीय आदेश काढला की, 'महार वतनाच्या खरेदी-विक्रीचे व्यवहार हे जर कलेक्टरच्या किंवा सक्षम अधिका-यांच्या मार्फत झाले नसतील तर ते गैर समजावेत. त्याच्या थोडा बहुत फायदा होऊन 25 ते 30 हजार एकर जमीन पश्चिम महाराष्ट्रात वतनदार महारांना परत मिळली.'⁵ दादासाहेबांच्या या कार्यामुळे अनेक निराधारांना आधार मिळाला.

रोजगार हमी योजनेमध्ये सुद्धा दादासाहेब गवई यांचे योगदान आहे. याविषयी आपला अहकल सादर करतांना प्रस्तावनेत त्यांनी पुढील विचार मांडले. 'भारतीय संविधानाच्या 41 व्या अनुच्छेदामध्ये देशातील प्रत्येक नागरिकांला रोजगार मिळविण्याचा हक्क प्राप्त करून दिलेला आहे. त्या तरतुदीस अनुसरून राज्य शासनाने सन 1972 मध्ये राज्यातील ग्रामीण भागातील अंगमेहनतीचे काम करण्याची इच्छा असलेल्या प्रत्येक व्यक्तीला रोजगार मिळवून देण्याच्यादृष्टीने रोजगार हमी योजनेचा अंगिकार केला. राज्यातील सुमारे 65 टक्के लोक ग्रामीण भागात राहत असून सुमारे 80 टक्के लोकांचे उदरनिर्वाहाचे साधन शेती व शेतमजुरी आहे. या शेतमजुरांना ही योजना सुरु होण्यापूर्वी केवळ शेतीच्या हंगामातच काम मिळत होते व उर्वरित कालावधीत त्यांना बेकार रहावे लागत होते. महाराष्ट्रातील ग्रामीण भागात उत्पादक कामे सुरु करून बेरोजगारी व अर्ध बेरोजगारीचा प्रश्न सोडवावा ह्या उद्देशाने प्रेरित होऊन ही योजना 1972 ला सुरु करण्यात आली.'⁶ या योजनेमुळे महाराष्ट्रातील बेरोजगारीचा प्रश्न सुटून विना हंगामाच्या काळात त्यांच्या हाताला काम मिळाले.

मंडल आयोगाच्या शिफारशी लागू करण्यात याव्यात याकरिता रा. स. गवई यांचे सुरुवातीपासूनच प्रयत्न सुरु होते. आपल्या देशातील समाजरचनाच मुळी जातीय व्यवस्थेवर आधारित असल्यामुळे काही जाती मागे राहिल्या तर काही पुढे गेल्या. सर्वांना बरोबरीने आणल्याशिवाय आपआपसातला भेदभाव, आर्थिक फरक कमी होणे शक्य नव्हते हे दादासाहेब गवईयांनी ओळखले होते. म्हणून मंडल आयोगाच्या शिफारशी त्वरीत लागू कराव्यात याकरिता ते सुरुवातीपासूनच प्रयत्न करीत होते. त्या अनुषंगाने त्यांनी विधान परिषदेत दिलेली भाषणे महत्वाची आहेत.⁷ ती वाचून ते मंडल आयोगाच्या शिफारशी लागू व्हाव्यात म्हणून किती प्रयत्न करीत होते ते लक्षात येते. मराठवाडा विद्यापीठाला डॉ. बाबासाहेब आंबेडकर यांचे नाव देण्याविषयीचा प्रश्न अनेक वर्षांपासून रेंगाळत होता. डॉ. बाबासाहेब आंबेडकर यांनी मराठवाड्याच्या विकासासाठी जे कार्य केले आहे ते पाहता ठरावाची अंमलबजावणी कधीच व्हायला हवी होती. 27 जुलै 1978 रोजी मराठवाडा विद्यापीठास डॉ. बाबासाहेब आंबेडकर मराठवाडा विद्यापीठ असे नाव द्यावे हा ठराव सभागृहाच्या दोन्ही सदन्यामध्ये मंजूर करण्यात आला होता. तरीही याविषयी दंगली उसळल्या होत्या. बौद्ध समाजातील लोकांच्या घरांना आंग लावण्याचे प्रकार घडले. त्यांचे जे काही उपजीविकेचे साधन होते, ते नष्ट करण्यात आले. या पार्श्वभूमीवर दादासाहेब गवई मराठवाड्यात दंगल झाल्यानंतर जवळजवळ अकरा दिवस मराठवाड्यात फिरले. घरे-दारे, झोपड्या उद्ध्वस्त झाल्या होत्या. त्यांनी हिंदू व बौद्ध यांच्या जवळजवळ 25-30 बैठका घेतल्या. सभागृहामध्ये सुद्धा त्यांनी याविषयी आपले मत मांडताना म्हटले की, आपण सर्व मराठवाड्याच्या जनतेचे प्रबोधन करू इच्छितो. आपण एकत्र येतो, भाषण देतो ते जनतेचे प्रतिनिधी म्हणून. खरी जनता ही महाराष्ट्राच्या द-याखो-यात राहते. त्या जनतेचे प्रबोधन करण्याची जबाबदारी आपण सर्वांनी स्वीकारली पाहिजे. केवळ सामाजिक कार्यकर्त्यांनी नव्हे तर माननीय मुख्यमंत्र्यांनीसुद्धा तेव्हा हिमालयाएवढे नेतृत्व असणा-या डॉ. बाबासाहेब आंबेडकरांचे नाव मराठवाडा विद्यापीठाला दिले तर मराठवाड्याची अस्मिता खुलून दिसेल. ज्या डॉ. बाबासाहेबांनी सर्वप्रथम मराठवाड्याच्या मागास भागाची

जाणीव ठेवली. ज्यांनी प्रथम शिक्षणाची ज्ञानगंगा तेथे नेली, त्या महान नेत्याची आपण जाणीव ठेवली पाहिजे. म्हणून या सभागृहामार्फत आपल्या सर्व सामाजिक कार्यकर्त्यांना बाहेरच्या कार्यकर्त्यांना माननीय मुख्यमंत्र्यांना मी सांगू इच्छितो की, आपण सर्वांनी समाज प्रबोधनाचे काम केले तर मराठवाड्यातील जनता ही यापेक्षा वेगळा निर्णय घेईल असे मला वाटत नाही. म्हणून आपण सर्वांनी मराठवाड्यातील संवर्जनतेचे प्रबोधन केले पाहिजे.⁸ कालांतराने या प्रश्नावर तोडगा काढून हा प्रश्न सोडविण्यात आला. परंतु या आंदोलनात अनेकांनी आपल्या प्राणांची आहुती देऊन ते आपल्या प्राणप्रिय बाबासाहेबांच्या नावासाठी शहीद झाले.

1978 मध्ये दादासाहेब गवई हे विधान परिषदेचे सभापती होते. केंद्रामध्ये जनता पार्टीचे सरकार होते. बौद्धांच्या सवलती करिता व अन्य मागण्यांकरिता दादासाहेब गवई, एन. एच. कुंभारे, आर.मुगम हे दिल्लीच्या बोटक्लब येथे उपोषणास बसले. तब्बल चौदा दिवसांच्या उपोषणानंतर तिघांच्याही प्रकृत्या ढासळल्या होत्या. इंदिरा गांधी यांनी उपोषणाच्या मंडपाला भेट देऊन या सरकारकडून बौद्धांना सवलती संबंधीची अपेक्षा करू नका पुढेमागे आपले सरकार आल्यानंतर त्या सवलतीचा विचार आपण करू असे म्हणाल्या. उपोषण संपल्यानंतर एका जाहीर सभेत उपोषण समितीचा समारोप झाला. समारोपानंतर हजारो कार्यकर्त्यांसह अटक करवून घेण्यात आली. जेलमधून सुटका झाल्यानंतर बौद्धांच्या सवलती कशा आवश्यक आहे, यासंबंधी प्रवचनासारखी दादासाहेब गवई यांची भाषणे होऊ लागली. पुढे या विषयासंबंधीची त्यांनी स्वतंत्र पुस्तिकाही काढली. याच तत्त्वाचा स्वीकार व्हि. पी. सिंगांनी बौद्धांच्या सवलती देण्याच्या बाबतीत केला. नव्हे त्या संबंधित संसदेत जे विधेयक पास झाले त्यातही दादासाहेब गवई यांनी लिहिलेल्या पुस्तिकेतील तत्त्वांचा स्वीकार करण्यात आला.

दादासाहेब गवई यांचे कार्य समाजामध्ये, विधान परिषदेमध्ये त्या-त्या कार्याची शान वाढविणारे होते. तसेच त्यांचे कार्य राज्यसभेमध्ये सुद्धा होते. डॉ. बाबासाहेबांविषयी अरुण शौरी यांनी आपल्या 'Worshipping false God' या स्व:लिखित पुस्तकात विपर्यस्त व आक्षेपार्ह विधान केले होते. या विधानाने दादासाहेब दु:खी झाले होते. आपल्या श्रद्धास्थानाविषयी सत्याला बाजूला सारून केलेले विधान ते सहन करू शकत नव्हते. भाजपचे नेते रामदास अगरवाल यांचा भारताच्या संविधानाची समीक्षा करण्यात यावी हा अशासकीय प्रस्ताव सधनात प्रलंबित होता. या सुधारणा प्रस्तावावरील सभागृहातील चर्चेच्या वेळी आपला राग व्यक्त करण्याची संधी त्यांना चालून आली. आपल्या भाषणाची सुरुवात त्यांनी मी या ठरावाचा माझ्या हातांनी आणि नखांनी विरोध करतो या वाक्याने करून सभागृह जिंकले. ज्या डॉ. बाबासाहेब आंबेडकरांनी लिहिलेल्या संविधानामुळे आज प्रत्येक भारतीयाला समान हक्क मिळाले आहे, ख-या अर्थाने स्वातंत्र्य आज भारतीय उपभोगतो आहे. ज्या संविधानामुळे आजचे उच्चपदस्थ आपल्या खुर्चीला टिकून आहेत आणि भारताचा अशांत व राजकीयदृष्ट्या अस्थिर पाकिस्तान झाला नाही. त्याच संविधानाचे शिल्पकार असलेल्या बाबासाहेबांविषयी सत्तारूढ पक्षातील एका कार्यकर्त्याने आपल्या पुस्तकातून असत्य विधान केलेले आहे. एकीकडे स्वार्थासाठी डॉ. बाबासाहेबांच्या नावाचा उदोउदो करून दुसरीकडे या असत्य विधानाकडे दुर्लक्ष करून त्या पदाधिका-याला बक्षिस म्हणून राज्यसभेतील जागाच नाही तर त्याचा मंत्रिमंडळातही समावेश करण्यात आलेला आहे. अशी अरुण शौरी यांचे नाव न घेता दादासाहेबांनी आपल्या चर्चेवरील भाषणाने सुरुवात केली. सत्ताधा-यांनी याला विरोध करताच दादासाहेब म्हणाले, मी सत्य प्रतिपादन केलेले आहे. पुस्तकातील विधान असत्य असल्याचे मी सप्रमाण सिद्ध करून देऊ शकतो. तेव्हा माफी मागण्याचा प्रश्नच उदभवत नाही. विरोधी पक्षांनी ही आपली मागणी उचलून घरली. या सर्व गोंधळात सभागृहातील कामकाज ठप्प पडले. याच विधेयकावर पुढच्या आठवड्यात चर्चा होणार होती, त्यासाठी दादासाहेबांनी जय्यत तयारी केली होती. चर्चेच्या प्रारंभीच दादासाहेब उभे राहिले आहे अशी मागणी सभापतींना केली. त्यामुळे सभागृहात दोन्ही बाजूने गोंधळ झाला. तेव्हा दादासाहेब माझक मध्ये जोराने म्हणाले, 'मला जर सिद्ध करण्याची परवानगी मिळत नसेल तर माझा निषेध मी असा सभागृहातच भिरकावले. त्यांच्या या कृतीने सभागृहात बॉम्बस्फोट झाल्यासारखा गोंधळ उडाला. दादासाहेब सभागृहातून बाहेर पडतात सर्व विरोधी पक्ष सदस्यांनी व पत्रकारांनी त्यांना जन्म गराडाच घातला. त्यांनी भविष्याची चिंता न करता केलेल्या या धाडसी कृत्याचे सर्वच विरोधी पक्ष सदस्यांनी व "Perspective" A National Interdisciplinary Annual Research Journal -Vol.I Issue-VIII-2020 ISSN-2249-5134

पत्रकारांनी आपल्या लेखणीतून कौतुक केले. पुढे कित्येक दिवस देशाच्या कानाकोप-यातून अभिनंदनाची पत्रे येत होते. सांगण्याचे तात्पर्य असे की, दादासाहेब गवई यांच्या मध्ये असे चातुर्य होते की आपले मत मांडण्याची संधी देत नसाल तर अशा प्रतिकूल परिस्थितीवर सुध्दा मात करून महासंधी प्राप्त करून घेत असत.

समीक्षा:संसदीय कामकाज पद्धतीचा भरपूर उपयोग करून जनतेच्या सर्वव्यापी प्रश्नावर अनेक आयुधे वापरून त्यांनी जनतेच्या प्रश्नांला न्याय मिळवून दिला. दादासाहेब गवई सभागृहात भाषण करण्याकरिता उभे राहिले की, सभागृहात टाचणी पडली तरी आवाज ऐकू येईल अशी शांतता पसरायची. अन्याय, अत्याचाराच्या प्रश्नांसंबंधी तर ते शासनावर तुटून पडायचे.दादासाहेब गवई यांनी अनेक देशांना भेटी देऊन त्यांनी आपल्या देशाची बौद्ध संस्कृती सांगून मान उंचावली. त्यांचा पहिला विदेश दौरा 1968 मध्ये झाला त्यावेळी दादासाहेब गवई विधानपरिषदेचे उपसभापती होते. विदेशात परिषदेला जाण्याचा पहिला मान स्वीकार व चेअरमनचा असतो. कोणाला पाठवायचे याचा निर्णय मुख्यमंत्री घेतात. जागतिक बौद्ध परिषदेलासुद्धा दादासाहेब अनेक वेळेस जाऊन आले.

एवढ्या व्यस्त जीवनात सुद्धा त्यांना वाचनाचा व लिखाणाचा छंद होता. प्रामुख्याने प्रवासामध्ये सुद्धा ते वाचन व लिखाण करायचे. म्हणूनच ते 1. फिथ फाईव्ह इयर प्लॅन इन रिलेशन टू शेड्युल कास्ट अॅन्ड शेड्यूल ट्राईब 2. सर्विस प्रिव्हिलेजेस टू शेड्युल कास्ट 3. बौद्धांच्या सवलती संपूर्ण कैफियत 4. कास्ट वॉर ओव्हर रिझर्वेशन 5. निमित्त राखीव जागांचे रणकंदन वर्णवर्चस्वाचे 6. डॉ. बाबासाहेब आंबेडकर डिझर्व ऑफ दि कॅन्ट्री 7. डॉ. बाबासाहेब आंबेडकर यांचे भारतीय जनतेला प्रकट पत्र इत्यादी पुस्तकांमधून त्यांनी समाजाला दिशादर्शक देण्याचे काम केले. संविधानाचा सखोल अभ्यास त्यांचा होता. संविधानातील प्रत्येक कलम जणू त्यांच्या मुखपाठ होती. या ज्ञानाच्या भरोषावरच त्यांनी संपूर्ण जीवनभर सत्ताधा-यांवर व विरोधी पक्षावर एखाद्या राजाप्रमाणे सत्ता गाजविली, ती ही प्रज्ञा, शील, करुणा व मैत्री या बुद्ध तत्वज्ञानातील मूल्यांची जोपासना करीत, म्हणूनच आजही दादासाहेब गवई त्यांच्या कार्याच्या माध्यमातून अजरामर आहेत, त्यांना व त्यांच्या कार्याला विसरता येणे अशक्य आहे

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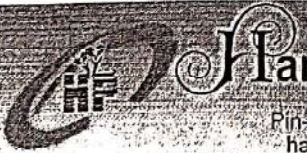
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मूल्यों के पतन पर व्यथित होकर सच्चाई बयान कर रहे हैं।

हिंदी गज़ल को दुष्यंतकुमार से आगे ले जाने में ज्ञानप्रकाश विवेक सफल हुए हैं। उन्होंने हिंदी गज़ल के कथ्य में व्यापक परिवर्तन किया है। आधुनिक चिंतन उनकी गज़लों में सर्वत्र परिलक्षित होता है। नव-नवीन विषयों को उन्होंने अपनी गज़लों के माध्यम से अभिव्यक्त किया है। महानगरीय जीवन की वास्तविकता का सूक्ष्म चित्रण आपकी गज़लों की महत्वपूर्ण विशेषता है। पर्यावरण बोध, नारी-विमर्श, जीवन-दर्शन जैसे विषयों को आधार बनाकर कहे गये आपके शेर पाठक के मन-मस्तिष्क को प्रभावित करते हैं। बदलते समय का प्रभाव आपकी गज़लों में स्पष्ट रूप से दृष्टिगोचर होता है। आशय एवं अभिव्यक्ति का सुंदर समन्वय ज्ञानप्रकाश की गज़लों में दिखाई देता है। अतः हम कह सकते हैं कि हिंदी गज़ल-साहित्य को संपन्न बनाने में ज्ञानप्रकाश विवेक की भूमिका महत्वपूर्ण रही है।

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पालि साहित्य में सरणत्तयं का महत्व

प्रा. डॉ. मोहन दे. वानखडे

राहयोगी प्राध्यापक, पाली प्राकृत विभाग प्रमुख,
डॉ. आंबेडकर महाविद्यालय, दीक्षाभूमी, नागपुर.

सारांश :-

पालि के अध्ययन का अनेक दृष्टियों से बड़ा महत्व है। आज अपनी अनेक प्रादेशिक बोलियों के, यहाँ तक कि कुछ अंशों में राष्ट्र भाषा हिंदी के भी, ध्वनि समूह आदि का पुरा ज्ञान हमें नहीं हो पाया है। अपनी भाषा के वर्तमान स्वरूप को समझने के लिए हमें पालि भाषा का वैज्ञानिक ढंग से अध्ययन करना ही होगा। पालि भाषा ने न केवल हमारी आधुनिक भारतीय भाषाओं को ही प्रभावित किया है। उसका प्रभाव सिंहल, ब्रह्मदेश, स्याम, कम्बोडिया और लाओस का भाषाओं के विकास पर भी पर्याप्त रूप से पडा है। पालि साहित्य ने विश्व के एक बड़े भू-भाग को शान्ति प्रदान की है, क्योंकि वह प्रधानता तथागत के सन्देश का वाहक है। उसका अध्ययन कर हम उस विशाल जन समुदाय से नाता जोड़ते हैं, जिसके साथ हमारे सांस्कृतिक और राजनैतिक सम्बन्ध नवयुग में और भी अधिक दृढ होंगे। यदि इस उपरी उद्देश को छोड़ दें तो भी विशुद्ध साहित्य की दृष्टि से पालि साहित्य के अध्ययन का प्रभुत महत्व है। पालि साहित्य के प्रकाश में हम देख सकेंगे कि भगवान बुद्ध का वास्तविक व्यक्तिमत्त्व क्या था और उन्होने जन समाज को क्या सिखाया था? पालि साहित्य का सबसे बड़ा महत्व वास्तव में उसकी प्रेरणादायी शक्ति ही है। पालि साहित्य के धम्मविचारोंने अधश््रद्धासे किसीका अनुसरण करना उचित माना नहीं जाता। इसीलिए 'सरणत्तयं' अर्थात् तिनो अनुसरण अधश््रद्धासे परे है। हम जब 'बुद्धं सरणं गच्छामि। धम्मं सरणं गच्छामि। संघं सरणं गच्छामि।' जैसे कहते हैं, तब मैं

बुद्ध के मार्ग का अनुसरण करता हूँ, धम्म के मार्ग का अनुसरण करता हूँ और संघ का अनुसरण करता हूँ। यह अनुसरण उच्च आदर्शों के प्रति व्यक्त होनेवाली सकारात्मक प्रतिक्रिया है। हम जब तथागत बुद्ध को नमन करते हैं, तब उन्होंने बताया हुआ विनय हमें मंजुर, स्वीकारणीय है और उसका पालन करने के लिए हम वचनबद्ध हैं यह उसमें प्रतिबद्धता होती है।

की-वर्ड:- पालि, राष्ट्रभाषा, शान्ति, तथागत के सन्देश, विशुद्ध, सरणत्तयं, बुद्ध, धम्म, संघ।

संशोधन पध्दती:- विश्लेषणात्मक और गुणात्मक संशोधन पध्दतीका उपयोग किया जाता है। इस संशोधन में प्राथमिक स्रोत्र, दुय्यम स्रोत्र, अनुवादित गुन्य आदि का उपयोग किया गया है।

संशोधन का उद्देश:- सरणत्तयं का अर्थ बुद्ध, धम्म और संघ का अनुसरण करना; बुद्ध, धम्म और संघ इन तिनो अनुसरणोंकी संकल्पना और महत्व स्पष्ट करना। यह इस संशोधन पत्र का उद्देश है।

गृहितके :- १. स्वातंत्र्य, समता, बंधुता और न्याय प्रदान करना २. मनुष्य को मनुष्यता प्रदान करना प्रस्तावना:-

मानवी जीवन में उत्पन्न होनेवाले दुःख यह अपने अग्यानतासे, अविचारोंसे उत्पन्न होते हैं। प्रग्याबुद्धीसे, विवेकबुद्धीसे आचरण न करने से उत्पन्न होते हैं। तथागत बुद्ध का धम्म यह इहवाद को स्वीकारनेवाला धम्म है, मानवतावाद को बतानेवाला धम्म है। यह धम्म मोक्ष प्राप्ति का, स्वर्ग प्राप्ति का धम्म नहीं तो असत्य को असत्य मानकर उसे नकारनेवाला धम्म है। विश्व के प्रत्येक मनुष्यने भ्रामक कल्पनाओं का त्याग करके, असत्य का त्याग करके और वास्तविकता को जाणकर अग्यानतासे आये हुये, अविचारोंसे आये हुये दुःखों से मुक्ति प्राप्त कर सकता है। इसपर तथागत बुद्ध के धम्म का विश्वास है। इसीलिए तथागत बुद्ध के धम्म को, मानवी समाज को गुलामी के मानसिकतासे मुक्त करके स्वतंत्र विचारों की दिशा देनेवाला, सम्यक आचरण करने की प्रेरणा देणेवाला धम्म कहा गया है। अन्य धर्मोंके समान इश्वर की आराधना करके उनके पास अच्छा जीवन प्राप्त होणे के लिए याचना करना यह उद्देश बुद्ध, धम्म और संघ का वन्दन करते हुये नहीं रहता। बुद्ध को अपना प्रेरणास्थल मानना, उनके धम्म के नुसार आचरण करना

और संघ का घटक बनकर अन्य लोगों को उस तरह आचरण करने के लिए प्रेरित करनेवाले संघ का अनुसरण करने की 'सरणत्तयं' यह एक प्रतिग्या है। इसीलिए जब हम 'बुद्ध सरणं गच्छामि।' और जब हम कहते हैं, तो किसी एक व्यक्ति को या सिध्दार्थ गौतम को सरण जाने के लिए हम प्रतिग्या नहीं करते, तो जिस मानवने अपने स्वं प्रयासे सम्यक संबोधी प्राप्त की है, उस प्राप्त किए हुये सम्यक सम्बोधि को, अपने जीवन का आदर्श माननेवाली वह प्रतिग्या रहती है। इसलिए 'बुद्धं सरणं गच्छामि' और जब हम कहते हैं तब ऐसे बुद्ध के अनुसरण करने की वह प्रतिग्या रहती है, जो अरहत है, सम्यक सम्बुद्ध, विग्या और आचरण से संपन्न है, सुगतीको प्राप्त हुआ है, लोगो में विव्यन है, अनुत्तर है पुरीस्सं धम्म सारथी है, सभी का शास्था है। और इस अनुसरण स्वयं की स्वयं को पैच्छाण बनानेवाला अनुसरण है। इस अर्थ से हम धम्म का भी अनुसरण करते हैं क्योंकि तथागत बुद्ध का धम्म यह प्रज्ञा, सील, समाधि का मार्ग है। यह मार्ग मानवी जीवन के विकास का मार्ग है। अच्छी तरह बताया हुआ धम्म है उसके नुसार आचरण करने से अपने आँखों के सामने यह फल देणेवाला धम्म है। कालांतर से नहीं तो तत्काल फल देनेवाला यह धम्म है। इसीलिए इस धम्म को 'एहि पस्सिको' अर्थात आजो और देखो 'ऐसा कहा गया है।' इसलिए 'धम्मं सरणं गच्छामि' और जब हम कहते हैं तब ऐसे धम्म का अनुसरण करने की हम प्रतिग्या करते हैं। मुझे इसी मार्गसे जाना है, यही मार्ग कल्याण का है, विकास का है, ऐसी उस प्रतिग्या में प्रतिबद्धता होती है। तथागत बुद्ध ने संघ की स्थापना क्यों की? इसपर डॉ.बाबासाहेब आंबेडकर इन्होंने कहा "बहुजन समाज को जीवन कैसे जिना चाहिए? इसका आदर्श समाज पर रहने हेतु बुद्ध ने संघ की स्थापना की। आगे बाबासाहेब कहते हैं- केवल आदर्श ही समाज के सामने रखना पूरा नहीं तो वह आदर्श आचरण में किस तरह लाना? यह लोगों को अच्छी तरह शिखाना चाहिए, उन्हें समझाना चाहिए इसीलिए बाबासाहेब ने कहा है की, आदर्श मानवी जीवन का मार्ग दिखाने के लिए और लोगों को शिखाने के लिए ऐसे दो कारनों के लिए तथागत बुद्ध ने संघ की स्थापना की, अच्छा मनुष्य बनने के लिए जिस तरह धम्म की आवश्यकता है उसी तरह ऐसा

यह धम्म समाज तक पहुँचाने के लिए, धम्म का प्रसार-प्रचार करने के लिए संघ की भी आवश्यकता है, इसीलिए यह संघ विद्वान, प्रज्ञावान, सीलवान, समाज का प्रबोधन करनेवाला, समाज को सम्यक रूप से संस्कारीत करनेवाला, समाज के प्रति अच्छी भावना रखनेवाला होना चाहिए, ऐसी बाबासाहब की इच्छा थी। जैसे संघ का आदर्श समाज के सामने रहना चाहिए, किस तरह जीना चाहिए? किस तरह व्यवहार करना चाहिए, बर्ताव करना चाहिए? किस तरह रहना चाहिए? इसका आदर्श संघ यह समाज के सामने रखेगा और उसी तरह समाज उनका अनुसरण करेगा, इस उद्देश्यसे तथागत बुद्ध ने संघ की स्थापना की। इसीलिए 'संघं सरणं गच्छामि' जैसे जब हम कहते हैं, तब बुद्ध के धम्म की विचारधारा जो लोग समाज में प्रवाहित करते हैं, उस आदर्श समाज की रचना करनेवाले संघ को अनुसरण करने की प्रतिग्या हम लोग करते हैं ऐसा इसका अर्थ है। इसलिए भिक्खू संघ का भी तथागत बुद्ध ने बताए हुये विनय के नुसार आचरण करना अनिवार्य है। तथागत बुद्ध ने भिक्खू के प्रति अपेक्षा की है कि, जिसने चित्तमल का परिमार्जन किया है, जिसमें सद्गुणों की वृद्धि हुई है, जो सत्य और संयम पालना शिखा है, वही सही अर्थ में काषाय वस्त्र का अधिकारी है।¹ इसतरह बुद्ध, धम्म और संघ का महत्व जानकर ही डॉ. बाबासाहब आंबेडकर इन्होंने अपने, 'बुद्धा अण्ड हिज धम्मा' इस ग्रंथ के समर्पण में इस सरणतय को महत्व देकर धम्मपद की गाथा नमुद की है, जो इस तरह है— 'सुखो बुद्धानमुप्पादो सुखा सध्दम्मदेसना। सुखा संघस्स सामग्गी समग्गान तपोसुखो।'² अर्थात् 'बुद्ध का जन्म सुखकारक है, सध्दम्म का उपदेश सुखकारक है, संघ में ऐक्य सुखकारक है और एकतायुक्त होकर तप करना सुखकारक है।'

तथागत बुद्ध चारिका करते हुये उनकी विभिन्न जगह विभिन्न लोगों से मुलाखत होती थी। कभी धनवान ब्राह्मण से, तो कभी परिव्राजक से, तो कभी राजपूत्रों से, तो कभी मागास लोगोंसे, तो कभी दीनदुर्बलो से। जैसा—जैसा संभाषण गहरा बन जाता था, वैसे—वैसे बुद्ध अपने अनुभवोंके गहराई से बोलते थे। बुद्ध जब धम्म को स्पष्ट करते थे, तब प्रत्यक्ष धम्म ही व्यक्त होता था। तथागत बुद्ध सत्य को स्पष्ट करते थे।

बुद्धत्व की ओर ले जानेवाले मार्ग का दिग्दर्शन करते थे, और उनका वह कहना, उनकी वह देसना सुनकर सुननेवाला अचानक आश्चर्यचकित होता था, प्रभावित होता था। कभी—कभी तो उनको कुछ कहना भी कठिन हो जाता था। कुछ क्षण के लिए ही, क्यों न हो, उन्हें सत्य का दर्शन होता था। भावना विद्वल होकर घोपना करते थे— 'बुद्धं सरणं गच्छामि'। 'धम्मं सरणं गच्छामि'। 'संघं सरणं गच्छामि'। मैं बुद्ध, धम्म और संघ का अनुसरण करता हूँ और यही सरण गमन का उगमस्थान हुआ।

बुद्ध एक प्रबुद्ध मानव थे। वे अपने स्व—प्रयत्न से मानविय पूर्णत्व के शिखरपर पहुँचें जैसे मानव थे, जिन्हे हम 'बुद्धत्व' कहते हैं। लेकिन वह केवल बुद्ध ही नहीं थे, तो सम्यक सम्बुद्ध थे।³ इसलिए हम जब बुद्धानुसरण करने की प्रतिग्या करते हैं, तो यही अर्थ से। बुद्ध सही अर्थ में अपने अंतर्मन का साकार रूप हैं। अपने सर्वस्व का सार हैं। 'इतिपि सो भगवा अरहं, सम्मासम्बुद्धो, विज्जाचरण सम्पन्नो, सुगतो, लोकविदू, अनुत्तरो, पुरिसदम्मसारथि, सत्था देव मनुस्सानं बुद्धो भगवा'ति। बुद्ध किसे कहते हैं और उनका अनुसरण क्यों करना चाहिए, इसके लिए यह गाथा महत्वपूर्ण है। भगवा— जिन्होंने अपनी वासना भग्न की है, वह भगवान; अर्हत— जिन्होंने इस संस्कारचक्र के आरे ग्यानरूपी शस्त्र से नष्ट किए हैं, पापकर्म करने का प्रयोजन ही नहीं रहा वह व्यक्ति; सम्यक सम्बुद्ध— जिसने धम्म का ग्यान स्वप्रयत्न से और ज्ञानदृष्टि से प्राप्त किया है, वह व्यक्ति; विज्जाचरण सम्पन्नो— जो विद्या और आचरण से सम्पन्न है, जिन्होंने सीलयुक्त ग्यान प्राप्त करके यह आचरण में लाया है, वह व्यक्ति; सुगत— जो उत्तम गति को पहुँचा है, वह व्यक्ति; लोकविदू— जो लोगों की प्रवृत्ति जाननेवाला है, वह व्यक्ति; अनुत्तरो— जो सर्वश्रेष्ठ है, जिसके जैसा कोई नहीं, जिसकी तुलना किसीसे नहीं हो सकती, वह व्यक्ति; पुरिसदम्मसारथि— मन का दमन करने के लिए सर्वोत्तम सारथि; सत्थादेवमनुस्सानं— जो सीलवान, सज्जनों का, सामान्यजनों का शास्था है, ऐसा व्यक्ति; बुद्ध— जो धम्म मार्ग के ग्यान से प्रकाशमान हुआ है, ऐसा व्यक्ति।⁴ जैसे व्यक्ति को जब हम नमन करते हैं तब उन्होंने दिया हुआ विनय, शिस्त हमें मान्य है और उनका पालन करने के लिए

हम वचनबद्ध हैं, यह कहने के लिए ही हम 'बुद्ध सरणं गच्छामि' ऐसी प्रतिग्या करते हैं।

तथागत बुद्ध का धम्म 'बहुजन हिताय, बहुजन सुखाय' है। उनका प्रत्येक सिद्धान्त मनुष्य विकास के लिए कल्याणकारी है। तथागत के धम्म में 'सील' यह प्रारंभ और अंतिम है। सभी कल्याण का वह उगमस्थान है। सभी कुशल अवस्थावोंसे वह सर्वोत्तम अवस्था है। प्रज्ञा और करुणा यह भी उनके धम्म के आधारस्तंभ हैं। धम्म में कर्मकांड, अंधश्रद्धा, यज्ञ, आत्मा, परमात्मा इनका कोई स्थान नहीं है। तथागत बुद्ध ने अपने धम्म का आचार-विचार उत्तम प्रकार से बताया है। उसकी प्रचिती हम ले सकते हैं धम्म मार्ग का अनुसरण करनेवाला तत्काल फल का अधिकारी हो सकता है। कोई भी व्यक्ति इसका अनुभव ले सकता है। निर्वाण प्राप्ति का केवल सदैव नहीं, तो मार्ग बतानेवाला यह धम्म है। विज्ञाननिष्ठ, बुद्धिप्रामाण्यवादी इसके अलावा सामान्यजनों को भी सहजता से समझ में आयेगा, ऐसा ही इस धम्म का सार है। तथागत बुद्ध का धम्म यह सदाचार की शिक्षा देनेवाला धम्म है। पृथ्वीपर सदाचार का राज्य प्रस्थापित करना यह उसका उद्दिष्ट है। तथागत बुद्ध का धम्म यह बुद्धिवादी है और वह धार्मिक कर्मकांडोंसे मुक्त करनेवाला मार्ग है। तथागत बुद्ध मैत्री, करुणा, बंधुता की शिक्षा देते हैं, जो मनुष्य को अपने बांधों की बन्धमुक्तता करने में सहाय्यभूत होती है। ऐसा यह धम्म मानवों के कल्याणार्थ हितकारक है। इसलिए इस धम्म का अनुसरण सबसे श्रेष्ठ अनुसरण है।

तथागत बुद्ध के धम्म का अनुसरण करने का और भी कारण है वह यह है की, इसमें अतिशयोक्ति नहीं है, तो वास्तविकता है इसीलिए तथागत के धम्म को 'ऐहि पस्सिको' कहा गया है। तथागत बुद्ध का मानविय रूप हमें पालि साहित्य में देखने को मिलता है, कहीं भी उनका दैवी रूप हमें देखने को नहीं मिलता। महायानी संस्कृत साहित्य में यह प्रयास किया गया है। तथागत बुद्ध ने स्वयं कहा है कि, 'मै मोक्षदाता नहीं तो मार्गदाता हूँ।' इसीलिए इस सरणत्तयं का उद्देश्य यही है कि, तथागत के शिक्षा को जानना, आचरण करना और समाज में अन्य लोगों तक धम्म का प्रसार-प्रचार करना। इसमें स्वयं के कल्याण के साथ-साथ हि शोषित-पिडीत, उपेक्षित, मागास समाज का भी कल्याण अभिप्रेत है।

मूल्यांकन:- तथागत बुद्ध का धम्म यह

मैत्री, करुणा, बंधुतापर आधारित है। उन्होंने अपने पुरे आयुष्य में मनुष्यमात्राका ही हित चाहा है। इसीलिए विषमतामूलक व्यवस्था का उन्होंने विरोध कर समाज में समता स्थापित करने का भरकस प्रयास किया। उनके प्रयास स्वरूपही आज पुरे बहुजन समाज को उनका हक्क और अधिकार संविधान के माध्यम से हमें प्राप्त हुये हैं। क्योंकि डॉ.बाबासाहब आंबेडकर इनपर बौद्ध धम्म का काफी प्रभाव था इसीलिए स्वातंत्र्य, समता, बंधुता, न्याय यह मूल्ये बाबासाहबने संविधान के माध्यम से हमें दिये हैं। इसीलिए बाबासाहब चाहते थे कि, तथागत बुद्ध का यह धम्म भारत के बहुतांश लोगों ने स्वीकारना चाहिए, वह भारत बौद्धमय करना चाहते थे। लेकिन भारतीय विषमतामूलक मानसिकता के वजह से उनका सपना साकार नहीं हो सका। आज भी सामाजिक परिस्थिती में कोई खास बदलाव दिखाई नहीं देता। उल्ट विषमतामूलक वर्णव्यवस्था प्रस्थापित करने की दृष्टिसे प्रयास होते दिख रहे हैं। तथागत बुद्ध का धम्म इसी भारत देश में उत्पन्न हुआ और इसी देश ने इस महानत्तम धम्म को नष्ट भी किया था। आधुनिक काल में डॉ. बाबासाहब आंबेडकर इन्होंने इस धम्म को पुनर्स्थापित किया है। भारत के बाहर अन्य देश इस धम्म का स्वीकार कर विकास की ओर बढ़ रहे हैं, लेकिन खेद की बात यह है कि, अपने भारत देश में ही इस धम्म के प्रति अच्छी भावना तो दूर लेकिन ब्देषमूलक भावना प्रतित होती है। बौद्ध धम्म का अध्ययन करने से यह स्पष्ट होता है कि, बौद्ध धम्म में मन शान्त और शुद्ध रखने कि ताकद है, जो अन्य किसी धर्म में शायद हि मिले। इसीलिए बाबासाहब ने कहा था- 'बौद्ध धम्म का बेस यह समता का है।' ऐसा यह बुद्ध धम्म हि भारत कि अखंडता कायम रख सकता है। भारत देश को पूरीतरह से स्वातंत्र्य, समता, बंधुता, न्याय, मैत्री और सही अर्थ में मुक्ती के मार्ग की ओर ले जा सकता है। ऐसे धम्म का हम सभी नें मिलकर प्रसार-प्रचार करना चाहिए। १३७ कोटी जनसंख्या के इस देश में आज भी वैधानिक दृष्टिकोन निर्माण नहीं हो पा रहा है। शिक्षा का प्रमाण बढ़ रहा है, लेकिन मानवतावाद, बुद्धिप्रामाण्यवाद, विज्ञानवाद समाज में आज कोसो दूर है। कुछ लोग जरूर अपवाद होंगे। ऐसा क्यों हो रहा है? इसपर

आज तथाकथित शिक्षित लोगो ने विचार करने की आवश्यकता है।

बुद्ध का धम्म यह सर्वव्यापी मानविय आवश्यकता ध्यानमें लेकर विकसित किया गया है। व्यक्ति के विकास को, समाज के विकास को संरक्षण देने के लिए ही बुद्ध धम्म में नीती का प्रयोजन है। व्यक्तिको विकृति से दूर रखने का उपाय यह तथागत बुद्ध का धम्म है। असा धम्म समाज में प्रसारीत करनेवाले संघ के भिक्षु और उपासक यह दो पहिये है। इस संघ के खडतर प्रयास से ही आज पूरे विश्व में बुद्ध, धम्म और संघ का अनुसरण हो रहा है। इसलिए भारतीयों ने अपनी मानसिकता में कुशल रूप से, सम्यक रूप से बदलाव लाने की आवश्यकता है और 'बुद्धं सरणं गच्छामि'। 'धम्मं सरणं गच्छामि'। 'संघं सरणं गच्छामि'। इस सरणत्तयं का अनुसरण करने की अपने स्वयं के कल्याण के लिए और समाज के कल्याण के लिए अति आवश्यक है, क्योंकि बुद्ध का धम्म यह धर्म नहीं है तो वह जीवन जीने का मार्ग है। इस मार्ग पर मानविय कल्याण के लिए मार्गक्रमण करना सभी के हित के लिए है।

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मध्यकालीन कवियों में संत कवि महात्मा कबीर का सामाजिक एवं साहित्यिक योगदान महत्वपूर्ण है। मध्यकाल का यह वह समय है, जब भारत में मुस्लिम शासक सिकंदर लोदी की सत्ता थी। तथा सत्ताधियों का धर्म इस्लाम था, और भारत में हिंदू धर्म था। इसके अलावा जैन, बौद्ध, शिख आदि धर्म भी थे। हिंदू और मुस्लिम शासक अपने अपने धर्म और जाति का विचार करके अपने अपने राज्य का विस्तार करने के लिए एक दुसरे से लड़ते रहते थे। हिंदू और मुस्लिम धार्मिक श्रेष्ठता के अहं के कारण एक दूसरे को निचा दिखाने में लगे रहते थे। इन दोनों धर्मों पर पंडित मुल्ला, काशी वर्ग का वर्चस्व था। मुस्लिमों में शिया, सुनी, सूफी वर्गों का संघर्ष था, तो वही हिंदूओं में ब्राह्मण, क्षत्रिय, वैश्य, क्षुद्र आदि वर्गों का संघर्ष था।

जाति पाँति, उँच —नीचता, कर्मकांड, पूजा, तीर्थाटन, पोथि — पुराण, नमाज, हज यात्रा आदि अनेक कुरीतियाँ प्रचलित थी। उस समय कबीर का जन्म हुआ। कबीर के जन्म तिथी के बारे में मतभेद है परंतु अधिकांश विद्वानोंने कबीर का जन्म इसविसन १३९८ तथा मृत्यु १५१८ मानते हैं। वे नीरू और नीमा के पुत्र थे, तथा उनकी पत्नी का नाम 'लोई' था। उन्हें कमाल और कमाली नामक दो संताने थी। उनके गुरु का नाम अधिकांश विद्वान 'रामानंद' कोही मानते हैं।

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शिक्षक-मूल्यांकन के लिए एक व्यापक, खुली, प्रतिभागी और आंकड़ा आधारित पद्धति स्थापित की जायेगी। जो थोड़े बहुत शिक्षक अपना निष्पादन नहीं दे सकते अथवा ध्यानपूर्वक काम नहीं करते उन्हें अलग कर दिया जायेगा और जहाँ आवश्यक होगा उन्हें समुचित दण्ड भी दिया जायेगा।

अतः शिक्षकों को चाहिए कि वे अपना कार्य जिम्मेदारी के साथ करें। शिक्षण एक पवित्र कार्य है। इस पवित्र कार्य हेतु उन्हें सुअवसर प्राप्त हुआ है। इसके माध्यम से वे मानव सेवा कर अपने जीवन के लक्ष्य को प्राप्त कर सकते हैं। शिक्षकों के मूल्यांकन की व्यवस्था होनी चाहिए और जो इसमें खरे न उतरते हों उनके लिए कुछ दण्ड का प्रावधान होना चाहिए। सरकार को प्राइवेट स्कूलों के शिक्षकों की समस्याओं की तरफ ध्यान देने की आवश्यकता है। इन स्कूलों के शिक्षकों के चयन की जिम्मेदारी सरकार के अधीन किसी राज्य स्तरीय संस्था के पास हो। इन शिक्षकों को सम्मान जनक वेतन दिलाने के साथ-साथ उनकी नौकरी की गारंटी की भी व्यवस्था की जानी चाहिये।

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तथागतस्स धम्मो—जातब्बो, उग्गण्हितब्बो

मोहन दे. वानखडो

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डा. आम्बेडकर महाविज्ञालयो, दीक्खाभूमि, नागपुरे

सारांस :

मनुस्सायत जीवितो अयं अति सरूपीतिं तं कीदिस पकारेन विकसितस्स अयं मनुजानं हत्थे अत्थि। यथासभावेन मनुजो यच्च सम्भते सज्जात होति ताणि सम्भतानुरूपेत्तव आचरणस्स तस्स चेतसिकविज्जा (मानसिकता) भवति। अथ सा सम्भता पूब्बपारम्मारिको धम्मात्थ पकारस्स भवेय्य उदाहु विव्यानता मानुसिकता भवेय्य तस्मा'व सङ्घणिकारस्मिं एवं बहुलं वेज्जो, वकिलो, यन्तसिणी, अधिकारियो, विज्जाविसारदो पस्सति, यं उच्च सिक्खितो भवत्वापि पूब्बपारम्मारिको मिच्छुगमतिस्मिं पतिट्टाने कम्मकाण्डो कुब्बन्तो अम्हे पस्सति। पय्याबुद्धिस्स अभावेन एवं होति। सचे पच्चेक पुग्गला तिकिच्छको पय्यस्स उपसेवि, सम्मा किं? असम्मा किं? किं सच्चं? किं असच्चं? यस्स सचे चिन्तयि पुग्गलो परम्परागतो चिन्तनानं पहाय सो तथागतस्स जनहिताय चिन्तनस्स पटिगण्हासति, एवं सामत्थियो तथागतानं चिन्तनेसु 'ति। तस्मा' व तथागतानं चिन्तनानं अज्ज सकल लोकेस्मिं पसारती 'ति।

पवेसना :

तथागतो धम्मपदे भासन्ति—'यं किञ्चि उपज्झति तं मने'व उपज्झति। सचे अम्हे दुट्ठ चिन्तना वा दुट्ठ कम्मं करेय्युं, दुक्खो अम्हे अनुबन्धना तथेव करेय्युं यथा गोनं पादं गोसकटानं चक्का करोन्ति। विपरियायेन दुतिया गाथायो अत्थि, सच्चे अम्हे सम्मा चिन्तना करेय्युं वा सम्मा कम्मं करेय्युं (करेय्यामपि), सुखो अम्हे अनुगच्छन्ति यथा कूदाचनं पि अम्हे सद्धिं न

पञ्चहन्ता छाया।^२

उपरिय गाथाय इदं पाकट भवति, सम्मा दुडानं अम्हे अत्तनो 'व धुखाही सन्ति। तस्मा 'व तथागतो कथेन्ति—'अत्तहि अत्तनो नाथो, कोहि नाथो परोसिया। अत्तनाव सुदन्तेन नाथं लभति दुल्लभं।।'^३ अत्थेत मनुजो अत्तनो 'व अत्तानं सामी अत्थि, तस्स अय्य कोवि पि सामी मा सक्कोती 'ति। सचे सो अत्तं सय्यमेति अकरि, इवा सो दुल्लभो यसं अप्पोति। तस्मा तं मनस्स कुसलो मसागतो करोते आवस्सकती 'ति। चित्तं अतिव परिसुध्दते आवस्सकती 'ति। मनुजो बुत्ति एवं अत्थि, सो अय्यानं विसयी अनावस्सको बुत्तान्तो ठपेति, तस्स पसार—पचार पि करोति—अमुको मनुजो एवं अत्थि, तमुको मनुजो एवं अत्थि, किं तु अत्तनो अम्हे किं अत्थि? एवं सो अवधान मा नत्थि। तस्मा मनुस्सेन सब्बपठमो अत्तनो मनेस्सिं पस्सितब्बं। मयि किं असावत्थिय सन्ति? तं ममं कथं आरायिस्सति? अय्ये सद्दे एवं कथेन्तस्सति, अम्हे अत्तनो अन्तोय्यनस्स निरिक्खणो कातब्बं, इमं 'व 'विपस्सना' कथेन्ति।^४ अत्तनो मनेस्सिं विसेस पकारेण पस्सते अत्थेत 'विपस्सना'। तं व अम्हे अत्तनो मनो थिर च नीतीसत्था च आरक्खको कताकारिता 'ति। एवं पकारेस्स मनो 'व सुखिता च प्मुदिता च तुत्थी—सन्तुट्ठि जीवीतो जीवितुं समत्थाती 'ति। इमायो विसयी तथागतेन अतिमत्त सम्मा व अगाध च व्यावच्छेद (विभाजना) अकरि। तथागतो बुध्दस्स धम्मस्स सच्चं पयोजनं अयं जीवेतेस्सिं परिपूणता पापुनेती 'ति। किं तु तस्स चित्तं परिसुध्दते आवस्सकती 'ति। परिसुध्दो मनेस्सिं 'व कुसलो कम्मानं उपज्जन्ति। तथैव तथागतेन कथेती 'ति — 'सब्ब पापस्स अकरणं कुसलस्स उपसम्पदा। सचित्त परियोदपणं एतं बुध्द वानसासनं।।'^५ अत्थेत कीदिसा 'व पकारेण मा पापं करोते, कुसला कम्मानं सख्यतेच चित्तं परिसुध्दते इमं 'व बुध्दानसासनं, बुध्दस्स धम्मो अत्थि। कीदिसा 'व पकारेण मा पापं करोते, कुसला कम्मानं च सख्यते च चित्तं परिसुध्दते अत्थेत कायेन, वाचेन च मनेन च कुसलो कम्मं करोते। मनुजे पाणातिपाता, अदिन्नदाना, कामेसुमिच्छाचार एतम्हा पटिविरतस्स कायस्स पवित्तता उपज्जति। वाचाय सुध्दतेन असच्चं वदम्हा पटिविरति, फरुसा वाचा, पिसुणा वाचा च सम्फप्पलापो च एतं

सब्बे वाचाय दुट्ठो कम्मेहि पटिविरती 'ति। चित्ताय सुध्दतेत अभिज्झाव्यापादा मिथ्यादिट्ठिया इमायो किलेसानं मनेस्सिं मा आगच्छस्सन्ति 'व ठानं न लभति। इमे किलेसानं मनेस्सिं मां आगच्छस्सन्ति 'व इमस्स बुद्धं रता आदातब्बं। इदं पकारे अम्हे चित्तं किलेसेहि पटिविरतो सक्कोति। अयं 'व धम्मस्स मेट्ठो उद्वेसो अत्थि। लोकेस्सिं पच्चेक मनुजे सुखितो प्मुदिता सन्तुट्ठि मनस्स सान्ति केवलं एतस्स 'व मग्गेण लभिते सक्कोति। इमे मग्गेस्सिं किच्चि पि पूजानुगता (कम्मकाण्डो) नत्थि। अयं मग्गो जीवितस्स अति सरलो च यमो च अयं मग्गो अत्थि। मग्गो अयं विचरन्तु सन्ति, ततो पच्चेक मनुजे अयं मग्गस्स अनुसरणं कातब्बं।

धम्मोस्सिं नीतीसत्था:

तथागतस्स धम्मो मनुस्सायत्त जीवितं, मनुस्सायत्त जीवितेस्सिं नीतीसत्थं अत्याधिकं प्थान (मुख्यताय) ददाति। तथागतस्स धम्मो अयं विवेकबुद्धि दं अनुकरोतिस्स कथेति अत्थेत चिन्नेतिसामत्थिय अनुकरोतिस्स कथेति, नीतीसत्थं अनुकरोतिस्स कथेति तस्मा 'धम्मं सरणं गच्छामि' एवं यदा अम्हे कथेन्ति तदा एवं धम्मं अनुकरोतिस्स अहं पटिय्या कामेि एवं तस्स अत्थो होति। तथागतस्स अयं धम्मो मनुजो मूलद्वनी 'ति। अयं धम्मो किच्चि पि विसिद्ध वण्णस्स, जच्चस्स, वग्गस्स नत्थि कारणो (हेतूयो) अयं धम्मो विनिच्छय पटिविरती 'ति। लोकेस्सिं यो—यो मनुजो अचिन्तेन आकरुड्ढसामत्थिस्स अभावेन पिलेतिस्सति, ताणि—ताणि पच्चेक मनुस्सायत्त घटकस्स अयं धम्मो अत्थि। कारणो तथागतस्स धम्मो इमं पटिगण्हाति, मनुस्सायत्त जीवितेस्सिं आगच्छन्ता दुक्खे इमे अचिन्तेता 'व निम्माणो होन्ति, आकरुड्ढसामत्थिस्स अभावेन 'व निम्माणो होन्ति, अविज्जेन 'व निम्माणो होन्ति, मनुजे—मनुजेसु विनिच्छयनीतीता 'व निम्माणो होन्ति, मनुस्सेस्सिं पय्याबुद्धि दं ना हिता 'व निम्माणो होन्ति। धम्मस्स तत्तय्यान इमे अवितात्थ जीवितं पटिगगाहक तत्तय्यानी 'ति। असच्चं असच्च मानित्वा तस्स पटिक्खिपक तत्तय्यानी 'ति।

धम्मोस्सिं पय्या :

मनुस्सायत्त सग्डनिकारतेन असच्चस्स पहाय सच्च पटिगहता, मनोविय्यानं (विवेकबुद्धिं) पटिगहता सो आगच्छन्त दुक्खेस्सिं अत्तहि अत्तस्स विमुत्तित्ता

करोतरस्स सककुनाति। अत्तरस्स मेधा (बुद्धि) उपसेवितस्स साधिनता, अत्तनो विवेको उपसेवितस्स आधिपच्च पि पकतिनेन मनुजानं दिन्नं महादानं अत्थि। तस्मा मनुजं सम्मा किं अत्थि? असम्मा किं अत्थि? सत्तु किं अत्थि? मित्तो किं अत्थि? इमस्मिं अन्तरा बुज्झितब्बो। अत्तनो सकत्थपरतस्स विसेस वग्गस्स अत्तनो सकत्थपरतस्स सत्तु पि मित्तस्स आयत्तकम्मे सग्ङणिकारतस्मिं आहिण्डतुं सककोति, एवं कालेन अत्तनो अत्तस्स पय्याबुद्धिस्स उपसेवितब्बं। इमस्स 'व तथागतेन कालामाजने उपदेसन्त कथयि (तथागतेन बुत्त वचनो)–

‘अहं कथामि तस्मा मयि विस्सास मा ठापेल, आक्खातुतस्स, पुग्गलिकत्त सम्मा अत्थि तस्मा तस्मिं विस्सास मा ठापेतु, अक्खातु मम गरूकातब्ब–गरूतो अत्थि तस्मा तस्मिं विस्सास मा ठापेतु, ते धम्मिका–धम्मसग्ङतो अत्थि तस्मा तस्मिं विस्सास मा ठापेतु, यायनुग (बुद्धिसग्ङतो) अत्थि तस्मा तस्मिं विस्सास मा ठापेतु, यायसग्ङतो अत्थि तस्मा तस्मिं विस्सास मा ठापेतु, ततो यावता तुम्हाकं सचेतनं (विवेकबुद्धिं) संसन्दत नत्थि च तस्मिं विस्सास ठपेत्वा ते सब्बेजनानं हितस्स 'व भविरस्सति एतं यावता तुम्हाकं सावधारणेन संसन्दत नत्थि तावता तस्मिं विस्सास मा ठापेतु। तथागतस्स इमं उपदेसो सग्ङनिकारतस्स विय पुग्गलो साधिनताय घोसनापत्तो 'व अत्थि। अत्तदीपा विहरथ, अत्तसरणा' एवं उपदेसो दायका तथागतो लोकेस्मिं सकिद 'इव सन्ति (आदरसुचक अनेकवचन)। तस्मा 'व तथागतस्स धम्मो इमे लोकेस्मिं सब्बे धम्मेस्मिं सेट्ठो धम्मो अत्थि। परियोसानं :

अज्ज देसस्मिं कलुसिकरण, बलक्कार, सोसणो, पारूपण, चोरिय, जातिवादो, उच्च–निच्चतो सरकारियं (राज्जानुसासन) करियालयस्मिं किं चि पि कम्मं कम्मचारियं, अधिकारियं मूला दिन्नासिवा न भवन्ति। अज्ज मनुस्सो इति काममिच्छाचारी अभवि, तं वयस्स, याजिस्स अन्तरा पि मा जानाती 'ति। इमे अधोस्स थरेस्मिं मनुजस्स नीतीसत्था संसिदती 'ति। इमं मनुजानं अविज्जा, धम्माश्रता (आधानगाहिता) कारणभूती 'ति। कारणेन अज्जपि बहुलं मनुजानं एवं मिच्छागहना अत्थि, अम्हे कीवतिक पि पापकम्मे अकरि इव पि देवस्स पूजना–याचना अकरि, मन्दिरे दानं ददासि, इव अम्हे पापम्हा मुत्तो भवन्तु (भवेय्य पि)। अयं अज्ज पि

सग्ङविकारतस्स विज्जमानती 'ति। यं नत्थि (इस्सरो) तयि विस्सास ठपेतकानं सग्ङया अति बहुलं सन्ति। तस्मा एत दसास्मिं बुद्धधम्मस्स पसार–पचारो करोते इमे एको दिब्ब एवं कम्मो अत्थि। तस्मिं एक व उपायो अत्थि यं पि बुद्धानुयायी 'न्ति, ते सब्बे धम्मानं सम्मुखे एको आयत्तकम्म आदिसिया–रूपा (रोलमडिल) निन्नेय्युं एवं आचरेन्तुं यथापरं 'व ते अम्हे समत्ता अभिबुद्धि परिसत्त्वा बुद्धधम्मस्स अनुगामिस्सन्ति एवं चिन्तति।

अज्जस्स कोरोनाय भयानको दारूणो अवत्था, तथागतस्स उपदेसानं महत्ता दस्सेतुं 'ति। यं किञ्चि करोतिस्सती ति, ते मनुजं 'व करोतिस्सती 'ति, तस्स कम्मेसु 'व तस्स अवत्था अवलम्बती 'ति। तस्मा अज्ज सब्बे देवडाना, मस्जिदा, देवायतना ओसानो 'न्ति। पूजना, कम्मकाण्डो निरत्थकी 'न्ति। इमे कोरोनेस्स रूपेण तथत्तं भवती 'ति। तस्मा तथागतस्स विव्यानना, मानुसिकत्ता (मानवतावाद) चिन्ततेन 'व मनुस्सायत्त अभिबुद्धि सककोती 'ति, इमे 'व अज्जस्स आवस्सकतो 'ति। तथागतस्स इमे वचनेन अहं लिखिते निडितामि– 'सब्बे सत्ता सुखि होन्तु, सब्बे होन्तुच खेमिने। सब्बे भद्दाय पस्सन्तु, मा कच्चि दुक्खमागमा।' सन्दब्बो गन्था :

१. धम्मरक्खितो, भिक्खु, धम्मपद, महाबोधि पोत्थक भण्डार, सारनाथ, वाराणसी, यमकवग्गो, गाथा ०१, पा.०१
२. धम्मरक्खितो, भिक्खु, धम्मपद, महाबोधि पोत्थक भण्डार, सारनाथ, वाराणसी, यमकवग्गो, गाथा ०२, पा.०२
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Environmental Pollution and Diseases: Issues, Challenges and Remedies

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Abstract

Different types of environmental pollutions such as Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, and Plastic Pollution are rampant in today's world due to industrialization and lot of other man-made issues. Their causes and remedies are discussed in detail in this paper. Also discussed in detail is how pollution contributed by human beings are effective in causing various diseases. Steps are also suggested to overcome these pollutions and environmental cleansing.

Keywords: Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, Plastic Pollution

1.1 Introduction

Pollution is the introduction of contaminants into the natural environment that causes adverse change [1]. Pollution can take the form of chemical substances or energy such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances or naturally occurring contaminants. Pollution is often classified as point source or non-point source. In 2015, pollution killed 9 million people in the world [2][3]. Major forms of pollution include air pollution, light pollution, littering, noise pollution, plastic pollution, soil contamination, radioactive contamination, thermal pollution, visual pollution and water pollution. Environmental Pollution is the addition of any substance (solid, liquid, or gas) or any form of energy (such as heat, sound, or radioactivity) to the environment at a rate faster than it can be dispersed, diluted, decomposed, recycled or stored in some harmless form. Modern society is also concerned about specific types of pollutants, such as noise pollution, light pollution, and plastic pollution [4].

.2 Air pollution

According to the World Health Organization (WHO), air pollution is linked to 7 million premature deaths. Here is a breakdown of the diseases air pollution causes: [5]

Air pollution diseases:

- ischaemic heart disease.
- stroke.
- chronic obstructive pulmonary disease.
- lung cancer.
- acute lower respiratory infections in children.
- different types of allergies
- Asthama, Bhonchitis

Remedies against Air Pollution

Following steps can be inculcated to reduce air pollution.

- ✓ Look out for the ENERGY STAR label when buying home or office equipment.
- ✓ Prefer carpool; use public transportation, bike or walk whenever possible.
- ✓ Time to conserve energy – at home, at work, everywhere.
- ✓ Use environmentally safe paints and cleaning products whenever possible.



- ✓ Follow gasoline refueling instructions for efficient vapor recovery and be careful not to spill fuel. Also make sure to tighten the gas cap securely.
- ✓ Consider purchasing portable gasoline containers labeled “spill-proof,” where available.
- ✓ Make sure that the car tyres are properly inflated.
- ✓ Use mulch or compost leaves and yard waste.
- ✓ One should ensure boat, car and other engines are properly tuned.

It was reported in the daily ‘The Hitavada’ that Air pollution claims maximum lives in India. There are number of studies which show the ill-effects of high air pollution levels on brain. Recent estimates put the annual number of deaths attributed to air at 9 million worldwide. In India alone 18 lakh people die every day due to air pollution. About 30% of the stroke cases in the world is due to air pollution. WHO found that 90% of the world breathes polluted air. Pollutants enter the body through the respiratory and alimentary canal. They cause sub-threshold responses and reach the brain either through the blood stream or the respiratory tract. Air pollution is, therefore, responsible for growing cases of neurological diseases, autism, attention deficit disorders, memory impairment in children, dementia and Parkinson’s in adults. It’s time that we take this as a wakeup call and seek some remedial action against air pollution [6].

1.3 Water pollution

Waterborne diseases are caused by pathogenic microbes which directly spread through contaminated water. Most waterborne diseases cause diarrheal illness. 88% of diarrhea cases worldwide are linked to unsafe water, inadequate sanitation or insufficient hygiene. These cases result in 1.5 million deaths each year – mostly in young children. The usual cause of death is dehydration. Most cases of diarrheal illness and death occur in developing countries. Other waterborne diseases do not cause diarrhea; instead these diseases can cause malnutrition, skin infections and organ damage.

Safe drinking water is a basic need for all humans. WHO reports that 80% diseases are waterborne. Industrialization, discharge of domestic waste, radioactive waste, population growth, excessive use of pesticides, fertilizers and leakage from water tanks are major sources of water pollution. These wastes have negative effects on human health. Different chemicals have different effects depending on their locations and kinds. Bacterial, viral and parasitic diseases like typhoid, cholera, encephalitis, poliomyelitis, hepatitis, skin infection and gastrointestinal diseases are spreading through polluted water. It is recommended to examine the water quality on a regular basis, to avoid its destructive effects on human health. Domestic and agricultural waste should not be disposed of without treating [7].

Waterborne diseases:

Some of the water borne diseases are Amoebiasis, Buruli ulcer, Campylobacter, Cholera, Cryptosporidiosis Cyclosporiasis Dracunculiasis (guinea-worm disease) Escherichia coli, Fascioliasis, Giardiasis, Hepatitis, Leptospirosis, Norovirus, Rotavirus Salmonella, Schistosomiasis, Shigellosis and Typhoid fever [8].

Remedy:

One can keep these diseases at bay by practicing proper hygiene. The most important prevention measure is to consume pure drinking water. Also, one should wash hands properly using soap, keep toilets clean, bathe daily and avoid sharing of personal items. Also, major

sources of water pollution are discharge of domestic and agricultural wastes, population growth, excessive use of pesticides and fertilizers and urbanization. Bacterial, viral and parasitic diseases are spreading through polluted water and affecting human health. It is recommended that there should be proper waste disposal system and waste should be treated before it enters the river [9].

1.4 Soil Pollution Diseases

Land or soil pollution diseases are caused by pollutants from the land/dirt/soil. The pollutants may enter the soil/land via:

- waste disposal (e.g. landfills).
- air deposition, either dry (e.g. from mining and smelting activities, foundries, etc.) or wet (e.g. acid rain).
- contact with contaminated surface or ground water.

While exposure to soil pollutants is generally less problematic than exposure to air and water pollutants, it might still have serious effects on children who usually play on the soil. Being in closer proximity to potential pollution, children could accidentally swallow soil particles while playing on the ground. The exposure to environmental pollution caused by soil contaminants may result in an increased risk of developing a series of health conditions.

Diseases caused by soil pollution

The exposure to environmental pollution caused by soil contaminants may result in an increased risk for developing a series of conditions. One of the most frequently encountered effects of toxic contamination is a series of symptoms that appear immediately after the exposure. The inhalation of soil particulate matter and the ingestion of contaminated food can potentially result in serious conditions, of which the most common include:

- Cancer, including leukemia – caused by the contact with soils contaminated with chemicals (e.g. gasoline, benzene).
- Nervous system damage – caused especially by the presence of lead (Pb) in soil and especially affecting children.
- Neuromuscular blockage and depression of the central nervous system.
- Kidney and liver damage – caused by chemicals such as Mercury (Hg) [10].

1.5 Noise pollution and diseases

Exposure to prolonged or excessive noise has been shown to cause a range of health problems ranging from stress, poor concentration and productivity losses in the workplace, communication difficulties and fatigue due to lack of sleep, to more serious issues such as cardiovascular disease, cognitive impairment, tinnitus and hearing loss.

Background noises of traffic, aircraft or music coming from a neighbour are being processed and your body is reacting to them in different ways via the nerves that travel to all parts of the body and the hormones released by the brain.

The most obvious is interrupted sleep, with its resultant effects of tiredness, impaired memory and creativity, impaired judgement and weakened psychomotor skills. Research has shown that people living near airports or busy roads have higher incidences of headaches, take more sleeping pills and sedatives, are more prone to minor accidents and are more likely to seek psychiatric treatment [11].



1.6 Light pollution and diseases

The strong illumination of artificial light attracts insects. Artificial lighting changed the behaviour of insect vectors and thereby the modes of disease transmission. For example, the chagas parasite usually transmits through the faeces of triatomine bug when the bug bites people. But of late, people in the Amazon region have become infected by the disease after eating sugarcane or fruits contaminated with the parasite. As artificial light surrounding houses attracts triatomine bugs, they rest on trees nearby the light source instead of entering into houses and infect animals living on the trees. Fruits contaminated with the faeces of these animals then cause the transmission of the disease to human beings. Night-time lighting also changes human behaviour. People stay outdoors for long hours during night, which augments their exposure to vectors like mosquito.

Remedial:

There are several ways to reduce the attraction of insects to light. For example, ultraviolet light filters attract 80% less insects. There are several such cost-effective and functional lighting systems that can minimise the impact of electrification on insects in rural areas [12].

1.7 Plastic Pollution and Diseases

At every stage of its lifecycle, plastic poses distinct risks to human health, arising from exposures to plastic particles and associated chemicals.

People worldwide are exposed at multiple stages of this lifecycle such as:

- Extraction and transportation of fossil feedstocks for plastic, which releases an array of toxic substances into the air and water, including those with known health impacts like cancer, neurotoxicity, reproductive and developmental toxicity and impairment of the immune system.
- Refining and production of plastic resins and additives, which releases carcinogenic and other highly toxic substances into the air, with effects including impairment of the nervous system, reproductive and developmental problems, cancer, leukemia and genetic impacts like low birth weight.
- Consumer products and packaging, which can lead to ingestion and/or inhalation of microplastic particles and hundreds of toxic substances.
- Plastic waste management, especially “waste-to-energy” and other forms of incineration, releases toxic substances including heavy metals such as lead and mercury, acid gases and particulate matter, which can enter air, water and soil, causing both direct and indirect health risks for workers and nearby communities.
- Fragmenting and microplastics, which enter the human body directly and lead to an array of health impacts (including inflammation, genotoxicity, oxidative stress, apoptosis, and necrosis) that are linked to negative health outcomes ranging from cardiovascular disease to cancer and autoimmune conditions.
- Cascading exposure as plastic degrades, which further leach toxic chemicals concentrated in plastic into the environment and human bodies.
- Ongoing environmental exposures as plastic contaminates and accumulates in food chains through agricultural soils, terrestrial and aquatic food chains and the water supply, creating new possibilities of human exposure [13].



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REVIEW OF APPLICATIONS OF FERROELECTRIC NANOPARTICLES IN MATERIALS TECHNOLOGY

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ABSTRACT

Ferroelectric materials are widely studied for their excellent ferroelastic, ferroelectric, pyroelectric, piezoelectric and inverse piezoelectric properties. Owing to these properties, ferroelectric materials find a lot of uses in commercial applications. Ferroelectric nanomaterials are used for multilayered capacitors and nanocomposites. This review details the present scenario of ferroelectric nanomaterials and also presents an overview of their applications. Ferroelectric nanomaterials are used as FeRAMs, FeFETs, photodetectors, biosensors, Ferroelectric e-skin, energy harvesting applications and so on. Such applications are discussed in detail in this paper.

Keywords: Ferroelectric, Ferroelectric nanomaterials, Applications, Nanocomposites, Multi-layered capacitors, FeRAM.

1. INTRODUCTION

1.1. What are ferroelectric materials?

In 1920, ferroelectric materials were discovered as bulk single crystals of Rochelle salt. Post that, a number of ferroelectric materials, like Lithium Niobate, Potassium Dihydrogen Phosphate, Lead Titanate, Barium Titanate and many others were grown in the form of bulk single-crystal and bulk polycrystalline ceramics. Many of these materials are found to be suitable in the production of electronic components and micro transducers. Moreover, with their two stable remnant polarization states, ferroelectric materials are also developed for applications in low write power nonvolatile memories. Also, ferroelectric materials are used as Modulators, Light Deflectors and Displays.

In addition to ferroelectric properties, the ferroelectric materials also reveal pyroelectricity and piezoelectricity, which have also been broadly utilized in a number of applications such as field effect transistors (FeFET), dielectric capacitors, piezo-sensors, piezo-actuators, nonvolatile memory (FeRAM) devices, energy harvesting devices and electro-optic devices [1].

In order to be used in devices, ideal ferroelectric materials have to meet following standards:

- High Curie temperature (beyond the range of storage and operating temperature of the device)

- Lower dielectric constant
- Fair self-polarization degree ($\sim 5\mu\text{C}/\text{cm}^2$)
- Fast internal switching speed (nanosecond level)

1.2. Applications of ferroelectric nanomaterials

There is a continuously ongoing effort to downscale dimensions of materials to promote miniaturization. This provides a massive impetus to develop nano-scaled ferroelectric devices [2-11]. Memory storage based on ferroelectric polarization reversal is an upcoming memory technology [2] due to superior read-write speed, lesser power consumption and better rewriting endurance [12, 13]. Lower dimensional ferroelectrics display significant variations of their properties in comparison to bulk ferroelectric materials, mainly because of increase in surface area.

1.3. Categorization of ferroelectric nanoscales

Nanoscaled materials are generally categorized as

- zero-dimensional (ex: nanoparticles)
- uni-dimensional (ex: nanowires, nanorods and nanotubes)
- two-dimensional (ex: thin films, lamellae patterns and nanodot arrays)
- three dimensional (ex: vertically aligned nanowires, tubes or rods)

1.4. Ferroelectric nanowires, nanotubes and nanofilms

For many years, ferroelectric nanostructures have drawn significant interest, which include effects of quantum measurement, quantum confinement and surface [14]. Lower scale ferroelectric nanomaterials are made up of 0D granular nanoparticles, 1D nanowires, nanotubes and 2D nanofilms [15]. Ferroelectric nanofilms have current lower voltage conversion levels, greater optical-electric sensibility and better optical confinement in comparison to bulk ferroelectric counterparts. Due to this, ferroelectric nanofilms can also be beneficial to be used in FeRAM, DRAM, optical waveguide and infrared imaging devices [16]. 0D ferroelectric nanoparticles portray distinctive nature like robust piezoelectric nature and an inherent single domain. Nevertheless, complications arising during their assembly pose challenges to their practical applications [17]. Due to their higher piezoelectric constant and mechanical strain tolerance levels, 1D ferroelectric nanostructure are potential candidates for energy harvesting applications [18, 19].

1.5. Nanocomposites of polymer/ferroelectric nanoparticles

The initial publications about nanotubes were made in 2002 by Mishina et al [20] and Hernandez et al [21]. The next consequential step was by Alexe et al [22] and by Morrison et al [23, 24] who fabricated a nano-hairbrush, which could have nanotubes open at each end to sanction its utilization in and as a microfluid device to be used as ink-jet printers or liquid drug distribution systems.

1.6. Multilayered capacitors and nanocomposites

Due to their very high dielectric constants (~ 1000), bulk ferroelectric materials found applications in the production of discrete and multilayered ceramic capacitors. Developments in the fabrication of ferroelectric nanoparticles broadened this application manifold. Nanosized BaTiO_3 powders were successfully used for manufacturing miniaturized and highly volume-efficient multilayer ceramic capacitors (MLCCs) [25].

Polymeric materials doped with ferroelectric nanoparticles arouse optimum interest as a solution for processable high permittivity materials for various electronic applications like high-energy-density capacitors, volume efficient multilayer capacitors, embedded

capacitors and gate insulators in organic field effect transistors [26].

1.7. 1D nanostructures (wires, rods, tubes, belts and fibers) and their applications

Ferroelectric nanostructures (wires, rods, tubes, belts and fibers) have been extensively explored due to their ferroelectric behaviour. 1D ferroelectric nanostructure also presents great possibility to be used in nonvolatile recollection systems, FE-PV devices, microelectromechanical devices, nanogenerators, nonlinear sensors and optics [27].

1.8. Ferroelectric random-access memories (FeRAMs)

Ferroelectric Random-Access Memory (FRAM) is a technology which merges the best of Flash and SRAM. It offers non-volatile storage like Flash, but provides faster writes, high read-write cycle endurance ($> 10^{15}$ cycles) and very low power consumption [28]. The National Aeronautics and Space Administration (NASA) is emerging with high-tolerance, radiation-hardened electronics for missions in and beyond Low Earth orbit. Ferroelectric-based electronics are highly feasible-candidates for these electronics because of their intrinsic radiation-hardened property. Since standard memory devices are susceptible to damage caused by radiation, ferroelectric memory may provide the desired radiation-tolerance [29].

H. Kohlstedt et al [30] have reported that Scanning probe techniques showed ferroelectric properties in dots as small as 20 nm. They have attained ultrathin ferroelectric films, as thin as a few unit cells on lattice matched substrates. These investigations can be well thought of as a guideline for the maximum achievable packaging density of FeRAMs, including low power consumption.

1.9. Nonvolatile Memory Device Based on FeFETs

HfO_2 based ferroelectric FET (FeFET) has been a recent topic of research for its application in nonvolatile memory (NVM) [31]. Unlike usual perovskite based ferroelectric materials, HfO_2 is CMOS compatible and retains ferroelectricity for thin film with thickness around 10 nm. Therefore, integration of ferroelectric HfO_2 into advanced CMOS technology makes this memory highly favorable for NVM [31]. Moreover, by tuning the portion of switched ferroelectric domain, a FeFET can display various intermediate states, which

enables its application as an analog conductance in mixed-signal in-memory computing. Such architectures have been applied to neuromorphic computing [32, 33]. Taking the technology further, a novel nonvolatile memory device using FeFETs was developed containing a p-type Si NW covered by omega-shaped gate organic ferroelectric PVDF-TrFE [34]. This device displayed lower programming voltage level (± 5 V), excellent memory characteristics, higher channel conductance modulation toggling between the ON and OFF states and exceeding 10^5 , longer retention times surpassing 3×10^4 s and higher endurance above 10^5 programming cycles while maintaining an I_{ON}/I_{OFF} ratio higher than 10^2 .

2. SENSORS OF STATIC AND DYNAMIC MECHANOTHERMAL SIGNALS: FERRO-ELECTRIC E-SKIN

Park et al [35] have reported about developing a ferroelectric e-skin using a nano-ferroelectric polymer composite which included poly vinylidene fluoride and abbreviated graphene oxide (rGO). This innovative e-skin could concurrently sense dynamic and static pressure, temperature variations and altered vibrations. The e-skin also differentiated between these stimuli via diverse signal generation types such as temperature (pyroelectric), temporal pressure (piezoelectric) and sustained pressure (piezo resistive). Further, a new ultrasensitive strain sensor, predicated on poly vinylidene fluoride (PVDF) thin film, was manufactured by Lu et al [36], which comprised of 16 microcapacitor units each with a 4×4 square structure and modeled on polydimethylsiloxane substrate. The sensor predicated on PVDF film was adapted to record a spatial distribution and magnitude of the pressure applied on a human finger during its different modes of kineticism, *i.e.*, shiatsu, rubbing and kneading. In order to track and distinguish between the pressure and temperature alternations, the ferroelectric e-skin was developed by Park et al [35] using an interlocked microdome array within rGO/PVDF composite. Replication of the e-skin resistance to the depletion of dihydrogen monoxide droplets was studied with variation in temperature.

2.1. Photodetectors

Ferroelectric materials displaying semiconducting properties are called photoferroelectrics [37]. Nowak et al [37] worked on analyzing photoelectrical properties of ferroelectric SbSI xerogel. He further reported that

ferroelectric P(VDF-TrFE) played a significant role in the development of photodetectors, which were constructed from a single semiconducting nanowire *e.g.*, CdS [39] and InP [40]. Its application in polymer side-gated devices resulted in enhanced sensitivity and reduction in dark current, in comparison to traditional nanowire field-effect transistors [39, 40].

2.2. Biosensors

Nguyen et al [41] studied nanoribbons of $PbZr_xTi_{1-x}O_3$ (PZT) to quantify mechanical deformations of neuronal cells in imitation to electrical excitations. Furthermore, during integration, they transferred arrays of PZT nanoribbons onto an elastomer (PDMS), in order to upscale to macroscopic areas. They then contacted them with interdigitated gold electrodes and poled in the plane of the ribbons. This appliance was then bio-interfaced with multicellular tissue of an extracted cow lung. Periodic deformations of PZT nanoribbons were induced by a respiration process, stimulated by a bicycle pump annexed to the lung [41].

2.3. Other Applications of nanoscale ferroelectric materials

Based on the principle of reversible polarization of ferroelectrics, various nanoscale devices with enhanced features have been realized *e.g.* application of switchable remnant polarization to FeRAM [42]. By scaling down the size of individual memory cells, the storage efficiency of FeRAMs can be enhanced [43]. Shen et al [44] studied the prospective usage of horizontally aligned arrays of PZT nanowires for multi-bit storage applications. The ferroelectric polarization can be linked to the channel of a field effect transistor (FET) to form ferroelectric FET, wherein the on-off state of the device is determined by the direction of the polarization [45, 46].

2.4. Applications of Ferroelectric Polymers

There has been paramount shift in research related to nanoscaled ferroelectric polymers, *e.g.* PVDF-TrFE copolymers for non-volatile memory cells, due to their inherent flexibility and cost-effective production [47-50]. PVDF-TrFE based FeFETs with improvised memory features are manufactured by nano-confinement of the polymer within self-assembled organosilicate lamellae [51]. The charge injection/transport properties of a ferroelectric material could be altered by reversible polarization, which also has the potential for fabrication of memory devices [52, 53]. Chanthbouala et al [54] have reported FTJ-based solid

state memory with high on/off ratios (100), and low write power using BaTiO₃.

2.5. Ferroelectric nanostructures for energy harvesting applications

Piezoelectric nanostructures, especially nanowires, are fabricated for their use in energy harvesting from collective mechanical movements. Zhong Lin Wang et al [55] studied this area of research and named it piezotronics. Electrical energy gathered from piezoelectric nanostructures has already been utilized effectively to power nanoelectronics devices and sensors [56], especially nanowires and rods. They have been mostly used for piezotronics applications owing to their large mechanical strain tolerance [55]. Xu et al [57] constructed vertically aligned arrays of lead zirconate titanate nanowires and reported that random mechanical movements of these wires produce electricity which could be used to power a commercial laser diode. Wu et al [58] have reported the fabrication of wearable and flexible nanogenerators using lead zirconate titanate nanowires implanted in a polymer and a textile matrix.

2.6. Some other applications of ferroelectric nanoscaled materials

Ferroelectric nanoscaled materials also find usage in a variety of applications as functional filler materials in polymer composite based organic field effect transistors (OFETs) [59]. Surface fictionalization is also a major subject of research for ferroelectric nanoparticles. Due to higher surface energy of nanoparticles, their fictionalization utilizing opportune organic moieties can integrate tunability to the functional and dielectric characteristics of ferroelectric nanoparticles [60].

2.7. Recent Ongoing Research (2020)

The use of ferroelectricity in place of magnetism in computer memory saves energy. Further, ferroelectric bits were made into nanosize, thereby also saving space [61]. The results are conclusive: hafnium oxide is ferroelectric at the nanoscale. This means that there is a possibility that minute bits can be manufactured from this material, with the add-on that that they switch at low voltage.

In 2019, potassium sodium niobate (KNN) based piezoelectric ceramics symbolized a major share of the low ferroelectric piezoelectric ceramics (LFPEC) market at 37.2% of the total [62]. Currently, these LFPECs find application mainly as automotive sensors as well as sound and vibration sensors. Similarly, in 2019,

barium sodium titanate (BNT) based piezoelectric ceramics were the second-largest segment of the market at 29.7% of the total. These products are mostly used as precision positioning devices and as actuators for inkjet printers [62]. They are being used primarily for ultrasonic applications that included drug extraction, welding, cleaning, cooling, grinding and emulsification [62].

Possibly ferroelectric piezoelectrics will find a way to be used for kinetic energy harvesting systems for distributed low-power systems, which include the Internet of Things, especially for emplaced sensors. The global piezoelectric ceramics market stands at around USD 1B annually. This market is dominated by lead zirconate titanate based (PZT) materials, wherein a number of formulations are employed to customize the coupling coefficients, field-induced hysteresis and piezoelectric responses. The potential applications of these piezoelectrics are precise positioners, ultrasound systems for nondestructive testing, fish finders, sonar systems, medical ultrasound transducers, fluid flow meters, high precision accelerometers and transformers, just to name a few [62].

Amongst these, medical ultrasound is the next potentially used imaging modality in the field of medicine and presents immense capability in high resolution imaging of subsurface features without requiring ionizing radiation. Many lives have been saved due to the use of medical ultrasound which employs ferroelectric-polymer composite transducers.

N. Humera et al. [63] has reported the existence of colossal dielectric constant along with ferroelectricity in BaTiO₃ nano-ceramics. This has prospective applications in modern microelectronic devices and for development of novel capacitive data storage devices.

A published study [64] presents an exciting step towards domain-wall nanoelectronics, which is an innovative form of future electronics based on nano-scale conduction paths which could permit dense memory storage. Scientists have made an imperative leap in finding a solution to the technology's primary long-standing challenge of information stability [64].

A new nanomaterial known as K_xW₇O₂₂ (K_xWO) was synthesized by Michael E. Johnson et al [65]. It demonstrates a stable room-temperature ferroelectric property. This unique ferroelectric property shows that K_xWO is a novel promising material for utilization in a breath sensor, which can be utilized for patients to keep an eye on their everyday health condition and diagnose disease with low cost and at an early stage, is

convenient and most importantly, is non-invasive. They further reported that the low temperature ferroelectric property of K_xWO generates an exceptional response to acetone, which can be used as a biomarker for diabetes

3. SUMMARY

Recent developments in the utilization of nano-ferroelectrics can be summarized as follows. The potential for nanoscale ferroelectric materials holds a promise as is obvious from the ever-increasing number of applications in nano-ferroelectrics. A fundamental understanding of the finite-size effect in ferroelectric nanomaterials is a precondition for the advancement of materials, especially for commercial application and market use. More emphasis needs to be put on manufacturing methods that can have the capacities of tailoring nanoscaled materials patterns with an ability to control shapes and dimensions for desired manufacture of the material.

One of the potential forthcoming research is fabrication of novel ferroelectric nanoscaled structures and optimization of their usage as sensors. It could be seen that evolution of smart sensors would affect in swift development of defense technologies, humanoid robotics and flexible electronics.

A wide canvas of ferroelectric nanomaterials application, ranging from ferroelectric memory gadgets to ferroelectric self-powered nanogenerators, may promote potential attentions in nano-ferroelectrics development and research. Also, piezotronics offers numerous promises in the development of efficient and economical self-powered microelectronic devices.

4. CONCLUSION AND FUTURE CHALLENGES

The synthesis processes to engineer ferroelectric nanomaterials employ numerous steps and are also susceptible to miniscule alterations in synthesis route. The optimization of experimentation is both vital as well as painstaking. This poses a great challenge for the utilization of 1D ferroelectric nanostructure for market needs and commercial exploitation. One of the key challenges also faced is the scaling up production for all practical purposes. Consequently, novel powder processing-based methods are often preferred to understand stable and mass production of low ferroelectric nanostructures. Also, further research must be conducted on the growth mechanisms so that 1D ferroelectric nanomaterials could be devised with controllable sizes and predictable shapes. The controlled

morphology of nanomaterials, fabricated over massive areas under reproducible synthesis conditions, is crucial for upscaling of their uses.

Also, in a nanoscale range, it is an arduous task to conduct conventional physical property measurement of the nanomaterials. Additional equipment and methodology are a requisite to conduct these physical manifestations. Numerous tests should be made on the materials in advance of their application to reinstate the long-term stability of nanomaterials.

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Growth Techniques of Ferroelectric Single Crystals

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Abstract— Various growth techniques to grow ferroelectric single crystals are discussed in this paper. Some prominent methods used are mainly discussed. Some of them are Growth from the Melt which includes Bridgmann method and Czochralski method. Some of the other methods prominently used in present scenario that are discussed in this paper are Solid-state crystal growth (SSCG), Vapor-phase growth, Solid State Single Crystal Growth (SSCG), Solid-state crystal growth (SSCG), and Abnormal Grain Growth (AGG).

Keywords— Single crystal, ferroelectric, crystal growth, techniques.

I. INTRODUCTION

Ferroelectrics: An overview

Ferroelectric materials have come up as a pathbreaking technology for a broad spectrum of semiconductor technology and electronic device applications. They find massive usage in digital information storage media and metal oxide semiconductor (CMOS) logic circuits.

Some of the areas in which ferroelectrics find a way for commercial exploitation are

- i. logic and memory application
- ii. organic, inorganic, and two-dimensional (2D) ferroelectric materials
- iii. device structures (metal/ferroelectric/metal (MFM))
- iv. metal/ferroelectric/semiconductor (MFS),
- v. metal/ferroelectric/insulator/semiconductor (MFIS)
- vi. metal/ferroelectric/metal/insulator/semiconductor (MFMIS)
- vii. next-generation electronic devices (negative capacitance field effect transistors (NC-FETs))
- viii. ferroelectric RAM (FeRAM)
- ix. ferroelectric field effect transistors (FeFETs)
- x. ferroelectric tunnel junctions (FTJs) [1].

A need for single crystal fabrication

Single crystals are very important group of materials because of their highly-ordered, continuous and uniform structure – all of which makes them possess exclusive properties. In many aspects, single crystal materials are

found to have advantages over polycrystalline materials. There are many properties in single crystals, which are not found in polycrystals [1].

In spite of the recent technological developments of advanced polycrystalline materials, which are often fabricated for specific applications, the dielectric, conductivity, electrical, optical, thermal, piezoelectric, pyroelectric, mechanical, and other properties of single crystals still remain a topic of utmost interest to explore. For this reason, single crystals and their fabrication methods are a topic of interest and concern among many scientists.

As technological development increases, there is a wide spread requirement of high-quality single crystal materials – both in bulk and in thin films.

Therefore, a huge demand of various single crystal materials has generated a necessity for improving the existing growth techniques as well as developing newer alternative techniques for single crystal growth.

II. CRYSTAL GROWTH METHODS CONVENTIONALLY USED

- Horizontal Boat Growth Methods. Horizontal Gradient Freezing (HGF) method. Horizontal Bridgman (HB) method. ...

- Vertical Boat Growth Methods. Vertical Bridgman (VB) method. ...
- Pulling Methods. Czochralski (CZ) method. ...
- Floating Zone (FZ) Method.
- Other Methods. Shaped Crystal Growth Method.

Basic crystal growth methods can be separated into four categories based on what they are artificially grown from: melt, solid, vapor, and solution. Specific techniques to produce large single crystals (aka boules) include the **Czochralski process (CZ)**, Floating zone (or Zone Movement), and the Bridgman technique.

The basic growth methods available for crystal growth can be broadly classified into [1]

- Growth from melt
- Growth from vapour
- Growth from solution
- Growth from solid

2.1 Growth From The Melt

- a) Bridgmann method
- b) Czochralski method
- c) Vernuil method
- d) Zone melting method
- e) Kyropoulos technique
- f) Skull melting

2.2 Conventional methods of single crystal growth

Presently, there are three methods by which single crystals can be made

- 1) growth from melt
- 2) growth from solution
- 3) growth from vapor phase [2].

Growth from melt is the most widely used method. It is based upon the solidification and crystallization of a melted material. The Bridgman and Czochralski methods are two most used melt-growth techniques. The Czochralski method (cz) is used for the production of single crystals for many commercial exploitation.

However, the melt-growth technique shows many disadvantages in the growth process. The main difficulty lies in maintaining a constant and uniform temperature during the entire crystal growth. The challenge also lies in maintaining and sustaining very high melting points. Also achieving chemical homogeneity is a bigger task in different materials with different chemical composition .

In a material where a lot of materials are present together in the system, it poses as a tougher challenge. For making a good quality crystal, there are factors like high costs of production and equipment's, reactivity of the melted

material with the crucible, chemical inhomogeneity of the input materials are also some of the factors which may contribute in making of good quality single crystal.

2.3 Czochralski method

The Czochralski (CZ) method is a crystal growth method which is widely used to grow ferroelectric single crystals. It usually initializes with insertion of a small seed crystal into a melt. The melt is often taken in a crucible. Thereafter, the seed is pulled upwards. This initiates in forming a single crystal. The method was initiated by a researcher named Jan Czochralski, who developed it in 1916.

The process starts with taking the material in a crucible. The material is then melted by resistance or radio-frequency heaters. After the material is completely melted, it is rested for some time to allow it to stabilize. Then a seed crystal is slowly inserted in the melt on the surface while giving crucible rotation and also slowly rotating the seed. A small portion of the dipped seed is melted.

Thereafter it is given some stabilizing time. It is minutely monitored to see that a melt meniscus to be initiated at the portion exactly where the seed and melt meet. The seed is then given small rotation time. This is all done to give a uniformly stabilizing temperature to be maintained throughout the melt.

Then, the seed is slowly pulled up from the melt (often under rotation). The growth of single crystal is usually to be seen as the seed crystal starts to swell up. The melt then starts growing at the interface by forming a new crystal. Further in the growth process, the shape of the crystal, especially the diameter, is monitored by maintaining the thermal equilibrium throughout the crucible, the pulling rate and the rotation rate of the crystal.

2.4 Solid-state crystal growth (SSCG)

Solid-state crystal growth (SSCG) has become an important technique in the development of high-quality single crystals for such systems. SSCG [4] is advantaged by its lower growth temperatures than conventional melt and solution growth techniques by producing crystals through a solid phase transformation of a polycrystalline matrix to a single crystal.

This in turn lets higher chemical homogeneity and volatility control. It also adds up to be cost-effective. Given the accurate polycrystalline microstructure and also the other processing parameters, large single crystals can be initiated. Especially those that are of incongruently melting systems those which are difficult to make using other techniques.

2.5 Vapor-phase growth

Vapor-phase growth is another method of growing single crystals. It is more pertinent to the fabrication of thin single crystals films on substrates, rather than bulk single crystals. In the instance of physical vapor transport (PVT) and chemical vapor transport (CVT) techniques, these two processes can aid in the growth of single crystals. While doing this, the vapor phase can be achieved using three processes such as reaction in the gas phase, transport reaction and sublimation process [5].

2.6 Solid State Single Crystal Growth (SSCG)

A possible way to enhance the homogeneity of crystals with complex composition is to grow them by using the low cost Solid State Single Crystal Growth (SSCG) method.

The SSCG method is essentially a form of induced abnormal grain growth, a phenomenon which is very well known in the solid state sintering community.

2.7 Abnormal Grain Growth (AGG)

A new technique of single crystal fabrication and growth, which has recently attracted lot of interest within the research community, is through the solid-state conversion of polycrystalline materials to single crystals. This technique is based on a phenomenon which can be determined in many systems, called atypical grain boom (AGG).

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Thermoluminescence in Pure and $\text{Nd}^{+3} + \text{K}^{+}$ Doped Lead Germanate Single Crystals

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Abstract— Pure lead germanate was grown by Zochralski's technique. $\text{Nd}^{+3} + \text{K}^{+}$ doped lead germanate was grown for comparative studies. Thermoluminescence studies were conducted on pure lead germanate and $\text{Nd}^{+3} + \text{K}^{+}$ doped lead germanate. Thermoluminescence in pure lead germanate single crystals (LG) and $\text{Nd}^{+3} + \text{K}^{+}$ doped lead germanate single crystals (DDLG) has been measured in terms of photomultiplier output current on Thermoluminescence Set Up. Thermoluminescence studies of LG revealed an increasing trend of Thermoluminescence output, with increasing temperature and sharp consistent maxima at 50°C and 100°C . TL studies of DDLG revealed a decreasing trend of Thermoluminescence output, with increasing temperature and a sharp consistent peak at 100°C and 120°C . It was further noted that doping increased Thermoluminescence output. Thermoluminescence in ferroelectric lead germanate was attributed to change in polarization with change in temperature and creation of defect states.

Keywords— lead germanate, thermoluminescence, doping, polarization, defect states.

I. INTRODUCTION

The process in which a material absorbs energy in one form or other and re-emits a fraction of it as a visible or near visible radiation is known as Luminescence. Thermoluminescence (TL) is interpreted as thermally stimulated release of an electron (or hole) from traps, into the conduction (or valance) band and its eventual radiative recombination with the hole (or electron) at the recombination center. Thermoluminescence can be sensitized in materials (which are originally not thermoluminescent) by means of irradiation.

Thermoluminescent detectors often use crystals that are purposely flawed by adding a small dopant portion or concentration of impurity to activate. However, there are some thermoluminescent detectors that can do away with the inclusion of an activator, but rely upon their own impurities and defects in the natural crystal. Upon heating, the trap is vacated and a TL photon is emitted.

Intrinsic shallow electron and hole traps can crucially influence thermoluminescence in perovskite materials. In particular, defects related to oxygen vacancies (V_o), always dissolved into these materials during crystal growth, have become a subject of intensive studies in the last few years.

Thermoluminescence in many perovskites is discussed based on radiative recombination of carriers freed from shallow traps with localized counterparts.

Thermoluminescence in Ferroelectrics

Many ferroelectric materials like BaTiO_3 , PbTiO_3 , KH_2PO_4 etc, exhibit thermoluminescence. Thermoluminescence is different in ferroelectrics than other materials because of the presence of spontaneous polarization. It is known that Thermoluminescence results due to the recombination of released charges from trap centers. The intensity of thermoluminescence depends upon the magnitude of these released charges. As temperature changes, polarization changes in lead germanate. This gives rise to the release of trap charges at the dipolar end. The subsequent recombination of which gives rise to thermoluminescence.

J.W. Gilliland Jr et al [1] reported TL studies on Rochelle salt and guanidine aluminum sulfate hexahydrate. Ferroelectric Rochelle salt and guanidine aluminum sulfate hexahydrate were irradiated with of Co^{60} gamma rays up to 3.5×10^6 r at liquid nitrogen temperature. They conducted the observations with a photomultiplier (PMT) tube. A glow peak at -61°C was found to yield by Rochelle salt.

M Aguilar [2] has studied Thermoluminescence of BaTiO₃ crystals. He has reported a study of the thermoluminescence (TL) of BaTiO₃ samples. The samples were X-irradiated at 20K. The value of dependence of TL on purity of crystal was studied. The change in the absorption spectrum with respect to thermal annealing was studied. Also its relation with TL peaks was obtained. Moreover, the spectral composition and kinetic order of all TL peaks was obtained. A discussion on the origin of thermoluminescence and X-ray induced luminescence in BaTiO₃ was reported.

Quan Zhan et al [3] have reported thermoluminescence studies in ferroelectric (K_xNa_{1-x})NbO₃:Pr³⁺. The change in dopants were ($x = 0, 0.1, 0.2, 0.3, 0.4, 0.5$). Dopants chosen were rare earth ions Pr³⁺.

Upon nm light irradiation, the samples showed strong red emissions at around 610 nm. The specimens showed a visible thermoluminescence when at 200 °C. They have discussed the mechanisms of thermoluminescence.

Thermoluminescence in lead germanate

However, Thermoluminescence in ferroelectric materials, particularly lead germanate single crystals, has not yet been explored extensively. In our humble approach we have tried to explore and report thermoluminescence in pure and double doped lead germanate single crystals in this chapter on a very elementary basis.

II. METHODOLOGY

1) Experimental Setup

Thermoluminescence in pure lead germanate single crystals (LG) and Nd³⁺ + K⁺ doped lead germanate single crystals (DDLG) has been measured in terms of photomultiplier output current on Thermoluminescence Set Up (Figure 6.2) procured from Scientific Equipment & Services, Roorkee. The set up primarily consisted of i) High Voltage Power Supply ii) Digital Nanoammeter iii) a Photomultiplier tube iv) small furnace.

i) Power Supply (High Voltage)

The EHT power supply, EHT-11 consists of a stable power oscillator being controlled by an input signal. A step-up transformer is used for the output of this oscillator. The output was controlled with the help of transformer and then rectified and filtered. The power supply was varied continuously. It was further electronically regulated with a fully solid-state circuit which had low power consumption. The continuously adjustable power supply was used which had a range of 0 to 1500V.

ii) Digital Nanometer

The Digital Nanoammeter DNM-121 had an accuracy of +0.25 % for all ranges and consisted of 4-decade ranges with 100% circuit over-ranging. The unit was made suitable for current measurement in the range of 100 pA to 200 uA. The readings could be obtained on a 3 1/2-digit 7 segment LED display with auto polarity and decimal indication. The instrument used a FET input operational amplifier that offered very low input bias current, low offset voltage, low drift and noise.

iii) Photomultiplier Tube

A R C A 931-A photomultiplier tube was used for experimental purpose. A schematic diagram of the photomultiplier is shown in Figure 6.3. Light strikes a photocathode C and liberates electrons, the electrons are accelerated by a voltage E and focused upon an electrode, the dynode D₁, where each incident electron causes the emission of several secondary electrons. The same process is repeated at the dynodes D₂, D₃. The electrons from the last dynode stage are collected by a positive anode A₁ and the current I_a is measured. If the gain of each stage (the number of electrons formed by secondary emission for each primary electron) is g and if n dynode stages are used, the total amplification is $A = g^n$.

The value of g varies with the voltage between successive dynodes and with the surface composition and the geometry of the dynodes from 0.5 to about 10.

The focusing of the electrons from one stage to the next can be accomplished with magnetic or electrostatic electron-optical systems. The gain and the sensitivity of the photomultiplier vary with the voltages applied to the dynode stage.

iv) Furnace

A small intact furnace, which could go up to 150°C, was employed for the experimental purpose. The furnace was square in shape. To avoid thermal losses while heating, the furnace was cemented compactly. The furnace had a small window on one of the sides, on which the mica sheet was pasted firmly. Any radiation could pass through this small window.

2) Experimental Procedure

A warm up time of about half an hour was given to the set-up, prior to the start of each run. Inside the furnace, a rod was provided on which one could mount the crystal. The crystal was mounted and adjusted to be exactly in front of a window, which was covered with a mica sheet through which the radiations could pass. In front of the window, the mouth of the photomultiplier tube was adjusted. The

photomultiplier tube had an adjustable window, which could be opened or closed to allow the inflow of the radiations coming out of the crystal. For taking measurements the crystal was mounted on the brass rod. The furnace was closed properly. The window of the photomultiplier tube was opened. The whole assembly was enclosed in a rectangular box. The whole box was covered with a black cloth so that no external light could enter the photomultiplier tube. A small hole was kept to insert the thermocouple. The thermocouple was inserted and placed just near the crystal, so that the exact temperature of the crystal could be monitored. The thermocouple, in turn, was connected to a microvoltmeter. A voltage of 800 V from the high voltage power supply was fed in to the photomultiplier tube. The Photomultiplier output was connected to a highly sensitive nano ammeter. Other parts of the furnace were perfectly insulated in order to avoid noise generation due to heat radiations. Thermoluminescence study was conducted for both, LG and DDLG from room temperature to 150°C, at an interval of 5°C. The study could be undertaken only upto 150°C, as the furnace could record a maximum temperature of 150°C. At each temperature interval, thermoluminescence readings were recorded without crystal (TL_i). The experiment was repeated for each temperature interval with crystal (TL₂). Thermoluminescence was evaluated using $TL = TL_2 - TL_i$. This was necessary to eliminate noise current. This procedure was repeated for all the crystals of LG and DDLG. A graph was plotted taking dTL on the y-axis and temperature in °C on the x-axis.

III. RESULTS AND DISCUSSION

Figures 1 a, 1 b and 1 c show the thermoluminescence output of the LG crystals. Figures 2 a, 2 b and 2 c show the thermoluminescence output of DDLG crystals. Thermoluminescence studies of LG revealed an increasing trend of Thermoluminescence output, with increasing temperature and sharp consistent maxima at 50°C and 100°C. TL studies of DDLG revealed a decreasing trend of Thermoluminescence output, with increasing temperature and a sharp consistent peak at 100°C and 120°C. It was further noted that doping increased Thermoluminescence output.

It is well known that in an inherent crystal lattice, the outermost atomic electronic energy levels that are there are extended into uninterrupted allowed energy bands. The levels are then divided into energy regions those are forbidden.

The uppermost filled band is called the valence band. It is then divided by several electron volts. The lowermost empty energy band is called the conduction band. When a crystal is subjected to ionizing radiation, electrons get energized. They then move out of the valence band and jump to the conduction band.

All this process manages to leave a vacancy in the valence band which can be termed as a hole. It is to be noted that the electron and hole are free to roam throughout their individual bands. The presence of lattice defects or impurities, gives rise to discrete local energy levels within the forbidden region, between the valence and conduction bands.

These energy levels manage to localize electrons/holes. This process on subsequent heating and recombination causes an interesting process termed as thermoluminescence. Thermoluminescence can be defined as light emission which is possible because of thermal stimulation.

It is the energy difference between the conduction band and valence bands that is responsible for the temperature required to release the electron. This process by enlarge is able to yield thermoluminescence. It is a characteristic of the material used and differs from material to material.

Usually, so many localized electrons and holes are made. As you go on increasing the temperature of the crystal, the probability of liberating an electron from a trap is higher. This gives a periodicity in the graph such that the light that comes out will be feeble at low temperatures., It is then able to give a maxima at temperatures that is on a higher side. It then further and drops down to zero if there is a probability that no more traps remain that is electron laden. A glow curve is a curve or a graph where graph of the light that comes out as a function of time or temperature.

Thermoluminescence in ferroelectric lead germanate may be due to,

1. change in polarization with change in temperature.
2. creation of defect states.

Thermoluminescence results due to the recombination of released charges from trap centers. The intensity of thermoluminescence depends upon the magnitude of the released charges. As the temperature changes, polarization changes in lead germanate. This gives rise to the release of trap charges at the dipolar end. The subsequent recombination of which gives rise to thermoluminescence.

It is well known that the loss of lead and oxygen in lead germanate during growth leads to generation of vacancies

leading to enhancement in the formation of defect states. With increase in temperature, the probability of thermal excitation increases resulting in higher release of trap charges and hence higher TL is observed.

It is well known that homogeneity of the crystalline internal field is disturbed due to doping. Therefore, apart from the depth the crystalline field surrounding the defect states is also going to control creation of defect states, trapping of charges and release of charge mechanism. Because of this the nature of TL in doped crystals is going to be different in LG and DDLG. Shifting of the two temperatures at which peaks have been observed from 50°C and 100°C to 100°C to 120°C may arise due to change in the crystalline field. The very fact that peaks have shifted to higher temperature side suggests comparatively higher depth of trap level in DDLG as compared to LG.

The peaks correspond to temperatures at which maximum release of trap charges occurs. $\text{Nd}^{+3} + \text{K}^{+}$ double doping probably creates additional defect states and consequently generation of additional trap levels. This may lead in enhancing the magnitude of liberated charges in DDLG. The observed increase in thermoluminescence output due to doping hence may also be due to the increase in the density of traps as a result of doping.

IV. CONCLUSION

The fact that peaks have shifted to higher temperature side suggests comparatively higher depth of trap level in doped single crystal lead germanate as compared to pure lead germanate. $\text{Nd}^{+3} + \text{K}^{+}$ double doping in lead germanate single crystals probably creates additional defect states and consequently generation of additional trap levels.

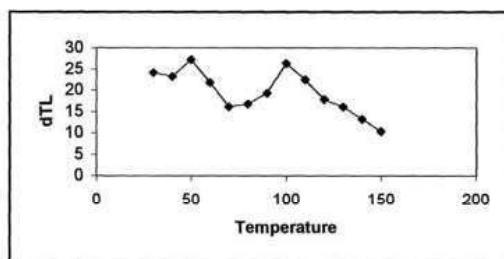


Figure 1a
Dimension of the sample (0.372cm x 0.306cm x 0.302cm)

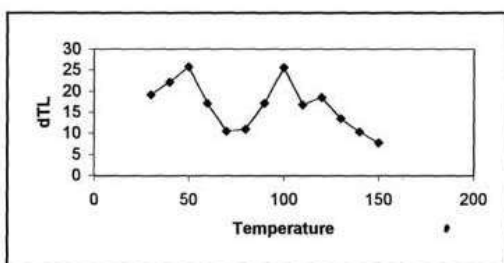


Figure 1b
Dimension of the sample (0.482cm x 0.370cm x 0.307cm)

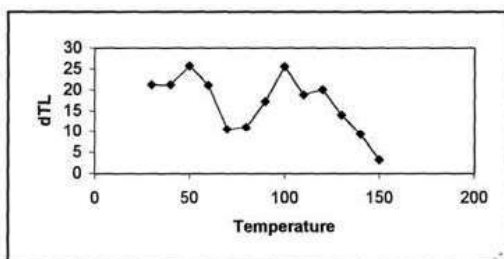


Figure 1c
Dimension of the sample (0.432cm x 0.338cm x 0.206cm)

Thermoluminescence in Pure ferroelectric lead germanate single crystal

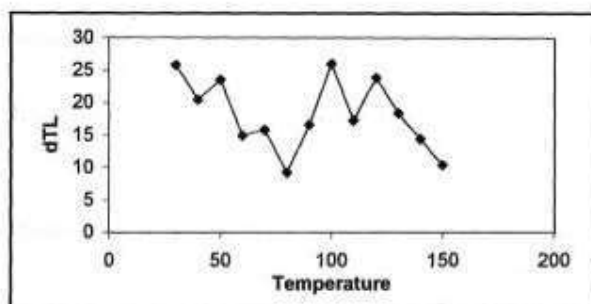


Figure 2a
Dimension of the sample (0.529 cm x 0.345 cm x 0.355cm)

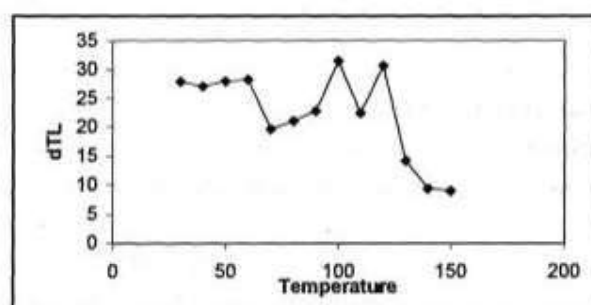


Figure 2b
Dimension of the sample (0.507 cm x 0.394 cm x 0.333cm)

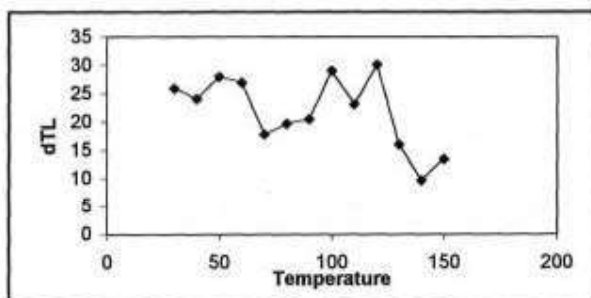


Figure 2c
Dimension of the sample (0.557 cm x 0.405 cm x 0.354cm)

Thermoluminescence in Nd³⁺ + K⁺ doped ferroelectric lead germanate single crystal

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QUALITY MANDATES IN HIGHER EDUCATION AND STUDYING COVID IMPACT ON HIGHER EDUCATION IN INDIA*

BY

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Abstract

The paper studies higher education in Global Scenario, its comparison with Indian higher education and how India has addresses Covid issue pertaining to higher education. It also presents global scenario of impact of Covid-19 on higher education. Students were found to be impacted from travel restrictions to social distancing, isolation measures, quarantines, campus closures, and border closures. Higher education in India is discussed. Then Covid-19 impact on higher education in India is discussed. A comparison is made between both. This paper reports comparison between remedial actions taken at both levels. Some measures taken by educational authorities of India to provide seamless educational services during the crisis are discussed. Also case study as how changes were brought about at our college level due to the pandemic is reported. Due to Covid-19 pandemic, many new modes of learning, new perspectives, new trends have emerged and the same may continue as we march ahead to a new tomorrow.

Keywords: Higher Education, Global Scenario, Covid-19, Remedial Action, Comparison

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1.1 Higher Education -Global View

Higher education systems are enhancing with the evolution of new campuses to enrol more undergraduate (UG) students. Simultaneously, they are reaching out with the launching of more graduate programmes. Enrolment in higher education has experienced great growth across Asia over the last 20 years. The reason being high birth rates, growing school participation rates, and importance of higher education in next lifestyles opportunities. As opportunities increase, higher education systems have diversified by evolution of new universities and introducing new faculty members, and segregating access to personal better training providers [1].

1.2 Global Higher Education – Covid Impact

Students throughout the better schooling quarter had been dramatically impacted via way of means of the unfold of the coronavirus, from journey regulations to social distancing, isolation measures,

quarantines, campus closures, and border closures. Students had been impacted because of journey regulations; college closures; flight cancellations; problems with acquiring scholarship interviews, visa applications, or language tests; examination cancellations or postponements; and fitness concerns. Universities throughout the globe had been compelled to shut campuses and transfer to on-line mastering and virtual equipment withinside the wake of the coronavirus. Universities are locating hard to preserve regular path delivery, making sure sturdy scholar recruitment numbers, and offering clean verbal exchange to personnel and students [2].

1.3 Remedial Actions by Universities at Global Level

Some universities swapped some of their scheduled courses online, while some of them postponed the start dates for some of their courses. While some changed their application deadlines for our next intake, some altered their offer acceptance deadlines for the next batch [2].

1.4 Issues and Challenges in India's Higher Education Sector

India's higher education system has the third largest number of students in the world after China and the United States, with a total enrolment (GER) of only 25.2% in higher education as compared to developing countries and others. In addition to this, lack of quality infrastructure facilities is a challenge for higher education in India. There is also regional diversity in access to higher education. Curriculum is another key aspect in progressive higher education. Curriculum should be original and should be a feed to enhance creativity. There is a shortage of undergraduate students, qualified teachers, and quality infrastructure. This pose a challenge to quality higher education in India.. Education in India also faces the challenge of transparency, public administration, and accountability. Following is the peephole for the regulatory framework of Higher Education in India.

1.5 Initiatives to upgrade Higher education in India:

Following are the initiatives taken to upgrade higher education in India.

- Additional funds are generated by Higher Education Financing Agency (HEFA) in aid to Central Universities, AIIMS, IISERs.
- Make India into an education hub by making available high-quality research infrastructure in Indian higher educational institutions.
- Bring Indian higher education to meet with the Global standards.

Regulatory Framework Of Higher Education In India



Figure 1

: Regulatory Framework of Higher Education in India [3]

1.6 Recent Initiatives Taken by the Government for Quality Upgradation in Education

Government has envisioned an ambitious five-year plan to enhance the quality of higher education over the next five years (2019-2024). The key features are

- Enhance accessibility to Indian higher education institutions
- To push at least 50 Indian institutions among the top-1000 global universities.
- To double the Gross Enrolment Ratio (GER) in higher education

1.7 Way Forward

Following pointers were thought to work in favour to rebuild Indian Higher Education system.

- Allow unfamiliar establishments to work joint degree programs with Indian organizations
- Amend UGC Act to give authoritative sponsorship to administrative construction
- Select Vice-Chancellors of colleges through a straightforward and target measure
- consolidation distinctive advanced education controllers (UGC, AICTE, NCTE and so on) to guarantee viable coordination

1.8 Dividing the Indian Higher Education into 3 Level System

- Level 1 incorporates research colleges zeroing in similarly on examination and educating,
- Level 2 incorporates training colleges zeroing in basically on instructing.
- Level 3 incorporates universities zeroing in just on educating at undergrad levels.

1.9 Strengthening the Indian Higher Education System

Following were some of the key aspects which may prove to be a game changer to change the scenario of higher education in India.

- Creating 'top notch colleges': 20 colleges – 10 each from general society and private area – are being chosen as 'Organizations of Eminence', to assist them with achieving elite guidelines of instructing and examination.
- Increased center around professional and calling drove schooling: Include professional subjects in standard colleges to take into consideration more noteworthy acknowledgment and utility for professional learning.
- All advanced education foundations should be licensed mandatorily and routinely, by top notch measure.
- All focal colleges ought to create key designs for getting into the best 500 worldwide colleges rankings in the following 10 years. Subsidizing to these establishments ought to be connected to execution and results through the MHRD and recently comprised Higher Education Funding Agency
- Restructuring of the advanced education framework into Level 1, Level 2 and Level 3.
- It was thought imperative to broaden the extent of Massive Open Online Course (MOOCs) and Open and Distance Learning (ODL).
- All 3 levels of education system will be self-reliant and move towards full self-governance - scholarly, regulatory, and monetary.
- To imbibe 'research culture' at the undergrad level.
- An evaluated component to guarantee extra supports stream to top state funded colleges was thought to be created, as in China and Singapore [4].

2.0 Higher Education in India : The Covid Impact

Because of Covid, in India, around 32 crore students' academic life came to halt. The effect have been massive having affected advanced education in India.

- Various exercises like confirmation, assessments, entrance tests, serious assessments directed by different institutions/schools/universities/colleges were suspended or postponed or taken on the web. Many passageway tests for higher investigation got cancelled or delayed which made students life very difficult as these examinations are very important for career advancement.
- Covid-19 has prompted all teachers and students to rely more and more on technology.
- The instructors and understudies improved the utilization of electronic media for sharing data by utilizing WhatsApp, Google drive, Telegram, Twitter, Google classroom and so forth.
- Students were encouraged to submit assignments through digital media.
- Institutions have additionally begun accepting temporary job reports and undertakings through email during the lockdown for Covid-19.
- Most of the outside assessments and inward evaluation have been dropped.

- The deferment of the outer evaluations, straightforwardly affects the instructive and word related fate of understudies' life.

2.1 Emerging approaches of India for Higher Education during Covid-19

University Grants Commission (UGC) has introduced many virtual platforms with, educational channels through Direct to Home TV e-books, Radios for students to continue their learning online depositories and other online teaching/learning materials. ICT initiative of MHRD predominantly is a means which brings all digital resources under one roof.

2.2 Digital Initiatives in India for Higher Education during Covid-19

Some of the digital initiatives of UGC & MHRD for higher education during COVID-19 are

- e-ShodhSindhu (<https://ess.inflibnet.ac.in/>) is an assortment of e-diaries, e-diary chronicles and digital books. It has 10,000+ e-diaries, 31,35,000+ digital books.
- SAKSHAT (<https://sakshat.ac.in/>) is one Stop Education Portal for tending to all the training and learning related to undergraduates, researchers, educators and students. This website gives the most recent news, official statements associated with Ministry of HRD.
- Virtual Labs (<http://www.vlab.co.in/>) has created web-empowered educational program based investigations intended for distant activity. These Virtual Labs takes into account understudies at the undergrad level, post alumni level just as to explore researchers.
- FOSSEE (<https://fossee.in/>) is short structure for Free/Libre and Open Source Software for Education, which is created to advance open source programming for instruction just as expert use.
- E-Adhyayan (digital books) is a stage that gives 700+ digital books to the Post-Graduate courses.
- National Educational Alliance for Technology (NEAT)(<https://neat.aicte-india.org/>) is an activity for skilling of students in most recent innovations through a Public-Private organization model between the Government (through its actualizing office AICTE) and the Education Technology organizations of India.
- e-Swayam highlights Massive Open Online Courses (MOOCs) with 140 colleges.
- Swayam Prabha gives great instructive projects through 32 DTH channels communicating instructive substance.
- Gyandhara (<http://ignouonline.ac.in/Gyandhara/>) is a web sound advising administration offered by IGNOU. It is a web radio where understudies can tune in to the live conversations by the educators and specialists on the top story and communicate with them through phone.
- darshan (<http://www.ignouonline.ac.in/gyandarshan/>) is an online TV channel gave to instructive and formative requirements for Open and Distance Learner.
- Shodhganga (<https://shodhganga.inflibnet.ac.in/>) is a stage for research understudies to store their Ph.D. propositions and make it accessible to the whole academic local area in open access. The archive

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- e-PG Pathshala (<https://epgp.inflibnet.ac.in/>) is for postgraduate understudies. Postgraduate understudies can get to this stage for digital books, online courses and study materials.
- National Digital Library of India (NDLI) (<https://ndl.iitkgp.ac.in/>) is an archive of e-content on various orders for a wide range of clients like understudies (all things considered), instructors, analysts, bookkeepers, library clients, experts, in an unexpected way abled clients and any remaining long lasting students.
- VIDWAN (<https://vidwan.inflibnet.ac.in/>) is a head information base and public exploration network which has profiles of researchers/specialists and other employees working at driving scholastic foundations and other Research and Development associations in India.

2.3 Case Study

During lockdown, our students were not only using popular social media tools like WhatsApp, Zoom, Google meet, Telegram, YouTube live, Facebook live etc. for online teaching learning system, but also used the media for upgrading their content. Regular theory classes of students were taken on Google Meet. Lectures were made interactive by making the students ask questions regularly. After regular theory classes, assignments were posted regularly on google classroom. Their attendance were monitored through an app known as Google Attendance. Videos related to each concept was shown to them which helped in strengthening their concept. After completion of each unit, the students volunteered to give presentation on topics pertaining to the unit completed.

Regular online activities were conducted for the students which they thoroughly enjoyed. Presentations by students, activities like quiz (online), poster making competition was a big success. Another activity pertaining to Physics that was a great success was that the students conducted an experiment pertaining to day to day concept in their respective homes pertaining to various concept in Physics. They posted the experiment in the WhatsApp groups. And questions related to the activity was asked later in the group. This also imbibed a culture of creativity and innovation in the students.

Regular examination on each unit was conducted. Examinations were conducted online. Question paper was displayed on Google Meet. Students were made to keep their cameras on. Papers were evaluated, suggestions given and the result were displayed online.

Google classroom was extensively used. Notices, assignments, question papers and question assignments were regularly posted on it. Videos, study material, video links and URL's were regularly posted on the groups of google classroom after the completion of a particular topic in the online class. This facilitated the students to have an access to the study material.

Students regularly posted their assignments on the google classroom. Also online tests were conducted which were solved by the students and the answer sheets were posted by them on the google classroom.

The above case study was just to emphasize the changing trend that the pandemic has introduced as it has impacted the students and teachers as well.

2.4 Scenario of Higher Education after Covid-19

Higher education will go about a sea change due to the Covid-19 impact. It has also brought about a sea change in the learning pattern as in:

- Numerous worldwide colleges have been influenced and are managing classes online mostly.
- New methods of social separating will proceed for a long while and may influence nearby eye-to-eye instructing learning and offline classes will take a beating.
- Parents will not be keen to send their wards to another country because of wellbeing reasons.
- Many guardians are not comfortable to send back their youngsters to schools/universities.
- Students are focussing more on self-study.
- May raise the gap between the privileged and unprivileged students. Learners from low-pay families may not be able to bear the cost of online education.
- Interest for Open and Distance Learning (ODL) and web-based learning may develop.
- Instructing learning may run with students will utilize web innovation to discuss basically with their educators through Videoconference, WhatsApp, E-mail, Instant message, and so on.

Conclusion

With Covid-19, we are perceiving how yesterday's bad lister can turn out to be the present day lifesavers. While conventional foundations once saw online instruction as a danger, it has come up as a hero. Nonetheless, instructors are as yet attempting to keep up similar commitment with students as they could have done in offline mode. The methods and means of instructing, teaching, evaluating on how to be interesting are significant for online method of training [6].

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Structural and photoluminescence study of SrAl₂O₄:Eu³⁺ phosphors synthesized by combustion method

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Abstract— The combustion synthesis method was employed for the synthesis of red-emitting monoclinic SrAl₂O₄:Eu³⁺ phosphors. Structural characterization of annealed samples was carried out via X-ray Diffraction (XRD). XRD patterns reveal that strontium aluminate samples were cubic spinel nanoparticles and the grain size determined by the Debye-Scherrer formula is 35.34 nm. The vibrational stretching frequencies corresponding to the composites were confirmed by FT-IR spectroscopy. The PL spectra show the strongest emission at 612 nm corresponds to the ³D₀ → ⁷F₂ transition of Eu³⁺, which results in bright red color emitting phosphor used for display devices and lamp industries.

Keywords— photoluminescence, strontium aluminate, XRD, FTIR.

I. INTRODUCTION

Inorganic materials doped with rare earth ions have generated considerable interest in recent years due to their exceptional luminescent properties. Rare-earth doped phosphors have previously proved their utility in a variety of sectors, including illumination, radiation detection, medicinal applications, and solar energy consumption[1–3]. Alkaline earth aluminate, SrAl₂O₄, is one of the most important persistent luminescent compounds. Due to their high initial luminescent intensity and low-dimensional long afterglow property, strontium aluminate phosphors are an ideal material for widespread use in a variety of fields, including the dial plate of a glow watch, warning signs, escape routines, airports, buildings, and various types of ceramic materials, as well as textiles, and this could result in future nanoscale display devices [4–6].

Due to their amazing properties, such as safety, stability, and high quantum efficiency, strontium aluminates have been extensively investigated for use as phosphor host materials in a variety of applications. SrAl₂O₄ crystallises in two distinct crystallographic forms, with a reversible transition occurring at around 650°C. The low-temperature phase is monoclinic (space group P₂₁, a = 8.447 Å, b = 8.816 Å, c = 5.163 Å and α = γ = 90°) [6–9], whereas the high-temperature phase has a hexagonal structure (space group P6₃). A three-dimensional framework of corner-sharing AlO₄ tetrahedrons forms the monoclinic SrAl₂O₄.

Following that, the oxygen is shared with two aluminium ions, resulting in a net negative charge in each tetrahedron that is balanced by massive divalent cations that occupy two unique interstitial sites inside the tetrahedron framework. [10].

The combustion synthesis method was employed in this study to produce SrAl₂O₄ phosphors doped with Eu³⁺ using urea as the fuel. X-ray diffraction (XRD) was utilized to assess the phase purity and structure of the phosphors as they were made. At room temperature, the photoluminescence characteristics of the resulting samples were analysed using a fluorescence spectrophotometer. The CIE chromaticity diagram was used to determine the CIE coordinates for the photoluminescent colour of nanophosphors. The FTIR technique is used to assess the existence of specific functional groups in a molecule.

II. EXPERIMENTAL

The SrAl₂O₄:Eu³⁺ phosphors were synthesized using a combustion method. Strontium nitrate [Sr(NO₃)₂], and aluminum nitrate nonahydrate[Al(NO₃)₃·9H₂O] was used as the oxidizers, while urea (CH₄N₂O) was used as the fuel for the method. Europium oxide (Eu₂O₃) was used as the dopant precursor. All the reagents were obtained A.R. grade and taken according to their stoichiometric ratio.

The schematic of the synthesis process is shown in Fig. 1. The precursor and initial reactant components were dissolved in double distilled water and combined using a porcelain mortar and pestle in a china dish. Later, the mixture was heated to 80 °C for 15-20 minutes to achieve a homogenous solution. The mixture was maintained at a temperature of about 525 °C in a preheated muffle furnace. As soon as the china dish was placed in the preheated furnace, the mixture boiled, triggering a breakdown process.

This resulted in a combustion reaction in which combustible gases such as nitrogen oxides and ammonium oxides were liberated. The combustion process is accomplished quickly. The generated sample was foamy, and the foamy powder was removed immediately after the combustion process was completed. The frothy powder was crushed to a fine powder and sintered for four hours at 800 °C. The final produced product was subjected to characterisation, which was carried out at room temperature.

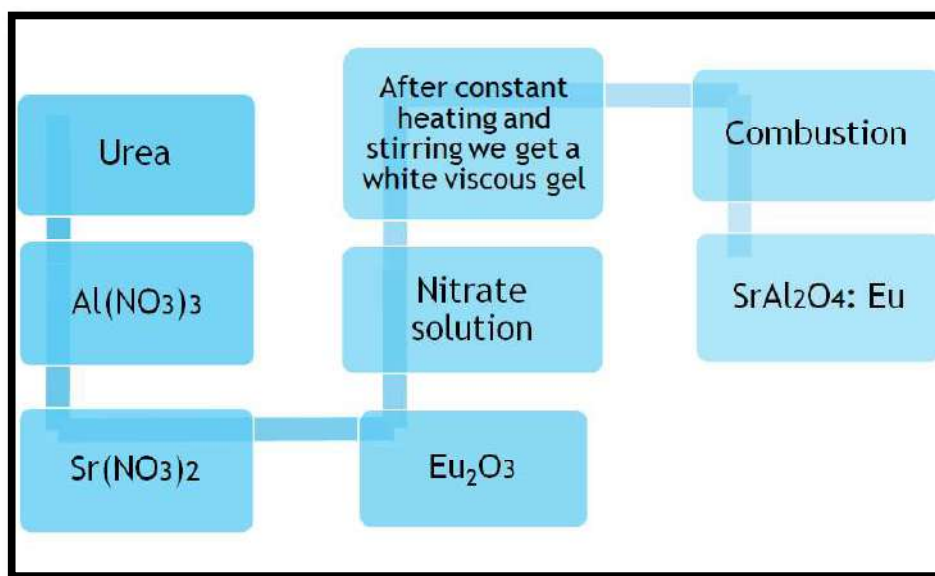


Fig. 1. 1 The schematic of the synthesis process $SrAl_2O_4:Eu^{3+}$

III. RESULTS AND DISCUSSION

X-RAY DIFFRACTION ANALYSIS

As seen by the XRD patterns (Fig. 1. 2), crystalline phase formation began at 800°C with the formation of a phase with diffraction peaks suggesting the presence of monoclinic $SrAl_2O_4$ (JCPDS #34-0379). Additionally, X-ray diffraction patterns suggest that the different diffraction peaks at 2θ values of 20.00, 22.73, 29.27, 29.88, 31.97, 35.05, 40.69, 42.88, and 62.77 correspond to the (0 0 2), (0 1 2), (2 2 0), (1 2 1), (0 1 3), (2 1 0), (2 0 1), (2 0 2), (0 3 3) and (-1 0 7) plane. The main peak at angle $2\theta = 29.27^\circ$ is the reflection of the crystallographic plane (220) for $SrAl_2O_4$. The XRD

patterns of the annealed samples demonstrated a significant improvement in crystallinity, with more intense and sharper diffraction peaks. Additionally, the number of diffraction lines is increased in $SrAl_2O_4$ orientations when 800°C annealing is used.

Scherrer's equation was used to calculate the crystal size of the sample based on the full width at half maximum (FWHM) of the most intense peak at $2\theta = 31.875^\circ$. The crystallite's average size was calculated to be approximately 35.34 nm. According to the literature, $SrAl_2O_4$ with filled tridymite-like structure belongs to the monoclinic P_{21} space group [9].

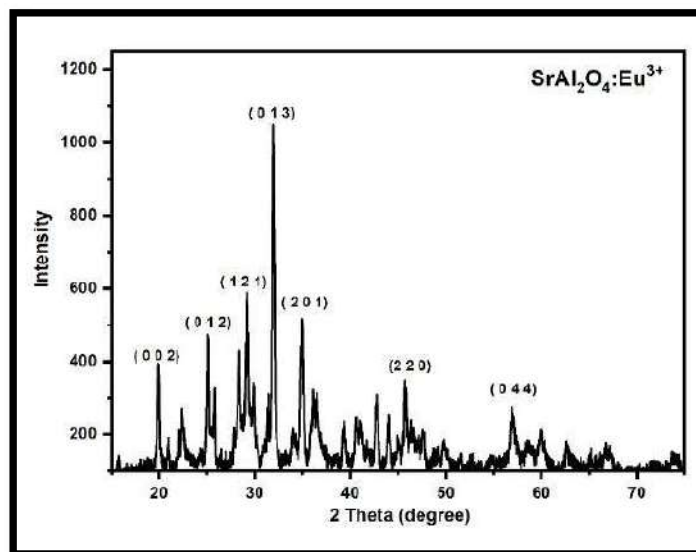


Fig. 1. 2 the XRD patterns $SrAl_2O_4:2\%Eu^{3+}$

Table 1: Various parameters, i.e. Lattice constants (a), cell volume (V), X-ray density (X-ray) and crystallite size (D)

Lattice Constant					Volume (V) Å ³	X-ray density (ρ _x) g/cm ³	Molecular weight (M) gm/mole	Crystallite size (D) nm
a[Å]	b[Å]	c[Å]	α=γ	β				
5.209	8.5649	8.9113	90	93.65	396.77	3.44	205.54	35.34

FOURIER TRANSFORMATION INFRARED SPECTROSCOPY

Fig. 1. 3 shows the FT-IR spectra of $SrAl_2O_4:Eu^{3+}$ powder. Due to the OH stretching vibrations of free and hydrogen-bonded hydroxyl groups, this spectrum reveals a broad band about 3433 cm^{-1} . However, a faint absorption band at 1632 cm^{-1} appears to be caused by the deformative vibration of water molecules, which is most likely caused by water

absorption during the compaction of the powder specimens with KBr [11,12]. The appearance of a very weak band at 1382 cm^{-1} is owing to the N–O group's symmetric stretching vibrations, which may have been caused by the initial material's nitrate. Metal-oxygen stretching frequencies in the range $400\text{--}1000\text{ cm}^{-1}$ are related with Al–O, Sr–O, and Sr–O–Al bonding vibrations. A prominent peak at 846 cm^{-1} was seen, which was attributed to the production of $SrAl_2O_4$ [13]

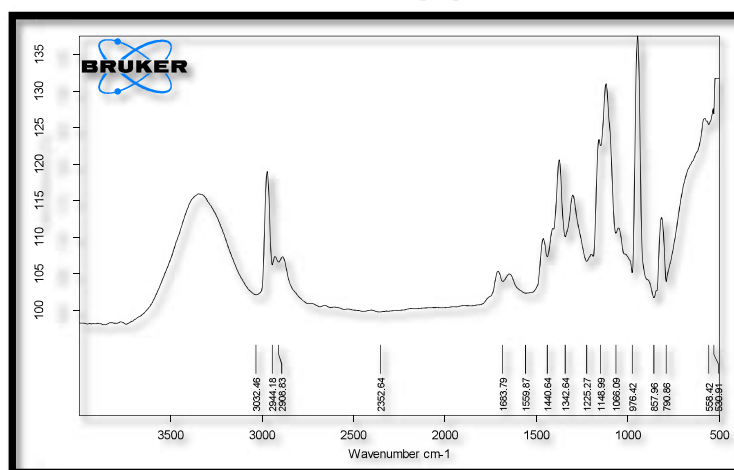


Fig. 1. 3 The FT-IR spectrum of $SrAl_2O_4:2\%Eu^{3+}$ powder

PHOTOLUMINESCENCE

Fig. 1. 4 shows excitation spectrum $\text{SrAl}_2\text{O}_4: 2\% \text{Eu}^{3+}$ was monitored at an emission wavelength of 616 nm and it exhibits a broad spectrum with peaks at around 394 and 466 nm, which correspond to transitions within the $4f_6$ configuration of Eu^{3+} ions [14]. **Error! Reference source not found.** Under 466 nm excitation, the apparent emission spectra of $\text{SrAl}_2\text{O}_4: \text{Eu}^{3+}$ phosphor consists of many narrow and strong emission bands at 616 nm, as well as several minor emission bands. The major emission band should be defined as the transition from the splitting level $^5\text{D}_0 \rightarrow ^7\text{F}_2$ of Eu^{3+} to the splitting level $^5\text{D}_0 \rightarrow ^7\text{F}_j$ of Eu^{3+} . The emission spectrum must be identified as $^5\text{D}_0 \rightarrow ^7\text{F}_j$. The spectra associated with the transitions $^5\text{D}_0 \rightarrow ^7\text{F}_j$ are composed of

several bands depending on the number of stark components in $^7\text{F}_j$ [15–17]. The $2J+1$ rule governs the amount of stark components of Eu^{3+} in SrAl_2O_4 crystals. The transition $^5\text{D}_0 \rightarrow ^7\text{F}_2$ produces bands at 581, 588, 593, and 599 nm; transition $^5\text{D}_0 \rightarrow ^7\text{F}_2$ produces bands at 620 and 630 nm; and transition $^5\text{D}_0 \rightarrow ^7\text{F}_3$ produces bands at 650 and 658 nm [18,19]. At 615 nm, the hypersensitive band is due to the electric dipole transition $^5\text{D}_0 \rightarrow ^7\text{F}_2$ of Eu^{3+} ions.

The CIE chromaticity diagram of $\text{SrAl}_2\text{O}_4: 2\% \text{Eu}^{3+}$ phosphors is shown in **Fig. 1. 5**. The CIE coordinates (0.5774, 0.4217) indicate red emission with a CCT of 1691 K and a CRI of 42. The CIE values of $\text{SrAl}_2\text{O}_4: \text{Eu}^{3+}$ red phosphor is nearly identical to those of the commercial red-emitting phosphor $\text{Y}_2\text{O}_3: \text{Eu}^{3+}$ [20,21].

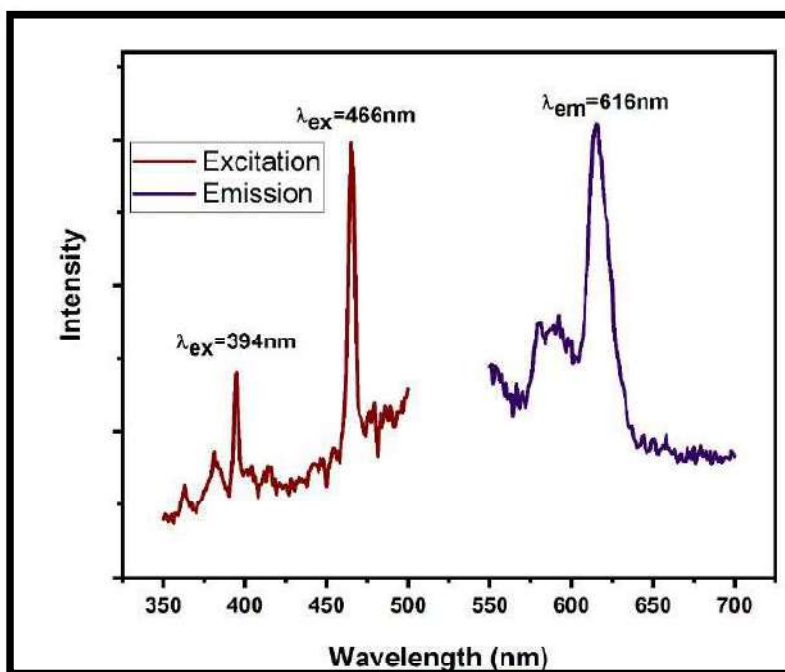


Fig. 1. 4 Photoluminescence graph of Europium doped $\text{SrAl}_2\text{O}_4: 2\% \text{Eu}^{3+}$

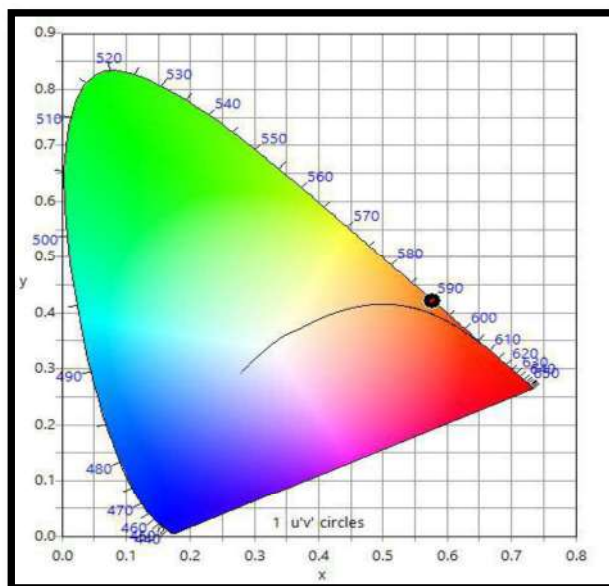


Fig. 1. 5 The CIE chromaticity diagram of $\text{SrAl}_2\text{O}_4:2\%\text{Eu}^{3+}$ phosphors

IV. CONCLUSION

Our results demonstrate that Eu is stabilised in the trivalent oxidation state in the produced SrAl_2O_4 phosphor. This phosphor might be generated in a short amount of time using the combustion process, resulting in a decrease in the rate of aluminate synthesis. X-ray Diffraction (XRD) was used to characterise the structural properties of annealed samples. Strontium aluminate samples were found to be monoclinic structure with a grain size of 35.34 nm as estimated by the Debye-Scherrer formula. FT-IR spectroscopy was used to confirm the vibrational stretching frequencies of the composites. The PL spectrum indicates that the highest emission occurs at 616 nm, which corresponds to the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$ transition of Eu^{3+} ion, resulting in a bright red colour emitting phosphor used in display devices and lamp manufacturers. $\text{SrAl}_2\text{O}_4: \text{Eu}^{3+}$ phosphors exhibit an orange-red emission band at 616 nm in their PL spectra. The CIE coordinates (0.5774, 0.4217) indicate red emission with a CCT of 1691 K and a CRI of 42.

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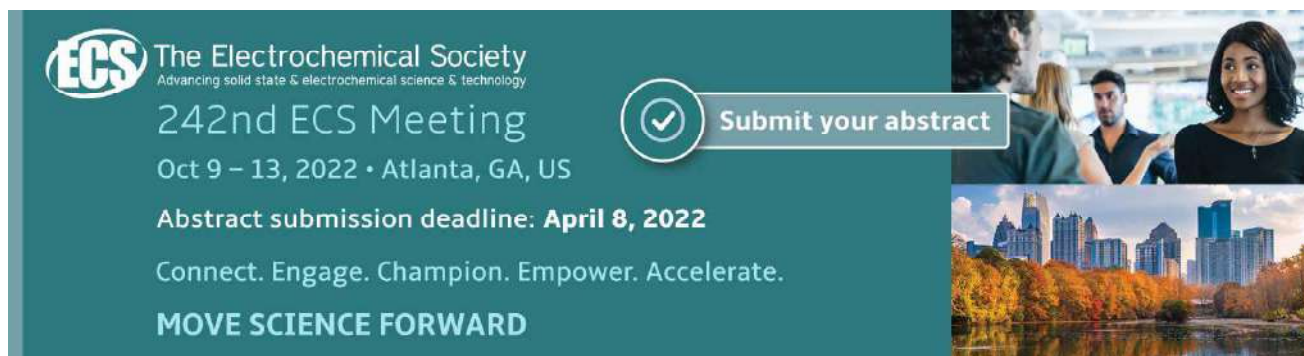
Investigation of structural and dielectric properties of Co-Zr doped Barium M-type Hexaferrites

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Investigation of structural and dielectric properties of Co-Zr doped Barium M-type Hexaferrites

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Abstract: The Samples of Cobalt- Zirconium doped Barium nano-hexagonal ferrites of chemical formula $BaFe_{12-2x}(Zr-Co)_xO_{19}$ ($x = 0.5, 0.9$) are prepared employing Microwave assisted Sol-gel auto-combustion Route, in which the ferrite materials were generated by providing continuous heat in microwave oven. The precursors in the form of nitrates are taken accompanied with urea as a fuel, supply energy to initiate exothermic reaction during the formation of materials. Uniform heating in the microwave leads to the ultrafast morphological transformations giving rise to a nano-scale particle size of the synthesized samples. The derived ferrites powders being analyzed for their structural and morphological characteristics with the help of X-ray diffraction techniques (XRD) and Transmission Electron Microscopy (TEM). Lattice constants 'a' and 'c', porosity (ρ) of the prepared materials were determined. Their d-values are counter checked and (h k l) planes were specified. TEM analysis confirmed the nano-scale particle size of the synthesized samples. The materials have been assessed with Impedance Analyzer for electrical resistivity (ρ). The obtained results suggest that the synthesized samples belong to the family of hexagonal M-type ferrites. A structural observation has verified that the space group symmetry of the prepared materials is $P6_3/mmc$. The ferrites samples show high resistivity of the order 10^7 ($\Omega\text{-m}$). Such types of nano-sized ferrite materials with high resistivity are helpful especially for various microwave absorbing applications.

Key words: Ba-hexaferrites, Microwave induced synthesis, Nanocrystalline, Porosity, Resistivity, XRD, and TEM, etc.

1. Introduction

Magnetic ions in ferrites, which are a part of a magnetic oxide, are arranged to achieve spontaneous magnetization even as preserving strong electrical and magnetic properties in ferrite. The most important feature of the hexaferrites is the prospect of tailoring the magneto- electric behavior depending upon the application, which can be achieved by the biased replacement of trivalent, simultaneous substitution of divalent-tetravalent metal ion, and other compatible combinations for Iron (Fe) in the parent hexaferrite matrix [1,2]. Cost effectiveness, simple processing and fascinating electrical and magnetic properties make hexagonal ferrite one of the most significant materials that have drawn tremendous exposure within an area of technical purposes [3, 4]. The process of synthesis, sintering temperature, etc. shall, in



particular, specify the particle size upon which electrical and magnetic characteristics of the substance rely. [5]. In present research module, the novel method of Microwave assisted Sol-Gel Auto-Combustion process is utilized to fabricate zirconium-cobalt substituted barium nano-hexaferrite samples with the general formula $\text{BaFe}_{12-2x}(\text{Zr}_x\text{Co}_x)\text{O}_{19}$ ($x=0.5, 0.9$) [6, 7]. This section aims to characterize the structural and Electrical behavior of the synthesized substituted barium nano-hexaferrites materials. The structural and morphological characteristics of the synthesized ferrites powder are studied by X-ray diffraction (XRD) and transmission electron microscopy (TEM). Impedance analyzer is employed to study for the electrical measurements of synthesized hexaferrite powder.

2. Experimental Procedure

For the synthesis of ferrites, a significant number of preparatory methods like Solid-state reaction, Coprecipitation, Hydrothermal synthesis, Glass crystallization, etc. had previously been documented. The documented Sol-gel assisted auto combustion route had several benefits to prepared doped M-type hexagonal ferrites owing to its high degree of simplicity in the process, lower anneal or calcine temperature, and, short reaction time [6]. Besides, the Sol-Gel auto-combustion method produces an ultra-fine nano powder with a substantial distribution of particle sizes, outstanding chemical uniformity and the probability of creating a unified single domain structure.

The Co-Zr doped BaM nano-hexagonal ferrites materials are processed by ‘Microwave induced Sol-gel auto combustion route, where the microwave is replaced in the place of conventional furnace, to assure the continual heating of the materials through the combustion method. AR grade nitrates like $\text{Ba}(\text{NO}_3)_2$, Ferric Nitrates, Cobalt Nitrates, Zirconyl Nitrates and Urea in proper stoichiometric proportion were liquefy with double filtered distilled water at 50°C temperature and kept for 20 minutes. Initiate an exothermic reaction with adequate energy available from the fuel as Urea. The generated gel is then stored at room temperature for an hour and then put inside the digitally operated 2.54GHz microwave for 10 min for thermal decomposition. The gel is thermally decomposed and eventually transformed into a loose, foamy, uniform nanocrystalline ash powder. After that the synthesized hexaferrite powder was grinded in pestle mortar for four hour with gradually slow cooling rate maintained at $50^\circ\text{C}/\text{minute}$, with further grinding for four hours.

3. Results and Discussions.

3.1. Structural Properties

The XRD diffract graph of fabricated materials were obtained by using Philips X’pert Diffractometer, with $\text{CuK}\alpha$ radiation of wavelength $\lambda=1.542(\text{\AA})$. Fig.1.(a and b) present the x ray intensity graphs of synthesized materials for $x=0.5$ and $x=0.9$ respectively. After matching the diffraction patterns with the JCPDS standard files, leveraging 2θ values, the observed d-values and intensity differences, the d-value is being determined and the (h k l) planes were specified. With the help of interplaner spacing d (h k l) corresponding to finalized planes the values of lattice parameters can be calculate employing relation

$$d_{hkl}^2 = \frac{3a^2}{h^2 + hk + k^2} + \frac{c^2}{l^2}$$

The percentage Porosity is being calculated by

$$P = \left(1 - \frac{D_{Bulk}}{D_{Xray}}\right)\%$$

Where, P is porosity, D_B is bulk density and D_{xray} is x- ray density of formulated materials

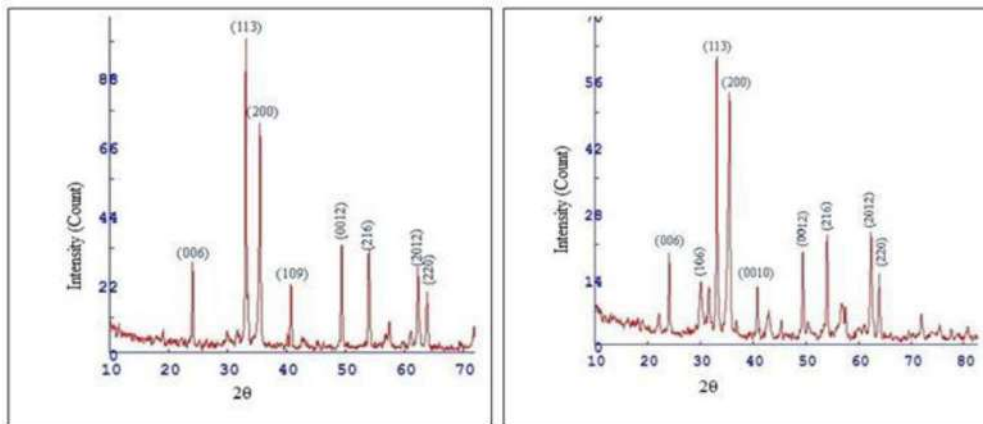


Fig a(x=0.5)

Fig b (x=0.9)

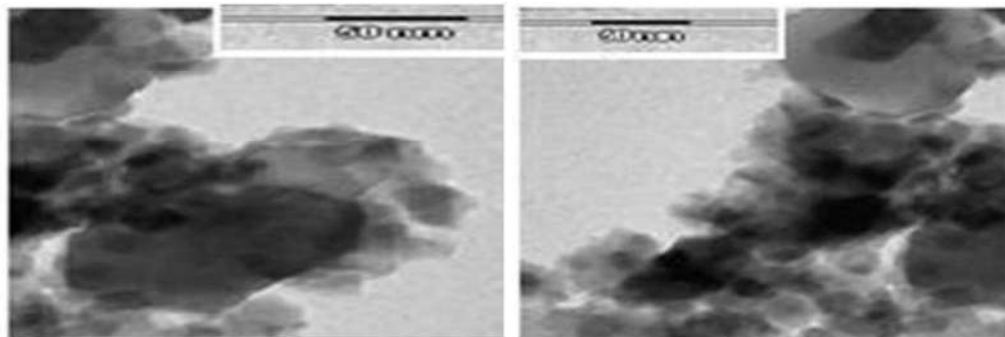
Figure 1. Powder XRD of Ba (Co-Zr)_xFe_{12-2x}O₁₉ Hexaferrite for x=0.5 and x=0.9

The value of lattice parameters affirms that the hexagonal ferrites with a single - phase is formed. Lattice constants 'a' and 'c' were observed to be 5.8256 (Å) and 23.124 (Å) independently for x=0.5 and 5.8239 (Å) and 23.127 (Å) for x=0.9 respectively. The space group symmetry of the formulated hexaferrites powder is found to P6₃/mmc.

Table 1 summarizes the Lattice parameters, x-ray and bulk density, porosity and the electrical Resistivity of these hexaferrites samples [15-17] at concentrations x = 0.5 and x = 0.9.

Table 1. Structural and Electrical Parameters

Conc.(x)	a (Å)	c (Å)	D _x (Å) ³	D _B (Å) ³	P (%)	ρ at 373K (Ω-m)
X= 0.5	5.8256	23.124	5.39	2.72	49.54%	1.229*10 ⁵
X= 0.9	5.8239	23.134	5.60	2.81	49.86%	1.788*10 ⁴

**Figure 2.** Transmission Electron Micrographs of the prepared Ba(Co-Zr)_xFe_{12-2x}O₁₉ materials, for x=0.5 and x=0.9.

3.2 Morphological Analysis.

Figure 2 displays TEM pictures of the prepared hexaferrites samples taken by TEM Philips Model CM 200. Micrographs showing hexagonal platelet structure with morphological homogeneity. Prominent grain boundaries are also observed.

TEM images of the samples are taken at nano-scale about 50nm, gives an idea about the particle size, which indicates the formation of the zirconium-cobalt substituted Barium nano- hexaferrite particles.

3.3 Electrical properties.

Precision impedance Analyser 6500B, Wayne kerr Electronics is used to study the electrical properties of synthesized materials. For regulated thermal variations, the material is housed inside the electric furnace operated digitally. Four probes techniques were utilized to calculate the electrical characteristics of prepared materials in palletized form. The electrical properties of ferrites termed phonon-assisted electron tunnelling can also be interpreted by the tunnelling of electrons among Fe^{2+} and Fe^{3+} . It is being noted that the electrons are closely bound to the lattice that participates in the $Fe^{2+} \leftrightarrow Fe^{3+} + e^-$ exchange mechanism and migrate from one lattice sites to other sites owing to the phonon-induced transfer process [8,9].

Table 1 indicates that with a rise in Co^{2+} and Zr^{4+} ions doped concentrations, the values of electrical resistivity at a normal temperature decreased from $1.229 \times 10^5 \Omega m$ to $1.788 \times 10^4 \Omega m$, while the percentage porosity (P) increased from 49.54 % to 49.86 %. This might be attributed to the evidence that, as a result of a increase in porosity, the driving pathways are made harder for charge carriers to travel from grain to grain. A number of reasons, along with the development of other secondary phases and significantly larger porosity values, may be accountable for the comparatively high resistivity value of the order of $10^5 \Omega m$. Separations in between grains are mostly attributed to increased porosity. And this separation can lead to difficulties in driving free electrons across grain boundaries [10].

4. Conclusion.

The series of Co^{2+} and Zr^{4+} doped Barium nano-hexaferrite of composition $BaFe_{12-2x}(Zr-Co)_xO_{19}$ via “ Microwave Assisted Sol-gel auto- combustion technique” synthesized successfully. The formation of hexaferrites is confirmed by XRD results and the values of lattice constant ‘a’ and ‘c’ of the processed materials support such assertion. The prepared materials have hexagonal symmetry with space group $P6_3/mmc$ (No.194) which is confirmed by the structural study. From TEM analysis, the size of crystallites is being noticed in nano scale.

With high values of electrical resistivity of such synthesized nano-scale barium hexaferrite doped with Zr^{4+} and Co^{2+} can prove to be a promising material in the microwave absorbing, EMI shielding applications. Also, the nanosize of the particles helps to reduce the noise produced in magnetic data storage devices which occur due to the displacement of domain boundaries. The lowering of hexaferrites crystallite size to nano scale range allow us to enhance improve the previously described electrical properties.


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Study of structural and magnetic properties of aluminium-substituted nanosized barium hexaferrite prepared by sol–gel auto-combustion technique

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Abstract. M-type nanosized barium hexaferrite $\text{BaMe}_x\text{Fe}_{12-x}\text{O}_{19}$ ($\text{Me} = \text{Al}^{3+}$ and $x = 0.0, 0.4, 0.8$) was synthesized by sol–gel auto-combustion method using urea as a fuel. Characterization of prepared sample was done by using different techniques, such as XRD (X-ray diffractometer), SEM (scanning electron microscope), EDAX (energy dispersive X-ray analysis), TEM (transmission electron microscope) and vibrating sample magnetometer (VSM). XRD studies show the formation of M-type barium hexagonal ferrite with space group P63/mmc. The effect of substitution of Al^{3+} ion for Fe^{3+} ion on the unit cell parameter, density, porosity has been studied. The SEM study shows that the samples exhibit spherical-shaped particles and agglomeration of individual particles in some parts. EDAX study confirms the elemental composition of prepared samples. TEM images confirm the nanosize of prepared samples. The VSM or magnetic study reveals that the saturation magnetization (M_s) value decreases from 57.1 to 33.6 emu g^{-1} , while coercivity (H_c) value increases from 1737 to 2071 Gauss by the substitution of Al content. Substitution of Al^{3+} ion in barium hexaferrite significantly improves the magnetic properties.

Keywords. Sol–gel auto-combustion; M-type nano hexaferrite; XRD; magnetic properties; saturation magnetization.

1. Introduction

Barium hexaferrite with a hexagonal structure ($\text{BaFe}_{12}\text{O}_{19}$) is well known for its high performance permanent magnetic and good mechanical hardness [1,2]. It has involved significant attention in recent years due to its high coercivity (magneto-crystalline anisotropy property), relatively large magnetization, high Curie temperature, and the superior chemical stability and corrosion resistivity [3–6]. Ferrite material can be categorized into three types namely spinel, hexagonal and garnets according to their crystal lattice structure. Today, modern developments in different areas lead to a continuous demand of materials with improved magnetic properties for such science and technology applications. BaM ($\text{BaFe}_{12}\text{O}_{19}$) has a hexagonal crystal structure with 64 ions per unit cell with space group of P63/mmc. In the crystal structure, the Fe^{3+} ion cations occupy five different interstitial sites i.e., three octahedral sites, one trigonal pyramidal and one tetragonal site (2b), (12k, 2a, 4f1), 4f2, respectively. As we know, physical properties of barium ferrites are mainly depend on the size and shape of the particles, different synthesis techniques have been used

to obtain the desired barium hexaferrite structure. Synthesis method of hexaferrite affects the structure, physical and magnetic properties for different applications. An ideal method to synthesize the substituted M-type hexaferrite should include the following: low annealing or calcination temperature, energy efficient and a short reaction time. Although some researchers have reported Al-substitution barium ferrite [7–11], which leads to decrease in magnetic properties and specially magnetization value, it is not best suited for different applications. The performance of M-type hexaferrite must be improved by substitution with trivalent ions, such as La^{3+} , Al^{3+} , Sm^{3+} , Bi^{3+} , Nd^{3+} , Cr^{3+} , etc. [12]. The nanosize ferrite particles can be prepared by a large number of methods like co-precipitation of hydroxides, hydrothermal synthesis, sol–gel synthesis [13,14], etc. Gawali *et al* [15] have synthesized the Al-substituted nano calcium hexaferrite $\text{CaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ ($x = 0, 2, 4$) by sol–gel auto-combustion technique using urea as a fuel. It has been observed that the lattice parameters and lattice volume decrease with increasing Al-ion concentration in pure sample of barium hexaferrites. The calculated values of a and c are found to be 5.8 and 22.1 Å, respectively [15].

So, in the present work, M-type barium hexaferrite substituted with trivalent aluminium ion has been synthesized by sol-gel auto-combustion method. This synthesis technique is simple, safe and low-cost, and also takes less time for processing as compared to other synthesis techniques. The main advantages of this method are: high purity, low sintering temperature, high homogeneity, ultrafine powder, easy handling of instruments, etc. Our aim is to investigate the enhancement of magnetic properties of barium hexaferrites substituted by Al ions substitution using nominal composition $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ ($x = 0.0, 0.4, 0.8$).

The substitution of Al^{3+} ions on the Fe sites can strongly affect the magnetic properties of hexaferrites, such as saturation magnetization (M_s) and coercive field (H_c) as recognized by powder X-ray diffraction (XRD) and vibrating sample magnetometer (VSM).

2. Experimental

2.1 Material preparation

The polycrystalline M-type barium hexaferrite with chemical formula $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$, $x = 0.0, 0.4, 0.8$, was synthesized by sol-gel auto-combustion method. The stoichiometric amount of AR grade chemicals like metal nitrates $\text{Ba}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ and $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ are dissolved in 40 ml distilled water using beakers and made into homogeneous solution. Urea ($\text{CO}(\text{NH}_2)_2$) also dissolves in this homogeneous solution and work as reducing agent.

Urea supplies the required energy to initiate exothermic reaction among the metal nitrates. Here, metal nitrates are used as oxidants. All the solution of metal nitrates and fuel were mixed properly to form homogeneous yellow brown colour aqueous solution. This homogeneous solution is now heated on a hot plate for 2–3 h at 80°C . After the evaporation of water, this homogeneous solution turns into a brown colour gel. Then, the gel is burnt by self-propagating combustion in microwave oven where large amount of gas is evolved and finally gets homogeneous into brown colour loose powder/ash. This ash was further grinded by pestle mortar for 3–4 h to form fine powder. This fine powder thus obtained were sintered in a muffle furnace at a temperature of 800°C for 5 h to obtain ferrite nanoparticles by increasing the temperature slowly to 100°C per hour, and then cooled at the same rate. The sample powder obtained from sintering is grinded by pestle mortar for 1–2 h and then, kept in moisture-free air tight bottles for further characterization.

2.2 Characterization techniques

Structural properties have been investigated using XRD pattern obtained from Bruker AXS D8 Advance X-ray diffractometer in the range of $10\text{--}80^\circ$ using $\text{CuK}\alpha$ radiation ($\lambda = 1.54060 \text{ \AA}$) operating at 40 kV and 35 mA having step size of 0.02° . The surface morphology was identified using scanning electron microscopy (SEM) JEO model JMM-6390LV instrument as well as TEM (FEI, model Tecnai G2, F30). The magnetic properties of all the samples were measured by using VSM at room temperature with a

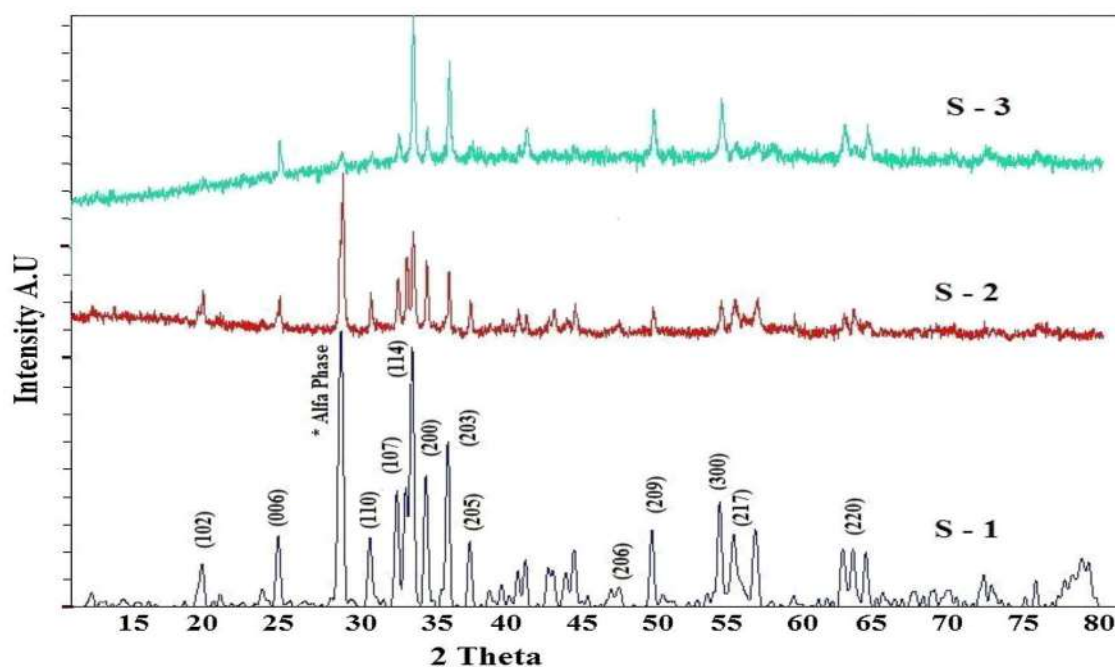


Figure 1. XRD patterns of $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$, S-1 ($x = 0.0$), S-2 ($x = 0.4$) and S-3 ($x = 0.8$).

maximum field of 10K Gauss. The magnetic hysteresis loops (M vs. H) are obtained to give the values of saturation magnetization (M_s), coercivity (H_c) and remanence magnetization (M_r).

3. Results and discussion

3.1 Structural analysis

Figure 1 shows XRD patterns of M-type hexaferrite with composition $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ ($x = 0.0, 0.4, 0.8$). The XRD patterns consist of reflecting planes (102), (107), (114), (200), (110), (203), (205), (217) and (300) confirming that prepared samples belong to M-type hexaferrite. Indexing of (hkl) planes were determined with the help of Match software as well as the manual method. Our XRD patterns were matched with JCPDS card no. 84-0757 of standard barium hexaferrite. In samples S-1 ($\text{BaFe}_{12}\text{O}_{19}$), S-2 ($\text{BaAl}_{0.4}\text{Fe}_{11.6}\text{O}_{19}$) and S-3 ($\text{BaAl}_{0.8}\text{Fe}_{11.2}\text{O}_{19}$), $\alpha\text{-Fe}_2\text{O}_3$ is present as secondary phase. This secondary phase may be due to incomplete crystalline reaction. The highest intensity peak value of all the samples were observed at (114) plane.

The average crystallite size was calculated from the peak positions (114) using the Scherrer formula [16].

$$D = k\lambda/\beta \cos \theta, \quad (1)$$

where D is the crystallite size in nm, k the Scherrer constant having value 0.9, β the full-width at half maximum

(FWHM), θ the peak position in radian and λ (1.540 Å) the wavelength.

X-ray density of sample was calculated by using the following reaction:

$$D_x = nM/N_A V_{\text{cell}}, \quad (2)$$

where n is number of molecules per unit cell, M the molecular weight, N_A the Avogadro's number, V the cell volume. The ratios of lattice constants vary with substitution of Al^{3+} ion in pure barium hexaferrites sample. The c/a ratio of all the samples is in the range of 3.8–3.95, which lies below the lattice constant ratio 3.98, confirming that prepared barium ferrites have hexagonal structure. The calculated values of crystallite size, lattice parameters and density are given in table 2. The c/a ratio is also an important parameter to quantify the M-type hexagonal structure [17–20]. The variation in the densities shows general behaviour i.e., the actual (experimental) density values were found to be in general less than those of X-ray density D_x (theoretical density), which are expected due to the presence of unavoidable pores created during firing [21]. The variation in porosity is related to values of lattice parameters and it is reported that if density increases, the volume of unit cell and lattice constant ultimately decrease and vice-versa [22,23]. The crystal size of all the samples is calculated by using the Scherrer equation and found to be 26.26, 24.42 and 22.16 nm, respectively. Due the smaller ionic radius of Al^{3+} (0.53Å) ions as compared to that of Fe^{3+} (0.67Å) ions, the lattice parameters (a , c) of the prepared samples were

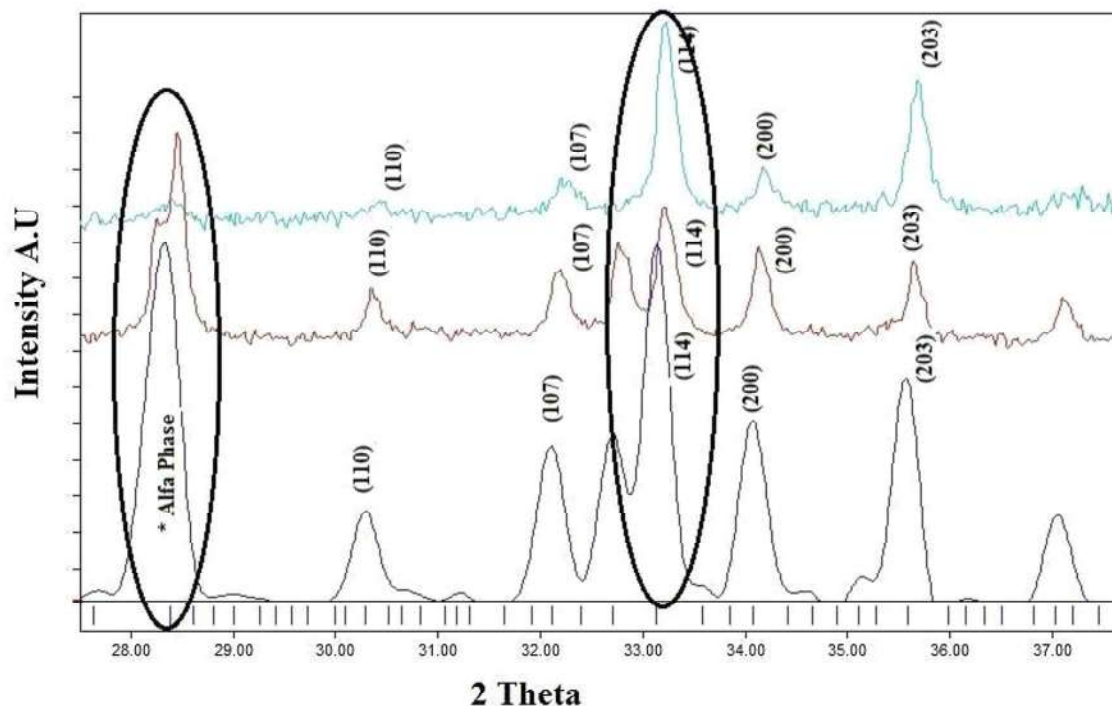
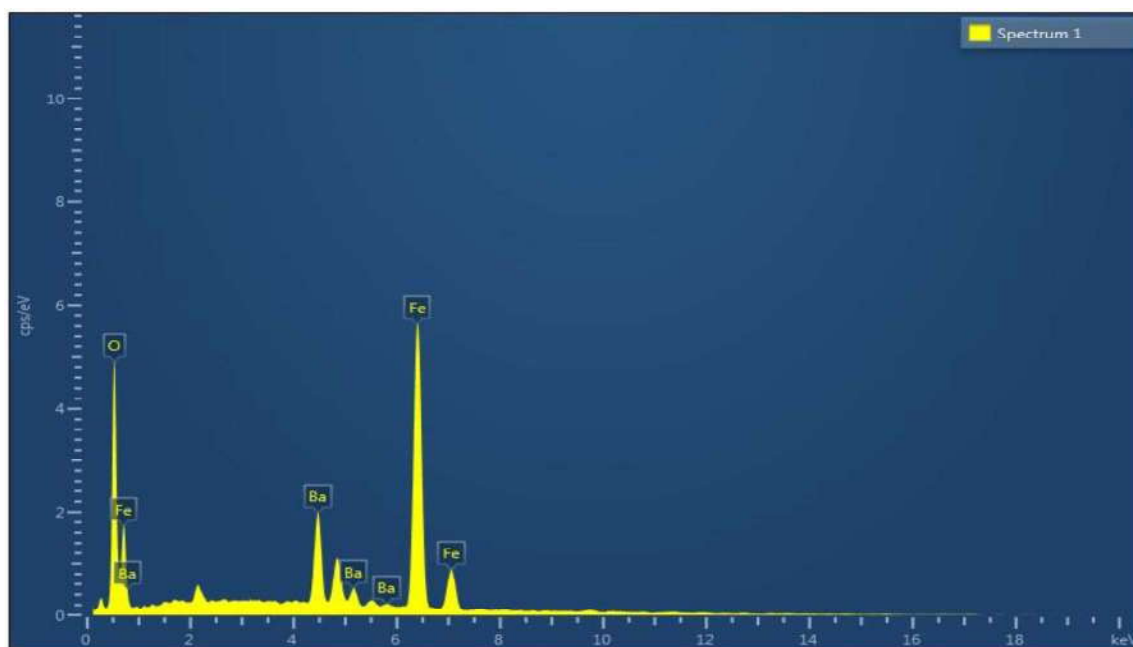
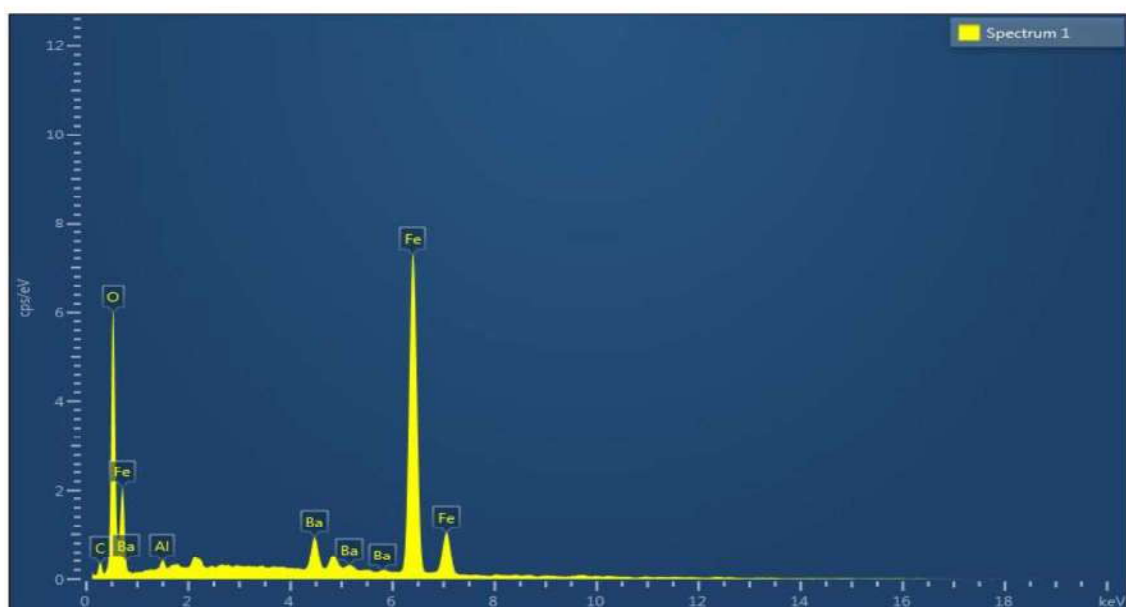


Figure 2. Enlarged view of some XRD peaks.

(a) $\text{BaFe}_{12}\text{O}_{19}$ (b) $\text{BaAl}_{0.4}\text{Fe}_{11.6}\text{O}_{19}(x = 0.4)$ **Figure 3.** EDAX spectrum of the prepared pure and doped samples.

decreased by increasing substitution amount of Al^{3+} ion. So, as a result, the crystal size and cell volume of samples were also decreased by substitution of Al^{3+} ion. The reduction in cell dimensions is due to the solubility of Al^{3+} ions in the M-type hexaferrite [24]. These results are well agreed with the results given by Zhang *et al* [25] for Al-substituted barium hexaferrite synthesized by sol-gel auto-combustion technique. The enlarged view of

some 2θ values vs. intensity count is shown in figure 2. It is observed that when Al^{3+} ion (0.53 \AA) is replaced by Fe^{3+} (0.67 \AA), the intensity peaks (114), (107) and (203) are shifting towards higher 2θ positions. It is obvious as there is constriction in the values of lattice parameters a and c . But the value of c for the sample S-3 is slightly lower than the value of S-2. But overall, the values of XRD peaks are shifting towards higher side of 2θ .

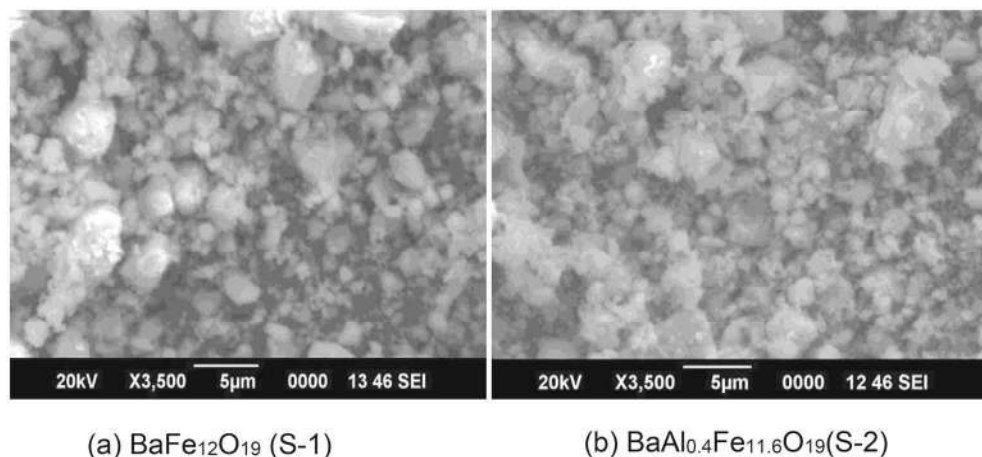


Figure 4. SEM micrographs of samples.

Table 1. Stoichiometric ratio of metal nitrates for synthesis of $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ ($x = 0.0, 0.4, 0.8$) samples for total of 30 g precursors.

Sample	Barium nitrate (g)	Ferric nitrate (g)	Aluminium nitrate (g)	Urea (g)
$\text{BaFe}_{12}\text{O}_{19}$	1.1182	20.745	—	8.1366
$\text{BaAl}_{0.4}\text{Fe}_{11.6}\text{O}_{19}$	1.1201	20.0866	0.6431	8.1501
$\text{BaAl}_{0.8}\text{Fe}_{11.2}\text{O}_{19}$	1.1219	19.426	1.2880	8.163

Table 2. Structural data of $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ samples ($x = 0.0, 0.4, 0.8$).

Sample code	Concentration (x)	a (Å)	c (Å)	Cell volume (Å ³)	Axial ratio (c/a)	X-ray density (D_x) (g cc ⁻¹)	Bulk density (D_b) (g cc ⁻¹)	Porosity (P) %	Crystal size (D) (nm)
S-1	0.0	5.851	23.177	687.23	3.79	5.370	3.252	39.44	26.26
S-2	0.4	5.848	22.989	680.85	3.93	5.36	3.452	35.63	24.41
S-3	0.8	5.841	22.725	671.52	3.89	5.38	3.125	42	22.16

It occupies the tetrahedral site of hexagonal crystal structure and makes a distortion in the geometry of hexagonal crystal structure. Therefore, the (hkl) planes get shifted to the higher value of 2θ positions which is well mentioned in figure 2.

3.2 Microstructural analysis

The energy dispersive X-ray (EDAX) analysis plots for synthesized samples are shown in figure 3. The EDAX plots show the presence of Ba^{2+} , Fe^{3+} and Al^{3+} ions with a proper ratio in desired stoichiometric composition. The

$\alpha\text{-Fe}_2\text{O}_3$ peak was also seen in the EDX spectrum analysis [26].

Surface morphology and microstructure of $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ of type samples $x = 0.0, 0.4, 0.8$ nanomaterial were observed by SEM. The SEM micrographs of Al ion-doped Ba-hexaferrite sintered at 800°C are shown in figure 4. Surface of the prepared samples appeared as a collection of individual nanoparticles. SEM images show that the particles have uneven distributions. The resolution of micrographs was taken up to the mark of micrometre range, the particle size taken from XRD and SEM images confirmed nanometre range. It is clearly noticed that

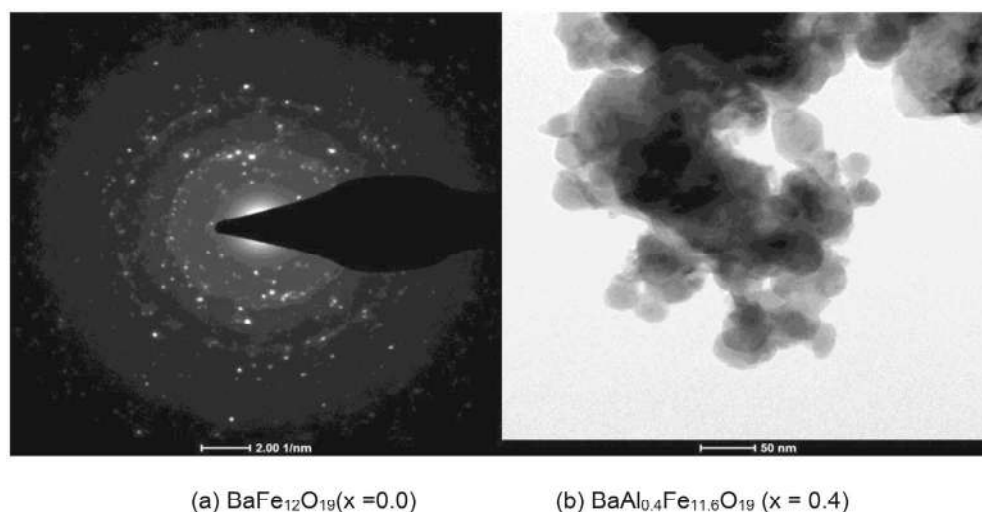


Figure 5. SAED and TEM images of the prepared pure and doped barium ferrite samples.

Table 3. Magnetic properties of prepared barium hexaferrite sample.

Sample	Saturation magnetization (M_s) $\text{emu g}^{-1} (10^{-3})$	Remanence magnetization (M_r) $\text{emu g}^{-1} (10^{-3})$	Coercivity (H_c) (Gauss)	Squareness ratio (M_r/M_s)
S-1 ($\text{BaFe}_{12}\text{O}_{19}$)	57.1	36.9	1737	0.64
S-2 ($\text{BaAl}_{0.4}\text{Fe}_{11.6}\text{O}_{19}$)	51.4	32.7	2071	0.63
S-3 ($\text{BaAl}_{0.8}\text{Fe}_{11.2}\text{O}_{19}$)	33.6	22.1	1789	0.65

powder particles have high tendency to join together and form spherically agglomerated shape [27,28] because we have not applied any kind of capping agent in the synthesized material, barium hexaferrite samples. The surface of synthesized samples appears to be a mixture of individual nanoparticles of good crystalline nature and aggregates formed as a resultant of agglomeration of individual nanoparticles. The agglomerated nature of the sample also indicates the pores present in the material because ferrite has a high tendency to absorb the moisture from the atmosphere. Water absorption by the aggregate also affected the early compressive strength of crystallites. The water molecules trapped in the crystal sites during the formation may lead to the porous nature of the ferrites.

During firing in microwave oven, oxygen ions diffuse through the materials which creates some unavoidable pores, which is one of the factors for densification of the samples [20]. Since, the materials were synthesized at very high temperature of up to 800°C, at this temperature some particles get diffused with the grain boundary of neighborhood particle which is neither a strong bond nor a loose bond, so there might be some possibility to trap some moisture inside the material. Particle size is large for sample with $x = 0.0$ as compared to sample with

$x = 0.4$ as shown in figure 4a and b, also agree with XRD data given in table 1. Particle size obtained from SEM images is in the range of 20–40 nm. This is well agreeing with structural data given in table 2.

Figure 5a shows SAED or electron diffraction images of bright ring spots which are indicators of polycrystalline nature of barium hexaferrite sample formed. Figure 5b shows TEM images, which confirm that all the prepared samples have nanosized crystals.

3.3 Magnetic properties

In the present work, the magnetic properties determined from hysteresis curve obtained from VSM have been summarized in table 3. Magnetic properties of hexagonal ferrite depend on the intrinsic properties of M-type phase. The effect of substitution of Al^{3+} has been seen on retentivity, saturation magnetization and coercivity is shown in figure 6. Table 3 shows the variation of magnetic properties of pure barium hexaferrite with substitution of Al^{3+} ions. It shows magnetic moments that lie in the range of 33.6–57.1 emu g^{-1} , retentivity between 22.1 and 36.9 emu g^{-1} and the coercivity between 1737 and 2071 Gauss and indicates the good quality of hard

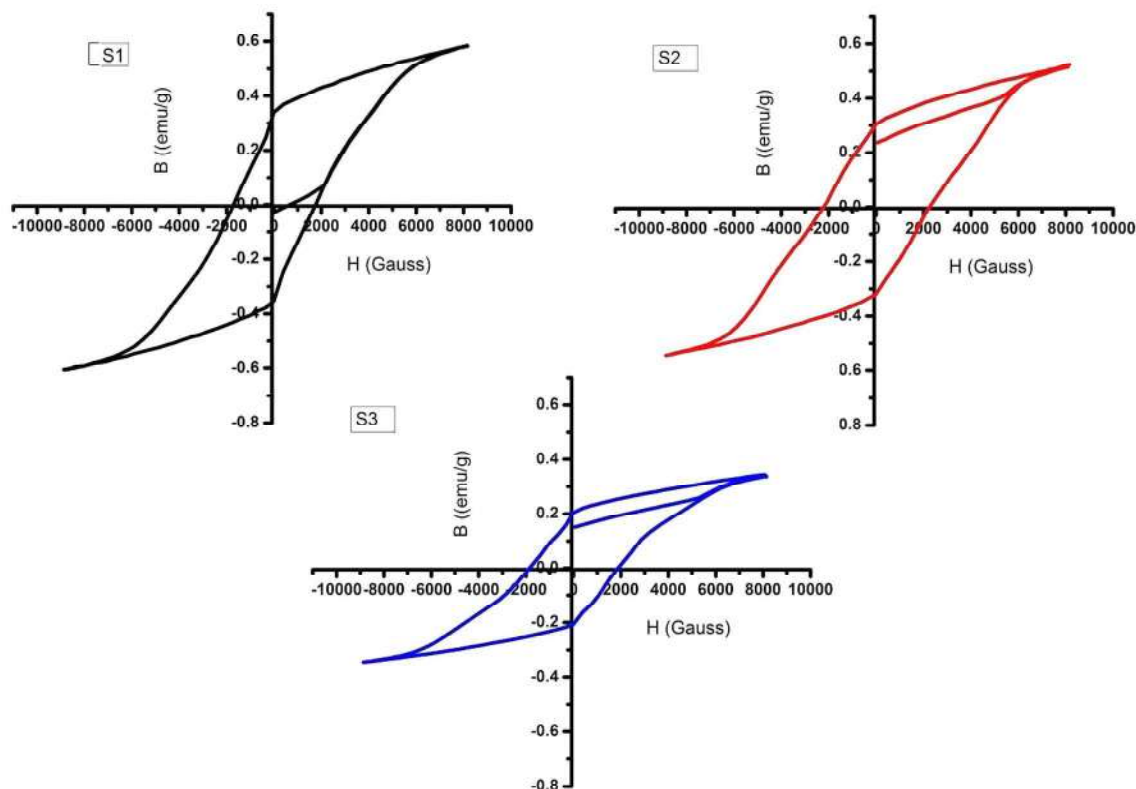


Figure 6. Magnetic hysteresis curve of $\text{BaAl}_x\text{Fe}_{12-x}\text{O}_{19}$ ($x = 0.0, 0.4$ and 0.8).

ferrites. The increase in coercivity and decrease in M_s with Al^{3+} ion substitution is well agreed with the observation made for Al-substituted barium hexaferrite prepared by glass ceramic method [29]. Al-doped $\text{BaAl}_{0.4}\text{Fe}_{11.6}\text{O}_{19}$ sample has high coercivity (2071 Gauss), it may be due to uniaxial magnetocrystalline anisotropy along c-axis [30].

The coercivity of sample S-3 decreases due to the replacement of iron ions from 12k site to result in a reduction in the magnetocrystalline anisotropy [31]. Similar types of variations have been reported by Fang *et al* [32]. The quick decrease in coercivity value of sample S-3 indicates the transformation of hard ferrite into soft ferrite. During the replacement of Fe^{3+} ($5 \mu\text{B}$) ions by Al^{3+} ($0 \mu\text{B}$) ions, 85% of Al ions occupy octahedral sites and 15% occupy tetrahedral sites [33]. The decrease in saturation magnetization value may be due to the Al^{3+} ($0 \mu\text{B}$) ions substituting Fe^{3+} ($5 \mu\text{B}$) at spin-up state in the hexagonal structure. Here, H_c values of sample S-2 was found to increase, as a result, magnetocrystalline anisotropy value also increases. Residual magnetization (M_r) is measured directly by hysteresis loop of all the samples. Similar changes in the saturation magnetization and remanence have also been observed for Al^{3+} and Cr^{3+} doped barium hexaferrite samples by Fang *et al* [34], Singhal *et al* [35] and Ounnunkad *et al* [36]. Values in table 3 prove that prepared nanomaterials are hard type ferrites and can be used for storage devices

because of high squareness ratio. Squareness ratio plays an important role in permanent magnets, storage devices and recording media applications.

4. Conclusions

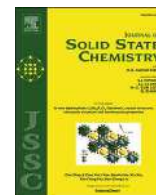
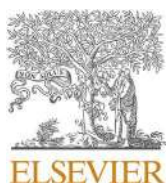
In the present research module, pure and Al^{3+} ion-doped samples of barium hexaferrite have been prepared successfully by sol-gel auto-combustion method. The XRD study shows that all the samples have hexagonal crystal structure with small impurities of α -phase present in all three samples S-1, S-2 and S-3. The synthesized aluminium-doped barium hexaferrite has particle size in the range of 20–30 nm. SEM images show particles have odd and even distributions and vary from sample to sample and also show agglomeration in some parts. EDAX spectrum confirms the elemental composition of the prepared samples. TEM images show that particles formed are in nano range. Magnetic properties show that substitution of Al^{3+} ion in barium hexaferrite can increase the coercivity and decreases saturation magnetization value which were observed in the magnetic measurements. We can see that in the present work, magnetic properties show improvement by Al-ion substitution and these prepared materials are hard type ferrites. The observed result shows that these synthesized hexaferrite materials have potential applications for high frequency microwave absorption, data storage devices and recording media.

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Evidence of magnetic dilution due to unusual occupancy of zinc on B-site in NiFe₂O₄ spinel nano-ferrite

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ABSTRACT

The present article investigates the influence of Zn substitution on magnetic properties of Ni_{1-x}Zn_xFe₂O₄ spinel nano ferrite compounds. The materials were prepared via sol-gel auto combustion method followed by suitable sintering. X-ray powder diffraction pattern shows formation of cubic nanostructure for all values of 'x'. The magnetic measurement at room temperature shows the narrow M – H curve indicating the superparamagnetic behavior. Unlike normal tetrahedral occupancy of Zn ions in bulk ferrite, the Zn ions peculiarly preferred octahedral sites and led to dilute magnetization in prepared nano ferrite. The nano ferrite shows small value of saturation magnetization and coercivity. Mössbauer spectra were studied at room temperature which also confirms the existence of superparamagnetic phase in nano ferrites and well supports the fact that Zn replaces the Fe ions at the octahedral site. The substitution of Zn ions gives paramagnetic doublet and lead to weakening the magnetic interaction and decrease hyperfine field at A and B sites. The study also explains the effect of Zn substitution on Bohr's magneton, Yafet–Kittel angle, coercivity (H_c), remnant magnetization, magnetic susceptibility and Curie temperature.

1. Introduction

Ferrites, the composite Fe₂O₃ materials catch the recognition of many research scholars because of its distinctive microwave, electro-magnetic properties etc and are extensively utilized for high-frequency applications [1]. Amongst different ferrites the M-type Ba and Sr-hexaferrites possesses hexagonal crystalline structure allows the electronic equipment operating at frequency of 10¹² Hz and above for high-frequency applications without electro-magnetic intervention because of their instantaneous magnetic-dielectric losses and high resistivity [2]. The present research module is more curious and tempted about nano-structured spinel ferrites due to its exceptional physio-chemical properties, crystal structure, electric and magnetic significances which makes it a potential material for numerous applications [3].

Even though the spinel ferrites are magnetic materials but they exhibit excellent electrical properties. Spinel ferrites owed unique electromagnetic properties and have applications in fields of biomedical viz.

drug carrier, hyperthermia, MRI, heating the cancer cells in human body etc. [4]. In general, the spinel ferrites have close-packed cubic structure that belongs to space group symmetry Fd3m [5]. The crystal structure formula of spinel ferrite is expressed as M²⁺Fe₂³⁺O₄ and has two interstitial sites viz. tetrahedral sites (A) and octahedral sites (B) filled by metal ions [6,7]. The properties of spinel ferrites can be significantly altered on the substitution of various cations into these sites and motivate the magnetic materials to enhance its wide range of applications [8,9].

In the spinel family, nickel ferrites are eye-catching and extensively studied due to its distinctive and fascinating properties [10]. If the particle size is about or less than 28 nm then nickel ferrites can be superparamagnetic [11]. In defining the properties of ferrites, zinc plays a vital role, and hence by varying the concentration of zinc in given ferrites compositional changes can be carried out [12]. With the substitution of nonmagnetic ions like zinc or copper in nickel ferrite, its magnetic properties are drastically modified due to the redistribution of ions in A and B sites [13]. In Ni–Zn ferrites, even zinc and nickel have their strong

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liking for octahedral and tetrahedral sites respectively [14]. Ni–Zn ferrites have mixed spinel structure and possess unique properties like low conductivity and coercivity and magnetization saturation like magnetite [15].

For the synthesis of ferrites, chemical methods are much beneficial over the physical methods because of better homogeneity, controlled particle size, stoichiometric proportion, and low cost [16]. An enormous number of chemical methods are available to synthesize ferrite nanoparticles such as sol-gel auto combustion [17], sonochemical [18], micro-emulsion [19], hydrothermal [20], co-precipitation [21], microwave-assisted combustion [22], etc. Amid such methods sol-gel auto combustion technique was used to synthesis the Ni–Zn mixed ferrites as it has more advantages in terms of simplicity, cheap cost, uniform size distribution, high reactivity, time saving, etc [23].

In present research module, diamagnetic zinc ion is substituted in ferromagnetic nickel spinel ferrite in different a proportionate ratios. Generally, there were two suppositions, in the first view Zn^{+2} ions would prefer A-sites that cause drift of Fe^{+3} ions to B sites where it replaces Ni^{+2} ions. In another view Zn^{+2} ions would be preferred B-sites and replaces Ni^{+2} ions in such case Fe^{+3} ions completely occupy the A-site by leaving B-site with the confirmed occupation of Zn^{+2} , Ni^{+2} , and Fe^{+3} ions. Keeping these facts in mind we have prepared nickel ferrite with different zinc substitution. The aim of the research paper is to report the results and discuss the effect of dopant on structural, morphological, and magnetic properties of mixed nano ferrites.

2. Experimental procedure and characterizations

Sol-gel auto combustion method was used to prepare $Ni_{1-x}Zn_xFe_2O_4$

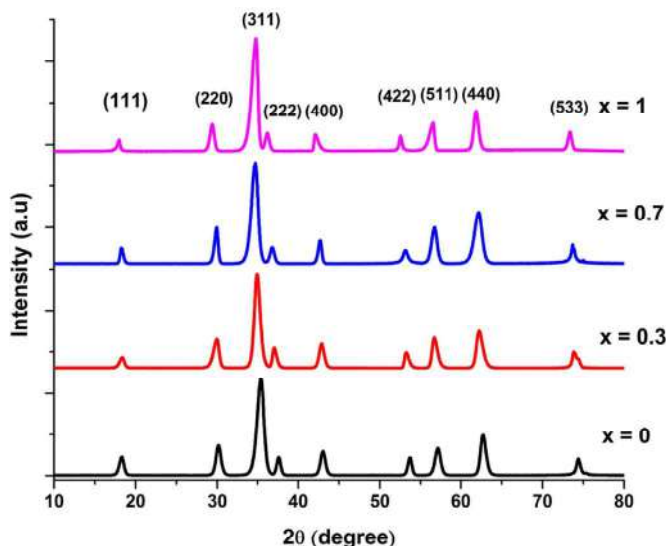


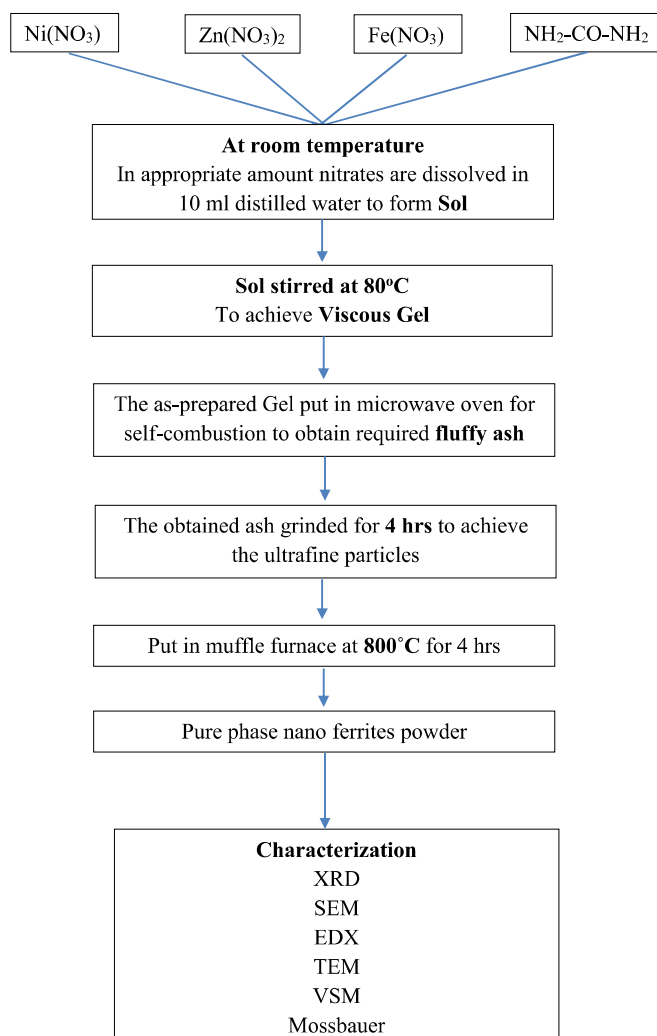
Fig. 1. X-ray diffraction patterns of $Ni_{1-x}Zn_xFe_2O_4$ nano ferrite.

Table 1

Calculated values of various structural parameters at room temperature for $Ni_{1-x}Zn_xFe_2O_4$ nanoferrite.

Parameter	x = 0	x = 0.3	x = 0.7	x = 1
Crystallite Size (nm)	28	21	16	12
Lattice Parameter (Å)	8.331	8.372	8.410	8.439
X-ray Density (gm/cm ³)	5.385	5.351	5.339	5.328
Bulk Density (gm/cm ³)	2.750	2.615	2.551	2.513
Porosity (%)	48.93	51.13	52.21	52.83
Lattice Strain(x10 ⁻³)	9.87	13.21	17.42	23.33
Surface Area (m ² /gm)	39.79	53.39	70.23	93.84
Dislocation Density (x10 ⁻³ lines per cm ²)	1.27	2.26	3.90	6.94
Packing Factor	11.14	8.32	6.31	4.71

(x = 0, 0.3, 0.7, 1) nano ferrites. The proposed method is well accepted to obtain the nanocrystallites of distinct average particle sizes [24]. All the materials of analytical grade were used viz. nickel nitrate, zinc nitrate and ferric nitrate while urea used as fuel to ignite the synthesis reaction [25]. The reaction scheme and characterization are illustrated in the following manner.



3. Results and discussion

3.1. Structural analysis

The XRD pattern of the synthesized nanoparticles carried out at room temperature is revealed in Fig. 1. The software MDI JADE was used to analyze the XRD patterns. All the peaks presented in the XRD pattern were intense, clear, and sharp confirming the formation of a cubic single phase with good crystalline nature. The broad XRD peaks indicate the synthesized ferrite samples were in a nanosize scale. The characteristics peaks of zinc substituted nickel nano ferrites were (111), (220), (311), (222), (400), (422), (511), (440) and (533) corresponds to the JCPDS Card no. 19–0629 [26]. The peaks indexed in the diffraction pattern for Ni ferrite and Zn ferrite reported in JCPDS Card No. 22–1086 and JCPDS Card No. 89–1012 respectively [27].

The Scherer equation (equation-1) was used to calculate the crystallite size for each synthesized sample from the most intense peak (311) [28]. The calculated crystallite size (D), lattice constant (a), X-ray density ($\rho_{x\text{-ray}}$), bulk density (ρ_{bulk}), and porosity (P) are listed in Table 1.

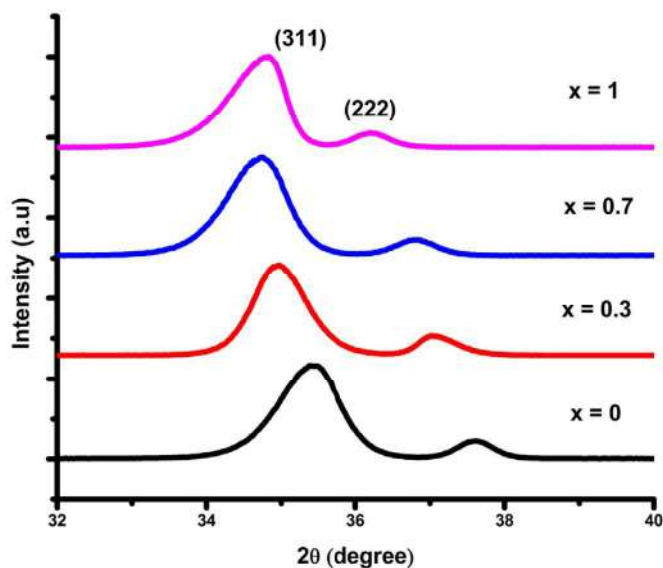


Fig. 2. Variation of most intense peak (311) of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanocomposites.

$$D = \frac{k\lambda}{\beta \cos\theta} \quad (1)$$

where k is constant ($k = 0.90$), λ is the X-ray beam wavelength, θ is the glancing angle and β is full-width half maximum of the XRD peaks.

In nickel ferrite, Fe^{+3} ions had its more liking for A site (tetra) as compared to B site (octa) [29] and hence Fe^{+3} and Ni^{+2} ions can easily occupy their preferred sites. As Zn^{+2} was substituted in NiFe_2O_4 , it usually prefers the A site but Fe^{+3} ions possibly force Zn^{+2} ions to occupy

B site which was also confirmed from the Mössbauer studies and reflected deviation in cation distribution. In Ni-Zn ferrite, where zinc ions occupy the octahedral site instead of the regular tetrahedral site, results in a reduction of crystallite size [30]. The average crystallite size of samples was decreased from 28 nm to 12 nm with the substitution of zinc. As zinc content increases, the X-ray diffraction peak broadening was observed indicating the reduction in crystallite size. The micrographs of SEM and TEM were also counter verified reduced crystallite size of the nano ferrites. Further, a large amount of heat released during the zinc ferrite formation has reduced its molecular concentration and affected the crystal surface by hammering the crystal growth which consequently reduced the crystallite size [31]. The electronic configuration was also one perspective responsible for the reduction of particle size. In contrast to Zn^{+2} ($3d^{10}$), Ni^{+2} had a deficient number of electrons ($3d^8$), and hence it had a strong affinity to form a network with oxygen ions and ligands. The deficiency of d-electron was accountable for expansion between zinc and its ligands and therefore with the incorporation of zinc in nickel ferrite blocks the growth and reduces the crystallite size [32].

The lattice constant (a) of synthesized Ni-Zn nanocomposites was calculated from the most intense peak (311) by using the following equation [33].

$$a = d_{(hkl)} \sqrt{h^2 + k^2 + l^2} \quad (2)$$

where, $d_{(hkl)}$ is the inter-planar distance and $(h\ k\ l)$ are miller indices.

As Zn^{+2} concentration increases in Ni^{+2} ferrite, the lattice constant changes from 8.3310 Å to 8.4390 Å. The rising trend is ascribed to the ionic radius as Zn^{+2} ions (0.82 Å) has larger ionic radii as compared to Ni^{+2} (0.78 Å) and Fe^{+3} (0.64 Å) ions that makes Fe^{+3} ions to move from tetrahedral site to octahedral site and hence the lattice broadens thereby increasing lattice parameter [14]. Interestingly the interstices of tetrahedral and octahedral sites in spinel ferrites are respectively 0.58 Å &

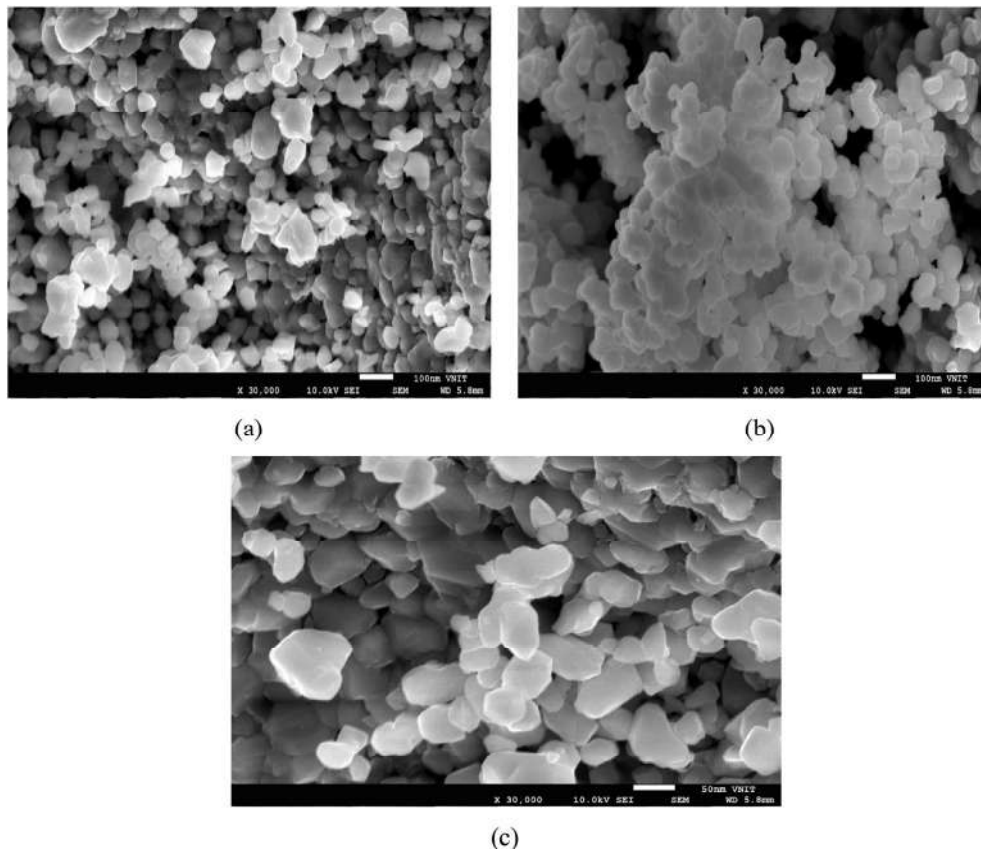


Fig. 3. SEM micrographs of (a) NiFe_2O_4 , (b) $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ and (c) $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$.

0.73 Å and are smaller than the ionic radii of zinc and nickel that leads to expanding the lattice [34]. Thus the increasing substitution of zinc in Ni-Zn ferrite leads to an increase in the lattice constant as shown in Table 1. The obtained change in lattice constant and reduced crystallite size must give some distortion and oxygen vacancies in the ferrite system [35]. The change in charge state of the 3d metals due to change in oxygen content lead to increase the lattice parameter [36]. Thus the increased oxygen vacancies with zinc content leads to deformations and dislocation in lattice parameter. As depicted in Fig. 2, the position of peaks is marginally shifted to the lower angles that also correspond to the different ionic radii of zinc and nickel that causes to expand the lattice constant.

The XRD study was used to calculate the structural parameters viz. X-ray density, bulk density, and porosity of nanoparticles by using respective equations (3)–(5) [37].

$$\rho_{X\text{-ray}} = \frac{ZM}{N_A V} \quad (3)$$

where, $Z = 8$ is the number of atoms per unit cell, M is the total molecular weight of the synthesized sample (gm), $N_A = 6.022 \times 10^{23}$ is the Avogadro's number (mole^{-1}) and $V = a^3$ is the volume of the unit cell (cm^3).

$$\rho_{\text{bulk}} = \frac{m}{\pi r^2 h} \quad (4)$$

m is the mass, r is the radius and h is the width of the circular pellet.

$$P = 1 - \frac{\rho_{\text{bulk}}}{\rho_{X\text{-ray}}} \quad (5)$$

The zinc ions have greater atomic weight (65.39 amu) than that of nickel ions (58.69 amu) leads to an increase in the X-ray density and bulk density respectively listed in Table 1. The presence of pores in the prepared nano ferrite facilitates a higher value of X-ray density than corresponding bulk density. Further, the X-ray density varies inversely with lattice constant hence it has shown a declining trend on increasing substitution of zinc in Ni-Zn ferrite [38]. The major role played by density to control the different properties. By using and altering Williamson and Hall equation, lattice strain (η) was measured, and values were listed in

Table 1 [39]. It was observed that the value of lattice strain rose with zinc concentration in nickel-zinc nano ferrites and this increment was also attributed to the shrinking in crystallite size [40].

$$\eta = \frac{d(K-1)}{D} \quad (6)$$

where, d is lattice spacing for (311) planes and $K (= 0.89)$ is the shape factor.

The specific surface area (S) was calculated using the following equation [41].

$$S = \frac{6}{D\rho_{X\text{-ray}}} \quad (7)$$

It depends on the crystallite size hence as crystallite size decreased the corresponding increase in surface area (S) was observed. The non-negative values of the specific surface areas indicate the tensile strain in the sample [42].

The mentioned equation was used to compute the dislocation density [43].

$$\sigma = \frac{1}{D^2} \quad (8)$$

The dislocation density determines the superiority of synthesized ferrites. On raising the content of zinc in nickel ferrite it also changes from 1.27×10^{-3} to 6.94×10^{-3} [44]. The fact is attributed to the larger ionic radii of Zn^{+2} as compared to Ni^{+2} and also Fe^{+3} ions forcing the Zn^{+2} ions to occupy the B site. As observed from Fig. 3, the reduction in crystallite size leads to an increase in the lattice strain and dislocation density this may affect the growth and crystalline nature of as-prepared samples as discussed earlier. The packing factor (P) which also depend the crystallite size was calculated using the following equation

$$P = \frac{D}{d_{(hkl)}} \quad (9)$$

The calculated values of the packing factor for Zn^{+2} substituted Ni^{+2} ferrite were presented in Table 1. As zinc substitution increases, it was observed that crystallite size reduces by decreasing the packing factor

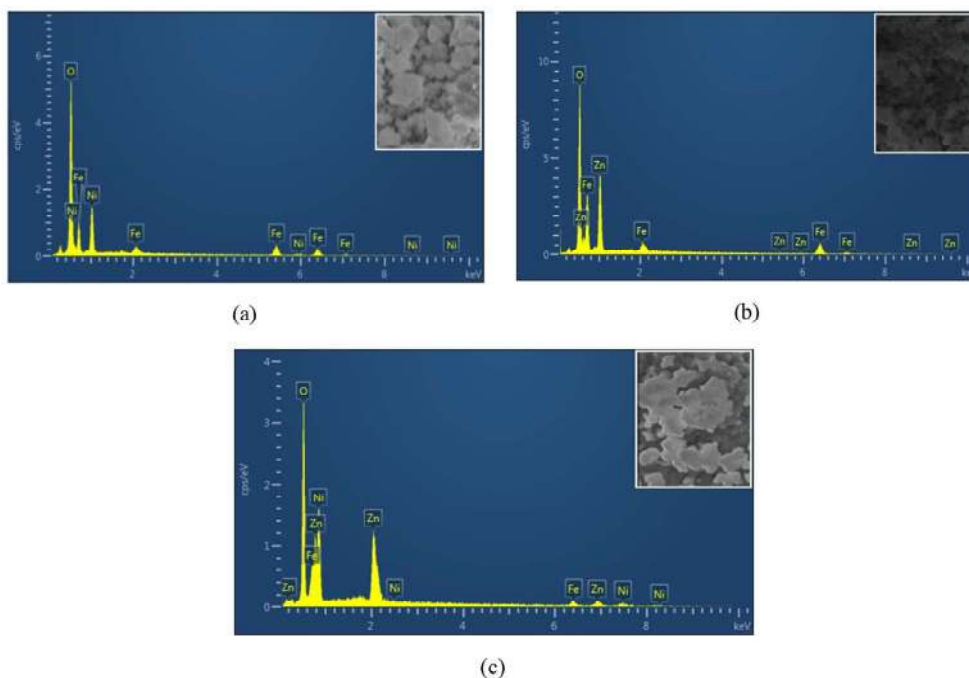


Fig. 4. EDX micrographs of (a) pure NiFe_2O_4 , (b) pure ZnFe_2O_4 and (c) $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$.

Table 2
Atomic and molecular weight % of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ spinel nano ferrites by EDX analysis.

Concentration Element	x = 0		x = 0.7		x = 1	
	Atomic weight (%)	Molecular weight (%)	Atomic weight (%)	Molecular weight (%)	Atomic weight (%)	Molecular weight (%)
Nickel	29.04	25.04	9.10	7.36	–	–
Zinc	–	–	18.20	19.14	28.2	27.12
Iron	44.28	47.65	42.00	46.72	44.20	46.33
Oxygen	26.68	27.3	30.7	26.77	27.6	26.55

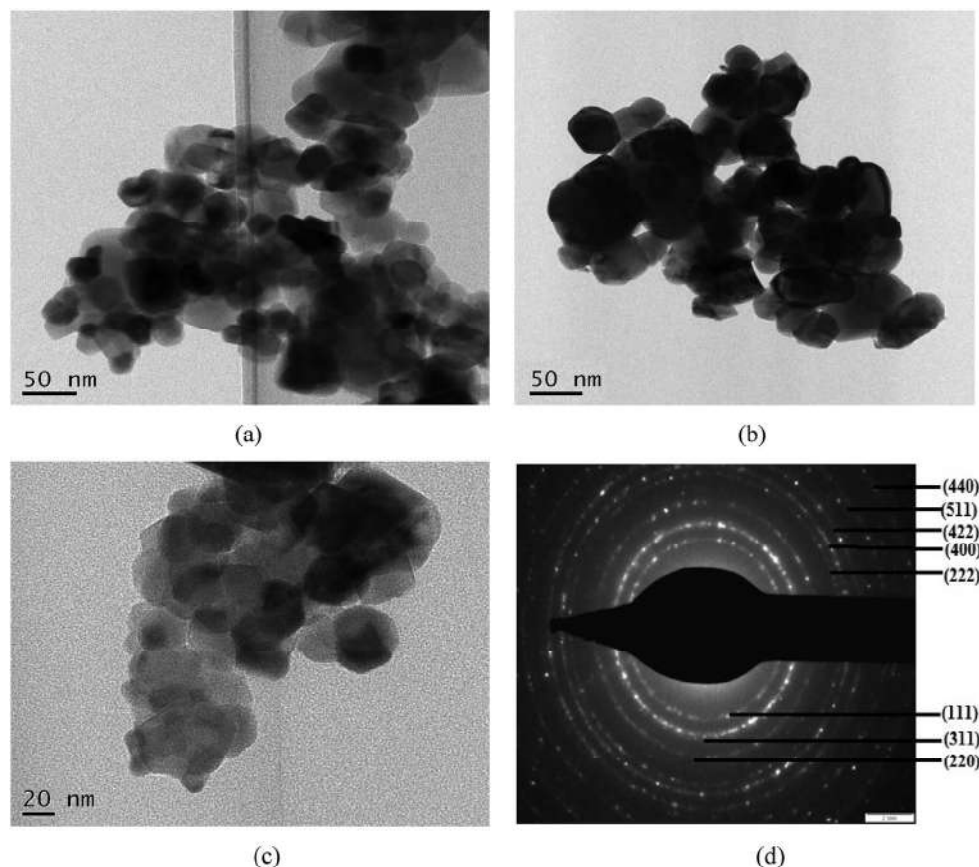


Fig. 5. TEM micrographs of (a) NiFe_2O_4 , (b) $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ (c) $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ and (d) SAED for $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$.

similar trend was reported earlier [45]. Hence the reduced crystallite size plays an extremely crucial role to improve the magnetic properties and cation distribution in Ni–Zn spinel nano ferrites.

3.2. Morphological and compositional analysis

The SEM micrograph of pure NiFe_2O_4 , $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$, and $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ nano ferrites are depicted in Fig. 3 and shown the expected morphology. The SEM images clearly revealed the nanoparticles were uniform and hence confirm the formation of single-phase structure [30]. The nano ferrites had almost spherical platelet structure with fine size distribution. The samples possessed porous nature and voids which was attributed to the unique property of the combustion method that involves evolution of the different gases during synthesis. Similar to XRD results, SEM also confirms on increasing substitution of Zn^{+2} in Ni^{+2} nano ferrites particle size was dropped drastically. The average sizes as obtained from SEM micrographs for pure NiFe_2O_4 and $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ nano ferrites were respectively 30 and 18 nm. The morphology and the nanosized dimensions of the nano ferrites quite easily affected the magnetic parameters and exchange interactions [46]. The average particle size obtained from XRD and SEM ensures that prepared nano ferrites

were in a single domain and were influenced by magnetic dipole moment interaction that causes agglomeration. The large internal magnetic energy was released during the dipole-dipole interaction in the form of heat that offers small clusters to add-up and form large agglomerates. As Zn^{+2} content was increased magnetic dipole moment was decreased thereby decreasing the dipole-dipole interaction and hence more Zn^{+2} substituted Ni^{+2} nano ferrites were less agglomerated than pure Ni^{+2} nano ferrite as observed from SEM images [36]. Further, the magnetic exchange interactions heavily depend on the average crystallite size at nano scale. At surface the nanoparticles forms the merged regions that affects the crystalline nature of structure which leads to defects formation and incorporation of amorphous form [47]. Such defects and dislocations at surface may have major consequences on structural parameters as discussed earlier in XRD.

The Energy Dispersive X-ray (EDX) was used to detect the ratio of present elements in chemical composition within the sample. The analysis of EDX results for $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ confirms that nano ferrites were contained the elements Ni, Zn, Fe, and O without any contamination as shown in Fig. 4. The EDX map of present elements has indicated homogeneity and ensures the proper substitution of zinc in nickel ferrite during synthesis. The obtained atomic percentage of elements shows good

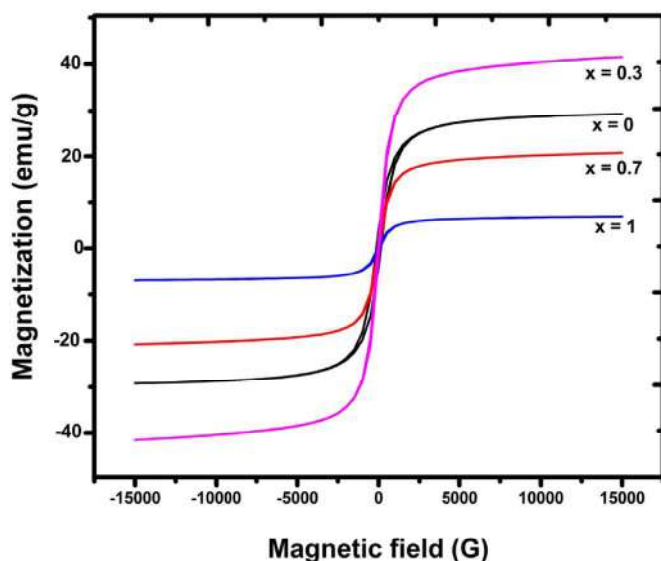


Fig. 6. Hysteresis curve of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanoferrite.

Table 3

Calculated values of various magnetic parameters at room temperature for $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ spinel nano ferrite.

Parameter	x = 0	x = 0.3	x = 0.7	x = 1
Magnetization Saturation (emu/g)	28.19	42.31	21.60	6.23
Coercivity (gauss)	120.16	78.03	8.24	2.31
Remanent magnetization (emu/g)	4.1	1.1	0.9	0.03
Squareness ratio (M_r/M_s)	0.145	0.026	0.042	0.004
Magnetic Anisotropy Constant (K_1)	3528.45	3439.01	185.40	14.99
Bohr's Magneton	1.18	1.79	0.92	0.27
Yafet-Kittel angles (α_{Y-K})	0	32.89	68.82	87.78

agreement with experimental stoichiometric values (molecular weight percentage) as depicted in Table 2.

Fig. 5 shows the TEM micrographs used to analyze the morphology and size of Zn substituted Ni nanoparticles. It can be seen from the TEM image that the nanoparticles were slightly agglomerated with regular morphology. Again the agglomeration can be justified by using a magnetic aspect as the magnetization of zinc ferrite is always lower than that of nickel ferrite that leads to less agglomeration in zinc substituted nickel nano ferrites [48]. With the addition of zinc, the morphology of nanoparticles alters toward an almost uniform spherical shape and has a relative smaller size [49]. The average particle size is approximately 10–25 nm holds a good agreement with crystallite size that calculated from XRD data and replicates the high crystalline nature of nanoparticles. As obtained grain size is within the limit of single-domain that makes them compatible for electronic applications [50]. The Selected Area Electron Diffraction (SAED) pattern of $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ nano ferrite is shown in Fig. 5 (d). It consists of a crystalline ring with no additional spots which confirm the crystalline nature of $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ nano ferrite [51]. The diffraction peaks from XRD were in completely agreement with corresponding crystalline rings of SAED pattern.

3.3. Magnetic aspects

The magnetic hysteresis curves for synthesized nano ferrites were measured by vibrating sample magnetometer (VSM) at room temperature with a maximum applied field of ± 15 KG. It was observed from Fig. 6, all nano ferrite had exhibited narrow hysteresis curves with negligible retentivity and coercivity indicating superparamagnetic behavior and single domain nature of the $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ system. The respective high and low values of M_s and H_c of nano ferrite was due to

well defined crystalline nature and homogenous morphology of nanoparticles [52]. With the substitution of zinc in nickel ferrites the magnetic properties viz. saturation magnetization, coercivity, remanent magnetization and Curie temperature were found to be exceptionally influenced because of cations distribution and occupancy in particular sites [53]. The calculated values of saturation magnetization (M_s), remanent magnetization (M_r), coercivity (H_c), squareness ratio (SQR), and magnetic moment (η_B) are listed in Table 3.

3.3.1. Effect on saturation magnetization (M_s)

The saturation magnetization (M_s) of un-doped Ni^{2+} ferrite was 28.19 emu/gm. Initially, with the substitution of zinc up to $x = 0.3$, it was found to be increased to 42.31 emu/gm and then subsequently decreases to 6.23 emu/gm for pure Zn^{2+} ferrite. The values of saturation magnetization have shown a characteristic trend of Zn^{2+} doped Ni^{2+} ferrite as stated earlier [48,54,55]. The overall decrease in saturation magnetization was because of ferromagnetic nickel ions in Ni-Zn ferrites were replaced by diamagnetic zinc ions [56]. Further, the magnetic dilution explains the substitution of nonmagnetic zinc, and its occupancy in the accessible site that weakens the interaction in occupied site causes the variation in saturation magnetization. In the present research module, the information obtained from cation distribution was used to explain the behavior of saturation magnetization. According to data, the majority of diamagnetic Zn^{2+} ions had to be found at B site and some of the Ni^{2+} ions at A site. The increase in saturation magnetization up to $x = 0.3$ can be explained with the help of Néel's theory. According to theory, un-doped Ni^{2+} ferrite have an inverse spinel structure where Fe^{3+} ions equally occupy A & B sites whereas Ni^{2+} ions occupy B sites [57]. Initially, the fractional occupancy of Ni^{2+} and Zn^{2+} at A sites forced several Fe^{3+} ions with a large magnetic moment to transfer from A sites to B sites and hence resulted in increase in M_s . However, at higher concentration of Zn^{2+} in $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nano ferrite (for $x = 0.7$ & 1) has shown a reduction in M_s . At $x = 0.7$ and above, all Zn^{2+} ions were found at B sites and dilutes B sites magnetically due to its diamagnetic nature. Moreover, its partial occupancy at A site causes a net magnetic moment to decrease which further reduces the saturation magnetization [30]. The XRD and TEM already confirmed a decrease in crystallite size with Zn^{2+} substitutions which resulted in an increase in grain boundaries thereby reducing saturation magnetization [58]. The decrease in crystallite size was attributed due to surface effects, presence of distortion of crystal surface, spin canting, and distribution of cation [59].

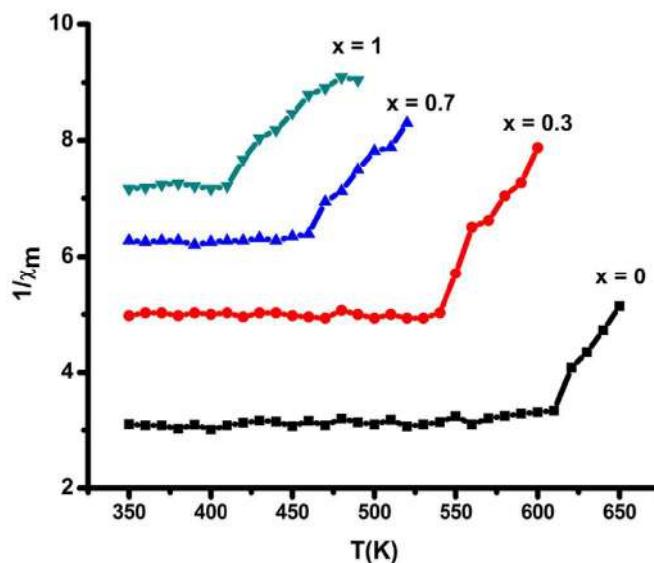


Fig. 7. Variation of Curie temperature with inverse of magnetic susceptibility of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanocomposites.

3.3.2. Effect on Bohr's magneton and Yafet-Kittel angle (θ_{Y-K})

The Bohr's magneton was calculated by the following equation [60].

$$\eta_B = \frac{M_s \times M_w}{5585} \quad (10)$$

where, M_w is the molecular weight of the sample.

Like M_s , Bohr's magneton also shown the same trend as it depends on M_s . The overall decrement in η_B was explained using cation distribution. In the present case, the diamagnetic Zn^{+2} ions occupied octahedral sites where they replace ferromagnetic Ni^{+2} and Fe^{+3} ions and results in reducing the magnetic dipole moments at octahedral sites.

Yafet and Kittel had explained the existence of non-collinear structure in nano ferrites [61]. The spin canting effect was responsible for the occurrence of the Yafet-Kittel angle that compares exchange interactions between tetrahedral and octahedral (A-B) and octahedral-octahedral (B-B) sites [62]. The θ_{Y-K} angles can be calculated using equation (11) [63].

$$\eta_B = (6+x)\cos\theta_{Y-K} - 5(1-x) \quad (11)$$

where, x = concentration of Zn^{+2}

As listed in Table 3, the measured values of the θ_{Y-K} angle were increased with an increase in Zn content. For pure $NiFe_2O_4$ ferrite, the value of θ_{Y-K} was zero which specifies that the magnetization can be described with the help of Néel's theory. But the non zero values of θ_{Y-K} is explained by using canted spin theory. The increased values θ_{Y-K} implies the increase of triangular spin arrangements on octahedral sites to create decrement in tetrahedral-octahedral sites exchange interactions lead to a consequent drop in M_s . The Goodenough-Kanamori empirical rules also suggest that when the charge on any cation increases, it enhances the covalent nature of the bond leading to the greater overlap of orbitals and giving strong exchange-interaction [64]. This Goodenough-Kanamori empirical rule also suggests that the exchange near the oxygen vacancies is negative. The oxygen vacancies are created due to the reduction of Fe^{3+} to Fe^{2+} , which can be reduced with the addition of transition elements. The oxygen vacancies can also be reduced with a particle size which may cause the magnetic transition. The increase in oxygen vacancy concentration led to decrease exchange interaction [65]. Moreover, with an increase in zinc content spin magnetic moment of Fe^{3+} is decreased, and the orbital magnetic moment is frozen which in turn reduces saturation magnetization. The sintering at high temperature in the presence of air considerably reduces oxygen defects and promote to transfer of few Fe^{3+} -OV- Fe^{3+} ferrimagnetic couplings into the Fe^{3+} -O $^{2-}$ - Fe^{3+} antiferromagnetic couplings. The $ZnFe_2O_4$ ferrite has a θ_{Y-K} angle close to 90° suggest that the M_s will be heading towards zero as octahedral-octahedral sites exchange interaction gets collapsed [63].

3.3.3. Effect on coercivity (H_c)

The coercivity of nano ferrite material depends on crystalline structure, morphology, crystallite size, porosity, magnetic anisotropy constant (K_1), etc. The coercivity of prepared nano ferrite was found to be decreasing with the substitution of Zn^{+2} . Here, the average crystallite size and magnetic anisotropy constant were responsible for the observed decrease in coercivity. The critical diameter of crystallite size and domain structure easily clarifies the relation between coercivity and crystallite size [66]. In the present work, coercivity was decreased with an increase in Zn content due to the formation of uniform morphology and small crystallite size as apparent from SEM and TEM studies [67]. Mono-domain crystallite possesses high magnetization energy but when the crystallite split into a number of domains then its magnetization energy decreases and hence the coercivity was decreased with smaller crystallite size [68]. In general nanosized crystallites are usually mono-domain possessing low H_c values and show superparamagnetic nature [69]. The decreasing trend of coercivity governs the nature of the material which changes from ferrimagnetic to superparamagnetic. The values of magnetic anisotropy constants are listed in Table 3 and

Table 4

Calculated values of various magnetic parameters for $Ni_{1-x}Zn_xFe_2O_4$ spinel nano ferrites.

Parameter	x = 0	x = 0.3	x = 0.7	x = 1
T_C (K)	610	540	460	410
μ_e	8.84	8.70	8.51	8.37
$1/\chi_m$ (g mole/emu)	3.4	5.2	6.4	7.2
C_M	9.75	9.45	9.05	8.75

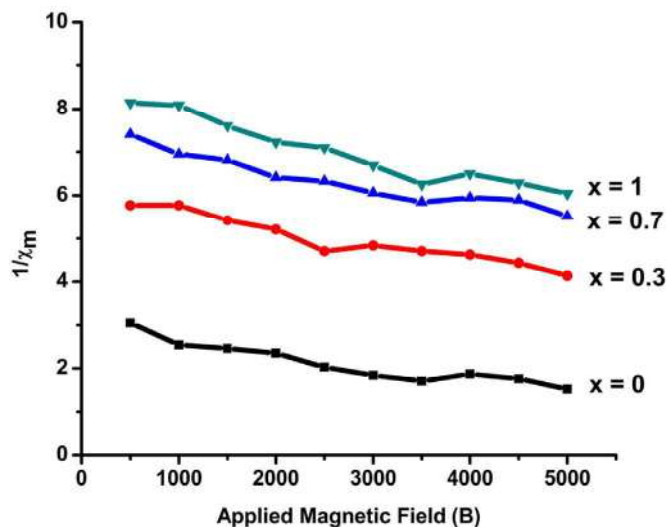


Fig. 8. Variation of inverse of magnetic susceptibility with applied magnetic field.

calculated using the following equation.

$$K_1 = \frac{M_s \times H_c}{0.96} \quad (12)$$

Both Zn and Ni ferrites have negative magnetic anisotropy constants (K_1) [70]. The Zn ferrite possesses a smaller value of K_1 as compared to Ni ferrite. In Zn substituted Ni ferrite the entire magnetic anisotropy constant is a sum of Zn and Ni anisotropy constant. As the concentration of Zn increases, the total magnetic anisotropy constant gets decreases due to smaller K_1 value of Zn ferrite, which in turn decreases coercivity [71].

3.3.4. Effect on remanent magnetization (M_r)

Like coercivity, the remanent magnetization M_r was also decreased with the increasing concentration of zinc. The nanosized crystallite acts as mono-domain was responsible for the decrement in M_r . The calculated squareness ratio was between 0.004 and 0.145 which is less than 1 and shows prepared material posses a mono-domain structure [72]. If the squareness ratio (M_r/M_s) is less than 0.5, then it shows uniaxial anisotropic behavior and if it is greater than 0.5 then it shows cubic anisotropic behavior [73,74]. When the coercivity and remanent magnetization is as low or inching towards zero the nanocrystallites exhibit exceptional characteristics known as superparamagnetism.

3.4. Temperature dependence AC susceptibility

The temperature dependence AC magnetic susceptibility measurement was examined at the magnetic field intensity of 2 KG. The plots of the inverse of magnetic molar susceptibility ($1/\chi_m$) versus temperature for Zn^{+2} substituted Ni^{+2} ferrite are given in Fig. 7 confirms the typical ferrimagnetic nature. The unexpected rise in the curve recommends that as-prepared samples exhibit a monophasic also revealed from XRD [75]. It was observed that the values of the inverse of magnetic susceptibility ($1/\chi_m$) increase with an increase in temperature for a certain range called

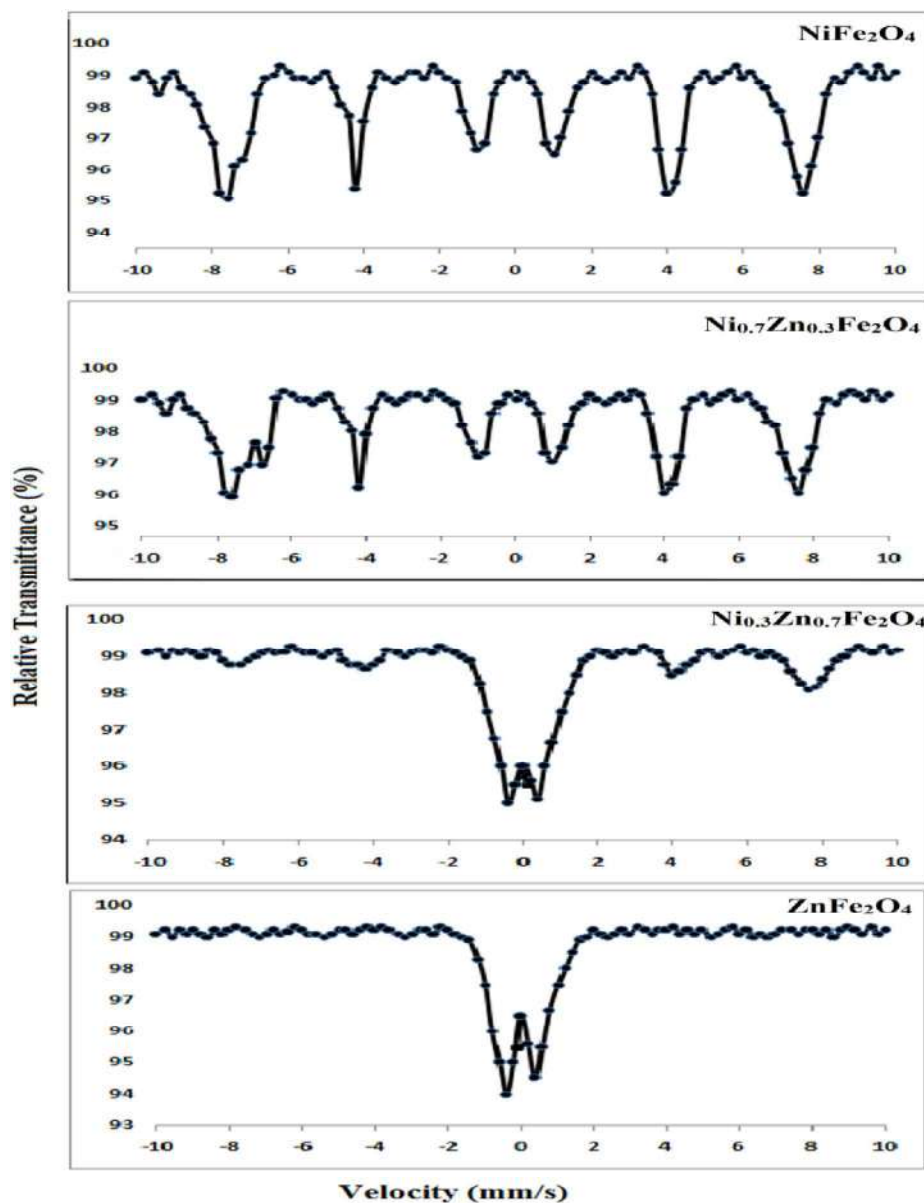


Fig. 9. Mössbauer spectra of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanocomposites.

Table 5

Calculated values of quadrupole splitting (Δ), hyperfine field (B_h), isomer shift (δ) and line width (Γ) $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ spinel nano ferrite.

Parameter	x = 0		x = 0.3		x = 0.7		x = 1	
	A	B	A	B	A	B	A	B
Quadrupole splitting (mm/s)	0.057	0.057	0.067	0.00	-0.03	0.079	0.130	0.130
Hyperfine Field (Tesla)	46.26	48.13	45.13	47.27	42.32	44.15	A and B sites overlapped	
Isomer Shift (mm/s)	-0.194	-0.056	-0.154	0.24	0.41	0.48	0.021	-0.041
Line width (mm/s)	0.44	0.40	0.59	0.48	0.81	0.65	0.89	0.76

the ferrimagnetic region then there was a sudden increase in $1/\chi_m$ at a certain temperature called Curie temperature (T_c) representing the transition to the paramagnetic region [76]. The calculated value of Curie temperature (T_c) was found to be decreased from 610 K to 410 K with an increase in the concentration of zinc in the nickel ferrite. This was attributed to replacement at the octahedral site of Ni^{+2} and Fe^{+3} ions by diamagnetic Zn^{+2} ions which has a magnetic moment (0 μB) very less than Fe^{+3} ions (5 μB) and Ni^{+2} (2 μB). Consequently, the decrease in exchange interaction between tetrahedral and octahedral (A-B) sites

leads to drop Curie temperature (T_c). More specifically, these substitution causes weakening of superexchange interaction of type $\text{Fe}^{3+}-\text{O}-\text{Fe}^{3+}$, leading to collapse co-linearity of the lattice [77]. Additionally, the temperature at which phase transition happens for ferro to para relies on the size of crystallite [78]. In given system of synthesized ferrites an observed drop-off in crystallite size confirmed from XRD and TEM leads to decrease the Curie Temperature.

The effective magnetic moment was measured using the following formula and listed in Table 4,

Table 6

Estimated cation distribution of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ spinel nanoferrites from Mössbauer spectra.

x	A site			B site		
	Ni	Zn	Fe	Ni	Zn	Fe
0	0	0	1	1	0	1
0.3	0.06	0.02	0.92	0.64	0.24	1.12
0.7	0.04	0.05	0.91	0.48	0.42	1.10
1	0	0.22	0.78	0	0.78	1.22

$$\mu_e = 2.83 \sqrt{C_M}$$

where, C_M is Curie molar constant.

The observed decrease in effective magnetic moment is owing to addition of the diamagnetic Zn^{+2} ions in Ni^{+2} nanoferrites. As discussed earlier magnetic study confirms the occurrence of spin canting that weakens the magnetic interactions leads to decrease effective magnetic moment. The calculated value of Curie molar constant was measured using spin magnetic moment of respective ions as mentioned in Table 4.

3.4.1. Variation of magnetic susceptibility (χ_m) with magnetic field (B)

In general, as strength of magnetic field increases the decrease in magnetic susceptibility is observed which shows typical ferrimagnetic nature [79]. The prepared samples follow the given relation,

$$\chi_m = \frac{M}{B}$$

Fig. 8 show normal ferrimagnetic behavior of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanoferrites.

3.5. Mössbauer spectra

Mössbauer spectroscopy was carried at room temperature to investigate the distribution of cations and to understand magnetic phenomena. Mössbauer spectroscopy technique profoundly used to examine the superparamagnetic nature of nano ferrites and to find the position of Fe ions. Fig. 9 shows the recorded Mössbauer spectra of $\text{Ni}_x\text{Zn}_{1-x}\text{Fe}_2\text{O}_4$ nanocomposites and the calculated parameters are listed in Table 5.

The Mössbauer spectra of pure NiFe_2O_4 has shown sextet which indicates Ni^{+2} ions occupy the B sites and Fe^{+3} ions equally occupy A and B sites. The crystallite size of NiFe_2O_4 was 28 nm and shown ferrimagnetic nature at room temperature. The hyperfine field (H_f) of NiFe_2O_4 nano ferrite for A and B sites were respectively 46.26T and 48.13T. This reduced values of the hyperfine field as compare to bulk NiFe_2O_4 was due to net magnetic anisotropy energy which was not sufficient to spin magnetic dipole moments about the easy axis of magnetization and therefore lead to a decrease overall hyperfine field. Further, the systematic substitution of Zn^{+2} ions also leads to a decrease hyperfine field at A and B sites because of magnetic dilution. The quadrupole splitting was found to be decreased with Zn^{+2} ions, mainly due to decreased crystallite size as confirmed from XRD and morphological studies. As listed in Table 5, the values of isomer shift for B sites were greater than A sites due to large overlapping of $\text{Fe}^{+3}\text{-O}^{2-}$ ions at A sites than B sites [80]. The listed values of isomer shift was less than 0.5 mm/s showing the presence of only Fe^{+3} ions in nano ferrite [81]. As Zn^{+2} content was increased, the Mössbauer lines appear to be more broaden which indicates the mixing of cation location on A and B sites leading to disorder. The XRD peak broadening was also analogous to broader Mössbauer lines.

The Mössbauer spectra of $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ have shown the presence of quadrupole doublet and magnetic sextet corresponding to superparamagnetic and ferrimagnetic crystallites in the material. The quadrupole doublet controlled the magnetic splitting that may make $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ superparamagnetic at room temperature. The substitution of diamagnetic Zn^{+2} ions in NiFe_2O_4 leads to a decrease in the

hyperfine field as expected because the non-magnetic Zn^{+2} ions replace magnetic Ni^{+2} and Fe^{+3} ions. Additionally, the reduced crystallite size of $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ ferrite plays a vital role in reducing the hyperfine field. Thus the existence of Zn^{+2} ions at B sites gave rise to paramagnetic doublet and lead to weakening the magnetic interaction.

The Mössbauer spectra of $\text{Ni}_{0.3}\text{Zn}_{0.7}\text{Fe}_2\text{O}_4$ has also shown doublet and possess indifferent distribution of cations shown in Table 6. Here, Zn^{+2} ions have occupied the B sites instead of A sites that decrease the saturation magnetization as confirmed from magnetic hysteresis. Further, reduced crystallite size, low coercivity, and retentivity confirm the superparamagnetic behavior of composed nano ferrites.

The Mössbauer spectra for pure ZnFe_2O_4 have shown intense paramagnetic doublet. This doublet suggests that prepared Zn^{+2} ferrite have identical nanostructure as that of bulk. The crystallite size of Zn^{+2} ferrite calculated from XRD was found to be 12 nm and possesses negligible coercivity that indicates the superparamagnetic state of ferrite. As lattice size of Zn^{+2} ferrite was decreased up to a few nanometers several Fe^{+3} ions were overturned to A sites that lead to altering the magnetic alignment [82]. Due to nanosized Zn^{+2} ferrite, some portion of A sites was occupied by Fe^{+3} ions whereas the same amount of Zn^{+2} ions has occupied the B sites. The Mössbauer spectrum was in good agreement with XRD and VSM data that stated that the Zn^{+2} ions preferred B sites over its normal preference for A sites.

4. Conclusion

$\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nano ferrite was prepared by sol-gel auto-combustion method and characterized by various techniques. XRD, SEM, and TEM confirmed the spinel ferrite phase having space group Fd3m with homogeneous particles nature. The lattice constant and porosity was found to be increasing with the Zn content. The EDX study shows homogeneity and ensures accurate substitution of zinc in nickel ferrite during synthesis. The maximum saturation magnetization was found to be 42.31 emu/gm with a negligibly small value of coercivity and remnant magnetization makes it suitable superparamagnetic material. The cation distribution of prepared nano ferrite has been determined using XRD and Mössbauer studies. The Mössbauer spectra corresponding to $\text{Ni}_{0.7}\text{Zn}_{0.3}\text{Fe}_2\text{O}_4$ shows quadrupole doublet and magnetic sextet corresponding to superparamagnetic and ferrimagnetic crystallites. The low coercivity and SQR of the samples favor their application in high-frequency transformers, high-density recording media, and biomedical.

CRediT authorship contribution statement

A.S. Kakde: Synthesis, Investigation, Validation, Writing – original draft. **R.M. Belekar:** Writing – review & editing. **G.C. Wakde:** Synthesis, Investigation, Validation, Writing – original draft. **M.A. Borikar:** Synthesis, Investigation, Validation, Writing – original draft. **K.G. Rewatkar:** Synthesis, Investigation, Validation, Writing – original draft. **B.A. Shingade:** Synthesis, Investigation, Validation, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Synthesis and Characterization of Nanocrystalline $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ Y-Type Hexaferrites by the Sol–Gel Combustion Method

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ABSTRACT

Nano-size Y-type hexaferrites powders are synthesized by using the sol–gel combustion method in nitrate urea systems. The X-ray diffraction patterns of $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ annealed above 800 °C manifest that all the species have hexagonal crystal structure. TEM observation of as-burnt powders of $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ shows the powder particles have an average particle size of 23 nm. Magnetic hysteresis loop measurements of the series $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ exhibit that the saturation magnetization (M_s), the remanent magnetization (M_r) and the coercivity (H_c) of compounds depend strongly on the chemical composition of materials. The maximum values of M_s (1.2898E-3 emu/g) and M_r (87.099E-3 emu/g) and the areas of magnetic hysteresis loop of compounds decrease with increasing the value of Al .

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1. Introduction

Calcium hexaferrites ($\text{Ca}_2\text{Fe}_{12}\text{O}_{22}$) is a hexagonal ferrimagnetic ceramic with good hard magnetic properties. Thin films of calcium ferrite have been recognized as one of the appealing candidates in the fabrication of low-noise high-density recording media due to their high coercivity H_c , high saturation magnetization M_s , high degree of crystalline anisotropy and excellent chemical stability [1–5]. In the magnetic recording media, decreasing the crystallite size has always been a path toward increasing the recording density [6, 7] Many studies were carried out to investigate the effects of ferrite materials and its volume percentage in the composite on absorption of microwave and the influence of the addition of conducting fiber on the microwave absorbing properties [8, 9]. To improve the performance of various hexaferrites, there is an increasing attention on the morphology and size control of materials synthesized on the micro- and nano-scale due to the fact that morphology and size play very important roles in determining chemical and physical properties of materials that are attributed to the novel applications [10–12].

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2. Experimental Procedure

The samples of Y-type hexagonal ferrite with formula $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ were synthesized by sol-gel auto-combustion technique. The synthesis technique involved the combustion of redox mixtures, in which metal nitrates acted as an oxidizing reactant and urea as a reducing reactant. The initial composition of solution containing metal nitrates and urea was based on the total oxidizing and reducing valences of the oxidizer and the fuel the concept of propellant chemistry.

The samples of Y-type hexagonal ferrite with formula $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ were calculated stoichiometrically. The stoichiometric amounts of AR grade, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, and $\text{Cu}(\text{NO}_3)_2$, $\text{Ca}(\text{NO}_3)_2$, $\text{Al}(\text{NO}_3)_3$ dissolved in an deionized distilled water at the temperature of 40°C , were placed in a beaker and stirred well until a clear homogeneous solution was obtained. The beaker containing the solution was introduced into a microwave oven. The homogeneous solution was placed in a microwave oven with microwave frequency 2.45 GHz and power 850 W for 10 min. When the solution reached the point of spontaneous combustion, heat is generated in microwave oven.

Initially, the solution boils and undergoes dehydration followed by decomposition with the evolution of a large volume of gases (N_2 , NH_3 , and HNCO). After the solution reaches the spontaneous combustion, it begins burning and releases more heat, vaporizes all solutions instantly, and becomes a solid burning at temperatures above 1000°C . The entire combustion process produces Y-type hexagonal ferrite powders in microwave oven. After the completion of combustion reaction, the solid powder was obtained and then, it was grounded well using mortar and pestle, respectively, and were used for further characterizations [5–12].

3. Characterizations

3.1. One Powder XRD

The material analysis with X-ray diffraction technique has indicated that, even after the first sintering process a major crystalline phase of hexagonal ferrite of Y-type is synthesized (JCPDS no: 82-2384). Secondary phases were traced and identified as $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ JCPDS data as shown in Table 1 and Figure 1. The structural properties of $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ Y-type hexagonal ferrites were investigated by XRD patterns of all compositions that were annealed for 7 h at 800°C . Lattice parameter value found varies from $a = 5.8868 \text{ \AA}$ to $a = 5.9002 \text{ \AA}$ and c values from $c = 44.6985 \text{ \AA}$ to $c = 44.0296 \text{ \AA}$ with space group P63/mmc. The crystallite size D was calculated by the relation: $D = 0.9 \lambda / \beta \cos\Theta$ where λ is the wavelength of X-ray beam used. β = The full width at half maxima (FWHM), Θ = The corresponding position at particular

Table 1. Lattice Parameter

Al_x composition	A \AA	C \AA	c/a	Unit cell volume (\AA^3)	X ray density gm/ cm^3	Bulk density gm/cm^3	Porosity %
0	5.8868	44.6985	7.5930	1341.43429	3.0436	2.8458	6.504
2	5.8865	44.3484	7.5339	1330.791887	2.9239	2.719	7.008
4	5.8464	44.1409	7.5501	1306.580364	2.8313	2.5453	10.103
8	5.9002	44.0296	7.4624	1327.382533	2.4981	2.1513	13.883

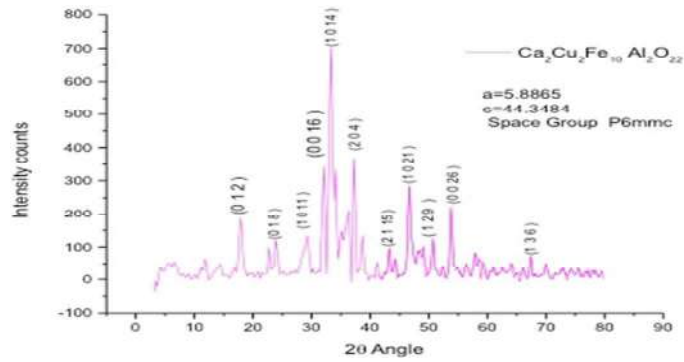


Figure 1. Powder XRD $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$.

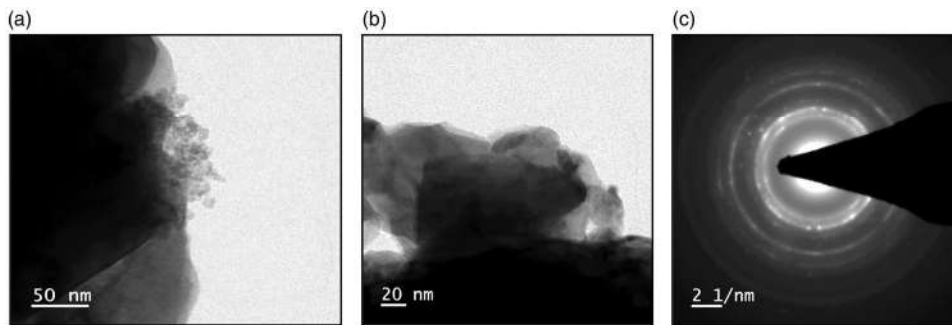


Figure 2. TEM.

angle. k is constant and is equal to 0.94. The crystallite size was found in the range of 40–120 nm [13–16].

3.2. Two TEM Analyses

The high-resolution transmission electron microscopy (HR-TEM) image of $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ sample, which consists of hexagonal shaped nanoparticles ranging from 40 to 120 nm, is in good agreement and is evident from HR-SEM images. Crystallite sizes, obtained from powder XRD analysis, are consistent with the sizes calculated from HR-TEM. Figures 2a and 2b show crystalline morphology of sample in 50-nm scale and 20-nm scale. Figure 2c shows the patterns of $\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ sample, which confirms well-crystalline nature of the final product [17, 18].

3.3. Three VSM Analysis

An intrinsic property such as saturation magnetization (M_s) is controlled by the composition, whereas an extrinsic property, the microstructure, is in turn governed by the processing techniques. The magnetization of magnetic materials is a structural sensitive static property (intrinsic property), and the magnetic field required to produce the saturation value varies according to the relative geometry of the field to the easy axes and

Table 2. Transition Temperature

Al _x Composition	Retentivity Mr emu 10 ⁻³	Magnetization Ms emu 10 ⁻³	Coersivity Hc G	Square ratio Mr/Ms
0	87.099	545.26	130.73	0.159738473
2	14	87.051	139.36	0.160825263
4	0.1326	5.6469	108.09	0.02348191
8	0.0808	1.2898	153.73	0.062645371

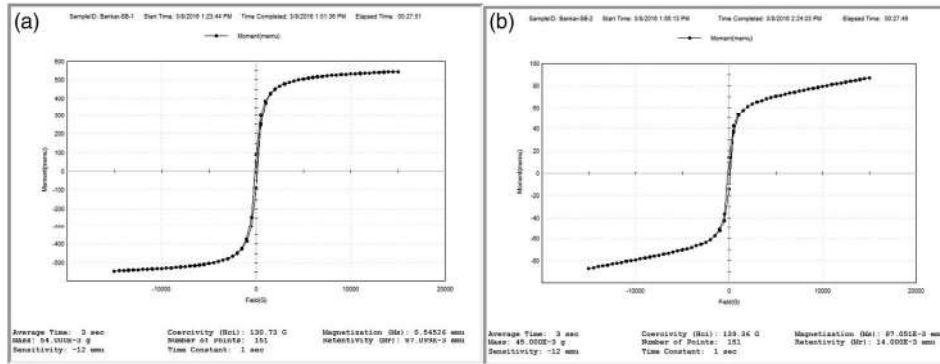


Figure 3. VSM.

Table 3. Squareness Ratio

Al _x Composition	Activation energy para eV	Activation energy ferro eV	Transition Temperature °K	Gouy balance Tc °K
0	0.54	0.16	557	568
2	0.56	0.19	563	580
4	0.43	0.17	575	597
8	0.42	0.2	593	618

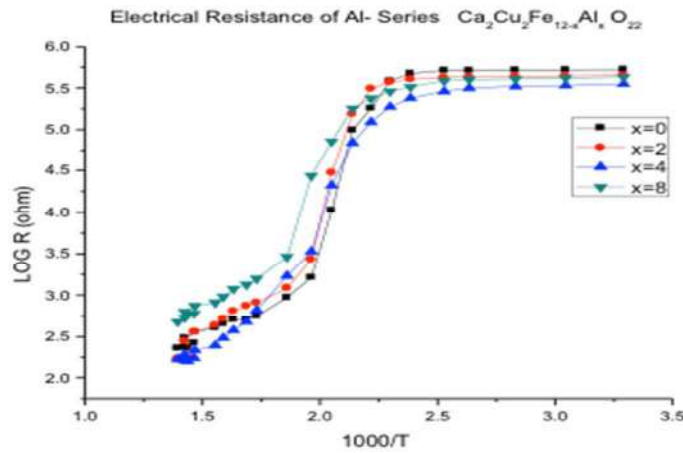


Figure 4. Transition temperatures.

other metallurgical conditions of the material. The magnetization as a function of applied magnetic field, M-H, for polycrystalline Ca₂Cu₂Fe_(12-x)Al_xO₂₂ samples at room temperature (300 K) is shown in Table 2 and Figures 3a and 3b. The magnetization of

$\text{Ca}_2\text{Cu}_2\text{Fe}_{(12-x)}\text{Al}_x\text{O}_{22}$ samples decreases linearly with increasing the applied magnetic field up to 0.1 T and attains its saturation value for fields higher than 1.5 Tesla [19].

3.4. Dielectric Properties

It is well known that in the case of low mobility semiconductors, such as ferrites, the activation energy is often associated with the mobility of charge carriers rather than their concentration. The temperature dependence of DC electrical conductivity is shown in Table 3 and Figure 4. The DC electrical conductivity reaches a maximum value at a particular temperature known as the transition temperature, as also reported for $\text{Ca}_2\text{Cu}_2\text{Fe}_{12}\text{O}_{22}$ ferrite Cu-substituted calcium hexaferrites [19, 20].

4. Conclusion

Y-type hexaferrites were prepared by the microwave-induced sol–gel combustion technique. The X-ray diffraction studies confirm the formation of monophase Y-type hexaferrites. The lattice parameter a and c values of the sample are in agreement with JCPDS data. The TEM study confirmed that samples exhibit relatively well-defined hexagonal-like grains with an average size range of 70 to 120 nm. The electrical conductivity of the samples increases with increase in the temperature. VSM graph shows improvement in many magnetic properties mentioned earlier due to the nanorange of particle size of hexaferrites.

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संशोधन

स्त्रियांची राजकीय
सत्ताहीनता

विद्या चौरपगार
व
विकास जांभुळकर

भारतीय समाज हा जाती, वर्ग, धर्म, वंश, पंथ या आधारावर तर विभाजित आहेच; पण तो स्त्री आणि पुरुष याही स्तरावर विभाजित आहे. अशा परिस्थितीत स्त्री सुधारणेच्या काळाचा इतिहास पाहिला तर असे दिसते की, स्त्रियांना हक्क व अधिकारांसाठी वेळोवेळी संघर्ष करावा लागला. लोकशाही शासनव्यवस्थेत सर्व स्त्री पुरुषांना मानव म्हणून समान हक्क, अधिकार, साधने, सुविधा, विकासाची समान संधी राज्यघटनेद्वारे प्राप्त होते. 'भारतीय संविधानाने हे अधिकार सर्व नागरिकांना बहाल केले. परंतु ज्या प्रमाणात सर्व स्त्री व पुरुष यांचा समान सामाजिक, आर्थिक, राजकीय विकास होणे गरजेचे होते त्या प्रमाणात झाल्याचे दिसत नाही. सार्वजनिक जीवनातील सर्वच

लेखिका विद्या चौरपगार नागपूरस्थित डॉ. आंबेडकर महाविद्यालयात राज्यशास्त्राच्या सहाय्यक प्राध्यापक असून, विकास जांभुळकर राष्ट्रसंत तुकडोजी महाराज नागपूर विद्यापीठात राज्यशास्त्राचे सहयोगी प्राध्यापक आहेत.

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१६ ते ३१ ऑक्टोबर २०२१ | परिवर्तनाचा वाटसरू | ३१

क्षेत्रांमध्ये महिला या घटकाचा सहभाग अत्यल्प किंवा दुबळा राहिला.’^१ जगातील कोणत्याही राष्ट्राच्या तुलनेत दक्षिण आशियातील देशात शक्तिशाली महिला राज्यकर्त्या अधिक प्रमाणात आहेत, उदा. चंद्रिका कुमारातुंगा (श्रीलंका) बेनझीर भुट्टो (पाकिस्तान) खलिदा जिया (बांगलादेश). भारतात तर इंदिरा गांधी, सोनिया गांधी, ममता बॅनर्जी, मायावती, उमा भारती, शीला दीक्षित, प्रतिभाताई पाटील, सुषमा स्वराज, मीराकुमारी अशा प्रसिद्ध राजकारणी महिलांची नावे घेता येतील. परंतु ‘महिलांचे राजकीय क्षेत्रातील वर्चस्व राजकारणातील उच्च स्थान काबीज करण्यात व्यर्थ ठरले. ग्रामीण स्तरावरील राजकारण तर पूर्णपणे पुरुषांच्या हातात आहे. या भागात स्त्रियांना अजूनही घरगुती कामातच गुंतवून ठेवले जाते. यावर तोडगा काढण्यासाठी महिलांचा राजकारणात सहभाग वाढविण्यासाठी आरक्षणाची तरतूद आशियाई राष्ट्रांनी केली.’^२ भारतात १९९३मध्ये आरक्षणाची तरतूद करण्यात आली. परंतु मागील १७ वर्षांपासून संसद आणि लोकसभेतील ३३ टक्के आरक्षणाचा प्रश्न निकाली लागला नाही.

आतापर्यंत जी सरकारे पदावर आली त्यांनी निवडणुकीतील अजेंडामध्ये आरक्षणाचा अंतर्भाव निश्चितच केला आहे. परंतु सघन चर्चा अथवा निर्णय मात्र अजूनपर्यंत झालेला नाही. ‘स्त्रियांनी पंचायत राज व्यवस्था, माहिती तंत्रज्ञान ते बचत गट अशा विविध क्षेत्रात प्रगती केलेली दिसून येत असली तरी त्याचवेळी स्त्रियांच्या विरुद्ध जाणारे लिंग गुणोत्तर, परिघावरील स्त्रियांवरचे नवनवे प्रकार, संसदेत स्त्रियांचे प्रमाण या सगळ्यांमुळे

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स्त्रियांची प्रगती झाली आहे किंवा होत आहे असे म्हणण्यास मन धजत नाही.’^३ महिलांच्या दुय्यम राजकीय स्थितीतील सर्वव्यापीपणा हे दर्शवितो की, जवळपास या सर्वच राष्ट्रातील महिलांची राजकीय स्थिती दुय्यम आहे. ‘बार्बरा नेल्सन आणि नजमा चौधरी यांनी वीमेन अँड पॉलिटिक्स वर्ल्डवाईड.’ या संपादित केलेल्या पुस्तकातील ४३ देशातील महिला सहभागाच्या अभ्यासावरून असे निष्कर्ष नोंदविले आहे की, ‘कोणत्याही देशातील राजकीय व्यवस्थांमध्ये महिलांचे स्थान व दर्जा दुय्यम आहे’^४ भारतात घराण्याचा वारसा घेऊन सत्तेत सक्षमपणे कार्यरत असलेल्या स्त्रिया, आरक्षणाचा आधार घेणाऱ्या स्त्रिया, आणि स्वबळावर राजकीय सक्षम झालेल्या स्त्रियांही आहेत. पण तरीदेखील लोकसंख्येच्या प्रमाणात स्त्रियांचा राजकीय सहभाग दिसत नाही.

‘महाराष्ट्रात तर साठीच्या दशकातील विधानसभेवर एका अर्थाने पुरुषांचेच नियंत्रण होते. पुरुषांनी महिलांच्या विधानसभेतील राजकीय सहभागावर बहिष्कार घातला होता. म्हणजेच मतदार महिला होत्या मात्र त्यांना राजकीय सहभागाची संधी उपलब्ध नव्हती. कारण या दशकात महाराष्ट्रातील समाज सरंजामी पद्धतीचा होता. त्यांनी पुरुषांना राजकारण करण्याचा अधिकार दिला होता.’^५ राजकारणातील पुरुषसत्तेच्या प्रभावाचे हे अत्यंत बोलके उदाहरण आहे. आजच्या दशकातदेखील चित्र फारसे बदललेले दिसत नाही. सर्वच घटक राज्यांमध्ये पुरुष प्रभावी राजकारण दिसून येते. ‘लोकशाहीचा हा एक पैलू आहे की, ज्यात बहुतांश संख्येने नागरिक स्त्रिया निर्णय निर्धारण प्रक्रियेत सहभागी व्हावयास

हव्यात आणि हीच गोष्ट राष्ट्रबांधणीत स्त्रियांना समान संधी प्रदान करते. प्रत्यक्षात स्त्रिया दुय्यम दर्जाच्या नागरिक मानल्या जातात. (राजकीय सहभाग व राजकीय शक्तीत) प्रत्यक्षात जगातील बहुतांश राज्यात त्यात भारताचाही समावेश होतो स्त्रियांना पुरुषांच्या बरोबरीने अधिकार दिले आहेत मात्र राजकीय सहभाग नगण्य आहे.’^६

स्त्री अस्तित्वाचे संघर्ष, स्त्रियांचे स्थान, दर्जा आणि प्रतिष्ठा, लिंगभेद, स्त्रियांचे दुय्यमत्व, राजकीय क्षेत्रातील सहभाग, पुरुषसत्तेचा प्रभाव, राजकीय सत्ताहीनता, हक्क व अधिकारांची विषम वितरण व्यवस्था, संधी व सुविधांची वंचितता, निर्णय प्रक्रियेतील सहभाग, स्त्रियांचे सक्षमीकरण हे प्रश्न दिवसेंदिवस अधिक तीव्र होत चालले आहे. अशा प्रश्नांना सोडविण्याच्या दृष्टीने महिलांचा राजकारणामध्ये सहभाग असणे अत्यंत महत्त्वाचे आहे. परंतु मागील ७० वर्षांपासून स्त्रियांना राजकीय व्यवस्थेत मोठ्या प्रमाणात वगळण्यात येत आहे. त्यांच्या राजकीय समावेशनाकडे भारतातील कोणताही राजकीय पक्ष फारसा गांभीर्याने बघत नाही. या पार्श्वभूमीवर प्रस्तुत अभ्यास महत्त्वाचा आहे.

गृहीतके :

१. समकालीन राजकारणातील स्त्रिया कमी अधिक प्रमाणात सामाजिक रचनेच्या बळी आहेत.
२. लिंगाधिष्ठितता ही राजकीय व्यवस्थामध्ये महत्त्वाचे परिवर्तक म्हणून काम करते.
३. राजकारणातील पुरुषसत्तेच्या प्रभावामुळे स्त्रिया सत्ताहीन

होतात.

अभ्यासाचे महत्त्व :

स्त्री व पुरुषांची सामाजिक व सांस्कृतिक जडणघडण करताना दोघांना वेगवेगळे नियम लावणे म्हणजे लिंगभाव. वास्तविकतः लिंगभेद हा स्त्री व पुरुषांमधील नैसर्गिक भेद आहे. परंतु या भेदाची नैसर्गिक बाजू विचारात न घेता स्त्री व पुरुषांसाठी वेगवेगळे सामाजिक व सांस्कृतिक प्रथा परंपरांची निर्मिती भारतात मोठ्या प्रमाणात झालेली दिसून येते. प्रसिद्ध स्त्रीवादी लेखिका सिमोन द बुव्हा 'द सेकंड सेक्स' या जगप्रसिद्ध ग्रंथात असे म्हणते, 'स्त्री जन्माला घातली जात नाही तर तिला घडविले जाते'. जशी स्त्री घडविली जाते तसाच पुरुष सुद्धा घडविला जातो. आपल्या समाजातील पितृसत्ता, विवाहसंस्था, कुटुंबसंस्था, धर्मसंस्था जन्मलेल्या व्यक्तीला पुरुष असल्याची जाणीव व स्व ओळख देण्याचे कार्य करित असतात. यामधून अधिकार, सत्ता, हिंसा, जबरदस्तीची भाषा करणारा, 'वर्चस्ववादी पुरुष' निर्माण केला जातो. हा पुरुष पुरुषसत्तेची सर्व स्थाने काबीज करायचा प्रयत्न करित असतो. आणि सत्तेची मुख्य केंद्रे जिथे जिथे असतील तिथे शिरकाव करतो. राजकारण हे त्यापैकी एक सत्ताकेंद्र आहे, जिथे वर्षानुवर्षेपासून कायमस्वरूपी पुरुषसत्तेचा प्रभाव दिसून येतो. 'भारतीय राजकारण हे पुरुषसत्तेचे वर्चस्व असलेली गुंतागुंतीची प्रक्रिया असलेली, स्त्री-पुरुष समानता आणि न्याय यासाठीच्या संघर्षातील ती अखेरच्या सरहद्दीचे प्रतिनिधित्व करते.'^७

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१९७५नंतर देशात आणीबाणी लागू झाली. या काळात स्त्रियांचे प्रश्न ऐरणीवर आले. वाढती महागाई, हुंडाबळीचे वाढते प्रमाण, लैंगिक अत्याचार, कौटुंबिक हिंसाचारासारखे प्रश्न मोठ्या प्रमाणात निर्माण झाले. '१९८५मध्ये शाहबानोच्या निमित्ताने मुस्लिम स्त्रियांना पोटगीचा हक्क नाकारण्यासाठी कायद्यात केलेली दुरुस्ती व त्यानंतर समोर आलेला अन्यायकारक व्यक्तिगत कायद्यांचा प्रश्न, मथुरा बलात्कार प्रकरण, १९८७चे रूपकुवरचे सती प्रकरण, मंडल आयोगाच्या शिफारशीच्या निमित्ताने दलित ओबीसी स्त्रियांची स्थिती, अशा विविध मुद्द्यांची चर्चा होत होती.'^६ यासर्व प्रश्नांना सोडविण्यासाठी स्त्रियांचे प्रतिनिधित्व फार अल्प आहे, हे जाणवत होते. याच दरम्यान जागतिक स्तरावर झालेल्या आंतरराष्ट्रीय परिषदांमध्ये स्त्री-पुरुष समानतेचे निकष पाळण्याविषयी जगाचे लक्ष वेधले गेले. उदा. कोपनहेगन आंतरराष्ट्रीय महिला परिषद १९८०, व्हिएन्ना परिषद १९९३, नैरोबी व केनिया परिषद १९८५, मानव विकास अहवाल १९९५ इ. यासर्व चर्चा आणि अहवालांनी असे निर्देशनास आणले की, देशाचे प्रतिनिधित्व करणाऱ्या उच्च संस्था मग ती संसद असो की, प्रशासन या सर्व ठिकाणी स्त्रियांची संख्या कमी आहे. 'राजकारणात सक्रिय सहभागाच्या बाबतीत केलेल्या अभ्यासावरून गेल ऑम्बेट म्हणतात, भारतात उत्पादक कामापेक्षाही राजकारणात महिलांचा सहभाग मोठ्या प्रमाणावर वगळला जात आहे.'^९ १९५२ ते २०१४पर्यंतच्या प्रत्येक निवडणुकीमध्ये महिलांना वगळण्याची प्रक्रिया घडली. स्त्रियांच्या राजकीय समावेशनाची दखल कोणत्याही पक्षाने तितक्या प्रमाणात

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घेतलेली दिसत नाही. या वगळण्याच्या प्रक्रियेला जवळजवळ पंच्याहत्तर वर्ष पूर्ण झाली आहेत. यामागे राजकारणातील संरचनात्मक पातळीवरील लिंगभेद प्रामुख्याने दिसून येतो. सोहिन पाल आणि अनुराधा मेहता असे म्हणतात की, 'भारतात अजूनही पुरुषी वर्चस्व आहे. लिंग असमानतेमुळे स्त्रिया राजकीय सत्तेपासून वंचित आहेत, हे राजकीय वास्तव आहे.'^{१०} आणि हे राजकीय वास्तव दिवसेंदिवस अधिक व्यापक होत चालले आहे. स्त्रियांचा राजकारणातील सहभाग हा केवळ स्त्रियांसाठी किंवा तिच्या कुटुंबासाठी महत्त्वाचा नसून देशाच्या सामाजिक, आर्थिक, राष्ट्रीय, शैक्षणिक क्षेत्रातील विकासात महत्त्वाचे योगदान देणारा ठरू शकतो. तेव्हा राजकारणातील स्त्रियांची सत्ताहीनता जातीय, धार्मिक आणि पुरुषसत्ताकतेच्या प्रभावातून निर्माण झालेल्या लिंगभाव परिप्रेक्ष्यातून अभ्यासणे, यादृष्टीने प्रस्तुत अभ्यासाचे महत्त्व आहे.

उद्दिष्टे

१. स्त्रियांचा समाजातील वर्तमानकालीन स्थान, दर्जा व भूमिका समजून घेणे.
२. राजकारणातील सत्तेच्या प्रक्रियेतील स्त्रियांचे दुय्यमत्व आणि सत्ताहीनतेचे विश्लेषण करणे.
३. राजकीय संरचनेमधील स्त्रियांचे स्थान शोधणे.
४. राजकारणातील पुरुषसत्तेचे विश्लेषण करणे.
५. राजकारणातील लिंगधिष्ठिततेचे राजकीय व सामाजिक विश्लेषण करणे.

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६. लिंगधिष्ठित राजकारणाचे जातीय आणि धार्मिक दृष्टिकोण अभ्यासणे.

स्त्रियांचा राजकीय प्रवास

प्राचीन काळात या देशात स्त्रियांची सत्ता होती. स्त्रियांना पुरुषांच्या बरोबरीत हक्क, अधिकार स्वातंत्र्य, समता प्राप्त होत असे. परंतु 'अपत्य निर्मिती प्रक्रियेमध्ये पुरुषांचे स्थान स्पष्ट झाल्यानंतर स्त्रीचे महत्त्व कमी होऊन पुरुषप्रधानतेचे आगमन झाले.'^{११} पुरुषसत्तेच्या या पर्वात स्त्रियांच्या वाट्याला दुय्यम स्थान आले. अधिकार, सत्ता आणि संपत्ती पासून स्त्रिया वंचित होऊ लागल्या. 'महिलांकडे संपत्तीचा अधिकार नव्हता. सत्ता, संपत्ती आणि अधिकार यांचा एकत्र संबंध असतो यामुळे राजकीय प्रभाव निर्माण करण्यास त्यांच्याकडे साधनसामग्री अपुरी ठरली आहे.'^{१२} परिणामी या काळात स्त्रिया सार्वजनिक व्यवहारातून बाजूला फेकल्या गेल्या.

स्त्री सुधारणेच्या कालखंडात १९वे शतक अनेक अर्थाने महत्त्वपूर्ण ठरते. या काळात अनेक सुधारकांनी स्त्रियांच्या सामाजिक, सांस्कृतिक, शैक्षणिक तसेच राजकीय प्रश्नांचा उदारमतवादी दृष्टीने विचार केला. स्त्री-शिक्षण, बालविवाह, जरठ विवाह, सती पद्धती, घटस्फोट, केशवपन, विधवा विवाह, वारसा मालमत्ता असे विविध प्रश्न महिलांनी हाती घेत भारतीय स्वातंत्र्य चळवळीत भाग घेतला. शिक्षणासाठी महात्मा फुले आणि सावित्रीबाई यांनी केलेले कार्य स्त्री विकासाच्या मार्गातील मैलाचा दगड ठरले. 'महात्मा फुले उदारमतवादाची सीमारेषा

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पार करून पुढे गेले. त्यांनी भारतीय स्वातंत्र्य चळवळीत स्वातंत्र्य कोणासाठी असा प्रश्न मांडला. महात्मा फुले यांनी राष्ट्रीय काँग्रेस व ब्रिटिश सरकार यांच्या समोर शेतकरी. कामगार महिला व शूद्र, अतिशूद्र यांच्या स्वातंत्र्याचा विचार मांडला. यामुळे भारतीय स्वातंत्र्य चळवळीला व्यापक असा अर्थ प्राप्त झाला.^{१३} ज्या समाजव्यवस्थेत स्त्रियांना ज्ञानी होण्याचा अधिकार नव्हता अशा स्त्रीला अक्षर ओळख आणि नंतर विचारप्रवृत्त करण्याचा फुल्यांचा मानस हा एक प्रकारचा राजकीय लढाच होता.

भारतात पुरुष वारसदार नसताना राज्य करणाऱ्या स्त्रिया होत्या. राज्य करण्याचे शिक्षणही त्यावेळी दिले जात होते. उदा. जिजाबाई, अहिल्यादेवी होळकर, राणी लक्ष्मीबाई व शूर चांदबिबी यांनी रणांगणावर गाजवलेल्या पराक्रमांची इतिहासात नोंद आहे. स्वातंत्र्यचळवळीत महात्मा गांधींनी महिलांना सार्वजनिक जीवनात सक्रीय केले. गांधींनी दिलेल्या आत्मविश्वासामुळे सर्व स्तरातून अनेक स्त्रिया सहकारिता व सविनय कायदेभंग या राष्ट्रीय चळवळीमध्ये सहभाग द्यायला पुढे आल्या. हा स्त्रियांचा राजकीय पटलावरील उदय म्हणायला हरकत नाही. भारतामध्ये मताधिकारासाठी स्त्रियांना युरोपीय चळवळींसारखा वेगळा संघर्ष करावा लागला नाही. भारतात स्त्रियांची राजकीय मतदानाची लढाई स्वातंत्र्य चळवळी सोबतच अविभाज्यपणे जोडल्या गेली होती. याच चळवळीचा एक भाग म्हणजे १९२७मध्ये अखिल भारतीय महिला परिषदेची स्थापना झाली. या परिषदेने वेळोवेळी स्त्रियांच्या सार्वत्रिक मताधिकाराचा प्रस्ताव मांडलेला आहे. '१९२७मध्ये मद्रास विधिमंडळावर

मुथुलक्ष्मी रेड्डी निवडून आल्या. देवदासी आणि बालविवाह प्रथांवर बंदी घालणारे कायदे, गरीब मुलींना शैक्षणिक सवलती, गरीब स्त्रियांना अर्थाजन करण्यासाठी प्रशिक्षण, लहान मुलांसाठी दवाखान्यांची उभारणी, अशा स्वरूपाचे कार्यक्रम त्यांनी राबवण्यासाठी पुढाकार घेतला. आणि लोकप्रतिनिधी या नात्याने स्त्रिया काय करू शकतात याचे उदाहरण घालून दिले.^{१४} पुढे अशाच काही राजकीय भूमिका घेऊन रमाबाई रानडे यांनी स्त्रियांच्या राजकीय विकासाच्या वाटचालीत महत्त्वपूर्ण योगदान दिले.

‘रमाबाई रानडे यांनी स्त्रियांना मताधिकार व प्रतिनिधित्व मिळावे यासाठी स्त्रियांचे आंदोलने केले होते. रमाबाई रानडेना स्त्रियांचे राजकीय स्वातंत्र्य हवे होते परंतु, त्या काळचा समाज पारंपारिक प्रतिगामी होता. त्यामुळे महिलांचा राजकीय सहभाग व स्वातंत्र्य यांना समाज विरोध करित होता.’^{१५} शेवटी या प्रतिगामी पुरुषसत्तेच्या प्रभावामुळे रमाबाईंची अनेक कार्ये मागे राहिली. शारदाबाई पवार यांनी रमाबाईंचे राजकीय कार्य पुढे सुरू ठेवण्यात अनेक प्रयत्न केले. ‘१९३८मध्ये जिल्हा लोकल बोर्डाच्या निवडणुकीसाठी काँग्रेस पक्षामार्फत शारदाबाई पवार निवडणुकीला उभ्या राहिल्या.’^{१६} परंतु त्यांचाही हा प्रवास म्हणावा तितका पुढे जाऊ शकला नाही. लोकमान्य टिळक यांच्या नेतृत्वाखाली स्थापन झालेली ‘होमरूल लीग’ची चळवळ व अॅनी बेझंटचे राजकीय कर्तृत्व यामधून स्वातंत्र्य प्राप्तीसाठी स्त्री सहभाग वाढायला मदत झाली.

‘महात्मा गांधी व पंडित जवाहरलाल नेहरू यांनी महिलांना

नेतृत्व व निर्णय निश्चितीमध्ये सहभागाची संधी दिली होती. मात्र इतर नेत्यांना गांधी नेहरूंची ही भूमिका मान्य नव्हती.’^{१७} महात्मा गांधी व पंडित जवाहरलाल नेहरू यांच्या नेतृत्वात सरोजिनी नायडू यांनी देशाच्या राजकीय स्वातंत्र्याचे राजकीय नेतृत्व केले. आणि स्वातंत्र्य प्राप्तीनंतर राजकीय पटलावर अनेक महत्त्वाची राजकीय पदे भूषविली. ‘अर्थातच स्वातंत्र्य चळवळीत महिलांचे राजकारण सुरू होण्याची प्रक्रिया सुरू झाली होती. महिलांनी निर्णयनिश्चितीचे राजकारण करण्याची अपेक्षा व्यक्त केली होती मात्र काँग्रेस पक्षाचे स्थानिक नेतृत्व महिलांनी राजकारण करण्याच्या विरोधातील होते. त्यामुळे महिलांचे राजकारण घडले नाही.’^{१८}

फुल्यांच्या नंतर स्त्रियांच्या राजकीय प्रवासात डॉ. बाबासाहेब आंबेडकर यांचे योगदान अनेक अर्थाने महत्त्वपूर्ण ठरते. डॉ. आंबेडकरानी त्यांच्या हयातभर निर्माण केलेल्या सामाजिक संघर्षात स्त्रिया मोठ्या प्रमाणात सहभाग घेताना दिसतात. मनुस्मृती दहन, काळाराम मंदिर प्रवेश, आणि महाडचा सत्याग्रह तसेच १९५६चे धर्मांतर अशा सर्व आंदोलनात स्त्रियांचा मोठा सहभाग होता. तेव्हा डॉ. आंबेडकरांच्या आंदोलनातील स्त्रिया प्रत्यक्ष व अप्रत्यक्षपणे सामाजिक व राजकीय अधिकार प्राप्त करण्याचा प्रयत्न करित होत्या हे स्पष्ट होते. बाबासाहेबांनी केवळ दलित स्त्रियांचेच प्रश्न सोडविले नाही तर संबंध स्त्रीजातीचा विचार वैश्विक दृष्टिकोनातून केला आहे. लिंगभाव समता प्रस्थापित करण्यासाठी डॉ. आंबेडकरांनी सर्वतोपरी प्रयत्न सुरू ठेवले. शेवटी घटनेच्या मार्फत डॉ. आंबेडकरानी स्त्रियांच्या सर्वच

अधिकारांचा सन्मान राखला. 'स्त्रीशोषणावरचा उपायच डॉ. आंबेडकरांची चळवळ आहे. संघर्ष, शील, प्रज्ञा, करुणा हे स्त्रीजीवनाचे अलंकार आहेत. शिका, संघटित व्हा, आणि संघर्ष करा हे शोषितांना व स्त्रियांनाही दिलेले महान तत्त्व आहे.'^{१९} डॉ. बाबासाहेब आंबेडकरांच्या नेतृत्वाखाली स्थापन झालेल्या घटना समितीने राज्यघटनेत स्त्रियांना समान प्रौढ मतदानाचा अधिकार दिला. केवळ मताधिकाराचाच अधिकार दिला नाही तर, शैक्षणिक, राजकीय, सामाजिक, आर्थिक, धार्मिक, सांस्कृतिक अधिकार स्त्रियांना बहाल केले.

भारताची पहिली सार्वत्रिक निवडणुक १९५२मध्ये झाली ही निवडणुक स्त्रियांसाठी अनेक पैलूंनी महत्त्वाची ठरली. १९५२पासून स्त्रिया अल्प प्रमाणात का होईना पण राजकारणात उतरल्या. उमेदवार महिलांची संख्या कमी जरी असली तरी अधिकाधिक राजकीय होण्याच्या दृष्टीने पहिले पथदर्शी पाऊल ठरले. यामधून स्त्रियांचे राजकीय नेतृत्व आकारास येऊ लागले. 'सरोजिनी नायडू, कमलादेवी चटोपाध्याय, अरुणा असफ अली, मॅडम कामा, गोदावरी परुळेकर, अहिल्या रांगणेकर, विमल रणदिवे, विमल चक्रवर्ती, गीता मुखर्जी, मृणाल गोरे, प्रमिला दंडवते, उषा मेहता यांचे सुरुवातीच्या प्रमुखप्रवाही राजकारणाशी कायम नाते राहिले.'^{२०} अशा नामवंत स्त्रियांनी केवळ तत्कालीन स्वातंत्र्य विषयक जबाबदाऱ्या सांभाळल्या नाही तर स्वातंत्र्यानंतर मोठमोठ्या राजकीय पदावर गेल्या. स्वातंत्र्योत्तर काळात भारतीय राजकारणातील स्त्रीनेत्या म्हणून इंदिरा गांधी, सोनिया गांधी, प्रतिभा पाटील, शीला दीक्षित, ममता बॅनर्जी, मायावती,

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जयललिता, फूलन देवी, जयललिता, उमाभारती, सुषमा स्वराज, वसुंधरा राजे, मीरा कुमारी, राबड़ी देवी, प्रियांका गांधी यांचे राजकीय कर्तृत्व सर्वपरिचित आहे. महाराष्ट्रात सुद्धा असे राजकीय महिला नेतृत्व अलीकडील काळात उदयास येताना दिसते. सुप्रिया सुळे, प्रणिती शिंदे, वर्षा गायकवाड, नवनीत राणा, यशोमती ठाकुर, भावना गवळी इत्यादी. अशा प्रकारे स्त्री नेत्रुत्वाचा उदय काही प्रमाणात आनंद देणारा आहे. पण उल्लेखनीय म्हणजे यापैकी बऱ्याच स्त्रिया ह्या घराणेशाहीच्या वारसदार म्हणून राजकारणात सक्रीय आहेत. स्वबळावर राजकीय रिंगणात उतरलेल्या फार कमी महिला आहेत.

एकंदरीत स्त्रियांच्या राजकीय प्रवासाचा आढावा घेताना असे म्हणता येईल की, सामाजिक सुधारणा चळवळीतून आणि समाजसुधारकांच्या प्रयत्नातून महिलांच्या सबलीकरणाला चालना मिळाली. महिलांचा सामाजिक दर्जा यामधून निश्चितच सुधारला. परंतु राजकीय समावेशनाची प्रक्रिया मात्र घडून आली नाही. स्वातंत्र्य प्राप्तीनंतर महिलांचा राजकारणात समावेश होईल, देशाचे प्रतिनिधित्व करण्याची संधी स्त्रियांना पुरुषांच्या बरोबरीत मिळेल असा आशावाद स्त्रियांमध्ये निर्माण झाला होता परंतु परिस्थितीत फारसा बदल झालेला दिसून येत नाही.

स्त्रियांच्या राजकीय सहभागातील आव्हाने

सामाजिक विषमता : (जात, धर्म, वर्ग, लिंग संदर्भात)

पुरुषसत्ताक, धर्माधिष्ठित, पारंपारिक अशा भारतीय समाज व्यवस्थेने स्त्रियांच्या बुद्धी व विवेकाचा वापर स्वतःच्या राजकीय

स्वार्थासाठी केलेला दिसून येतो. यामधून स्त्रिया प्रवाहाच्या बाहेर राहिल्या. '१९७५ साली आंतरराष्ट्रीय स्त्री वर्ष जाहीर झाले. जागतिक पातळीवर स्त्रीवादाची चर्चा सुरू झाली उदारमतवादी स्त्रीवाद, समाजवादी स्त्रीवाद, मार्क्सवादी स्त्रीवाद, जहाल स्त्रीवाद, उत्तर आधुनिक स्त्रीवादी असे विचार प्रवाह स्त्रीवादात उदयाला आले यातून महिलांच्या सबलीकरणाला गती मिळाली.'^{२१} महिला सबलीकरणाचा विचार या विचारधारांत असल्यामुळे स्त्रिया सबलीकरणाला समजू लागल्या व सार्वजनिक तसेच खाजगी जीवनात स्वतःचे स्थान व दर्जा निर्माण करण्यासाठी धडपड करू लागल्या.

'महाराष्ट्र विधानसभा पातळीवर राजकीय सहभागाच्या संदर्भात महिला या सामाजिक घटकाला वगळण्याची प्रक्रिया १९६२ ते २००९ या अकरा निवडणुकांमध्ये घडली आहे. हा महिला पुरुष अशा भेदभावाचा परिणाम आहे. लिंग भेदाखेरीज जात व वर्ग या दोन घटकांचाही परिणाम अकरा निवडणुकांवर झाला आहे.'^{२२} महिलांचा राजकारणात प्रवेश वाढीस लागावा म्हणून कौटुंबिक, राजकीय, सामाजिक, शैक्षणिक, आर्थिक, सांस्कृतिक, पातळीवर ज्या प्रमाणात प्रयत्न होणे गरजेचे होते, त्या प्रमाणात भारतात प्रयत्न होत असलेले दिसून येत नाही. लिंगाधारित जात व पुरुषसत्तेच्या अभ्यासक उमा चक्रवर्ती असे म्हणतात की, 'भारतीय इतिहासात महिलांचा केवळ सामाजिक दर्जा काय आहे, यामध्ये मालमत्ता हक्क, विवाह कायदा, धार्मिक प्रश्न यासारख्या मर्यादित प्रश्नांकडे लक्ष दिले जात होते.'^{२३} अर्थातच पुरुषसत्ता, जात, वर्ग, लिंग हे विषय दुर्लक्षित राहिले. किंबहुना

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ठेवले गेले.

खऱ्या अर्थांने महिलांचे राजकीय सक्षमीकरण करायचे असेल तर जातीय, धार्मिक, लिंगभावात्मक, राजकारण संपुष्टात येणे गरजेचे आहे. रूपकुवर, भवरी देवी, मथुरा, खैरलांजी, दिल्ली, कोपर्डी, कथुआ, उन्नाव, पायल तडवी, हिंगणघाट जळीत प्रकरण, डॉ. प्रियंका रेड्डी बलात्कार प्रकरण आणि अगदी अलीकडील हाथरसचे सामूहिक बलात्कार प्रकरण अशा जातीय, धार्मिक व लिंगभावाने प्रभावित मानसिकतेतून घडणाऱ्या हिंसाचारावर आवाज उचलण्यासाठी संसदेत महिलांचे प्रतिनिधित्व अपूर्ण आहे. लिंगभेदावर आधारित श्रम विभागणी, घरकाम, स्त्रियांच्या न्यायाबाबत होत असलेला दुजाभाव, वैवाहिक व कौटुंबिक कायदे, संपत्ती, वारसा हक्क, कुटुंब नियोजन, गरिबी, उपासमार, शिक्षण पाणी, ऊर्जा, शेती, मालमत्ता, सातबारा, अन्नसुरक्षा आरोग्य, निर्णय प्रक्रियेतील अनुपस्थिती, या सर्व अदृश्य प्रश्नांना दृश्य करण्यासाठी स्त्रियांचा राजकीय सहभाग अत्यंत तोकडा आहे. कारण कुटुंब आणि समाज अजूनही स्त्रियांना स्वतंत्रपणे विचार करू देण्यास पोषक असे वातावरण देत नाही. त्यामुळे त्या समाजात दुय्यम होत जातात. सामाजिक दुय्यमतेमुळे राजकीय परीघावर दूर दूरपर्यंत स्त्रिया दिसत नाहीत. स्त्रियांवरील हिंसा संपुष्टात आणायच्या असतील तर समताधिष्ठित समाज निर्माण होणे गरजेचे आहे आणि अर्थातच ही जबाबदारी शासनाने घेणे महत्त्वाची आहे. पण तसे होताना दिसत नाही, कारण हिंसा आणि सत्ता यांचा फार निकटचा संबंध असतो. यामध्ये स्त्रियांचे आयुष्य पणाला लागले असते.

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स्त्रियांच्या राजकीय सहभागाकडे मर्यादित चौकटीत न पाहता जात, वर्ग आणि लिंगभाव, पुरुषसत्ता या घडणीतून पाहणे महत्त्वाचे आहे. जाती आणि लिंगभाव यांचा अभ्यास करणाऱ्या अभ्यासक वीणा पुनाचा त्यांच्या एका संशोधनात असे म्हणतात की, उच्च जातीतील महिलांवर अत्याचार होतात तेव्हा त्याची दखल गांधीर्याने घेतली जाते. आणि ह्याच घटना खालच्या जातीतील स्त्रियांसोबत घडल्या तर प्रशासन आणि राजकारण तितकी दखल घेत नाही.^{२४} याअर्थी महिला अत्याचाराच्या मुळाशी असलेले राजकारण ओळखणे गरजेचे आहे. मुर्लीच्या जडणघडणी मध्ये कुटुंबव्यवस्थेची मोठी भूमिका असते. स्वातंत्र्य, हक्क अधिकार, न्याय या मुल्यांची ओळख तिला कुटुंबातच झाली तर ती समाजात आत्मविश्वासाने जगू शकते. पण कुटुंब आणि तेथील स्त्रीपुरुष नाते संबंध हेच मुळात असमानतेवर आधारित आहेत. 'धर्म, जात, विवाह, कुटुंब आणि स्त्रीपुरुष नातेसंबंध तसेच पुरुषी परिप्रेक्ष्यातून निर्माण झालेले हितसंबंध या वातावरणात स्त्रीमुक्तीची दिशा कोणती असावी याचा संभ्रम निर्माण होण्याच्या खूप शक्यता असतात.'^{२५} यादृष्टीने कुटुंबातील पारंपारिक प्रतिकामध्ये स्त्रियांना अडकवून ठेवण्याचे राजकारण प्रथमतः घराघरातून थांबणे गरजेचे आहे. प्रख्यात समाजशास्त्रज्ञ शर्मिला रेगे असे म्हणतात की, भारतीय समाजाच्या जात, वर्ग, समुदाय आणि लिंगभाव या प्रमुख वैशिष्ट्यपूर्ण घटकांची गुंतागुंत आहे. स्त्रियांचे आयुष्य जात, वर्ग आणि धार्मिक समुदायांच्या सीमारेषेवर असतात. आणि म्हणूनच स्त्रिया अनेकदा जाती, वर्ग, समुदाय यांच्यातील फरक दाखविणाऱ्या दृश्य खुणा

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असतात.'^{२६} धर्म, जात आणि लैंगिकतेची गुंतागुंत हीच मुळात एक राजकीय खेळी आहे. धर्माच्या नावाखाली स्त्रियांचे होत असलेले शोषण हे शोषण समजले जात नाही तर स्त्रियांचे कर्तव्य म्हणून पाहिले जाते. स्त्रियांच्या धार्मिक भावना वाढीस लागाव्या यादृष्टीने धार्मिक सण, उत्सवांचे आयोजन राजकीय पक्षांच्या पुढाकार - पाठिंब्याने केले जाते. परंतु यामागे केवळ मतांचे राजकारण असते, आणि त्यासाठी स्त्रियांचा वापर केला जातो. पण प्रत्यक्ष अधिकार व न्याय देताना मात्र धार्मिक श्रद्धा, अंधश्रद्धा, धर्मग्रंथ, लिंगभाव यांच्या प्रभावाखाली निर्णय दिले जातात. 'लिंगभाव संदर्भातील असमानतेची व्याप्ती ही अपेक्षेपेक्षा अधिकच तीव्र होत चालली आणि वेगवेगळ्या क्षेत्रात स्त्रियांची प्रगती होण्याऐवजी अधोगतीच झालेली दिसून येत आहे. या अधोगतीस लिंगभाव, जाती, वर्ग, धर्म वंश जबाबदार आहेत.'^{२७} यावरून असे म्हणता येईल की, जाती, वर्ग, धर्म, वंश, लिंग या आधारावर स्त्रिया विभाजित केल्या जातात, धर्म, परंपरा व समाजाने घालून दिलेले नियम पाळणे स्त्रियांना बंधनकारक असतात. आणि राजकारण याला अपवादात्मक स्थितीत विरोध करते.

पुरुषसत्तेचा प्रभाव

भारतीय समाजाचा इतिहास पुरुष प्रधान संस्कृतीत विकास पावलेला आहे. त्यामुळे पुरुष प्रधान तत्त्वांचा प्रभाव समाजव्यवस्थेवर दिसून येतो. ज्यामुळे स्त्रिया सर्वच क्षेत्रात दुय्यम ठरत गेल्या. यातूनच काही क्षेत्रे पुरुषांची मक्तेदारी म्हणूनच

उद्याला आली. ज्यात राजकारण हे अत्यंत महत्त्वाचे असे क्षेत्र आहे. 'भारतीय समाजात इतिहास पाहता काही राजघराण्यातील स्त्री सदस्य वगळता इतर सर्वसामान्य स्त्रिया राजकारणापासून व राजकीय सहभागा पासून अनभिज्ञ व विन्मुख राहिल्या. त्यांचा राजकारणाशी अर्थाअर्थी संबंध नव्हता.'^{२८}

Women, Political parties and social movements in South Asia २००५ या विषयावरील अहवालात अमृता बसू यांनी असे निष्कर्ष नोंदविले की, 'भारतातील बहुतांश राजकीय पक्ष हे पुरुषवर्चस्व असलेले पक्ष आहेत. ते स्त्रिया आणि त्यांच्या हिताकडे दुर्लक्ष करतात. खरे तर भारतीय राजकारणात स्त्रियांनी उच्चपदस्थ आणि महत्त्वाच्या भूमिका बजावल्या आहे. २०१४च्या सार्वत्रिक निवडणुकांमध्ये ९३.६ टक्के स्त्रियांचे डिपॉझिट सुद्धा पक्षाला वाचविता आले नाही. आणि याबाबतीत कोणताच राजकीय पक्ष गंभीर दिसत नाही.'^{२९} १९५२पासून तर २०१९च्या सर्वच सार्वत्रिक निवडणुका ह्या स्त्रीप्रधान कधीच राहिल्या नाही. कारण पितृसत्ताक व्यवस्थेचा भाग येथील राजकारण आणि राजकीय संस्था, शासन संस्था आणि पक्ष हे सर्वच आहे. 'राजकारण हे पुरुषांचे क्षेत्र मानत त्यातल्या स्त्रिया तिथे अपघातानेच पोचल्या आहेत असे समजून अपवादात्मक ठरवल्या गेल्या किंवा पुरुषाची उपमा देऊन त्याचे समर्थन केले गेले (इंदिरा गांधी त्यांच्या मंत्रिमंडळातील एकमेव पुरुष आहेत असे कौतुकाने म्हटले जायचे!)^{३०} पुरुष प्रधानव्यवस्थेचे प्राबल्य असलेल्या राजकीय व्यवस्थेमध्ये फार अल्प स्त्रियांनी शिरकाव केला आहे. केट मिलेट म्हणते की, आपला समाज पितृसत्ताक आहे येथील

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लष्कर, उद्योग, तंत्रज्ञान, विद्यापीठ, राजकीय कार्यालय, वित्त, इतकंच नव्हे तर शक्तीची स्थाने पुरुषांच्या हातात आहे.^{३१} केट मिलेटचे विचार येथील पुरुषसत्तेवर अचूक बोट ठेवतात.

‘भारतीय स्त्रियांची एकूण शैक्षणिक स्थिती, अनुभव व क्षमता लक्षात घेता; देशातल्या सर्वात उच्च अशा कायदेमंडळात आरक्षणाच्या आधारावर निवडून आलेल्या स्त्रियांना संसदेचे कामकाज पेलणार नाही असे काहींचे मत आहे. काहींच्या मते आरक्षणामुळे संसदेत बीबी बेटींची फौज प्रवेश करेल.’^{३२} मंत्रिमंडळात महिलांना खाते वाटप करतानादेखील एक किंवा दोन कॅबिनेट खाती महिलांकडे दिली जातात तसेच तीन चार राज्यमंत्री खाती महिलांकडे दिली जातात. यावरून असे म्हणता येते की, ‘विधिमंडळातील सत्तेवर पुरुषांचे नियंत्रण होते. विधिमंडळातील सत्तेचे स्वरूप पुरुषी वर्चस्वाचे गेल्या साठ वर्षात राहिले आहे.’^{३३} प्रसिद्ध अर्थतज्ज्ञ नोबेल पारितोषिक विजेते अमर्त्य सेन त्यांच्या आशियाई देशातील ‘मिसिंग विमेन’च्या अभ्यासात असे म्हणतात, ‘या राष्ट्रातील पुरुषांच्या तुलनेत महिलांच्या गळतीचे प्रमाण आकडेवारी देऊन येथील सामाजिक आणि सांस्कृतिक परिस्थिती जगासमोर आणली.’^{३४} या गळतीमागे ‘पुरुषसत्ता’ आहे असे विधान सेन करतात. राजकारणातील पुरुषी वर्चस्वामुळे अनेक सक्षम अशा स्त्री राज्यकर्त्यांना राजकारणाच्या बाहेर जावे लागले. या क्षेत्रात कोणत्याच प्रकारे समानतेचे तत्त्व पाळले जात नाही त्यामुळे स्त्रिया राजकीयदृष्ट्या सत्ताहीन होतात.

महिलांना संधीची समानता दिली गेली नाही. नागरिक या

नात्याने संसाधने आणि सुविधा यांच्या संदर्भात निर्णय घेण्याचा अधिकार नाकारण्यात आला. संसाधने आणि सुविधा यांच्या वितरणामध्ये हेराफेरीचे सूक्ष्म तत्त्व यामुळे राहिले सहभागाच्या संर्धीमधूनच राजकीय क्षमतांचा विकास होणार होता, तोही नाकारण्यात आला.^{३५} यावरून हे स्पष्ट होते की, समानता या मुल्याची जोपासना करण्यात आपला समाज कमी पडतोय हे स्पष्ट होत चालले आहे.

राजकीय अभ्यासक प्रमिला जाधव यांनी जेव्हा राजकीय क्षेत्रात सक्रीय असलेल्या बीड जिल्ह्यातील स्त्रियांच्या राजकीय अनुभवावर आधारित चर्चा केली तेव्हा त्यांना मिळालेली उत्तरे विचार करण्यासारखी आहेत. 'स्त्रियांना पुरुषांकडून संधी दिली जाते का? असा महत्त्वाचा प्रश्न विचारला असता केवळ २५ टक्के महिलांनी होय असे उत्तर दिले. तर ७५ टक्के महिलांनी नाही असे उत्तर दिले. मग राजकारणात तुम्ही सहभागी कसे झालात? असा एक प्रश्न विचारला असता आरक्षणामुळे नाईलाजास्तव संधी दिली जाते. असे त्यांनी स्पष्ट केले. आरक्षण दिले नसते तर स्त्रियांना राजकारणात संधीच मिळाली नसती. स्त्रियांच्या राजकारणात सहभाग होत नाही असाही प्रश्न विचारला असता, ७५ टक्के महिलांनी पुरुष प्रधान संस्कृती याला जबाबदार आहे, असे ठामपणे सांगितले.'^{३६}

महिलांना राजकीय क्षेत्रामध्ये पुरुषांकडून संधी उपलब्ध करून दिली जात नाही असे ७५ टक्के महिलांचे आहे. यावरून पुरुषांना अडचण निर्माण होते व अन्य दुसरा कोणता पर्याय राहत नाही त्यावेळेस नाईलाज म्हणून महिलांना पुरुषांकडून संधी प्राप्त

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होताना दिसते. असे निष्कर्ष या अभ्यासात नोंदविण्यात आले आहे.

महिलांचे राजकीय सक्षमीकरण

‘भारतीय राज्यघटनेचा सरनामा, मूलभूत हक्क व मूलभूत कर्तव्य व मार्गदर्शक तत्त्वे यामध्ये स्त्री पुरुष समानता हे तत्त्व व्यक्त होते. राज्यघटना केवळ महिलांना सोबती याची शाश्वती देत नाही तर राज्यसंस्थेने प्रसंगी किंमत मोजूनही महिलांच्या सार्वजनिक हिताचा विचार केला पाहिजे अशी भूमिका घेते. यासाठी राज्यसंस्थेला अधिकार राज्यघटना देते.’^{३७} याच अधिकाराचा वापर करून संसदेने महिलांना राजकीयदृष्ट्या सक्रीय करण्याचे प्रयत्न नक्की केले. परंतु ते अत्यंत तुटपुंजे होते. १९९०नंतर काही पक्षांनी महिलांना पक्षात सक्रीय करण्याचा प्रयत्न केलेला दिसतो. त्यासाठी त्यांनी महिलांच्या आघाड्या निर्माण केल्या. याचा परिणाम असा झाला की, बहुसंख्येने स्त्रिया राजकारणात दिसू लागल्या. परंतु हा सहभाग सुद्धा उच्च जातीच्या स्त्रियांच्या बाबतीतच घडून आलेला दिसतो. विशेष म्हणजे केवळ मतांचे राजकारण यामधून करण्यात आले. त्यामुळे महिला राजकारणाच्या निर्णय निर्धारण प्रक्रियेत सक्रीय झाल्या नाही. वीणा मुजुमदार यांनी, ‘१९७५ या वर्षात ‘महिलांचा दर्जा’चा विषयावर संशोधन करून एक विस्तृत अहवाल तयार केला. या अहवालामुळे स्त्रियासंबंधीचे अतिशय विदारक चित्र समोर आले आणि यातूनच स्त्रियांच्या आरक्षणाचा मुद्दा समोर आला.’^{३८}

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Representation of Women in Lok Sabha 1952-2014 ^(*)

Table No. 1

Lok Sabha	Representation of Women in Lok Sabha 1952-2014		
	Total No. of Seats	Women members	Percentage %
1952	489	22	4.49
1957	494	27	5.46
1962	494	34	6.88
1967	523	31	5.92
1971	521	22	4.22
1977	544	19	3.49
1980	544	28	5.14
1984	544	44	8.08
1989	529	28	5.29
1991	509	36	7.07
1996	541	40	7.39
1998	545	44	8.07
1999	543	48	8.83
2004	543	45	8.28
2009	543	59	10.86
2014	543	61	11.23

Source: Election Commission of India, New Delhi.

Notes: * Including one nominated member.

Table No. 2

Women Members of Rajya Sabha

Year	Numbers	Percentage
1952	15	06.94
1954	17	07.79
1956	20	08.62
1958	22	09.52
1960	24	10.25
1962	18	07.62
1964	21	08.97
1966	23	09.82
1968	22	09.64
1970	14	05.85
1972	18	07.40
1974	18	07.53
1976	24	10.16
1978	25	10.24
1980	29	11.98
1982	24	10.16
1984	24	10.24
1986	28	11.98
1988	25	10.59
1990	24	10.34
1992	17	07.29
1994	20	08.36
1996	19	07.81
1998	19	07.75
2000	22	09.01
2002	25	10.20
2004	28	11.43
2006	25	10.41
2008	23	09.50

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Table No.3Representation of Women MPs/MLAs state-wise: ⁽⁸⁸⁾

Elected from House/Assembly	Total voters in the House/Assembly	No. of Men MPs/MLAs	% of Men MPs/MLAs	Total Women MPs/MLAs	% of Women MPs/MLAs
Loksabha	543	484	89%	59	11%
Rajysabha	244	210	90%	28	10%
Uttar Pradesh	403	371	92%	32	8%
Maharashtra	288	277	96%	11	4%
West Bengal	294	260	72%	34	12%
Andhra Pradesh	294	260	88%	34	12%
Bihar	243	209	86%	34	14%
Tamil Nadu	234	217	93%	17	7%
Madhya Pradesh	230	205	89%	25	11%
Gujarat	182	166	91%	16	9%
Karnataka	224	221	99%	03	1%
Rajasthan	200	172	86%	28	14%
Odisha	147	140	95%	07	5%
Kerala	140	133	95%	07	5%
Assam	126	112	89%	14	11%
Jharkhand	81	73	90%	08	10%
Punjab	117	103	88%	14	12%
Chhattisgarh	90	79	88%	11	12%
Haryana	90	81	90%	09	10%
Jammu & Kashmir	87	84	97%	03	3%
Uttarakhand	70	65	93%	05	7%
NCT of Delhi	70	67	94%	03	6%
Himachal Pradesh	68	63	93%	05	7%
Tripura	60	57	95%	03	5%
Manipur	60	57	95%	03	5%
Meghalaya	60	59	97%	01	3%
Goa	40	39	98%	01	3%
Nagaland	60	60	100%	00	0%
Puducherry	30	30	100%	00	0%
Arunachal Pradesh	60	58	97%	02	3%
Mizoram	40	40	100%	00	0%
Sikkim	32	28	88%	04	13%

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भारतीय संसदेने २२ डिसेंबर १९९२ रोजी आरक्षण विधेयकाला मान्यता दिली. ७३ व ७४वी घटना दुरुस्ती २४ एप्रिल १९९३ रोजी अस्तित्वात आली. 'या घटनादुरुस्ती अन्वये त्रिस्तरीय पंचायतीमध्ये व नगरपालिका, महानगरपालिका या संस्थांमध्ये स्त्रियांसाठी त्यात ३३ टक्के जागा आरक्षित ठेवण्यात आल्या. हे आरक्षण केवळ सर्वसाधारण जागांसाठीचे नव्हते तर स्त्रियांसाठी ३३ टक्के अधिकारपदे महापौर-उपमहापौर नगराध्यक्ष सरपंच जिल्हा परिषद अध्यक्ष राखीव ठेवण्यात आली.'^{३९} या आरक्षणामुळे महिलांचा राजकारणातील सहभाग निश्चितच वाढला. परंतु लोकसंख्येच्या प्रमाणात हा सहभाग नव्हता. शासनाने महिला, अनुसूचित जाती व अनुसूचित जमाती यांना ५० टक्के आरक्षण देऊन पंचायत व महानगरपालिका यांच्या पातळीवर महिलांचा सहभाग वाढविला. मात्र विधानसभा व लोकसभा या पातळीवरही हे आरक्षण अद्याप पोहचू शकले नाही. '१९९३ साली स्थानिक स्वराज्य संस्थेत महिलांना ३३ टक्के जागा राखीव करण्याचा निर्णय घेतल्यानंतर काही समाजवादी पक्षाच्या नेत्यांनी या निर्णयाबद्दल नाराजी व्यक्त केली होती. महिलांच्या नावावर त्यांचे पती किंवा मुले राजकारण करतील, राजकीय पार्श्वभूमी असणाऱ्या कुटुंबातील महिलांनाच या निर्णयाचा फायदा होईल अशा प्रकारची टीका त्यावेळी केली गेली होती.'^{४०} राजकारणात प्रभाव निर्माण होण्यासाठी प्रचंड राजकीय इच्छाशक्ती असावी लागते. जी इच्छाशक्ती महिलांकडे नसते. असा पुरुषांचा समज आहे. ना. नीलम गोऱ्हे (उपसभापती, विधानपरिषद) यांनी, विधानसभेमध्ये महिला आरक्षणाबाबत

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महिला सरपंचाना कायद्याचे संरक्षण देण्याचा विधेयक मांडताना काही घटना सभागृहात नोंदविल्या होत्या. ती निरीक्षणे अशी की, ज्या गावामध्ये महिला सरपंच आहे, त्या गावातील प्रमुख दबाव गटाप्रमाणे महिला सरपंच काम करत नसतील तर महिला सरपंचाने घेतलेल्या विकासाच्या निर्णयावर एक दोन वर्षातच अविश्वासाचा ठराव मांडला जातो. पुणे जिल्ह्यातील आंबेगाव तालुक्यातील धोंडमाळ या गावी श्रीमती वत्सलाबाई काळे ही महिला सरपंच का झाली म्हणून त्यांच्यावर अविश्वासाचा ठराव आणला. त्यावेळेपासून सातत्याने वेगवेगळ्या मुख्यमंत्र्यांनी आश्वासने दिली होती की, महिला सरपंचाना आम्ही कायद्याचे संरक्षण देण्याचा प्रयत्न करू.^{४९} पण अजून कोणत्याही प्रकारची सुरक्षा महिला सरपंचाना मिळालेली नाही. निवडून आलेल्या स्त्रियांना पुरुषांच्या दबावात काम करावे लागते, हे या घटनेवरून स्पष्ट होते.

‘सरकार संसदेत ३० टक्के जागा महिलांसाठी राखीव ठेवण्यात याव्यात यासाठी तयार करण्यात आलेल्या बिलाला खूपच विरोध आहे स्त्रियांच्या सक्षमीकरणासाठी जागा राखीव ठेवणे हा उपाय असू शकतो का? ती एक आपली थोडीशी केलेली वरवरची मलमपट्टी आहे याविषयी चर्चा सर्वत्र चालू आहे. स्त्रियांच्या बाजूने शासनाने उभे राहिल्याचा दावा अगदीच तुटपुंजा किंवा मर्यादित आहे विशेषतः धोरणाचा मसुदा किंवा विधानसभेतील किंवा लोकसभेतील छोट्या-मोठ्या गोष्टींचा पुरते मर्यादित आहे.’^{४९} यावरून महिलांच्या राजकीय सत्तेच्या समान सहभागाबत शासन उदासीन असल्याचे निर्देशनास येते.

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लोकसभेतील महिला प्रतिनिधित्वाचे प्रमाण गेल्या ७० वर्षांपासून फारसे वाढलेले दिसून येत नाही. मागील ५० वर्षातील हे प्रमाण ३.४% ते ६.७% इतक्या प्रमाणात राहिलेले दिसते. १९८४-८५मध्ये संख्या प्रमाण वाढलेले दिसत असले तरी ते जास्त नाही. नंतर २००९ आणि २०१४मध्ये महिलांची राजकीय टक्केवारी वाढली असे लक्षात येत असले तरी लोकसंख्येच्या प्रमाणात ही वाढ नाही.

लोकसभेप्रमाणेच वरिष्ठ सभागृह म्हणजे राज्यसभा इथे सुद्धा चित्र सारखेच आहे. लोकसभेच्या तुलनेत प्रमाण जास्त असले तरी पुरुषांच्या तुलनेत नक्कीच कमी आहे.

महिलांना राजकीय क्षेत्रातून वगळण्याची प्रक्रिया

वरील आकडेवारी स्त्री प्रतिनिधित्वाचे वास्तव चित्र दाखविते. १६व्या लोकसभेत केवळ ५४३ पैकी केवळ ५९ महिलांचा संसदेत समावेश आहे. म्हणजेच महिला केवळ ११ टक्केच आहेत. राज्यसभेत २४४ सदस्यात २८ स्त्रिया खासदार आहेत यावरून लक्षात येते की, राजकारणात पुरुषांचे प्रमाण आणि मक्तेदारी किती मोठ्या प्रमाणात आहे. मिझोराम, नागालँड, पाँडिचेरी या राज्यांत महिलांना खातेही उघडता आले नाही. जम्मू काश्मीर, ओरिसा, केरळ येथील महिलांनी प्रथमच खाते उघडले. पुरोगामी समजल्या जाणाऱ्या महाराष्ट्रात सुद्धा राजकीय चित्र फारसे समाधानकारक नाही. जवळपास सर्वच घटकराज्यांमध्ये महिला प्रतिनिधित्व अल्प प्रमाणात आहे. 'महिला सबलीकरण उद्दिष्टांची पूर्ती करायची असेल तर महिलांना राजकीय प्रक्रियेचा

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सर्व पातळ्यांवर होणाऱ्या निर्णय प्रक्रियांमध्ये सहभागी करून घेतले पाहिजे. प्रत्येक पातळीवरील निर्णय निश्चितीच्या मंडळावर महिलांना समान संधी व पूर्ण सहभाग मिळाला पाहिजे. कायदेमंडळ, कार्यकारी मंडळ, न्यायमंडळ, सहकार, सल्लागार, समित्या, मंडळे, विश्वस्त संस्था यासारख्या महत्त्वाच्या संस्थांच्या निर्णय प्रक्रियेत महिलांना अधिकार असले पाहिजे.^{४५} परंतु असे होताना दिसत नाही. निवडून आल्यानंतर सत्तेचा मोह आणि कुरघोडीचे राजकारण यामध्ये सर्वच पक्ष व्यस्त असतात. याचे परिणाम असे की, सरपंच पदापासून राजकारणाची सुरवात करीत असलेल्या स्त्रिया विधानसभा, विधान परिषद, लोकसभा राज्यसभा अशा सत्तेच्या केंद्रस्थानी असलेल्या गृहात किती प्रमाणात पोहचू शकल्या हा खरोखरच संशोधनाचा विषय आहे. 'गेली पन्नास वर्षे स्त्रियांच्या राजकीय सहभागाच्या बाबतीत भेदभावाचे प्रकार दिसून येत आहेत. सर्व प्रकारच्या निर्णयक्षम संस्थांमध्ये स्त्रियांना वगळणे आणि खालच्या आर्थिक वर्गाची आणि ग्रामीण स्त्रियांची राजकीय प्रक्रियेमध्ये पूर्ण अनुपस्थिती दिसत आहे.'^{४६}

निष्कर्ष

स्त्रियांना समानतेचा दर्जा मिळावा, निर्णय निर्धारण प्रक्रियेमध्ये सहभाग वाढावा, सत्तेतील सहभाग वाढावा या अनुषंगाने राज्यघटनेने बहाल केलेली साधने पुरेशी आहेत. या आधारावर स्त्रिया सामाजिक क्षेत्रात सक्रिय झालेल्या दिसतात. उदा. महागाई विरोधी आंदोलने, विद्रोही आंदोलन, आदिवासी आंदोलन,

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पर्यावरण, पाणी प्रश्नांचे आंदोलन, भूमिहीनांचे आंदोलन, शेतकरी आंदोलन, सामाजिक अत्याचार विरोधी आंदोलन, दारूबंदी, हुंडाबळी, दलित महिलांवरील अत्याचार विरोधी आंदोलन, अंधश्रद्धा निर्मूलन आंदोलन, स्त्रीमुक्ती आंदोलन, नागरिकत्वाशी संबंधित मुस्लिम स्त्रियांनी केलेले शाहीनबाग येथील आंदोलन इत्यादि अनेक अशा आंदोलनातून स्त्रियांचा सहभाग वाढलेला दिसतो. पण यासर्व प्रश्नांची उकल ज्या राजकीय व्यवस्थेतून होते, तिथे मात्र स्त्रिया मोठ्या संख्येने पोहचल्या नाही. राजकीय प्रतिनिधित्वामध्ये पुरुष आणि महिला यांच्यातील समान नेतृत्वाचे तत्त्व पाळण्यात येत नाही, हे स्पष्टपणे म्हणता येईल. निवडणुकांमध्ये राजकीय पक्ष महिलांचे संघटन करताना दिसत असले तरी स्वतंत्रपणे महिला राजकारणात सक्षम होण्याच्या दृष्टीने म्हणावे तितके ते गंभीर नाहीत. भारतीय संविधानाने समतेच्या अधिकारात जात, वंश, धर्म, पंथ, लिंग या आधारावर कुठेही भेदाभेद केला जाणार नाही अशी हमी दिली असताना सुद्धा उघडउघडपणे राजकारणात लिंगभेद बघायला मिळतो. हा प्रश्न जातीय, धार्मिक, तसेच लिंगभाव पातळीवर अधिक जटिल होत चाललेला आहे. स्त्रियांच्या राजकीय सहभागाबाबत शासन फारसे गंभीर दिसत नाही. स्त्रियांना अजूनही कौटुंबिक जबाबदारीमधून बाहेर पडता येणे शक्य होत नाही. राजकीय चर्चा, आंदोलने, निवडणुका, भाषणे, राजकीय संवाद, राजकीय घडामोडी यापासून स्त्रिया फार लांब आहेत. स्त्रियांना राजकारणातलं काय कळतं असे म्हणणारे पुरुष संख्येने जास्त आहेत. ज्या स्त्रिया राजकारणात सक्रीय आहेत त्यांची अनेक

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प्रकारे अवहेलना केली जाते. समाज माध्यमांवर त्यांना ट्रेलिंग केले जाते. राजकारणातील भ्रष्टाचार, स्पर्धा, हेवेदावे, जातीय व धार्मिक संघर्ष, चढाओढ, झुंडशाही, लोकशाहीचे अवमूल्यन या सर्वांमध्ये स्त्रिया स्वतःला टिकवून ठेवू शकत नाही. स्त्रियांना राजकीयदृष्ट्या पोषक असे वातावरण या क्षेत्रात मिळत नाही. त्यामुळे राजकारणापासून स्त्रिया दूर राहतात व सत्ताहीन होत जातात.

यासर्व चर्चेमधून शेवटी हे सिद्ध होते की, समकालीन राजकारणातील स्त्रिया कमी अधिक प्रमाणात सामाजिक रचनेच्या बळी आहेत. लिंगधिष्ठितता ही सामाजिक आणि राजकीय रचनांमध्ये महत्त्वाचे परिवर्तक म्हणून काम करते आहे. त्यामुळे स्त्रिया दिवसेंदिवस राजकीयदृष्ट्या अधिक सत्ताहीन आणि दुय्यम ठरत आहे. समाजाचे जसजसे आधुनिकीकरण होईल तसतसे स्त्रियांचे समाजातील स्थान उंचावेल असा विश्वास घटनाकारांना होता. परंतु एकंदरित स्त्रियांच्या प्रश्नाकडे बघता लक्षात येते की, स्त्रीप्रश्नाची व्यापकता दिवसेंदिवस रुंदावत आहे. 'लैंगिक विषमतावादी गैरसमज आणि भेदभाव केला गेल्याने समकालीन समाजामध्ये सर्व ठिकाणी स्त्रिया दुय्यम बनविल्या जातात.'^{४७} हे दुय्यमत्व समूळ नष्ट करायचे असेल तर स्त्रियांनी बिगर राजकीय राहून चालणार नाही हे त्यांनी समजले पाहिजे.

आपण आधुनिक झालो असलो तरी लिंगभाव पातळीवर अजूनही मागासलेले आहोत. केट यंग यांनी म्हटल्याप्रमाणे, सर्व प्रकारच्या साधनसामुग्रीच्या मालकी पासून स्त्रियांना वंचित ठेवले जाते. आणि सामाजिकरणातून त्यांना दुय्यम स्थान

स्वीकारण्यास भाग पाडले जाते.*५ स्त्रियांना राजकारणात अजिबातच स्थान नाही असे म्हणता येणार नाही. केंद्रस्थानी असलेल्या सत्तेला स्त्रियांच्या प्रश्नांकडे लक्ष वेधून घेणे ही स्त्रियांची जबाबदारी आहे. आणि यासाठी स्त्रियांना राजकीय व्यवस्थेत प्रत्यक्ष सहभागी होणे गरजेचे आहे. राजकीय सत्तेसाठी संविधान हा मार्ग अत्यंत सविनय तसेच उदारमतवादी आहे. महिलांच्या राजकीय सहभागाने स्त्री प्रश्नांकडे गांभीर्याने बघितले जाईल. विषमता रहित स्त्री-पुरुष समानतेवर आधारित लोकशाही समताधिष्ठित समाजनिर्मितीसाठी सर्वच क्षेत्रातील लिंगभाव नष्ट होणे गरजेचे आहे. त्यासाठी महिलांनी सुद्धा राजकीय सत्तेच्या सहभागासाठी पुढे येणे गरजेचे आहे.

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ROLE OF THE POLICE DEPARTMENT (BHAROSA CELL) IN THE PREVENTION OF DOMESTIC VIOLENCE

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ABSTRACT

Domestic violence (also known as spousal abuse, intimate partner violence, domestic assault, or family violence, etc.) is a term used to describe violence or abuse of one partner at the domestic level after cohabitation or marriage. Abuse with an intimate partner or life partner also comes under the category of domestic violence. Domestic violence can also occur in heterosexual or homosexual relationships. Domestic violence can take various forms, including physical, emotional, verbal, economic, and sexual abuse, ranging from coercion to coercive sex after marriage and violent physical abuse, and can result in mental or physical disfigurement or even death. Globally, the wife or the female partner is more commonly the victim of domestic violence, although the victim may be the male partner, or both may be victims of domestic violence against each other, or may also be victims of domestic violence due to culpable self-defense or retaliation. While women who are victims of domestic violence in the developed world are encouraged to make open complaints to the authorities, it is argued that domestic violence against men goes unreported because it makes them look socially cowardly and cowardly. considered man less. In this research paper, the role of the Police Department (Bharosa Cell) in the prevention of domestic violence has been studied.



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KEYWORDS: *Bharosa Cell, Domestic Violence, Police Department, Domestic Violence, Marital Abuse.*

INTRODUCTION

In today's time, women are contributing in every field. Whether at home or outside, women do their work properly, but due to some reasons, they must face many problems. They must face all the troubles like domestic violence, gender discrimination, women's harassment, etc. But if women are aware of their legal rights, then they can raise their voices against any harassment before they suffer. If the woman's husband commits domestic violence against the woman, then the woman has the right to file a complaint against him at the police station. At present, for the prevention of domestic violence in the police department, the Bharosa cell has been formed, through which the cases related to domestic violence are solved at a fast pace.

According to Section 498 of the Indian Constitution, the wife, the woman who lives with the live-in partner, or the woman living in anyone's house, who is facing domestic violence, has the legal right to protest this violence. Raise your voice and file a case. By doing this, the accused (who is committing the violence) must pay a heavy fine or is also imprisoned for 3 years. If the boy's family or the boy himself demands a dowry at the time of marriage or after that, then the girl's family need not compulsorily give

a dowry. Can file a complaint against it according to the Dowry Prohibition Act. Due to this, the family members must pay a heavy fine along with being jailed.

Any adult male, if related to any woman living in a domestic relationship, such as wife, ex-wife, widow, a woman living in a relationship like marriage, mother, sister, girl, child (boy or girl) of a joint family, financially, if someone commits physical, sexual or material and emotional violence, then it is called domestic violence. The Domestic Violence Act covers all forms of violence against women and children living in adopted, unmarried, married, and married status. Resolving physical, mental, economic, and sexual violence and various types of rights of women living in shared households or domestic relationships effectively. The legislation mentioned in this activity helps prevent domestic violence against women. Along with this, provision has been made for maintenance and the right to stay.

Most people consider the hand of stress, intoxication, or any disease behind domestic violence but, it has been observed that those who do violence to women at home do not behave the same way with their co-workers on the street or with their friends at the workplace. They do because they do not have any rights there. Domestic violence is always done intentionally and the person who commits it knows that he can have power over the person in front. The husband is sure that the victimized wife will never open her mouth against him and being a husband, no one will dare to ask him for an answer. This ground is sufficient to commit atrocity or violence.

The aggrieved person himself, any other person on behalf of the aggrieved person, neighbour, social worker, or relative who believes that an incident of domestic violence has occurred, may occur, or is occurring. Complaints of domestic violence can be made by the aggrieved person to the Women's Helpline, Women's Police Station, Police, or Judicial Magistrate anywhere. Women can also register their complaints on the toll-free helpline number '181'.

Magistrate, by passing a protection order in the interest of the aggrieved person, restrains the accused from committing any act of domestic violence, aiding in the act of domestic violence, entering a place where the aggrieved person resides or frequents, accompanying the aggrieved person Withhold any communication in person, oral, written, electronic or telephonically. The accused shall not evict the aggrieved woman from possession of the shared household, nor shall he obstruct her. If the woman does not want to live in the shared household, then the accused can be ordered to decide, all the expenses of which will be borne by the accused. To compensate the victim for the financial loss caused by not going to work, an order can be given to give financial relief in one lump sum or every month. Due to physical, and mental violence, the victim must face a lot of trouble and financial loss, in such a situation, the magistrate can order the accused to pay compensation. In the Act, the Magistrate can pass such interim and ex-parte orders as he thinks fit or just. If any party does not accept the decision of the court, then that party can appeal to the sessions court within 30 days of the order given by the court. If the accused does not comply with the protection order given by the court and commits violence against the victim woman again, then the accused can be punished with imprisonment of 1 year or a fine of Rs 20,000 or both. One or more of these orders may be made, as the court thinks fit. As per the Act, the date of the hearing will be fixed within 3 days after the receipt of the application and the case must be disposed of within 60 days from the first hearing.

Most people do not interfere in the quarrel of husband and wife considering it a mutual matter. But the behaviour which affects not one person but the society and the future generations of society cannot be a personal matter for anyone. Domestic violence is a personal issue for a woman as well as has an impact on social development. Honour is the birth right of a human being. If someone's honour is violated, then we all have the right to raise our voices against it.

RESEARCH METHODOLOGY:

The research paper has depended on secondary data.

OBJECTIVE OF RESEARCH:

- 1) To know the concept of the Bharosa Cell.

- 2) To study the role of the Police Department (Bharosa Cell) in the prevention of domestic violence.
- 3) To study the procedure of the police department for the prevention of domestic violence by the Bharosa Cell.

THE ROLE OF THE POLICE DEPARTMENT (BHAROSA CELL) IN THE PREVENTION OF DOMESTIC VIOLENCE:

Apart from acting after a crime is committed, various measures are taken by the government to prevent the crime from happening. For this purpose, the Bharosa cell has been established in the state by the police department. Through this 'cell', while providing security to women and children, they are being properly guided for crime prevention. The 'Bharosa Cell' launched to empower a woman or girl child to fight back against the abuses she is subjected to, has become a trust for the state police. Therefore, this pattern of winning the 'trust' of women and girls is being implemented in some other cities of the state.

W.E.C.A.R.E. (Women Effulgence Center for Aid and Empowerment), through 'Bharosa Cell' and 'Damini Pathak', all kinds of help and facilities are being provided to the victimized women and children in one place. Through this, police, medical services, psychiatrists, counseling, legal experts, protection officers, and rehabilitation services are being provided immediately to women and children in distress to solve their problems. The women and children who are the target of violence must be getting the psychological strength to fight against the oppression due to the support of the Bharosa Cell.

The 'Bharosa Cell' is open round-the-clock to receive the complaints of the victimized women and children. The administration of this cell starts in three periods. If a woman comes at night, arrangements are also made for her accommodation. Also, the complaints of the complainants are received on the women's helpline numbers 1091 and 100 and sent to the concerned experts immediately. Importantly, the complaints received from the victimized women are sorted and guided according to their needs. The concerned complainants are counseled and arranged for temporary accommodation if required. No unilateral decision is taken by closing the complaint until the victim gets justice in the complaints received in Bharosa Cell. Bharosa Cell includes protection under the Domestic Violence Act as well as legal services, medical services, a child helpline, a women's helpline, a women's helpline, a psychiatrist, counseling, and rehabilitation of women victims.

A victim of sexual abuse or other forms of violence, a woman or girl sometimes has to go from door to door for justice. Rape-victimized women or girls are often treated with contempt by the family as well as society. So, she gets tired physically and mentally. The same goes for widows seeking rights and women in divorce cases. There are also ways to take advantage of her vulnerability. Many women often do not understand where and how to seek justice in cases like dowry and domestic violence. Similarly, they need to be counseled on time. In order not to disturb anyone's happy life, both families are counseled in the 'Bharosa Cell'. If they are not satisfied even after counseling, finally a case is filed. This is helping women to get justice by saving their time and money.

In Nagpur city, apart from lawyers, counselors, social workers, and doctors, the local Bharosa Cell also has 17 staff including one senior police inspector, one assistant inspector, and one sub-inspector. They have received 2078 complaints of different types in the last 8 months. Out of which 1182 complainants were counseled and the disputes were resolved. In 442 cases, women girls, or other complainants have been reconciled with the congregation of the opposite party. So, 454 complaints were disposed of in different ways. Just like women, 'Bharosa Cell' is helping men too. The number of victims seeking justice in this cell is increasing. 10 to 20 new complaints are filed here every day.

In various programs organized in the Bharosa cell, awareness is given by giving information about sexual exploitation (Good Touch, Bad Touch). Many women also come with the question of living here. Their accommodation is arranged according to their age group. Because of this, the victimized women and children have received a lot of support through the 'Bharosa Cell'. Apart from the analysis and settlement of complaints received in Bharosa Cell, a newly established de-addiction counseling center, self-guided karate training, and yoga classes have also been started. This branch has a specially created cell to look into the complaints of women and cases of domestic violence. Women social

workers and members of non-governmental organizations have been taken on the panel. They listen to the cases of victims and other family members and try to find a solution through counseling. Unsolved cases are referred to police stations for legal action. This section deals with the trafficking of children and women and children against the law.

Maharashtra State Police is running Women Protection Cell for the protection and welfare of women. This cell is a social branch. Women who are victims or distressed women who have been abused by their husbands or mother-in-law or fathers-in-law or have family problems come to the police station or directly to the Women's Protection Cell. Complaints were received at Police Station or referred to the Women's Protection Cell. After registering the complaint, the women's protection cell gives notice to the applicant or non-applicant. The staff tries to solve the problem through counseling with the social worker in the women's protection cell. If both parties are satisfied, then the women's protection chamber succeeds in its mission to protect women.

In the last few years, there has been an increase in the number of divorces over very small things. This ratio is slightly higher in love marriages. So divorced couples should have an idea of how explosive the word divorce is. Nowadays, divorce is also being demanded based on issues like mobile phones and social media. Apart from this, divorce is also being filed based on domestic violence, dowry, mental harassment, addiction, and minor quarrels. The increasing rate of divorce has become a serious problem for our society. So, the police department set up a trusted cell a few years back to find an early solution to some of these problems. About 130 to 170 cases are received in the form of complaints every month in Nagpur city. The complaints based on family discord, husband-wife quarrels, and problems arising out of it are the most common. In the seven months of the current year, 1341 cases have been registered in the judicial cell, out of which 940 cases have been resolved. Bharosacell has achieved great success in solving 402 cases. If you look at the percentage of these figures, then this amount is 30 percent. Apart from this, the counseling process is going on in 401 cases and most of these cases will be resolved successfully. So the officials believe that this year the reconciliation percentage will go up to 40 to 45 percent. Also, 64 cases have been sent for police action. A total of 22 cases have been referred to the court under the Domestic Violence Act. According to the applicants, 339 cases have been closed. Last year, there was reconciliation in 39 percent of cases. Bharosa cell has got support from many people. Incidents of family disputes, violence, and verbal abuse increased during the layoffs. Under the Domestic Violence Act, 34 cases have been referred to the court while 794 cases have been closed as per the applicants.

The Vasai Virar (MBVV) Police is playing the role of the right friend to resolve disputes and conflicts in the bi-weekly meetings of the Bharosa (Trust) Cell – a multi-nodal unit to help people in distress under one roof. With the success rate being over 75 percent, the police have been able to solve around 350 cases in the last 18 months. From society affairs and petty quarrels to marital discord and even financial disputes- the cell, which has legal advisors, counselors, NGO members, women police, and psychologists, receives 40 to 50 cases every month. While 90% and 6% of the complaints pertain to matrimonial disputes and injustice to senior citizens, 4% percent of cases pertain to children. It is not that only women approach us for help, in about 30% of cases the complainants are men. It has been observed that through counseling and gentle advice, litigation can be avoided after a long court battle.

Police have made a lot of efforts to address the concerns of the weaker sections of society through the Bharosa Cell, while society has continuously supported these efforts. People in distress can visit the cell or call 112 or 28040006 for help. Further, the legal points, practicality of the case, and problems that may arise during the proceedings are also explained to the appellants, so that the issues are resolved amicably and the minimum number of cases reach the already overburdened courts.

CONCLUSION:

Due to the decline of the joint family system, the number of family disputes is increasing day by day. Many people's lives are being ruined because they do not want the interference of other family members in the life of husband and wife. Many complaints of family disputes come to the 'Bharosa Cell'. They are counseled. However, out of 100 complainants, 70 percent of the women want divorce only, in

earlier times due to the joint family system, elders were respected and respected. Now times have changed and the nuclear family system has taken root due to jobs, city attraction, and education. Today's woman does not want her mother-in-law in the house. The emphasis of the newlyweds is on creating a different world that does not take place in marriage. The husband also starts living separately from his parents due to his wife's demands so as not to break the family. This confuses parents. Due to the presence of mother-in-law in the house, there are frequent quarrels in many families. The husband is not ready to go away from his parents even when his wife is angry. This leads directly to divorce. Some women are conditioned to choose between parents or wives. Many such cases come in the 'Bharosa Cell'. Elderly mothers-in-law have been exposed to obscene abuse, beating, starving, or keeping locked up in a room. After a dispute in the family, a complaint is made directly to the police station. Then these cases come to the 'Bharosa Cell' for counseling. The Bharosa Cell of the Police Department plays an important role in the redressal of domestic violence complaints.

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ORIGINAL ARTICLE

Seasonal Changes of Total Protein Content among Olfactory organ, Forebrain, Pituitary gland and Ovary in *Garra mullya* (Sykes)

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Abstract

In the present study, proteins are estimated in *G. mullya* throughout the reproductive cycle. Their content is demonstrated in olfactory organ, forebrain along with pituitary and ovary. Proteins are also electrophoretically separated using SDS-PAGE. The whole hypothalamo-hypophysial-gonadal axis contributes towards the gonadal growth which is evident when proteins are estimated biochemically. Total protein content increases during pre-spawning phase, in olfactory rosette, forebrain and pituitary gland but it is highest in the ovary during spawning phase; decreases in olfactory rosette and pituitary gland in the spawning; in the forebrain it is low compared to olfactory rosette and pituitary gland in all the phases. It is inferred that, the surge of proteins in forebrain during pre-spawning period could be the result of positive feedback from steroids synthesized by the ovary in *G. mullya*. The increase in the pituitary gland in the preparatory phase is due to the involvement of gonadotropins in early gonadal development and also due to stimulatory role of them in ovulation. In fact almost all the proteins are present in all the phases; but as vitellogenesis proceeds, higher molecular weight proteins replace the lower ones.

Keywords : protein content, SDS-PAGE, olfactory, forebrain, pituitary, ovary, *Garra mullya*

INTRODUCTION.

Proteins are nitrogenous compounds which are most abundant solids in the cell protoplasm. About three quarters of the body solids are proteins. Principal constituents of proteins are amino acids, 21 of which are present in the body in significant quantity and are called as globular proteins. Proteins are soluble in water or salt solution and they are held in a globular shape by coiling and folding of the peptide chains. These proteins perform thousands of different functions in the body. Some tissues of the body participate in storage of amino acids, some acids to a greater extent than others (Guyton, 1976).

Proteins as with all other cellular constituents are in a state of continuous turnover which may significantly alter the organism's ability to readily adapt to changes in its environment (Goldberg and Dice, 1974). Protein turnover is of course a function of the rate of synthesis and degradation, both of which are under separate control (Goldberg and Odessey, 1974). Protein retention is higher in fish which consume higher protein diets and it is suggested that a portion of the digested proteins is used as energy for maintenance and routine metabolism and remaining energy is diverted for somatic and gonad tissue growth (Lee and Putman, 1973).

Olfactory proteins are electrophoretically separated and electrophoretic changes occurring in the olfactory system in *masu salmon* are reported by Amano *et al.*, (1995). Protein N24 of molecular wt 24Kda is specially present in the olfactory system of *Kokanee salmon*, *Oncorhynchus nerka*, the first olfactory specific protein reported in salmonids. In Crucian carp (*Carassius carassius*), the olfactory system detects pre-ovulatory pheromones reflected in key amino acids in water (Stacey *et al.*, 1983). Jafri and Khawaja (1968) noted protein cycle in various tissues of *Ophiocephalus punctatus* and showed a correlation between feeding and spawning. Singh and Naurial (1990) studied the protein content in the ovaries of hill stream teleosts, *Schizothorax richardsonii* and *Glyptothorax pectinopterus* and revealed that protein content increased during the maturing stage becoming highest at the maturing stage and a sharp decline was noticed at the spent stage. Verma (2013) stated that during resting phase, protein percentage was low while it was maximum during maturity phase in testes and ovaries.

Verma (2013), studied the seasonal gonadal biochemical changes, associated with the reproductive cycle in *Labeo dyocheilus* and stated that the correlation of gonadosomatic index with gonadal lipid, protein and water percentage shows that the water content is more responsible for maturation of testis and lipid content for ovary as compared to other factors. Protein turnover is the function of rate of protein synthesis and the rate of its degradation both of which are under separate control. Energy associated with spawning derived from gonad is 3%. As in other oviparous vertebrates, in fishes also during vitellogenesis, the yolk precursor protein, vitellogenin (Vg) is synthesized in liver and then secreted into blood from where it is sequestered into the developing oocytes (Wallace, 1985; Mommsen and Walsh, 1988). Studies on the protein content have been carried out on number of fishes such as protein in gonads of females *Schizothorax richardsonii* and *Glyptothorax pectinopterus* (Singh *et al.*, 1990); protein in muscle of *G. mullya* (Somvanshi, 1980); mobilization of RNA and protein in liver of *G. mullya* (Khan and Mehrotra, 1991); *Channa orientalis* (Saksena and Saxena, 1999); catfish, *Heteropneustes fossilis* (Hunge and Baile, 2003); males of *Labeo rohita* (Bhute, 2004); *Ophiocephalus striatus* (Khaparde, 2010); females of *H. fossilis* and *Ophiocephalus striatus* (Sonparote, 2010) throughout the reproductive cycles. A positive correlation between condition factor and gonad protein show that fish in good condition may have well developed gonads have lower than average level of muscles and liver protein (Love, 1970). In the present study, proteins are estimated in *G. mullya* throughout the reproductive cycle. Their presence is histochemically demonstrated in olfactory organ, forebrain along with pituitary and ovary. Proteins are also electrophoretically separated using SDS-PAGE.

MATERIALS AND METHODS

Biochemical method (Lowry et al., 1951):

Tissue extract: Female, *G. mullya* killed by decapitation. Olfactory organ, forebrain, pituitary and ovary were dissected out in the ice cold Ringer solution. Tissues were weighed and homogenized at 0°C in ice cold Ringer solution using mortar and pestle.

Estimation: Tissue proteins were estimated by Lowry et al., (1951) with minor modifications. 1 ml of homogenate was mixed with 1 ml of 10% Trichloroacetic acid (TCA) and centrifuged for 15 min at 10,000 rpm. The precipitate was dissolved in 3 ml of 0.1N NaOH, of which 1 ml of dissolved precipitate was taken in a clean glass test tube which was raised to 4 ml by adding 3 ml distilled water, then 5.5 ml alkaline copper sulphate reagent was added and kept for 30 minutes. Simultaneously, bovine serum albumin (2 mg/1 ml) as standard and distilled water (blank) was taken in separate test tubes, 3 ml distilled water and 5.5 ml of shaking in each test tube. The test tubes were kept for 30 minutes and colour intensity was noted at 650nm in the spectrophotometer. The standard graph was drawn with five standard BSA solutions from this, the unknown amount of proteins was determined from the extracted samples. Values are expressed proteins in mg /gm of tissue weight.

SDS- PAGE (PLATE) Electrophoresis:

SDS-PAGE Electrophoresis was carried out by Laemmli (1970) method with minor modifications for separation of proteins. Female fishes were killed by decapitation. The olfactory organ with bulb, telencephalon, pituitary gland and ovaries were removed and homogenized in lysis buffer separately containing 50mM Tris-HCl, PH 7.5, 50mM MgCl₂, 1 mM EDTA, 1% Triton x-100 and 1 mM PMSF (Phenyl methyl sulphonyl fluoride) as protease inhibitor. The homogenized tissues were centrifuged at 5000 rpm for 30 minutes and supernatants were taken as a protein sample. The protein sample was added to an equal volume of sample buffer (0.1 M Tris-HCl, PH 6.8; 10% glycerol; 1% sodium dodecyl sulphate (SDS); 0.02% bromophenol blue), treated with 1% β-mercaptoethanol and denatured at 90°C for 3 min. A lane containing molecular weight marker (Bangalore Genei, India) was included in each gel and 20 µl protein sample was loaded in each well of stacking gel (15%) with a micropipette and 35 mA was supplied to electrophoretic chamber. The gel was then stained with coomassie brilliant blue R-250 (SRL, India) and destained.

Statistical methods:

Statistical analysis of the data was done using online Graph Pad Quick Calcs software. Values were expressed as mean values ± standard mean error (SEM). Student t-test was applied to locate significant difference between different groups at 0.05 significance level.

OBSERVATIONS

Biochemical estimation of protein in *G. mullya*: (Table.01 & Graph.1,2,3&4) Presence of proteins in olfactory rosette, forebrain, pituitary and ovary is estimated by Lowry et al., (1951) method.

1. **Resting phase (late October - mid February).** Total protein content in the olfactory rosette is 9.19±2.33 mg/gm. Total protein content in the fore brain is 12.13±1.35 mg/gm. Total protein content in the pituitary is 10.72±1.35 mg/gm. Total protein content in the ovary is (19.44±2.66) mg/gm.

2. Preparatory phase (late February - mid April). Total protein content in the olfactory rosette is 13.77 ± 2.03 . Total protein content in the fore brain is 16.91 ± 2.60 mg/gm. Total protein content in pituitary is 16.84 ± 0.76 mg/gm. Total protein content in the ovary is 23.78 ± 1.86 mg/gm.

3. Prespawning phase (late April - early June). Total protein content in the olfactory rosette is 20.54 ± 2.68 mg/gm. Total protein content in the fore brain is 19.01 ± 1.57 mg/gm. Total protein content in pituitary is 21.95 ± 1.92 mg/gm. Total protein content in the ovary is 25.08 ± 1.87 mg/gm.

4. Spawning phase (June – August end). Total protein content in the olfactory rosette is 18.08 ± 1.60 mg/gm. Total protein content in the forebrain is 13.85 ± 1.85 mg/gm. Total protein content in pituitary is 17.69 ± 2.67 mg/gm. Total protein content in the ovary is 30.56 ± 1.18 mg/gm.

5. Postspawning phase (September – mid October). Total protein content in the olfactory rosette is 10.13 ± 0.89 mg/gm. Total protein content in the fore-brain is 11.94 ± 1.26 mg/gm. Total protein content in pituitary is 16.67 ± 1.26 mg/gm. Total protein content in the ovary is 20.07 ± 2.23 mg/gm. Protein content of olfactory rosette increases from resting phase (9.19 ± 2.33) upto prespawning phase (20.54 ± 2.68) and decreases in postspawning phase (18.08 ± 1.60). Protein of forebrain also significantly increases from resting phase (12.13 ± 1.35) to prespawning phase (19.01 ± 1.57). Pituitary gland show significant increase in protein from resting phase (10.72 ± 1.35) to preparatory phase (16.84 ± 0.76) to prespawning phase (21.95 ± 1.92). In spawning protein content decreases (17.69 ± 2.67) and again elevate in postspawning (16.67 ± 1.26). Protein content in ovary increases from resting phase (19.44 ± 2.66) upto spawning phase (30.56 ± 9.27) respectively.

Electrophoretic pattern of protein in G.mullya. Presence of proteins is analyzed by 10% SDS polyacrylamide gel electrophoresis (SDS-PAGE) (Fig.01, 02, 03, 04).

1. Resting phase (late October - mid February). (Fig.01) When proteins are separated by SDS-PAGE, electrophoretic pattern in the olfactory rosette, proteins bands are observed with molecular weight of 30.26 kDa. In forebrain, proteins bands are observed with molecular weight of 15.47 kDa. In pituitary gland, proteins bands are observed with molecular weight of 42 kDa. In ovary, protein bands are observed with molecular weight of 9.44 kDa, 17.34 kDa, and 36.63 kDa.

2. Preparatory phase (late February - mid April). (Fig.02) When proteins are separated by SDS-PAGE, electrophoretic pattern in the In olfactory rosette, proteins bands are observed with molecular weight of 21.10 kDa, 46.89 kDa, and 72.92 kDa. In forebrain, proteins bands are observed with molecular weight of 8.93 kDa, 26.38 kDa, 50.94 kDa, 130 kDa, 147.65 kDa. In pituitary, proteins bands are observed with molecular weight of 45.31 kDa, 128 kDa, and 147.65 kDa. In the ovary, proteins bands are observed with molecular weight of 15.7 kDa, 20.66 kDa, 37.74 kDa, 51.73 kDa, 59.09 kDa, 80.45 kDa.

3. Prespawning phase (late April - early June). (Fig.03) In olfactory rosette, protein bands is observed with molecular weight of 32.24kDa, 53.61kDa, 59.53kDa, 75.82kDa. In forebrain, protein bands is observed with molecular weight of 10.11kDa, 31.45kDa, 37.21kDa, 43.11kDa, 51.01kDa, 127.73kDa. In pituitary, protein bands is observed with molecular weight of 37.21kDa, 42.97kDa, 48.57kDa, 73.95kDa, 89.98kDa, 120.76kDa. In ovary, protein bands is observed with molecular weight of 17.80 kDa, 22.46 kDa, 37.14 kDa, 43.35 kDa, 51.93 kDa, 61.81 kDa, 81.05 kDa, 121.67 kDa, 134.03 kDa

4. Spawning phase (June – August end). (Fig.04) Electrophoretic pattern of protein bands observed in the olfactory rosette, with molecular weight of 69.14 kDa, 84.04 kDa. In forebrain, pattern of protein bands observed with molecular weight of 14.96 kDa, 36.81 kDa, 57.31 kDa, 68.62 kDa, 79.14 kDa, 94.76 kDa, 126.03 kDa. In pituitary, pattern of protein bands observed with molecular weight of 65.02 kDa and 70.85 kDa. In the ovary, pattern of protein bands observed with molecular weight of 23.46 kDa, 29.39 kDa, 48.96 kDa, 55.20 kDa, 70.72 kDa, 99.13 kDa.

DISCUSSION

Many proteins of the odour detection/signal transduction cascade are either abundant or selectively expressed in the olfactory sensory area (Buck, and Axel, 1991; Shephard, 1994). Olfactory cilia contain 3-10 times more membrane associated proteins as compared to respiratory cilia. Cytoplasmic protein is expressed almost exclusively by mature olfactory neurons in all the vertebrate species (Margolis, 1991), in *L. rohita* (Bhute, 2004) and *O. striatus* (Khaparde, 2010).

When the protein content is estimated in the olfactory organ of *G. mullya*, it is highest during pre-spawning phase of reproduction. Olfactory epithelium is also intensely stained for proteins in this phase. Mixture of amino acids and hormonal metabolites are proved to be used by catfish and goldfish to mediate feeding and reproduction (Evans, 1998). The peptides and protein hormones are localized in the olfactory system of various teleosts, *Rhodiis armatus* (Baby *et al.*, 2000), *O. mossambicus* (Singru *et al.*, 2003), and *L. rohita* (Bhute, 2004). GnRH is a leading peptide which regulates various reproductive processes. This peptide as well as its receptor proteins are present in the olfactory system of various fishes, Sea bass (Gonzalez- Martinez *et al.*, 2000), and *O. striatus* (Khaparde, 2010).

In *G. mullya*, pre-spawning period ranges from late April to early June, when temperature is high. Rising temperature, aquatic vegetation and pheromones bring about surge in gonadotropin (GTH) in response to which the goldfish ovulates. First pheromone is released by the ovulatory female prior to spawning and functions primarily as a steroidal primer. The second pheromone is released by recently ovulated (Sexually active) females which stimulates the male sexual activity thus functioning as a releaser. Both cues are rather common hormonal metabolites which the males olfactory system has evolved to detect (Sorenson *et al.*, 1994 and Kobayashi *et al.*, 2002).

Total protein content in the olfactory organ of *G. mullya* comparatively decrease during the spawning phase than in the pre-spawning phase. Olfactory epithelium is also lightly stained for proteins in this phase. Sorenson *et al.*, (1994) postulated the poor correlation between the pattern of steroid hormone release by gold fish and olfactory sensitivity suggesting that these cues evolved as a result of chemical spraying rather than specialization. Studies on olfactory system of common carp and other salmonid species (Hara, 1994), also suggest that the olfactory system of these species is capable of discriminating multiple classes of amino acids.

Shimizu (1993), identified an olfactory system-specific protein designated as the olfactory marker protein as a band on the SDS gel electrophoresis of only olfactory system. Olfactory system-specific protein of 24 KDa (N24) was identified in Sockeye salmon. (*Oncorhynchus. nerka*). In Salmonids, Thommesen (1983) found

responses to amino acids in the epithelium which are correlated with the presence of microvillous olfactory receptor cells. Speca *et al.*, (1999) postulated that microvillous receptor cells mediate amino acid signals in goldfish. Hamdani *et al.*, (2001) reported that in a carp, microvillous ORNs project to the posterolateral olfactory bulb, which is crucial for feeding related behaviours, thereby implicating microvillous ORNs in response to food odours.

Intensity of staining for proteins becomes less in *G. mullya* olfactory epithelium through spawning up to post spawning along with quantitative reduction in total protein content. These proteins are elevated in resting and preparatory phase. Staining intensity also becomes moderate in this phase. Electrophoretic separation of proteins in the olfactory organ during entire breeding cycle of *G. mullya* was taken up to note the variations and similarity of proteins in relation to breeding habits.

In olfactory epithelium of *G. mullya*, an array of proteins with varying molecular weights appear in the different phases of reproduction. A distinct feature noted in this study is the highest number of protein bands in the range varying from 32.24 KDa to 75.82 KDa are observed. Four (04) bands are observed in pre spawning phase of reproduction and bands are intensely stained with Coomassie blue. Two (02) protein bands in the range varying from 69.14 kDa to 84.04 kDa are lightly stained in the spawning phase.

Reproductive cycle is influenced not only by environmental factors but regulated by a proper balance and interplay between the hormones of the hypothalamus, anterior pituitary and gonads which is classically referred to as the hypothalamo-hypophyseal- gonadal axis (Bhardwaj *et al.*, 2012). To have insight along this axis, proteins are histochemically located in the fore brain and pituitary during the entire ovarian cycle. Attempt is made to establish the correlation of protein content depending upon the seasonal variation in *G. mullya* along this axis, because it is well known that both the energetic and nutritional requirements of maturing fish increase during the gametogenesis. All these changes involve an increased energy demand which has been demonstrated in several fish species (Montechia *et al.*, 1990). Olfactory receptor neurons specialize both in the nature and number of receptor proteins which are expressed in individual cell. Though olfactory receptor cells are sensitive in the entire olfactory epithelium, it is MOT which carries pheromonal information to the ventral telencephalic and pre-optic areas in the fish *L. rohita* (Bhute, 2004).

Studies on Masu Salmon revealed that sGnRH level in pre-optic area (POA) and the pituitary increase alongside gonadal maturation (Amano *et al.*, 1992) which provide interactions along this axis. sGnRH neurons in the ventral telencephalon (POA) and hypothalamus are essential for gonad maturation in goldfish (Amano *et al.*, 1995) and sbGnRH is also involved in the gonadal maturation in barfin flounder via synthesis of steroid hormones (Amano *et al.*, 2004a, 2008).

Recently, direct connections between telecephalon, hypothalamic region and the pituitary were demonstrated in the electric fish *Apteronotus leptorhynchus* and in the goldfish (Anglade *et al.*, 1993). These data support the hypothesis that sGnRH neurons

in the pre-optic area and ventral telencephalon innervate the pituitary and regulate GTH secretion.

In the hypothalamus of fore brain, NPO and NLT are located at the base of pituitary and are said to be involved in the regulation of GTH secretion for gonadal recrudescence in *C. batrachus* (Khan *et al.*, 1999; Sarkar and Subhedar., 2001). In the fore brain of *G. mullya*, both NPO and NLT neurons are intensely stained for protein during pre-spawning phase. In the fore brain, quantitative variations match with the histochemical staining where highest protein contents are observed in pre spawning phase. Intensity of staining for proteins becomes moderate in the spawning phase in along with reduction of total protein content. These proteins are elevated in the preparatory phase. Staining intensity becomes light to moderate in this phase.

A correlation between cytological activity in the NLT and/or the NPO and reproductive activity is noted for a number of teleosts (Peter, 1970). NLT is speculated to be a source of GnRH and its destruction alters the GTH secretion leading to the gonadal effects.

Among physiological factors, gonadal steroids are one of the probable, candidates for regulation of GnRH neuronal system in teleosts. There are several reports indicating that sex steroids affects the GnRH system in brain, especially articles on positive feedback in female fish, Sockeye salmon (Okuzawa, 2002) are common. The surge of proteins in hypothalamus during pre-spawning period can be correlated to such positive feedback from sex steroids synthesized by ovary in *G. mullya*.

Negative feedback effects of sex steroids on GnRH system are reported in African Cichlids (Francies *et al.*, 1993). It is likely that status of fish, such as its gonadal maturity determines the direction (Negative or Positive) of feed back on sex steroids. Similar situation can be speculated *G. mullya*.

In the fore brain, maximum protein content is in the pre spawning phase where 1st peak is obtained. An array of proteins with varying molecular weight appear in the different phases in *G. mullya*. A distinct feature is noted in this study, large number of protein bands (07) in the range varying from 10.11 kDa to 127.73 kDa in the fore brain are observed and bands are intensely stained. This may be due to release of GnRH during this phase from brain. In the spawning phase, six (06) number of protein bands in the range varying from 14.96 kDa to 126.03 kDa and bands are moderately stained. Gonadotropin hormones GTH-I and GTH-II from the pituitary which secreted under the command of GnRH secretion from the hypothalamus (Kah, 2009; Zohar *et al.*, 2010). In *G. mullya*, cells in the PPD region of pituitary are intensely stained for proteins and highest protein content is noted in the pre-spawning phase while in spawning gonadotropin secreting cells are moderately stained for proteins. Protein content also decreases. During spawning period, intensity of staining is reduced and there is a drop of protein content in pituitary. Reduction of protein in spawning might be due to the action of dopamine (DA), another neuropeptide, which inhibits the GnRH induced GTH-II response via D2 receptors on gonadotrophs in a various fishes including cyprinids, salmonids, catfish, eel, tilapia. In some of the species, DA also reduces basal GTH-II secretion directly at pituitary cell level. At this time, there is significant rise in gonadal proteins in *G. mullya*. It may either be due to increase in synthetic activity of proteins from pituitary which might have been

diverted to gonad in response to spawning activity. In *G. mullya*, protein content slowly increases in post spawning. It is probably due to active feeding resumed by teleost in the post spawning phase. Cells are moderately stained and a second surge is noted in resting phase which can be due to non utilization of proteins by target organs during this phase.

The proximal pars distalis (PPD) where GTH cells are located, receive innervations from neurosecretory fibers in number of fish species, goldfish (Anglade *et al.*, 1993) and *L. rohita* (Bhute, 2004). Innervation of pituitary by the fibers from the brain is seen *G. mullya*. Thus, involvement of GnRH in regulation of GTH secretion cannot be ruled out in this fish.

It is well known that neurohypophysial peptides may act as chemical messengers delivered to target cells as hormone, neurotransmitter or local paracrine factor (Hazon and Baltment, 1998).

Existence of separate hormones with distinct gonadotropic activities in Chum salmon pituitary is established. In *G. mullya*, highest protein content in pituitary is noted in the pre spawning phase. In this phase, six (06) bands are noted of which 37.21 kDa and 42.97 kDa bands are intensely stained. These may be involved in the release of GTH-I and GTH-II from pituitary which are involved in maturation of ovary and ovulation. In the spawning phase, two (02) bands are noted 65.02 kDa and 70.85 kDa, of these, 65.02 kDa band is lightly stained.

Biochemical studies on the fish tissue are of considerable importance as they help in evaluating the nutritive value as well as physiological need of the fish at different periods of life. According to various studies (Satou *et al.*, 1999; and Kalinina *et al.*, 2005), protein content of the ovary is a crucial factor for the development of oocytes.

Quantitative biochemical protein variation in gonad is reported by various workers in different fishes. In *G. mullya*, ovarian protein varies according to the annual cycle. It increases from resting phase onwards and is highest in the spawning phase where as decline in post-spawning phase. Similar results also are reported in the ovaries of *G. mullya* (Khan and Mehrotra, 1991), *H. fossilis* (Hunge and Baile, 2003) and *O. striatus* (Khaparde, 2010).

Proteins are separated electrophoretically in all the ovarian phases except post-spawning phase. Initially lower molecular weight of proteins is apparent in the range of 9.44 kDa, 17.34 kDa and 36.63 kDa in the resting phase. 9.44 kDa protein band is prominent and lower in resting phase. During early ovarian development of rainbow trout, follicles measuring 0.8 mm and below are reported to contain whole series of yolk proteins of undermined origin. In preparatory phase, number (06) of protein bands increases in the range of 15.7 kDa, 20.66 kDa, 37.74 kDa, 51.73, 59.09 kDa and 80.45 kDa. 37.14 kDa and 51.73 kDa protein bands are more prominent.

In the pre-spawning phase, there is further increase in the protein bands (09) 51.93 kDa and 81.05 kDa are near about apparent. This can be due to the vitellogenic yolk material in the egg which has lipoprotein composition and is being synthesized in the pre-spawning phase. Ovary is full of matured eggs in the spawning phase, when even (99.13 kDa) molecular weight band.

CONCLUSION

The whole hypothalamo-hypophysial-gonadal axis contributes towards the gonadal growth which is evident when proteins are estimated biochemically. Total protein content increases during pre-spawning phase, in olfactory rosette, forebrain and

pituitary gland but it is highest in the ovary during spawning phase. Total protein content decreases in olfactory rosette and pituitary gland in the spawning. Proteins content in the forebrain is low compared to olfactory rosette and pituitary gland in all the phases. Quantification of proteins in the forebrain match with these findings. It is inferred that, the surge of proteins in forebrain during pre-spawning period could be the result of positive feedback from steroids synthesized by the ovary in *G. mullya*. Less of protein content in forebrain during spawning may be due to ovarian steroids secretion. In the pituitary gland, the protein content increases in the preparatory phase that may be due to the involvement of GTH-I in early gonadal development and also due to stimulatory role of GTH-II in ovulation. In electrophoretic separation of proteins, in forebrain, it is observed that initially higher molecular weight proteins prevailed ranging from 8.93 kDa to 147.65 kDa in preparatory phase, 10.11 kDa to 127.73 kDa in prespawning phase and 14.96 kDa to 126.03 kDa in spawning phase. While in both prespawning and spawning phases, 37.21 kDa to 68.62 kDa are prominent. These may be related to GnRH content in these phases. In the pituitary 48.57 kDa is a prominent band of protein in pre-spawning and spawning phase which may be functioning in the maturation of ovary. In the immature ovary, low molecular weight proteins are prevalent. In fact almost all the proteins are present in all the phases; but as vitellogenesis proceeds, higher molecular weight proteins replace the lower ones. 51.01 kDa protein appeared in prespawning and continued upto spawning but it is weakly stained here. This protein may be involved in the final oocyte maturation process.

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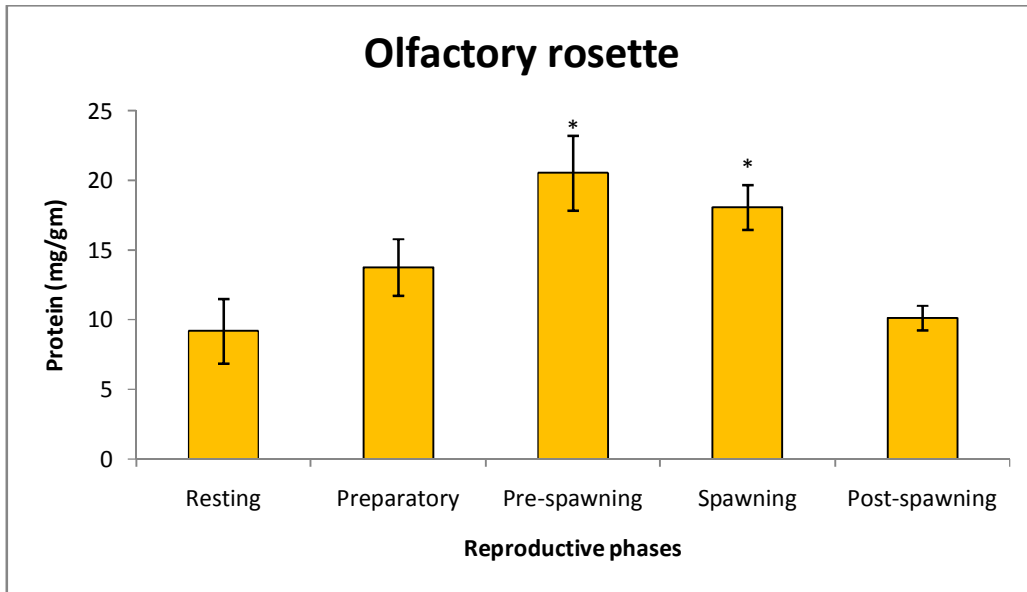
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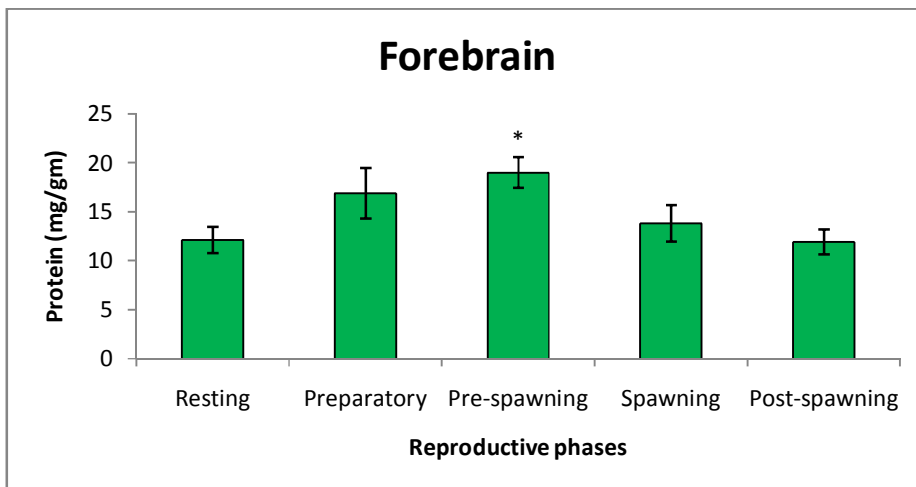
Table 01: Protein content during reproductive phases of female *G. mullia*. n= 6 (NS P≥0.05, * P=0.01 to 0.05, ** P=0.001 to 0.01, ***

p<0.0001)

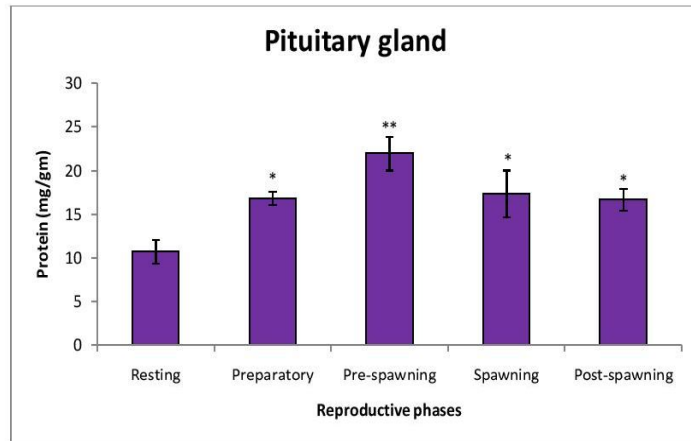
	Resting	Preparatory	Pre-spawning	Spawning	Post-spawning
Olfactory rosette	9.19±2.33	13.77±2.03 ^{NS}	20.54±2.68*	18.08±1.60*	10.13±0.89 ^{NS}
Forebrain	12.13±1.35	16.91±2.60 ^{NS}	19.01±1.57*	13.85±1.85 ^{NS}	11.94±1.26 ^{NS}
Pituitary gland	10.72±1.35	16.84±0.76*	21.95±1.92**	17.69±2.67*	16.67±1.26*
Ovary	19.44±2.66	23.78±1.86 ^{NS}	25.08±1.87 ^{NS}	30.56±1.18*	20.07±2.23 ^{NS}



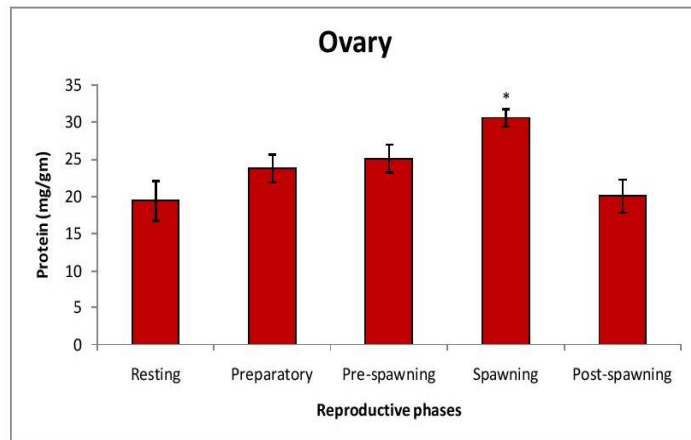
Graph 01: Variations in protein content of olfactory organ during reproductive phases of *G. mullya*. (NS $P \geq 0.05$, * $P = 0.01$ to 0.05 , ** $P = 0.001$ to 0.01 , *** $p < 0.0001$)



Graph 02: Variations in protein content of forebrain during reproductive phases of *G. mullya*. (NS $P \geq 0.05$, * $P = 0.01$ to 0.05 , ** $P = 0.001$ to 0.01 , *** $p < 0.0001$)



Graph 03: Variations in protein content of pituitary gland during reproductive phases of *G. mulya*. (NS $P \geq 0.05$, * $P = 0.01$ to 0.05 , ** $P = 0.001$ to 0.01 , *** $p < 0.0001$)



Graph 04: Variations in protein content of ovary during reproductive phases in *G. mulya*. (NS $P \geq 0.05$, * $P = 0.01$ to 0.05 , ** $P = 0.001$ to 0.01 , *** $p < 0.0001$)

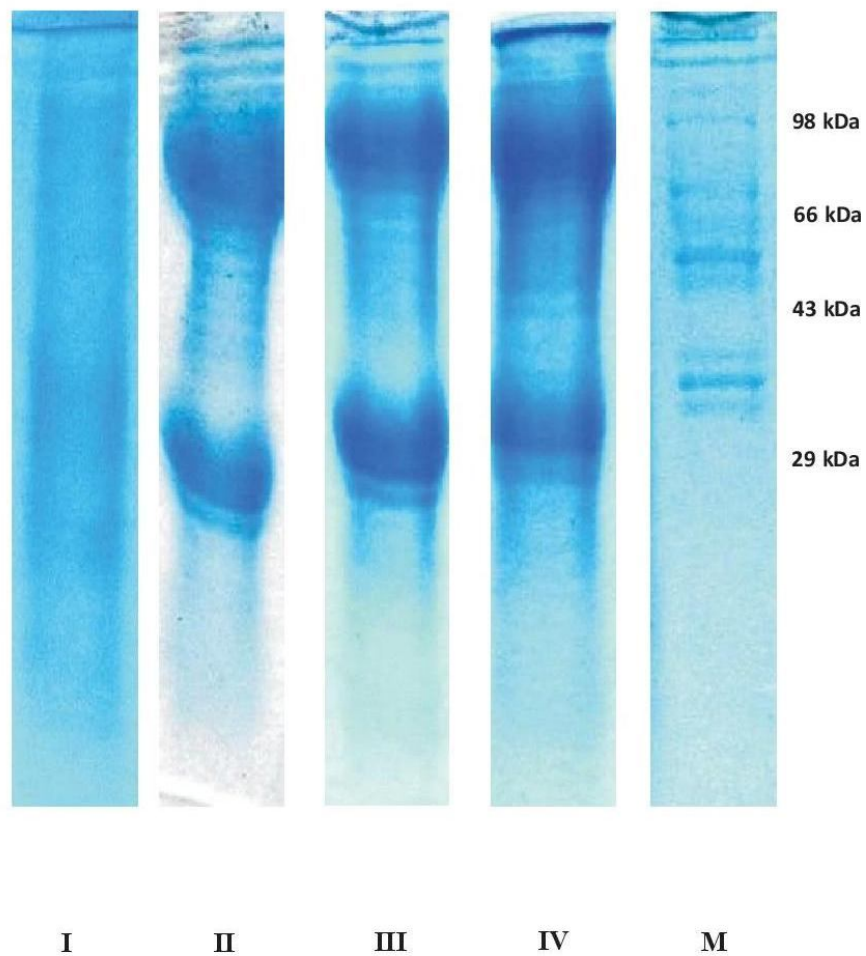


Fig. 147 A: SDA-PAGE of extract of ovary in the annual reproductive cycle of *Garramullya*.

Abbreviations: I- Resting phase, II- Preparatory phase, III- Pre-spawning phase, IV- Spawning phase, M-Standard Marker

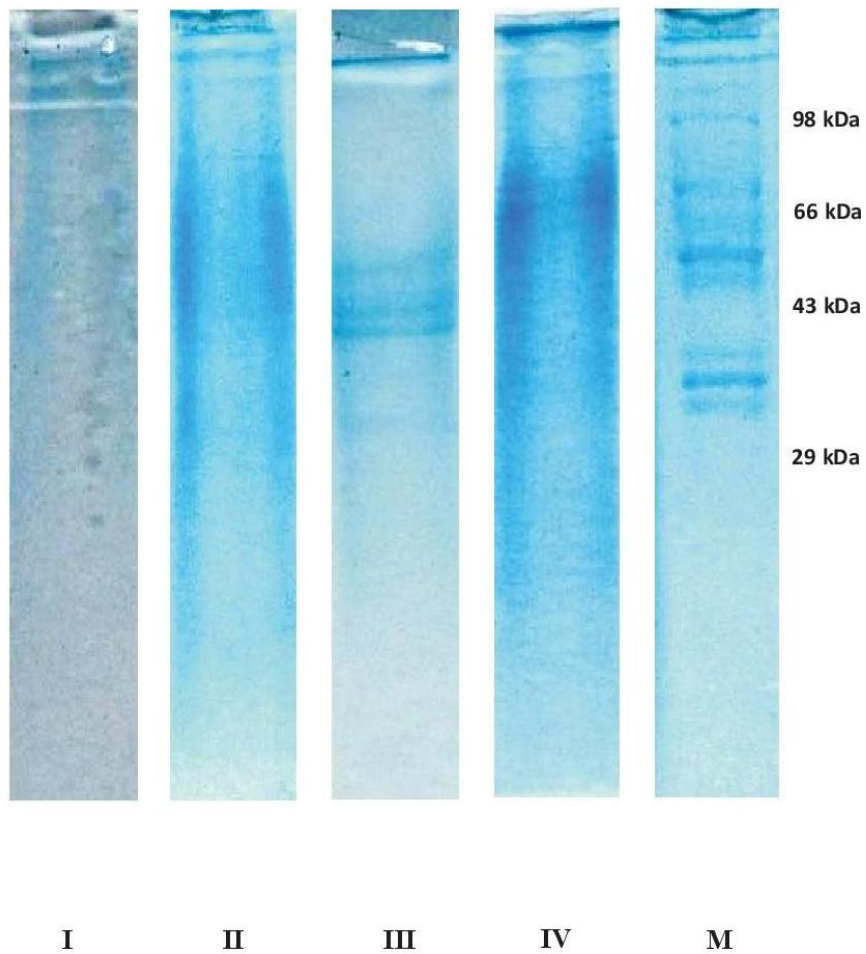


Fig. 147 B: SDA-PAGE of extract of olfactory organ in the annual reproductive cycle of *Garra mullya*.

Abbreviations: I- Resting phase, II- Preparatory phase, III- Pre-spawning phase, IV- Spawning phase, M-Standard Marker

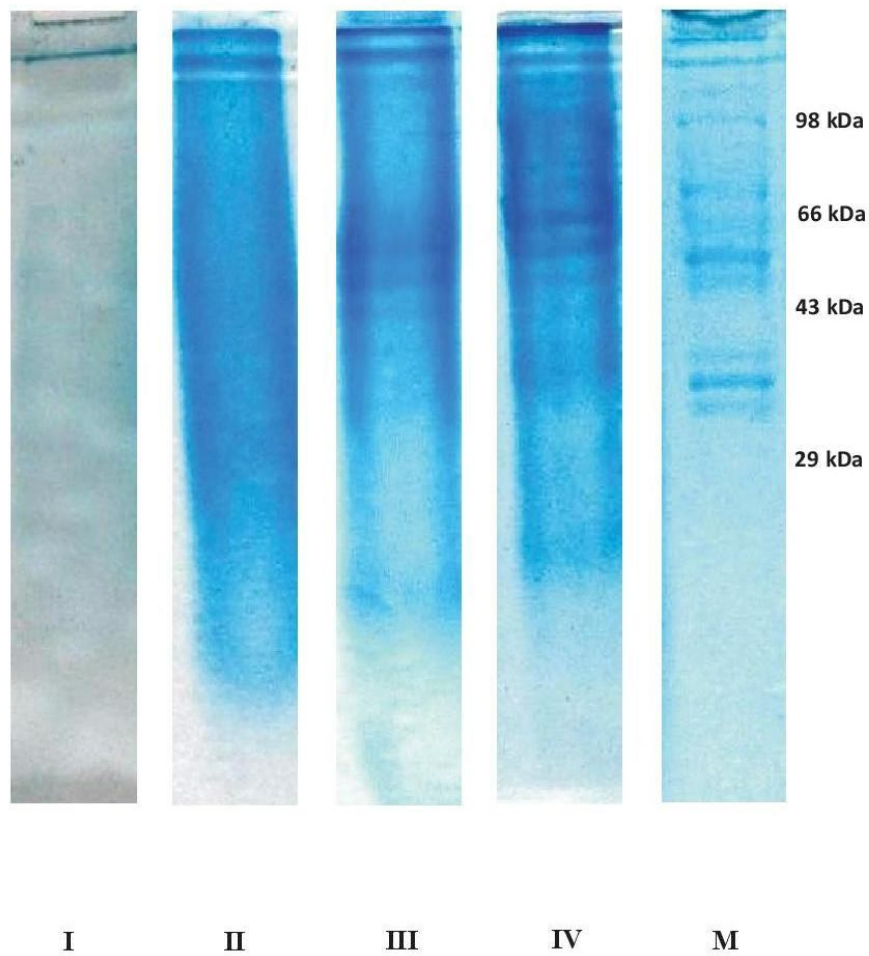


Fig. 147 C: SDA-PAGE of extract of forebrain in the annual reproductive cycle of *Garramullya*.

Abbreviations: I- Resting phase, II- Preparatory phase, III- Pre-spawning phase, IV- Spawning phase, M-Standard Marker

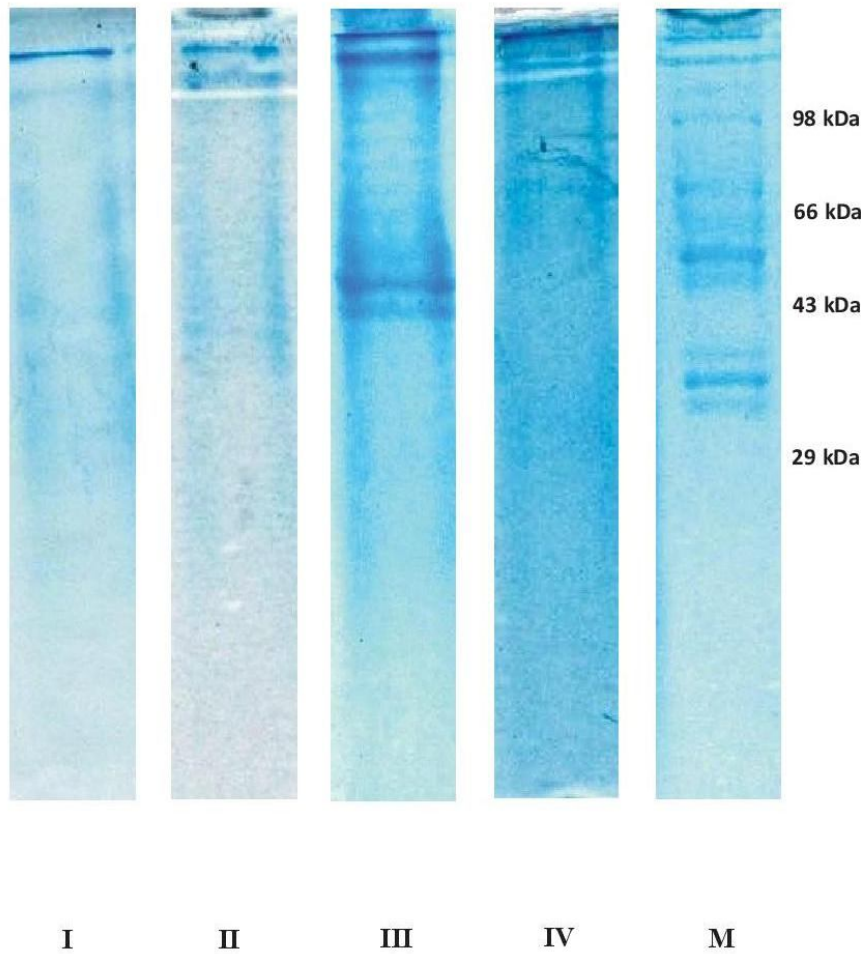


Fig. 147 D: SDA-PAGE of extract of pituitary gland in the annual reproductive cycle of *Garra mullya*.

Abbreviations: I- Resting phase, II- Preparatory phase, III- Pre-spawning phase, IV- Spawning phase, M-Standard Marker

Taxonomic Update and Habitat Status to *Byttneria herbacea* from Peninsular India

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Abstract *Byttneria herbacea* is a threatened and endemic species to Indian Peninsular region. It was earlier placed in *Sterculiaceae* and then a separate family *Byttneriaceae*. As per APG classification, it is now treated in family *Malvaceae*. Endemic taxa are usually more vulnerable to anthropogenic threats, natural and climate changes, and therefore hold a higher extinction risk. Taxonomic study on endemic taxa improves a basic understanding for correct identification and description. Habitat and distribution study are essential to get specific information and interpretation on current status and population dynamics of the taxon including niche requirements. It mainly contributes to several branches of applied biology. Frequent botanical exploration work was undertaken to collect the *Byttneria herbacea* in the forests of Peninsular India and it was identified with help of various Floras. The present study provides the information to *Byttneria herbacea*, which includes a detailed morphological description with data on its relevant taxonomic notes, illustration, current distribution patterns with distribution map, habitats, ecological note, population size, conservation status and threats to the selected species. The present study is the first-ever attempt at studying the taxonomic and habitat distribution aspects of *Byttneria herbacea* in the Indian Peninsular region. This study helps for long-term conservation and management plan of *Byttneria herbacea* for foresters and researchers.

Keywords *Byttneria herbacea*, Peninsular India, Habitat, Geographical Distribution, Taxonomy

1. Introduction

Byttneria Loefling, named after David Sigismund A.

Byttner (1724-1768), a physician and botanist at the University of Gottingen, Germany [1]. *Byttneria* Roxb. was first placed in *Sterculiaceae*, then a separate family *Byttneriaceae*. As per Angiosperm Phylogeny Group-APG-IV [2] classification *Byttneria* is now included in the family *Malvaceae* of Malvales clade. The Malvales clade also includes *Malvaceae*, *Tiliaceae*, *Bombacaceae*, *Bixaceae*, *Cistaceae*, *Cochlospermaceae*, *Diegodendraceae*, *Dipterocarpaceae*, *Mutingiaceae*, *Neuradaceae*, *Sarcoalaenaceae* and *Thymelaeaceae* [2-4]. Finding of Judd and Manchester [5], Alverson, *et al.*, [6] and Bayer, *et al.*, [4] has led to the proposal to combine *Sterculiaceae*, *Bombacaceae*, *Malvaceae* and *Tiliaceae* into a broadly defined *Malvaceae* family. Contribution from molecular data, new morpho-anatomical data and progress in methodological approaches has recently led to a new broader concept of this order namely “expanded malvales”. Recent taxonomic treatments group taxa formerly included in “core malvales” in a broader concept of malvales. Additionally, the intra-familial taxonomy has been profoundly modified and in its present circumscription, *Malvaceae* comprises subfamilies e.g., *Grewioideae*, *Byttnerioideae*, *Tiliodeae*, *Bombacoideae*, *Malvoideae*, *Helicteroideae* in 2 main lineages [7].

Hooker [8] initiated taxonomic study of *Byttneria* genus at the Indian subcontinent level and documented nine species of *Byttneria* genus. *Byttneria andamanensis* from Andaman Islands, *B. aspera* and *B. crenulata* reported in Nepal, *B. jackiana* from Penang while *B. elliptica*, *B. uncinata*, and *B. maingayi* from Malaka, *B. pilosa* from eastern Bengal including Burma and Chittagong of Bangladesh [8]. In independent Republic India, the genus *Byttneria* is composed of four species represented by *B. andamanensis*, *B. aspera* (Syn. *grandifolia*), *B. herbacea* and *B. pilosa*. *Byttneria herbacea* occurs in Western Peninsula, Karnataka, Orissa and Konkan [8-9].

2. Materials and Methods

Frequent botanical explorations were carried out to document and collect the *Byttneria herbacea*, grown in deciduous forests to moistsemi-evergreen forests of Peninsular India. To know the correct identity of the collected specimens, the Flora of British India by Hooker [8], Flora of India (*Sterculiaceae*) by Malick [9], An Excursion Flora of Central Tamilnadu by Matthew [10], Flora of Maharashtra by Almeida [11], Envis Bulletin, Special habitats and threatened plants of India by Botanical Survey of India (BSI) Government of India, Ministry of Environment, Forest and Climate Change [12] and eFlora of India [13] were referred. *Byttneria herbacea* plant species identified after keen morphological and floral observations and perusal of literature. All relevant data were recorded in a field book along with photographs and herbariums.

3. Results

3.1. Taxonomic Treatment

Byttneria herbacea Roxb., Pl. Coromandel 1:28.1795 and Fl. Brit. India 1:376

Published in: Plants of the Coast of Coromandel 1(1-2): 28, t. 29. 1795 [14]. Mast. In Hook.f. Fl. British India 1:376. 1874 [8]; Malick in Sharma *et al.*, Fl. India 3:412, f. 115. 1993 [9].

Synonyms: *Commersonia herbacea* (Roxb.) G. Don

Basionym: *Commersonia herbacea* (Roxb.) G. Don

Family: *Malvaceae* Jussieu

Subfamily: *Byttnerioideae* Burnett

Taxonomic note: *Byttneria herbacea* Roxb. was earlier placed in *Sterculiaceae* R. Salisbury, and then a separate family *Byttneriaceae* R. Brown. As per Angiosperm Phylogeny Group classification [2] the genus *Byttneria* is now treated in family *Malvaceae* Jussieu.

Taxonomic description: A branched (rarely unbranched), sub-fruticose, procumbent spreading (up to 30 cm) unarmed herb with a perennial 4 -10 cm long woody root-stock. Leaves simple, alternate distichous, ovate-oblong to ovate-lanceolate, 1.5-6 × 1-3 cm, apex acute to acuminate, base obtuse, rounded or sub-cordate, margin irregularly dentate, sparsely hairy, glabrous beneath; bracts 1-3, subulate, 3-5 veined at base, venation actinodromous, herbaceous, sparsely hairy on both the

surface, with a linear gland at base on lower side of midrib. Petiole 2.5 to 3.2 cm long, slender, sparsely hairy. Stipules 2.2 to 3 cm long, linear to subulate. Flowers bisexual, small, purple in axillary or terminal umbellate cymes. Calyx lobes basally fused, 4 mm, oblong, linear-lanceolate, acuminate, reflexed. Petals 4 mm, red, with long, slender tips and 2 fid appendages. Staminal tube with 5 stamens all with 5 staminoides, fertile anthers with very short filaments, staminodes ovate. Carpel stylocarpellous, stigma and style terete, Ovary pubescent, pentalocular. Capsules 0.8cm across, globose, shortly spiny, septicidally 5-valved. Axile placentation. Seeds 5, one in each locule, 0.5cm long, ovoid, angular, muricate.

Flowering and Fruiting: July - January

Peak Flowering and Fruiting: October - November

Life Cycle: June - January

Vernacular Names: Marathi: Madnyakalmeshwar, Pilyamul.

Oriya: Samarkhoi, Samarkhai

Bengali: Kamraj

Irula: Vipuri chedi

Telugu: Rudraksha, Yerra katla, Erra teega.

Tribal: Dikku sindur, Kamraj rahet.

Propagation: It is conventionally propagated through both seed and perennial root stock (genet).

3.2. Status

Byttneria herbacea plant species is threatened and endemic to Peninsular India [12, 15].

3.3. Habitat

Byttneria herbacea is undergrowth herbaceous and rare species found mostly in scrubby deciduous forests to moist semi-evergreen bush land, often on gallery and woodland forest, stream banks or on termite hills. It is found growing most preferably at rocky terrain on red gravelly soils along the foot hills/slopes or forest edges, under thickets forest from 800-1100 Mt. above sea level. It is fast growing species which takes 1.5 - 2.5 month/s to reach its reproductive stage. It shows narrow and restricted habitat range and localized by forming small cluster of its individuals. In population dynamics study of selected species in Maharashtra state, only 13 pockets of *B. herbacea* with small sub-population and less area of occupancy in its natural habitat have been observed.

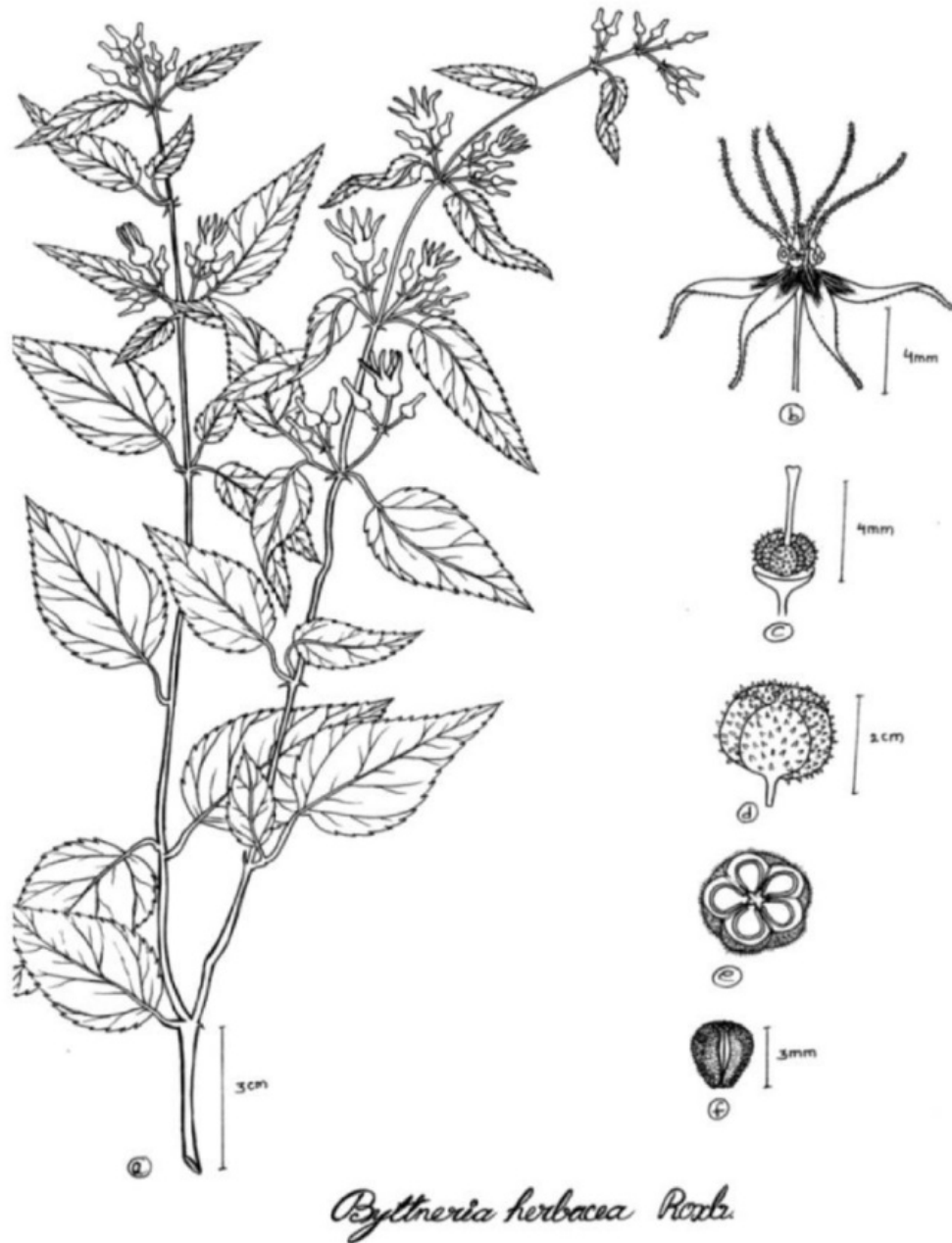


Figure 1. An Illustration of *Byttneria herbacea* Roxb. a: Habit, b: Flower, c: Carpel, d: Mature fruit, e: T.S of Fruit, f: seed.

3.4. Distribution Pattern of *Byttneria herbacea*

Global distribution: Envis Bulletin [12] of Wildlife Institute of India, Dehradun, India and Singh *et al.* [15] Botanical Survey of India has recognized *Byttneria herbacea* is an endemic to the Indian Peninsular region.

Indian distribution: *Byttneria herbacea* is distributed in Andhra Pradesh, Assam, Karnataka, Kerala,

Maharashtra, Madhya Pradesh, Nagaland, Orissa, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal states of India. The selected species potentially occur in 12 states of India, but in reality, it has become threatened and restricted in very few forest pockets of Peninsular India with less number of occurrences and individuals in its sub-population.

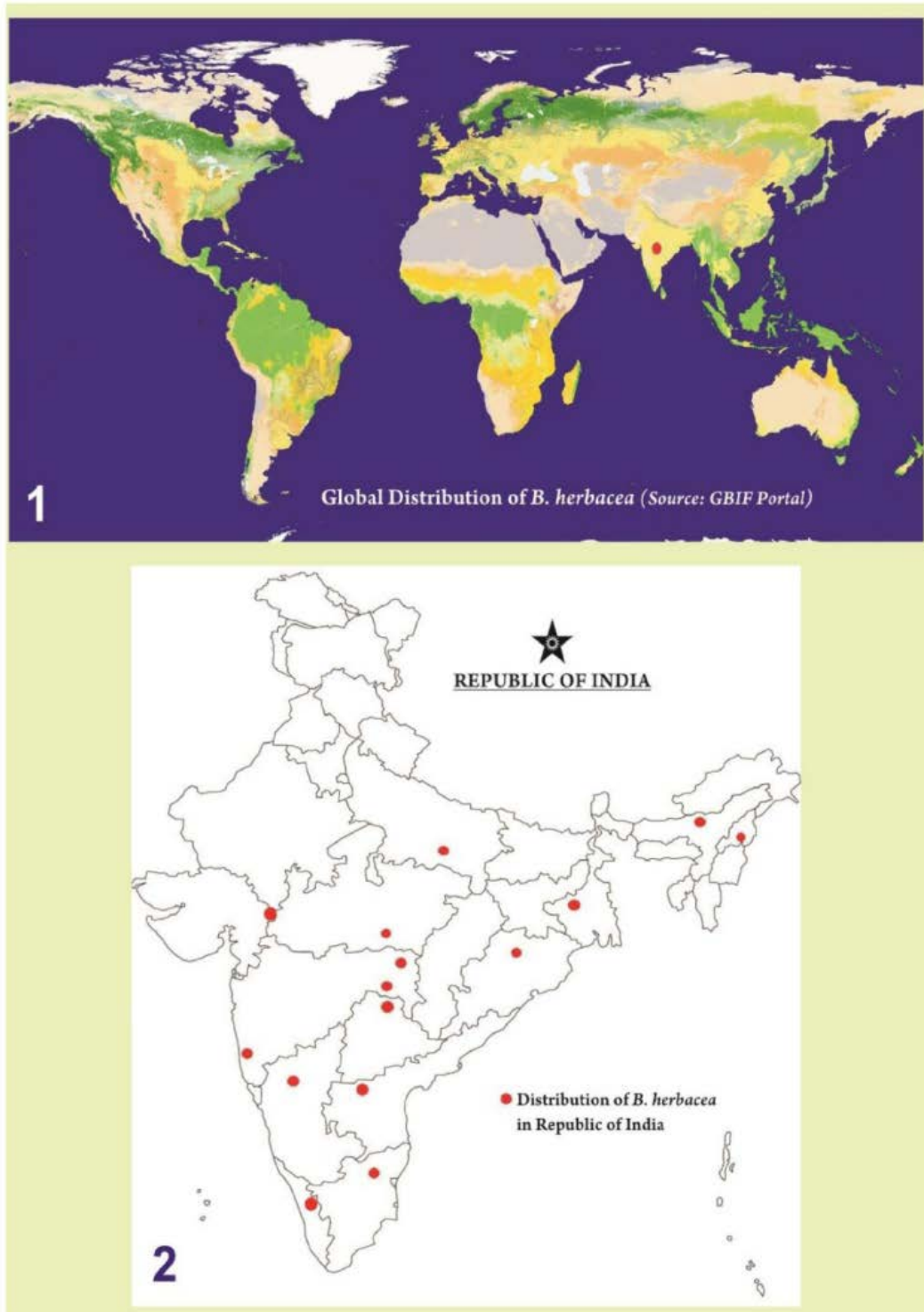


Figure 2. Distribution Pattern of *Bytneria herbacea*

4. Discussions

Endemic plants may actually be competitively inferior to other more widespread taxa [16]. The term endemic has a slightly different definition, depending on the author, e.g. according to Brown and Lomolino [17] when the term endemic is mentioned, it means that it simply does not

occurs anywhere else, while in the same year Peterson and Watson in 1998 [18] stated that we should use endemic only when referring to a taxon that is restricted to a stated geographical region (either in natural or political borders). Since narrowly endemic species are threatened frequently [19] and since areas rich in endemism are more likely to be considered as a rich species area [20]. Narrow endemic

species may harbour significantly lower genetic diversity at the population level than their widespread congeners [21-22]. Hence, endemic species may exhibit reproductive traits likely to reduce outcrossing rates, such as fewer and smaller flowers, less stigma-anther separation and lower pollen-ovule ratios [23-25]. The endemics constitute the foremost group of conservations.

A rare species is one that occurs in widely separated small sub-population so that inter-breeding between sub-populations is seriously reduced or restricted to a single population [26]. They are not at present endangered or vulnerable but face a high risk of being so and usually localized within restricted geographical areas or habitats or are thinly scattered over a more extensive range [27]. A hypothetical rare species is one with narrow habitat range, low climate tolerance; specialized adaptation requiring an outside agency for pollination, poor dispersal strategies, few seeds per fruit and poor viability of seeds [28]. Distribution study of threatened and endemic plant taxa provides insights for prioritizing such plant species conservation as well as processing the mechanisms of distribution patterns. Site containing national endemic and threatened species is more important for distribution study.

The outputs of floristic modelling and assessment can be used to improve understanding on conservation and protection of threatened plant species over the range in a suitable habitat [29] as well as identification of areas that represent biological species richness and endemic taxa [30]. Study on distribution and status of threatened and endemic species provides valuable data helps in conservation decisions for ecologists and conservationists. The ability to completely sample large areas in order to assess distribution is often difficult, hence smaller sampling areas to be used to make predictions about the distribution of a species over a larger area based on geographic and environmental predictor variables.

Byttneria herbacea Roxb. was earlier placed in *Sterculiaceae* and then a separate family *Byttneriaceae*. Edlin [31] divided the family *Sterculiaceae* into two tribes: *Sterculineae* containing only *Sterculia* and *Tarrietieae* which included *Tarnetia* and *Heritiera*. In *Buettneriaceae* Edlin [31] included other genera such as *Pentapetes*, *Melochia*, *Commersonia*, *Buettneria*, *Leptonychia*, *Abroma*, *Pterospermum*, *Helicteris* and *Kleinhouia*. In the broader APG [2] circumscription, *Malvaceae sensu lato* corresponds to the four traditional plant families *Malvaceae sensu stricto*, *Bombacaceae*, *Sterculiaceae* and *Tiliaceae*. Thus, the family *Malvaceae* has expanded to include 250 genera and has been divided into nine subfamilies, one of which is *Malvaceae sensu stricto* [4-5]. These families are closely related to *Malvaceae sensu stricto* but they are not monophyletic groups as shown by

numerous researchers on the Malvales [5, 32-34]. The broad circumscription of the family, as mentioned above, is defined as core Malvales in the Cronquist system. This classification has been adopted by [4, 32-34, 36-37]. Hinsley [38] has put several alternatives for a new classification of *Malvaceae* (core Malvales).

According to Cronquist [39] the order Malvales includes four polypetalous dicotyledonous families such as *Malvaceae sensu stricto*, *Bombacaceae*, *Sterculiaceae* and *Tiliaceae*. Bentham and Hooker [40] have placed *Malvaceae sensu lato*, *Sterculiaceae* and *Tiliaceae* families under the order Malvales. While Hutchinson [41-42] considered that the order Malvales should contain only *Malvaceae* as the order Malvales is more advanced than *Tiliales* and hence the families *Sterculiaceae*, *Tiliaceae* and *Bombacaceae* are treated under *Tiliales*. Bentham and Hooker [40] and Hutchinson [43] have placed the genus *Byttneria* (also spelled as *Buettneria*) under the tribe *Byttnerieae* in *Sterculiaceae* family but Takhtajan [44] has placed it under the tribe *Byttnerieae* of the subfamily *Byttnerioideae* of *Sterculiaceae* family.

Molecular phylogenetic studies (chloroplast *ndhF* gene-aligned length 2226 bp; *rbcL* sequence data) have shown that the traditional dicotyledonous families such as *Malvaceae sensu stricto*, *Sterculiaceae*, *Tiliaceae* and *Bombacaceae* are closely related and thus these families are merged into a more circumscribed family *Malvaceae sensu lato* under the core 'Malvales' (APG-III) [3]. Judd and Manchester [5] studies states that *Malvaceae sensu stricto* is monophyletic in origin while *Bombacaceae*, *Sterculiaceae* and *Tiliaceae* are not monophyletic which supports the view of Edlin [31]. As a result, those genera once placed under *Sterculiaceae* family are treated under subfamilies like *Byttnerioideae*. The members of *Byttnerioideae* clade show (i) a general reduction of stamen number compared to *Grewioideae* and other putative groups (ii) the fertile stamens are gathered into antipetalous fascicles and if staminodes present are antiseptalous and (iii) the petals are broad or concave at their base. Further, the *rbcL* sequence data suggests that the separation of *Byttnerieae* and *Theobromeae* tribes of subfamily *Byttnerioideae* from the rest of traditional *Sterculiaceae* family as predicted by Edlin [31] is accepted by Whitlock, *et al.*, [45], Alverson, *et al.*, [46] and Bayer, *et al.*, [36]. Based on stem structure, vegetative organs, flowers, schizocarpic fruit and spiny pollen grains character, Edlin [31] has created a new family *Buettneriaceae* by dividing the tribes traditionally placed in *Sterculiaceae* into two families: *Sterculiaceae sensu stricto* (*Sterculieae*) and *Byttneriaceae* (remaining tribes). Cronquist [39] however, stated that the *Byttneriaceae* is still quite heterogeneous (in morphology, anatomy, and pollen features) and is paraphyletic or polyphyletic.

Table 1. Table showing classification of the Genus *Byttneria* by different authors

	Bentham & Hooker-1862-1883 [40]	Masters-1874 [53] & Hutchinson-1967 [54]	Takhtajan-1997 [44]	Cronquist-1988 [50] & Mabberley-2008 [51]	APG-IV 2016 [2]
Family	<i>Sterculiaceae</i>	<i>Sterculiaceae</i>	<i>Sterculiaceae</i>	<i>Malvaceae</i>	<i>Malvaceae</i>
Subfamily	-	-	<i>Byttnerioideae</i>	<i>Byttnerioideae</i>	<i>Byttnerioideae</i>
Tribe	Buettnerieae	Buettnerieae	-	-	-

Thorne [47] has divided the family *Sterculiaceae* into two subfamilies namely *Sterculioideae* and *Dombeyoideae*. Thorne [47] system gives family status to *Byttnerioideae* and hence the subfamily *Byttnerioideae* is elevated to family level *Byttneriaceae*. Takhtajan [44] has also accepted this classification but he further subdivided these two subfamilies into a series of tribes. But the recent version of the Thorne system [48] takes an intermediate approach in combining *Bombacaceae* and *Sterculiaceae* under *Malvaceae sensu lato*, but retaining *Byttneriaceae* (containing traditional *Sterculiaceae* and *Tiliaceae*) and a considerably restricted *Tiliaceae* as separate families. Whitlock, *et al.*, [49] have considered *Dombeyoideae* as a distinct family *Byttneriaceae*. In fact, the family *Sterculiaceae* is very diverse and is characterized by a great diversity of morphological, anatomical and palynological features, particularly between *Byttnerioideae* and *Sterculioideae*. Since the molecular phylogenetic studies (both *rbcL* sequence data and chloroplast *ndhF* gene analysis) have confirmed that the traditional family *Sterculiaceae* is one among the elaborated family *Malvaceae sensu lato* and the subfamily *Byttnerioideae* is a separate clade in *Malvaceae sensu lato* family where the genus *Byttneria* belongs to and not under *Sterculioideae* clade.

As per embryological observation carried out in the present study, *Byttneria herbacea* has circinotropous ovules. Circinotropous ovules are not observed earlier by any researchers in the of *Sterculiaceae* and *Malvaceae* family members. Therefore, *Byttneria* genus deserves critical analysis for proper taxonomic placement. As per Cronquist [50], Takhtajan [44], Mabberley [51] and Angiosperm Phylogenetic Group [2-3, 52] classification system the family status of *Byttneriaceae* merged under *Malvaceae*. I still support the view of Cronquist [50], Takhtajan [44], Mabberley [51] and APG [2-3,52] classification system.

5. Conclusions

Habitat loss and unchecked business of wild endemic medicinal plants is threatening the future of essential resources, as well as the beauty, diversity and natural heritage of our green planet earth. As natural habitats are destroyed or degraded, we lose many unique and precious endemic species of plants every year from the wild habitat. This loss of diversity may also take with it important

cures for diseases-both those face by us now and those that may emerge in the future. Conservation of existing wild habitat of endemic and threatened medicinal plant species are very essential to minimize or avoids the loss of these endemic plant resources. Sustainable use and ex-situ propagation and cultivation methods are already being suggested by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Biological Diversity, the National Center for the Preservation of Medicinal Herbs, International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP), the Medicinal Plant Working Group and other organizations. The present study is the first-ever attempt at studying the taxonomic aspects and habitat distribution study of *Byttneria herbacea* in the Indian Peninsular region. This study helps for long term conservation and management plan of *Byttneria herbacea* for foresters and researchers. Further studies in view of embryological context are likely to yield more comprehensive results to improve fundamental understanding systematics of *Malvaceae* family members.

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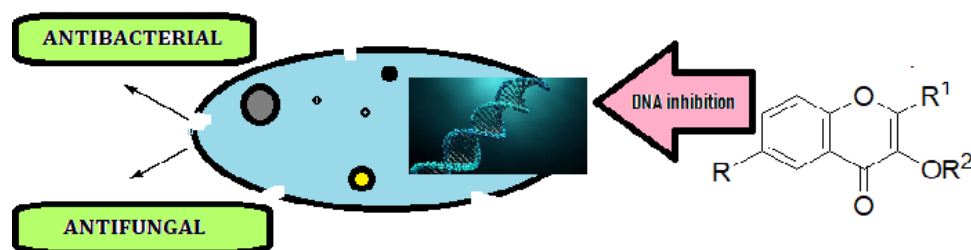
Design, synthesis and evaluation of 4*H*-Chromene-4-one analogues as potential Anti-bacterial and Anti-fungal agents

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ABSTRACT



A library of 28 newer 4*H*-chromen-4-one derivatives were designed, synthesized and screened for their antibacterial and antifungal efficacy against a panel of bacterial and fungal causative species. Fries and oxa-Michael protocols were employed to achieve the target compound. From the assayed, compounds **5c**, **5e**, **6a**, **7b**, **7d**, **9a** and **9b** demonstrated promising anti-bacterial profile whereas products **6a**, **7b**, **8b** and **9c** elicited excellent anti-fungal properties. Further, *in silico* molecular properties were predicted for these sketched analogues to assess their bio availability and drug likeness by using molinspiration software/toolkit. None of them violated Lipinski's rule of five, signifying them as better anti-bacterial and anti-fungal agents. Both *in-silico* and biological studies predict derivative **6a** and **7b** as best agent.

Keywords: 4*H*-chromen-4-one, Oxidative Michael addition, *in-silico* analysis, drug likeness score, antimicrobial activity.

INTRODUCTION

Chromone (4*H*-chromen-4-one) and its derivatives have been an integral part of innumerable natural products and are endowed with a broad spectrum of pharmacological and biological applications. They possess anticancerous,¹⁻⁷

neuroprotective,⁸⁻⁹ anti-HIV,¹⁰⁻¹² antibacterial,¹³⁻¹⁶ antifungal,¹⁷⁻²⁰ gastroprotective²¹⁻²² and antioxidant activities.²³⁻²⁶ Synthesis of chromone derivatives is challenging and enticing enough to explore these inventively from medicinal chemistry standpoint.²⁷

Motivated by the multitherapeutic potential of chromones, we ventured to design newer molecules based on the understanding of enhanced lipophilicity significance in the structures like ammosesinol, osthol and imperatorin (Figure 1) that are suggestive to possess anti-microbial activity²⁸⁻³² and by introducing structurally diversified substituents with chromone cores we aspire to enhance the pharmacological activities of the synthesized compounds by the virtue of their lipophilic attributes.

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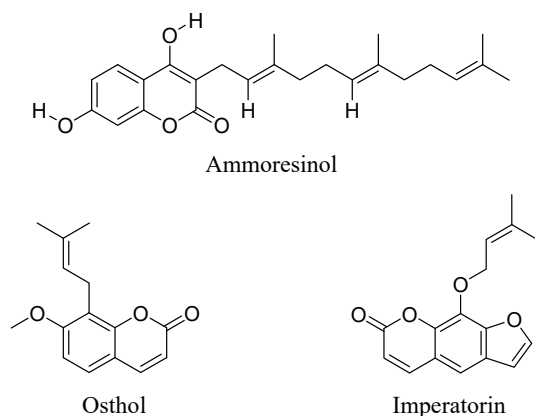


Figure 1. Important natural molecules with Chromone core.

Lipophilicity; in drug design and discovery plays a critical role as it is considered to be a key physicochemical characteristic that helps in determining ADMET (absorption, distribution, metabolism, excretion, and toxicity) properties and the overall performance of lead drug candidate.³³⁻³⁴ There is irrefutable evidence to suggest that control of physicochemical properties such as lipophilicity, within a defined optimal range, can improve pharmacological features of the molecules and the probability of their therapeutic success. Heretofore, Chiranjeevi Bingi et al. have synthesized a series of 3-hydroxy-6-(hydroxymethyl)-2-(2-phenyl-4H-chromen-4-yl)-4H-pyran-4-ones as potential antimicrobial agents against a panel of microbial strains.³⁵

We envisioned that it would be interesting to use –OH group of 3-hydroxychromone as an anchoring handle to explore further functionalization. Though the hydroxyl group was justifying lipophilicity of the molecule, but the drug likeness scores and results for it were quite poor. The SAR studies suggested that modification at hydroxyl center would increase the number of rotatable bonds for enhanced efficiency and would also increase the number of hydrogen bonds so as to compensate for the lipophilicity loss, thus providing a smooth pathway for bioavailability of the hydroxyalkylated drug analogues. We have been intrigued with the pharmacological elements of chromone derivatives and eventually embarked on the synthesis of hydroxyalkylated analogues in order to introduce balanced polar and nonpolar characteristics. Bioisoteres piperidine and pyrrolidine as the part of the molecules are often considered to be pharmacophores exhibiting various biological activities. Hence, we aimed at developing a single molecular framework encompassing both the moieties i.e. chromone and piperidine/pyrrolidine (Figure 2), anticipating that the fusion of these pharmacologically active moieties would certainly exhibit superior biological potency. Here in, we have reported synthesis and evaluation of a new class of molecule as potent anti-bacterial and anti-fungal agents.

The drug molecule was designed as a hybrid structure of chromone and alkylated chains of pyrrolidine and piperidine in order to explore the potent activities arising due to the

combination of two. While designing the molecule, factors like lipophilicity and polarity were kept under consideration.

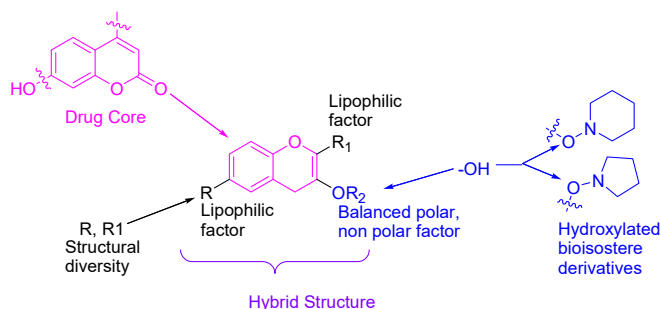


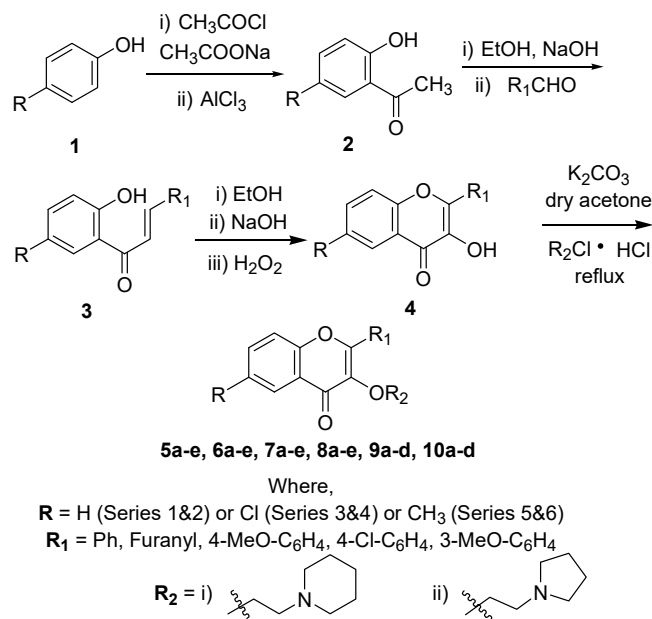
Figure 2. Design of target molecules

EXPERIMENTAL

CHEMISTRY

MATERIAL AND METHOD:

All the chemicals and solvents used were purchased from Merck, Himedia and Sigma Aldrich. ¹H NMR and ¹³C NMR of the synthesized compounds were recorded in CDCl₃ on Wormhole-Vnmrs 400 and Bruker advance II 400 FT NMR spectrometer with TMS as internal standard.



Scheme 1. Synthesis of chromone analogues

Chemical shifts (δ) were measured in ppm. Mass analysis was carried out using Waters Q-TOF Micro Mass spectrometer. IR spectrum were obtained from Perkin Elmer RX1 FT-IR spectrometer and pellets were made using KBr. Elemental analysis was done on Perkin Elmer 2400 elemental analyser. Purity of the compounds was checked on Merck TLC silica gel 60 F254 plates using TLC chamber and iodine vapours were employed as a visualizing agent. For the sake of simplicity, the designed analogues were divided into series 1 to series 6 as depicted in **Table 1** by varying R, R₁ and R₂.

Series 1: 5a-e, R=H					
Substituents	5a	5b	5c	5d	5e
R ₁	Ph	Furanyl	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄
R ₂					
Series 2: 6a-e, R=H					
Substituents	6a	6b	6c	6d	6e
R ₁	Ph	Furanyl	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄
R ₂					
Series 3: 7a-e, R=Cl					
Substituents	7a	7b	7c	7d	7e
R ₁	Ph	Furanyl	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄
R ₂					
Series 4: 8a-e, R=Cl					
Substituents	8a	8b	8c	8d	8e
R ₁	Ph	Furanyl	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄
R ₂					
Series 5: 9a-d, R=CH ₃					
Substituents	9a	9b	9c	9d	
R ₁	Ph	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄	
R ₂					
Series 6: 10a-d, 6, 7, R=CH ₃					
Substituents	10a	10b	10c	10d	
R ₁	Ph	4-MeO-C ₆ H ₄	4-Cl-C ₆ H ₄	3-MeO-C ₆ H ₄	
R ₂					

Table 1. Synthesized chromone analogues.

CHARACTERIZATION:

Compounds of these six series were prepared by conventional as well as under microwave irradiation. To optimize the reaction conditions in both methods, experiments were carried out by taking 3-hydroxy-2-substituted-4H-chroman-4-ones^{36, 37} which were reacted with 1-(2-chloroethyl)-piperidine/ pyrrolidine hydrochloride. In these experiments substrate to potassium carbonate ratio was varied i.e. 1:1, 1:1.5 and 1:2. We got best results in 1:1 ratio, hence we have selected substrate to K₂CO₃ ratio as 1:1. Following compounds (5a-e, 6a-e, 7a-e, 8a-e, 9a-d, 10a-d) were synthesized according to this method:

General procedure for the synthesis of compound under conventional heating:

5 mmol of 3-hydroxy-2-substituted-4H-chroman-4-one (4), 5 mmol of 1-(2-chloroethyl)-piperidine hydrochloride/ 5mmol of 1-(2-chloroethyl)-pyrrolidine hydrochloride, 5 mmol of anhydrous potassium carbonate (which was earlier dried in oven at 100°C for 3 hrs.) and 20 ml of dry acetone were taken in 50 ml round bottom flask containing a magnetic needle. The reaction mixture was refluxed with continuous stirring. The progress of the reaction was monitored by TLC. Reaction mixture was filtered and washed with 10 ml acetone. Filtrate was distilled and degassed on rotatory evaporator. The crude product was purified by column chromatography to get entitled compounds 5a-e, 6a-e, 7a-e, 8a-e, 9a-d, 10a-d.

General procedure for the synthesis of compounds under microwave irradiation:

In a 50 ml round bottom flask, mixture of 5 mmol 3-hydroxy-2-substituted-4H-chroman-4-one (4), 5 mmol 1-(2-chloroethyl)-piperidine hydrochloride/ 5mmol of 1-(2-chloroethyl)-pyrrolidine hydrochloride and 5 mmol anhydrous potassium carbonate (which was previously dried in oven at 100°C for 3 hrs.) and 10 ml dimethylformamide (DMF) was taken. This mixture was irradiated in microwave oven at 300 W for 3 mins. The completion of reaction was monitored by TLC. The reaction mixture was cooled and poured in cold water. The precipitate was filtered, washed thoroughly with water, dried and purified by column chromatography to get entitled compounds 5a-e, 6a-e, 7a-e, 8a-e, 9a-d, 10a-d. All the experimental reactions were carried out by taking substrate to potassium carbonate ratio 1:1.

The spectral data of all the synthesized compounds is as:

2-Phenyl-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one

(5a): White solid; Yield 71%; m.p.114-116°C. ¹H NMR (400 MHz, CDCl₃): δ 8.273-8.253 (d, 1H, J = 8 Hz, Ar-H), 8.147-8.128 (dd, J = 3.2 and 4.4 Hz, 1H, Ar-H), 7.709-7.668 (dd, 1H, Ar-H), 7.555-7.508 (m, 5H, Ar-H), 7.429-7.391 (d, 1H, J = 7.6 and 7.6 Hz, Ar-H), 4.241-4.212 (t, 2H, J = 6 and 5.6 Hz, -OCH₂-), 2.812 (t, 2H, -NCH₂), 2.556 (t, 4H, piperidinyl-H), 1.590 (m, 4H, piperidinyl-H), 1.436 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.09, 155.81, 155.23, 140.47, 133.45, 130.90, 130.69, 128.68, 128.57, 128.43, 125.74, 124.67, 124.10, 117.99, 69.07, 58.27, 54.34, 25.42, 23.89. IR (KBr, cm⁻¹): 3059, 2938, 2860, 1634, 1613, 1466, 1447, 1538, 1385, 1238, 1200, 1148, 759. MS (m/z): 350.1[M+1]. Elemental: Calculated for C₂₂H₂₃NO₃: C=75.62, H=6.63, N=4.01, O=13.74; Found for C₂₂H₂₃NO₃: C=75.67, H=6.60, N=3.95, O=13.92.

2-Furan-2-yl-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one

(5b): Yellowish solid; Yield 69%; m.p.108-110°C. ¹H NMR (400 MHz, CDCl₃): δ 8.249-8.226 (dd, 1H, Ar-H), 7.732-7.656 (m, 3H, Ar-H), 7.584-7.564 (d, J = 8 Hz, 1H, Furanyl-H), 7.419-7.380 (t, J = 8 and 7.6 Hz, 1H, Furanyl-H), 6.646-6.632 (dd, J = 3.2 and 2 Hz, 1H, Furanyl-H), 4.394-4.367(t, J = 5.6 and 5.2 Hz, 2H, -OCH₂-), 2.916 (dt, 2H, -N-CH₂), 2.642 (m, 4H, piperidinyl-H), 1.661-1.648 (m, 4H, piperidinyl-H), 1.487 (m, 2H, piperidinyl-H). ¹³C NMR (100MHz, CDCl₃): δ 174.05,

154.65, 148.06, 145.077, 144.15, 168.01, 133.34, 125.55, 124.69, 124.17, 117.95, 117.37, 112.71, 68.43, 58.47, 54.40, 25.44, 23.93. IR (KBr, cm^{-1}): 2929, 1634, 1613, 1571, 1480, 1467, 1384, 1256, 1202, 1174, 757. MS (m/z): 340.1[M+1]. Elemental: Calculated for $\text{C}_{20}\text{H}_{21}\text{NO}_4$: C=70.78, H=6.24, N=4.13, O=18.85; Found for $\text{C}_{20}\text{H}_{21}\text{NO}_4$: C=70.70, H=6.29, N=4.16, O=18.85.

2-(4-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (5c): Colourless solid; Yield 75%; m.p. 94-96°C. ^1H NMR (400 MHz, CDCl_3): δ 8.252-8.228 (d, 1H, Ar-H), 8.184-8.146 (dd, 1H, Ar-H), 7.671-7.628 (dd, 1H, Ar-H), 7.521-7.501 (d, J=8.0 Hz, 1H, Ar-H), 7.865-7.354 (d, 2H, Ar-H), 7.015-6.997 (d, 2H, Ar-H), 4.213-4.184 (t, J=5.6 Hz, 6.0 Hz, 2H, $-\text{OCH}_2-$), 3.888 (s, 3H, $-\text{OCH}_3$), 2.763-2.734 (t, J=6 and 5.6, 2H, $-\text{N}-\text{CH}_2-$), 2.480 (t, 4H, piperidinyl-H), 1.601-1.545 (m, 4H, piperidinyl-H), 1.448-1.406 (m, 2H, piperidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 174.95, 161.44, 155.70, 155.13, 139.91, 133.20, 130.48, 125.74, 124.51, 124.16, 123.38, 117.86, 113.85, 58.66, 55.40, 54.65(2C), 25.79, 24.18. IR (KBr, cm^{-1}): 3065, 3006, 2932, 1633, 1603, 1557, 1507, 1471, 1302, 1257, 1176, 1011, 758. MS (m/z): 380.1[M+1]. Elemental: Calculated for $\text{C}_{23}\text{H}_{25}\text{NO}_4$: C=72.80, H=6.64, N=3.69, O=16.87; Found for $\text{C}_{23}\text{H}_{25}\text{NO}_4$: C=72.82, H=6.62, N=3.69, O=16.87.

2-(4-Chloro-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (5d): Amorphous solid; Yield 71%; m.p. 92-94°C. ^1H NMR (400 MHz, CDCl_3): δ 8.201-8.195 (d, J=2.4 Hz, 1H, Ar-H), 8.151-8.139 (dd, 1H, Ar-H), 7.632-7.603 (dd, J=2.8 and 2.4 Hz, 1H, Ar-H), 7.521-7.502 (d, 1H, Ar-H), 7.487-7.459 (d, J=5.2 and 6.4 Hz, 2H, Ar-H), 7.278-7.252 (d, J=5.2 and 6.4 Hz, 2H, Ar-H), 4.239-4.210 (t, J=6 and 5.6 Hz, 2H, $-\text{OCH}_2-$), 2.661-2.632 (t, J=6.0-5.6 Hz, 2H, $-\text{N}-\text{CH}_2-$), 2.371 (t, 4H, piperidinyl-H), 1.539-1.478 (m, 4H, piperidinyl-H), 1.410-1.404 (m, 2H, piperidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 173.85, 154.41, 153.46, 140.71, 136.90, 133.73, 130.70, 130.15, 129.21, 128.75, 125.06, 125.01, 119.64, 69.57, 58.76, 54.77(2C), 25.89(2C), 24.22. IR (KBr, cm^{-1}): 3049, 2928, 1629, 1609, 1572, 1471, 1336, 1238, 1192, 1152, 756. MS (m/z): 384.1[M+1]. Elemental: Calculated for $\text{C}_{22}\text{H}_{22}\text{ClNO}_3$: C=68.83, H=5.78, Cl=9.24, N=3.65, O=12.50; Found for $\text{C}_{22}\text{H}_{22}\text{ClNO}_3$: C=68.81, H=5.80, Cl=9.21, N=3.68, O=12.50.

2-(3-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (5e): Amorphous solid; Yield 73%; m.p. 70-72°C. ^1H NMR (400 MHz, CDCl_3): δ 8.218-8.210 (d, J=3.2 Hz, 1H, Ar-H), 7.754-7.704 (dd, J=0.8 and 1.2 Hz, 1H, Ar-H), 7.660-7.650 (dd, J=2.0 and 2.0 Hz, 1H, Ar-H), 7.598-7.576 (d, J=2.2 and 2.8, 1H, Ar-H), 6.652 (d, 1H, Ar-H), 6.863 (d, 1H, Ar-H), 7.104 (dd, 1H, Ar-H), 6.879 (s, 1H, Ar-H), 4.198-4.169 (t, J=5.6 and 6.0 Hz, 2H, $-\text{OCH}_2-$), 3.885 (s, 3H, $-\text{OCH}_3$), 2.677-2.649 (t, J=5.4 and 5.8 Hz, 2H, $-\text{N}-\text{CH}_2-$), 2.365 (t, 4H, piperidinyl-H), 1.521-1.473 (m, 4H, piperidinyl-H), 1.406-1.377 (m, 2H, piperidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 173.89, 159.39, 155.64, 153.57, 140.91, 133.58, 131.91, 130.60, 129.51, 125.01, 124.87, 121.21, 119.67, 116.61, 114.14, 69.88, 58.71, 55.37, 54.35(2C), 25.74, 24.25. IR (KBr, cm^{-1}): 3055, 2998, 2935, 1640, 1602, 1560, 1463, 1312, 1277, 1197, 1130, 760. MS (m/z): 380.1[M+1]. Elemental: Calculated for $\text{C}_{23}\text{H}_{25}\text{NO}_4$:

C=72.80, H=6.64, N=3.69, O=16.87; Found for $\text{C}_{23}\text{H}_{25}\text{NO}_4$: C=72.82, H=6.62, N=3.69, O=16.87.

2-Phenyl-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (6a): Yellowish solid; Yield 75%; m.p. 88-90°C. ^1H NMR (400MHz, CDCl_3): δ 8.266-8.250 (d, 1H, J = 6.4 Hz, Ar-H), 8.134-8.110 (m, 1H, Ar-H), 7.706-7.671 (t, J = 6.8 and 7.2 Hz, 1H, Ar-H), 7.554-7.503 (m, 5H, Ar-H), 7.430-7.392 (t, J = 8 and 7.2 Hz, 1H, Ar-H), 4.237-4.209 (t, J = 5.6 and 5.6 Hz, 2H, $-\text{OCH}_2-$), 3.007 (dt, 2H, $-\text{N}-\text{CH}_2-$), 2.753 (m, 4H, pyrrolidinyl-H), 1.835 (m, 4H, pyrrolidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 175.03, 155.95, 155.23, 140.48, 133.48, 130.84, 128.64, 128.55, 128.43, 127.71, 125.71, 125.39, 124.70, 124.10, 118.00, 70.28, 55.30, 54.02, 23.42. IR (KBr, cm^{-1}): 3055, 2952, 1636, 1616, 1567, 1469, 1447, 1397, 1243, 1198, 1149, 765. MS (m/z): 336.1[M+1]. Elemental: Calculated for $\text{C}_{21}\text{H}_{21}\text{NO}_3$: C=75.20, H=6.31, N=4.18, O=14.31; Found for $\text{C}_{21}\text{H}_{21}\text{NO}_3$: C=75.12, H=6.35, N=4.18, O=14.33.

2-Furan-2-yl-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (6b): Yellowish solid; Yield 71%; m.p. 108-110°C. ^1H NMR (400MHz, CDCl_3): δ 8.251-8.227 (d, 1H, Ar-H), 7.707-7.648 (dd, 1H, Ar-H), 7.580-7.559 (dd, J = 8.4 Hz, 1H, Ar-H), 7.415-7.378 (d, J = 7.6 and 7.2, 1H, Ar-H), 7.543-7.526 (d, 1H, Furanyl-H), 7.092-7.013 (d, 1H, Furanyl-H), 6.617 (dd, 1H, Ar-H), 4.380-4.351 (t, J = 5.6 and 6 Hz, 2H, $-\text{OCH}_2-$), 3.045-3.020 (t, J = 4.8 and 5.2 Hz, 2H, $-\text{N}-\text{CH}_2-$), 2.724 (t, 4H, pyrrolidinyl-H), 1.846 (m, 4H, pyrrolidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 173.98, 154.63, 148.01, 145.03, 144.18, 138.11, 133.30, 125.53, 124.65, 124.19, 117.93, 117.03, 112.65, 70.04, 55.64, 54.08, 23.47. IR (KBr, cm^{-1}): 3057, 2979, 1638, 1613, 1572, 1466, 1385, 1257, 1202, 1169, 759. MS (m/z): 326.1[M+1]. Elemental: Calculated for $\text{C}_{19}\text{H}_{19}\text{NO}_4$: C=70.14, H=5.89, N=4.31, O=19.67; Found for $\text{C}_{19}\text{H}_{19}\text{NO}_4$: C=70.16, H=5.87, N=4.29, O=19.69.

2-(4-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (6c): Cream solid; Yield 73%; m.p. 110-112°C. ^1H NMR (400 MHz, CDCl_3): δ 8.252-8.228 (d, 1H, Ar-H), 8.184-8.146 (dd, 1H, Ar-H), 7.671-7.628 (dd, 1H, Ar-H), 7.521-7.501 (d, J=8.0 Hz, 1H, Ar-H), 7.865-7.354 (d, 2H, Ar-H), 7.015-6.997 (d, 2H, Ar-H), 4.169-4.139 (t, J=6.4 and 5.6 Hz, 2H, $-\text{OCH}_2-$), 3.891 (s, 3H, $-\text{OCH}_3$), 2.863-2.833 (t, J=6.2 and 5.8 Hz, 2H, $-\text{N}-\text{CH}_2-$), 2.571-2.539 (m, 4H, pyrrolidinyl-H), 1.781-1.747 (m, 4H, pyrrolidinyl-H). ^{13}C NMR (100 MHz, CDCl_3): δ 173.69, 161.58, 156.01, 153.39, 139.91, 133.36, 130.41, 130.36, 125.03, 125.01, 122.96, 119.61, 113.80, 70.69, 55.65, 55.38, 54.18, 23.51. IR (KBr, cm^{-1}): 3046, 2959, 1627, 1601, 1550, 1470, 1364, 1259, 1191, 1153, 759. MS (m/z): 366.1[M+1]. Elemental: Calculated for $\text{C}_{22}\text{H}_{23}\text{NO}_4$: C=72.31, H=6.34, N=3.83, O=17.51; Found for $\text{C}_{22}\text{H}_{23}\text{NO}_4$: C=72.28, H=6.35, N=3.85, O=17.51.

2-(4-Chloro-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (6d): White solid; Yield 72%; m.p. 134-136°C. ^1H NMR (400 MHz, CDCl_3): δ 8.201-8.195 (d, J=2.4 Hz, 1H, Ar-H), 8.151-8.139 (dd, 1H, Ar-H), 7.632-7.603 (dd, J=2.8 and 2.4 Hz, 1H, Ar-H), 7.521-7.502 (d, 1H, Ar-H), 7.487-7.459 (d, J=5.2 and 6.4 Hz, 2H, Ar-H), 7.278-7.252 (d, J=5.2 and 6.4 Hz, 2H, Ar-H), 4.219-4.190 (t, J=5.6 and 6.0 Hz, 2H, $-\text{OCH}_2-$),

2.845-2.816 (t, J=6 and 5.6 Hz, 2H, -N-CH₂-), 2.541-2.509 (m, 4H, pyrrolidinyl-H), 1.773-1.717 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.80, 154.69, 153.33, 140.92, 137.03, 133.58, 130.63, 130.01, 129.32, 128.62, 125.25, 125.11, 119.75, 70.73, 55.68, 54.26, 23.43; IR (KBr, cm⁻¹): 3051, 2962, 1629, 1606, 1575, 1355, 1239, 1194, 1153, 753. MS (m/z): 371.1[M+1]. Elemental: Calculated for C₂₁H₂₀ClNO₃: C=68.20, H=5.45, Cl=9.59, N=3.79, O=12.98; Found for C₂₁H₂₀ClNO₃: C=68.20, H=5.49, Cl=9.57, N=3.77, O=12.98.

2-(3-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (6e): White solid; Yield 73%; m.p.92-94°C. ¹H NMR (400 MHz, CDCl₃): δ 8.218-8.210 (d, J=3.2 Hz, 1H, Ar-H), 7.754-7.704 (dd, J=0.8 and 1.2 Hz, 1H, Ar-H), 7.660-7.650 (dd, J=2.0 and 2.0 Hz, 1H, Ar-H), 7.598-7.576 (d, J=2.2 and 2.8, 1H, Ar-H), 6.652 (d, 1H, Ar-H), 6.863 (d, 1H, Ar-H), 7.104 (dd, 1H, Ar-H), 6.879 (s, 1H, Ar-H), 4.160-4.130(t, J=6.0 and 6.0 Hz, 2H, -OCH₂-), 3.882 (s, 3H, -CH₃), 2.843-2.814(t, J=5.8 and 5.8 Hz, 2H, -N-CH₂-), 2.543-2.511(m, 4H, pyrrolidinyl-H), 1.764-1.716 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.90, 159.41, 155.89, 153.49, 141.06, 133.58, 132.01, 130.76, 129.45, 125.16, 121.03, 119.88, 116.61, 114.25, 71.04, 55.81, 55.53, 54.29, 23.51. IR (KBr, cm⁻¹): 3061, 3011, 2964, 1641, 1605, 1559, 1471, 1341, 1277, 1197, 758. MS (m/z): 366.1[M+1]. Elemental: Calculated for C₂₂H₂₃NO₄: C=72.31, H=6.34, N=3.83, O=17.51; Found for C₂₂H₂₃NO₄: C=72.34, H=6.31, N=3.84, O=17.50.

6-Chloro-2-Phenyl-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (7a): White solid; Yield 70%; m.p.146-148°C. ¹H NMR (400 MHz, CDCl₃): δ 8.219-8.211 (d, J=3.2 Hz, 1H, Ar-H), 8.129-8.081 (m, 2H, Ar-H), 7.623-7.597 (m, 1H, Ar-H), 7.511-7.469 (m, 4H, Ar-H), 4.223-4.193 (t, J=5.8 Hz and J=6.2 Hz, 2H, -OCH₂-), 2.906-2.760 (t, J=5.6 and 5.6 Hz, 2H, -N-CH₂-), 2.612-2.572 (m, 4H, piperidinyl-H), 1.799-1.743 (m, 4H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.17, 155.15, 152.97, 141.43, 133.45, 130.79, 130.48, 130.36, 128.90, 128.69, 128.37, 126.01, 120.08, 70.13, 54.67, 54.75, 25.61, 23.14. IR (KBr, cm⁻¹): 2959, 2921, 1646, 1609, 1560, 1488, 1336, 1235, 1161, 1141, 759. MS (m/z): 384.1[M+1]. Elemental: Calculated for C₂₂H₂₂ClNO₃: C=68.83, H=5.78, Cl=9.24, N=3.65, O=12.50; Found for C₂₂H₂₂ClNO₃: C=68.80, H=5.80, Cl=9.25, N=3.67, O=12.48.

6-Chloro-2-Furan-2-yl-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (7b): White solid; Yield 72%; m.p.82-84°C. ¹H NMR (400 MHz, CDCl₃): δ 7.718-7.681 (s, 1H, Ar-H), 7.630-7.625 (d, J=2 Hz, 1H, Ar-H), 7.308-7.302 (d, J=2, 1H, Ar-H), 7.539-7.517 (d, 1H, Furanyl-H), 7.102-7.089 (d, 1H, Furanyl-H), 6.653-6.646, (dd, J=1.2 Hz and 1.6 Hz, 1H, Furanyl-H), 4.418-4.393 (t, J=5.2 and 4.8 Hz, 2H, -OCH₂-), 3.048 (t, 2H, -N-CH₂-), 2.794 (t, 4H, piperidinyl-H), 1.739 (m, 4H, piperidinyl-H), 1.533 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 172.92, 153.00, 148.44, 145.54, 143.78, 137.83, 133.67, 130.80, 125.10, 124.90, 119.73, 117.80, 112.90, 68.07, 58.13, 54.26, 24.93, 23.47. IR (KBr, cm⁻¹): 3031, 2994, 1636, 1607, 1570, 1468, 1365, 1255, 1195, 1124, 759. MS (m/z): 374.2[M+1]. Elemental: Calculated for C₂₀H₂₀ClNO₄:

C=64.26, H=5.39, Cl=9.48, N=3.75, O=17.12; Found for C₂₀H₂₀ClNO₄: C=64.21, H=5.42, Cl=9.50, N=3.75, O=17.12.

6-Chloro-2-(4-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (7c): Crystalline white; Yield 65%; m.p.84-86°C. ¹H NMR (400 MHz, CDCl₃): δ 7.862-7.832 (s, 1H, Ar-H), 7.595-7.566 (d, J= 5.8Hz, 1H, Ar-H), 7.112-7.132 (d, J=5.8Hz, 1H, Ar-H), 7.475-7.453(d, 2H, Ar-H), 6.998-6.968 (d, 2H, Ar-H), 4.223-4.195 (t, J=5.6 and 5.6 Hz, 2H, -OCH₂-), 3.884 (s, 3H, -OCH₃), 2.850-2.822 (t, J=5.6 and 5.6 Hz, 2H, -N-CH₂-), 2.594 (t, 4H, piperidinyl-H), 1.650-1.594 (m, 4H, piperidinyl-H), 1.482-1.454(m, 2H, piperidinyl-H). ¹³C NMR (100MHz, CDCl₃): δ 173.73, 161.69, 156.10, 153.43, 139.80, 133.45, 131.36, 130.33, 125.08, 125.02, 122.86, 119.63, 114.14, 113.96,112.98, 68.82, 58.25, 55.43, 55.26, 54.99, 54.39, 25.4,23.88. IR (KBr, cm⁻¹): 3068, 2935, 1633, 1605, 1574, 1469, 1368, 1258, 1181, 1030, 790. MS (m/z): 414.2[M+1]. Elemental: Calculated for C₂₃H₂₄ClNO₄: C=66.74, H=5.84, Cl=8.57, N=3.38, O=15.46; Found for C₂₃H₂₄ClNO₄: C=66.70, H=5.86, Cl=8.59, N=3.39, O=15.45.

6-Chloro-2-(4-Chloro-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (7d): Crystalline white solid; Yield 71%; m.p.122-124°C. ¹H NMR (400 MHz, CDCl₃): δ 7.630-7.601(s, 1H, Ar-H), 6.981-6.942 (d, 1H, Ar-H), 7.466-7.266 (d, 4H, Ar-H), 4.238-4.209 (t, J=5.6 and 6.0 Hz, 2H, -OCH₂-), 2.663-2.634 (t, J=6.0 and 5.6 Hz, 2H, -N-CH₂-), 2.379 (t, 4H, piperidinyl-H), 1.545-1.490 (m, 4H, piperidinyl-H), 1.412-1.99 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.87, 154.46,153.42, 140.74, 136.94, 133.75, 130.71, 130.12, 129.18, 128.74, 125.13, 125.03, 119.69, 69.51, 58.78, 54.74, 25.94, 24.27. IR (KBr, cm⁻¹): 3091, 3050, 3031, 1630, 1607, 1571, 1558, 1472, 1359, 1240, 1193, 1153, 1012, 842. MS (m/z): 417.9[M+1]. Elemental: Calculated for C₂₂H₂₁Cl₂NO₃: C=63.17, H=5.06, Cl=16.95, N=3.35, O=11.47; Found for C₂₂H₂₁Cl₂NO₃: C=63.11, H=5.09, Cl=16.98, N=3.35, O=11.47.

6-Chloro-2-(3-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (7e): Off white solid; Yield 74%; m.p. 88-90°C. ¹H NMR (400 MHz, CDCl₃): δ 7.650 (s, 1H, Ar-H), 7.38-7.29 (d, 1H, Ar-H), 6.920-6.892 (d, 1H, Ar-H), 6.81 (s, 1H, Ar-H), 6.860-6.854 (d, 1H, Ar-H), 7.10 (t, 1H, Ar-H), 6.652-6.546 (d, 1H, Ar-H), 4.195-4.166 (t, J=5.6 and 6.0 Hz, 2H, -OCH₂-), 3.882(s, 3H, -OCH₃), 2.688-2.659(t, J=5.6 and 6.0 Hz, 2H, -N-CH₂-), 2.384 (s, 4H, piperidinyl-H), 1.537-1.481 (m, 4H, piperidinyl-H), 1.410-1.382 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.99, 159.43, 155.68, 153.53, 140.81, 133.64, 131.89, 130.59, 129.49, 125.10, 125.07, 121.17, 119.77, 166.59, 114.16, 69.66, 58.78, 55.44, 54.71, 25.86, 24.26. IR (KBr, cm⁻¹): 3080, 3055, 2998, 1640, 1602, 1578, 1560, 1470, 1355, 1252, 1197, 1054, 777. MS (m/z): 414.2[M+1]. Elemental: Calculated for C₂₃H₂₄ClNO₄: C=66.74, H=5.84, Cl=8.57, N=3.38, O=15.46; Found for C₂₃H₂₄ClNO₄: C=66.70, H=5.86, Cl=8.59, N=3.38, O=15.46.

6-Chloro-2-Phenyl-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (8a): Off white; Yield 66%; m.p.78-80°C. ¹H NMR (400 MHz, CDCl₃): δ 8.215-8.208 (s, J=2.8 Hz, 1H, Ar-H), 8.121-8.098 (d, 2H, Ar-H), 7.520-7.488 (m, 5H, Ar-H), 4.211-4.183 (t, J=5.6Hz and 5.6 Hz, 2H, -OCH₂-), 2.948 (dt,

2H, -N-CH₂-), 2.687 (m, 4H, pyrrolidinyl-H), 1.809 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.85, 156.14, 153.52, 140.50, 133.65, 130.93, 130.60, 130.50, 128.63(2C), 128.54(2C), 128.45, 125.02, 119.76, 70.42, 54.38, 54.09(2C), 23.42(2C). IR (KBr, cm⁻¹): 3062, 3031, 2955, 1637, 1609, 1561 1469, 1365, 1267, 1232, 1191, 700. MS (m/z): 370.1[M+1]. Elemental: Calculated for C₂₁H₂₀ClNO₃: C=68.20, H=5.45, Cl=9.59, N=3.79, O=12.98; Found for C₂₁H₂₀ClNO₃: C=68.22, H=5.48, Cl=9.54, N=3.81, O=12.95.

6-Chloro-2-Furan-2-yl-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (8b): Yellowish crystals; Yield 73%; m.p.108-110°C. ¹H NMR (400 MHz, CDCl₃): δ 7.982 (s, 1H, Ar-H), 7.659-7.648 (d, 1H, Ar-H), 6.894-6.872 (d, 1H, Ar-H), 7.818 (d, 1H, Furanyl-H), 7.186-7.159 (d, 1H, Furanyl-H), 6.543-6.526 (t, 1H, Furanyl-H), 4.418-4.392 (t, J=4.8 Hz and 5.2 Hz, 2H, -OCH₂-), 3.050 (t, 2H, -N-CH₂-), 2.788 (t, 4H, pyrrolidinyl-H), 1.736 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 172.73, 153.27, 148.21, 145.75, 143.66, 137.23, 133.35, 129.80, 125.90, 125.03, 119.36, 118.02, 113.09, 68.28, 58.49, 54.25, 24.89. IR (KBr, cm⁻¹): 3010, 2956, 1639, 1607, 1556, 1488, 1352, 1257, 1199, 1133, 757. MS (m/z): 360.1[M+1]. Elemental: Calculated for C₁₉H₁₈ClNO₄: C=63.42, H=5.04, N=3.89, O=17.79; Found for C₁₉H₁₈ClNO₄: C=63.58, H=4.94, N=3.86, O=17.83.

6-Chloro-2-(4-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (8c): Cream white; Yield 61%; m.p.124-126°C. ¹H NMR (400 MHz, CDCl₃): δ 7.983 (s, 1H, Ar-H), 7.430-7.736 (d, 1H, Ar-H), 6.564-6.532 (d, 1H, Ar-H), 7.234-7.212 (d, 2H, Ar-H), 6.784 (d, 2H, Ar-H), 4.172-4.143 (t, J=6 and 5.6 Hz, 2H, -OCH₂-), 3.896 (s, 3H, -OCH₃), 2.866-2.836 (t, J=6.0 and 6.0 Hz, 2H, -N-CH₂-), 2.578-2.546 (t, 4H, pyrrolidinyl-H), 1.789-1.756 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.72, 161.60, 156.03, 153.42, 139.94, 133.37, 130.47, 130.44, 125.13, 125.05, 122.97, 119.62, 113.84, 70.71, 55.75, 55.42, 54.28, 23.52. IR (KBr, cm⁻¹): 3048, 2962, 1626, 1603, 1572, 1559, 1439, 1381, 1253, 1193, 1183, 1035, 842, 727. MS (m/z): 400.13[M+1]. Elemental: Calculated for C₂₂H₂₂ClNO₄: C=66.08, H=5.55, Cl=8.87, N=3.50, O=16.00; Found for C₂₂H₂₂ClNO₄: C=66.04, H=5.57, Cl=8.89, N=3.50, O=16.00.

6-Chloro-2-(4-Chloro-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (8d): White solid; Yield 69%; m.p.118-120°C. ¹H NMR(400 MHz, CDCl₃): δ 7.986 (s, 1H, Ar-H), 7.654-7.653 (d, 1H, Ar-H), 6.876-6.868 (d, 1H, Ar-H), 7.320-7.387 (d, 2H, Ar-H), 7.286-7.279 (d, 2H, Ar-H), 4.209-4.180 (t, J=6.0 and 5.6 Hz, 2H, -OCH₂-), 2.837-2.808 (t, J=6 and 5.6 Hz, 2H, -N-CH₂-), 2.553-2.520 (t, 4H, pyrrolidinyl-H), 1.785-1.726 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.81, 154.67, 153.43, 140.72, 136.97, 133.76, 130.73, 130.06, 129.12, 128.71, 125.12, 125.05, 119.70, 70.93, 55.71, 54.22, 23.52. IR (KBr, cm⁻¹): 3091, 3050, 3131, 1631, 1607, 1571, 1474, 1353, 1238, 1195, 1154, 839. MS (m/z): 404.08[M+1]. Elemental: Calculated for C₂₁H₁₉Cl₂NO₃: C=62.39, H=4.74, Cl=17.54, N=3.46, O=11.87; Found for C₂₁H₁₉Cl₂NO₃: C=62.33, H=4.76, Cl=17.56, N=3.47, O=11.88.

6-Chloro-2-(3-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (8e): White solid; Yield 77%; m.p.90-92°C. ¹H NMR (400 MHz, CDCl₃): δ 7.965 (s, 1H, Ar-H), 7.654-7.643 (d, 1H, Ar-H), 6.868-6.862 (d, 1H, Ar-H), 6.812 (s, 1H, Ar-H), 6.766-6.759 (d, 1H, Ar-H), 6.045-6.034(d, 1H, Ar-H), 7.154-7.149 (t, 1H, Ar-H), 4.170-4.140 (t, J=6.8 and 6.0 Hz, 2H, -OCH₂-), 3.898-3.887 (s, J=4.4 Hz, 3H, -OCH₃), 2.843-2.818 (t, J=6.0 and 6.0 Hz, 2H, -N-CH₂-), 2.553-2.520 (d, 4H, pyrrolidinyl-H), 1.776-1.727 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 173.93, 159.44, 155.85, 153.54, 140.76, 133.65, 131.83, 130.61, 129.46, 125.10, 121.05, 119.78, 116.70, 114.11, 70.99, 55.76, 55.44, 54.27, 23.48. IR (KBr, cm⁻¹): 3060, 3012, 1639, 1602, 1558, 1469, 1359, 1276, 1252, 1195, 1051, 780. MS (m/z): 400.13[M+1]. Elemental: Calculated for C₂₂H₂₂ClNO₄: C=66.08, H=5.55, Cl=8.87, N=3.50, O=16.00; Found for C₂₂H₂₂ClNO₄: C=66.04, H=5.57, Cl=8.89, N=3.50, O=16.00.

6-Methyl-2-Phenyl-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (9a): White solid; Yield 76%; m.p.150-152°C. ¹H NMR (400 MHz, CDCl₃): δ 8.068-8.035(m, 2H, Ar-H), 8.001 (s, J=0.84 and 0.48Hz, 1H, Ar-H), 7.549-7.423 (m, 5H, Ar-H), 4.286-4.260 (t, J=5.4 and 5.2 Hz, 2H, -OCH₂-), 3.116-3.090 (t, J=5.2 and 5.2 Hz, 2H, -N-CH₂-), 2.925 (s, 4H, piperidinyl-H), 2.463-2.446 (s, 3H, -CH₃), 1.817-1.760 (m, 4H, piperidinyl-H), 1.576-1.547 (t, J=6.8 and 4.8 Hz, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.06, 156.23, 153.61, 140.02, 135.08, 134.89, 130.91, 130.69, 128.60, 128.59, 124.87, 123.66, 117.84, 67.95, 57.59, 53.86, 24.41, 23.01, 20.92. IR (KBr, cm⁻¹): 3055, 2942, 1626, 1609, 1579, 1560, 1485, 1376, 1235, 1211, 1168, 1081, 785. MS (m/z): 364.8[M+1]. Elemental: Calculated for C₂₃H₂₅NO₃: C=76.01, H=6.93, N=3.85, O=13.21; Found for C₂₃H₂₅NO₃: C=75.99, H=6.95, N=3.85, O=13.21.

6-Methyl-2-(4-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (9b): Yellowish powder; Yield 77%; m.p.78-80°C. ¹H NMR (400 MHz, CDCl₃): δ 8.09 (s, 1H, Ar-H), 7.562-7.534 (d, 1H, Ar-H), 6.876-6.843 (d, 1H, Ar-H), 7.267-7.189 (d, 2H, Ar-H), 6.745-6.659 (d, 2H, Ar-H), 4.170-4.143 (t, J=5.4 and 5.4 Hz, 2H, -OCH₂-), 3.881 (s, 3H, -OCH₃), 2.881-2.851 (t, J=5.6 and 6.4 Hz, 2H, -N-CH₂-), 2.598 (t, 4H, piperidinyl-H), 2.448 (s, 3H, -CH₃), 1.786-1.743 (m, 4H, piperidinyl-H), 1.546-1.501 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 174.89, 161.41, 155.63, 153.38, 139.83, 134.60, 134.38, 130.21, 124.63, 123.48, 123.39, 117.35, 113.94, 70.13, 55.52, 55.32, 54.25, 24.69, 23.56, 20.45. IR (KBr, cm⁻¹): 3030, 2958, 2921, 1633, 1598, 1483, 1343, 1247, 1183, 1071, 786. MS (m/z): 394.2[M+1]. Elemental: Calculated for C₂₄H₂₇NO₄: C=73.26, H=6.92, N=3.56, O=16.26; Found for C₂₄H₂₇NO₄: C=73.21, H=6.95, N=3.57, O=16.26.

6-Methyl-2-(4-Chloro-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (9c): Crystalline solid; Yield 71%; m.p.102-104°C. ¹H NMR (400 MHz, CDCl₃): δ 7.765 (s, 1H, Ar-H), 7.198-7.164 (d, 1H, Ar-H), 6.643-6.34 (d, 1H, Ar-H), 7.242-7.232 (d, 2H, Ar-H), 7.135-7.118 (d, 2H, Ar-H), 4.225-4.196 (t, J = 6 and 5.6 Hz, 2H, -OCH₂-), 2.678-2.649 (t, J = 5.6 and 6.0 Hz, 2H, -N-CH₂-), 2.466(s, 3H, -CH₃), 2.395 (t, 4H,

piperidinyl-H), 1.561-1.505 (m, 4H, piperidinyl-H), 1.432-1.404 (m, J = 6.0 and 5.2 Hz, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.03, 154.11, 153.42, 140.64, 136.57, 134.87, 134.69, 130.10, 129.64, 128.64, 125.02, 123.78, 117.69, 69.48, 58.79, 54.75, 25.94, 24.29, 20.95. IR (KBr, cm⁻¹): 3055, 2931, 1630, 1613, 1576, 1492, 1290, 1240, 1212, 1091, 1014, 835. MS (m/z): 398.0[M+1]. Elemental: Calculated for C₂₃H₂₄ClNO₃: C=69.43, H=6.08, Cl=8.91, N=3.52, O=12.06; Found for C₂₃H₂₄ClNO₃: C=69.41, H=6.10, Cl=8.90, N=3.54, O=12.05.

6-Methyl-2-(3-Methoxy-phenyl)-3-(2-piperidin-1-yl-ethoxy)-4H-chromene-4-one (9d): Colourless crystals; Yield 76%; m.p.80-82°C. ¹H NMR (400 MHz, CDCl₃): δ 7.986 (s, 1H, Ar-H), 7.234-7.220 (d, 1H, Ar-H), 6.876-6.872 (d, 1H, Ar-H), 6.812 (s, 1H, Ar-H), 6.675-6.671 (d, 1H, Ar-H), 6.113-6.089 (d, 1H, Ar-H), 7.165 (t, 1H, Ar-H), 4.186-4.157 (t, J = 5.6 and 6.0 Hz, 2H, -OCH₂-), 3.887 (s, 3H, -OCH₃), 2.703-2.674 (t, J = 5.6 and 6.0 Hz, 2H, -N-CH₂-), 2.465 (s, 3H, -CH₃), 2.4 (t, 4H, piperidinyl-H), 1.537-1.496 (m, 4H, piperidinyl-H), 1.40-1.387 (m, 2H, piperidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.15, 159.39, 155.34, 153.53, 140.70, 134.77, 134.56, 132.37, 129.39, 125.00, 123.82, 121.17, 117.77, 116.38, 114.07, 69.66, 58.80, 55.42, 54.73, 25.87, 24.28, 20.94. IR (KBr, cm⁻¹): 3081, 3024, 2998, 2935, 1637, 1618, 1488, 1581, 1561, 1488, 1356, 1287, 1201, 1178, 1056, 805. MS (m/z): 394.0 [M+1]. Elemental: Calculated for C₂₄H₂₇NO₄: C=73.26, H=6.92, N=3.56, O=16.26; Found for C₂₄H₂₇NO₄: C=73.23, H=6.95, N=3.54, O=16.28.

6-Methyl-2-Phenyl-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (10a): Off white solid; Yield 70%; m.p.88-90°C. ¹H NMR (400 MHz, CDCl₃): δ 8.047-8.023(m, 2H, Ar-H), 8.002-7.991(s, J=2.2 and 2.2 Hz, 1H, Ar-H), 7.539-7.414 (m, 5H, Ar-H), 4.281-4.259 (t, J=4.4 and 4.4 Hz, 2H, -OCH₂-), 3.114-3.088 (t, J=5.2 and 5.2 Hz, 2H, -N-CH₂-), 2.954-2.903 (d, 4H, pyrrolidinyl-H), 2.446 (s, 3H, -CH₃), 1.819-1.772 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.15, 156.32, 152.95, 140.37, 135.01, 134.82, 130.84, 130.59, 128.93, 128.47, 124.01, 123.56, 117.34, 113.14, 67.98, 57.79, 53.58, 24.39, 20.89. IR (KBr, cm⁻¹): 3053, 2940, 1630, 1610, 1571, 1483, 1361, 1231, 1169, 1127, 1054, 760. MS (m/z): 350.1[M+1]. Elemental: Calculated for C₂₂H₂₃NO₃: C=75.62, H=6.63, N=4.01, O=13.74; Found for C₂₂H₂₃NO₃: C=75.60, H=6.65, N=4.03, O=13.72.

6-Methyl-2-(4-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (10b): White solid; Yield 73%; m.p.116-118°C. ¹H NMR (400 MHz, CDCl₃): δ 7.765 (s, 1H, Ar-H), 7.214-7.206 (d, 1H, Ar-H), 6.875-6.868 (d, 1H, Ar-H), 7.192-7.178 (d, 2H, Ar-H), 6.432-6.418 (d, 2H, Ar-H), 4.171-4.142 (t, J=5.6 and 6 Hz, 2H, -OCH₂-), 3.883 (s, 3H, -OCH₃), 2.883-2.853 (t, J=5.6 and 6.4 Hz, 2H, -N-CH₂-), 2.602-2.570 (t, 4H, pyrrolidinyl-H), 2.450 (s, 3H, -CH₃), 1.793-1.753(m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 174.92, 161.38, 155.66, 153.44, 139.89, 134.50, 134.41, 130.41, 124.98, 123.86, 123.51, 117.62, 113.77, 70.64, 55.75, 55.38, 54.27, 23.52, 20.91. IR (KBr, cm⁻¹): 2957, 2919, 2848, 1631, 1603, 1573, 1509, 1487, 1362, 1306, 1257, 1180, 1021, 835. MS (m/z): 380.0[M+1]. Elemental: Calculated for C₂₃H₂₅NO₄:

C=72.80, H=6.64, N=3.69, O=16.87; Found for C₂₃H₂₅NO₄: C=72.50, H=6.58, N=3.59, O=16.86.

6-Methyl-2-(4-Chloro-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (10c): Yellowish solid; Yield 65%; m.p.76-78°C. ¹H NMR (400 MHz, CDCl₃): δ 8.023 (s, 1H, Ar-H), 7.564-7.558 (d, 1H, Ar-H), 6.897-6.889 (d, 1H, Ar-H), 7.424-7.413 (d, 2H, Ar-H), 7.342-7.328 (d, 2H, Ar-H), 4.223-4.194 (t, J = 5.6 and 6 Hz, 2H, -OCH₂-), 2.664-2.634 (t, J = 6 and 6 Hz, 2H, -N-CH₂-), 2.459 (s, 3H, -CH₃), 2.388-2.347 (d, 4H, pyrrolidinyl-H), 1.569-1.561 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 174.92, 154.13, 153.34, 141.23, 136.48, 135.03, 134.91, 130.02(2C), 129.54, 128.76 (2C), 124.83, 124.01, 117.30, 69.70, 58.38, 54.64(2C), 25.93 (2C), 24.87, 20.88. IR (KBr, cm⁻¹): 3053, 2929, 1628, 1609, 1570, 1487, 1351, 1248, 1179, 1153, 839. MS (m/z): 384.1[M+1]. Elemental: Calculated for C₂₂H₂₂ClNO₃: C=68.83, H=5.78, Cl=9.24, N=3.65, O=12.50; Found for C₂₂H₂₂ClNO₃: C=68.80, H=5.79, Cl=9.24, N=3.66, O=12.51.

6-Methyl-2-(3-Methoxy-phenyl)-3-(2-pyrrolidin-1-yl-ethoxy)-4H-chromene-4-one (10d): White amorphous; Yield 63%; m.p.80-82°C. ¹H NMR (400 MHz, CDCl₃): δ 7.986 (s, 1H, Ar-H), 7.432-7.435 (d, 1H, Ar-H), 6.765-6.756 (d, 1H, Ar-H), 7.109 (t, 1H, Ar-H), 6.867 (s, 1H, Ar-H), 6.679-6.674 (d, 1H, Ar-H), 6.564-6.549 (d, 1H, Ar-H), 4.164-4.134 (t, J = 6.0 and 6.0Hz, 2H, -OCH₂-), 3.886 (s, J = 6.0 Hz, 3H, -OCH₃), 2.855-2.825 (t, J = 6.0 and 6.0 Hz, 2H, -N-CH₂-), 2.562-2.529 (d, 4H, pyrrolidinyl-H), 2.481-2.464 (s, 3H, -CH₃), 1.779-1.738 (m, 4H, pyrrolidinyl-H). ¹³C NMR (100 MHz, CDCl₃): δ 175.09, 159.40, 155.47, 153.53, 140.66, 134.78, 134.58, 132.31, 129.36, 124.99, 123.82, 121.05, 117.77, 116.47, 114.03, 70.94, 55.81, 55.42, 54.29 (2C), 23.47 (2C), 20.94. IR (KBr, cm⁻¹): 3079, 3031, 3012, 2968, 2928, 1635, 1617, 1578, 1558, 1488, 1359, 1287, 1199, 1176, 1052, 783. MS (m/z): 380.0 [M+1]. Elemental: Calculated for C₂₃H₂₅NO₄: C=72.80, H=6.64, N=3.69, O=16.87; Found for C₂₃H₂₅NO₄: C=72.81, H=6.65, N=3.67, O=16.87.

IN-SILICO COMPUTATIONAL STUDIES

Molinspiration and Molsoft analytical tools were used for predicting in silico molecular properties drug likeness scores of the compounds.

ANTIMICROBIAL ASSAY

In vitro antibacterial assay was performed using Mueller Hinton Agar of Himedia make. Antibacterial activity was determined by agar disc diffusion method on four different bacterial strains; *Staphylococcus aureus*, *Bacillus subtilis* (Gram positive bacteria) and *Escherichia coli*, *Proteus vulgaris* (Gram negative bacteria). For antifungal activity also, agar disc diffusion method was used and tested on *Candida albicans* and *Aspergillus niger*.

Stock solutions of the test compounds were prepared in dimethylsulfoxide (DMSO). However, the concentration did not show by itself any antimicrobial activity. The resultant concentration of 50, 100 and 150 µg/ml was prepared. Whatman no. 1 sterile filter paper discs (6 mm) were impregnated with solution for 10 min and dried at room temperature under aseptic

Table 2: Prediction of Molecular Properties of the synthesized compounds.

Compound	MOLECULAR PROPERTIES									
	TPSA			N atom	MW	nON	nOHNH	n violations	Nrotb	Volume (Å ³)
	miLogP	(Å ²)	%Abs							
5a	4.66	42.6	94.28	26	349.4	4	0	0	5	328.54
5b	3.8	55.8	89.74	25	339.3	5	0	0	5	310.1
5c	4.72	51.9	91.09	28	379.4	5	0	0	6	354.08
5d	5.34	42.6	94.28	27	383.8	4	0	1	5	342.07
5e	4.69	51.9	91.09	28	379.4	5	0	0	6	354.08
6a	4.15	42.6	94.28	25	335.4	4	0	0	5	311.73
6b	3.3	55.8	89.74	24	325.3	5	0	0	5	293.3
6c	4.21	51.9	91.09	27	365.4	5	0	0	6	337.28
6d	4.83	42.6	94.28	26	369.8	4	0	0	5	325.27
6e	4.19	51.9	91.09	27	365.4	5	0	0	6	337.28
7a	5.31	42.6	94.28	27	383.8	4	0	1	5	342.07
7b	4.46	55.8	89.74	26	373.8	5	0	0	5	323.64
7c	5.37	51.9	91.09	29	413.9	5	0	1	6	367.62
7d	5.99	42.6	94.28	28	418.3	4	0	1	5	355.61
7e	5.35	51.9	91.09	29	413.9	5	0	1	6	367.62
8a	4.81	42.6	94.28	26	369.8	4	0	0	5	325.27
8b	3.95	51.9	89.74	25	359.8	5	0	0	5	306.84
8c	4.87	42.6	91.09	28	399.8	5	0	0	6	350.81
8d	5.49	55.8	94.28	27	404.2	4	0	1	5	338.81
8e	4.84	51.9	91.09	28	399.8	5	0	0	6	350.81
9a	5.08	42.6	94.28	27	363.4	4	0	1	5	345.1
9b	5.14	51.9	91.09	29	393.4	5	0	1	6	370.64
9c	5.76	42.6	94.28	28	397.9	4	0	1	5	358.63
9d	5.12	51.9	91.09	29	393.4	5	0	1	6	370.64
10a	4.58	42.6	94.28	26	349.4	4	0	0	5	328.29
10b	4.64	51.9	91.09	28	379.4	5	0	0	6	353.84
10c	5.26	42.6	94.28	27	383.8	4	0	1	5	341.83
10d	4.61	51.9	91.09	28	379.4	5	0	0	6	353.84

miLogP- logarithm of compound partition coefficient between n-octanol and water; Å²-Polar surface area; %Abs- percentage of absorption; TPSA- topological polar surface area; nON- number of hydrogen bond acceptors; nOHNH- number of hydrogen bond donors; nviolations- number of violations; Nrotb- number of rotatable bonds.

conditions. For antibacterial assay, specified (3.8 g) quantity of Mueller Hinton agar and agar agar were accurately weighed, dissolved in distilled water (100 ml) and sterilized by autoclaving at 120°C for 15 minutes. The media was cooled to 50°C. It was then inoculated with the test organisms using physiological saline and plates were prepared. The above operation was carried-out under aseptic condition in sterile area. The discs were put on plates and incubated at 37°C for 18-24 hours. At the end of 24th hours the zone of inhibition produced by the test compounds was measured in mm. The zone of inhibition obtained by different test compounds was compared with that of standard antibacterial drugs ciprofloxacin and gentamycin (100 µg/ml). Similarly, for antifungal assay, test solutions were prepared in the same manner and Sabouraud dextrose agar was used in place of Mueller Hinton agar for petri-plate preparation. The discs were then applied and the plates were incubated at 28°C for 72–96 hours and finally the inhibition zone were measured and expressed in mm. The results were compared using nystatin (100µg/ml) and clotrimazole (100 µg/ml) as standard reference drug.

RESULT AND DISCUSSION

CHEMISTRY

The synthesis of the hitherto unreported designed compounds was accomplished in analogy with the Scheme 1, which involves acylation of phenol derivative (1), followed by Fries rearrangement, leading exclusively to the formation of *ortho* isomer (2) due to the blockage of *para* position. Aldol condensation of 2 with variety of aldehydes furnished the product 3 in good yields, which upon subsequent oxa-Michael addition trailed by oxidation with hydrogenperoxide afforded the pivotal intermediate (4). Potassium carbonate assisted alkylation of 4 with diverse chlorides and afforded the target compounds 5a-e, 6a-e, 7a-e, 8a-e, 9a-d, 10a-d, in line with Scheme 1.

IN-SILICO COMPUTATIONAL STUDIES

30% drugs become non-functional ahead of reaching clinical trials due to meagre pharmacokinetics. Better oral availability can be achieved by accurate balance between solubility and partitioning properties. In order to obtain better derivatives of chromene, we have performed computational investigations of all the designed compounds for predicting their properties based

Table 3: Predicted Drug Likeness Scores of the synthesized compounds.

Compound	R	R ¹	R ²	BIOACTIVITY SCORES						Drug Likeness
				GPCRL	ICM	KI	NRL	PI	EI	
5a	-H	-Ph		0.04	-0.16	0.11	0.06	-0.11	0.1	1.84
5b	-H	-Furanyl		-0.03	-0.29	-0.07	-0.1	-0.32	-0.1	1.59
5c	-H	4-MeO-C ₆ H ₄		0	-0.2	0.07	0.04	-0.15	0	2.22
5d	-H	4-Cl-C ₆ H ₄		0.04	-0.16	0.09	0.04	-0.15	0	2.25
5e	-H	3-MeO-C ₆ H ₄		0	-0.2	0.1	0.04	-0.16	0	1.83
6a	-H	-Ph		0.05	-0.16	0.16	0.11	-0.06	0.1	1.7
6b	-H	-Furanyl		-0.03	-0.29	-0.03	-0.06	-0.29	-0.1	1.45
6c	-H	4-MeO-C ₆ H ₄		0.01	-0.21	0.11	0.07	-0.1	0	2.09
6d	-H	4-Cl-C ₆ H ₄		0.05	-0.16	0.13	0.08	-0.1	0.1	2.12
6e	-H	3-MeO-C ₆ H ₄		0	-0.2	0.14	0.08	-0.12	0.1	1.71
7a	-Cl	-Ph		0.03	-0.16	0.09	0.04	-0.14	0	1.86
7b	-Cl	-Furanyl		-0.04	-0.29	-0.08	-0.11	-0.34	-0.1	1.65
7c	-Cl	4-MeO-C ₆ H ₄		-0.01	-0.21	0.06	0.02	-0.17	0	2.04
7d	-Cl	4-Cl-C ₆ H ₄		0.03	-0.16	0.09	0.04	-0.13	0	1.82
7e	-Cl	3-MeO-C ₆ H ₄		-0.01	-0.2	0.08	0.02	-0.18	0	1.77
8a	-Cl	-Ph		0.04	-0.16	0.13	0.08	-0.09	0.1	1.75
8b	-Cl	-Furanyl		-0.04	-0.29	-0.05	-0.08	-0.3	-0.1	1.54
8c	-Cl	4-MeO-C ₆ H ₄		0	-0.21	0.09	0.05	-0.13	0	1.94
8d	-Cl	4-Cl-C ₆ H ₄		0.04	-0.16	0.13	0.08	-0.09	0.1	1.71
8e	-Cl	3-MeO-C ₆ H ₄		0	-0.21	0.11	0.06	-0.14	0	1.67
9a	-CH ₃	-Ph		0	-0.24	0.06	0.04	-0.16	0	1.56
9b	-CH ₃	4-MeO-C ₆ H ₄		-0.03	-0.27	0.03	0.02	-0.19	0	1.71
9c	-CH ₃	4-Cl-C ₆ H ₄		0	-0.23	0.04	0.02	-0.2	0	1.78
9d	-CH ₃	3-MeO-C ₆ H ₄		-0.04	-0.27	0.05	0.02	-0.2	0	1.5
10a	-CH ₃	-Ph		0.01	-0.24	0.1	0.08	-0.11	0	1.45
10b	-CH ₃	4-MeO-C ₆ H ₄		-0.03	-0.28	0.06	0.05	-0.15	0	1.6
10c	-CH ₃	4-Cl-C ₆ H ₄		0	-0.24	0.07	0.06	-0.15	0	1.68
10d	-CH ₃	3-MeO-C ₆ H ₄		-0.03	-0.272	0.08	0.06	-0.16	0	1.4

GPCRL: GPCR ligand; ICM: ion channel modulator; KI: kinase inhibitor; NRL: nuclear receptor ligand; PI: protease inhibitor; EI: enzyme inhibitor.

on Lipinski's rule of five (**Table 2**), ADME properties - adsorption, distribution, metabolism and excretion (**Table 2**), and drug likeness scores (**Table 3**).^{38,39} The principle behind molinspiration software working includes summation of correction factors and fragment-based contributions. Lipinski's rule of five acts as a selector for drug like property prediction and mentions that whether a potential molecule is orally active

or not. A molecule is said to be orally active only if it's: (a) molecular weight ≤ 500 da, (b) $\log P \leq 5$, (c) number of hydrogen bond acceptors ≤ 10 , (d) number of hydrogen bond donors ≤ 5 .⁴⁰ Among all the synthesized compounds, all products except **5d**, **7a**, **7c**, **7e**, **8d**, **9a-d**, **10c** exhibited partition coefficient ($\text{milog}P$)⁴¹ which accounts for molecular hydrophobicity suggesting them for good bioavailability (Table 2). However,

Table 4: Antibacterial activity of the synthesized compound.

COMP	ZONE OF INHIBITION IN mm.											
	CONC. IN µg/ml.											
	<i>P. vulgaris</i>			<i>B. subtilis</i>			<i>E. coli</i>			<i>S. aureus</i>		
	50	100	150	50	100	150	50	100	150	50	100	150
5a	7.1	7.9	8	0	9.2	16	6.7	7.1	7.2	0	6.9	9.3
5b	0	0	0	8.1	10.1	11.2	0	6.4	7.4	0	8.2	9.1
5c	6.8	7.5	8.1	9.1	9.3	14	8.2	11	12	8.1	8.8	9.2
5d	0	0	14	8.4	8.5	9	9.1	11.1	11.9	0	0	6.9
5e	0	6.9	8.1	9.2	9.6	11	8.1	9.3	10.7	6.9	7.8	9.2
6a	7	8	12.5	0	0	9.1	6.8	7.3	13.2	8.2	8.9	10.1
6b	0	7	15.1	8.2	10	10.2	0	6.6	6.8	0	0	8
6c	0	7.6	15.2	8.4	9.1	10.4	0	0	7.2	0	0	7.9
6d	0	0	8	9.3	10.1	10.4	0	7	8	8	8.9	10.4
6e	0	7	11.5	8.2	9	11	0	6.5	7.1	0	6.9	8
7a	0	8	24	6.6	8.8	12.2	6.5	6.7	7	7.8	8.6	10
7b	0	0	0	10	10.4	10.4	9.1	11.2	13.3	0	7.4	8.1
7c	0	0	7.1	8.1	9.8	11	0	6.8	7	7.4	7.9	9
7d	0	8.1	13	0	7.8	12.3	10	12.1	15.6	7.9	9.8	11
7e	6.8	7.8	10	7.8	9.1	9.8	6.7	9.1	10	0	0	10
8a	0	7.1	7.4	0	9.8	10.4	0	0	7.2	0	7.2	8
8b	6.8	7	7.2	0	8.1	12	0	0	0	0	0	7
8c	0	7.7	8.1	8	9.2	9	0	0	0	7.6	8.1	9.2
8d	0	7.8	9.2	7.8	10	11.1	6.6	6.9	7.2	6.9	8.8	9.1
8e	0	8	8	8	9.2	10.1	6.9	7.9	9	0	0	8.2
9a	7.8	8	13.9	8.8	10.1	10.4	9	10	11.1	7.9	9	10
9b	6.8	7.9	11	8.9	10.1	12.3	9.8	10	11.2	0	0	0
9c	0	7.8	8	7.8	8.1	11.9	0	0	0	0	0	7.7
9d	6.8	9.1	21.3	8	8.9	9.1	0	6.8	8	0	6.8	10
10a	0	0	11.1	0	7	7.1	0	0	6.8	6.9	7.8	8.8
10b	0	7.1	7.9	6.8	8.9	9.1	0	0	7	8.9	9	9.1
10c	0	0	9.2	7.9	8	9.2	7.8	9.1	10	0	6.9	9.2
10d	0	0	8	7.7	9	9.3	0	0	8.1	0	0	9.1
STD 1	0	33	33	0	26	25.7	0	33	38.8	11.6	26.4	26

Zone of Inhibition = ±0.03mm.; STD 1- Ciprofloxacin.

one violation of Lipinski's rule of five is acceptable and indicates their moderate oral availability.⁴² Hydrogen bonding is an important parameter for defining drug permeability. All the derivatives **5a-e**, **6a-e**, **7a-e**, **8a-e**, **9a-d**, **10a-d**, under study have numerous hydrogen bond acceptors (≤ 5) (**Table 2**), thus confirming the oral availability of drug.⁴³ Nrotb stands for number of rotatable bonds which describe the molecular flexibility and conformational changes possible in the molecule with respect to binding with receptors or channels. The criteria for nrotb for standard should be ≤ 10 . The compounds under study exhibit a high number of nrotb (5–6) thereby exhibiting conformational flexibility. Volume, percentage of absorption (%ABS), molecular polar surface area (PSA) for the synthesized compounds are presented in **Table 2**. PSA has been shown to be a very good descriptor characterizing drug absorption and transportation properties apart from intestinal absorption, bioavailability, human intestinal epithelial adenocarcinoma (Caco-2) cell permeability and blood-brain barrier (BBB) penetration. Magnitude of absorption is expressed by percentage of absorption and is calculated by the expression: $\%ABS = 109 - 0.345 * PSA$. PSA is the sum of fragment contributions of polar atoms such as oxygen, nitrogen and

attached hydrogen as calculated by Ertl et al. methodology. PSA and volume are inversely related to %ABS. Compounds **5a**, **5d**, **6a**, **6d**, **7a**, **7d**, **8a**, **8d**, **9a**, **9c**, **10a**, **10c** have maximum absorption (94.28%) due to their least corresponding polar surface area and volume. PSA and logP are considered to be two key parameters for oral bioavailability prediction of a drug. TPSA is associated with the transport properties of drug across the membranes, prediction in BBB and intestinal crossing. Molecules with TPSA/PSA in the range $\leq 160 \text{ \AA}^2$ have good intestinal absorption and $\leq 60 \text{ \AA}^2$ has BBB penetration. Among the predicted analogues all displayed TPSA $\leq 60 \text{ \AA}^2$ suggesting them as better BBB agents.^{44,45} The bioactivity scores of all the newer derivatives were presented in the **Table 3** by means of numerical assignment. High score implies higher the probability for a molecule to be active. In this connection molecules with score > 0.00 indicates them to be highly active, value between -0.50 and 0.00 marks them as moderately active and < -0.50 are inactive.

Drug likeness model score of the synthesized compounds have been predicted by using molsoft toolkit which predicts an overall drug-likeness score using Molsoft's chemical fingerprints by considering training set of 5K of marketed drugs

from WDI (World drug index) (positives) and 10K of carefully selected non-drug compounds (negatives). Among the analyzed compounds, all the compounds have proved to be highly potent drug molecules with DSL values > 1.0 (\AA^2) thereby indicating high probability of the molecule to be proven a drug entity.

ANTIMICROBIAL ASSAY

This array of synthesized molecules was evaluated for their antibacterial efficiency against *E.coli*, *P.Vulgaris*, *S.aureus*, *B.Subtilis* strains. The obtained biological data is tabulated in Table 4 as zone of inhibition tested at 50 $\mu\text{g/mL}$, 100 $\mu\text{g/mL}$ and 150 $\mu\text{g/mL}$ respectively. Ciprofloxacin was used as standard drug. A graphical representation of the same has also been shown. From the first inspection of these results, it can be inferred that significant difference in activities can be observed among all the tested compounds. Enlightened with these results, we began to understand the effect of heterocyclic moiety containing nitrogen and two carbon-spacer on the inhibition of bacteria and fungi. Eventually, we arrived to a conclusion that there are few compounds e.g. **5a** against *B.Subtilis*, **7a** against *P.Vulgaris*, and **7d** against *E.Coli*, *S.Aureus* can be considered as potential hits tested at 150 $\mu\text{g/mL}$. From the close scrutiny of the data, it is clear that piperidine bioisosteres (**5c**, **5d**, **5e**, **7b**, **7d**, **7e**, **9a**, **9b** zone of inhibition >10 mm at 150 $\mu\text{g/mL}$) exhibited greater activity than pyrrolidine derivatives except **6a** against *E.coli* and for compounds **5a**, **5c**, **7a**, **7d**, **9b** (ZI >12 mm at 150 $\mu\text{g/mL}$) against *B.Subtilis*. Similar pattern is seen for products **7a**, **9d** (ZI >20 mm at 150 $\mu\text{g/mL}$) against *P.Vulgaris*. However, none of the synthesized off-shots elicited better activity than the reference drugs. Products **5a**, **7a**, **7d** exhibited promising activity against *B.Subtilis* (ZI = 16.0 mm at 150 $\mu\text{g/mL}$), *E.coli* (ZI = 15.6 mm at 150 $\mu\text{g/mL}$), *S.aureus* (ZI = 11.0 mm at 150 $\mu\text{g/mL}$) and *P.Vulgaris* (ZI = 24.0 mm at 150 $\mu\text{g/mL}$) respectively. Superior activity of the chlorinated products **7a**, **7d** might be due to enhanced physicochemical properties, lipophilicity, electronegativity, pharmacokinetic properties, endurance for metabolic destruction and improvised hydrogen bonding contacts with the receptors. Incorporation of furan moiety in chromene core i.e., **5b**, **6b** led to mediocre activity against all the strains employed in the present assay and for the analogues **7b**, **8b** good to moderate activity against *P.Vulgaris* and *E.coli* respectively. For the regio-isomers **5c** (p-OCH₃), **5e** (m-OCH₃) decrement in activity was observed suggesting that introduction of methoxy group at meta-position is not preferred over para-position for all the strains consumed. Exactly, reverse trend was pragmatic for **8c** (p-OCH₃), **8e** (m-OCH₃) and **10b** (p-OCH₃), **10d** (p-OCH₃) i.e., meta-position is preferred compared to para-region against all the strains indicating the selectivity of these class of compounds towards a particular strain. The activity pattern for series 1 is **5a** (-H) $>$ **5c** (p-OCH₃) $>$ **5d** (p-Cl) compared to *S.aureus*, *B.Subtilis* follows that the unsubstituted moiety shows greater activity compared to electron donating group effect which in turn shows greater effect than electron withdrawing group effect; whereas, for series 3 order is **7d** (p-Cl) $>$ **7a** (-H) $>$ **7c** (p-OCH₃) against *E.coli*, *S.aureus*, *B.Subtilis* and for series 6 it is **10c** (p-Cl) $>$ **10b** (p-OCH₃) $>$ **10a** (-H) against *E.coli*, *S.aureus*, *B.Subtilis*

respectively; tested at 150 $\mu\text{g/mL}$ illustrating their idealistic responses or behaviour for the strains.

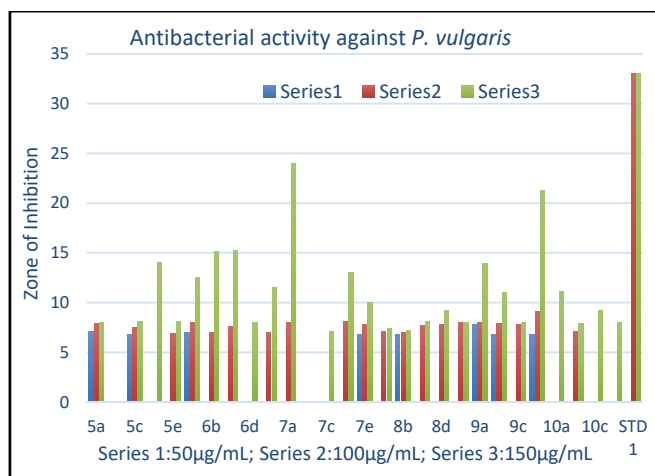


Figure 3: Graphical Representation of Antibacterial activity against *P. vulgaris*.

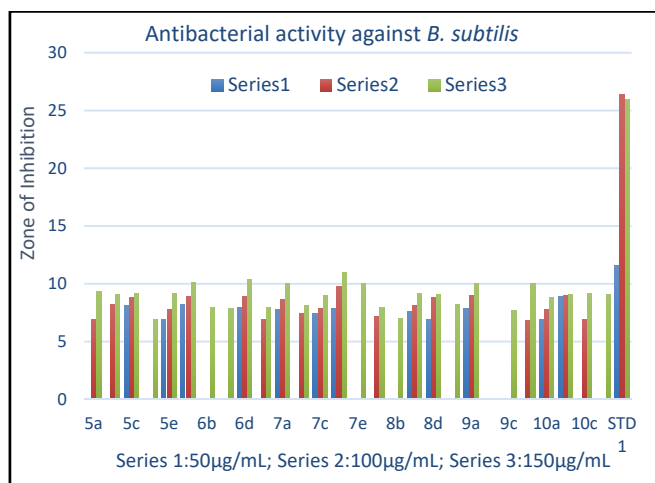


Figure 4: Graphical Representation of Antibacterial activity against *B. subtilis*.

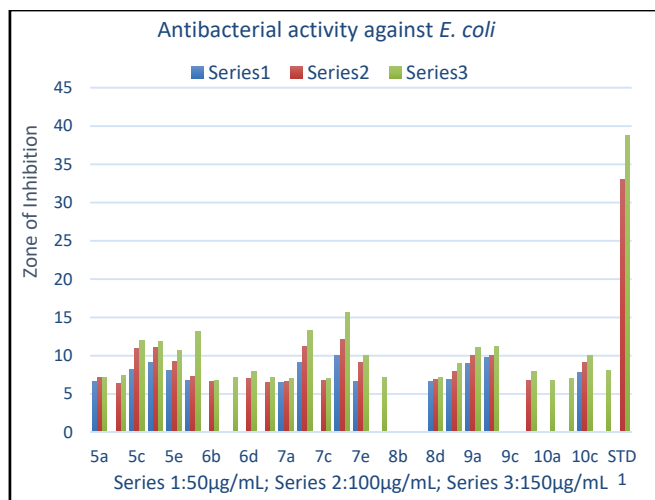


Figure 5: Graphical Representation of Antibacterial activity against *E. coli*.

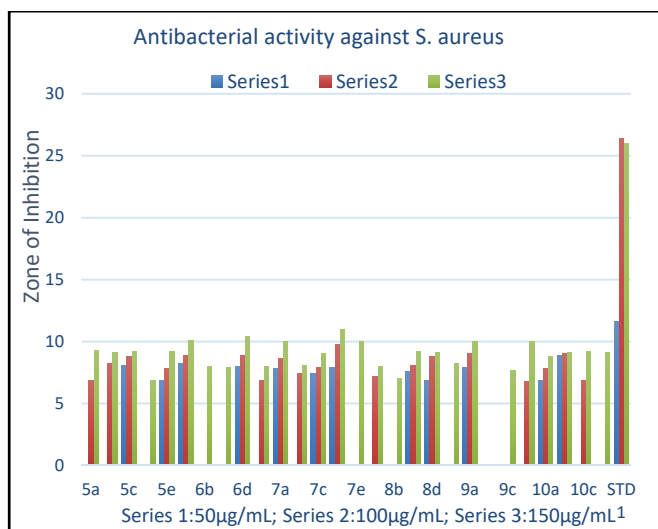


Figure 6: Graphical Representation of Antibacterial activity against *S. aureus*.

Chromene derivatives are structurally similar to quinolone antibiotics (ciprofloxacin) and we entrust that these molecules would interfere and attribute to the changes in DNA supercoiling by binding to topoisomerase II or IV. This hampers the formation of new double-stranded DNA and cell death occurs.

Further the synthesized compounds were screened to ascertain their antifungal capacity against *Aspergillus niger* and *Candida albicans* as summarized in **Table 5** expressed in terms of zone of inhibition (ZI). A graphical representation of the same is given. From the assay it was clear that, some compounds from the series were found to be linked with promising anti-fungal properties. In the array of analogues; compounds **5c**, **8b**, **8c**, **5a**, **5b**, **7b**, **8a** and **9c** presented superior activity against *Aspergillus niger* and *Candida albicans* respectively. Derivatives **8a**, **9b**, **6a**, **6e**, **8e**, **9a**, **10c** demonstrated passable commotion against *Aspergillus niger* and *Candida albicans* respectively. Clotrimazole has been used to compare the fungicidal activities of newly synthesized molecules.

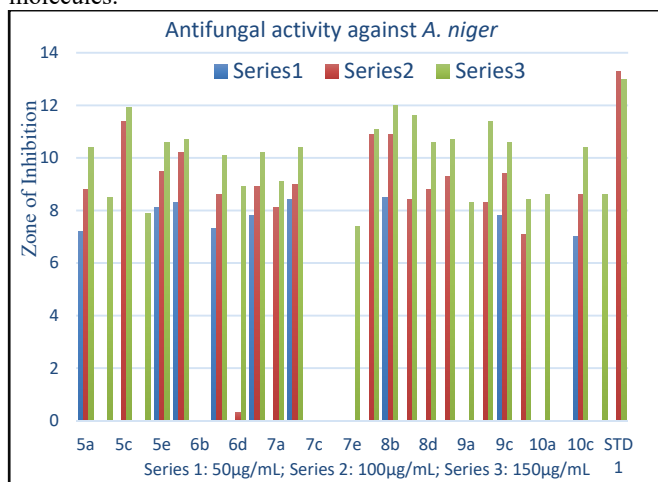


Figure 7: Graphical Representation of Antifungal activity against *A. niger*.

Structural dimension of chromone is comparable to clotrimazole and we believe that the mode of action of these molecules possibly be similar to clotrimazole.

Table 5: Antifungal activity of the synthesized compounds.

COMPD.	ZONE OF INHIBITION IN mm.					
	CONC. IN µg/mL.					
	<i>A. niger</i>			<i>C. albicans</i>		
	50	100	150	50	100	150
5a	7.2	8.8	10.4	9.1	10	11.6
5b	0	0	8.5	0	9.5	11.8
5c	0	11.4	11.9	0	8.9	10.5
5d	0	0	7.9	8.1	9.2	10.3
5e	8.1	9.5	10.6	0	0	9.5
6a	8.3	10.2	10.7	7.2	8.4	11.4
6b	0	0	0	0	0	0
6c	7.3	8.6	10.1	0	7.7	10.8
6d	0	0.3	8.9	0	8.2	9.8
6e	7.8	8.9	10.2	7.6	9.3	11.1
7a	0	8.1	9.1	0	8.5	10.1
7b	8.4	9	10.4	8.5	10	11.9
7c	0	0	0	0	0	10.7
7d	0	0	0	0	0	0
7e	0	0	7.4	8	9.2	10.6
8a	0	10.9	11.1	0	10	11.6
8b	8.5	10.9	12	7.6	8.9	10.4
8c	0	8.4	11.6	0	8.6	10.7
8d	0	8.8	10.6	0	7.9	10
8e	0	9.3	10.7	0	10.6	11.1
9a	0	0	8.3	8.8	10.2	11.2
9b	0	8.3	11.4	0	8.1	9
9c	7.8	9.4	10.6	8.3	9.4	11.8
9d	0	7.1	8.4	0	0	8.1
10a	0	0	8.6	7.1	8.3	8.8
10b	0	0	0	0	0	0
10c	7	8.6	10.4	9.7	10.2	11.3
10d	0	0	8.6	0	8.4	10.7
STD 1	0	13.3	13	0	12.7	18.9

Zone of inhibition = ± 0.03 mm; STD 1- Clotrimazole.

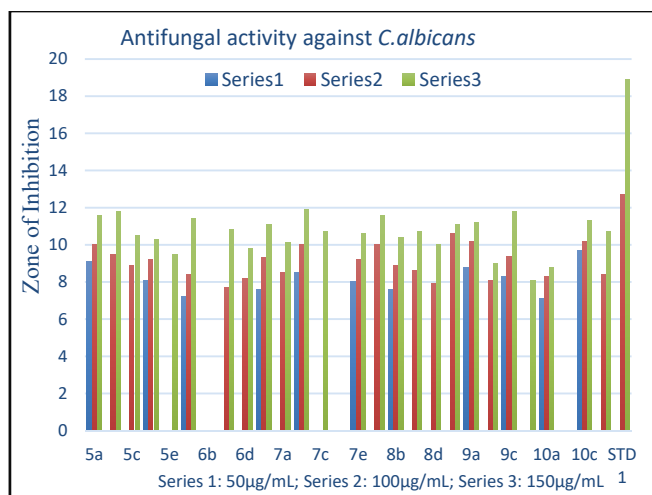


Figure 8: Graphical Representation of Antifungal activity against *C. albicans*.

CONCLUSION

In this work, we reported synthesis and evaluation of new class of molecules as potent anti-bacterial and anti-fungal agents aimed to develop chromone based lead structures. There was library of 28 compounds synthesized and evaluated. We were able to introduce polar and non-polar characters in the form of ethoxypiperidine or ethoxypyrrolidine moieties and we believe that antimicrobial activities are attributed to optimum lipophilic (non-polar)- and hydrophilic (polar) characteristics of the molecules. Out of 28 compounds; **5c**, **5e**, **6a**, **7b**, **7d**, **9a** and **9b** possessed competent antibacterial activity while **6a**, **7b**, **8b** and **9c** were found to be good antifungal agent. Compounds **6a** and **7b** were found to be good antimicrobial agents and were active against both bacterial as well as fungal strains. Further work on diversification towards improving therapeutic potential of chromone analogues is under development.

Bacterial and fungal strains are continuously developing resistance against existing antibiotics and antifungals thereby we tried to explore new drug molecules with possible active pharmacophores. The heterocyclic cores collaborated with chromone core was an ideal combination for antifungal drug entity. The SAR studies and the in-silico studies also manifested them to be good drug entities and hence, the work was tried based on the designing and computational studies of the molecules.

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Conflict of Interest

Authors declare no conflict of interest.

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