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Deeksha Bhoomi, Nagpur



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3.3.1

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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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| 8 | Rare actinobacteria: a potential source of bioactive polyketides and peptides. | Bundale, S., J. Singh, D. N. Begde , Nashikkar, and A. Upadhyay" | World Journal of Microbiology and Biotechnology | Biochemistry | Yes | 46-56 |
| 9 | Natural Alternatives to Treat Cancer: A Study on Anticancer Activity of Lawsonia Inermis Linn. | Mungle, A., A. Ittadwar, and D. Begde | International Journal of Pharmaceutical Science and Research | Biochemistry | Yes | 57-62 |
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| 14 | Data of characterization and adsorption of fluoride from aqueous solution by using modified Azadirachta indica bark | Dr. N. G. Telkapalliwar | Data in brief | Chemistry | Yes | 92-106 |
| 15 | Comparative study of various adsorption isotherms, by the adsorption of succinic acid onto activated carbon of bhagar rice husk | V. M. Shivankar | International Journal of Current Engineering and Scientific Research (IJCESR) | Chemistry | No | 107-113 |
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| 24 | Design and Implementation of Low-cost Blood Pressure and Body Temperature Monitoring System using Wireless Technology | K.Y.Rokde, P.B.Dahikar, S.S.Shende | International Journal of Current Engineering and Scientific Research-IJCESR | Electronics | Yes | 187-192 |
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| 29 | Dr. Babasaheb Ambedkaranchya Sankalpanetil Bharatiya Ripublikan Paksha | Avinash Fulzele | AJANTA an International Multidisciplinary Research journal | History | No | 216-226 |
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| 45 | Phytochemical screening of root of Orthosiphon Rubicundus (D. Don) | Dr. D. Y. Panhekar | Bioinfolet - A Quarterly Journal of Life Sciences | Chemistry | No | 336-337 |
| 46 | Knoevenagel Condensation Shadowed by Michael Addition & O-Alkylation of Resorcinol, Malononitrile and Benzaldehyde to form Pyrrolidine, Piperidine and Morpholine Substituted Benzopyran Derivatives in Dry K ₂ CO ₃ | Dr. D. Y. Panhekar | Asian Journal of Chemistry | Chemistry | Yes | 338-340 |
| 47 | Phytochemical screening of root of Orthosiphon Rubicundus (D. Don) | RC Sawant, SR Somkuwar, TV Biswas, TP Sawant, DY Panhekar | Bioinfolet - A Quarterly Journal of Life Sciences | Chemistry | No | 341-342 |

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES PERFORMANCE ANALYSIS OF AES AND BLOWFISH CRYPTOGRAPHIC ALGORITHMS

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ABSTRACT

Information security plays very important role in storing and transmitting the data through unsecured channel. Cryptography plays a very important role in the network security to maintain the CIA triad that is Confidentiality, Integrity, Authentication and non-repudiation of information. Due to that security of information is much important in data storage and transmission process. Using cryptography, the data is encoded before sending it and decoded after receiving, Cryptographic algorithms are broadly divided into two types, symmetric key and asymmetric key cryptographic algorithms. There are various symmetric key algorithms available such as DES, AES Blowfish, Two fish, SAFER etc. This paper deals with the performance analysis of symmetric key cryptographic algorithms AES and Blowfish.

Keywords: *Cryptography, AES, Blowfish, Symmetric key cryptography.*

I. INTRODUCTION

Cryptography is a technique which is used to secure transmitting information. The process includes encryption and decryption. Secret key is used in the process to convert the plaintext into encrypted format [1]. Symmetric key and asymmetric key cryptography are the two classifications of cryptography.

Various symmetric key cryptographic algorithms are available. In this paper we have considered only AES and Blowfish algorithms.

AES operates on a 128 bit data block at a time and uses 128, 192 or 256 bits key length and uses 10, 12 or 14 rounds. If both block length and key length are 128 bits, AES will perform 9 processing rounds. If the block and key are 192 bits, AES will perform 11 processing rounds. If the block and key are 256 bits [3], then it performs 13 processing rounds. Each processing rounds involves four steps.

Blowfish is a symmetric 64-bit block cipher invented by Bruce Schneier [4]; optimized for 32-bit processors with large data caches, it is significantly faster than DES on a Pentium or Power PC-class machine. Key lengths can vary from 32 to 448 bits in length [5]. Blowfish, available freely and intended as a substitute for IDEA, is in use in over 80 products. Blowfish is an algorithm of my own design, intended for implementation on large microprocessors. The algorithm is unpatented.

Blowfish is designed to meet the following design criteria.

1. **Fast.** Blowfish encrypts data on 32-bit microprocessors at a rate of 26 clock cycles per byte.
2. **Compact.** Blowfish can run in less than 5K of memory.
3. **Simple.** Blowfish uses only simple operations: addition, XORs, and table lookups on 32-bit operands. Its design is easy to analyze which makes it resistant to implementation errors.
4. **Variably Secure.** Blowfish's key length is variable and can be as long as 448 bits. Blowfish is optimized for applications where the key does not change often, like a communications link or an automatic file encryptor. It is significantly faster than DES when implemented on 32-bit microprocessors with large data caches, such as the Pentium and the PowerPC. Blowfish is not suitable for applications, such as packet switching, with frequent key

changes, or as a one-way hash function. Its large memory requirement makes it infeasible for smart card applications [6].

II. SYMMETRIC KEY ALGORITHMS

The following are the symmetric key cryptographic algorithm used in this paper.

Advanced Encryption Standard Algorithm

A data block is partitioned into an array of bytes. Such bytes are interpreted as a finite field elements using polynomial representation. The input is divided into 16 bytes and then arranged into a 4x4 matrix column wise [7]. This matrix is known as the state matrix. The original 128-bit key is also divided in to 16 bytes as like 128 bit data and arranged in the form of 4x4 matrixes. This matrix is called keyMatrix.

Both these matrices form the necessary inputs to the algorithm.

AES encryption includes,

- 1) An initial round (0)
- 2) Nine general rounds (1 to 9) and
- 3) A final round (10)

In round(0) the two matrices are simply XORed under AddRoundKey transformation. The output of Round0 is given as the input to Round 1. Each round composed of four distinct, uniform and invertible transformations: Subbytes, ShiftRows, MixColumn and AddRoundKey[8].

i) Subbytes

This stage also known as Substitute Bytes, it is simply a table lookup using a 16x16 matrix of byte values called s-box. This matrix consists of all the possible combinations of an 8 bit sequence ($2^8 = 16 \times 16 = 256$). It is a non-linear byte substitution operation designed to give the required amount of Confusion. It operates independently on each byte of the State matrix using a substitution table S-box. Each byte is substituted by corresponding byte in the S-box.

ii) ShiftRows

This stage is also known as Shift Row Transformation. It works as follows:

- 1) The first row of state is not altered.
- 2) The second row is shifted 1 bytes to the left in a circular manner.
- 3) The third row is shifted 2 bytes to the left in circular manner.
- 4) The fourth row is shifted 3 bytes to the left in a circular manner

It is a transposition step that gives the required amount of Inter – word Diffusion and operates individually on each of the last three rows of state matrix shifting cyclically a certain number of bytes. The first row is left unchanged. The second row is left rotated by one byte, third row by two bytes and fourth row by three bytes as shown in fig 1.

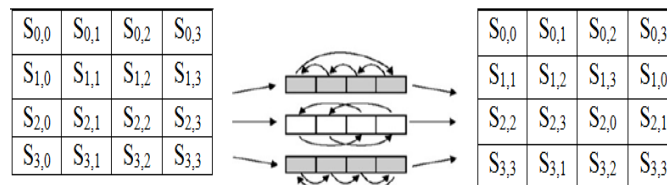


Figure 1 : ShiftRows stage

iii) MixColumn

This operation gives intra-word Diffusion and operates on each column of the state matrix individually, combining the four bytes in each column using multiplications and additions in GF (2^8). Each byte of a column is mapped into a

new value that is a function of all four bytes in the column. The transformation can be determined by the following matrix multiplication on state.

The MixColumn transformation of a single column j ($0 \leq j \leq 3$) of state can be expressed as follows:

$$\begin{pmatrix} 02 & 03 & 01 & 01 \\ 01 & 02 & 03 & 01 \\ 01 & 01 & 02 & 03 \\ 03 & 01 & 01 & 02 \end{pmatrix} \begin{pmatrix} S_{0,j} & S_{0,1} & S_{0,2} & S_{0,3} \\ S_{1,j} & S_{1,1} & S_{1,2} & S_{1,3} \\ S_{2,j} & S_{2,1} & S_{2,2} & S_{2,3} \\ S_{3,j} & S_{3,1} & S_{3,2} & S_{3,3} \end{pmatrix} = \begin{pmatrix} S'_{0,j} & S'_{0,1} & S'_{0,2} & S'_{0,3} \\ S'_{1,j} & S'_{1,1} & S'_{1,2} & S'_{1,3} \\ S'_{2,j} & S'_{2,1} & S'_{2,2} & S'_{2,3} \\ S'_{3,j} & S'_{3,1} & S'_{3,2} & S'_{3,3} \end{pmatrix}$$

$$S'_{0,j} = (2 \cdot S_{0,j}) \oplus (3 \cdot S_{1,j}) \oplus S_{2,j} \oplus S_{3,j}$$

$$S'_{1,j} = S_{0,j} \oplus (2 \cdot S_{1,j}) \oplus (3 \cdot S_{2,j}) \oplus S_{3,j}$$

$$S'_{2,j} = S_{0,j} \oplus S_{1,j} \oplus (2 \cdot S_{2,j}) \oplus (3 \cdot S_{3,j})$$

$$S'_{3,j} = (3 \cdot S_{0,j}) \oplus S_{1,j} \oplus S_{2,j} \oplus (2 \cdot S_{3,j})$$

Where \cdot denotes multiplication over the finite field $GF(2^8)$.

Figure 2 : Matrix Multiplication on state

iv) **AddRoundKey**

It is designed to provide Key Dependency and Asymmetry. It operates independently on each byte of the State matrix by adding it with the corresponding byte of the Subkey using bitwise XOR. For each round, a Subkey is derived from the main key using the keyexpansion function. Each subkey has the same size as the state matrix .

The final round includes all the transformations except MixColumn. After completing all the ten rounds the output is 128 bits in encrypted format called cipher text.

Key Expansion

Key expansion is an important for both encryption and decryption. The AES key expansion algorithm takes as input a 4-word (16 bytes) key and produces a linear array of 44 words (176 bytes). This is sufficient to provide a 4-word round key for the initial Add Round Key stage and each of the 10 rounds of the cipher. The following figure shows pseudo code for generating the expanded key from the actual key.

```
KeyExpansion (byte key [16], word w [44])
{
  Word temp
  for(i=0;i<4;i++)
  w[i]=(key[4*i], key[4*i+1], key[4*i+2], key[4*i+3]);
  for(i=4;i<44;i++)
  {
    temp=w[i-1];
    if(i mod 4=0)
    temp=SubWord(RotWord(temp)) ⊕ Rcon[i/4];
    w[i]=w[i-4] ⊕ temp;
  }
}
```

The key is copied into the first four words of the expanded key. The remainder of the expanded key is filled in four words at a time. Each added word $w[i]$ depends on the immediately preceding word, $w[i-1]$, and the word four positions back $w[i-4]$.

Blowfish

begin itemize

Blowfish has 16 rounds.

The input is a 64-bit data element, x.

Divide x into two 32-bit halves: xL, xR.

Then, for i = 1 to 16:

xL = xL XOR Pi

xR = F(xL) XOR xR

Swap xL and xR

After the sixteenth round, swap xL and xR again to undo the last swap.

Then, xR = xR XOR P17 and xL = xL XOR P18.

Finally, recombine xL and xR to get the ciphertext. Decryption is exactly the same as encryption, except that P1, P2,..., P18 are used in the reverse order. Implementations of Blowfish that require the fastest speeds should unroll the loop and ensure that all subkeys are stored in cache [9, 10].

Key generation

- Large number of sub keys is used in blowfish.

- The p-array consists of 18, 32-bit sub keys.

P1,P2,.....,P18

- S-Boxes consist of 256 entries each,

S1, 0, S1,1,..... S1, 255

S2, 0, S2,1,..... S2, 255

S3, 0, S3,1,..... S3, 255

S4, 0, S4,1,..... S4, 255

Steps to Generate Sub Keys

1) Initialize first the P-array and then the four S-boxes.

2) The first 32 bits of the key is with XOR P1, the second 32-bits of the key is with XOR P2.

3) Encrypt the all-zero string with the Blowfish algorithm, using the sub keys described in steps (1) and (2).

4) This new output is now P1 and P2.

5) Encrypt the output of step (3) using the Blowfish algorithm with the modified sub keys.

6) This new output is now P3 and P4.

7) Repeat 521 times in order to calculate the new sub keys for the P- array and Four S- boxes.

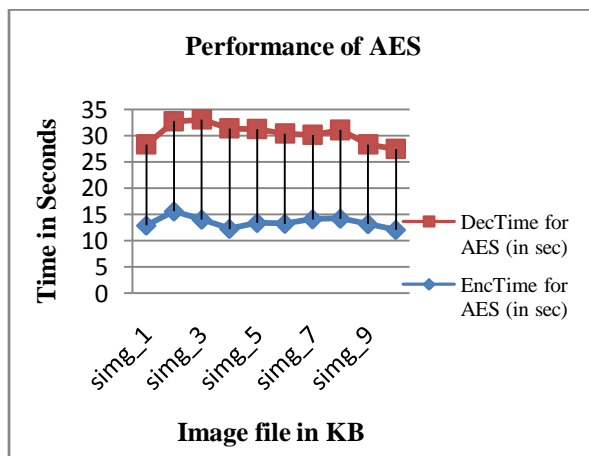
III. IMPLEMENTATION

Both the algorithms AES and Blowfish are implemented in MATLAB 2011B on Street View Text (SVT) dataset. The following table shows the results for AES algorithm.

Table 1:Encryption and Decryption time using AES algorithm

| Image File | EncTime for AES (in sec) | DecTime for AES (in sec) |
|------------|--------------------------|--------------------------|
| simg_1 | 12.8963 | 15.4335 |
| simg_2 | 15.5877 | 17.1697 |
| simg_3 | 14.0168 | 19.049 |
| simg_4 | 12.2666 | 19.1165 |
| simg_5 | 13.3995 | 17.8594 |
| simg_6 | 13.2348 | 17.1037 |
| simg_7 | 14.0978 | 16.0071 |

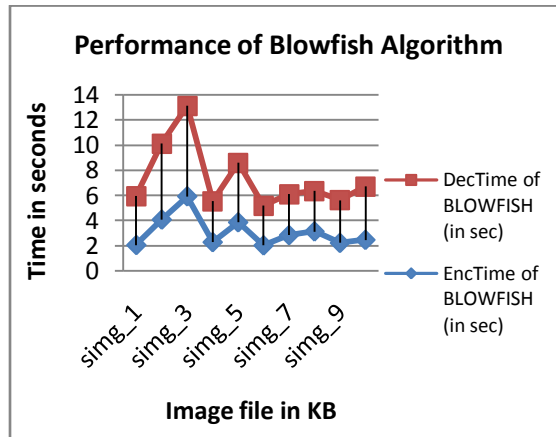
| | | |
|---------|---------|---------|
| simg_8 | 14.2068 | 16.851 |
| simg_9 | 13.1588 | 15.0954 |
| simg_10 | 12.0649 | 15.393 |



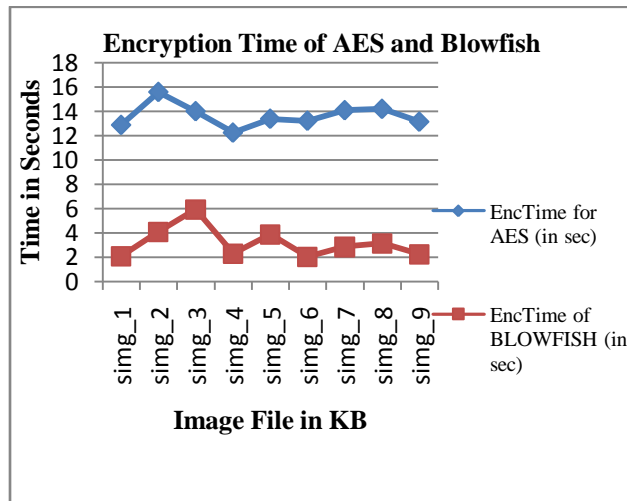
Graph 1: Encryption and Decryption time of AES algorithm

Table 2: Encryption and Decryption time using BLOWFISH algorithm

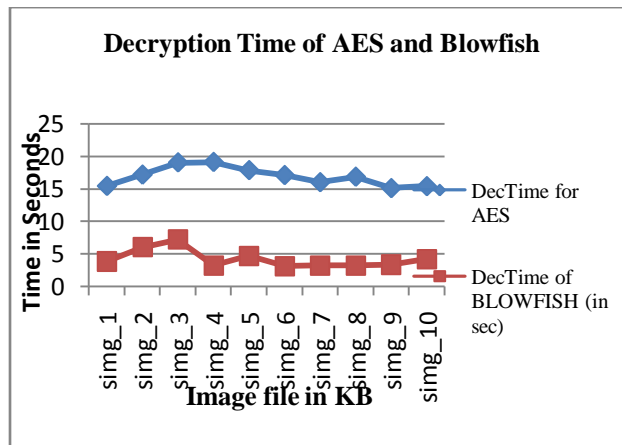
| Image File | EncTime of BLOWFISH (in sec) | DecTime of BLOWFISH (in sec) |
|------------|------------------------------|------------------------------|
| simg_1 | 2.0741 | 3.8855 |
| simg_2 | 4.0829 | 6.0387 |
| simg_3 | 5.9221 | 7.2156 |
| simg_4 | 2.3013 | 3.2498 |
| simg_5 | 3.8681 | 4.7308 |
| simg_6 | 2.0435 | 3.1608 |
| simg_7 | 2.8564 | 3.2649 |
| simg_8 | 3.1485 | 3.2146 |
| simg_9 | 2.2426 | 3.4008 |
| simg_10 | 2.4819 | 4.2392 |



Graph 2: Encryption and Decryption time for Blowfish algorithm



Graph 3: Encryption Time required for AES and BLOWFISH



Graph 4: Decryption Time required for AES and BLOWFISH

Cryptography deals with the actual securing of digital data. It refers to the design of mechanisms based on mathematical algorithms that provide fundamental information security services. It is an establishment of a large toolkit containing different techniques in security applications.

The encryption and decryption time of symmetric key algorithms AES and Blowfish is compared and analyzed. The evaluation result shows that, the execution time required for Blowfish algorithm is less than AES algorithm therefore the performance of Blowfish algorithm is found to be better than AES.

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GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

CLUSTERING AND CLASSIFICATION TECHNIQUES USING TEXT MINING

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ABSTRACT

The text is nothing but the combination of characters. Therefore, analyzing and extracting information patterns from such data sets are more complex. Several methods have been proposed for analyzing such texts and extracting information. Data mining, a specific area named text mining is used to classify the huge semi structured or unstructured data needs proper clustering. Maximum text documents involves fast retrieval of information, arrangement of documents, exploring of information from the documents. Declaration of text input data and classification of the documents is a complex process.

Text Clustering is an unsupervised method in which no input out patterns is predefined. This method is based upon the idea of dividing the similar text into the same cluster. Individual cluster consists of number of records. The clustering is thought better if the contents of documents of intra cluster are more alike than the contents of inter-cluster documents.

Classification is used to find out in which group each data instance is related within a given dataset. It is used for classifying data into different classes according to some constrains. Several major kinds of classification algorithms including C4.5, ID3, k-nearest neighbor classifier, Naive Bayes, SVM, and ANN are used for classification. This paper describes the comparative study of clustering and Classification Algorithms.

Keywords: Data mining, Text mining, Classification, Clustering and Rapid Miner.

I. INTRODUCTION

Text Mining [1] is the process of extracting useful information or patterns from the unorganized (unstructured) text that are from various sources. As the text is in unorganized form, it is quite difficult to handle it. For finding interesting information from the natural language text is the main purpose of text mining. The text mining process is shown in below figure 1:

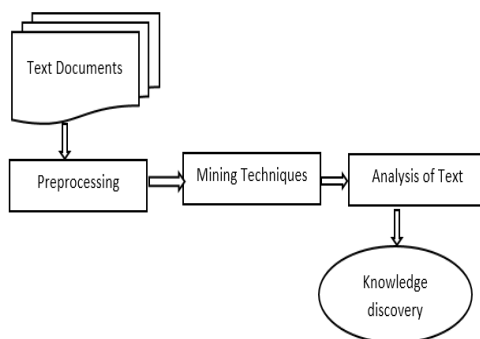


Figure1: Framework of Text Mining

Here we present the approaches for the analysis of tasks preprocessing, classification and clustering.

Step I- Pre-processing Text: As compare to natural languages documents, Mining from a pre-processed document is easy. Thus, pre-processing of documents is an important task during text mining process before applying any text mining technique. As Text documents can be represented as - a bag of words on which different text mining methods. To reduce the dimensionality of the texts words, appropriate methods such as filtering and stemming are used. Filtering techniques remove those words from the set of all words that do not give relevant information; stop word filtering is a conventional filtering method. After this step is applied, every word is represented by its root word.

Step II- Mining Technique: In this step the selected algorithm is applied to text in order to process the document. Here, the clustering and Classification and classification algorithms are used.

Step III - Analysis of Text: For knowledge discovery purpose, outputs which are coming from initial stage are analyzed here. For this purpose, various tools such as link discovery tool can be used. Here the unstructured text has been converted into some meaningful information from which one can make decisions.

II. CLASSIFICATION ALGORITHMS

Classification [2, 3] means turning over a document or object to one or more classes. This may be done manually or algorithmically. Classification is done mainly based on attributes, behavior or subjects.

Classification [4] is a mining technique that assigns categories to a collection of data in order to aide in more accurate predictions and analysis [5], is known Decision Tree, classification is a method intended to make the analysis of very large data sets effective. To create an effective set of classification rules which answers a query, makes decision based on the query and predicts the behavior. To begin with a set of training data sets are created with certain set of attributes or outcomes.

The Classification [6] problem can be specified as a training data set consisting of records. Each record is identified by unique record id, and consist of fields corresponding to the attributes. The continuous attribute is an attribute with a continuous domain and an attribute with a finite domain of discrete values is called a categorical attribute. One of the categorical attribute is the classifying attribute or class and the value in its domain are called class labels. The main objective of the classification algorithm is, how to set of attributes reaches its conclusion.

K-Nearest Neighbor (KNN)

K-Nearest Neighbor [4] classifier is an Algorithm which is based on a distance function for pairs of observations, such as the Euclidean distance or Cosine. In this hypothesis, k nearest neighbors of a training data is computed first. Then the similarities of one sample from testing data to the k nearest neighbors are aggregated according to the class of the neighbors, and the testing sample is assigned to the most similar class. KNN is nonparametric lazy learning algorithm. A technique is nonparametric, it means that it does not make any assumptions on the underlying data distribution.

Naive Bayes Classifier

Naive Bayes[7] is used to deal with the problem of document classification by a deceptively simplistic model. The Naive Bayes approach is applied in Flat (linear) and hierarchical manner for improving the efficiency of classification model. It has been found that Hierarchical Classification technique is more effective than Flat classification. It also performs better in case of multi-label document classification. Bayesian classifier is a statistical classifier as well as a supervised learning method. It will predict class membership probabilities. It calculates explicit probabilities for hypothesis and it is robust to noise in input data. When Bayesian classifier is applied to large datasets, it shows high accuracy and speed. Naïve Bayesian classifiers assume that the effect of an attribute value on a given class is independent of the values of the other attributes.

Decision tree

Decision tree [8] is classification algorithm in which there are several popular decision algorithms such as Quinlan's ID3, C4.5, C5, and CART [9]. A decision tree is a flow-charting like structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node holds a class label [10]. This technique separates observation into branches to construct tree on repetition basis. In most cases, tree classifiers

perform classification in two stages: tree-growing and tree-pruning. The tree-growing is top down approach. In this stage, the tree is split in a recursive manner called recursive partitioning. It is completed when the subset at a node has all the same value of the target variable, or when splitting no longer adds value to the predictions. In the tree-pruning, the tree will be fully grown, fully grown tree is cut back to avert over fitting data and this way it improves the correctness of the tree in bottom up manner. This technique is used to improve the estimate and correctness of the algorithm by minimizing the over fitting. Decision tree is widely used in various areas because it is strong enough for data distribution.

Random Forest

Random forests [4] is an ensemble learning method. It is one of the accurate learning algorithm. The basic concept of the algorithm is to build many small decision-tree and then merging them to form a forest. It is computationally easy and cheap process to build many such small and weak decision trees. So such decision trees can be formed in parallel and then it can be combined to form a single and strong forest. The algorithm for random forests uses the common technique of bootstrap bagging. Given a training set $S = \{(x_1, y_1), \dots, (x_n, y_n)\}$, bagging repeatedly (B times) selects a random sample from the training set and construct trees to fit these samples. This procedure leads to better performance that while the predictions of a single tree are highly sensitive to noise in its training set, the average of many trees is not, as long as the trees are not correlated.

SVM Based Classification

Support vector machines [11] are based on the Structural Risk Minimization principle [12] from computational learning theory. The idea of structural risk minimization is to find a hypothesis h . The true error of h is the probability that h will make an error on an unseen and randomly selected test example. An upper bound can be used to connect the true error of a hypothesis h with the error of h on the training set and the complexity of H (measured by VC-Dimension), the hypothesis space containing h [12]. Support vector machines find the hypothesis h which minimizes this bound on the true error by effectively and efficiently controlling the VC-Dimension of H . SVMs are very universal learners, in their basic form, SVMs learn linear threshold function. Nevertheless, by a simple "plug-in" of an appropriate kernel function, they can be used to learn polynomial classifiers, radial basic function (RBF) networks, and three-layer sigmoid neural nets. One remarkable property of SVMs is that their ability to learn can be independent of the dimensionality of the feature space. SVMs measure the complexity of hypotheses based on the margin with which they separate the data, not the number of features. This means that we can generalize even in the presence of very many features, if our data is separable with a wide margin using functions from the hypothesis space.

The same margin argument also suggest a heuristic for selecting good parameter settings for the learner. The best parameter setting is the one which produces the hypothesis with the lowest VC-Dimension. This allows fully automatic parameter tuning without expensive cross-validation.

Text Clustering

Clustering [13] is one of the commonly used unsupervised learning methods for analyzing the context of text data in natural language form [14]. Clustering [15] is the process of grouping or classifying objects based on information obtained from the data describing the relationship among objects in principle to maximize the similarities among members of the same class and to minimize the similarities among the class or cluster [16]. It is a mathematical approach in collecting and segmenting similar documents into clusters. It helps trim down the volume of unstructured text and provide a simpler understanding and thematic structure of the data. It also provides the keywords in each cluster that is useful in extracting valuable insights, hence, customer sentiments can be summarized using these keywords.

Clustering is concerned with grouping objects together that are similar to each other and dissimilar to the objects belonging to other clusters. For our analysis have chosen Random Clustering algorithm to cluster documents.

This algorithm performs a random flat clustering of the given Dataset. Please note that this algorithm does not guarantee that all clusters will be non-empty. It creates a cluster attribute in the resultant Dataset. It is important to note that this algorithm randomly assigns examples to clusters.

III. RESULT & DISCUSSION

For the analytical study we have taken the two folders i.e. **Sports Baseball** and **Sports Hockey** from **Mini 20 News Group Dataset**. The values for **Accuracy, Precision, Recall and Execution Time** for Random Clustering and Classification Algorithms i.e. K-NN, Naïve Bayes, Decision Tree, Random Forest and Support Vector Machine (SVM) are calculated. Two methods are considered in this paper. In **Method 1** we have executed Classification algorithm first then the clustering Algorithm and in **Method 2** we have executed Clustering algorithm first then the Classification Algorithm.

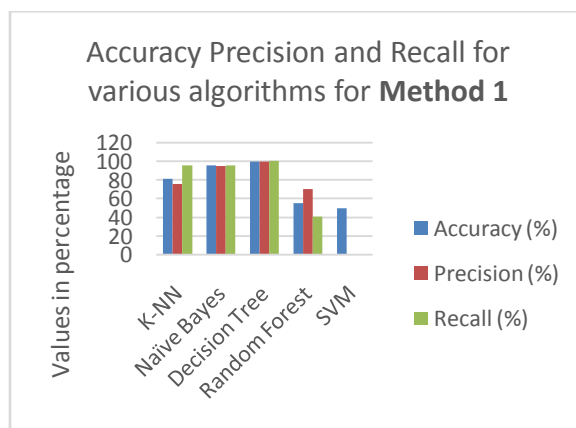
The following Table1 shows the values for metrics, when method 1 is executed.

Tables:

Table 1. Performance of Method 1

| Metrics Algorithm | Accuracy (%) | Precision (%) | Recall (%) | Time (min & sec) |
|--------------------------|-----------------|------------------|---------------|---------------------------|
| K-NN | 80.35 | 74.77 | 94.60 | 5:01 |
| Naïve Bayes | 94.85 | 94.82 | 94.90 | 1:26 |
| Decision Tree | 99.70 | 99.41 | 100 | 1:47 |
| Random Forest | 55.15 | 78.77 | 38.10 | 4:17 |
| SVM | 50.00 | Unknown | 0.00 | 2:44 |

From Graph 1 it is clear that, Decision Tree algorithm is better among all the five algorithms.

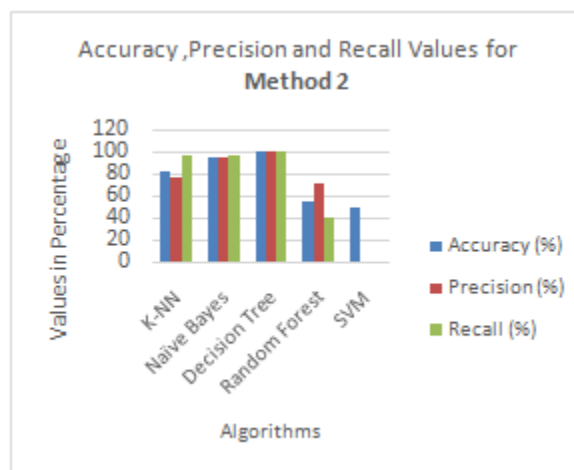


Graph 1: Results for Method 1

The following Table 2 shows the values of metrics, when we execute Method 2.

Table 2. Performance of Method 2

| Metrics Algorithm | Accuracy (%) | Precision (%) | Recall (%) | Time (Min & Sec) |
|-------------------|--------------|---------------|------------|------------------|
| K-NN | 81.40 | 75.58 | 95.60 | 5:8 |
| Naïve Bayes | 95.30 | 95.00 | 95.70 | 1:34 |
| Decision Tree | 99.70 | 99.41 | 100 | 1:43 |
| Random Forest | 55.10 | 70.2 | 40.84 | 4:31 |
| SVM | 50 | Unknown | 0.0 | 2:44 |



Graph 2: Results for Method 2

From Graph 2 it is clear that, Decision Tree algorithm is better among all the five algorithms.

IV. CONCLUSION

This paper deals with various Classification and Clustering techniques used in TextData mining. Data Mining is a wide area that integrates techniques from various fields including machine learning, artificial intelligence, statistics and pattern recognition, for the analysis of large volumes of data. Classification methods are typically strong in modeling interactions, these classification algorithms are implemented on 20 News Group dataset. In this paper, we have compared and analyzed the classification and clustering algorithms. The clustering and classification algorithms are executed in sequence and analyzed. We observed the results in Method 2 is better than Method 1. Classification algorithms such as K-NN, Naïve Bays, Decision Tree, Random Forest and SVM compare with the results for Decision Tree algorithm is better in terms of both the Method – 1 & 2 Accuracy (99.70), Precision (99.41) and Recall (100).

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REVIEW OF WORK LOAD MANGEMENT ISSUE FOR BETTER INTEROPERABILITY IN CLOUD ENVIRONMENT

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ABSTRACT

In cloud computing environment, the data to be provided and used by user is stored in data centres which are situated across the world. The cloud providers choose developed countries like USA, UK, and other European Countries for the data centres so that they can be accessed by the cloud users across the world. The data centres consist of hundreds of nodes which are hundreds in number. The data centres provided the services to users like storage, resource usage for computational purposes over the middleware which is internet. These services are provided through the power of virtualization in the form of virtual machines. The virtual machines differ in the terms of configuration like CPU speed, memory capacity, bandwidth etc. Due to the dynamic nature of cloud computing it is very necessary that the data centres should satisfy the dynamic need of users with the best quality of service. The most important aspect of this diverse nature of data centres is interoperability. This paper reviews the workload management issue for a better interoperability in cloud environment.

Keywords: s

I. INTRODUCTION

A cloud comprises processing, network, and storage elements, and cloud architecture consists of three abstract layers. *Infrastructure* is the lowest layer and is a means of delivering basic storage and compute capabilities as standardized services over the network. Servers, storage systems, switches, routers, and other systems handle specific types of workloads, from batch processing to server or storage augmentation during peak loads. The middle *platform* layer provides higher abstractions and services to develop, test, deploy, host, and maintain applications in the same integrated development environment. The *application* layer is the highest layer and features a complete application offered as a service. [1]

In cloud environment everything is provided in the form of a service. All these services are provided to the customers according to their need be. The need of every customer is different. Accordingly either of the service providers comes into action. Here are three service providers which are working in cloud environment:

- SAAS(Software AS A Service): This service provider allows to run all types of software without even installing them priorly.
- PAAS(Platform As A Service): This service provider allows the customer to access all platform without constructing them from basics.
- IAAS(Infrastructure As a Service):This service provider consists of infrastructure facilities like storage, servers, email servers, domain server. IAAS on demand can provide different operating systems or softwares without need to pay heavy license fees. [2]

The above services can be provided through the following deployment models:

- Private Cloud: This type of cloud deployment model is built especially and exclusively for the company customers and no other customers can access it. It is model a very cost effective model but the security provided is the reason why most of the customer opt it.

- **Public Cloud:** Public cloud infrastructure can be accessed ubiquitously by all types of customers. Though security remains an issue still many facilities like fast access etc are the reasons why mid-sized companies choose this deployment model.
- **Hybrid Cloud:** This cloud deployment model is a power-pack combination of one or more private and public clouds. Hybrid cloud can be considered as a best solution to interoperability issue as it allows the data to migrate from private cloud to public cloud as and when needed. Hybrid cloud ensures safety, reliability and scalability which are the best services of private and public cloud. The best part is hybrid cloud leverages the cost benefits to a great extent. [3] [4].

This paper concentrates on the workload management issue of the interoperability problem. This would also benefit both Cloud customers and Cloud providers. There has to be much needed focus on interoperable Cloud environment which will make customers able to compare and choose among Cloud offerings with different characteristics while they will switch between Cloud providers whenever needed without setting data and applications at risk. They will interoperate and cooperate according to demand without conflicts due to interoperability problems. This work will deal with different interoperability standards and frameworks. Standardization issues need

Interoperability continues to be an issue when cloud providers design their own proprietary solutions for managing and monitoring resources.

NIST defined cloud computing as a model for enabling convenient, on-demand network access to a shared pool of computing resources which can be rapidly provisioned and released with minimal management efforts or service provider interaction. NIST, OMG, DMTF as a part of their efforts related to standardization for cloud interoperability have developed use cases for cloud computing. These use cases are divided into cloud management, cloud interoperability and cloud security. As we cannot directly work on cloud environment for interoperability the related issues needs to be focused are as follows:

1. User Authentication.
2. WorkLoad Migration And Management.
3. Data Migration
4. Load Balancing

interoperability solutions will abide to. There are different options and techniques discovered for attaining interoperability. Reaching consensus of all top players in not an easy task for cloud computing.

Cloud computing should provide users with full benefits of cloud properties including elasticity, scalability, accessibility and flexibility. These benefits should not be limited within only one particular cloud provider. There are various protocols, standards and concepts available which specifically target interoperability problems in clouds. Cloud interoperability can be said “As an ability to migrate services or transfer data from provider to another”.

II. LITERATURE REVIEW

Rajkumar Buyya, Rajiv Ranjan, Rodrigo Calheiros, in their paper “Intercloud: Utility Federation of Cloud computing Environments For Scaling Application Services”, presents vision, challenges, and architectural elements of InterCloud for utility-oriented federation of Cloud computing environments. The proposed InterCloud environment supports scaling of applications across multiple vendor clouds. The approach has been validated by conducting a set of rigorous performance evaluation study using the CloudSim toolkit. The results demonstrate that federated Cloud computing model has immense potential as it offers significant performance gains as regards to response time and cost saving under dynamic workload scenarios. [5]

Jamie Loret, Miguel Garcia et. al. in their paper “Architecture and Protocol For Intercloud Communication” propose that clouds should interrelate through networking protocols in order to provide scalability, efficiency and flexibility by using services and computational and storage resources infrastructures of the other clouds. The paper proposes an architectural and protocol that allows exchanging information, data services, storage and resources between interconnected clouds. The architecture is highly scalable and permits to add new clouds easily. The protocol

designed provides node discovery and fault tolerance. The testing and analysis has been done is controlled test bench. [6]

Grace A. Lewis in the report “Role Of Standards In Cloud Computing Interoperability” focuses on the interoperability issue in cloud computing. The report proposes various solutions to interoperability problem like standardization. The research report proposes various interoperability use cases and their solutions as effort towards solving interoperability issue. It focuses on the four use cases of interoperability as follows: 1) User Authentication 2) Data Migration 3) Workload Migration and Management 4) Load Balancing. The paper proposes various recommendations as a part of solution towards interoperability. [7]

Rodrigo Calheiros et al in their paper “Cloudsim: A Toolkit For Modelling And Simulation Of Cloud Computing Environment And Evaluation Of Resource Provisioning Algorithms”, discuss the importance of CloudSim simulator by a case study using dynamic provisioning of application services in hybrid cloud federated cloud environment. The application services hosted under cloud computing model are complex provisioning, composition, configuration and deployment. Evaluating the performance of cloud provisioning policies, workload management and resource performance model in different conditions and repeatable manner are very difficult. The result of the case study which was undertaken by authors, prove that use of federated hybrid clouds significantly improves the QOS requirements under varying demand pattern. [8]

Pankaj Sareen, Dr. Tirpat Singh in the paper “Simulation Of Cloud Computing Environment Using CloudSim”, propose a simulator environment of cloud environment called CloudSim. The authors in this paper reveal that testing of any algorithm in real environment of cloud is very difficult. The authors propose that CloudSim simulator helps to test and analyze the real cloud environment. CloudSim toolkit supports both system and behaviour modeling of cloud components like data centres, processors, virtual machines and resource provisioning policies. All these are tested and analyzed in CloudSim with limited efforts and costs. The paper discusses the power of CloudSim and all the variants of CloudSim like Cloud Analyst, Cloud Reports etc. [9]

Prof. S.M.Ranbhise, Prof. K.K.Joshi in their paper “Simulation and Analysis of Cloud Environment” focuses on the advantages of cloud environment. There are different resources in cloud environment like Virtual Machine, CPU, resource, Memory, Hard disk space of server machines located in data centre. The server machines are consuming energy to provide services to users in cloud computing. For analyzing the resource allocation in cloud computing environment which is scalable to n servers then we will require Cloud simulation and modeling tool which will take create the cloud as per requirement. This paper analyzes simulation of cloud on CloudSim and Cloud report for better analysis of cloud environment. [10]

III. WORK LOAD MANAGEMENT

Interoperability refers to moving of data from one cloud environment to another when two clouds make mutual agreement for exchange without bothering or changing the semantics. For effective implementation of interoperability the basic need of exchanging or transferring the workload among different clouds without any issues is very important. The workload can be transferred from public to private or vice a versa. Thus, workload management can be viewed as one of the important issues of interoperability. Workload management literally means finding the most appropriate virtual machine in a specific data centre with the help of combination of broker policies and load balancing algorithms.

To move out for workload management with respect to interoperability basic need of workload management and its proper approach should be thought of with respect to time, cost and energy efficiency. The interoperability implementation in cloud environment would be at its best when all the metrics such as resource utilization.

Cloud workload is an agglomeration of many dissimilar applications and services, having different performance and resource requirements. They are also constrained in the form of Service Level Agreements (SLAs). Many factors affect cloud performance such as the variability in the resource and network conditions and the highly vibrant nature

of the workloads. This totally depends on user interactions. In this scenario the use of virtualized resources could lead to performance degradation. This degradation is the consequence of heterogeneous workloads on the same physical infrastructure and also due to the overheads caused by the resource management policies being implemented. The blend of workloads concurrently executed on a given virtual machine (VM) may lead to degradation in performance because of incompatible usage of resource. These performance issues could become even more critical in federated cloud environments where the workload is distributed across different cloud infrastructures. Hence, effective deployment of cloud technologies and workload management it is of utmost importance to expect and get desired service levels and QOS parameters.

Workload management is the management of inputs i.e. applications, services, transactions, data transfers submitted and processed in a cloud environment. Cloud workloads are batch mode and not hard real-time applications. Workload management is an important issue but very less study has been done on this. So for deeper knowledge, pattern of cloud workloads i.e. their qualitative and quantitative attributes are studied to identify some broad categories specified in terms of various dimensions as given in the diagram.

IV. SIMULATION STUDY OF WORKLOAD MANAGEMENT

In this experiment workload migration and management are studied in terms of broker policies and scheduling algorithm. The study evaluates different broker policies along with different scheduling algorithms and their role towards workload management. The experiment selects most appropriate combination of broker policy and scheduling algorithm for workload management in hybrid cloud.

The study has been done by focusing on the issue of workload management and the metric for evaluating the performance was Execution Time. The user first sends a request which is processed by the Data Centre Controller and then forwarded to Data Centre Broker which decides the best broker policy to implement according to the need of the user. The broker checks the data centre for allocation according to the need of the user. As the suitable data centre is chosen the next job of the broker is to choose the virtual machine to assign for the workload to execute. The VM LoadBalancer decides the appropriate allocation of load balancing policy to be implemented. The User Base Generates the Internet Cloudlet and the Internet redirects the request to Service Broker for Data Centre Controller selection. The service broker makes use of the service broker policy to decide the data centre to be assigned to the user request. In this experiment the study was done on all three broker policies with respect to interoperability in hybrid cloud [11]. On studying all the three broker policies it has been decided that the best broker policy would be which gives best execution for the workload to be executed in hybrid cloud while interoperability is being facilitated.

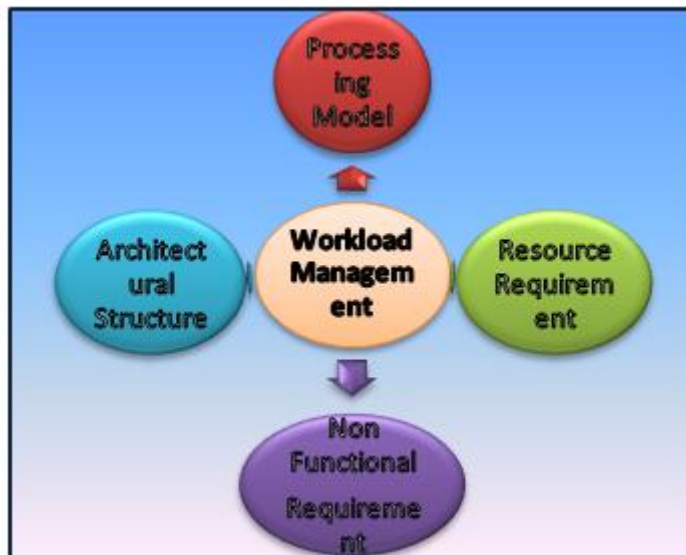
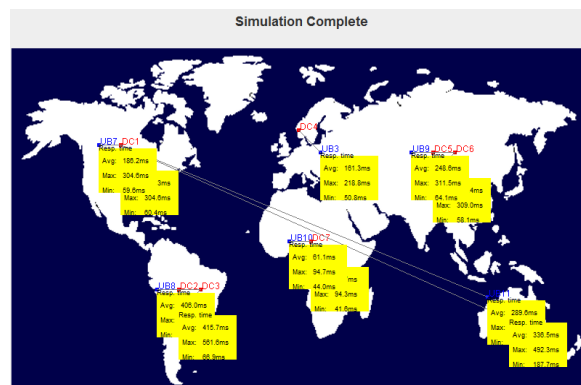


Figure 1: Workload Management



workload management

V. RESULT & DISCUSSION

The performance of workload management in hybrid cloud is studied using utility based resource distribution policy i.e. Response Time. This means that the resource distribution is done dynamically as per need of the user which expects that the workload management is done to the data centre which has least response time.

In cloud computing there are two players on is cloud provider and other is cloud user. The cloud provider holds massive high speed resources clubbed in data centres to be provided to the users on a pay per use basis. The cloud users rent these resources in a variable approach. The user's view of resources is just to generate as much as profits in a less investment. There are various such users in the environment with varying workloads and also varying number of resources demand. Thus in short these massive high speed resources are shared in the cloud environment to maximize resource utilization thereby generating more money and less cost to put in. But this does not go that smoothly i.e. if the resources are not used efficiently then either the virtual machines providing the resources are overloaded or under loaded. The user wants the resources to do as much work as possible in less cost. This situation is addressed as efficient resource utilization.

Thus in the workload management there should be ideal workload allocation to the resources without any overloading or under-loading which in turn provides energy efficiency and less execution time.

VI. CONCLUSION

Interoperability issue in cloud environment is very well addressed by using hybrid cloud framework. The cloud federation or hybrid cloud technology is still in its development stage. The hybrid cloud architecture proves out to be a better solution for interoperability. It can be concluded that hybrid cloud architecture helps to achieve better interoperability as it is a powerful combination of public and private clouds which takes care of continuity of service and also boosts the reliability of the participating Cloud providers.

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Design of Data Warehouse Model using Decision tree Data Mining Tool for Target Marketing in e-Business

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Abstract: *The data warehouse is set key information that can be used in business management. Target marketing has generated an increasing interest among academics and practitioners over the past few years. This is due to competitive market environment, advancement in technology and changing behavior of customers which are difficult to predict. Despite of numerous studies that have provided important insights into the target marketing, the understanding of this topic of growing interest and importance still remains deficient. Therefore, the objective of this paper is to provide a comprehensive framework to guide research efforts focusing on target marketing strategies in e-Business and aid practitioners in their quest to achieve target marketing success using data mining methods. The framework builds on the literature from target marketing concepts in e-Business and data mining methods that provides a systematic approach to users who have little knowledge in data mining in order to carry out effective marketing campaigns in e-Business*

Keywords: *Data Mining, Target marketing, Decision Tree, Data warehouse model*

I. Introduction

The data warehouse is set key information that can be used in business management. This information can be of great value e.g. within carrying a promotion campaign or when deciding about the level of goods in a storehouse. Target marketing is the process of identifying potential buyers of certain products and promoting the products accordingly [1]. There are two methods of advertisement and promotions, namely target marketing and mass marketing. Mass marketing targets general public by using media such as newspapers, radios and television. This results in high waste and low response rate from customers who will actually buy the product [2]. In today's competitive market place, mass marketing is no longer efficient and reliable method. Hence, marketers are shifting their focus from traditional mass marketing to target marketing. Target marketing studies customers' characteristics, needs and selects certain customers as their target for promotion.

To counteract the rising costs and declining response rates from customers, target marketing use predictive modeling by analyzing the customers data (demographic and historical purchase data) in order to select the customers who are more likely to respond to a promotion [3], [4], [5] which give higher response rate and it is an effective method for marketing. Large amounts of data are generated every day in many organizations. These data can be used to establish and maintain direct relationship with the customers in order to target them individually for specific offers.

To extract hidden predictive information from large amounts of data, Organizations are now realizing the importance of data mining in their strategic planning and successful application of data mining methods that can generate useful knowledge to organizations[6], [7]. There are a lot of research papers on computational and theoretical aspects of target marketing though little efforts have been put on technological aspects of applying data mining in the target market process.

This is due to the complexity of the data mining models that make it difficult for marketers to use and understand them [8]. In addition, the marketers have little knowledge on data mining skills; hence there is a need to develop a simplified framework to guide marketers in making use of data mining methods for target marketing.

II. Data Mining

These tools include mathematical algorithms, statistical models and machine learning methods. The growing interest of data mining in business is enhanced by number of technological factors. The growing amounts of customer data are collected and made accessible in data repositories and data marts. Powerful new data analysis algorithms are discovered by researchers from statistical pattern recognition and artificial intelligence field such as machine learning, neural networks and evolutionary computation. Recently, ordinary office computers are powerful enough to run these advanced data mining algorithms [6], [9].

Data mining tools takes data and construct a model as a representation of the reality. The aim of data mining is to solve an e-business problem [4]. In target marketing, data mining are used to reveal a specific class of customers which are most likely to be interested in a particular product. This will allow the planning of a

target marketing campaign aimed toward a specific class of customers with the aim of achieving higher response [8]. The data mining process is sometimes referred to as Knowledge Discovery in Databases (KDD). The “KDD” refers to the overall process of discovering useful knowledge from data. Knowledge discovery in database is the process of identifying valid, novel, potentially useful and understandable patterns or models in data. Data mining itself is a step in knowledge discovery process. The steps involved in knowledge discovery are:

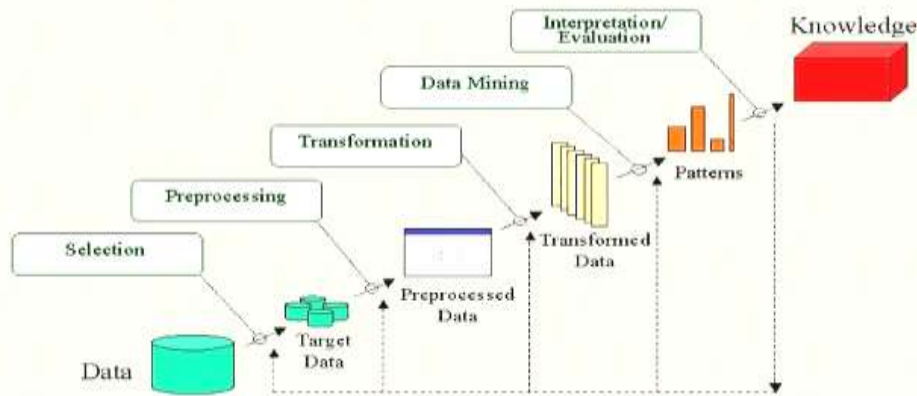


Fig. 1 Knowledge discovery process

Data Selection: The data relevant to the analysis is decided and retrieved from the various data locations.

Data Preprocessing: This stage consists of:

Data Cleaning: This is the removing of noisy data and irrelevant data from the data collected.

Data Transformation: This is where the selected data is transformed into forms appropriate for the mining procedure.

Data Mining: It is the crucial step in which clever techniques are applied to extract potentially useful patterns. The decision is made about the data mining technique to be used.

Interpretation and Evaluation: In this step, interesting patterns representing knowledge are identified based on given measures. The discovered knowledge is visually presented to the user. This essential step uses visualization techniques to help users understand.

III. Classification In Data Mining

Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large [9]. Classification is a data mining function that assigns items in a collection to target categories or classes. The goal of classification is to accurately predict the target class for each case in the data. Basically classification is used to classify each item in a set of data into one of predefined set of classes or groups. Classification method makes use of mathematical techniques such as decision trees, linear programming, neural network and statistics [9].

A classification task begins with a data set in which the class assignments are known. In training process, a classification algorithm finds relationships between the values of the predictors and the values of the target. Different classification algorithms use different techniques for finding relationships.

These relationships are summarized in a model, which can then be applied to a different data set in which the class assignments are unknown. Classification models are tested by comparing the predicted values to known target values in a set of test data. The historical data for a classification project is typically divided into two data sets: one for building the model; the other for testing the model.

3.1 Decision Tree

A decision tree is a popular classification technique that results in flowchart like tree structure where each node denotes test on an attribute value and each branch represents an outcome of test. The leaves represent classes. Using training data decision tree generates a tree that consists of nodes that are rules and each leaf node represents a classification or decision. The data usually plays important role in determining the quality of the decision tree. If there are number of classes, then there should be sufficient training data available that belongs to each of the classes. Decision trees are predictive models, used to graphically organize information about possible options, consequences and end value. They are used in for calculating probabilities.

3.2 C 4.5 Decision tree Algorithm

C4.5 builds a decision tree from set of training data using the concept of Information entropy. The training data is a set $S = s_1, s_2, \dots$ of already classified samples. Each sample $s_1 = x_1, x_2, \dots$ is a vector where x_1, x_2, \dots represent attributes or features of the sample. The training data is augmented with a vector $C = c_1, c_2, \dots$ where c_1, c_2, \dots represent the class to which each sample belongs. At each node of the tree,

C4.5 chooses one attribute of the data that most effectively splits its set of samples into subsets enriched in one class or the other. Its criterion is the normalized information gain (difference in entropy) that results from choosing an attribute for splitting the data. The attribute with the highest normalized information gain is chosen to make the decision. The C4.5 algorithm then recurses on the smaller sub lists. In general, steps in C4.5 algorithm to build decision tree are:

1. Choose attribute for root node
2. Create branch for each value of that attribute
3. Split cases according to branches
4. Repeat process for each branch until all cases in the branch have the same class.

IV. Design of Data Warehouse Model For Target Marketing in e-Business using Data Mining Tool

The data warehouse model for target marketing in e-Business consists of five phases outlined below:

Understanding the problem domain- The starting point of any data mining project is to understand the business goals and requirements of the e-business. The next step is to translate the data mining problem into a preliminary plan in order to attain the project objective. In this stage the problem is defined in details and selection of data mining tools to be used in the later process is identified.

The four main data mining activities involved in this phase are trend analysis, customer profiling, project goals and deviation analysis [10], [11].

Data Preprocessing or Data Sources- Data preparation accounts for 60%- 80% of the time spent on a data mining project. Data preprocessing consists of four tasks namely:

Data cleaning:Raw data is often incomplete, inconsistent and contain many errors. Data cleaning is achieved by filling in missing values, smoothing the noisy data and resolving the inconsistencies in the data therefore improving the quality of data.

Attribute or feature selection:In this stage one has to select a relevant attribute that appears to be a good predictor of the class and remove irrelevant or redundant attributes.

Data transformation:This is the transformation of raw data into an understandable format e.g. Microsoft excel, database etc. for further analysis and processing.

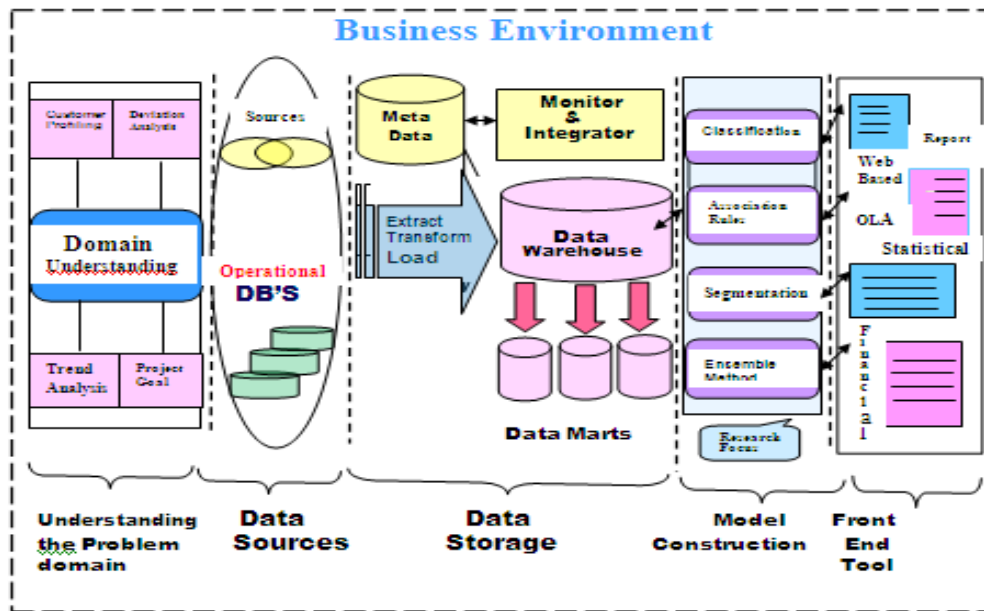


Fig.2 Conceptual Data Warehouse model for target marketing in E-Business using Data Mining tool

ETL: this stands for Extract, Transform and Load. One has to extract data from the outside sources, transform it to fit into operational needs and load it into the end target e.g. data base or data warehouse.

Model construction- Once the historical data has been collected, the next thing is model construction. This is achieved by applying different models to the same data set and then comparing their performance to choose the best model. The main aim of creating a model is to predict the purchasing behavior of customers. Decision tree are the best and popular models for classification. This is because they have the ability to generate rules that can be translated into natural language. Complex decision trees can be dealt with by following the path through the tree to a particular leaf which makes the explanation of any particular classification or prediction relatively easy [9].

Model Evaluation- Model Evaluation is an important part of the model development process. It helps to find the best model that represents our data and how well the chosen model will work in the future. There are two methods of evaluating models in data mining, Hold-Out.

Hold-out method is meant for large data sets and it is divided into three parts:

Training set- is a subset of the data set used to build predictive models.

Validation set- is a subset of data set used to assess the performance of the model built in the training phase. It provides a test platform for fine tuning model's parameters and selecting the best performance model. Not all modeling algorithms need a validation set.

Test set- a subset of the dataset to assess the likely future performance of a model. If a model fit to the training set much better than it fits the test set, over fitting is probably the cause.

Cross validation is used when only a limited amount of data is available; to achieve an unbiased estimate of the model performance we use k -fold cross-validation. In k fold cross-validation, we divide the data into k subsets of equal size. We build models k times, each time leaving out one of the subsets from training and use it as the test set. If k equals the sample size, this is called "leave-one-out. The model with the best performance is selected for campaign [12].

Visualization (Front End Tools)-This is the application of a model for prediction or classification to new data. After a satisfactory model or set of models has been identified (trained) for a particular application, we usually want to apply those models so that predictions or predicted classifications can quickly be obtained for new data. We use lift chart to measure the effectiveness of a classification model which is calculated as the ratio between

the results obtained with and without the model. Lift charts are visual aids for evaluating performance of classification models. The lift chart shows how much more likely we are to receive positive responses than if we contact a random sample of customers [10].

V. Case Study of Target Marketing in Volvo Cars

The data set we used was from Volvo cars and had 45,212 observations. Each observation represents a customer and is described by 17 attributes, both categorical and continuous. The variable “y” (target) describes whether the customer had subscribed to a term deposit. There were no missing values since detailed descriptions on the meaning of each variable were provided. All of the observations had received the direct promotion. The classification goal is to predict if the client will subscribe to a term deposit (variable y). Decision tree algorithm was chosen because they are powerful and popular tools for classification and prediction. The model constructed had great interoperability because rules can readily be expressed so that humans can understand them [13]. In addition, decision trees have the ability to generate rules that can be translated into natural language in contrast to neural networks. Complex decision trees can be dealt with by following the path through the tree to a particular leaf which makes the explanation of any particular classification or prediction relatively easy [9] [13]. The experiments were conducted using the supervised learning algorithm C4

VI. Experimental Results

We performed our experiments using 10-fold cross validation. The original dataset was randomly portioned into ten disjoint subsets. In each of the ten runs, nine of the subsets are combined to form the training set while the remaining subset forms the testing set. Based on the response rate, there are two classes, the positive class consists of the responders and negative class consists of non-responders. The highest responders are put into decile

1. The response rate is high showing that the supervised learning algorithm performs well using the training data being sampled. Lift is the most commonly used metric to measure the performance of targeting models in marketing applications. The target members selected are those likely to respond positively to a marketing offer. The results of the model are shown in figure 4.1 below. The x-axis represents the different percentiles x. The y-axis represents the response rate.

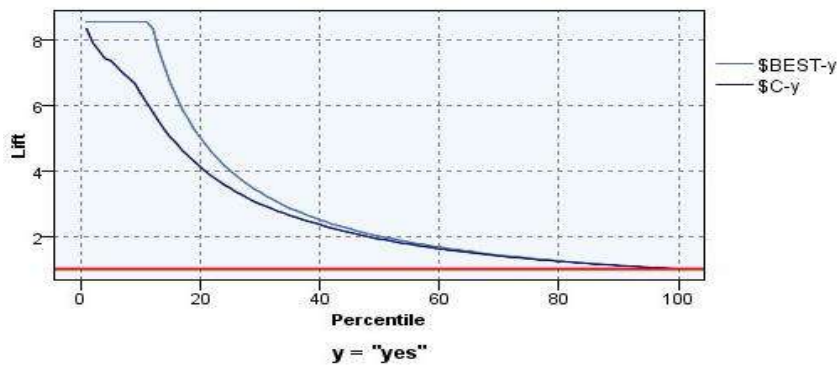


Fig. 3 Lift chart

Results for output field y

Comparing \$C-y with y

| | | |
|---------|--------|--------|
| Correct | 42,212 | 93.37% |
| Wrong | 2,999 | 6.63% |
| Total | 45,211 | |

Performance Evaluation

| | |
|-----|-------|
| no | 0.074 |
| yes | 1.882 |

Fig.4.1 Results for output field y

VII. Conclusion

We demonstrated that data mining is an effective tool for target marketing in e-Business which can improve target marketing campaigns. Most research papers focus on computational and theoretical aspects of target marketing though little efforts have been put on technological aspects of applying data mining in the direct market process. The complexity of the data mining models makes it difficult for marketers to use it, hence; we outlined a simplified framework to guide marketers and managers in making use of data mining methods and focus their advertising and promotion on those categories of people in order to reduce time and costs. We explained all the steps and tasks that are carried out at each stage of the data warehouse model framework using data mining tool.

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IMPACT OF IT FOR CREATING A MORE EFFECTIVE FINANCIAL SYSTEM IN INDIA

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Abstract:

The use of IT solutions for providing banking facilities at doorstep holds the potential for scalability of the financial inclusion initiatives. The recent developments in banking technology and expansion of telecommunication network in the hinterlands of the country have provided the perfect launch pad for extending banking outposts to remote locations without having to open bank branches in the area. The RBI's Annual Policy for 2016-17 also urged the banks to scale up efforts for IT-based financial inclusion and develop technologies that are highly secure, amenable to audit and follow widely accepted open standards to allow inter operability among the different systems adopted by different banks. The RBI has set up an advisory group for IT-enabled financial inclusion to facilitate development of IT solutions for delivery of banking services. The present paper discusses about the importance and recent initiatives of IT based financial inclusion; and models of delivery of IT- enabled banking services to rural areas.

Key words: *Financial Inclusion, Financial Exclusion, Financial Services*

Introduction

Financial inclusion is considered to be critical for achieving inclusive growth; which itself is required for ensuring overall sustainable overall growth in the country. Financial inclusion may be defined as the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low income groups at an affordable cost. The approach to financial inclusion in developing countries such as India is somewhat different from the developed countries. In the latter, the focus is on the relatively small share of population not having access to banks or the formal payments system, whereas in India, majority of the population are excluded from financial system. Financial exclusion can be thought of in two ways. One is exclusion from the payments system i.e. not having access to a bank account. The second type of exclusion is from formal credit markets, requiring the excluded to approach informal and exploitative markets. The financially excluded sections largely comprise marginal farmers, landless labourers, oral lessees, self employed and unorganised sector enterprises, urban slum dwellers, migrants, ethnic minorities and socially excluded groups, senior citizens and women. While there are pockets of large excluded population in all parts of the country, the North East, Eastern and Central regions contain most of the financially excluded population. There are a variety of reasons for financial exclusion. In remote, hilly and sparsely populated areas with poor infrastructure, physical access itself acts as a hindrance. From the demand side, lack of awareness, low incomes/assets, social exclusion, and illiteracy are different reasons act as barriers. The requirements of independent documentary proof of identity and address can be a very important barrier in having a bank account especially for migrants and slum dwellers. From

the supply side, distance from branch, branch timings, cumbersome documentation and procedures, unsuitable products, language, staff attitudes are common reasons for exclusion. All these result in higher transaction cost apart from procedural hassles.

IT Solutions for Financial Inclusion

The use of IT solutions for providing banking facilities at doorstep holds the potential for scalability of the financial inclusion initiatives. Pilot projects have been initiated in the country by using smart cards for opening bank accounts with biometric identification. Link to mobile or hand held connectivity devices ensure that the transactions are recorded in the banks books on real time basis.

Some State Governments are routing social security payments and payments under the National Rural Employment Guarantee Scheme through smart cards. The same delivery channel can be used to provide other financial services like low cost remittances and insurance. The use of IT also enables banks to handle the enormous increase in the volume of transactions for millions of households for processing, credit scoring, credit record and follow up.

The recent developments in banking technology and expansion of telecommunication network in the hinterlands of the country have provided the perfect launch pad for extending banking outposts to remote locations without having to open bank branches in the area. In short, technology has to enable the branch to go where the customer is present, instead of the other way around. Further, RBI's Annual Policy for 2007-08 also urged the banks to scale up efforts for IT-based financial inclusion and develop technologies that are highly secure, amenable to audit and follow widely accepted open standards to allow inter operability among the different systems adopted by different banks. The enabling provisions and support of RBI has facilitated successful pilot projects in use of IT for extending the banking outreach for the "excluded". These projects are premised on technology which uses hand-held devices and connectivity with host computers through General Packet Radio Service (GPRS) / Global System for Mobile Communications (GSM) / Code Division Multiple Access (CDMA) / landline networks. The devices also come in several forms like Simputers (Simple Inexpensive Multi-lingual Computers) / personal digital assistants, programmed mobiles, etc. There are also rural biometric ATMs, which have been introduced by banks and found to be very popular among rural masses. Some major banks are introducing low cost rural ATMs for cash dispensing and other services in rural areas.

The RBI has set up an advisory group for IT-enabled financial inclusion to facilitate development of IT solutions for delivery of banking services. The issue of using technology as a driver is of the opinion that the requirement of rapid financial inclusion as a national goal can only be achieved by using appropriate IT. The creation of a national database, sectoral, geographic and demographic reports, and also a payment system among the cardholders to benefit the under privileged unbanked population of the country is not possible without extensive use of IT. This alone can bring down the costs of the small ticket transactions of the financially included and make nationwide financial inclusion a reality. The technology suppliers and banks should evolve common minimum standards for ensuring inter-operability between their systems. Use technology to reduce cost of delivery. A recent Boston Consulting Group report estimates that the cost of funds today is 9 per cent, provision for bad debts is 10 per cent and cost of consumer acquisition and transaction and operation cost is 13 per cent for the poorest customers, leading to banking for the poor becoming unprofitable. The key role that technology has to play is to reduce the last two components drastically. Reducing these costs can translate into lower lending costs, which would help improve the viability of risky rural businesses and allay concerns

that the high cost of lending to poorer segments is resulting in over indebtedness. Equally, distances are large in rural areas and transport sparse.

Here again, communications technology could play an important role by bridging the last miles between the customer and the provider and thus facilitating transactions. Transaction and operation costs consist of front-end costs, network costs and back-end operation costs. Back-end costs for banks vary from Re 1 to 2 per transaction. While banks have done a good job in computerizing their operations, they need to learn from mobile operators and optimize back-end technologies and leverage volume to significantly reduce these costs.

The front-end continues to be the dominant costs for banks. The use of ATMs has significantly reduced front-end costs but they are still too high. Banks need to promote lower costs indigenous ATM technologies, especially for rural areas. Going beyond ATMs, front-end costs can be brought to negligible amounts by replacing cash transactions with electronic transactions. More than 80 per cent of India's financial transactions are processed in physical cash. Cash as means of payment has a large cost in terms of handling, transaction processing, holding and risk of loss. On the other hand, Internet banking transactions have zero front-end cost for the banks; efforts have to be made to make this a preferred mode of transactions for large corporations. Its extension to SMEs may have much larger impact. Rural Internet Kiosks can be used by all rural businesses to carry out such transactions. Mobile banking is perhaps the most promising front-end technology for facilitating financial inclusion in India, especially for individual customers. The telecom and the banking industry along with RBI has recently constituted a Mobile Payment Forum of India (MPFI) to examine technological, regulatory and business constraints related to the scaling up of mobile banking in India. This Forum's recommendations would be the key to provide a roadmap for mobile banking. Additionally, Stored Value Cards would be another important vehicle for financial inclusion. There is a need to create common payments systems with participation by multiple banks, to reduce transaction costs and substantially increase the deployment and utilization of POS terminals. An important advantage of all these interfaces is that they are essentially cash-less and minimize fraud and the costs related to cash handling. Further, technology can be significantly leveraged for acquiring customers. Banking correspondents (BC) with Internet Kiosks at villages as well as BCs armed with mobile phones with back-end interface (e.g., the kirana shop) has to be used extensively. A unique ID for each citizen would help accelerate this. Finally technology has to be used to reduce provisions for bad debt. Credit ratings for retail customers and a unique citizen ID are critical in this regard. Capturing all the transactions electronically and mandatory sharing of data with a credit bureau would significantly help in this direction. The absence of this and high provision for bad debts, is in fact hurting the poorest most. The role of public policy is to enable the adoption and scale up of appropriate technologies while mitigating risks of their misuse. Public policy can play an important role in the establishment of a unique identification number and the promotion of biometric authentication, which would facilitate the development of credit bureaus.

Models of IT Based Delivery of Financial Services

1. ICT Based Solution

International Institute of Information Technology, Bangalore has developed an ICT based Solution in which the banking services delivery can be done using the electronic platform. The three key principles used in this model are –

a) unbundling and outsourcing non-statutory services needed for banking and establishing digital rural information infrastructure

b) automating the workflow, the records management and follow-up and recovery, and c) the use of entrepreneurship model for achieving effectiveness, efficiency and economy in the performance of the rural information infrastructure, rural information services and other follow-up functions e.g., credit rating of rural individuals and analytics for decision support. An ICT-based solution focuses on improving the delivery of credit and other services of the rural areas. The solution proposes common infrastructure for the rural data collection and information management and processing and the sharing of the delivery channel by the banks with a view to substantially reducing the transaction costs and improving the speed and quality of delivery. The elements involved in the solution are the establishment of a data centre and ensuring its two-way connectivity to the mobile multi-service delivery system available at the villages for providing the banking, extension and other services as well as connectivity to all the concerned banks and other service-providing agencies. The solution involves the outsourcing of the data management as well as of the delivery channel establishment and operations with required safeguards regarding the data ownership and operations. The model envisaged provides a cost-effective but efficient technology platform for rural banking. Technologically, the solution involves four main elements: such as establishment of digital rural information infrastructure; multi service delivery system; integrated multi-entity database system; and service provider's workstation. The Figure 1 gives a diagrammatic representation of the Model.

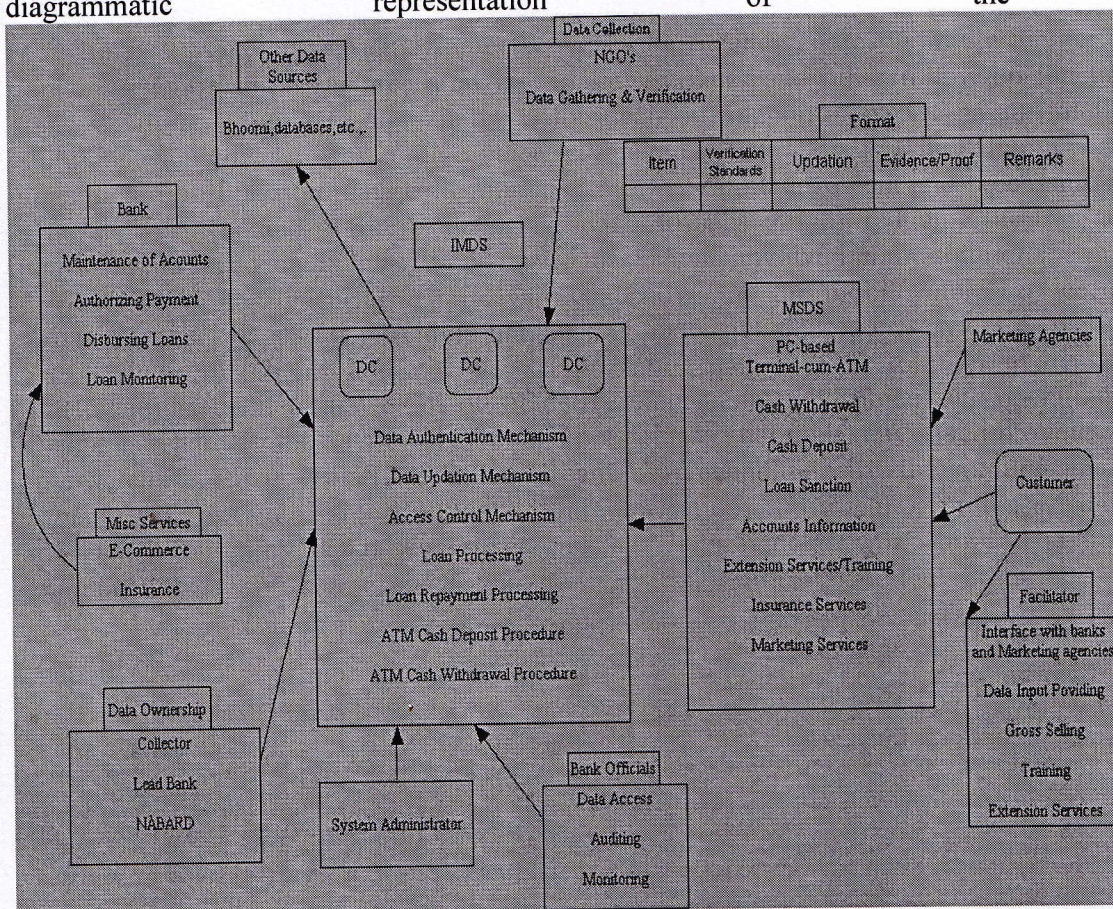


Figure 1: Diagrammatic Representation of the ICT Based Model

2 Primary Agricultural Co-operative Societies as Village Knowledge Center (PACS -VKCs)

The Government of India (GoI) has sought World Bank assistance to support a comprehensive reform program to transform India's Rural Cooperative Credit System (CCS)—comprising over 108,000 village level Primary Agricultural Societies (PACS), 367 District Central Cooperative Banks (DCCBs) and 30 State Cooperative Banks (SCBs)—into robust and reliable providers of finance to the rural poor, particularly small and marginal farmers. In January 2006, GoI announced a reform package designed to transform the potentially viable CCBs into democratically governed, efficiently managed, financially sustainable, self-reliant entities that can provide a wider range of financial services to the rural poor on more affordable terms. States are free to participate in the package on a voluntary legal, regulatory and institutional reforms to address the governance and operational weaknesses affecting CCBs. Promoting PACS as Village knowledge Center allows Rural Customer to look at PACS for short and long term needs through multi offerings including Financial Services, Citizens' Services, Agro Advisory & Market Information and Educational & Support Services. This Approach would attract the rural customers and village community to PACS as Village Knowledge Center for multiple services and develop loyalty. In the long term, a rural consumer would be less influenced by informal channels such as local money lenders. As the physical infrastructure already exists for the PACS, they are evolved as model centers of transformation of rural economy. Rather than dependency on financial revival packages, PACS can evolve into highly independent commercial business center offering multiple services, apart from banking and financial services. This Approach involves: - tying up with 3rd Party Business Entities for Services Offerings; and multi-Agency Services Delivery Approach through NGOs & SHGs. It is a 4 tier Approach and involves modules at each of the highlighted tier (Figure 2). This Model relies on ICT based Solution in which the banking & other value added services delivery can be done using integrated technology and communication

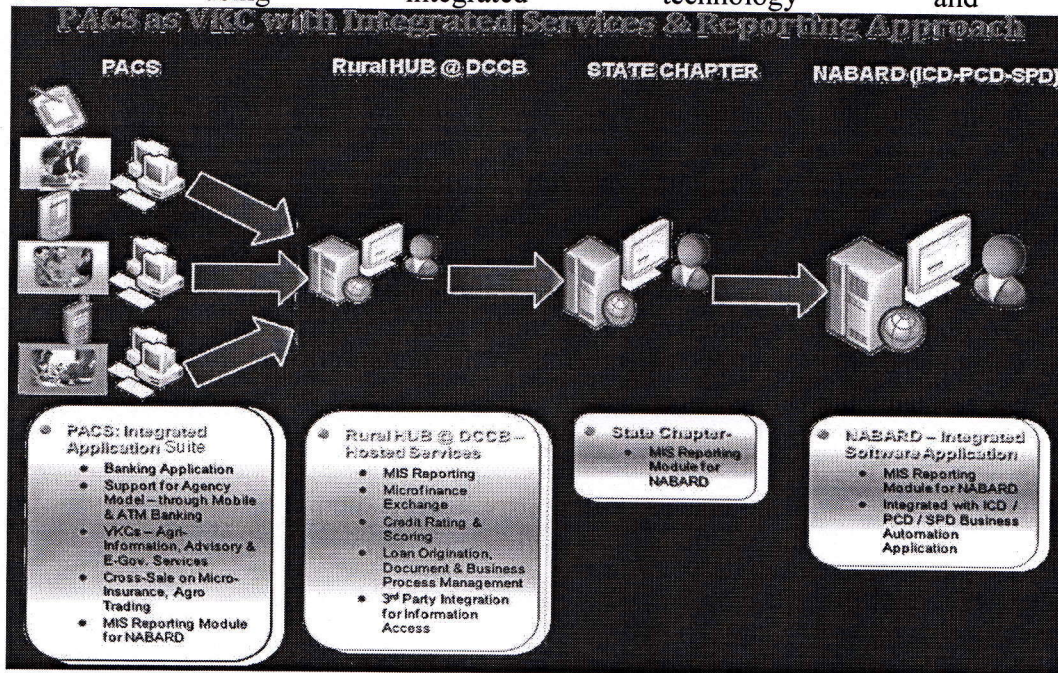


Figure 2: PACS as Village Knowledge Center – A Technology Approach

3 Other Models and Cases on the Use of Technology

- **GANASEVA Model** - The project was implemented in five villages in the Honavar block of the Uttara Kannada district of Karnataka, having approximately 4000 families, involved in essentially agricultural activity. The banks which are participated in this project are State bank of India, ING Vysya Bank, Syndicate Bank, who has agreed to use the data / documents available through the system. Besides the rural information service and credit rating, there is support in the system for the crop loan and Kisan Credit Card and Savings Bank Account Operations. The Project also wanted to link the Primary Agricultural Co-operative Societies (PACS) to the system for providing banking services through their automation.

- **Union Bank of India-** Union Bank of India has launched doorstep banking operations in rural areas of Uttar Pradesh using biometric smart cards. The bank has launched a pilot project in Chahania block in Chandauli district with FINO and Cashpor Micro Credit Ltd., an MFI. FINO provides technical support, which enables the bank to leverage technology to service rural customers. Union Bank of India has introduced biometric cards for vegetable vendors through Hawkers' Association of Mumbai and opened „no-frills“ accounts for them, which will help them deposit money and take loans. The bank is working with FINO in issuing the smart cards. These cards store data on the customer and the account. The banking correspondent, Fintech Foundation, appointed by FINO, goes to these hawkers with point of transaction devices. By swiping the card through these hand-held devices, hawkers can deposit their savings or borrow money. The data from the cards, stored on the terminals, is later transferred to the bank's servers.

- **Punjab National Bank (PNB)** - Punjab National Bank is working with FINO to roll out smart cards for the rural population in Rajasthan. FINO would enable PNB's zero-balance savings account customers to carry out transactions by providing FINO smart cards and point of transaction devices. The project aims at catering to PNB's rural clients across the country. Insurance Company is introducing biometric cards in rural and semi-rural areas. ICICI Lombard plans to offer biometric cards to families under group health insurance schemes. The card enables policyholders to get hospital treatment without making any advance cash payment.

- **ICICI Prudential Life Insurance Company-** ICICI Prudential Life Insurance Company has launched the use of biometric smart cards for their rural policyholders to pay premiums. Biometric cards contain details of the policyholder such as name, age, address and finger print information. The card enables them to move away from the connectivity and infrastructure barriers and provides real time solutions to policyholders in rural areas.

Conclusion

Technology-based solutions can be used by formal financial institutions to provide a range of financial services to the poor and support the drive for financial inclusion. The effective use of technology can help standardize processes in banking and microfinance as well as reduce the cost of operations. Through technology, banks have the potential to reach out to millions of poor and „unbanked“ people through the use of automated teller machines (ATM) and Point-of-Sale (POS) networks. For the sustained financial inclusion, there is a need for creation of a nationwide electronic financial inclusion system (NEFIS) that would link bank accounts and allow funds to be transferred into them electronically. Such mechanisms can present a saving to the government, both in terms of administrative burden and in terms of cost. There is also a need for the Rural Information Infrastructure for the collection of comprehensive data about the social and economic aspects of the 700 + million rural people at the level of individuals in a self-validating and ready-to-use form and for updating the data on an ongoing basis and managing and processing this data for making it available to the various users viz., the banks, the governmental authorities and various service and utility providers for enabling the delivery of high quality services to the rural people in a cost effective manner.

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negative interaction of ragging among the new students.

Students' Senate:

On several occasions it was found that, opportunities would have to be created for sharing responsibilities, for practicing transparency in all dealings and for helping students to cope with the demands of higher education. The student's senate ensures good governance by elected student representatives. It fosters and promotes cordial relationships between Students and teaches and among students themselves. It facilitates the smooth functioning of academic and non-academic events, co-curricular and extracurricular activities. It also trains students to participate in administration. It consists of office bearers of the union. The president calls the meetings. The vice-President assists in the proceeding. The secretary records minutes and the Treasurer is in charge of finances. There are chairpersons who are individually responsible for religious activities, hostel administration-supervision of food, water, power, sanitation and health services, games and sports, cultural activities and non-residents. Others are in charge of social work. Students are motivated and empowered by this and become self confident.

Quality Education Management:

Students of today are the future of the country. Hence, it becomes our prime responsibility to involve them directly or indirectly in the education system to

know their ideas; which may sometimes be very helpful in deciding the curricular and co-curricular activities essential for betterment of future generation. In education system, teachers and all other participants involved with the system directly or indirectly are always learners. Hence, they must remain open to receive any new good ideas from anyone, even from their students, for improving quality we have to impart value based education, to inculcate civic responsibilities among students and also make them face real life situations with confidence, competence and coverage we have to promote general skills such as responsibility towards community, communication skills, use of information technology among students and know the latest trends in the society.

Green Campus through students' participation:

Every college has its own extension activities but most of the colleges have N.S.S. Unit in their colleges. Through this unit students participate in different social welfare programs one of the programs is plantation of sapling. By involving students in this practice we can create awareness among them about the ecological balance and the greenery of the campus is being maintained by the N.S.S. Volunteers. Each volunteer is instructed to plant at least five saplings inside or outside the campus by involving them we can achieve more than our target.

Involvement of Alumni in Student Development:

There is a need to make students aware of new career trends in the job market. New skill-based courses that can create better job opportunities for undergraduate students need to be introduced. The experience of alumni in the world of work may help in addressing this need. Partnership between alumni and management is necessary for the on-going development of the college. Regular meetings are scheduled between the alumni (office bearers) and the college Management. Alumni are involved in the planning, feasibility studies, finance generation plans and the implementation of the new projects and professional courses of study in the college. At the beginning of each academic session, the office bearers of the alumni associations work out details of the Career Guidance Cell of the college.

Feedback and Action Plan:

Students, the prime stakeholders, have their own set of priorities and needs. Insensitivity to them may render the educational effort of the institution partially ineffective. An assessment of their perceptions is necessary for imaginative planning and effective performance. Hence there is a need to

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obtain their feedback. Their feedback will improve following things.

- Bring about improvement in teaching-learning process.
- Update the Knowledge Facilities, infrastructure to the needs of the time.
- Reframe the existing Curriculum to suit the demands of newer courses.

Student's participation in welfare Programs:

Student's involvement in different government programs will give the program more enthusiasm e.g. Swachh Bharat Abhiyan; Unnat Bharat Abhiyan, Tree plantation, etc. Participation in these programs not only enhances the quality of student but also quality of institution.

Conclusion:

Students' representation in various Committees, the students take active part and make valuable suggestions for the quality development issues of the college. Strengths and weakness of the program are identified and Strategies chalked out to increase operational efficiency, output and the perceived quality Decisions taken are implemented and positive impacts reflected in the enhancement of the performance at all levels.

Impact of ICT on Teaching and Learning Environment

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Abstract

The use of ICT in the classroom is very important for providing opportunities for students to learn to operate in an information age. The initiation of Information and communication technology has made tremendous changes in the present day world. The advent of ICT in education helped to improve the quality of education where teaching and learning eventually became an engaging active process related to real life. Twenty-first-century teaching learning skills emphasize the need to transform the conventional teacher-centered pedagogy to more learner-centered methodology. Active and collaborative learning conditions facilitated by ICT helps to develop a knowledge-based student community. The finding indicate that the use of ICTs in the field of education focusing on its impact on teaching learning process, quality and accessibility of education, motivating learners, learning environment, and students' academic performance.

Key Words: ICT, Education, Teaching, Learning Environment, Motivation

1. INTRODUCTION

Information and communication technology (ICT) has become an important part of most organisation and businesses these days. Over the past two decades, Information Technology (IT) has broadened to become Information and Communication Technology (ICT), and has become better established within schools and colleges. It is difficult and maybe even impossible to imagine future learning environments that are not supported, in one way or another, by Information and Communication Technologies (ICT). When looking at the current widespread diffusion and use of ICT in modern societies, especially by the young – the so-called digital generation – then it should be clear that ICT will affect the complete learning process today and in the future. ICTs have an important role to play in

changing and modernising educational systems and ways of learning. The contemporary society is highly influenced by ICTs in every aspect of life, including education. The effects are experienced more in the field of education since it has the potential for teachers to transform the teaching methodology to meet individual needs. ICT provide remarkable opportunities for developing countries to enrich their educational system since it can help in acquiring and assimilating knowledge.

The importance of ICT has been recognized by educational institutions worldwide. Asserts that ICT has influenced the way people function today, both personally and professionally, which demands change in the educational arena. Colleges that train their students in yesterday's skills and outdated technologies are not meeting the

needs of tomorrow's world. Such students will not fit into tomorrow's professional requirements. Effective use of ICT is crucial to countries that are progressing towards information or knowledge-based society. ICT is a pivotal tool in spreading quality education. The application of information and communication technologies in education has been divided into two main categories: ICTs for Education and ICTs in Education. ICTs for education identify the development of information and communications technology especially for teaching-learning purposes while the ICTs in education includes the adoption of basic elements of information and communication technologies in the teaching-learning process.

2. ICT INTEGRATION ENHANCE TEACHING AND LEARNING

The application of ICT is creating significant changes in the teaching and learning process. The traditional approach in teaching has stressed on content. ICT-enhanced learning stimulates augmented learner involvement. The constructivist method views learning as realistic and learner-centered. ICT is an effective tool in constructivist approach of learning, where teachers can layout simulated and tailor-made learning conditions to students. In this regard, applying educational technology as a constructivist device can help students to display their ideas, express their knowledge, examine, exploit, and process information, in a collaborative learning environment. For instance, software applications like databases and excel sheets foster inquiry-based learning activities. Multimedia is a powerful tool

that assists thinking activities of learners and also helps them to share and express their knowledge. These software applications help students in understanding the concept by doing. It also facilitates in developing an independent approach towards problem – solving. Also went in the same direction by stating that ICT integration helps in constructivist learning where students interact with other learners, the teacher, sources of information, and technology. Such an atmosphere provides the learner with direction and settings to build their knowledge and skills. It also gives a rich collaborative learning condition providing the learner to mull over different perspectives in dealing with issues and solve problems. ICT also facilities collaborative learning. Points out that "the flexible time-space accounted for by the integration of ICT into teaching and learning processes contributes to increasing the interaction and reception of information. Such possibilities propose changes in the communication models and the teaching and learning methods used by teachers, giving way to new scenarios which favour both individual and collaborative learning".

Teachers play a crucial role in integrating ICT. According to in order to integrate ICT in teaching teachers must recognize the usefulness of technology, they should believe that the application of technology does not disrupt the classroom climate. Moreover, they should also have the confidence to manage technology. Nevertheless, research studies indicate that majority of the teachers do not take advantage of the potential of ICT to promote the quality of learning, even

though they have a favorable attitude towards it. Thus, "ICTs are exerting impacts on pedagogical approaches in the classrooms. Their contribution to changes in teaching practices, school innovation, and community services is considerable."

3. ICT ENHANCES ACCESSIBILITY TO LEARNING

Education is not just teaching students based on prescribed syllabus in the four walls of a classroom. It has much border objectives, goals as well as other concepts. Hence, Classrooms without borders needs to be the concept of the contemporary education system. It helps to deliver education anytime and from anywhere. It also affects the way knowledge is imparted and students learning process since learning will be effective if only the strategies are learner driven rather than by the teacher.

ICT provides a great flexibility in education to ensure that learners are able to access knowledge regardless of space and time. Observed that using ICT helps students to communicate, share ideas, and work as a team anywhere, anytime. This includes teleconferencing classroom where students around the world are invited to meet together for discussion related to a specific topic. Under such circumstances students besides acquiring knowledge collectively, also share their learning experiences, which enable to express themselves and contemplate on their learning. ICT also helps to involve the students in a global collaborative learning.

Mobile technologies and immaculate communications technologies support 24/7 teaching and learning process. The

time duration will be utilized within the 24/7 time frame which will be a challenge that educators face in future. Hence, the ICT-empowered education system will eventually result in the democratization of education, predominantly in developing countries like India. Effectual utilization of ICT for the educational purpose will be able to bridge the digital divide that exists in the nation today.

The need for spreading education in developing countries like India has gained impetus since education remains an important platform of social, economic and political mobility of individuals. According to, there are several impediments exist in India, such as socio- economic, physical, linguistic and infrastructure, for individuals who wish to access quality education. The same scenario can be seen in most of the developing countries where there is a lack of learning resources, poor educational facilities, lack of teachers and high rate of dropouts. ICT can be a solution to these problems since it has the potential to overcome the barriers of lack of teachers, lack of quality education, as well as geographical hindrances.

ICT helps to reduce communication obstacles like space and time. ICTs also make it easy for the development of electronic resources such as electronic libraries where the students, teachers and experts are able to access research information and study materials from anywhere at their own pace. Such conveniences provide exposure of academics and research scholars in sharing scholarly material.

4. ICT ENHANCING THE LEARNING ENVIRONMENT AND MOTIVATION

ICT is a powerful tool for promoting educational opportunities. It is transforming the processes of teaching and learning environment by including elements of vitality to the learning milieu. Present day education system insists on research, critical thinking, and evaluation skills since students have access to large variety of sources to get information. Hence, the learning environment provided should follow an effective application of knowledge that students are required to master, in order to avoid the attained knowledge being passive. Furthermore, teachers need to encourage students to be active learners so as to engage in active knowledge construction. This entails open-ended learning situations rather than a learning condition which focus on the sheer transmission of facts.

ICT has the potential to create powerful learning environments in various ways. It has the potential to access numerous information using various sources. It also helps in examining information from different perspectives, thus promoting the credibility of learning environments. Furthermore, ICT may also help to understand complex concepts through simulations, contributing to an authentic learning environment. Consequently, ICT functions as a facilitator of active learning and high-order thinking.

Moreover, ICT can also function as an instrument of curriculum differentiation. It promotes opportunities to modify the learning material and activities to the requirements and capabilities of every individual learner, particularly by giving

personalized feedback. As emphasize, ICT might appeal to an array of educational techniques, ranging from traditional to ingenious.

ICTs are also transformational devices, if used effectively, can shift the classroom atmosphere to a learner-centered environment. Therefore, it is necessary to equip the classroom with computers in order to enhance the learning opportunities for students through different curriculum activities. ICT environment develops the experience of both teachers and students so that they can utilize the learning time effectively. Hence, ICT-enriched learning is a motivating factor for both teachers and learners.

ICT can strengthen the quality of education in different ways. It can boost up the learner motivation and involvement, by providing the opportunity to gain basic learning skills.

Multimedia computer software can be used to provide an audio-visual effect which helps to create interest and engage students in the learning process. Interactive software applications can also help students to get engaged in the lesson activities.

Research proves that students using ICTs for learning purposes are engaged in the process of learning. Since ICT can alter the learning tasks and nature of problems, it acts as a mediator of cognitive development, augmenting the acquisition of basic cognitive competencies which are essential in a knowledge society. Stated that students utilizing ICTs for educational purposes get immersed or involved in the process of learning. As a greater number of

students utilize computers as a source of information and as an intellectual device the impact of the technology on promoting student learning will develop constantly. Computers with Internet access can enhance learner motivation since it incorporates the media opulence and interactivity of different ICTs. It gives an opportunity to connect with real people and to get involved in real life situations. Consequently, the application of ICT in teaching and learning will not only improve the learning environments but also help next generation for their future lives and careers.

5. ICT ENHANCING ACADEMIC PERFORMANCE

The relation between ICT integration and student performance has been the topic of research and discussion for the last two decades. Believe that ICT improves the performance of students since technology helps to improve teacher-students interaction. Meta-analysis study pointed out that, in general, students who used computer-based learning scored higher than students who taught without computers. ICT integrated learning helps students to grasp the concept better and also retain it for a longer period of time. ICT also help students to develop a positive attitude towards learning since they are engaged in the learning process. Analyzed the international data from the Programme for International Student Assessment (PISA). The findings revealed that there is a significantly. Positive correlation exists between the availability of ICT and students performance. However, the correlation becomes weak and insignificant when other student environment factors are taken into consideration. Similarly,

studied the correlation between having a home computer and students' academic performance. Thus, ICT helps to intensify students' content knowledge, involving them in building their own knowledge of the topic, and also help them in the development of high order thinking skills. ICT-enhanced learning is student directed and homiletic. Unlike inert, text books or any other printed course material, ICT-enhanced learning identifies that there are different learning techniques and types of knowledge. Therefore successful integration of ICTs facilitates collaborative and constructive learning, which promotes the academic performance of students.

6. CONCLUSION

The aim of this paper was to provide the impact of ICT in the present day education system. The findings of this study indicate that teachers have a strong desire for the integration of ICT into education. Persistent application and development of ICTs in the education system will have a strong influence on teaching learning process, accessibility of education, motivating learners, creating a congenial learning environment and improving academic performance. ICT integration in education has a positive impact on both teaching and learning process. Technology makes a lot of difference in the delivery of lessons or even education at large. ICT has the potential for a wider accessibility to educational resources.

Furthermore, it enhances flexibility, so that, students can have access to learning irrespective of time and geographical limitations. It can also have an impact on the way students are taught in the classroom and the way they learn. It

Comparative Evaluation of Serum Malondialdehyde (MDA) Level in Oral Submucous Fibrosis and Oral Squamous Cell Carcinoma

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ABSTRACT

Introduction: Lipid peroxidation which is induced by reactive oxygen species is involved in the pathogenesis of malignancy. This lipid peroxidation levels are indicated by Malondialdehyde (MDA), which is the most frequently, used biomarker for the detection of oxidative changes.

Aim: Comparative evaluation of serum MDA level in Oral Submucous Fibrosis (OSMF) and Oral Squamous Cell Carcinoma (OSCC) patients and comparison of their serum MDA levels with healthy controls.

Materials and Methods: The study included 150 patients comprising 50 apparently healthy controls without any tobacco chewing habits, 50 clinically diagnosed patients with OSMF which were also subgrouped according to Interincisal Opening (IIO) and 50 clinically diagnosed patients with OSCC, they were also subgrouped according to site, size and histopathological differentiation. Blood samples were obtained; serum was separated and evaluated for MDA levels which are the measure

of oxidative stress by using principle of spectrophotometry at 532 nm absorbance. Statistical analysis were conducted using independent t-test and one-wayanova test. Statistical package for social science (SPSS 16) was used for the analysis.

Results: The mean serum malondialdehyde level in the control group was found to be 10.50 nmol/mL, whereas it was 25.87 nmol/mL and 57.00 nmol/mL in OSMF and OSCC, respectively. The study revealed enhanced MDA levels in serum of OSMF and OSCC patients as compared to controls. Different grades of OSMF patients according to IIO showed $p < 0.05$, which was statistically significant. Among the subgroups of OSCC patients with respect to site and histopathological differentiation the results were not significant and there was statistically significant increase in MDA levels with increase in primary tumour size.

Conclusion: The increased level of MDA reflects the extent of lipid peroxidation and is considered to be mutagenic as well as carcinogenic and can also modulate the expression of genes related to tumour promotion.

Keywords: Lipid peroxidation, Oral cancer, Oral potential malignant disorders, Oxidative stress, Reactive oxygen species

INTRODUCTION

OSCC is one of the major cause of morbidity and mortality and is the sixth most common malignancy known. It is the most common form of cancer affecting males and account for 50-70% of all cancers diagnosed in India [1]. India has always been cited as country with highest incidence of oral cancer with registration of over 1,00,000 cases every year [2]. Five year mean survival rate remains very low, despite improvements in diagnostic and treatment modalities. Two-thirds of oral cancer patients are diagnosed at advanced tumour stages, where survival drops to a little more than 30% and its prognosis is unpredictable [3]. Tobacco is an exogenous source of Reactive Oxygen Species (ROS) that subsequently leads to Oxidative Stress (OS). Tobacco products of Polynuclear Aromatic Hydrocarbons (PAH) and nitrosoamines cause increase in free radicals and ROS production, which have a pathognomonic role in multistep carcinogenesis. They initiate mutagenic events by causing DNA damage that ultimately leads to degeneration of cellular components [4]. This ROS and free radicals primarily target peroxidation of poly unsaturated fatty acids in membrane lipids. Lipid peroxidation produces many damaging or mutagenic aldehydes like MDA, propanedial, 4-hydroxynonenal (4-HNE), etc., [5]. Malondialdehyde is a major genotoxic carbonyl compound which is generated by lipid peroxidation. It is a three carbon dialdehyde compound that appears mostly in blood, saliva and urine and serves as an important biomarker for oxidative stress [6]. During intracellular oxidative stress

and there reaction with biological important macromolecules, MDA formation occurs endogenously and they form MDA-DNA adducts which is a suitable biomarker of endogenous DNA damage. Oral submucous fibrosis is a potentially malignant and crippling condition of the oral mucosa in which the oral epithelium becomes atrophic and more vulnerable to carcinogens [7]. The risk of malignant transformation of patients with OSMF increasing day by day and hence it is very important to monitor these patients to identify early transformation into OSCC patients [8]. If identified at initial stages, the incidence of death rates due to OSCC can be reduced considerably. Thus, there is a need to measure the oxidative stress in normal individuals, in oral potentially malignant diseases and in oral cancer. Previously many investigators has done various studies to measure oxidative stress by using different biomarkers such as C-reactive protein, some investigators measure oxidative stress using different group of potentially malignant disorders such as leukoplakia, oral lichen planus [9,10]. To our knowledge till date there is no data available in literature where comparison of serum MDA was done exclusively in OSMF in such a large sample within potentially malignant group. There is overall limited data on serum MDA expression in OSMF and OSCC compared to high burden of these entities on society. Hence, the present study was carried out to evaluate and compare serum MDA level to assess the degree of oxidative damage caused in OSMF and OSCC patients and to establish the diagnostic efficacy of serum in evaluating serum levels of MDA in OSMF and OSCC patients.

MATERIALS AND METHODS

Source of Data

This was a prospective cross-sectional study. The study was independently reviewed and approved by Ethical Committee of Government Dental College and Hospital, Nagpur, Maharashtra, India (MUHS/PG/E-2/2240/2014). The study was conducted at the Outpatient Department of College, from January 2015 to October 2016 which included 150 patients divided into three groups: Group I: 50 apparently healthy controls not habituated to tobacco chewing and smoking, Group II: 50 clinically diagnosed cases of oral submucous fibrosis, they were not histopathologically confirmed because it is not possible to do the biopsy for each and every OSMF patients unless indicated. All the patients of OSMF were having habit of chewing areca nut and/or tobacco chewing habit in various forms (kharra, pan masala, gutkha etc.,) for over 5 years. The patients were subgrouped according to IIO based clinical grading as per Khanna and Andrade classification [11]. Grade I which is >35 mm IIO consisted of 3 patients, Grade II (26-35 mm IIO) of 17 patients, Grade III (16-25 mm IIO) of 20 patients and Grade IV A (<15 mm IIO) of 10 patients. Group III consisted of 50 clinically diagnosed and histopathologically confirmed cases of OSCC of which 37 had well differentiated, 10 moderately differentiated and 3 poorly differentiated OSCC. These patients were selected irrespective of tumour size, site and grade and all were regular tobacco chewers in various forms for over 10 years.

All individuals included in the study were aged from 18-60 years. The control group included age and gender matched 50 healthy individuals from a similar socioeconomic background as that of the patient group. They did not have any tobacco habits, systemic or local illness and had visited the hospital for routine check-ups or other minor problems. Patients with HIV, chronic alcoholics, with underlying systemic diseases, cancer other than oral cancer were excluded from the study. Written informed consent was obtained from the patients, after the planned study was explained in detail. A detailed history with thorough clinical examination was performed, and the findings were recorded. The clinical characteristics of controls, OSMF and OSCC patients are shown in [Table/Fig-1].

| | Control group (Group I) | OSMF (Group II) | OSCC (Group III) |
|--------------------|-------------------------|-----------------|------------------|
| Number of patients | 50 | 50 | 50 |
| Mean age | 28.98 yrs | 28.98 yrs | 43.04 yrs |
| Gender | M= 25 F=25 | M=47 F=03 | M=39 F=11 |

[Table/Fig-1]: Clinical and sociodemographic details of patients.

Sample Collection

5 mL of Intravenous blood sample was collected from all 150 patients for estimation of MDA. It was collected using a disposable syringe with 23-gauge needle and was transferred into plain vacutainer. The blood is allowed to clot in an upright position for at least 30 minutes but not longer than 1 hour before centrifugation. These samples were centrifuged in Remi bench top centrifuge for 15 minutes at 3000 RPM within one hour of collection. Serum was seen separated as the top transparent layer. Serum was then transferred to a new test tube and stored in a deep freezer at -20°C for quantitative estimation of serum MDA. MDA forms a 1:2 adduct with thiobarbituric acid and produce coloured complex which can be measured by fluorometry or spectrophotometry. Mean±SD or SE must be established by each laboratory. Variations may occur in individual laboratories due to pipetting, geographic temperature change, incubator temperature etc. As oxidativestress increases Thiobarbituric Acid Reactive Substances (TBARS) which is present in biological specimens also increases. Depending

upon the presence of anti-oxidants TBARS return to normal levels over time. TBARS expressed in terms of MDA equivalents in practice. In the assay a standard curve is constructed using MDA standard against unknown samples. The tests can be performed by using the Oxitek TBARS Assay kit and is specially designed for researchers studying oxidative stress and anti-oxidant activity. Every reagent was prepared fresh for each analysis. Absorbance of supernatants was read at 532 nm with the help of BIO RAD SmartSpec Plus spectrometer.

STATISTICAL ANALYSIS

The data was collected, tabulated and analysed by SPSS 16© (Statistical package for Social Sciences) software. Appropriate test of significance was applied. For inter group comparison One-way ANOVA and Post-hoc test were applied and for comparison between two groups independent t-test was applied p-value <0.05 was considered as statistically significant and <0.001 as highly significant.

OBSERVATION AND RESULTS

Comparative statistics for mean serum MDA levels between the healthy control group, OSMF and OSCC groups was done; results are shown in [Table/Fig-2]. The present study has revealed an intriguing aspect of tumour biochemistry. This study showed highest values of MDA in OSCC (57 nmol/mL), in OSMF (25.87 nmol/mL) and lowest (10.50 nmol/mL) in normal healthy control. Thus, a significant increase in serum MDA levels was found from normal healthy individuals to OSMF to OSCC. One-way ANOVA test was applied p-value was <0.001 i.e., statistically highly significant. When post-hoc test was applied for further inter group comparison; the mean serum MDA level was significantly high in OSCC patients (Group III) as compared to OSMF patients (Group II) and control group (Group I). Estimation of mean serum MDA level of Group II patients with subgroups according to IIO was done, calculated and compared as shown in [Table/Fig-3].

| Group | No. of patients | Mean MDA (nmol/mL) | Standard deviation | p-value | Post-hoc test |
|--------------|-----------------|--------------------|--------------------|---------|----------------------------|
| Group I | 50 | 10.50 | 8.43 | <0.001 | Group III>Group II>Group I |
| Group II | 50 | 25.87 | 13.36 | | |
| Group III | 50 | 57.00 | 26.80 | | |
| Total | 150 | 31.85 | 26.24 | | |

[Table/Fig-2]: Comparison of mean serum MDA values in Group I (Healthy controls), Group II (OSMF patients) and Group III (OSCC patients).

| Grade | Number of patients | Mean MDA (nmol/mL) | Std. deviation | p-value | Post-test |
|-----------|--------------------|--------------------|----------------|-----------------------------|--------------|
| Grade I | 3 | 23.31 | 1.01 | 0.000000251 i.e., < 0.05 | IVA=III>II>I |
| Grade II | 17 | 27.77 | 8.55 | | |
| Grade III | 20 | 29.42 | 9.77 | | |
| Grade IVA | 10 | 27.21 | 13.95 | | |
| Grade IVB | 0 | 0 | 0 | | |

[Table/Fig-3]: Comparison of mean serum MDA values in Group II (OSMF) patients according to IIO based clinical grading.

Group III patients were categorised based on site of lesion in oral cavity and estimation of serum MDA value was done based on site distribution and the results were tabulated as shown in [Table/Fig-4]. It was observed from the results that buccal mucosa was a predominant site for the occurrence of squamous cell carcinoma. Out of 50 patients, 26 patients were having lesion over buccal mucosa but the average serum MDA value was highest in patients involving alveolus and minimum with tongue lesions. When one-way ANOVA test was applied to compare these values, p-value was 0.77 i.e., statistically not significant. Group III patients were subgrouped according to primary tumour size, for which TNMS classification of clinical grading was used [12]. The results are shown

in [Table/Fig-5]. It was observed that there was a significant increase in serum MDA value from T1 to T3 group. One-way ANOVA test was applied and p-value was <0.05 (i.e., statistically significant). This implies that, there was a significant difference in level of mean serum MDA in patients of OSCC with different tumour size. Group III patients were also grouped according to histopathological grading for which Bryne's histopathological grading (1989, 1992) (ITF) which is based on Invasive Tumour Front Grading System was used [13]. Bryne M et al., suggested a hypothesis that at the invasive front area of several squamous cell carcinomas, the morphological characteristics reflects tumour prognosis far better than any other parts of the tumour [13]. Estimation of serum MDA value was done according to histopathological differentiation as shown in the following [Table/Fig-6]. Serum MDA level was evaluated according to histological grading but the measured parameter did not show significant changes. In Oral squamous cell carcinoma the level of lipid peroxidation was inversely proportional to the degree of differentiation. MDA levels in well-differentiated squamous cell carcinoma were greater as compared to moderately differentiated and poorly differentiated squamous cell carcinoma, thus this difference was statistically not significant.

| Group | No. of patients | Percentage | Mean MDA (nmol/mL) | S.D. | p-value |
|-----------------------|-----------------|-------------|--------------------|-------|---------|
| Alveolobuccal complex | 9 | 18% | 54.19 | 26.68 | >0.05 |
| Buccal mucosa | 26 | 52% | 55.57 | 27.25 | |
| Alveolus | 9 | 18% | 70.50 | 30.46 | |
| Alveololabial complex | 1 | 2% | 46.57 | - | |
| Lip | 2 | 4% | 57.13 | 20.43 | |
| Tongue | 3 | 6% | 40.71 | 14.82 | |
| Total | 50 | 100% | | | |

[Table/Fig-4]: Distribution of Group III (OSCC) patients based on site and Comparison of mean serum MDA values in Group III (OSCC) patients based on site. (ANOVA TEST).

| Size | Avg. Tumour size in (sq.cm) | No. of patients | Percentage | Avg. MDA (nmol/mL) | S.D. | p-value | Post-hoc test |
|------|-----------------------------|-----------------|------------|--------------------|------|---------|---------------|
| T1 | 1.42 | 03 | 6% | 29.04 | 8.08 | <0.05 | T3>T2>T1 |
| T2 | 8.27 | 29 | 58% | 44.94 | 17.7 | | |
| T3 | 18.34 | 18 | 36% | 81.09 | 23.4 | | |

[Table/Fig-5]: Distribution and comparison of Group III (OSCC) patients based on primary tumour size and serum MDA value.

| Histopathological grade | No. of patients | Percentage | Mean MDA (nmol/mL) | S.D. | p-value |
|-------------------------|-----------------|------------|--------------------|-------|---------|
| WDSCC | 37 | 74% | 59.81 | 26.9 | >0.05 |
| MDSCC | 10 | 20% | 53.55 | 28.13 | |
| PDSCC | 03 | 6% | 33.79 | 1.7 | |

[Table/Fig-6]: Distribution and comparison of serum MDA in Group III (OSCC) patients based on histopathological differentiation.

p<0.05=Significant and p<0.001=Highly significant

WDSCC: Well differentiated squamous cell carcinoma; MDSCC: Moderately differentiated squamous cell carcinoma; PDSCC: Poorly differentiated squamous cell carcinoma

DISCUSSION

Areca nut is a known etiological factor for oral submucous fibrosis which contains arecoline, arecaidine, guvacolin and guanine which produces numerous free radicals and ROS. Free radicals can produce lipid peroxidation in membrane, Oxidative modification of proteins, and lesions in DNA which can directly and indirectly stimulate the carcinogenic effect in cells. Intracellular and extracellular antioxidant system neutralises the deleterious effects of ROS. Hence, estimation of the level of ROS in Oral submucous Fibrosis patients may serve as important biomarker to analyse the progression and malignant transformation of the disease [14]. Nicotine which is present in tobacco causes pH changes during

chewing which causes partial reduction of oxygen and produces highly reactive free radicals like hydrogen peroxide (H_2O_2), hydroxyl radical (OH^*) and superoxide anion (O_2^-) in the body fluid, such as blood and enhance lipid peroxidation levels of biological molecules, hence serum MDA levels thus thereby increased, as seen in OSMF and OSCC patients [15]. Naturally occurring lipid peroxidation end product MDA is highly mutagenic and tumourigenic. The MDA reacts with both the Deoxyadenosine and Deoxyguanosine in the DNA and produce DNA-MDA adduct [14]. Early detection of OSCC and OSMF transforming into malignancy can drastically improve the treatment outcomes and prognosis. In the search for possible causes of malignancies on one hand, and the need for the modality affording early diagnosis, there are various biochemical findings which can be useful in early diagnosis at an early stage of the disease [16]. The MDA value in blood is a measure of the ability of the body to handle the oxidative stress [17]. So, in the present study serum MDA level in OSMF and OSCC was estimated to assess the degree of oxidative damage of the disease so that it can be arrested in early stages to avoid the possible consequences of OSMF turning into malignancy. There was a statistically significant increase in serum MDA level from group I (10.50 nmol/ml) to group II (25.87 nmol/ml) to group III (57.00 nmol/ml) with p-value < 0.001. The present study findings were in accordance with the study conducted by Chole RH et al., Korde SD et al., D'souza D et al., and Ganesan A et al., [17-20]. ROS-induced lipid peroxidation has been indicative in malignant transformation. The prime targets of peroxidation by ROS are the polyunsaturated fatty acids in membrane lipids. The decomposition of these peroxidised lipids yields a variety of end products which also includes MDA. Thus, the level of MDA indicates the extent of lipid peroxidation and serves as a marker of cellular damage due to free radicals. The increase in MDA may be attributed to excessive formation of free radical due to various tissue abuse habits and due to decomposition of polyunsaturated fatty acids present in membranes. It may also occur due to inadequate clearance of free radicals by poor cellular antioxidant system [21]. In group II patients clinical grade wise analysis showed that mean MDA level gradually increased from grade I to grade IV and the result were statistically significant (p< 0.05) and so there exists a direct correlation between clinical grading and MDA value. However, there was slight reduction in mean serum MDA value in grade IVA probably because of unequal distribution of sample size in each grade. It was established that the lipid peroxidation increases with the severity of disease thus indicating the extent of tissue injury [19]. These findings were similar to Metkari SB et al., and Paulose S et al., [22,23]. Contrasting results were reported by Tejasvi MA et al., [24]. Our findings were also not in accordance with the findings by Shakunthala GK et al., in which the difference in serum MDA levels among different clinical staging of OSMF patients were not statistically significant [25]. The present study results showed slight reduction in serum MDA level in grade IVA than in grade III could be due to self-defence mechanism by the proliferative tumour cells to resist deleterious effects of lipid peroxidation on their cell membranes or possible reason could be due to utilisation of MDA in crosslinking of collagen. Chojkier M et al., studied the effects of MDA on collagen production and they found that the addition of MDA (200 μ M), to the cultured human fibroblasts incubated in MEM {Eagle's minimal essential medium} without fetal calf serum (to minimise MDA binding to media proteins), increased 2-fold the production of collagen without affecting non-collagen protein production. The concentration of MDA in the media was 80% of the initial concentration after 3 hour incubation [26]. Thus, it can be concluded that the addition of MDA to cultured fibroblasts increase collagen production by 2-3 times [27]. Group III patients were categorised based on site of occurrence of lesion, serum MDA level in patients involving alveolus was highest. In contrast to the results obtained by Subapriya R et al., who found highest serum MDA level in buccal mucosa [28]. The results of the present study

revealed that the tumour site and blood comprise two separate metabolic compartments with respect to their susceptibility to lipid peroxidation levels.

Comparison of mean serum MDA level done based on tumour size, a statistically significant difference ($P < 0.05$) was found with mean serum MDA value being highest in T3 patients. Therefore a positive relationship between tumour size and serum MDA was found. Similarly, Manoharan S et al., obtained results in oral cancer patients and found a significant increase in serum MDA level with increase in clinical staging [29]. Our findings were also in accordance with the findings of Srivastava KC et al., [30]. Our results were not in accordance with the study done by Rasheed MH et al., Gupta A et al., who showed no statistical difference in mean serum MDA level with increase in clinical staging [31,32]. Advance stage Head and Neck cancers patients were exposed to higher oxidative stress. Measurement of lipid peroxidation by product in circulation of oral cancer patients may thus be helpful in assessing the clinical stage of oral squamous cell carcinoma. Cell membranes of erythrocytes and other cells are mainly composed of Polyunsaturated Fatty Acid (PUFA) which is considered to be highly susceptible to oxidative attack and also become the major substrate for ROS mediated damage. Due to such damage the fluidity and permeability of the membranes are altered. Thus, large volumes of MDA levels in plasma could be attributed to its increased formation in erythrocytes and its consequent leakage into the plasma or due to inadequate clearance of free radicals by the cellular antioxidants.

A significant decrease in serum MDA level was observed from well differentiated to poorly differentiated squamous cell carcinoma and was not found to be significant statistically ($P > 0.05$). Similar results were obtained by Metgud R et al., Patait MR et al., [15,33]. A complex relationship is anticipated in histopathological differentiation and serum MDA levels which is very poorly explored till date. In our study, there was no significant difference in serum MDA levels of Group III subjects based on histopathological differentiation, probably due to random selection of the patients and thereby unequal distribution of patients in each grade, hence; there is need to conduct further studies in this area, with equal number of patients in each group.

There is overall limited data on serum MDA expression in OSMF and OSCC compared to high burden of these entities on society. Hence studies need to be conducted on a large population with similar sample size for longer duration of time to establish a definitive relationship between various clinical and histopathological parameters of OSMF and OSCC and serum MDA; and find their correlation if any with the progress of the disease.

LIMITATION

This study is an effort to find out a cause and effect relationship between OSMF, OSCC and serum MDA levels. The patients were selected randomly for this study. In this study an attempt to correlate serum MDA levels with histopathological grading of OSMF patients was not done as it was not possible to obtain biopsy of these patients unless it is advised/indicated. For OSCC patients instead of the entire TNMS clinical staging only tumour size was considered for the study purpose since the patients were selected randomly and enrolled prior to the treatment at the institute. The disease was diagnosed based on their clinical, radiological, and histopathological examinations. Large scale studies with long term follow up and equal distribution of samples among different grades of OSMF and OSCC should be carried out in order to establish MDA as a potential biomarker for oxidative stress.

CONCLUSION

The estimation of serum MDA levels might be helpful to determine the possibility of malignant transformation of OSMF, assessing the status of OSCC and thereby possibly in clinical intervention of OSCC patients to some extent. In such patient's antioxidant therapy as an

adjunct might be of some help to patients of OSMF and OSCC. ROS and free radicals have predominant deleterious role in inducing and promoting carcinogenesis. The present study suggests a role of MDA as one of the diagnostic biomarkers and innovative tools to monitor oxidative stress and their impact on progression of oral potentially malignant disorders and epithelial malignancy. Serum can be used to determine the impact of redox imbalance on the progression of OSCC but it is difficult to prove cause-effect relationship or to predict its prognostic use with such observational study with small sample size. In future, a long term studies with larger sample size could be conducted to obtain definitive results for establishing serum as a reliable laboratory tool and then monitoring serum MDA level could be of great clinical utility in assessing the patient's status during progression of disease and its management.

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Rare actinobacteria: a potential source of bioactive polyketides and peptides

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Abstract

Polyketides and peptides obtained from actinobacteria are important therapeutic compounds which include front line antibiotics and anticancer drugs. Many screening programs are directed towards isolation of bioactive compounds from these organisms but the chances of finding novel antimicrobial leads among common actinobacteria are fast dwindling. As a result, the focus has shifted to the members of less exploited genera of rare actinobacteria. Three isolates, MMS8, MMS16 and KCR3 found to be potent polyketide and peptide producers were identified by 16S rRNA gene sequencing and their sequences deposited in the GenBank under the accession numbers MG407702, MG372012 and MG430204 respectively. MMS8 identified as *Micromonospora auratinigra*, yielded one potent compound determined to be chloroanthraquinone with an minimum inhibitory concentration (MIC) of 8 µg/ml against *Bacillus subtilis* and an IC₅₀ value of 10 µg/ml and 4 µg/ml against HeLa and IMR cell lines respectively. This is the first report of the production of chloroanthraquinone by *M. auratinigra*. MMS16, identified as a member of the family *Micromonosporaceae*, yielded a potent compound MMS16B analyzed to be a novel bafilomycin analogue. The MIC of the compound was found to be 7 µg/ml against *B. subtilis* and IC₅₀ value against HeLa and IMR was observed to be 9 µg/ml and 14 µg/ml respectively. MMS16B was also found to exhibit anti-quorum sensing (AQS) activity at sublethal concentrations. KCR3 identified as *Kocuria kristinae* yielded a novel antimicrobial peptide with antibacterial, antifungal and AQS activity. To the best of our knowledge, no antimicrobial activity has ever been reported from *K. kristinae*.

Keywords Anti-quorum sensing · Peptides · Polyketides · Rare actinobacteria

Introduction

Actinobacteria are aerobic, gram-positive, filamentous, soil dwelling bacteria (Anderson and Wellington 2001) with exceptional metabolic diversity and are a rich source of several useful bioactive natural products, such as polyketides and peptides (Bundale et al. 2018a; Zhao et al. 2018). Polyketides, which contain repeating (–CH₂–CO–) groups,

represent 20% of pharmaceutical drugs in the market (Tiwari and Gupta 2012).

Based on the diversity in structure and function, polyketides can be divided into three classes. The type I polyketides include macrolides like erythromycin, azithromycin and rapamycin and polyenes like amphotericin B and nystatin. The type II polyketides are aromatic polyketides such as tetracycline, doxorubicin, daunorubicin, rhodomycin, actinorhodin etc. The type III polyketides include chalcones and stilbenes in plants and polyhydroxy phenols in bacteria (Shen 2003).

Antimicrobial peptides (AMPs) are a well-known group of therapeutic agents, including tyrocidin, gramicidins, cyclosporine, polymyxins, daptomycin and surfactin. Non-ribosomal peptides, synthesized by non-ribosomal peptide synthetases are known to exhibit a wide range of biological activities including, antiviral, antiprotozoal, hypocholesterolemic, antifungal, siderophore, antimicrobial, antitumor,

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antioxidant, anti-hypertensive and immunomodulatory activities (Hamed et al. 2015; Rajanbabu and Chen 2011).

Most of these antibiotics in clinical use today have been developed from compounds isolated from actinobacteria, *Streptomyces* being the dominant genus (Barka et al. 2016). However, the recent search for the novel compounds from *Streptomyces* species has often led to the rediscovery of known compounds. Hence, the focus of screening programs has shifted to bioactive compounds from non-*Streptomyces* group also referred as rare actinobacteria (Bundale et al. 2018b). At present more than 50 rare actinobacterial taxa are reported to produce 2500 bioactive compounds (Kurtböke 2012). Thus, it is crucial that new groups of rare actinobacteria be pursued as sources of novel pharmaceutically active metabolites. Amongst the novel metabolites, anti-quorum-sensing (AQS) agents, which can curb infection without a killing action, are gaining importance. Bacterial cell–cell communication, dubbed quorum sensing, is intricately related to virulence. An associated phenomenon is the bacterial swarming which allows the spread of disease and virulence. With this as a background and the rising incidence of resistance to extant antibiotics, a search for AQS agents as new molecules to treat infection has become logical and gathered momentum (Nashikkar et al. 2011; Kurtböke 2012). Although antimicrobial properties of actinobacteria have been extensively studied, less is known about AQS activities of rare actinobacteria which may be a rich source of active compounds that can act against bacterial quorum sensing systems.

The current study involves the purification and characterization of the bioactive polyketides and peptides from the three isolates selected from our previous study and their evaluation for antimicrobial, anticancer and AQS properties. These isolates were identified by 16S rRNA gene sequencing as *Micromonospora auratinigra*, Family *Micromonosporaceae* and *Kocuria kristinae* and their sequences deposited in the GenBank under the accession numbers MG407702, MG372012 and MG430204 respectively (Bundale et al. 2018b).

Materials and methods

Chemicals and media

All chemicals and solvents were of analytical grade and purchased from Merck, Germany and culture media from Hi-media, Mumbai, India.

Test organisms and animal cell lines

The target strains used for screening antimicrobial activity were procured from Microbial Type Culture Collection (MTCC), IMTECH, Chandigarh, India and were: *Bacillus*

subtilis MTCC 441, *Escherichia coli* MTCC 443, *Proteus mirabilis* 425, *Serratia marcescens* MTCC 86 and *Candida albicans* MTCC 227. HeLA and IMR cell lines were purchased from National Centre for Cell Science (NCCS), Pune, India.

Methods

Production of polyketides and peptides

The selected potent isolates were grown in potato dextrose broth and incubated in a rotary shaker incubator (REMI CIS-24 BL) at 130 rpm at 28 °C. 1 ml aliquots were withdrawn after every 24 h for a period of 12 days to optimize incubation period for maximum bioactive metabolite production. The cell free supernatant was concentrated fivefold in a vacuum concentrator and 50 µl was used to determine antimicrobial bioactivity against test organisms. The diameters of zones of inhibition were noted and correlated to the concentration of the bioactive compound in the cell free supernatant (Bundale et al. 2015).

Extraction of the bioactive compounds

For polyketides Crude antimicrobial compound was recovered from the mycelium as well as culture filtrate of both bioactive isolates by solvent extraction with ethyl acetate (1:1 v/v). The solvent was evaporated to dryness in a vacuum concentrator to obtain the crude cell and broth extracts which were stored at – 20 °C until further use (Bundale et al. 2018a).

For peptides The cell free broth was cooled overnight and acetone precipitation/ammonium sulphate precipitation was carried out. The protein precipitate was separated by centrifugation. Ammonium sulphate precipitate was resuspended in phosphate buffer and was subjected to dialysis using a dilute buffer. The dialysed peptide was used for bioactivity studies. The solvent in the acetone precipitate was allowed to evaporate completely overnight at 4 °C. This precipitate was resuspended in phosphate buffer and used for bioactivity studies. The presence of protein in the precipitate was confirmed by biuret and ninhydrin tests.

Purification of the bioactive compounds

For polyketides The dried crude extract was dissolved in ethyl acetate and 100–500 µl was loaded over the silica gel column. A stepwise gradient of chloroform/methanol was applied and the fractions thus separated were collected.

Preparative thin layer chromatography (TLC) with silica gel plate 60 F254 was used for the partial purification of antimicrobial products. The crude extracts were spotted and developed in different solvent systems.

The solvent systems used were chloroform:petroleum ether:methanol (10:10:3), chloroform:acetone:methanol (75:15:10), chloroform:methanol (8:2), petroleum ether:chloroform:methanol (7:2:1), chloroform:methanol (9:1), benzene:acetone:methanol (100:10:1). The developed plates were air dried and the separated bands were detected by observations of the color of the bands. The TLC was repeated several times and the mean R_f of the bands was calculated. The fractions were physically separated from each other by scraping the bands from the plates, extracting with methanol, concentrating the extracts and again subjecting each concentrate to TLC using the same solvent system, thereby confirming the purity of each fraction (Bundale et al. 2018a; Johdo et al. 1991; Kim et al. 1996).

For peptides The protein precipitate was purified by preparative TLC using the solvent system butanol:acetic acid:water (3:1:1) (Dharmaraj 2011). The developed plate was air dried and the band was visualized by spraying ninhydrin and the R_f was noted. The TLC was repeated in parallel and the band calculated by R_f was scraped and later extracted in the same solvent system. The purified extract was concentrated and again subjected to TLC using the same solvent system to confirm its purity. The peptide thus purified was sent for LC–MS analysis to confirm its purity and to assess its molecular weight.

Spectral studies The UV–vis absorption spectra (190–1100 nm) of the purified fractions were determined to identify the chromophores present in the metabolites by using a double beam bio-spectrophotometer (BL-198, Elico Ltd.) (Silverstein et al. 2014). Furthermore, Fourier transform infra red (FT-IR) spectrum of each active extract was obtained (as KBr discs) between 400 and 4000 cm^{-1} on Perkin Elmer 2000 FT-IR spectrophotometer and plotted as intensity versus wave number (Augustine et al. 2005). ^1H NMR spectra of the purified bioactive compounds was measured using a Bruker AMX 300 Coupling constants (J) in Hz. The mass spectra were obtained on a Bruker micro TOF-Q II 10,330 between 50 and 3000 m/z .

Bioactivity studies

Antimicrobial activity The antimicrobial activity of the pure compounds was assessed by the agar well diffusion method using Mueller–Hinton agar for the antibacterial and potato dextrose agar for anti fungal assays.

15 μl of 1 mg/ml stock were used for the tests. The diameter of the inhibition zones was determined after 24 h of incubation at 37 °C for bacteria and 28 °C for *C. albicans*. The minimum inhibitory concentrations (MICs) of the bioactive compounds were determined via a microdilution method using sterile 24-well plates with tetracycline as a standard (Arthington-Skaggs et al. 2002).

MTT-based cytotoxicity assay The cytotoxicity of bioactive fractions on established cell lines like HeLa and IMR was determined in vitro by the MTT based cytotoxicity assay (Mosmann 1983; Begde et al. 2011). The adherent cells were exposed to a concentration gradient of 1–40 $\mu\text{g/ml}$ of the purified compounds.

Anti-quorum sensing activity Pigment quenching assay Quorum sensing inhibition (QSI) by the bioactive compounds was determined by studying pigment quenching using agar well diffusion method with *S. marcescens* as the indicator organism. A positive QSI result was indicated by a lack of pigmentation of the indicator strain around the vicinity of the well. Negative results were indicated by no pigmentation inhibition (Kanagasabhapathy et al. 2009; Bundale et al. 2018b).

Swarming motility assay To study the effect of bioactive compounds from rare actinobacteria on the swarming motility of *P. mirabilis*, 5 μl of an overnight culture was centrally inoculated on swarm agar plates containing various concentrations of the compounds. Two control plates were also set up for each study; one containing no additives and termed positive control and the other containing 20% DMSO and termed solvent control. All the plates were incubated at 37 °C for 20 h. Thereafter, the diameter of the swarm zone was measured and compared to the control (Nashikkar et al. 2011).

Statistical analysis

The MIC values were expressed as average of four independent replicates \pm SD and IC_{50} values in the MTT based cytotoxicity assay as an average of eight replicates \pm SD. Student's *t*-test was performed using SYSTAT Software (Systat Software, Inc., Chicago, IL, USA). *P* value \leq 0.05 was considered significant unless otherwise mentioned.

Results

Three rare actinobacterial strains, MMS8, MMS16 and KCR3, which exhibited the ability to produce bioactive polyketides and peptides on the basis of pre-screening results were selected for this study.

Production and extraction of bioactive compounds

The bioactive compound production by the three isolates was monitored over a period of 12 days and was found to start only after 48 h for all the three isolates. It reached a maximum (24 mm) for KCR3 on the 4th day, and remained almost stable till the 12th day. A similar

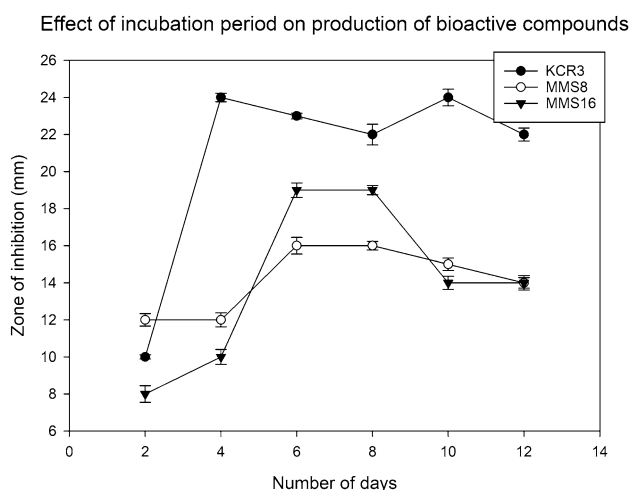





Fig. 1 Effect of incubation time on production of polyketides by MMS8 and MMS16 and antimicrobial peptide by KCR3. Each point represents mean of three independent observations \pm SD

pattern was observed for MMS8 where, maximum bioactive metabolite production was observed on the sixth day (16 mm). But for MMS16, maximum production reached on 6th day (19 mm) and then showed a sharp decline from day 10 (Fig. 1).

The polyketide complexes extracted from MMS8 and MMS16 were purified using silica gel adsorption column chromatography followed by preparative TLC. The purified fractions were named MMS8A, MMS8B, MMS8C and MMS8D for the isolate MMS8. A similar numbering scheme was used for MMS16 too. The AMP from KCR3 was purified by acetone precipitation followed by preparative TLC. The solvent system used, colour, and R_f 's of the fractions obtained from each organism are given in the Table 1.

Table 1 R_f values and antimicrobial activity of fractions of the isolates

| Isolates | Solvent system | Fractions | R_f of fractions | Color of fractions | Antimicrobial activity (zone of inhibition, cm) | | | | |
|----------|--|-----------|--------------------|--------------------------------|---|----------------|----------------------|--------------------|-----|
| | | | | | <i>B. subtilis</i> | <i>E. coli</i> | <i>S. marcescens</i> | <i>C. albicans</i> | |
| KCR3 | Butanol:acetic acid:water (3:1:1) | A | 0.52 | Purple (after ninhydrin spray) |  | 2.2 | 1.7 | 3.2 | 0.8 |
| MMS8 | Benzene:acetone:methanol (80:15:5) | D | 0.23 | Purple |  | – | – | 1.1 | 2.0 |
| | | C | 0.48 | Orange | | 0.8 | – | 1.0 | 1.8 |
| | | B | 0.79 | Pale yellow | | – | – | 0.7 | 2.2 |
| | | A | 0.93 | Brownish yellow | | 1.2 | – | 1.5 | 1.2 |
| MMS16 | Chloroform:acetone:methanol (75:15:10) | C | 0.93 | Yellow |  | 1.87 | – | 1.0 | 2.5 |
| | | B | 0.86 | Orange | | 1.2 | – | 0.96 | 2.6 |
| | | A | 0.78 | Brown | | 1.3 | – | 0.6 | 3.1 |

Characterization of the polyketides and peptides produced by rare actinobacterial isolates

This section describes the characterization of the most potent bioactive compounds produced by the respective organisms.

Identification of bioactive compound from MMS8

The UV–vis spectra of MMS8B, which was the most potent compound showed the peaks at 247, 303, 379 and 410 (Fig. 2a). The IR (KBr) spectra of MMS8B showed prominent peaks at 3326, 2946, 2833, 1651, 1447, 1418, 1113, 1020, 666 (cm^{-1}) (Fig. 2b). The ^1H NMR spectra showed chemical shifts at δ 9.99 (aldehyde), δ 7.06– δ 7.57 (3 aromatic protons), δ 2.36 (C attached to Cl), δ 1.15– δ 1.39 (alkyl, methylene), δ 0.9 (methyl), δ 0.02– δ 0.096 (Fig. 2c). The mass spectrum of the compound showed a peak at m/z

242. The obtained molecular ion peak showed a further fragmentation to give a base peak at m/z 214 (Fig. 2d).

Identification of bioactive compound from MMS16

MMS16B, the most potent compound was found to be soluble in acetone, methanol and chloroform and showed a sharp yellow band with an R_f of 0.48 in chloroform:methanol (9:1). The UV–vis spectra of MMS16B showed the peaks at 255, 280, 318, 342, 417 nm (Fig. 3a). The IR (KBr) spectra of MMS16B showed prominent peaks at 3344, 2943, 2833, 1650, 1438, 1131, 1028 (cm^{-1}) (Fig. 3b). The chemical shifts shown by the proton NMR were at δ 7.07– δ 7.57 (3 aromatic protons), δ 2.19– δ 2.29 (C attached to N), δ 1.28– δ 1.57 (alkyl, methine, methylene), δ 0.9 (methyl), δ 0.02– δ 0.096 (Fig. 3c). The molecular weight was determined by mass spectra and by high resolution of the molecular ions to be m/z 811 (Fig. 3d).

Fig. 2 Characterization of compound MMS8B obtained from MMS8: **a** UV–vis spectra of compound MMS8B, **b** IR spectra of compound MMS8B, **c** proton NMR of compound MMS8B and **d** mass spectra of compound MMS8B

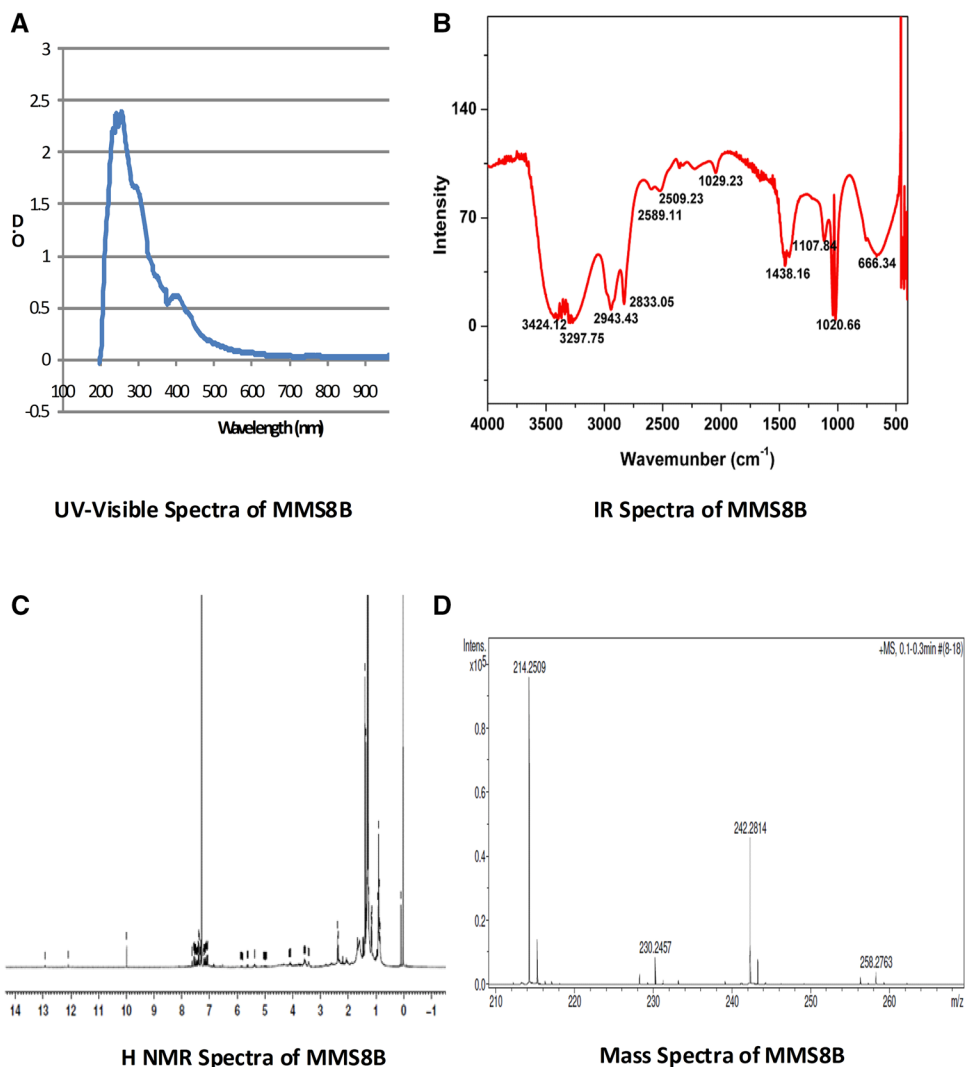
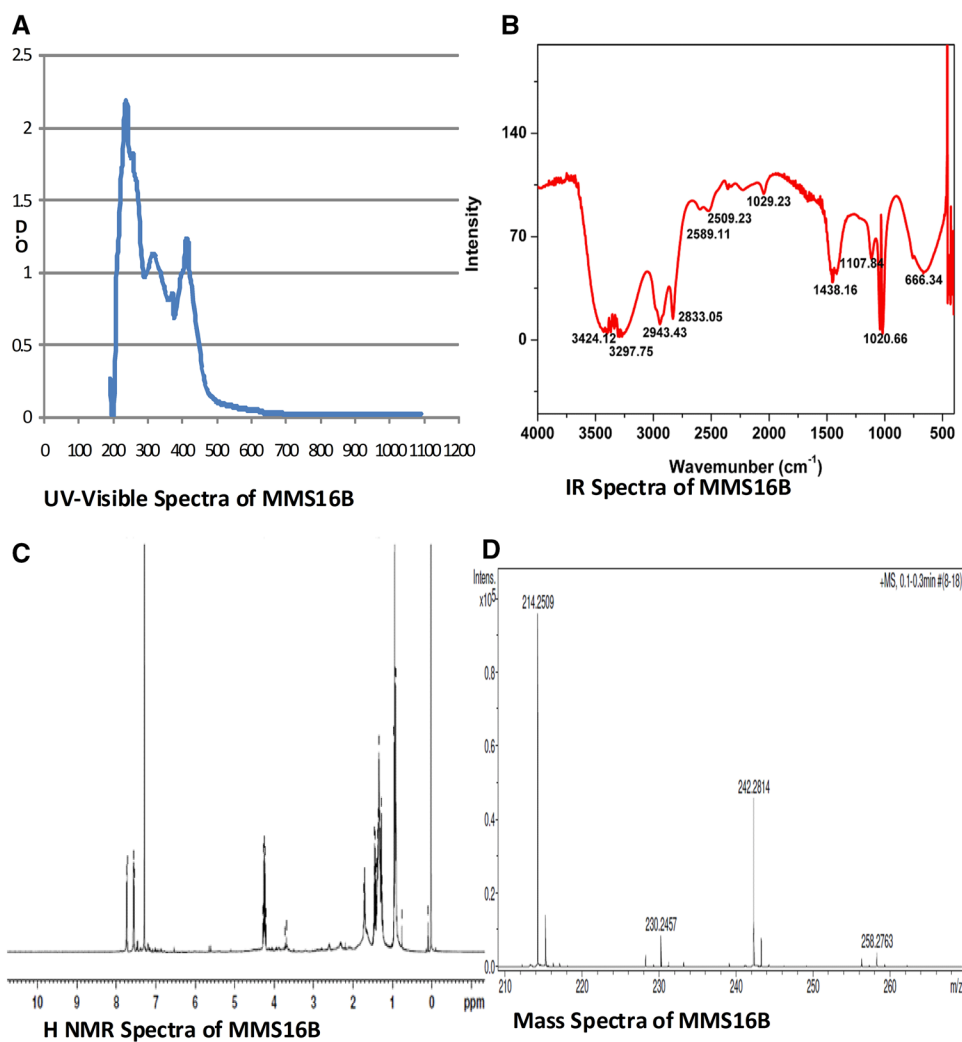


Fig. 3 Characterization of compound MMS16B obtained from MMS16: **a** UV-vis spectra of compound MMS16B, **b** IR spectra of compound MMS16B, **c** proton NMR of compound MMS16B and **d** mass spectra of compound MMS16B



Identification of AMP from KCR3

The peptide nature of the bioactive compound, KCR3A obtained from KCR3 has been established in a previous study by us. The purified compound from KCR3 resolved as one single band with an R_f of 0.52 in the solvent system butanol:acetic acid:water (3:1:1) which turned purple on spraying with ninhydrin. The UV-vis spectra showed prominent peaks at 232 and 372 nm (Fig. 4a). The IR (KBr) spectra showed prominent peaks at 2281, 1595, 1488, 1153, 1069, 1039 and 962 (cm^{-1}) (Fig. 4b). High resolution LC-MS of the KCR3A yielded highest molecular mass of 1097 with a range of several fragmentation peaks (m/z 579, 637, 695, 753, 811, 869, 927, 985) (Fig. 4c, Supplementary Fig. 1).

Table 2 summarizes the physicochemical properties of the purified compounds obtained from all the three isolates.

Bioactivity studies

Antimicrobial activity

MMS8A and MMS8C did not exhibit any activity against *B. subtilis* but MMS8B and MMS8D were active. None of the compounds of MMS8 was active against *E. coli*. All purified compounds of MMS8 were active against *C. albicans*. MIC of MMS8B against *B. subtilis* was found to be 8 $\mu\text{g}/\text{ml}$. The purified compounds from isolate MMS16 were found to be active against *B. subtilis* with zones of inhibition in the range of 14–17 mm. These compounds were not active against *E. coli*. The compounds were also antifungal exhibiting zones of inhibition against *C. albicans*. The MIC of MMS16B, the most potent compound, against *B. subtilis* was found to be 7 $\mu\text{g}/\text{ml}$. The purified peptide from KCR3 was potent against all test organisms (refer Table 1).

Fig. 4 Characterization of compound KCR3A obtained from KCR3: **a** UV-vis spectra of compound KCR3A, **b** IR spectra of compound KCR3A and **c** mass spectra of compound KCR3A

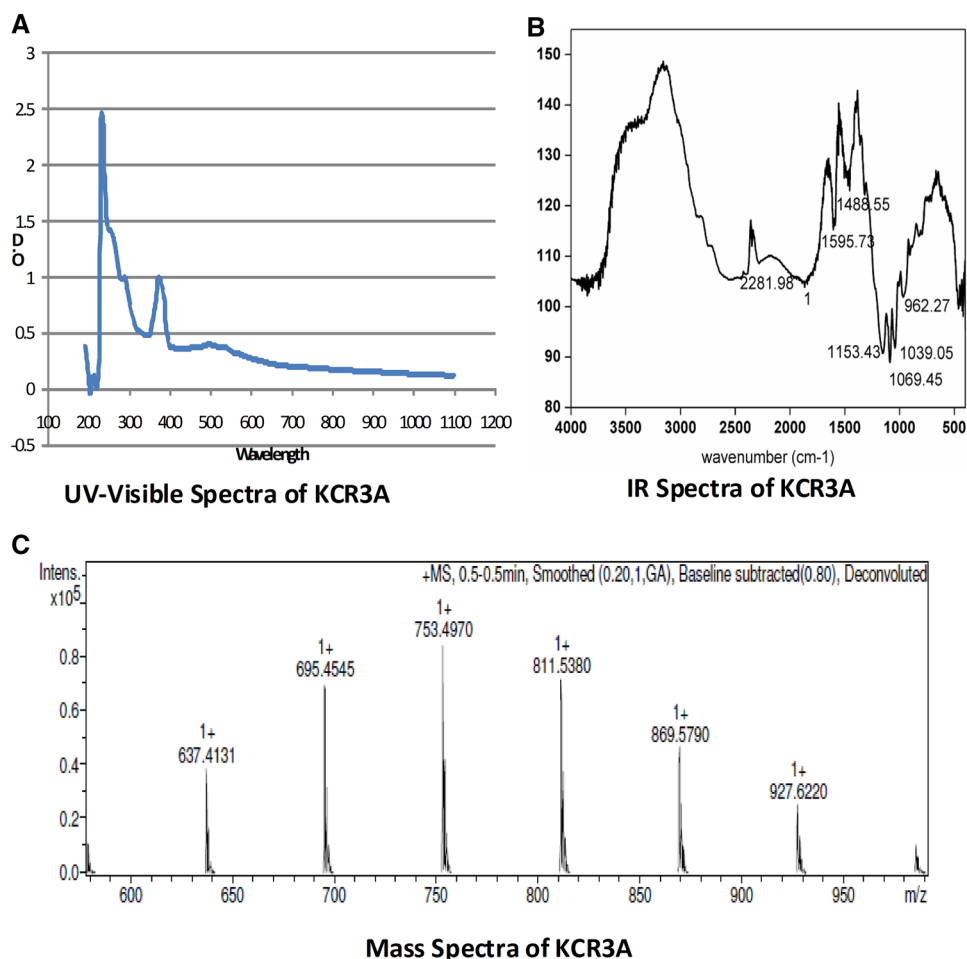


Table 2 Physicochemical properties of the Bioactive Compounds

| Compound → properties ↓ | KCRA | MMS8B | MMS16B |
|------------------------------|---|--|---|
| Appearance | White amorphous powder | Yellow solid | Orange solid |
| UV-vis λ_{\max} (nm) | 232, 372 | 247, 303, 379, 410 | 255, 280, 318, 342, 417 |
| IR _{max} | 2281, 1595, 1488, 1153, 1069, 1039, 962 | 3326, 2946, 2833, 1651, 1447, 1418, 1113, 1020, 666 | At 3344, 2943, 2833, 1650, 1438, 1131, 1028 |
| NMR | ND | δ 9.99, δ 7.06– δ 7.57, δ 2.36, δ 1.15– δ 1.39, δ 0.027– δ 0.921 | δ 7.28– δ 7.74, δ 4.22– δ 4.28, δ 1.25– δ 1.72, δ 0.027– δ 0.96 |
| Molecular mass (m/z) | 1097 | 242 | 811 |
| Compound identified as | Non-thio peptide | Chloroanthraquinone | Bafilomycin |

Anticancer activity

In vitro antitumor activity of the bioactive compounds was judged by MTT based cytotoxicity assay against established cancer cell lines, HeLa and IMR. The IC₅₀ of MMS8B determined from the graph was ~ 10 μ g/ml for HeLa and ~ 4 μ g/ml for IMR and that of MMS16B was observed to be ~ 9 μ g/ml for HeLa and ~ 14 μ g/ml for IMR (Fig. 5a, b).

Anti-QS activity

All purified compounds from both the polyketide producers exhibited AQS activity. The most potent compounds, MMS8B and MMS16B showed pigment quenching zones of 10 mm and 12 mm respectively against *S. marcescens*. KCR3A showed extremely high AQS activity against *S. marcescens* with a turbid zone of inhibition of 32 mm

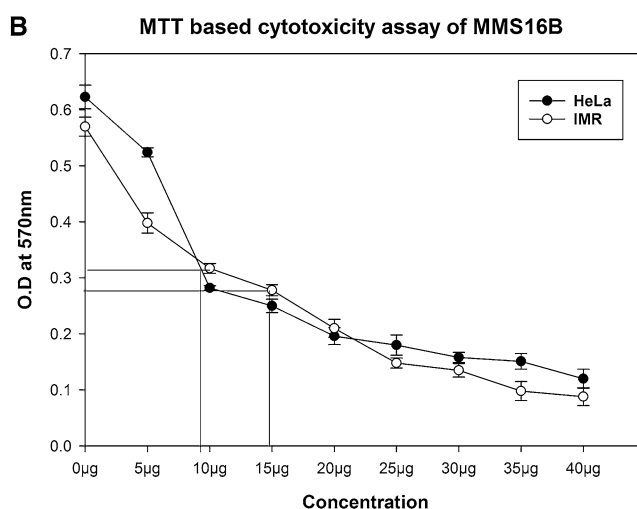
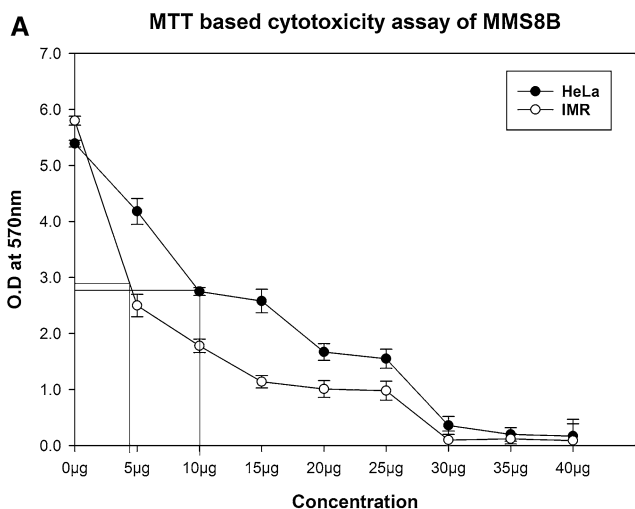


Fig. 5 a MTT based cytotoxicity assay of MMS8B on HeLa and IMR, IC_{50} against HeLa was found to be 10 μg and 4 μg respectively and **b** MTT based cytotoxicity assay of MMS16B on HeLa and IMR,

IC_{50} against HeLa was found to be 9 μg and 14 μg respectively. Each point represents mean of three independent observations \pm SD



Fig. 6 Anti-quorum sensing activity of KCR3A against *Serratia marcescens*. The compound has inhibited the pigment formation but has not inhibited the growth as can be seen by the turbid zone

(Fig. 6) However, nisin used as a standard, failed to show AQS even at concentration of 10 mg/ml. MMS16B also showed antiswarming activity against *P. mirabilis* at a concentration of 0.3 mg/ml and 0.5 mg/ml with 70–80% reduction in swarm zones as can be seen in Fig. 7.

Discussion

The current study was undertaken with the aim of obtaining novel polyketides and peptides from rare actinobacteria isolated from soil. These were purified and their antimicrobial, anticancer and anti-QS activities were assessed followed by their structure elucidation.

Compound MMS8B isolated from *M. auratinigra*, was obtained as an orange yellow compound with an R_f of 0.45 in the solvent system chloroform:methanol (9:1). The UV-vis

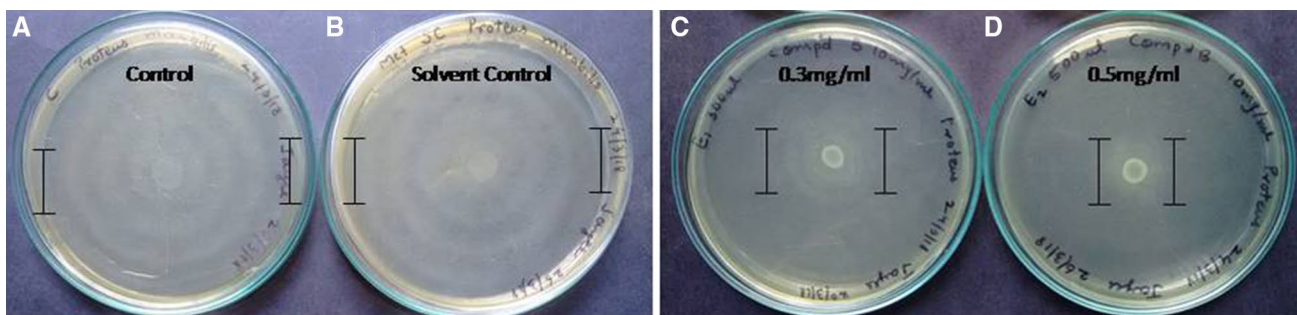


Fig. 7 Anti swarming activity of MMS16B against *Proteus mirabilis*: **a** positive control, **b** solvent control, **c** swarm zone inhibition by compound MMS16B at 0.3 mg/ml concentration (50% reduction in

swarm zone) and **d** swarm zone inhibition by compound MMS16B at 0.5 mg/ml concentration (80% reduction in swarm zone)

spectrum indicates the compound to belong to anthraquinones showing bands in the wavelength range 220–350 nm and one absorption band at longer wavelengths, close to 400 nm (Osman et al. 2014). IR spectra and NMR indicate the compound MMS8B to be chloroanthraquinone, with the presence of a peak at 660 cm^{-1} (C–Cl) in IR spectrum and chemical shift at δ 2.37 (C attached to Cl) in ^1H NMR. The structure of the compound was further confirmed by the fragmentation pattern of the molecule in the mass spectrum showing a sharp peak at 242 and fragmentation peak at 214 as reported in Pubchem. The compound was thus identified as chloroanthraquinone, reported to have a molecular mass of m/z 242 in published data.

Anthraquinone derivatives other than chloroanthraquinones have been previously reported from *Micromonospora rhodorangea* (Xue et al. 2009) and *Micromonospora lupini* (Igarashi et al. 2007). However, to the best of our knowledge, this is the first report of chloroanthraquinone being isolated from *M. auratinigra* which is a relatively less studied species of this widely reported genus with only one report wherein, Talukdar et al. have reported the bioactive compound, 2-methylheptylisonicotinate, similar to isoniazids from this organism (Talukdar et al. 2016).

MMS8B was found to have antimicrobial, antifungal and anticancer activity. A similar range of activity was also reported in 7-chloroemodin, a novel chloroanthraquinone isolated from lichen (Rosso et al. 2003). Moreover, 2-methylheptylisonicotinate isolated from *M. auratinigra* has been reported to have very high values of MIC of $40\text{ }\mu\text{g/ml}$ against *B. subtilis* (Talukdar et al. 2016). As compared to it, chloroanthraquinone, isolated from this strain of *M. auratinigra* has been found to have a much lower MIC of $8\text{ }\mu\text{g/ml}$. There are practically no reports on anticancer activities of chloroanthraquinone. However our compound was found to be potent against both the tested cell lines.

Isolate MMS16, identified as novel member of Family *Micromonosporaceae* sp., yielded a yellow coloured compound, MMS16B. The UV–vis spectra indicate that it may belong to bafilomycin group of macrolide antibiotics exhibiting maximum absorptions at 242, 248 and 280 nm. Bafilomycins B and C show in addition, shoulders between 340 and 360 nm (Werner et al. 1984). The additional shoulder at 343 in our compound, indicates that it may be bafilomycin B. Further the R_f also matches to that reported for setamycin which is a type of bafilomycin B₁ (Omura et al. 1981). The IR spectra too was very similar to that reported for setamycin by Omura et al. (1981), showing peaks in the range of $3300\text{--}3500\text{ cm}^{-1}$ and around 1650 cm^{-1} as reported for bafilomycins (Werener et al. 1981). However, the peak due to an ester group at $1710\text{--}1730\text{ cm}^{-1}$ and at 1220 cm^{-1} , reported for bafilomycin B₁, was missing.

High resolution LC–MS of the compound yielded molecular weights of 811 which matches the published data for

bafilomycin B₁. The mass showed the same fragmentation peaks (m/z 568, 525, 399, 368, 338, 211, 169, 137, 113, 109) as reported by Otoguro for setamycin (bafilomycin B₁). Also the appearance of characteristic fragment peak at around m/z 211 in our compound is assignable to flavensomycinoic acid which has been involved in the molecules of bafilomycin B₁ (Otoguro et al. 1988). The chemical shift values shown by the ^1H NMR of MMS16B were very similar to that of bafilomycins. Thus R_f , UV spectra, and mass spectra of MMS16B is almost identical to setamycin (bafilomycin B₁) but IR spectra is similar to bafilomycin A. This indicates that MMS16B might be slightly different from the known bafilomycins.

MIC of MMS16B ($7\text{ }\mu\text{g/ml}$) was found to be much lower than the reported value of $25\text{ }\mu\text{g/ml}$ for setamycin against *B. subtilis* (Omura et al. 1981; Otoguro et al. 1988). As MMS16B did not show any appreciable activity against *E. coli* and *P. mirabilis* but exhibited pigment quenching against *S. marcescens*, it was explored further for its AQS properties. MMS16B showed antiswarming activity against *P. mirabilis* at a concentration of 0.3 mg/ml and 0.5 mg/ml with 70–80% reduction in swarm zones. To the best of our knowledge there are no previous reports on the AQS properties of any analogue of bafilomycins.

The IC_{50} value against cancer cell lines HeLa and IMR is comparable to that of reported values of bafilomycin B₁, 5.88 nM and 14.37 nM for other cell lines like leukemia and melanoma (Laakso et al. 2003). These studies on the antimicrobial, AQS and anti cancer properties of MMS16B, which may be a bafilomycin analogue, make it a good candidate for being studied as an AQS and anticancer drug.

KCR3 identified as *K. kristinae*, was found to produce an AMP. The IR spectra of the AMP obtained from KCR3 shows the characteristic IR bands of peptide linkage ($2281\text{--}C\equiv N$ stretch, $1595\text{--}C=O$ amide region, $1488\text{--}NH$ bending and CN stretching, $1153\text{--}C\text{--}OH$ stretch, $C\text{--}O\text{--}C$ stretch, $962\text{--}C\text{--}H$ out of plane bending) (Fabian and Mäntele 2006). However, the peak of 2500 cm^{-1} indicative of $S\text{--}H$ stretch, was lacking in KCR3A, confirming the absence of thiol group in this AMP. The mass spectra indicated that the component with m/z 753 was present at the highest concentration and is likely to be the active compound. Our peptide showed a much broader bioactivity range unlike the AMP's produced by other species of *Kocuria* such as kocurin produced by *Kocuria palustris* and variacin produced by *Kocuria varians*. KCR3A showed activity against both gram positive as well as gram negative bacteria and was also found to be antifungal in nature. Further, it was found to have very high AQS activity at sublethal concentrations as judged by the pigment quenching capability using *S. marcescens* as the test organism. Kocurin is a thiazolyl peptide, reportedly showing in vitro activity against gram-positive bacteria (Martín et al. 2013). Similarly, variacin, a lantipeptide has also been

reported to be active against gram positive bacteria with no antifungal activity (Pridmore et al. 1996). To the best of our knowledge, *K. kristinae* has not been previously studied for production of any bioactive compounds.

Compounds like KCR3A and MMS16B, which interfere with the QS mechanism of pathogens, may prove to be highly effective in controlling their pathogenicity, especially opportunistic pathogens, that cause disease only when their population becomes quorate, and they are able to express their virulence factors. AQS compounds like these can hence attenuate the virulence of the pathogens without challenging their growth, thereby preventing the emergence of drug resistant strains.

Although screening programs do not always result in the discovery of new compounds, this study yielded two novel polyketides and an AMP which can be taken up in a drug development program wherein they may be chemically modified to further increase their activity. These can be subsequently evaluated in clinical trials rendering valuable chemotherapeutic compounds in future.

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest.

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NATURAL ALTERNATIVES TO TREAT CANCER: A STUDY ON ANTICANCER ACTIVITY OF *LAWSONIA INERMIS* LINN.

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ABSTRACT: Henna (*Lawsonia inermis*) is widely used cosmetically and medicinally. Literature survey reveals that the plant henna also has anticancer activity. Most of the anticancer activities of *Lawsonia inermis* plant are carried out using total leaves extract, and purified individual compounds also. The cytotoxicity profile of the extracts, as well as purified fractions, was determined by MTT assay on HeLa cell line. As the total ethanolic extract demonstrated growth inhibition in cancer cells, attempts were made to isolate the active compound from total ethanolic extract, with potent activity. Lawsone, 2-hydroxy-1, 4-naphthoquinone is the active constituent of *Lawsonia inermis* (Henna), *L. alba*, and other species of Lythraceae family. It is reported to possess various medicinal properties. The present study reports the anticancer activity of lawsone, naphthoquinone derivative isolated from the henna leaves, and its predictive conformation by spectral studies. Isolated lawsone was tested for the anticancer activity, which showed significant results.

INTRODUCTION: The associated intolerable side effects of the radiation and some chemotherapeutic agents take away the “Quality of Life,” of a cancer patient, though they provide effective control over cancer. Some of them are effective and agents of choices by the oncologist. However, the pain and agony through which the cancer patient goes due to side effects are unexplainable. Hence, the other side of cancer is compiling to take a look and give thought process to alternate medicine. Given ancient claims about the utility of plant material on understanding the molecular mechanism of cell multiplication and testing chemical entities for the targeted interruption in the cell proliferation in cancer, modern research indeed revealed some effective phytochemicals for the cancer therapy^{1,2}.

A single plant cell is a huge chemical reactor, that way a plant is a huge chemical factory. And if the chemical structures of latest anticancer drugs are studied their identical or prototypes are already available in plants. Hence, it is not unreasonable to believe that a potent anticancer drug can be isolated from the plant. Interest has reviewed recently, in henna to investigate isolation, purification, and identification of novel anticancer active phytochemicals that might lead to drug development for intolerable and incurable cancer disease. These plant-derived drugs are considered natural, safe, beneficial and affordable². Henna is considered a safe herbal medicine with only a few and insignificant side effects^{16,17}.

***Lawsonia Inermis* Linn. (Henna):** *Lawsonia inermis* L., (Henna) belongs to family Lythraceae is an ornamental flowering plant found abundant in Iran, Sudan, Somalia, Egypt, Morocco, Yemen, Niger, India and Pakistan³. This plant is multi-branched, deciduous shrub or small tree having 2.6 m height. Leaves of this plant are 1.3-3.2 cm broadly or elliptic-lanceolate and bear grey-white color flowers⁴.

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Flowers are used as a fragrant agent in local scent. Seeds are deodorant and yield oil, while flowers are refrigerant and soporific and yield a fragrant oil⁵. All parts of this plant are reported to have some medicinal use. Leaves contain a dyeing pigment lawsone (2-hydroxy-1,4-naphthoquinone), which is widely used in cosmetic and textile industry⁶. Henna is a well-known plant for centuries. Throughout the world, it is used medicinally and cosmetically. Since, ancient culture, this plant is used in wedding, especially to grace / embellish bride, in Eids and social celebrations. Henna is applied to dye palms, hands, forearms, fingernails, hairs, legs, soles or feet, and other body parts. All over the world henna body art is very much popularised, in the form of tattoos, designed on arms, legs, behind the neck. This stain last for 3-4 weeks⁷.



FIG. 1: HENNA PLANT

The plant is reported to contain carbohydrates, proteins, flavonoids, tannins and phenolic compounds, alkaloids, terpenoids, quinones, coumarins, xanthenes and fatty acids⁸. The plant has a wide range of phytochemicals including lawsone, isoplumbagin, lawsoniaside, lalioside, lawsoniaside B, syringinoside, daphneside, daphnorin, agrimonolide 6-O- β -D-glucopyranoside, (+)-syringaresinol O- β -D-glucopyranoside, (+)-pinoresinol di-O- β -D-glucopyranoside, syringaresinol di-O- β -D-glucopyranoside, isoscutellarin 3β , hennadiol, (20S)- 3β , 30-dihydroxylupane, lawnermic acid, 3-methyl-nonacosane-1-ol, laxanthenes I, II, III and lacoumarin^{9, 10, 11}.

Various *in-vitro* and *in-vivo* biological studies of *L. inermis* have reported the plant to have analgesic, hypoglycemic, anti-malarial, hepatoprotective, nootropic, immuno-stimulant, anti-inflammatory, antibacterial, antimicrobial, antifungal, antiviral,

anti-parasitic, antitrypanosomal, antidermatophytic, anti-oxidant, anthelmintic, antifertility, tuberculostatic and anticancer properties^{12, 13, 14, 15}. The Scientific Committees on Consumer Products and Consumer Safety has presented a summary of detailed toxicity studies done on henna^{16, 17}. In some cases, the henna extract was found to induce allergic reactions such as itching, depigmented skin patches, blistering and permanent scarring also, which are treated with antibiotics and corticosteroids¹⁸⁻²². The use of paraphenylenediamine (PPD) in henna for getting a long-lasting stain, is the main cause of allergic contact dermatitis or serious allergic reactions²³⁻²⁹.

MATERIAL AND METHODS:

Plant Material: The leaves of *Lawsonia inermis* were collected from the local area of Nagpur region. The leaves were washed with water to remove the dust and were shade-dried. The leaves of *Lawsonia inermis* were authenticated from the Botany Department of Rashtrasant Tukdoji Maharaj, Nagpur University, Nagpur allotted with the specimen number 10014. The cancer cell lines were procured from National Centre for Cell Science, Pune and pure lawsone was procured from Himedia, India.

Preparation of Extract (Extraction of Plant Material): Two extracts were prepared, one alcoholic and the other hydroalcoholic (1:1). The extraction was carried out by the cold maceration process. Ethanol was added to the shade dried leaves of *Lawsonia inermis*, mixed properly and was kept for maceration for 15 days with occasional shaking. After completion of extraction with ethanol, the leaves were air dried, and the same leaves were extracted with the mixture of ethanol and water (1:1), by cold maceration for 15 days. In both the cases solvent was removed by evaporation, the residue obtained was dried, weighed and percentage yield was determined. This was followed by defatting of the total ethanolic extract by *n*-hexane. All these three extracts, *i.e.* alcoholic, hydroalcoholic and the defeated fraction where tested for anticancer activity.

Anticancer Activity (MTT ASSAY): The cytotoxicity of the alcoholic extract on *in-vitro* cultured HeLa cell (the human cervical cancer cells) was determined. Freshly passaged HeLa cells

were centrifuged and washed with MEM. The cell count was adjusted to 2.5×10^5 cells/ml by suspending the cells in fresh RPMI with 5% FBS (Invitrogen). This cell suspension was then transferred to a 96-well TC plate for the assay. A gradient of extract concentrations was supplemented in the medium for the assay and had the final concentration 500, 1000, 1500 and 2000 $\mu\text{g/mL}$.

The plate was incubated at 37°C in a humidified environment with 5% CO_2 in air for 48 h. After incubation, the cells were washed and re-suspended in fresh medium containing MTT (Himedia) and were further incubated for 3 h. The MTT formazan formed in the viable cells was extracted in DMSO (BIOGENE Reagents Inc., CA, USA) and read at 570 nm in the Bio-Rad ELISA plate reader. All the three extracts were subjected to MTT assay.

Apoptosis Assay:

DNA Fragmentation Analysis: DNA fragmentation is the biochemical hallmark of apoptosis. Jurkat, Molt-4 cells and human lymphocytes were exposed to nisin at the cytotoxic concentration, and the cells were incubated at 37°C for 6 h as well as for 48 h. The degree of DNA fragmentation was determined by performing electrophoresis, as per the protocol detailed by Barry et al.,³⁰ the treated and untreated cells were directly subjected to agarose gel electrophoresis. The cells were loaded into the wells cast in the cell lysis gel- 0.9% agarose in TBE buffer pH 8.0 with 2% SDS and 64 $\mu\text{g/mL}$ proteinase K (SIGMA). The cell lysis gel was followed by the 2% agarose separating gel. The electrophoresis was carried out in TBE buffer pH 8.0 overnight at 35V.

Single Cell Gel Electrophoresis (SCGE) / Comet Assay:

To further assess apoptosis and DNA fragmentation, a more specific and sensitive comet assay was performed^{31, 32, 33}. The Jurkat, Molt-4 cells and human lymphocytes were treated with 600 μM concentration of nisin in RPMI without serum for 3 h at 37°C . Cells exposed to 60 μM H_2O_2 ³⁴ were treated as a positive control and untreated cells as negative control. After incubation, the cells were embedded in 1% low melting agarose in PBS and were lysed in lysis buffer at 4°C for 2 h. The lysed cells were then incubated in 0.3N NaOH, 1mM EDTA solution for

30 min at room temperature and further electrophoresed at 25V for 20 min in the same buffer. After electrophoresis, the agarose-embedded cells were stained with propidium iodide (20 $\mu\text{g/mL}$) in PBS washed with chilled distilled water and observed under Motic Fluorescent microscope.

Isolation of the Lawsone: The lawsone isolation was carried out as per the procedure is given in the book Practical Pharmacognosy by Dr. C. K. Kokate.

About 50 g of crushed fresh henna leaves were agitated for 2 h with 20% sodium bicarbonate solution. The extract was filtered, and the marc was re-extracted for 1h with the same solution, filtered and the alkaline extracts were combined. The extract was acidified with dilute sulphuric acid and was re-extracted with sufficient quantity of ammonium hydroxide, followed by dilute hydrochloric acid to acidify it.

The product was finally extracted with benzene and yielded yellowish-brown colored crystals of lawsone. The yield of lawsone was found to be 1.5% w/w. This isolated pure lawsone was tested for anticancer activity using above said MTT Assay on the HeLa cell line, which showed prominent activity.

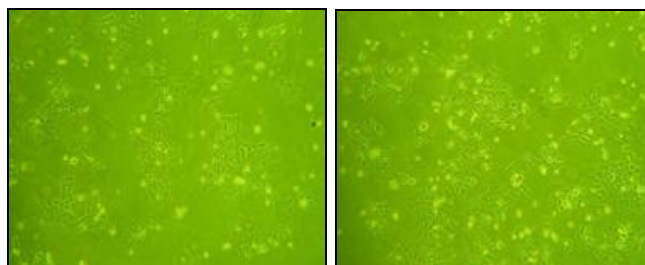


FIG. 2: THE HeLa CELLS USED TO PERFORM MTT ASSAY

RESULTS AND DISCUSSION: The prominent color and maximum yield of lawsone could be used as a hallmark compound in *Lawsonia inermis* L. Comparison of the isolated compound, and standard lawsone was carried out using Co-TLC plate, in which R_f value of both were the same, i.e. 0.66. The melting point of isolated lawsone was carried out, which was found to be same as that of standard lawsone i.e. $195-196^\circ\text{C}$. Isolated compound was confirmed by using spectral studies. The UV spectra of the isolated compound and

standard lawsone was found to be same with 1.78 λ_{max} . Also the, IR results were found to be similar to each other. Thus, from the above analytical results, there is no doubt to reason that the isolated compound was lawsone, an active naphthoquinone derivate.

TABLE 1: THE ABOVE TABLE ILLUSTRATES THE WAVE NUMBER AND FUNCTIONAL GROUP OBTAINED IN IR ANALYSIS

| Wave Number (cm ⁻¹) | Functional Group |
|---------------------------------|------------------|
| 3649.32 | -OH |
| 1697.36 | -C=O (Ketone) |
| 1600 | C=C (aromatic) |

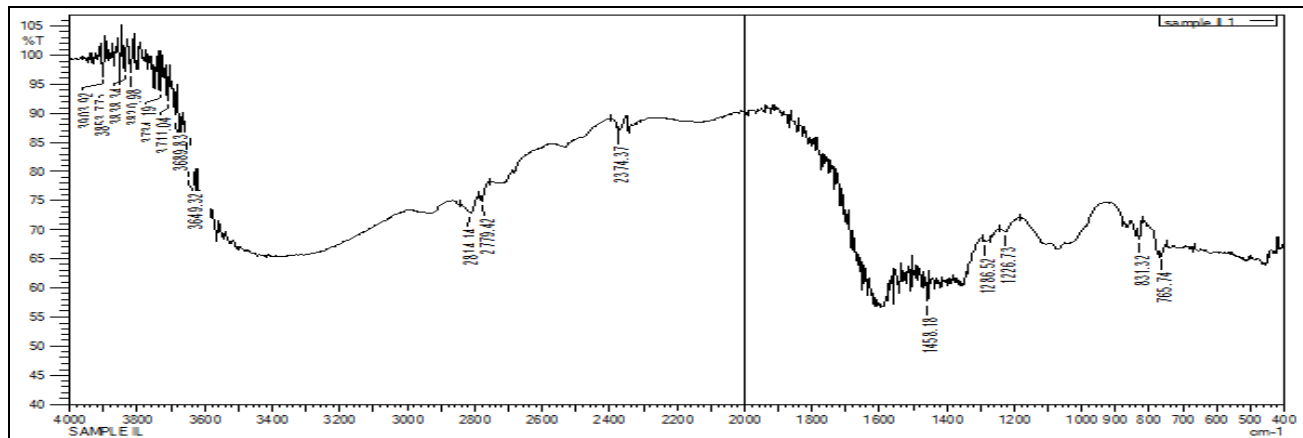
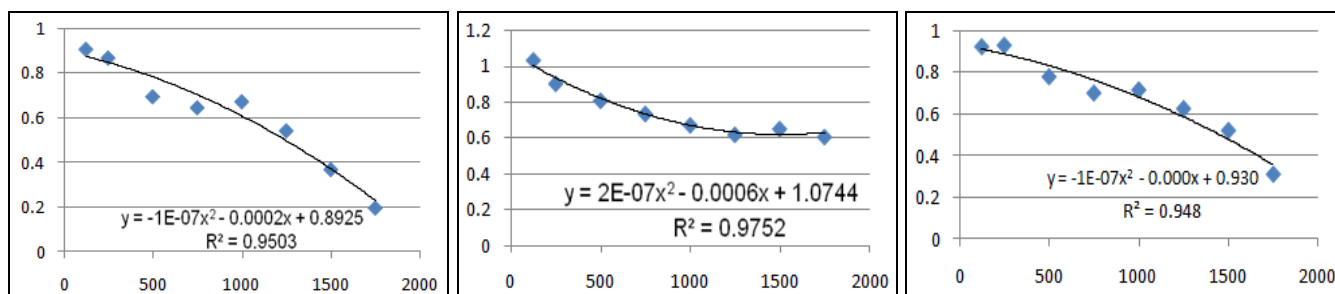
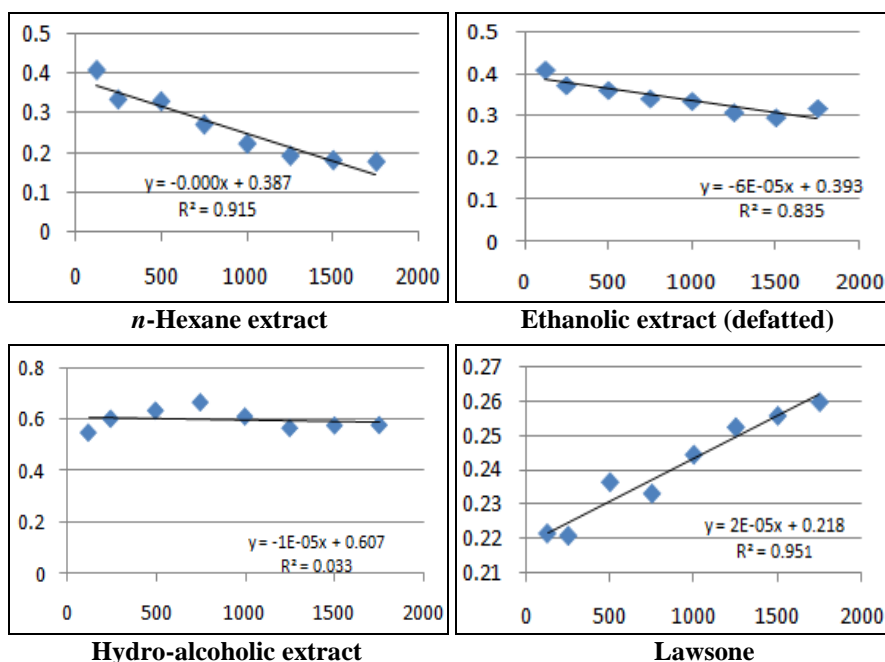


FIG. 3: THE ABOVE IR SPECTRA CONFIRMS THE FUNCTIONAL GROUP OF ISOLATED LAWSONIA INERMIS L.



Ethanolic extract (Defatted) Isolated lawsone Hydro-alcoholic extract
 FIG. 4: MTT ASSAY RESULTS OF THE HENNA EXTRACT AND LAWSONE ON HELA CELLS



n-Hexane extract Ethanolic extract (defatted) Hydro-alcoholic extract Lawsone
 FIG. 5: MTT ASSAY OF HENNA EXTRACT AND LAWSONE ON IMR-32 CELL LINE

To further confirm the results of electrophoresis Fig. 8, comet assay was performed using same cytotoxic concentration of isolated lawsone derivative versus pure lawsone to treat the cells and as was used for agarose gel electrophoresis. But even much higher concentration purified lawsone derivative exposure failed to induce actual comets with substantial tail length, as were induced by 60 μM H_2O_2 Fig. 7C. All the comets were graded as per Choucroun *et al.*,³⁵ and a count of C>1 was

determined to derive a percentage of cells with DNA damage from a total of 50 randomly scored cells. There was no significant difference in the percentage of C>1 cell in the batch of lawsone treated and untreated cells. From the above data, it can be confirmed that the plant has anticancer activity. The above graph shows that both henna alcoholic extract and isolated lawsone displayed the cytotoxic effects against HeLa cell line.

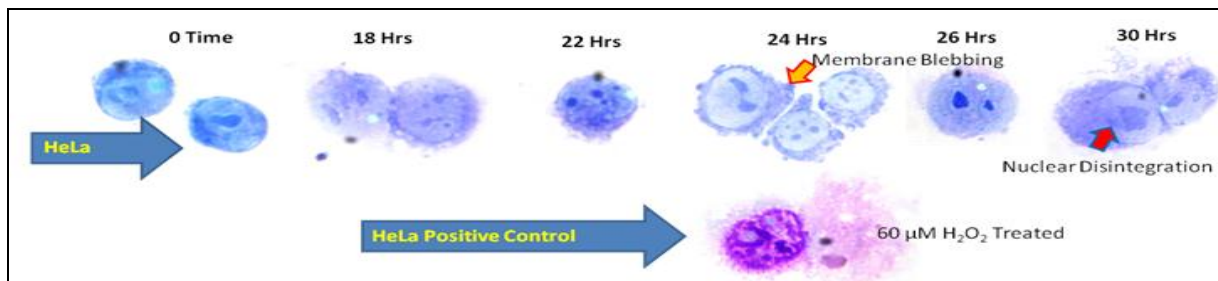


FIG. 6: GIEMSA STAINING FOR CELL MORPHOLOGICAL ANALYSIS. The cells treated with a cytotoxic concentration of purified lawsone derivative demonstrated typical apoptotic cellular morphological changes when pictured at different incubation time intervals.



FIG. 8: SINGLE CELL GEL ELECTROPHORESIS (SCGE) / COMET ASSAY. Comet assay results revealed that the purified lawsone derivative (A) was more potent in inducing DNA fragmentation in HeLa cells compared to pure lawsone (B). However, the extent of DNA fragmentation induced by purified lawsone derivative could not induce very drastic DNA fragmentation as was shown by 60 μM H_2O_2 (C) which served as positive control.

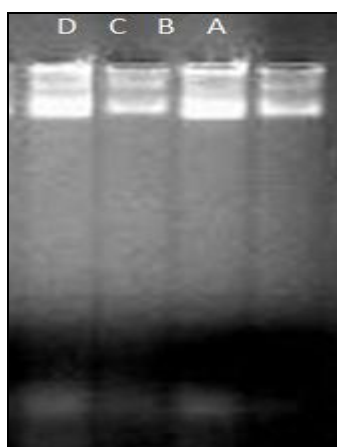


FIG. 7: DNA FRAGMENTATION ANALYSIS. Agarose gel electrophoresis of cells subjected to standard lawsone (A), purified lawsone derivative (B), untreated control (C), and positive control 60 μM H_2O_2 (D) are depicted in this figure. Purified lawsone derivative and positive control gave the same pattern of DNA fragmentation while standard lawsone and untreated control cells showed similar DNA pattern on 1% agarose gels.

CONCLUSION: In view to discovering an effective, potent and economic anticancer drug from the herbal origin with no or fewer side effects, the literature search for local plants having alleged anticancer activity ended on one of the potential plants namely *Lawsonia inner*. MTT assay performed on various extracts using HeLa and IMR-32 cell lines showed prominent anticancer activity with alcoholic extract. Lawsone, a naphthoquinone derivative with prominent color and maximum yield has proved to have anticancer activity, which is further proved by DNA fragmentation. The spectral studies and Co-TLC of the isolated compound showed similar results as that of the lawsone.

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Implementing the Learning Management System in University Affiliated Colleges: Perks and Challenges

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Abstract

The present article explores the perks and challenges of implementing LMS in University Affiliated Colleges while focusing on the importance of ICT in higher education and innovative teaching. With the availability of MOOCs and other online sources the content is easily available to students. Using this content in meaningful way can enhance learning among students which could be assisted by teachers. LMS helps teachers and students to manage learning in an effective way. But implementing LMS in colleges possess challenges due to the economic diversity of the students. This and other road blocks can be taken care of by proactive intervention by the college authorities and creative teachers.

Key Words: Learning Management System (LMS), Google Classroom (GC), Information and Communication Technology (ICT), MOOCs, National Assessment and Accreditation Council (NAAC)

Role of ICT in Education

As defined by National Assessment and Accreditation Council (NAAC) in its newly published manual for Self-Study Report (SSR) for affiliated College, Information and Communication Technology or ICT “consists of the hardware, software, networks and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images) as well as related services.”[1] Until now the implementation of ICT was restricted to the use of overhead/LCD projectors and smart boards for delivering lectures by the means of power point presentation. This method of delivering lectures limits the scope of pedagogy in the classroom as same lectures could be repeated every year without keeping up with

the latest development in the field. In order to project the use of ICT in SSR, mentioning the power point presentation as ICT demean its exact purpose and meaning in teaching and learning process. This is because of unimaginative and non-explorative approach of teachers.

With the growth of Internet and World Wide Web, ICT have been proven to be a very powerful and effective tool in different fields including education. For example very good quality of scientific content is generated and posted on YouTube by both well-known scientific institutes as well as private individuals. Such resources have proven to present complicated ideas in an interesting way. Beside this the content can be repeatedly seen which is not possible in the live lectures.[2]

The Rise of MOOCs and other online resources

To reach larger groups of students with similar interest many leading Universities started their online courses in early 2010s. These courses followed a uniform design which is available to anyone and anywhere with little or no price and are now known as Massive Open Online Courses or MOOCs. Government of India also initiated its own MOOC as SWAYAM which stands for Study Webs of Active –Learning for Young Aspiring Minds where good quality of online courses is available for students worldwide. These and other online resources are easily available to students with good internet connection and a computer. It has become possible for students to get almost every information from internet which poses threat for live lectures as teachers may reason that student will not attend their lectures.

QUALITY INDICATOR FRAMEWORK (QIF) Criterion II: - Teaching Learning and Evaluation and use of LMS

Criteria II of QIF by NAAC suggest that Higher Educational Institutes (HEIs) should ensure effective teaching-learning for students. NAAC advises to use “Interactive instructional techniques that engage students in higher order ‘thinking’ and investigation, through the use of interviews, focused group discussions, debates, projects, presentations, experiments, practicum, internship and application of ICT resources.”

NAAC also states that “Quality of learning provided in the institution depends largely on teacher readiness to draw upon recently available technology supports and also the

initiative to develop such learning resources to enrich teaching-learning; on teacher’s familiarity with Learning Management Systems (LMSs), other e-resources available and how to meaningfully incorporate them in one’s scheme of teaching-learning.” Where “A learning management system (LMS) is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training Programmes. They help the instructor deliver material to the students, administer tests and other assignments, track student progress, and manage record-keeping [1].” Such software applications are commercially available which requires dedicated personals to manage suggesting investment from authorities in terms of both monetary and space. MOODLE is a good example of this.

Google Classroom: A free LMS

Google Classroom (GC) is web service created by Google and freely available to anyone with G mail account. This web service is combination of other application by Google like Drive, Docs, Sheets and Forms. GC can be used as a LMS where teachers can create their classes and share study material, give and asses assignments and take tests. On larger scale these services by Google can be used using Google Suite for Education. All the data used in the classroom is saved in Google Drive therefore can be recovered or reused in future classes. With GC students can access the study material posted by the teachers anytime and anywhere. It has been seen that using GC tracking and assessing assignments becomes easy as compared to traditional manual submission. And as with

most of the web services the more it is used the more refined it gets with users feedback.[3]

Flipped classroom and LMS

A novel concept of flipped classroom is being used in several institutes where the classroom teaching or the material is provided to students before actual class. Thus enabling the students to inculcate self-learning abilities while skipping lecturing in the class. In the class the teacher's major role is assessing the students understanding of the material provided and directing them to apply the gained knowledge. Combining lectures from MOOC and/or other open sources and LMS, a teacher can create new lesson plans and enhance the learning of their students in an innovative method. Group discussion and debating on given topic can also lead to deeper understanding of a topic and higher order thinking among students [4].

Applying Bloom's taxonomy using LMS

Bloom's taxonomy is central part of pedagogy where knowledge based learning objective is classified into levels like Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation. These levels when used in teaching and assessing students, gives clear picture of the learning of whole class. Due to larger size of classes in colleges these techniques are not applied, resulting in mediocre learning experience by the students. LMS can be used to apply Bloom's taxonomy in teaching and assessing the students. With easy access to each student's learning, teachers can track their progress and design personalized

material and quiz to help weaker students [5].

Major Challenges for LMS implementation

As discussed before LMS like MOODLE require specialized person to manage and operate it as an administrator. It also require dedicated server at institute level. All these things require financial support from the institute which might not be possible for every college. GC being a free service proves to be an effective alternative. Besides being freely available other services by Google are easily and effectively used in GC.

Another challenge faced by colleges and teachers is, the device on which GC is used. GC can be operated from any personal computer with an internet connection and from smartphones as well. For smartphones GC app can be downloaded from Google Play store for free. This indirectly implicates that both students and teachers must have at least a personal computer if not a smart phone with an internet connection. Such things cannot be expected from economically weaker students. Here the college administration must intervene by providing computer labs to both students and teachers. With the development of technology it has become mandatory for any youngster irrespective of their background to be familiar with computers and related technologies. Therefore having an email ID and knowing how to use computer is essential for students but owning a computer or smartphone is secondary and not necessary.

When it comes to use of technologies in colleges, older teachers are more reluctant towards it and show resistance to learn new things. But learning new things and other cognitive stimulation have proven the positive effect on healthy brain aging including delaying dementia [6]. Besides this the huge experience possessed by older teachers when combined with the technology like LMS can lead to extraordinary classroom experience for students.

Conclusion

ICT is an important aspect of 21st century education. With arrival of MOOCs and other online resources which are available for less or no price, role of teachers as content

provider will be diluted if not become obsolete. To keep up with such trends teachers have to include tools like LMS in their classrooms. They also need to develop deep understanding about teaching and learning in addition to keep up with the overflowing knowledge in their domain. Application of Bloom's taxonomy while preparing and delivering lectures will keep the human touch in education intact. LMS provides an effective tool for creating and managing the teaching learning process in colleges whilst providing proper monitoring by the authorities. At the end it is up to the creativity and willingness of teachers and HEIs to use LMS, MOOCs and other ICT for the benefit of students and for country.

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Review Article

IN VITRO HAIRY ROOT CULTURE: A PROMISING APPROACH TO INVESTIGATE MOLECULAR MECHANISM OF PHYTOREMEDIATION

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Abstract

Environmental pollution caused by natural processes or anthropogenic activities is a major global problem. Although several physical and chemical strategies have been used for environmental remediation, these methods are expensive and associated with certain limitations. Phytoremediation is an alternative, biological approach where different plant species are used for the removal of pollutants from the environment or for converting toxic molecules to non toxic forms. Both organic and inorganic compounds of various types are the targets of phytoremediation. Recently Hairy root cultures have been considered as a superior model system to investigate molecular mechanism of phytoremediation processes as rhizofiltration, phytostabilization and phytoextraction of organic and inorganic pollutants because of their biochemical and genetic stability and easy maintenance. This review focuses on the phytoremediation process, induction and establishment of *in vitro* hairy root culture, advantages of hairy root culture, future application of hairy root culture system to understand the molecular mechanism of phytoremediation

Key words: Hairy Root, Phytoremediation, *Agrobacterium rhizogenes*, *In vitro* Culture

Introduction

Environmental contamination has become a concerning issue worldwide due to number of risks it poses to human health and ecosystem functioning (Malik *et al.*, 2017). Contaminants present in soil or water can go up through the trophic chain via microbial or plant incorporation (Chibuike and Obiora, 2014). Remediation of contaminated sites using conventional practices, such as ‘pump-and-treat’ and ‘dig-and-dump’ techniques, is often expensive, has limited potential, and is usually only applicable to small areas. Additionally, these conventional approaches to remediation often make the soil infertile and unsuitable for agriculture and other uses by destroying the microenvironment (Vidali, 2001). Hence now a day’s Phytoremediation is an alternative, biological approach where different plant species are used for the removal of pollutants from the environment. In recent years, hairy roots (HRs) have been successfully used as research

tools for screening the potentialities of different plant species to tolerate, accumulate and/or remove environmental pollutants, such as PCBs, TNT, pharmaceuticals, textile dyes, phenolics, heavy metals, and radionuclides (Agostini *et al.*, 2013). It makes the use of various plants to remove, transfer or stabilize pollutants in an environmental friendly manner. Hairy roots of plants are among the several experimental systems which have been employed to improve the efficiency of phytoremediation (Majumder and Jha, 2012). Hairy root disease, characterized by a massive production of adventitious roots with numerous root hairs at the wound site, is caused by *Agrobacterium rhizogenes*, a gram negative soil bacterium. The bacterium transfers a segment (the transferred DNA or T-DNA) of its root inducing (Ri) megaplasmid into the plant genome, modifying the normal hormonal metabolism of the plant; this hormonal imbalance induces the formation of hairy roots at the site of infection (Agostini *et al.*, 2013). This article discusses the phytoremediation process, induction and establishment

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of hairy root culture, advantages of hairy root culture, future application of hairy root culture system to understand the molecular mechanism of phytoremediation.

Phytoremediation

Phytoremediation ('phyto' means plant) is a generic term for the group of technologies that use plants for remediating soils, sludges, sediments and water contaminated with organic and inorganic contaminants (Champagne, 2007). Plants have evolved a great diversity of genetic adaptations to handle the accumulated pollutants that occur in the environment (Sakina Saadawi *et al.*, 2015). Growing and, in some cases, harvesting plants on a contaminated site as a remediation method is a passive technique that can be used to clean up sites with shallow, low to moderate levels of contamination (Azubuike *et al.*, 2016). Phytoremediation can be used to clean up metals, pesticides, solvents, explosives, crude oil, polyaromatic hydrocarbons, and landfill leachates (Mahendran, 2014). It can also be used for river basin management through the hydraulic control of contaminants (Champagne, 2007). Phytoremediation has been studied extensively in research and small-scale demonstrations, but full-scale applications are currently limited to a small number of projects. Further research and development will lead to wider acceptance and use of phytoremediation (Kokyo *et al.*, 2014).

Phytoremediation is:

A low cost, solar energy driven cleanup technique.

Most useful at sites with shallow, low levels of contamination.

Useful for treating a wide variety of environmental contaminants.

Phytoremediation Processes

Different techniques have been introduced to exploit the potential of plants for the removal of hazardous compounds from contaminated water and soil.

Schwitzgubel has explained different technological subsets of phytoremediation (Razzaq, 2017).

Phytoextraction (Phytoaccumulation): Removal of pollutants using the plants having the ability to accumulate pollutants from the soil and store them in their shoots so that they can be harvested.

Phytotransformation: It is the phenomenon in which the complex organic molecules are converted into the simpler one by degrading them and the simpler one can then be incorporated in the tissues of plants.

Phytostimulation: This process includes the stimulation of enzymes present in the rhizosphere which can lead to the bioremediation using microbes or fungal degradation by releasing exudates.

Phytovolatilization: In this, the plants take up the pollutants and then they can volatile from the surface of the leaves.

Phytodegradation: In this technique, there is the use of enzymes for the breakdown of harmful organic pollutants like herbicides or trichloroethylene. This can happen both inside or outside the plants as the plants can also secrete the enzymes outside.

Phytorhizofiltration: It is the inhibition of organic pollutants from mixing into the water streams or groundwater using roots for filtration purpose as they can absorb or adsorb the pollutants.

Phytostabilization: This technique involves the prevention of mobility of organic pollutants into the soil thus reducing its bioavailability and stops them from entering into the food chain. Some types of phytoremediation process and removal of respective pollutants mentioned in table 1.

Does Phytoremediation Work at Every Site?

Phytoremediation technologies have been used to clean up metals, pesticides, solvents, explosives, crude oil, polyaromatic hydro-carbons, and landfill leachates

Table 1: Outline of Phytoremediated Chemicals (Nwoko, 2010)

| Type of phytoremediation | Chemicals Treated |
|---------------------------------|---|
| Phytoaccumulation/extraction | Cd, Cr, Pb, Ni, Zn, radionuclides, BTEX*, penachlorophenol, short chained aliphatic compounds |
| Phytodegradation/transformation | Nitrobenzene, nitroethane, nitrotoluene, atrazine, chlorinated solvents (chloroform, carbon tetrachloride, etc) |
| Phytostabilization | Heavy metals in ponds, phenols and chlorinated solvents |
| Phytostimulation | Polycyclicaromatic hydrocarbon, BTEX, PCB#, tetrachloroethane |
| Phytovolatilization | Chlorinated solvents, Hg, Se. |
| Phytofiltration | Heavy metals, organics and radionucleides |

*BTEX = benzene, toluene, ethyl benzene, xylenes; #PCB = Polychlorinated biphenyl

(Mahendran, 2014). Phyto-remediation can be used in combination with other cleanup approaches as a ‘finishing’ or ‘polishing’ step. Some phytoremediation applications are slower than mechanical and chemical methods and are limited to the depths that are within the reach of the plant roots (Singh, 2005). Generally, the use of phytoremediation is limited to sites with low to medium contaminant concentrations and contamination in shallow soils where phytotoxicity does not occur and the roots of plants can easily access the contaminant (Bieby *et al.*, 2011). Plants can also be used to clean up contaminants in streams and groundwater. Researchers are finding that the use of trees (rather than smaller plants) allows for the treatment of contamination at greater depths, as tree roots penetrate more deeply into the ground. Very deep contaminated ground-water may be treated by first pumping the water out of the ground and then using plants to treat the contamination (Pierret *et al.*, 2016).

Further research is needed to study the effects of bioaccumulation and biomagnification in the food chain that could occur if insects and small rodents eat the plants that are collecting contaminants and are then eaten by larger mammals. In addition, scientists need to establish whether contaminants can collect in the leaves and wood of trees used for phytoremediation and be released when the leaves fall in the autumn or when firewood or mulch from the trees is used.

Induction and Establishment of Axenic Hairy Root Culture

Hairy root disease is caused by a naturally occurring gram negative soil bacterium *Agrobacterium rhizogenes* that contains root inducing (Ri) plasmid (more than 200 kb). T-DNA on Ri-plasmid is transferred and integrated into the nuclear genome of the host plant upon infection with *A. rhizogenes* (Nilsson and Olsson, 1997; Riva *et al.*, 1998; Sevón and Oksman-Caldentey, 2002). Opines

are produced as a result of infection, and based on the opines produced, *A. rhizogenes* strains are classified into octopine, agropine, nopaline, mannopine, and cucumopine type (Zhou *et al.*, 1998). Choice of proper explant, an appropriate *A. rhizogenes* strain, culture medium, as well as selection of antibiotic to remove the bacteria after cocultivation are important factors for establishing hairy root culture (Hu and Du, 2006). Different explants like root, stem, leaf, hypocotyl, cotyledons, nodal segments, and embryo axis can be used for initiation of hairy roots. Out of all the strains, agropine is the most commonly used due to its strong induction ability. The protocol for successful establishment of axenic hairy root culture (HRC) involves three steps *viz.* root induction, decontamination of roots and establishment in liquid medium. Seedling grown under sterile conditions is inoculated with an appropriate strain of *Agrobacterium rhizogene*. A commonly used technique is to wound the axenic seedling or suitable plant material with an overnight culture of *A. rhizogene*. Hairy root emerge from the site of infection within 2-4 weeks. Putative hairy roots are established on MS medium. The hairy roots are decontaminated by subculturing on MS solid medium containing 250 mg/l antibiotic. The bacteria free hairy roots can be successfully grown in a phytohormone free MS liquid medium. The cultures are incubated on a rotary shaker at 100 RPM, with 25° C temperature (Uozumi, 2004; Guillon *et al.*, 2006). Hairy roots are characterized by a large number of highly branched fast growing adventitious roots at the wound site which are capable of growing on hormone free medium. These are plagiotropic in nature and are found to be genetically as well as biochemically stable over a long period of time (Hu and Du, 2006; Uozumi, 2004; Guillon *et al.*, 2006; Chilton *et al.*, 1982).

Table 2 : Pollutants and Hairy Root culture of plant species (Sonia Malik *et al.*, 2017)

| Pollutant | Hairy root culture of plant species |
|----------------------------------|--|
| Cadmium | <i>Beta vulgaris, Nicotiana tabacum, Solanum nigrum, Thlaspi caerulescens, Adenophora lobophylla, A. potaninii</i> |
| Copper | <i>Rubia tinctorum, Hyptis capitata</i> |
| Uranium | <i>Chenopodium amaranticolor, Brassica juncea</i> |
| Nickel | <i>Alyssum sp., Alyssum murale</i> |
| Phenol | <i>Brassica juncea, B. napus, Lycopersicon esculentum, Armoracia lapathifolia, Daucus carota</i> |
| RDX and HMX | <i>Catharanthus roseus</i> |
| Tetracycline and Oxytetracycline | <i>Helianthus annuus</i> |
| PCBs | <i>Solanum nigrum</i> |

Abbreviations: (DDT- dichloro-diphenyl-trichloroethane, HMX oxtahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine, PCBs- polychlorinated biphenyls, RDX - hexahydro-1, 3-5-trinitro-1, 3-5-triazine)

Advantages of Hairy Root Culture for Phytoremediation

Plant roots are in direct contact with pollutants in contaminated soil or water, their responses to toxic substances are of particular importance in phytoremediation and phytomining research. Genetically transformed hairy roots offer many practical advantages compared with untransformed roots or dedifferentiated plant cells in experimental studies, such as ease of initiation, culture, and maintenance, indefinite propagation of material derived from the same parent plant, genotype and phenotype stability, biochemical stability, autotrophy in plant hormones. Hairy roots have been applied mainly in metabolic studies of xenobiotic biotransformation and degradation in plants, and for determining the responses of plant tissues to toxic heavy metal (Arora's, 2010; Doran, 2013). Hairy roots provide a large surface area due to fast growth and highly branched nature and hence contact between the contaminants and tissue in comparison to naturally growing roots thus providing reliable and reproducible experimental system to study the pollutants and their response to toxic substances (Suza *et al.*, 2008; Eapen *et al.*, 2003). Introduction of foreign genes and their resultant proteins to metabolize environmental pollution in transformed hairy roots can be expressed for a long term due to genetic stability (Bernejee *et al.*, 2002). Another advantage associated with the hairy roots is absence of shoots that help in understanding the mechanisms present only in roots for removal of contaminants without the translocation effects (Majumder and Jha, 2012). These roots can also be used to understand the enzymatic processes involved in bioconversion of toxic pollutants to nontoxic compounds (Macek *et al.*, 2000). Literature studies showed the number of reports wherein hairy roots have been successfully used to study phytoremediation. Some of the examples of hairy root cultures from different plant species employed to uptake and degrade the various pollutants are presented in table 2.

Cellular and Molecular Mechanisms of Phytoremediation

Exposure to pollutants may cause a series of symptoms in plants. Pollutant action can result in inhibition of cellular activity or rupture of cell structure, due to possible damages of essential components (Cherian and Oliveira, 2005). Plants show some potential cellular and molecular mechanisms and strategies, which can be involved in detoxification of organic and inorganic pollutants such as herbicides, explosives and heavy metals. These mechanisms can be related to the cell wall composition and root environment, plasma membrane

properties and integrity, enzymatic transformation, complexation with ligands and vacuolar compartmentalization (Hall, 2002; Mello-Farias and Chaves, 2008). Depending on the nature of pollutant (organic or inorganic) plant cells can use one or some of these systems of remediation (Cherian and Oliveira, 2005); Hall, 2002; Mello-Farias and Chaves, 2008). Hairy root cultures provide an ideal model system to identify the role of plants in phytoremediation and have been used frequently for this purpose (Doran, 2009). They allow researchers to monitor and quantify the uptake of pollutants and follow the detoxification process in detail. Thus, hairy roots will help in gaining a greater understanding of the way plants deal with pollutants. In addition, hairy roots can be subjected to various physiological assays. This information will be valuable in choosing the best plant species for use in bioremediation (Suza *et al.*, 2008).

Much work on metal transport in plants is done with the hyperaccumulator *T. calerulescens*. Molecular genetics comparison of different ecotypes has resulted in the identification of genes involved in transmembrane metal transport and hyperaccumulation (Plaza *et al.*, 2007; Plessl *et al.*, 2010; Visioli *et al.*, 2010), a key role is played by genes belonging to the ZIP, HMA, MATE, YSL, and MTP families (Rascio and Navari-Izzo, 2011). High-throughput technologies, in particular microarray, have allowed the complexity of plant stress response to be tackled. Much work has been reported recently in these filed. Here, we reviewed the progresses since 2009. For more information, readers can refer to the reviews by Verbruggen *et al.*, (2009), Thapa *et al.*, (2012), Claire-Lise and Nathalie (2012) and other related papers.

Transgenic Hairy Roots for the Improvement of Phytoremediation

The understanding of the physiological and biochemical processes, types of enzymes and genes involved in the metabolism of a particular compound, allows the obtainment of genetically modified plants with the purpose of improving the efficiency of pollutants removal or transformation. Furthermore, encouraging results have been obtained using transgenic HRs. For inorganic compounds, subcellular targeting of metal-binding proteins to cytoplasmic membrane or to desired cell organelles could enhance metal accumulation (Bizily *et al.*, 2003; Hussein *et al.*, 2007). As it was mentioned before, Cu hyperaccumulating *A. thaliana* plants were generated by expressing Cu-binding periplasmic protein CopC (Rodríguez-Llorente *et al.*, 2012). This novel strategy has been also applied to obtain transgenic HRs, which accumulated high Cu concentrations by expressing

CopC protein either in the cytoplasm of cells or by targeting it to the vacuole (Pe' rez-Palacios, 2015). HRs by a multi-transgene strategy, could contribute with an increased phytoremediation of mixed polluted environments.

Hairy Roots Versus Plants for Phytoremediation Studies

HRs have proved to be useful for phytoremediation researches providing basic information related on the capability of plant cells to tolerate, detoxify, metabolize, and store a wide variety of organic and inorganic pollutants. Particularly, many aspects of the primary interaction roots-pollutants have been elucidated taking advantage of the physiologic similarity between HRs and real roots (Nedelkoska and Doran, 2000). Recently, omic technologies have allowed deepening our knowledge about the HRs biotechnological potential and they have revealed the main similarities and differences between HRs and their mother plants (Sharma *et al.*, 2013; Gao *et al.*, 2014; Georgiev *et al.*, 2015). Thus, it is expected that these technologies would be useful tools to clarify some aspects related with phytotransformation of recalcitrant xenobiotics, which still remain unclear. In addition, transgenic HRs give the possibility to study genes functionality and the role of some key proteins and enzymes involved in several metabolic pathways used by plant cells to tolerate and detoxify environmental pollutants. As it was pointed out, HRs have an undeniable potential regarding to the use of plants for *in vitro* phytoremediation studies. However, some limitations, mostly associated with their application in a real scenario should be considered

Conclusion and Perspectives

The environment has become more and more concerned in the fields of economics, politics, social and cultural affairs, science and technology. To enhance the potential for environmental protection and conservation, a considerable amount of researches have been done for phytoremediation. However, those studies in the field of biological applications do not provide much attention to uncertainty in the molecular principles. HRs have contributed to the knowledge of the complex biochemical and molecular mechanisms involved in phytoremediation. In this sense, a better understanding of the intrinsic roots metabolism is allowed since there is not translocation of the pollutant or its intermediates to aerial parts. HRs have proved to be effective tools for studying the mechanisms of metal uptake, accumulation and tolerance. The phytoremediation is still under investigation as well in methodological aspects as in concrete applications. In

order to move phytoremediation forward, it is important to look for and investigate the molecular mechanism of new plant species with the ability to remove contaminants from our environment.

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Green fabrication of zinc oxide nanospheres by *aspidopterys cordata* for effective antioxidant and antibacterial activity

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Abstract

The present work portray the *Aspidopterys Cordata* (AC) leaf extract-assisted fabrication of zinc oxide nanospheres (ZnO NSs) using an eco-friendly approach for antibacterial and antioxidant activity. As fabricated ZnO NSs were characterized by X-ray diffraction (XRD), fouriertransform infrared (FT-IR), energy dispersive X-ray diffraction (EDX), UV-Visible diffuse reflectance spectroscopy (UV-DRS), Raman, X-ray photoelectron spectroscopy (XPS), scanning electron microscope (SEM), and transmission electron microscope (TEM) for authenticate the structure, shape, size, chemical state, and morphological facet. XRD pattern showed the strong and intense diffraction peaks indicating the formation of crystalline ZnO NSs with hexagonal phase. Further, EDX revealed the formation of highly pure ZnO with signals of Zn and O elements. UV-DRS reveals absorption band at 370 nm, assigned to the intrinsic band-gap absorption of ZnO, owing to the electron transitions from valence band to conduction band. TEM images inveterate the formations of ZnO NSs with mean particle size of 11.6 nm. The antibacterial activity of ZnO NSs was examined against gram-positive (*Staphylococcus aureus*) and gram-negative (*Proteus vulgaris*, *Escherichia coli*, and *Klebsiella pneumonia*) human pathogenic bacteria using ZnO NSs by *agar-well diffusion method*. Furthermore, ZnO NSs exhibited significant antioxidant activity against scavenging 1, 1-Diphenyl-2-picrylhydrazyl (DPPH) free radicals. Copyright © 2019 VBRI Press.

Keywords: ZnO nanospheres, aspidopterys cordata, electron spectroscopy, antioxidant activity, antibacterial assay.

Introduction

Nanotechnology is emerging as a fast-rising field with its applications in science and technology for the rationale of developed novel materials at the nanoscale level [1]. Nanomaterials (NMs) of diverse composition dimension and controlled morphology can be fabricated using green nanotechnology, which has huge applications in the area of medical science, biology and pharmacology [2]. NMs are main ingredient of a commercial rebellion that has resulted in an outburst of innovative products, due to their different physico-chemical properties, enabling their usage in a wide range of novel applications [3-4].

Majority of nanostructured synthesis has associated with the use of toxic organic solvents, hazardous chemicals as surfactants or reducing agents and severe reaction conditions such as high temperature, pressure,

and long refluxing time. Owing to the ever-increasing environmental concerns, attempts have been routinely made to develop NMs fabrication using plant extracts, microorganism over chemical and physical methods. An eco-friendly NMs synthetic approach doesn't use any noxious solvents and chemicals in the synthesis protocols. In these facets, synthetic approach based on naturally occurring biomaterials offer a low cost substitute means for obtaining industrially required NMs.

The nanostructured zinc oxide nanoparticles (ZnO NPs) with features of high surface area to volume ratio, high ultraviolet absorption and long lifespan has been widely used in numerous applications such as catalyst, gas sensor, active filler for rubber and plastic, UV absorber in cosmetics and antiviral agent in coating applications [5-12]. Usually, ZnO NPs are synthesized by employing various methods [13-17]. However,

several reports are documented in the literature on plant assisted-synthesis of ZnO [18-21]. The plant-mediated ZnO synthesis is preferred because of its low-cost, eco-friendly and safe nature for human therapeutic uses.

Earlier, authors have reported the synthesis and antibacterial properties of histidine-capped ZnO NPs [22], α , γ -bismuth oxide (Bi_2O_3) for as photocatalyst for dye degradation [23] and copper aluminate (CuAl_2O_4) nanocomposites for electrochemical application [24]. In the present study reported a green approach for the fabrication of ZnO NSs using *Aspidopterys Cordata* (AC) leaf extract, which is an eco-friendly route due to their vital applications. As per authors' knowledge, it is the first report on the synthesis of ZnO NSs by AC leaf extract, and no attempts have been made earlier. The fabricated ZnO NSs have been consequently characterized by various electron spectroscopy techniques. Furthermore, the antibacterial assay against gram-positive and gram-negative human pathogenic microorganism. Moreover, the scavenger activity of synthesized ZnO NPs was examined in ethanol and methanol by 1, 1-Diphenyl-2-picrylhydrazyl (DPPH) free radicals.

Experimental

Materials and methods

Zinc sulfate heptahydrate ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$) was purchased from Himedia Laboratories Ltd. 1-Diphenyl-2-picrylhydrazyl (DPPH) was procured from Merck (India). *Aspidopterys Cordata* (AC) leaf was collected from Gorewada National Park, Nagpur (India). *Staphylococcus aureus* (*sa*), *Pseudomonas aeruginosa* (*pa*), *Escherichia coli* (*ec*), and *Klebsiella pneumonia* (*kp*) were purchased from National Centre for Cell Collection (NCCS), Pune (India). Standard antibiotics (Ampicillin, Streptomycin and Chloramphenicol) and Muller-Hinton agar was obtained from Hi-Media Pvt. Ltd. Bombay (India). All chemicals were used without further purification.

Characterization techniques

The crystal structure of ZnO was analyzed by X-ray diffraction (XRD) using Advance X-ray diffractometer (Bruker AXSD8) with $\text{CuK}\alpha$ radiation. The qualitative elemental analysis of ZnO was performed on Energy Dispersive X-ray diffractometer (EDX; JEOL (Model JED-200). Fourier-transformed infrared (FT-IR) spectra were recorded on a Bruker (IFS 66v) FT-IR, at a resolution (2 cm^{-1}) from 4000 to 400 cm^{-1} using KBr pellets technique. UV-diffused reflectance spectrum (UV-DRS) was recorded on (Cary-100UV) spectrophotometer and band gap $(\alpha h\nu)^2$ vs photon energy) is calculated using Kubelka-Munk (K-M) remission function. Raman spectra were performed using a JY Horiba (HR-800) spectrophotometer. X-ray photoelectron spectroscopy (XPS) was performed with a Sigma Probe, Thermo-VG, and monochromatic Al $\text{K}\alpha$ X-ray source for exciting photoelectrons. The morphology of ZnO was examined by a JEOL JSM-

6380 LA SEM and a JEOL TEM 2100F TEM with an acceleration voltage of 200 kV.

Preparation of AC leaf extract

The leaf of AC was washed several times with de-ionized water to remove the dust particles from surface. The AC leaf extract was prepared by placing 20 g of finely cut dried leaves in 500 mL round bottom flask along with 100 mL of de-ionized water. The mixture was then boiled at for 20 min. until the color of solution changes from watery to light yellow. The extracts was cooled at room temperature and filtered through simple filter through Whatman filter paper (Grade-42). The filtrate was again centrifuged for 15 min at 1500 rpm and was stored in a refrigerator.

Synthesis of ZnO NSs

ZnO NSs was synthesized by precipitation method at room temperature. An aqueous solution of $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ (0.1 M) was added in round bottom flask (RBF). Then, 10 mL freshly prepared AC leaf extract was added dropwise to the above solution. The reaction mixture was kept under continuous stirring at room temperature for 3 h. A pale-milky precipitate of ZnO was obtained. The obtained product was repeatedly centrifuge with de-ionized water and ethanol. The obtained white precipitated was kept $80\text{ }^\circ\text{C}$ in vacuum oven for 24 h. The dried ZnO powder was calcined at $800\text{ }^\circ\text{C}$ for 2 h to get nanosized dimension. The fabrication scheme of ZnO NSs is given in supplementary information.

Antibacterial activity

The antibacterial activity of ZnO NSs was performed against four bacterial strains namely: *sa*, *pa*, *ec*, and *kp* by agar-well diffusion method [22]. About 20 mL of sterile molten Muller-Hinton agar was poured into sterile petri plates. Triplicates plates were swabbed with the overnight culture (10^8 cell/mL) of pathogenic bacteria. Wells of size 6 mm have been made on Muller-Hinton agar plates using gel puncture. Finally, ZnO samples were dissolved in de-ionized water ($50\text{ }\mu\text{g/mL}$) were added from the stock into each well and incubated for 24h at $37\pm 2\text{ }^\circ\text{C}$. After 24 hour the zone of inhibition was measured and expressed as millimeter in diameter.

The activity was studied with AC-assisted ZnO and at the same time the standard antibiotics (as positive control) were tested against the pathogens by using Streptomycin and Chloramphenicol as positive control. Then, the plates were incubated at $37\text{ }^\circ\text{C}$ for 36 h. After the incubation period, the zone of inhibition of each well was measured and the values were recorded, average values were calculated for the eventual antibacterial activity.

Antioxidant activity

The antioxidant activity of ZnO NSs was carried out by free radical scavenging activity of DPPH assay at concentrations of 50–200 $\mu\text{g/mL}$, at an equal volume of

ethanol and methanol solution of DPPH. The mixture was allowed to react at room temperature in the dark for 30 min. Ascorbic acid was used as a standard control. The optical density of DPPH radical is monitored. After 30 min, the absorbance (A) was measured at 518 nm using visible spectrophotometer and converted into the percentage antioxidant activity using the equation:

$$\text{Activity (\%)} = [(A_0 - A_1)/A_0] \times 100$$

where, A_0 was the absorbance of the control and A_1 was the absorbance in the presence of composite.

Results and discussion

Structural and morphological aspect

XRD pattern of AC-assisted ZnO NSs is presented in **Fig. 1a**. The distinct diffraction peaks at $2\theta = 31.50^\circ$, 34.14° , 35.97° , 47.29° , 56.38° , 62.67° , 66.19° , 67.76° , 68.88° , 72.42° and 76.80° were allocated to (100), (002), (101), (102), (110), (103), (200), (112), (201), (004) and (202) planes respectively. The obtained diffraction peaks well matches with the hexagonal wurtzite structure (JCPDS File No-36-1451). The existence of (100), (002) and (101) planes in the XRD pattern confirmed the formation of high purity ZnO NSs using AC leaf extract. The sharp and strong diffraction peaks intensity of ZnO NSs indicated that the resulting product was highly crystalline in nature. Average crystallite size of ZnO NSs was estimated by *Debye-Scherrer* formula and it was found in the range of 16-17 nm. The particle size of AC-assisted ZnO is presented in **Table 1** and compare with the previous reports [25].

Table 1. Morphology and particle size comparison of present study with documented literature.

| Source | Part | Morphology | Size (nm) |
|--------------------------------|--------|-----------------------|-----------|
| <i>Aloe vera</i> | Leaf | Spherical & hexagonal | 8-18 |
| <i>Azadirachta indica</i> | Leaf | Spherical | 40 |
| <i>Solanum nigrum</i> | Leaf | Spherical | 20-30 |
| <i>Moringa oleifera</i> | Leaf | Spherical | 6-20 |
| <i>Citrus aurantifolia</i> | Fruits | Spherical | 50-200 |
| <i>Mimosa pudica</i> | Leaf | Wurtzite | 3 |
| <i>Hibiscus rosa-sinensis</i> | Leaf | Spherical | 23-48 |
| <i>Carica papaya</i> | Leaf | Hexagonal | 10 |
| <i>Pongamia pinnata</i> | Leaf | Spherical | 100 |
| <i>Calotropis procera</i> | Latex | Spherical & Granular | 5-40 |
| <i>Aspidopterys chordata</i> * | Leaf | Hexagonal | 16-17 |

*Present study

A Raman spectrum of AC-assisted ZnO NSs is depicted in **Fig. 1b**. The acoustic phonon overtone and optical overtone with A_1 (LO) symmetry located at 205 cm^{-1} and 335 cm^{-1} respectively. The E_2 (high) mode is at 446 cm^{-1} , which indicating the crystal quality of ZnO NSs. The bands at 589 cm^{-1} are the contributions of the E_1 (LO) mode of ZnO associated with oxygen (O) atoms. The additional peak at 689 cm^{-1} , contributes the $2E_1$ (LO) mode. The bands appeared at 1150 cm^{-1} is overtones and/or combination bands in ZnO [26, 27].

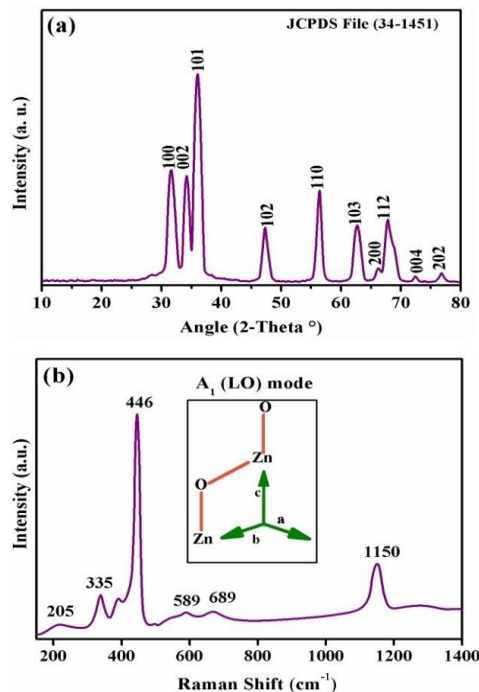


Fig. 1. (a) XRD and (b) Raman spectra of AC-assisted ZnO NSs.

Furthermore, the chemical composition of AC-assisted ZnO was analysed by EDX and spectra displayed in **(Fig. 2a)**. An existence of strong signals of zinc (Zn) and oxygen (O) and carbon (C) atom at very low intensity (**Fig. 2a**), which confirms the compositional purity. It is also well-supported by XRD and Raman study. The atomic and weight percentage of Zn, O and C is presented in **Fig. 2a**. Following, FT-IR spectra of AC-assisted ZnO NSs show the absorption band at 3739 cm^{-1} , 3429 cm^{-1} , 2931 cm^{-1} , 1637 cm^{-1} , 1452 cm^{-1} , 1056 cm^{-1} , 875 cm^{-1} , 457 cm^{-1} respectively. The peaks in the region between $600\text{-}400 \text{ cm}^{-1}$ are allotted to Zn-O linkage [28]. The band at 457 cm^{-1} confirms stretching vibrations of ZnO NSs [29].

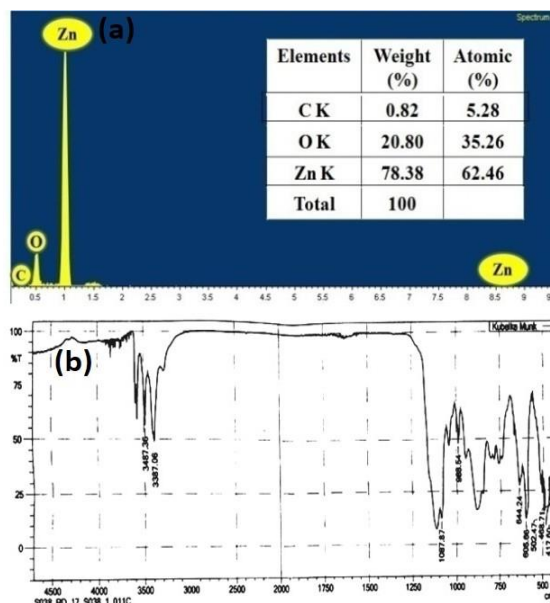


Fig. 2. (a) EDX and (b) FT-IR spectra of ZnO NSs.

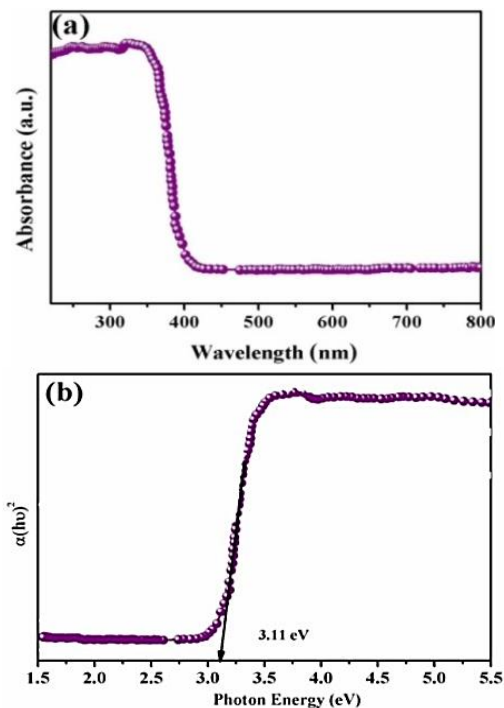


Fig. 3. (a) UV-DRS spectra and (b) K-M plot of ZnO NSs.

UV-DRS spectrum is presented in **Fig. 3a**, which reveals a typical absorption peak of ZnO NSs at wavelength ($\lambda = 370$ nm). This is assigned to the intrinsic band-gap absorption of ZnO NSs, owing to the electronic transitions from valence band to conduction band. Band gap energy was calculated by using K-M plot function (**Fig. 3b**). The band gap (3.11 eV) was obtained by the extrapolation of a linear regression on X-axis in the plot.

To further ascertain the chemical state characteristic of AC-assisted ZnO NSs. The sample was analysed by XPS. The XPS (**Fig. 4**) of AC-assisted ZnO NSs comprise of Zn, O and a trace amount of C was mainly accredited to the adventitious hydrocarbon from XPS itself [30]. The deconvoluted XPS spectrum of O 1s region can be fit by the two peaks at 534.2 eV and 537.6 eV. The less intense low energy component at 534.2 eV was attributed to O^{2-} ions in ZnO NSs and an intense high energy component at 537.6 eV, was credited to hydroxyl species present on the surface of NPs [30]. The peaks located at 1024.1 eV and 1046.7 eV were associated to Zn 2P_{3/2} and Zn2P_{1/2} respectively, which confirms the presence of Zn²⁺ as Zn²⁺ as well as oxygen vacancies [31].

Furthermore, morphological aspect like shape and size of as-synthesized ZnO NSs were analyzed by SEM and TEM (**Fig. 5**). AC-assisted ZnO material exhibited well distributed spherical shaped morphology with aggregation. However, aggregation is seen probably due to high surface energy of ZnO particles that usually occurs when synthesis is carried out in aqueous medium and also possibly due to densification resulting in narrow space between particles [32, 33]. Further, a TEM image of AC-assisted ZnO fully supported for nanospheres like structures with sizes in the range 20-

30 nm. The interplanar *d*-spacing calculated from the image matches closely with (002) plane *d*-spacing of hexagonal ZnO, well-supported by XRD [34]. The morphology of earlier leaf assisted ZnO reports is presented in **Table 1** along with AC-assisted ZnO NSs [25].

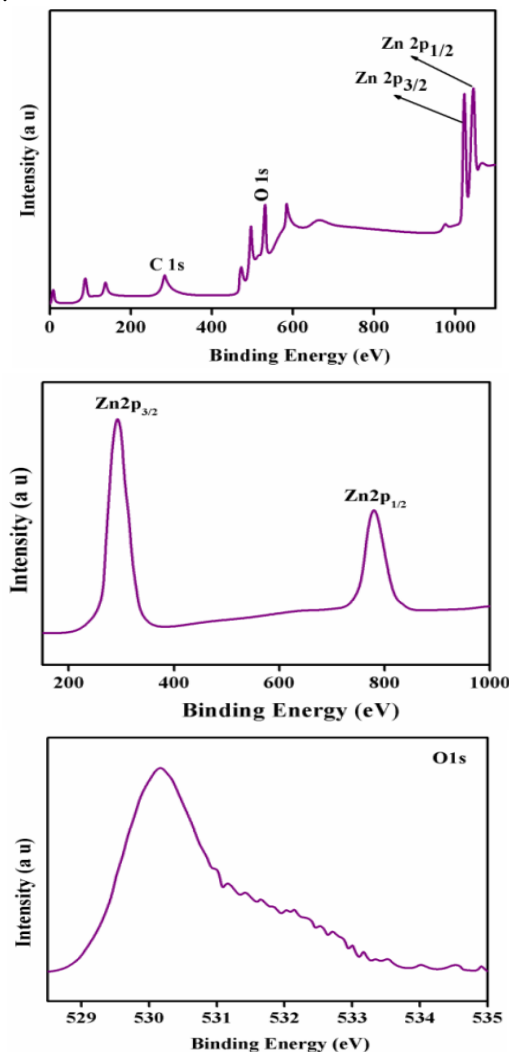


Fig. 4. XPS spectra of ZnO NSs

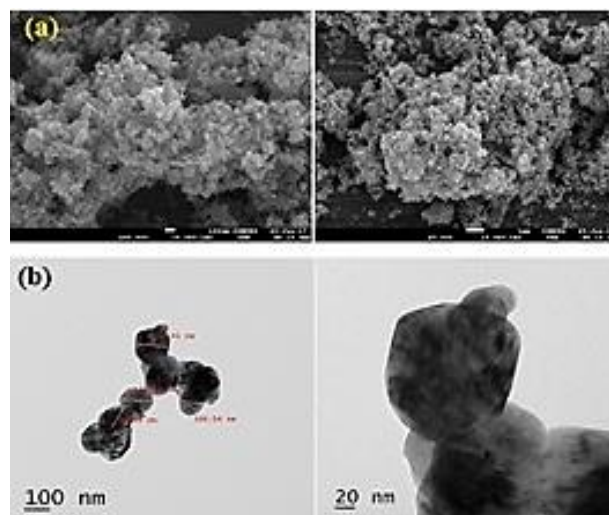


Fig. 5. (a) SEM and (b) TEM images of ZnO NSs.

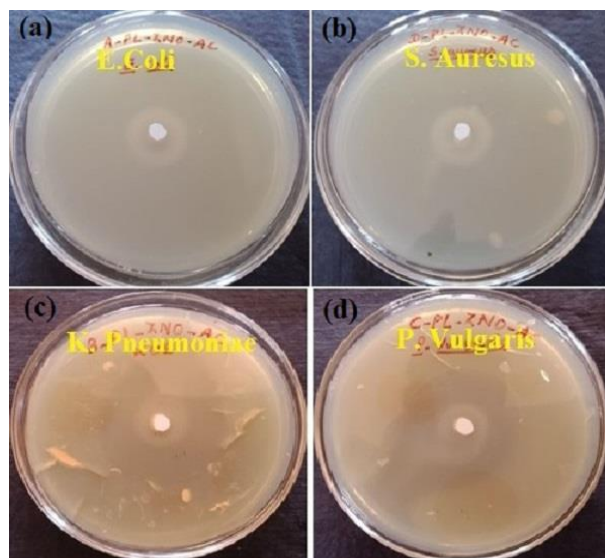


Fig. 6. Antibacterial activity against human pathogens (a) *ec* (b) *sa* (c) *kp* (d) *pv*.

Antibacterial assay

The antimicrobial activity of ZnO NSs was examined against gram-positive and gram-negative human pathogens on the basis of a zone of inhibition and compared with standard antibiotics. An antibacterial activity of ZnO NSs against human pathogens viz *ec*, *sa*, *kp* and *pv* are presented in **Fig. 6**. An enhanced antibacterial activity observed for gram-negative than gram-positive bacteria (**Fig. 7a**). This may be due to difference in cell wall structure and chemical composition of bacteria. The cell wall of gram-positive bacteria made up of thick peptidoglycan and teichoic acid on the outside of plasma membrane. While, cell wall of gram-negative contains thin peptidoglycan surround by lipopolysaccharides owned negative electricity leading to whole membrane to be negatively charged, thus ZnO ions able to bind the sulfhydryl group (SH) of bacterial enzyme, leads to cell death quickly. Among the standard antibiotics, chloramphenicol showed maximum zone of inhibition than ampicillin, and streptomycin. The opposite charges of bacteria and ZnO NSs are attributed to their adhesion and bioactivity due to an electrostatic force. The antimicrobial activity of ZnO NSs depends on the availability of the surface area for interaction.

The antioxidant activity of AC-leaf extract and AC-assisted ZnO NSs in methanol, ethanol, and standard ascorbic acid at a concentration (100 ug/mL) is given in **Fig. 7b**. The main intention of this study is to authenticate the antioxidant property of as-fabricated materials. Among the solvents, sample in ethanol shows more scavenging activity than in methanol. The higher antioxidant activity was seen for AC-leaf extract than AC-assisted ZnO NSs. This may be due to the presence phenols, hydroxyl groups, which are known to be good natural antioxidants [35, 36]. Antioxidant activity of ZnO NPs ascribed due to smaller particle grain size and may be a phenomenon of transfer of electron density from oxygen atom to odd electron located at nitrogen

atom in DPPH, which results in decreasing transition intensity at 517 nm [37].

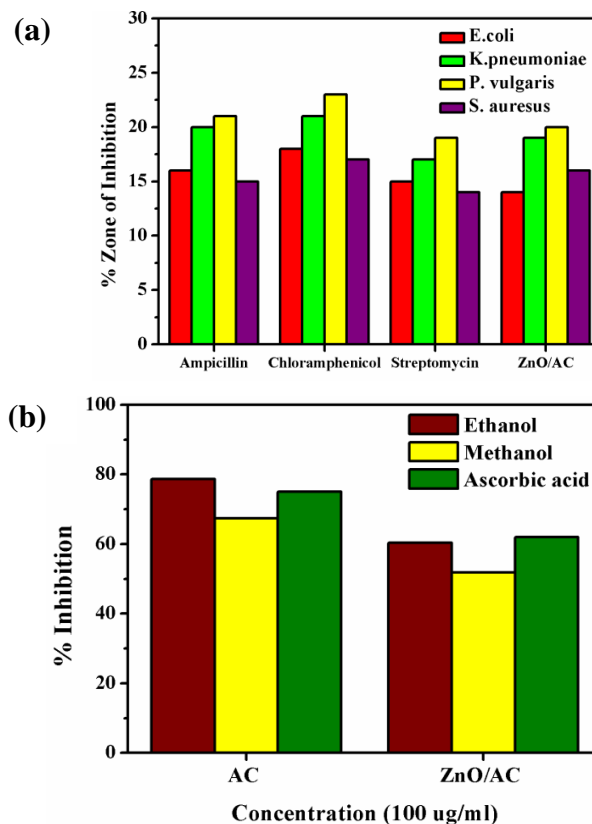


Fig. 7. (a) Antibacterial activity of ZnO NSs against standard antibiotics and (b) Antioxidant activity of AC leaf extract and AC-assisted ZnO by DPPH scavenging.

Conclusion

AC-assisted ZnO NSs was fabricated *via* eco-friendly approach. The XRD patterns of ZnO NSs were indexed to hexagonal-wurtzite structure. EDX gives the compositional purity of ZnO NSs, while XPS results confirmed the existence of Zn²⁺ ions. The band gap energy calculated from K-M plot and was found 3.11eV. The AC-assisted ZnO NSs exhibited good antimicrobial activity against *kp* and *sa*. Also, displayed enhanced antioxidant activity. In brief, the present study established a simple, eco-friendly technique for the synthesis of ZnO NSs with effective antibacterial and potential antioxidant agents. Hence, it may be targeted drug delivery application.

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Author's contributions

Conceived the plan: R.G. Chaudhary, S. Somkuwar, R.K. Mishra; Performed the experiments: P.B. Chouke, A.K. Potbhare; Data analysis: R.G. Chaudhary, G.S. Bhusari, D. PWD. Shaik; Wrote the paper: P.B. Chouke, G.S. Bhusari, R.K. Mishra (PBC, AKP, RGC are the initials of authors). Authors have no competing financial interests.

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Adsorption of Zinc onto Microwave assisted carbonized *Acacia nilotica* bark

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Abstract

Microwave assisted carbonized *Acacia nilotica* bark (MACANB) was investigated as a suitable low cost adsorbent for the removal of zinc (II) ions from aqueous solutions through batch adsorption. The ability of MACANB to remove zinc (II) ions from aqueous solutions by adsorption has been studied under several conditions such as pH, contact time, adsorbent dose, initial concentration of Zinc (II) ion and temperature. The models of Langmuir and Freundlich were applied to describe adsorption equilibrium. Kinetics data were fitted by pseudo-first-order and pseudo-second-order models. The results show that the equilibrium data follow Langmuir isotherm and the kinetic data follow pseudo-second-order model. Thermodynamic parameters (ΔG° , ΔS° and ΔH°) for adsorption system were determined at 30°C.

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Keywords: *Acacia nilotica*, Zinc, adsorption, isotherms, kinetics.

1. Introduction

Heavy metal releases to the environment have been increasing continuously as a result of industrial activities and technological developments, posing a significant threat to the environment and public health because of their toxicity, accumulation in the food chain and persistence in nature. Living organisms require varying amounts of heavy metals viz Iron, cobalt, copper, manganese, etc in small quantities. But excessive levels can be damaging to the organism and their accumulation over time in the bodies of animals can cause serious illness [1]. Zinc is a trace element that is essential for human health. It is important for the physiological functions of living tissue and regulates many biochemical processes. The proposed limit of Zinc in drinking water is 5 ppm as proposed by FDA. However, too much zinc can cause eminent health problems, such as stomach cramps, skin irritations, vomiting, nausea and anemia [2].

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It is essential to remove Zn (II) from industrial wastewater before being discharged. For this reason, it is generally used the advanced treatment processes such as chemical reduction, ion exchange, reverse osmosis, electro dialysis and adsorption. Since the costs of these processes are rather expensive, the use of agricultural residues having biological activities has been received with considerable attention [4].

Adsorption is considered quite attractive in terms of its efficiency of removal from dilute solutions. Many adsorbents have been used for removal of heavy metals [3, 4]. These adsorbents were used in raw state [6, 7] or with modified surface [8-10]. Agricultural materials contain proteins, polysaccharides and lignin which are associated with functional groups responsible for metal ion adsorption [11]. The abundant natural occurrence and presence of large amount of surface functional groups make various agricultural wastes good alternatives to expensive synthetic adsorbents [12]. In recent years, agricultural by-products have been widely studied for metal removal from water. These include peat, wood, pine bark, banana pith, soybean and cottonseed hulls, peanut, shells, hazelnut shell, rice husk, sawdust, wool, orange peel, compost, leaves and almond husk [13]. Thus, there is a growing demand to find relatively efficient, low cost and easily available adsorbents for the adsorption of heavy metals, particularly if the adsorbents are the wastes [14]. The present study was carried out to show the potential of zinc adsorption on *Acacia nilotica* bark. The aim of this research, were to evaluate the adsorption behavior of zinc (II) onto microwave assisted carbonized *Acacia nilotica* bark (MACANB).

2. Experimental

a. Preparation of the adsorbent

The experiments were carried out using the adsorbent *Acacia nilotica* bark. *Acacia nilotica* bark were collected from the local area and washed several times with distilled water to remove dust and other impurities. Then drying, it was ground using domestic mixer and sieved to 300 mesh size. The sample is washed with distilled water to remove colour and dried in an oven at 80°C for 24 hours. The dried *Acacia nilotica* bark powder was carbonized on muffle furnace for 5 Hours at 500°C. This carbonized bark powder again activated in domestic microwave (900MW) by one minute intervals for 30 minutes. The microwave assisted carbonized *Acacia nilotica* bark (MACANB) then washed with deionised water to remove colour and other impurities. This MACANB was dried at 110°C in vacuum oven for 24 hours, grind well and kept in air tight plastic bottles for further use.

b. Preparation of stock solution of Zn (II)

All reagents used are of analytical reagent grade. A Stock solution of 1000 ppm of Zn (II) ion was prepared by dissolving zinc nitrate hexahydrate [$Zn(NO_3)_2 \cdot 6H_2O$] in deionised water. Adsorption experiments were conducted to study the influence of adsorption parameters such as pH, initial Zn (II) ion concentration, adsorbent dose, contact time and temperature by using MACANB.

c. Adsorption Experiment

Batch adsorption experiments of zinc were carry out to determined the adsorption capacity of MACANB at different Zn (II) ion concentrations ranging from 25 to 150 ppm. The 100 ml of Zn (II) solutions of specified concentration of samples were shaken at 120 rpm for predetermined pH, adsorbent dose, contact time and temperature. The initial and final concentrations of the solutions were measured and determined by Atomic absorption spectrophotometer (AAS) at the maximum adsorption wavelength and the adsorption capacities of the adsorbent were calculated. After equilibrium was attained, the metal uptake capacity for each sample was calculated according to a mass balance on the metal ion using equation (1):

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

Where m is the mass of adsorbent (g), V is the volume of the solution (L), C_0 is the initial concentration of metal ($mg L^{-1}$), C_e is the equilibrium metal concentration ($mg L^{-1}$) and q_e is the metal quantity adsorbed at equilibrium (mg/g). Experiments were carried out at different initial pH values. The initial pH of the solution was adjusted with either HCl or NaOH. The percent removal of metals from the solution was calculated by the following equation (2):

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

Where C_0 (mg/L) is the initial metal ion concentration and C_e (mg/L) is the equilibrium metal ion concentration in the solution.

3. Results and Discussion

a. Effect of pH on Zn (II) adsorption

Figure 1, illustrated that pH obviously influenced the removal efficiency of the zinc ions in the aqueous solution. The results indicated that Zn (II) removal was increased to maximum and then decreased with pH variation from 2 to 10 keeping all other parameters constant (adsorbent dose = 0.2 g, initial Zn (II) concentration = 50 ppm, contact time = 60 min, agitation speed = 120 rpm and T = 30°C). The maximum % removal of Zn (II) was about 92.40% at pH 4. At pH . . 3.0, H⁺ ions compete with Zn(II) ions for the surface of the adsorbent which would hinder Zn(II) ions from reaching the binding sites of the sorbent caused by the repulsive forces. However, the metal removal is minimum presumably due to the enhanced competition of proton with zinc ions for ligand binding sites and complex formation. At pH . . 7.0, the Zn(II) ions get precipitated due to hydroxide anions forming a zinc hydroxide precipitate. For this reason, the optimal pH value was selected to be 5.0.

b. Effect of Contact time on Zn (II) adsorption

The effect of contact time on the adsorption of Zn (II) ions by MACANB can be seen in figure 2. All parameters such as pH, adsorbent dose, etc. were kept constant (pH = 4, adsorbent dose = 0.2 g, initial Zn (II) concentration = 50 ppm, agitation speed = 180 rpm and T = 30°C). The removal of Zn (II) ions increased rapidly with time up to 60 min and there after increased slowly. According to the results, the equilibrium reached at 60 min and was taken as the optimal contact time for the subsequent experiments.

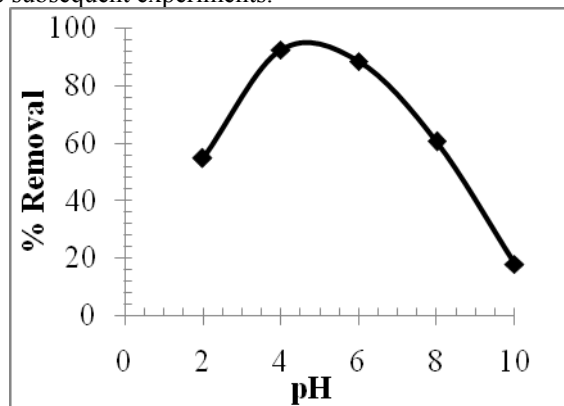


Fig 1. : Effect of pH on removal of Zn(II)

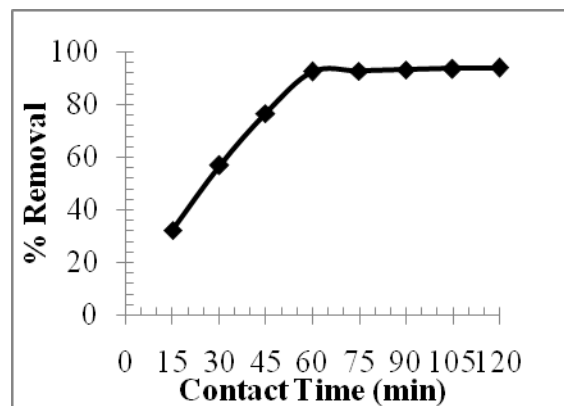


Fig 2. : Effect of contact time on removal of Zn(II)

c. Effect of adsorbent dose on Zn (II) adsorption

Adsorption efficiency of Zn (II) adsorption was studied by varying the amount of adsorbents from 0.1-0.5 gm keeping other parameters constant (pH = 4, initial Zn (II) concentration = 50 ppm, contact time = 60 minutes,

agitation speed = 120 rpm and $T = 30^{\circ}\text{C}$). Figure 3 shows the effect of adsorbent dose on removal of Zn (II) uptake for MACANB. The removal efficiency of the zinc usually improved on increasing adsorbent doses. This may occur due to the fact that the higher dose of adsorbents in the solution provides the greater availability of exchangeable sites for the ions. From the figure 3, it is clear that the no further increase in adsorption after a certain amount of adsorbent was added (0.2 gm). Hence, optimal adsorbent dose was selected to be 0.2 g. This result also suggest that after a certain dose of adsorbent, the equilibrium conditions reached and hence the amount of ions bound to the adsorbent and the amount of free ions in the solution remain constant even with further addition of the dose of adsorbent.

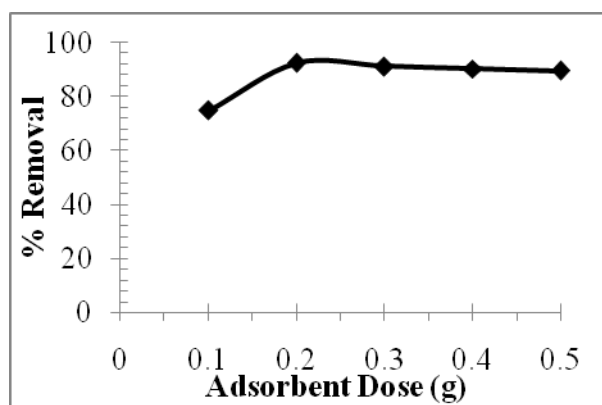


Fig. 3 : Effect of adsorbent dose on removal of Zn(II)

d. Effect of temperature on Zn (II) adsorption

The temperature dependence of the adsorption process is related with several thermodynamic parameters. The temperature showed the negative effect on adsorption of zinc onto MACANB as adsorbent. The temperature effect on removal of zinc ion using MACANB was studied within the range of 30°C to 60°C keeping other parameters constant (pH = 4, adsorbent dose = 0.2 g, initial Zn (II) concentration = 50 ppm, contact time = 60 minutes and agitation speed = 120 rpm). With increase in temperature from 30°C to 60°C the percent removal of zinc ions was decreased. From the figure 4, it is clear that the low temperatures are in favours of zinc ion removal. This may be due to a tendency for the metal ions to escape from the solid phase to the bulk phase with an increase in temperature of the solution. The result shows that adsorption mechanism related with removal of zinc is physical in nature. The adsorption process takes place from the electrostatic interaction, which is in general related with low adsorption heat. This implies that the adsorption process was exothermic in nature [15].

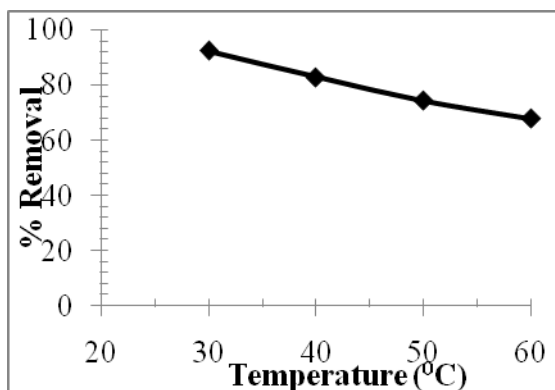


Fig. 4 : Effect of temperature on removal of Zn(II)

e. Effect of initial Zn (II) ion concentration on adsorption

The effect of initial zinc ion concentration on the adsorption rate was studied in the range 25 – 150 ppm at pH 4, adsorbent dose 0.2 g, contact time 60 minutes, agitation speed 120 rpm and temperature 30°C. Figure 5 indicates the effect of initial Zn (II) ion concentration on the adsorption by MACANB. When the initial Zn(II) concentration of sample was increased from 25 to 150 ppm, the removal decreased from 93.60 % to 43.27 % for MACANB. Therefore it was evident from the results that zinc adsorption was dependent on the initial metal concentration.

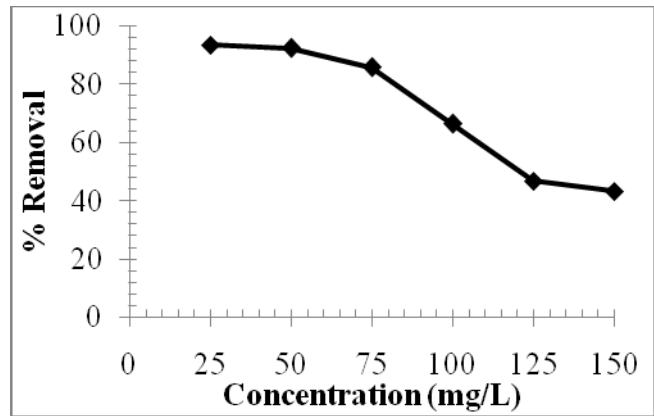


Fig. 5 : Effect of initial Zn (II) ion concentration.

f. Adsorption Isotherms of Zn (II) onto MACANB

The equilibrium adsorption study of zinc removal was carried out by contacting 0.2 g of the MACANB as adsorbent with 100 ml of diverse concentrations from 25 mg/L to 150 mg/L in 250 ml conical flasks for 60 minutes contact time. The data obtained was fitted into four well known adsorption isotherms i.e. Langmuir, Freundlich, Temkin and Dubinin-Radushkevich isotherm models.

1) Freundlich isotherm

The Freundlich model [16] is a well known equation based on sorption on a heterogeneous surface. In Freundlich equation (3), q_e is the amount of zinc adsorbed by sorbent at equilibrium (mg/g), C_e is the equilibrium concentration of zinc (mg /L), K_F and n are Freundlich constants shows measure of the adsorption efficiency (mg/g) and adsorption intensity respectively.

$$q_e = K_F C_e^{1/n} \tag{3}$$

Freundlich adsorption parameters were calculated by converting the Freundlich equation (3) into its linear form.

$$\ln q_e = \ln K_F + (1/n) \ln C_e \tag{4}$$

A value of $1/n$ less than 1 indicates a normal Freundlich isotherm while $1/n$ more than 1 is suggestive of supportive adsorption [17, 18]. The Freundlich isotherm constants K_F and n were estimated from the slope and intercept from Fig. 6. The value of $1/n = 0.204$ while $n = 4.901$ confirms that the adsorption of zinc onto MACANB is favourable along with the R^2 value 0.657.

2) Langmuir isotherm

Langmuir isotherm model [19] was used to estimate zinc adsorption onto MACANB. The Langmuir isotherm is given by Eq. (5).

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \tag{5}$$

Converting the Langmuir equation (5) into its linear form is used to calculate parameters of Langmuir adsorption isotherm.

$$\frac{C_e}{q_e} = \frac{1}{K_L q_m} + \frac{C_e}{q_m} \tag{6}$$

Where, q_m is the adsorption capacity at complete monolayer coverage (mg /g) and K_L (L/mg) is the Langmuir isotherm constant which relates to the energy of sorption. Slope and intercept of the straight line plot of C_e/q_e vs. C_e were used to calculate the values of q_m and K_L . The feasibility of the Langmuir isotherm can be expressed in terms of a dimensionless constant or separation factor, R_L of Eq. (7) where K_L is the Langmuir isotherm constant and C_0 is the initial concentration of zinc (mg/L).

$$R_L = \frac{1}{1 + K_L C_0} \quad (7)$$

In the present study, the maximum monolayer coverage adsorption capacity (q_m) from Langmuir Isotherm model was found to be 32.258 mg/g, K_L (Langmuir isotherm constant) is 0.794 L/mg, R_L (the separation factor) is 0.047 which confirms that the equilibrium sorption was favourable and the R^2 value is 0.993 (Fig.7). This shows that adsorption isotherm data fitted well to Langmuir isotherm model.

3) Temkin Isotherm

Temkin Isotherm contains a factor that clearly takes account of interactions among the adsorbent–adsorbate. By avoiding the particularly low and large value of concentrations, the model considers that heat of adsorption (function of temperature) of all molecules in the layer would decrease linearly rather than logarithmic coverage [20, 21]. As shown in the equation, its derivation is considered by a regular distribution of binding energies was carried out by plotting the quantity adsorbed q_e against $\ln C_e$. The model is known by the following equation (8):

$$\begin{aligned} q_e &= \frac{RT}{b_T} \ln(A_T C_e) \\ q_e &= \frac{RT}{b_T} \ln(A_T) + \frac{RT}{b_T} \ln(C_e) \\ B &= \frac{RT}{b_T} \\ q_e &= B \ln K_T + B \ln C_e \end{aligned} \quad (8)$$

Where, C_e (mg/L) is equilibrium concentration of zinc, q_e (mg/g) is amount of zinc adsorbed at equilibrium, K_T (L/g) represent the Temkin isotherm equilibrium binding constant, b_T is the Temkin isotherm constant and B (J/mol) is Constant related to heat of adsorption. In this study, the linear plot of q_e versus $\text{Log}C_e$ gave a straight line with the R^2 value of 0.686 (Fig. 8). Temkin constants K_T , b_T and B are calculated from the values of slope and intercept of the plot.

4) Dubinin–Radushkevich isotherm

Dubinin–Radushkevich (D-R) isotherm is usually used to state the adsorption mechanism with a Gaussian energy allocation onto a heterogeneous surface [22, 23]. The D-R model effectively fitted high solute activities and the transitional range of concentrations data.

$$\ln q_e = \ln q_D - (K_D) \varepsilon^2 \quad (9)$$

In the above D-R isotherm equation, q_e is amount of adsorbate in the adsorbent at equilibrium (mg/g); q_D is theoretical isotherm saturation capacity (mg/g); K_D is Dubinin–Radushkevich isotherm constant (mol^2/kJ^2) and ε is Dubinin–Radushkevich isotherm constant. The method was usually applied to differentiate the physical and chemical adsorption of zinc ions with its mean free energy, E per molecule of adsorbate can be determined by the relationship [24, 25]:

$$E = \frac{1}{\sqrt{2 K_D}} \quad (10)$$

Where, K_D is D-R isotherm constant. In the meantime, the parameter ε can be designed as:

$$\varepsilon = RT \ln \left(1 + \frac{1}{C_e} \right) \quad (11)$$

Where, R is gas constant (8.314 J/mol K), T is absolute temperature (K) and C_e represent adsorbate equilibrium concentration (mg/L). Dubinin–Radushkevich (D-R) isotherm model lies on the reality that it is temperature-dependent, which when adsorption data are fitted at different temperatures as a function of logarithm of amount adsorbed ($\ln q_e$) vs ε^2 (the square of potential energy), all appropriate data will be positioned on the same curve, named as the characteristic curve [26]. From the linear plot of D-R model (Fig. 9), q_D was found to 31.55 mg/g, the mean free energy (E) = 0.104 KJ/mol and R^2 = 0.977 higher than that of Tempkin model.

Langmuir, Freundlich, Temkin and Dubinin-Radushkevich adsorption isotherms for removal of zinc from aqueous solution onto MACANB are described in Fig. 6, 7, 8, and 9. It established that the experimental information fitted well to all these isotherm models. Correlation coefficients values indicated that Langmuir isotherm gives a good model for the adsorption system, which is based on monolayer sorption on to the surface limiting finite number of identical sorption sites. The values of various constants of isotherm models were determined and were represented in the **Table-1**.

Table-1. : Langmuir, Freundlich, Temkin and Dubinin-Radushkevich Isotherm parameters of zinc sorption on MACANB

| Isotherm | Parameters | |
|-------------------------------|--|------------------------|
| Langmuir Isotherm | q_m (mg/g) | 32.258 |
| | K_L (L/mg) | 0.794 |
| | R_L | 0.048 |
| | R^2 | 0.993 |
| Freundlich Isotherm | K_F (mg/g) | 14.621 |
| | $1/n$ | 0.204 |
| | n | 4.901 |
| | R^2 | 0.657 |
| Temkin Isotherm | K_T (L/mg) | 34.348 |
| | B (J) | 4.311 |
| | b_T | 584.307 |
| | R^2 | 0.686 |
| Dubinin-Radushkevich Isotherm | q_D (mg/g) | 31.55 |
| | K_D (mol ² /kJ ²) | 4.606×10^{-5} |
| | E (KJ/mol) | 0.104 |
| | R^2 | 0.977 |

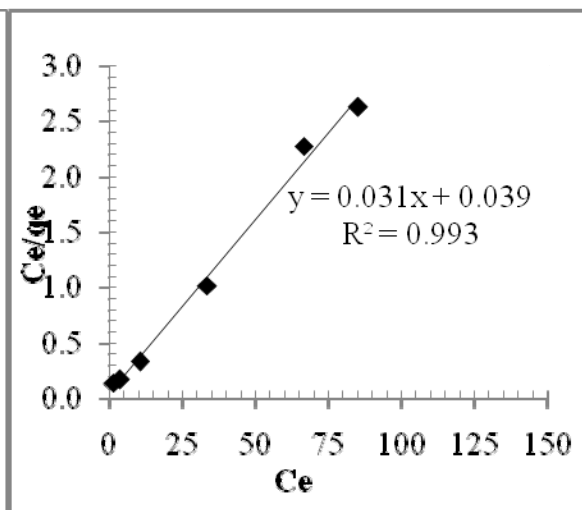
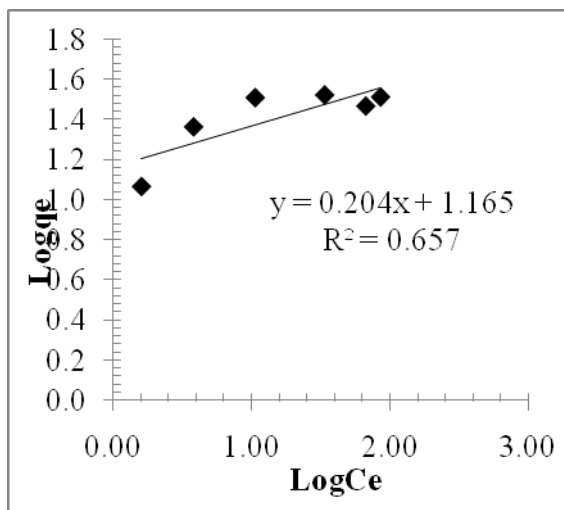


Fig. 6 : Freundlich model for zinc sorption onto MACANB.

Fig. 7 : Langmuir model for zinc sorption onto MACANB.

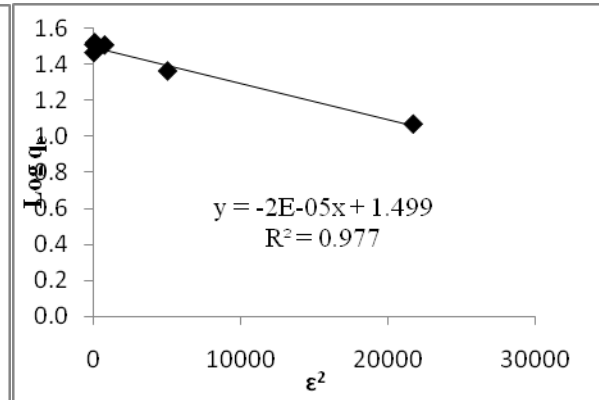
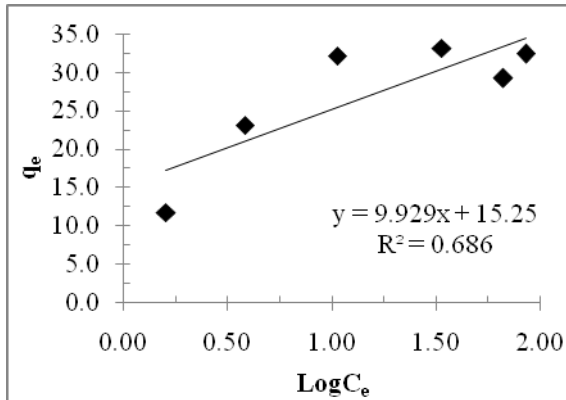


Fig. 8 : Temkin model for zinc sorption onto MACANB.

Fig. 9 : Dubinin-Radushkevich model for zinc sorption onto MACANB

g. Adsorption Kinetic Study of Zn (II) onto MACANB

The kinetic study of adsorption of metal ions from aqueous solutions plays an important role because it demonstrates important insight into the reaction pathways and mechanism of the adsorption process. The rate and kinetics of adsorption of zinc on to the MACANB was studied with pseudo first-order model, pseudo second-order model, Intra-particle diffusion model and Elovich kinetic model.

1) Pseudo first-order kinetic model

The pseudo first-order kinetic model [27] has been extensively used to understand the metal adsorption kinetics. The pseudo first-order kinetic model is given by equation (12),

$$\frac{dq}{dt} = k_1 (q_e - q_t) \quad (12)$$

Where k_1 (min^{-1}) is the rate constant of the pseudo first-order adsorption, q_t (mg/g) represent the amount of adsorption at time t (min) and q_e (mg/g) is the amount of adsorption at equilibrium. By applying boundary conditions $q_t=0$ at $t=0$ and $q_t=q_t$ at $t=t$, the integrated form of equation (12) becomes,

$$\log(q_e - q_t) = \log q_e - \left(\frac{k_1}{2.303}\right) t \quad (13)$$

The sorption rate can be estimated by plotting $\log(q_e - q_t)$ versus t . Linear kinetics plot were obtained that can be clearly seen in Fig 10 with excellent correlation coefficient ($R^2 = 0.934$), which shows that pseudo first-order kinetic model is suitable to the zinc adsorption onto MACANB. The zinc adsorption was found with the rate constants $k_1 = 5.98 \times 10^{-2} \text{ min}^{-1}$. The amount of zinc adsorbed (q_e) was estimated and it was found to be 40.179 mg/g.

2) Pseudo second-order kinetics model

Ho's pseudo second-order kinetics [27] was used to analyze the adsorption kinetic data. This is represented by,

$$\frac{dq}{dt} = k_2 (q_e - q_t)^2 \quad (14)$$

By applying boundary conditions $q_t=0$ at $t=0$ and $q_t=q_t$ at $t=t$, integrated form of equation (14) becomes,

$$\left(\frac{t}{q_t}\right) = \left(\frac{1}{k_2 q_e^2}\right) + \left(\frac{1}{q_e}\right) t \quad (15)$$

Where k_2 ($\text{g/mg}\cdot\text{min}$) symbolise the rate constant of the pseudo-second-order adsorption, q_t (mg/g) represents the amount of adsorption at time t (min), q_e (mg/g) stand for the amount of adsorption at equilibrium and initial sorption rate, h stand for $k_2 q_e^2$ ($\text{mg/g}\cdot\text{min}$). Plot of t/q_t versus t , gives the parameters of pseudo second-order kinetics model. From Fig. 11, the values of q_e , k_2 , h and correlation coefficient (R^2) was found to be 32.258 mg/g, $9.02 \times 10^{-4} \text{ g}\cdot\text{mg}^{-1}\cdot\text{min}^{-1}$, $0.938 \text{ mg}\cdot\text{g}^{-1}\cdot\text{min}^{-1}$ and 0.961 respectively.

3) Intra-particle diffusion model

Intra-particle diffusion kinetic model was proposed by Weber and Moris [28–30] for the diffusion controlled sorption process. The intra-particle diffusion equation is given by Eq. (16),

$$q_t = k_d t^{1/2} + C \quad (16)$$

Where, k_d is the intra-particle rate constant ($\text{mg g}^{-1} \text{min}^{-0.5}$). Plot of q_t versus $t^{0.5}$ was determined the values of the intra-particle rate constant and constant C (mg g^{-1}) that gives an idea about the thickness of the boundary layer, i.e., the higher the value of C , greater is the boundary layer effect. Fig. 12 suggested that two different types of mechanisms are mixed up in the adsorption process. The preliminary curve represents the boundary layer effect while the linear part relates to intra-particle diffusion. The high correlation coefficient (R^2) value (Table 2) indicates the probability of the sorption process being inhibited by both the particle and the pore diffusion models [31–32].

4) Elovich kinetic model

Elovich kinetic model [33] is the useful kinetic models for describing sorption process. The Elovich equation is known by Eq. (17) where A is the initial sorption rate ($\text{mg g}^{-1} \text{min}^{-1}$) and B is the constant of desorption (g mg^{-1}) for adsorption experiment. Eq. (18) is the simplified appearance of Elovich kinetic equation [45].

$$\frac{dq_t}{dt} = A e^{(-Bqt)} \quad (17)$$

$$q_t = \left(\frac{1}{B}\right) \ln AB + \left(\frac{1}{B}\right) \ln t \quad (18)$$

The plot of q_t against $\ln t$ (Fig. 13) gives a slope $1/B$, which shows the number of available sites to put up zinc ions. From the information of available sites, the adsorption behaviour of the adsorbent is designed which eventually validates that chemisorption step is rate determined [35]. The correlation coefficient (R^2) values from Table 2 validated the appropriateness of this model.

The validity of the above kinetic models for the removal of zinc onto MACANB was observed in the subsequent order as pseudo second-order > pseudo-first-order > Elovich > Intra-particle diffusion. The reported correlation coefficients (R^2) value indicates that the adsorption experimental results shows better fit to pseudo second order kinetic model. The values of different constants of kinetic models were calculated and were presented in the **Table-2**.

Table-2. : Kinetics parameters of the different kinetic models for adsorption of Zn (II) .

| Kinetic Model | Parameters | |
|--------------------------------|--|-----------------------|
| Pseudo first-order model | q_e (mg/g) | 40.179 |
| | k_1 (min^{-1}) | 5.98×10^{-2} |
| | R^2 | 0.934 |
| Pseudo second-order model | q_e (mg/g) | 32.258 |
| | k_2 ($\text{g mg}^{-1} \text{min}^{-1}$) | 9.02×10^{-4} |
| | h ($\text{mg g}^{-1} \text{min}^{-1}$) | 0.938 |
| | R^2 | 0.961 |
| Intra-particle diffusion model | k_d ($\text{g mg}^{-1} \text{min}^{-0.5}$) | 2.142 |
| | C | 2.83 |
| | R^2 | 0.827 |
| Elovich kinetic model | A ($\text{mg g}^{-1} \text{min}^{-1}$) | 1.735 |
| | B (g mg^{-1}) | 0.128 |
| | R^2 | 0.916 |

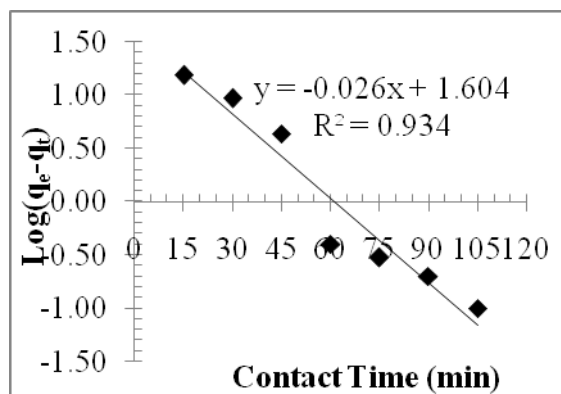


Fig. 10 : Pseudo first order model for zinc adsorption

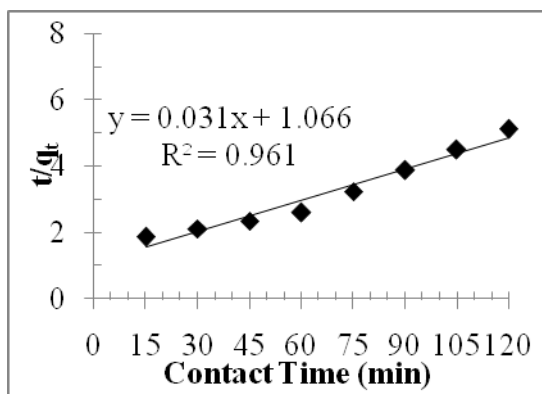


Fig. 11 : Pseudo second order model for zinc adsorption

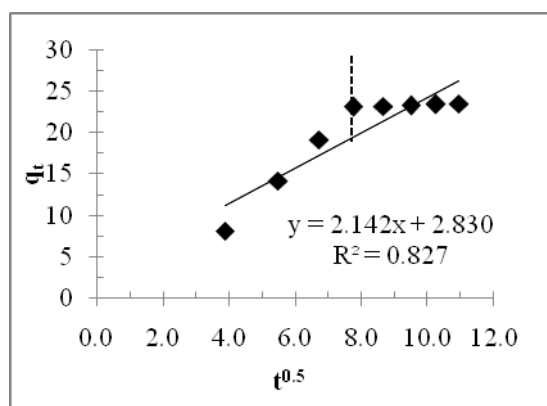


Fig. 12 : Intra-particle diffusion model for zinc adsorption

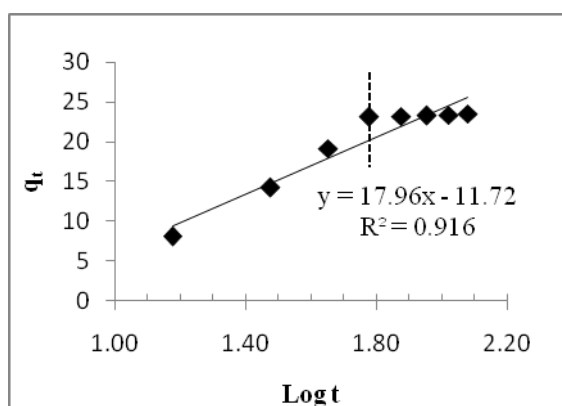


Fig. 13 : Elovich kinetic model for zinc adsorption

h Thermodynamic Study

Thermodynamic study is much more useful as it provides effective information on carrying out adsorption. To find out thermodynamic parameters of zinc adsorption onto MACANB study was carried at four different temperatures i.e. 303, 313, 323, 333 K. This helpful study was done to see the consequence of temperature on zinc adsorption onto MACANB, thermodynamic parameters related with adsorption method, such as standard free energy change (ΔG°), standard enthalpy change (ΔH°) and standard entropy change (ΔS°) were determined by using the following equations (19, 20 and 21) [36].

$$\Delta G^\circ = -RT \ln K \quad (19)$$

$$\Delta G^\circ = \Delta H^\circ + T \Delta S^\circ \quad (20)$$

$$\ln K = \frac{\Delta S^\circ}{R} - \frac{\Delta H^\circ}{RT} \quad (21)$$

Where K_c is adsorption equilibrium constant; R is Universal gas constant ($8.314 \text{ Jmol}^{-1}\text{K}^{-1}$) and T is Temperature in Kelvin.

The values of ΔS° and ΔH° can be determined from intercept and slope of linear plot of $\log K$ against $1/T$ (Fig 14). The calculated values of ΔG° , ΔH° , and ΔS° are shown in Table 3. The negative value of ΔG° indicates the feasibility and spontaneous nature of the adsorption process and more negative which indicates that the adsorption process becomes more spontaneous with rise in temperature, which favours the adsorption process. The negative value of ΔH° represents an exothermic adsorption process and negative value of ΔS° indicates the decrease in randomness at the solid-solution interface during sorption process [37].

Table-3 : Thermodynamic parameters of adsorption of zinc onto MACANB

| T(K) | ΔG (kJ/mole) | ΔH (kJ/mole) | ΔS (kJ mol ⁻¹ K ⁻¹) |
|------|----------------------|----------------------|--|
| 303 | -4.547 | | |
| 313 | -2.286 | | |
| 323 | -1.003 | - 47.925 | - 0.144 |
| 333 | -0.0142 | | |

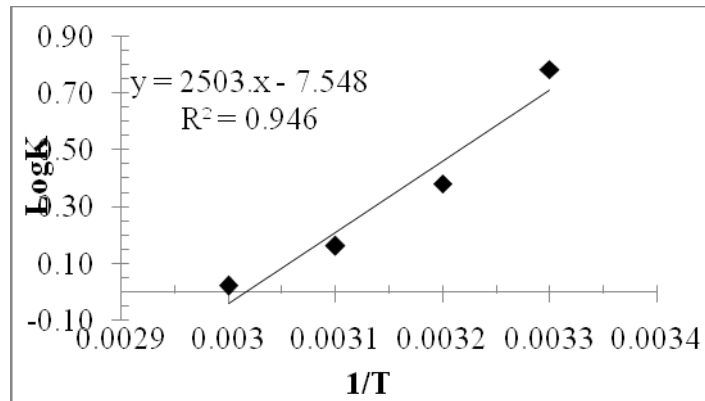


Fig. 14 : The plot of logK vs. 1/T

Conclusion

Present paper reported the efficiency and applications of microwave assisted carbonized *Acacia nilotica* bark (MACANB), one of the modified inexpensive easily available adsorbent for the removal of zinc from aqueous solution. The investigation of effect of initial pH, initial zinc ion concentration, contact time, temperature and adsorbent dose on the removal capacity of zinc by MACANB indicates the dependency on these parameters. Quantitative adsorption equilibrium study of removal of zinc onto MACANB from aqueous solution confirms the validity of obtained results and the adsorption data are well fitted for the Langmuir adsorption isotherm model. The kinetic data obtained for adsorption of zinc on MACANB followed the pseudo second-order kinetic model with good correlation coefficient value. Thermodynamic study of sorption of zinc using MACANB indicates the feasibility and spontaneous nature of the adsorption process.

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Data Article

Data of characterization and adsorption of fluoride from aqueous solution by using modified *Azadirachta indica* bark

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ABSTRACT

This data was decisive on the adsorption of fluoride by microwave assisted carbonized *Azadirachta indica* bark (MACAIB) adsorbent material from aqueous solution. *Azadirachta indica* bark is a plant-based effortlessly available item which is transformed into a carbonaceous adsorbent material and utilized for the removal of fluoride from aqueous solution. Characterization of the MACAIB adsorbent material demonstrated that it was porous and extremely effective in the removal of fluoride. The operating parameters such as pH, adsorbent dose, agitation speed, initial fluoride concentration, contact time and temperature were efficient on the adsorption ability of fluoride. The maximum removal efficiency of fluoride with an initial fluoride concentration 2 mg/L was found to be 83.50%. Experimental adsorption isotherm equilibrium data furnished was the best with Langmuir adsorption isotherm model, showing monolayer adsorption on a homogenous surface (most extreme monolayer adsorption capacity was 0.923 mg/g at 303 K). The adsorption kinetics experiment was followed by pseudo second-order kinetic model that indicated chemisorptions process. Intra-particle diffusion mechanism was not the sole rate-controlling factor. Thermodynamic analysis proposes that removal of fluoride from aqueous solution by MACAIB material was an exothermic and spontaneous process. Characterization of the MACAIB carbon material before and after adsorption through FTIR, SEM, EDX and XRD techniques confirmed the fluoride adsorption on the adsorbent surface. It could be accomplished that

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MACAIB is an effective adsorbent material for successful removal of fluoride from aqueous solution.

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Specifications Table

| | |
|----------------------------|---|
| Subject area | Chemistry, Environmental Sciences |
| More specific subject area | Adsorption |
| Type of data | Table, image, graph, figure |
| How data was acquired | SEM (JEOL Model JSM - 6390LV), EDX (JEOL JSM-7600F FEG-SEM model), FT-IR(Thermo Nicolet, Avatar 370), XRD (Bruker AXS D8 Advance diffractometer model), BET analyser (Quanta Chrome Nova-1000 surface analyser), CHNS analyser (Elemental Vario EL III model), Ion selective electrode (HANNA Model No. HI 4522), pH meter (ELICI LI 120) |
| Data format | Analyzed |
| Experimental factors | The developed adsorbent from <i>Azadirachta indica</i> bark characterized and performed its capability for removal of fluoride from aqueous solution. |
| Experimental features | Development of adsorbent, characterization by ultimate, proximate and instrumental analysis, performance of adsorbent for removal of fluoride by adsorption method. |
| Data source location | Dr. Ambedkar College, Deeksha Bhoomi, Nagpur, India |
| Data accessibility | Data is accessible with this article |
| Related research article | N. G. Telkapalliwar, V. M. Shivankar, Adsorption of Zinc onto Microwave assisted carbonized <i>Acacia nilotica</i> bark, <i>Material Today Proceedings</i> , 5 (2018) 22694–22707 [1]. |

Value of the Data

- Data showed that the modification of conventional adsorbent can be used to remove fluoride with greater enhancement.
- Characterization data of the MACAIB is useful for the scientific community to complete studies related to fluoride adsorption.
- Data of isotherms, kinetics and thermodynamics is informative for predicting and modeling of the adsorption of fluoride from aqueous solution by MACAIB.
- Data of this project can be used to improve drinking water quality.

1. Data

The FT-IR, SEM, EDX and XRD results of removal of fluoride before and after fluoride adsorption from aqueous solution are shown in Figs. 1–5. The effects of operational parameters such as pH [2–4], agitation speed (20–180 strokes/min), an adsorbent dose (1–6 g/L), initial fluoride concentration (2–10 mg/L), contact time (30–300 minute) and temperature (303–333 K) of MACAIB on fluoride adsorption are presented in Figs. 6–11 respectively. The linear plots of four well known adsorption isotherms viz. Langmuir, Freundlich, Temkin and Dubinin-Radushkevich models are presented in Figs. 12–15 respectively. The rate and kinetics of fluoride adsorption onto the MACAIB material was studied via, pseudo first -order, pseudo second-order, Intra-particle diffusion and Elovich kinetic equation based models presented in Figs. 16–19 respectively. The data of change in enthalpy (ΔH) and change in entropy (ΔS) are estimated from the intercept and slope of a direct plot between $\log K$ versus $1/T$, Fig. 20. The obstruction of different counter ions on fluoride removal by MACAIB material was investigated and the results acquired were plotted as appeared in Fig. 21. The physico-chemical characterization data of MACAIB adsorbent material is illustrated in Tables 1 and 2. FT-IR absorption bands and possible functional groups of MACAIB before and after fluoride adsorption are presented in Table 3. The EDX analysis data of MACAIB before and after fluoride adsorption is illustrated in Tables 4 and 5. The four well known adsorption isotherms and kinetic equations are presented in Table 6. The adsorption isotherms and kinetic data for removal of fluoride onto MACAIB material are presented in Tables 7 and

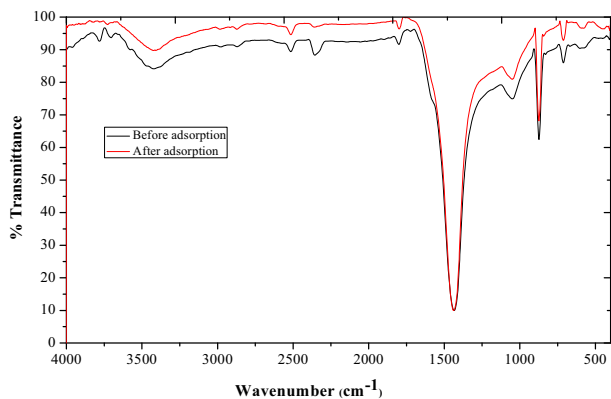


Fig. 1. Fourier Transform Infrared (FTIR) spectra of MACAIB before and after fluoride adsorption.

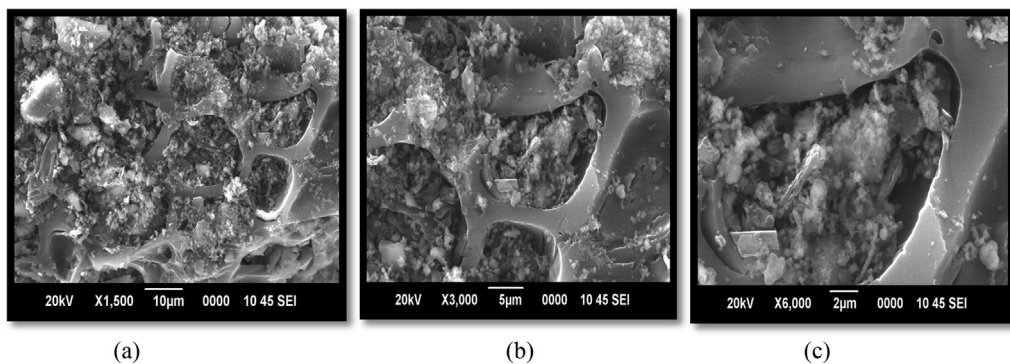


Fig. 2. (a, b, c): SEM micrographs (10, 5 and 2 μm) of MACAIB before fluoride adsorption.

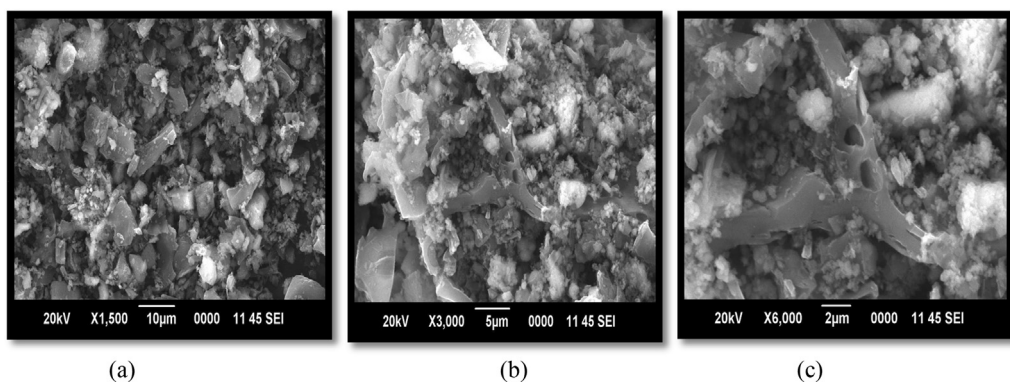


Fig. 3. (a, b, c): SEM micrographs (10, 5 and 2 μm) of MACAIB after fluoride adsorption.

8. The thermodynamic parameters calculated in the investigation are presented in Table 9. It was discovered that change in enthalpy (ΔH) varied from -28.452 to -17.591 kJ mol^{-1} in the initial fluoride concentration range of 2–10 mg/L , while the change in entropy (ΔS), varied from -0.081 to -0.066 $\text{kJmol}^{-1} \text{K}^{-1}$.

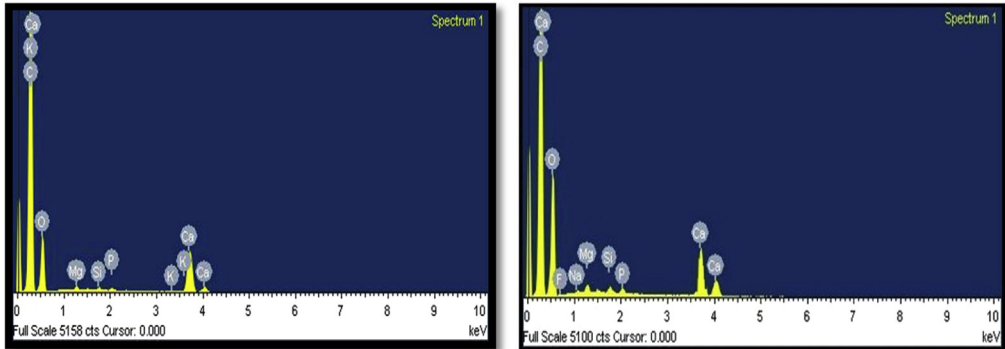


Fig. 4. EDX monograph of MACAIB before and after fluoride adsorption.

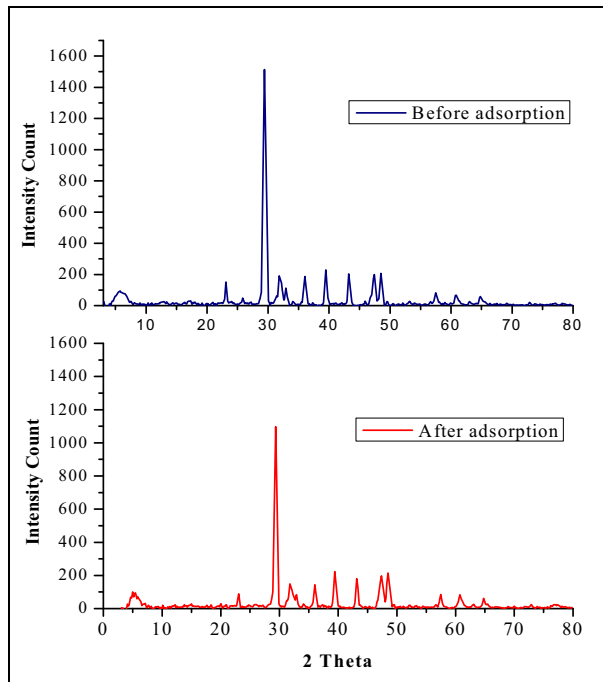


Fig. 5. Powder X-ray diffraction (XRD) of MACAIB before and after fluoride adsorption.

2. Experimental design, materials, and methods

2.1. Preparation of adsorbent

Azadirachta indica bark sample was collected from the local village area and cut into small pieces. The dried *Azadirachta indica* bark powder was carbonized on muffle furnace for 5 Hours at 500 °C. This carbonized bark powder was again activated in domestic microwave (900MW) with an interval of one minute for 30 successive minutes. The microwave assisted carbonized bark was then impregnated with

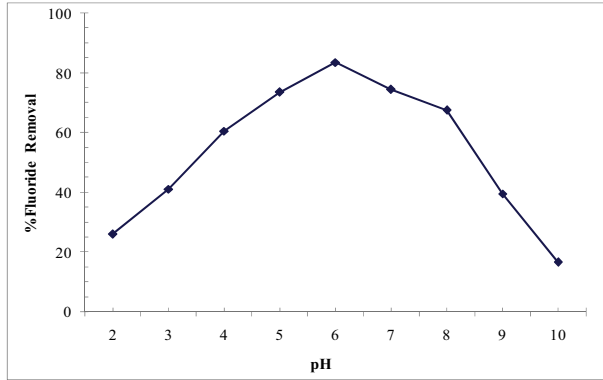


Fig. 6. Effect of pH on fluoride adsorption by MACAIB.

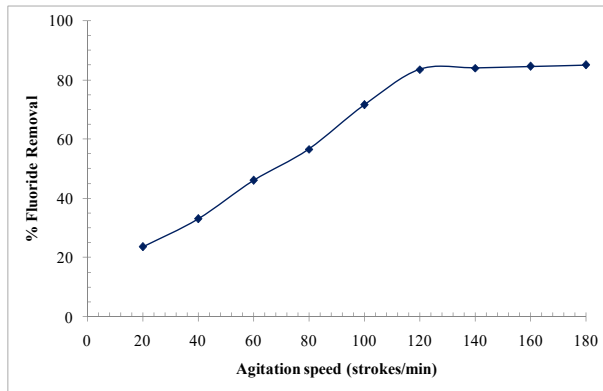


Fig. 7. Effect of agitation speed on fluoride adsorption by MACAIB.

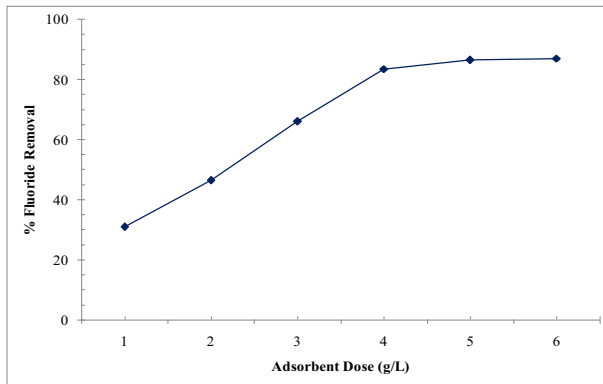


Fig. 8. Effect of adsorbent dose of MACAIB on fluoride adsorption.

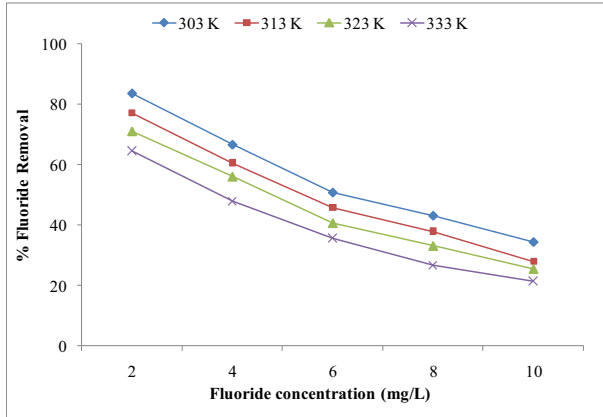


Fig. 9. Effect of fluoride concentration on its adsorption by MACAIB.

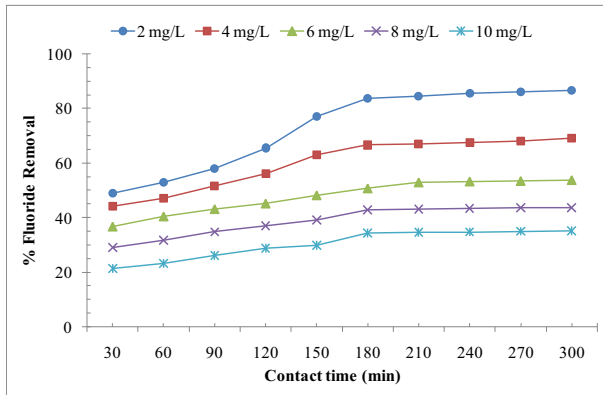


Fig. 10. Effect of contact time on fluoride adsorption by MACAIB.

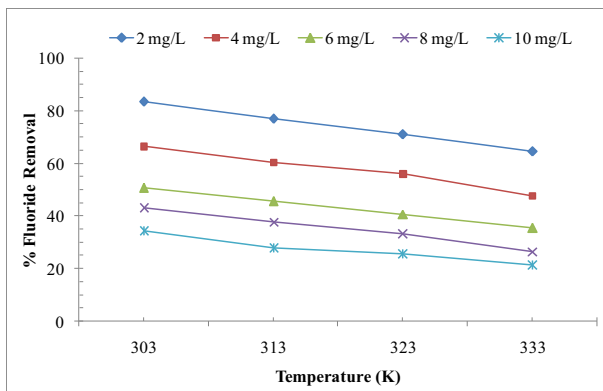


Fig. 11. Effect of temperature on fluoride adsorption by MACAIB.

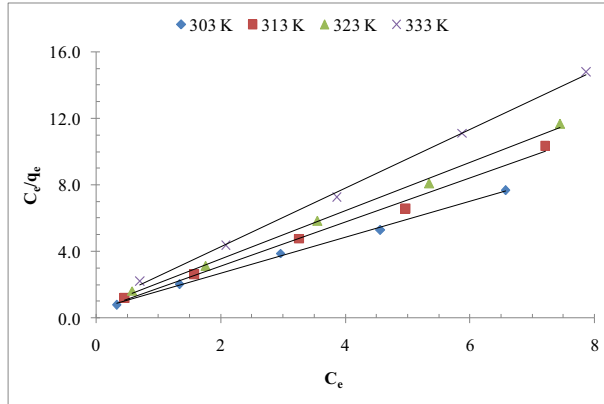


Fig. 12. Langmuir isotherm model for adsorption of fluoride by MACAIB.

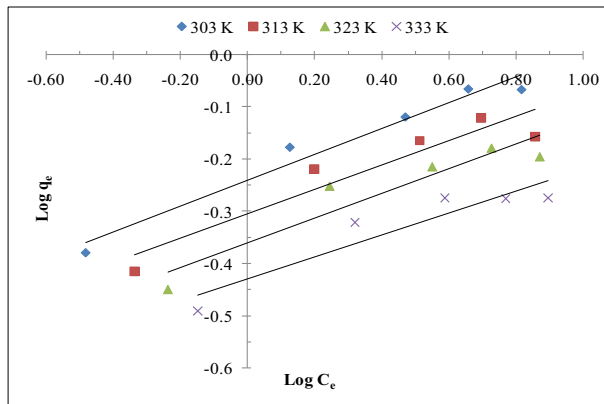


Fig. 13. Freundlich isotherm model for adsorption of fluoride by MACAIB.

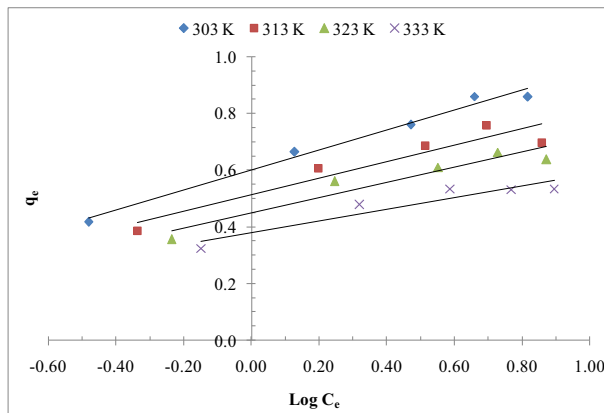


Fig. 14. Temkin isotherm model for adsorption of fluoride by MACAIB.

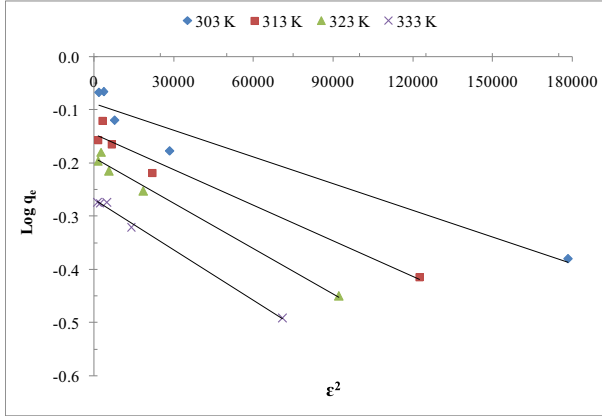


Fig. 15. Dubinin-Radushkevich (D–R) isotherm model for adsorption of fluoride by MACAIB.

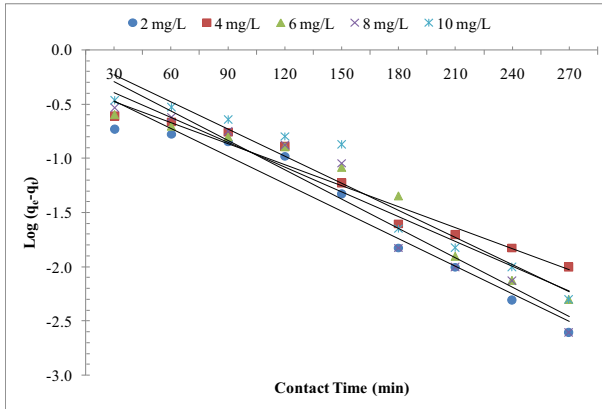


Fig. 16. Plots of Pseudo first-order kinetic model for adsorption of fluoride on MACAIB.

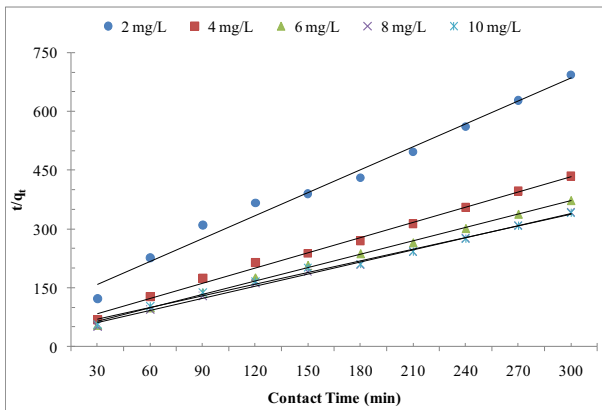


Fig. 17. Plots of Pseudo second-order kinetic model for adsorption of fluoride on MACAIB.

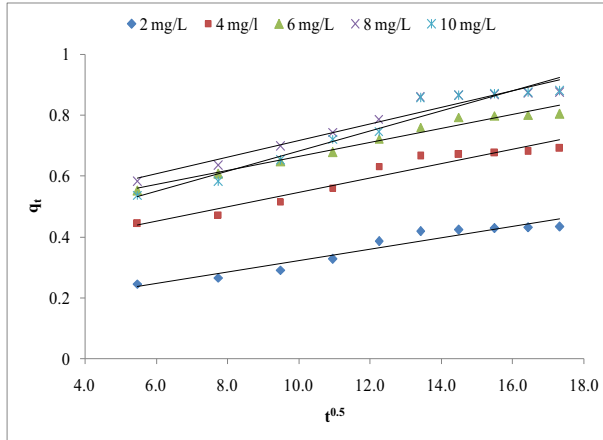


Fig. 18. Plots of Intra-particle diffusion model for adsorption of fluoride on MACAIB.

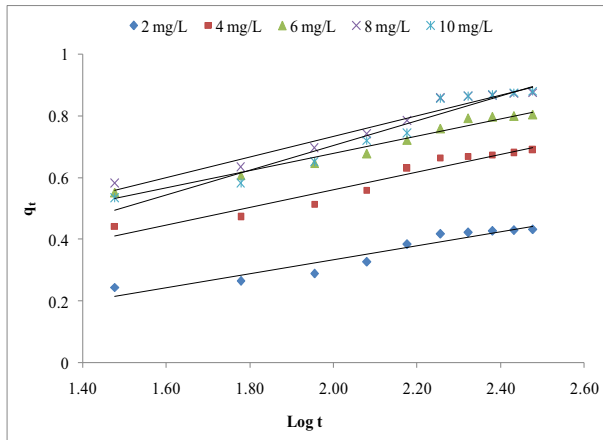


Fig. 19. Plots of Elovich kinetic model for adsorption of fluoride on MACAIB.

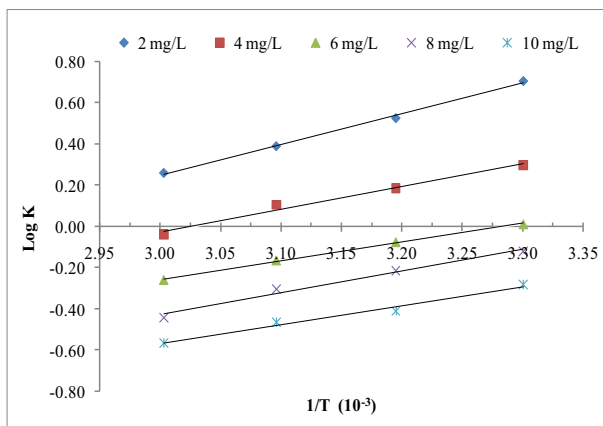


Fig. 20. Plots of Log K versus 1/T for adsorption of fluoride by MACAIB.

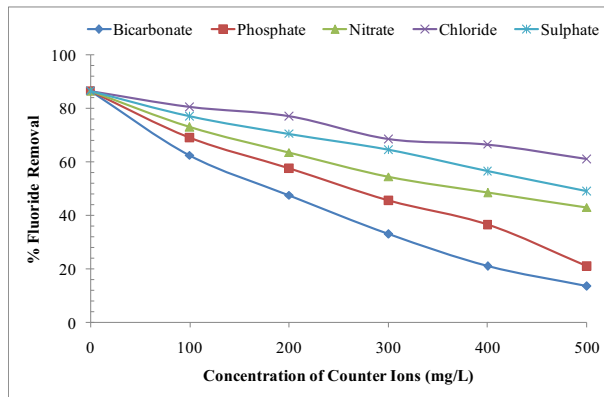


Fig. 21. Effect of counter ions on fluoride adsorption by MACAIB.

Table 1

Proximate analysis of MACAIB material.

| S. N. | Parameters | Values |
|-------|--|--------|
| 1 | Bulk density (gm/cm^3) | 0.46 |
| 2 | Moisture content% | 5.73 |
| 3 | Ash content % | 12.85 |
| 4 | Volatile matter content % | 16.44 |
| 5 | Fixed carbon content % | 64.98 |
| 6 | pH | 7.36 |
| 7 | Water Soluble Matter (%) | 0.93 |
| 8 | Acid soluble matter (%) | 3.87 |

Table 2

Ultimate analysis of MACAIB material.

| S. N. | Parameters | Values |
|-------|--|--------|
| 1 | Carbon % | 58.54 |
| 2 | Hydrogen % | 1.48 |
| 3 | Nitrogen % | 1.39 |
| 4 | Sulphur % | ND |
| 5 | Oxygen % | 38.59 |
| 6 | Surface Area (m^2/g) | 65.82 |
| 7 | Average Pore Diameter (A^0) | 99.79 |
| 8 | Total Pore Volume (cc/g) | 0.11 |

Table 3

FT-IR absorption bands and possible functional groups of MACAIB before and after fluoride adsorption.

| IR Peaks | Before adsorption | After adsorption | Difference | Possible functional groups |
|----------|-------------------|------------------|------------|---------------------------------------|
| 1 | 3422.20 | 3425.13 | 2.93 | -N-H and -O-H stretching |
| 2 | 2871.63 | 2917.91 | 46.28 | Aliphatic -C-H asymmetric str. |
| 3 | 2514.85 | 2510.99 | -3.86 | -CH ₂ symmetric str. |
| 4 | 2356.70 | 2358.06 | 1.36 | Aliphatic -C-H asymmetric str. |
| 5 | 2055.85 | Disappeared | - | Aliphatic -C-H symmetric str. |
| 6 | 1794.56 | 1805.09 | 10.53 | -C=O stretching |
| 7 | 1434.85 | 1438.71 | 3.86 | -N-H bending |
| 8 | 1049.14 | 1054.92 | 5.78 | -C-N stretching |
| 9 | 873.64 | 873.64 | 0 | -C-O-C-, -C-N stretching |
| 10 | 717.42 | 708.39 | -9.03 | -C-O stretching |
| 11 | 605.57 | 576.64 | -28.93 | -C-C- deformations, -C-H deformations |
| 12 | 711.64 | 713.57 | 1.93 | -C-C- stretching. |

Table 4
EDX analysis results of MACAIB before fluoride adsorption.

| Element | Weight % | Atomic % |
|---------|----------|----------|
| C K | 51.10 | 62.17 |
| O K | 35.48 | 32.60 |
| Mg K | 0.46 | 0.28 |
| Si K | 0.29 | 0.16 |
| P K | 0.38 | 0.18 |
| K K | 0.31 | 0.12 |
| Ca K | 11.98 | 4.49 |

Table 5
EDX analysis results of MACAIB after fluoride adsorption.

| Element | Weight % | Atomic % |
|---------|----------|----------|
| C K | 47.37 | 56.32 |
| O K | 38.82 | 38.09 |
| F K | 0.47 | 0.39 |
| Na K | 0.13 | 0.09 |
| Mg K | 0.47 | 0.29 |
| Si K | 0.28 | 0.15 |
| P K | 0.37 | 0.19 |
| Ca K | 12.09 | 4.48 |

Table 6
Empirical adsorption isotherm and kinetic equations and constant parameters [9].

| Isotherm Models | Isotherm Equations and Constant parameters | Kinetic Models | Kinetic equations and constant parameters |
|--------------------------------|--|-----------------------------------|---|
| Langmuir adsorption isotherm | $q_e = \frac{q_m K_L C_e}{1 + K_L C_e}$ (3) | Pseudo first-order kinetic model | $\frac{dq}{dt} = k_1 (q_e - q_t)$ (12) |
| | $\frac{C_e}{q_e} = \frac{1}{K_L q_m} + \frac{C_e}{q_m}$ (4) | | |
| | $R_L = \frac{1}{1 + K_L C_0}$ (5) | | |
| Freundlich adsorption isotherm | $q_e = K_F C_e^{1/n}$ (6) | Pseudo second-order kinetic model | $\frac{dq}{dt} = k_2 (q_e - q_t)^2$ (14) |
| | $\ln q_e = \ln K_F + (1/n) \ln C_e$ (7) | | |
| Temkin Isotherm | $q_e = \frac{RT}{b_T} \ln (A_T C_e) q_e = \frac{RT}{b_T} \ln (A_T) + \frac{RT}{b_T} \ln (C_e) B = B \ln A_T + B \ln C_e$ (8) | Intra-particle diffusion model | $q_t = k_d t^{1/2} + C$ (16) |
| Dubinin-Radushkevich isotherm | $\ln q_e = \ln q_D - (K_D) \epsilon^2$ (9) | Elovich kinetic model | $dq_t = Ae^{(-Bq_t)}$ (17) |
| | $E = \frac{1}{\sqrt{2} K_D}$ (10) | | |
| | $\epsilon = RT \ln \left(1 + \frac{1}{C_e} \right)$ (11) | | |
| | | | $q_t = \left(\frac{1}{B} \right) \ln AB + \left(\frac{1}{B} \right) \ln t$ (18) |

0.5 N sodium hydroxide and afterwards with 0.5 N sulphuric acid for 24 hours separately. The resultant carbon was washed with double distilled water until the point when a steady pH of the slurry was reached. The subsequent material was dried at 110°C in vacuum oven for 24 hours; grinded well and kept in air-tight plastic bottles for further use. The carbon material obtained from the bark of *Azadirachta indica* was later referred as microwave assisted carbonized *Azadirachta indica* bark (**MACAIB**).

Table 7

Adsorption isotherms parameters and coefficients for removal of fluoride on MACAIB.

| Isotherm | Parameters | Temperature | | | |
|----------------------|--|-------------|----------|----------|----------|
| | | 303 K | 313 K | 323 K | 333 K |
| Langmuir | q_m (mg/g) | 0.923 | 0.755 | 0.690 | 0.567 |
| | K_L (L/mg) | 2.091 | 2.880 | 2.222 | 2.393 |
| | R_L | 0.193 | 0.148 | 0.184 | 0.173 |
| | R^2 | 0.997 | 0.993 | 0.997 | 0.998 |
| Freundlich | K_F (mg/g) | 0.575 | 0.497 | 0.438 | 0.372 |
| | $1/n$ | 0.247 | 0.233 | 0.235 | 0.210 |
| | N | 4.049 | 4.292 | 4.255 | 4.762 |
| | R^2 | 0.964 | 0.887 | 0.883 | 0.864 |
| Temkin | K_T (L/mg) | 50.316 | 57.928 | 48.749 | 70.596 |
| | B (J/mol) | 0.153 | 0.126 | 0.116 | 0.089 |
| | b_T (kJ/mol) | 16.481 | 19.936 | 21.810 | 28.301 |
| | R^2 | 0.982 | 0.898 | 0.909 | 0.884 |
| Dubinin-Radushkevich | q_D (mg/g) | 0.817 | 0.716 | 0.647 | 0.540 |
| | K_D (mol ² /kJ ²) | 3.84E-06 | 5.13E-06 | 6.54E-06 | 7.28E-06 |
| | E (kJ/mol) | 0.361 | 0.312 | 0.276 | 0.262 |
| | R^2 | 0.948 | 0.969 | 0.989 | 0.995 |

Table 8

Adsorption kinetics parameters and coefficients for removal of fluoride on MACAIB.

| Kinetic Model | Parameters | Initial fluoride concentrations (mg/L) | | | | |
|--------------------------|------------------------------------|--|-------|-------|-------|-------|
| | | 2 | 4 | 6 | 8 | 10 |
| Pseudo first-order | q_e (mg/g) [Plot] | 0.606 | 0.526 | 0.688 | 0.950 | 1.044 |
| | q_e (mg/g) [Expt.] | 0.432 | 0.690 | 0.805 | 0.875 | 0.881 |
| | k_1 (min ⁻¹) | 0.583 | 0.447 | 0.525 | 0.622 | 0.573 |
| | R^2 | 0.951 | 0.951 | 0.936 | 0.937 | 0.932 |
| Pseudo second-order | q_e (mg/g) [Plot] | 0.424 | 0.647 | 0.793 | 0.868 | 0.873 |
| | q_e (mg/g) [Expt.] | 0.432 | 0.690 | 0.805 | 0.875 | 0.881 |
| | k_2 (g/mg min) | 0.549 | 0.529 | 0.512 | 0.445 | 0.343 |
| | h (mg/g min) (10 ⁻¹) | 0.099 | 0.222 | 0.323 | 0.334 | 0.250 |
| Intra-particle diffusion | R^2 | 0.984 | 0.994 | 0.996 | 0.996 | 0.991 |
| | k_d (mg/g min ^{0.5}) | 0.018 | 0.023 | 0.023 | 0.027 | 0.033 |
| | C | 0.134 | 0.309 | 0.432 | 0.441 | 0.352 |
| | R^2 | 0.913 | 0.941 | 0.971 | 0.945 | 0.945 |
| Elovich | A (mg/g min) (10 ⁻¹) | 0.295 | 1.132 | 3.182 | 2.243 | 0.997 |
| | B (g/mg) | 10.235 | 8.024 | 8.225 | 6.874 | 5.743 |
| | R^2 | 0.918 | 0.938 | 0.969 | 0.957 | 0.942 |

Table 9

Thermodynamic adsorption parameters for removal of fluoride onto MACAIB.

| C_0 (mg/L) | ΔH (kJ/mole) | ΔS (kJ/mol K) | ΔG (kJ/mole) | | | |
|--------------|----------------------|-----------------------|----------------------|--------|--------|--------|
| | | | 303 K | 313K | 323 K | 333 K |
| 2 | -28.452 | -0.081 | -4.085 | -3.145 | -2.405 | -1.653 |
| 4 | -21.023 | -0.064 | -1.728 | -1.110 | -0.648 | 0.249 |
| 6 | -17.391 | -0.057 | -0.067 | 0.452 | 1.015 | 1.653 |
| 8 | -20.257 | -0.069 | 0.710 | 1.288 | 1.887 | 2.825 |
| 10 | -17.591 | -0.066 | 1.638 | 2.471 | 2.880 | 3.619 |

2.2. Characterization of adsorbent

The physico-chemical characterization such as proximate, ultimate and instrumental analysis of the MACAIB adsorbent were performed by BET surface analyser, CHNS elemental analyser, FT-IT, SEM, EDX and XRD [2–9].

2.3. Fluoride adsorption experiments

Batch adsorption experiments were carried out to find the adsorption capacity of MACAIB at different fluoride concentrations ranging from 2 mg/L to 10 mg/L. Samples of 50 ml each of fluoride solution of a particular concentration were shaken at 120 strokes/min for predetermined pH, adsorbent dose, contact time and temperature. The initial and final fluoride concentrations of the solutions were measured by using an ion selective meter (HANNA Model No. HI 4522) and Fluoride ion selective electrode (HANNA Model No. HI 4110). The fluoride adsorption capacities of the MACAIB were calculated using the equation (1):

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

where m is the mass of adsorbent (g), V is the volume of the solution (L), C_0 is the initial fluoride concentration (mg/L), C_e is the equilibrium fluoride concentration (mg/L) and q_e is the fluoride quantity adsorbed at equilibrium (mg/g). The percent removal of fluoride from the aqueous solution was evaluated by the equation (2):

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

The effects of pH, adsorbent dose, agitation speed, initial fluoride concentration, contact time and effect of temperature are studied for removal of fluoride from aqueous solutions by using MACAIB carbon material. Adsorption isotherm, adsorption kinetic and thermodynamic study was performed by varying respective parameters for adsorption of fluoride on MACAIB material by Batch adsorption experiments. Finally, desorption of fluoride and effect of different counter anions was studied for fluoride removal on MACAIB.

2.4. Adsorption isotherms

The adsorption isotherms are a standout amongst the most important methods for demonstrating the adsorption capacity of the adsorbent material and the mechanism of the adsorption system. This system expresses the precise connection between the concentration of fluoride adsorbate and its degree of adsorption onto adsorbent surface. The fluoride adsorption equilibrium records of MACAIB at four different temperature (303, 313, 323 and 333 K) have been analyzed by using four surely understood isotherm models, viz. Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (Table 6) [1]. It recognized that the experimental data fitted well to all these adsorption isotherm models. Correlation coefficients (R^2) values demonstrated that Langmuir adsorption isotherm gives a decent model for the adsorption of fluoride on MACAIB 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 suggested that the binding energy on the whole surface of the MACAIB adsorbent material was uniform and that adsorbate-adsorbate interaction was small. The values of various constants of four adsorption isotherm models were determined and presented in Table 7.

2.5. Adsorption kinetics

The kinetic investigation of adsorption of fluoride from aqueous solutions plays a significant role because it shows crucial knowledge insight into the reaction pathways and mechanism of the fluoride adsorption process. The rate and kinetics of fluoride adsorption onto the MACAIB material was studied via, pseudo 1st -order, pseudo 2nd -order, Intra-particle diffusion and Elovich kinetic equation based models. The observed kinetic equations and kinetic parameters of adsorption kinetic models are discussed in Table 6 [1]. The adsorption kinetics experiments followed pseudo second-order kinetic model

indicating to chemisorptions process. It is noted that Intra-particle diffusion mechanism was not the sole rate-controlling factor.

2.6. Thermodynamic study

The Thermodynamic investigation is significantly more valuable as it gives powerful information on doing the adsorption process. Thermodynamic parameters of the adsorption system, for example, change in free energy (ΔG), change in enthalpy (ΔH) and change in entropy (ΔS) were determined at four different temperatures for initial fluoride concentrations 2 mg/L - 10 mg/L by using the equations (19)–(21). The Gibbs free energy (ΔG) for fluoride adsorption by MACAIB adsorbent material at all temperatures is obtained by using equation (19).

$$\Delta G = -R T \ln K \quad (19)$$

$$\Delta G = \Delta H + T \Delta S \quad (20)$$

$$\ln K = \frac{\Delta S}{R} - \frac{\Delta H}{RT} \quad (21)$$

where, K represents adsorption equilibrium constant, T is Temperature in Kelvin and R is a Universal gas constant ($8.314 \text{ J K}^{-1} \text{ mol}^{-1}$). A linear plot of Log K versus $1/T$ can be applied to find out the values of ΔS and ΔH from the slope and intercept. The values of change in enthalpy (ΔH) and change in entropy (ΔS) are estimated from the intercept and slope of a direct plot between Log K versus $1/T$ (Fig. 21). The thermodynamic parameters calculated in the present study are presented in Table 9. Thermodynamic analysis proposes that removal of fluoride from aqueous solution by MACAIB material was an exothermic and spontaneous process.

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Conflict of 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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COMPARATIVE STUDY OF VARIOUS ADSORPTION ISOTHERMS, BY THE ADSORPTION OF SUCCINIC ACID ONTO ACTIVATED CARBON OF BHAGAR RICE HUSK

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ABSTRACT

The aim of this investigation was to determine the adsorption behaviour of succinic acid solution on activated carbons prepared from Bhagar Rice husk. The activated carbons were prepared by chemical activation method. The adsorption data were well described by the Langmuir and Freundlich adsorption methods. A variety of adsorbents are available naturally- orange pills, rice husk, neem bark, clays etc. that can be used to remove acids from the discharged waste. In this review, we look at the various adsorbents available particularly Bhagar rice husk and see how effectively they can be utilized to meet our requirements. The acid removal process followed Freundlich isotherm in most of the cases and in few investigations, it followed Langmuir. The adsorption equilibrium of succinic acid on prepared activated carbon was then examined. The adsorption isotherms of succinic acid on activated adsorbent was determined and correlated with common Langmuir and Freundlich isotherm models. The Freundlich isotherm showing a better fit for the adsorption data than the Langmuir isotherm. The maximum monolayer adsorption capacity obtained from Langmuir isotherm of succinic acid on activated carbon of Bhagar rice husk.

Keywords: Adsorptions, succinic acid, Activated carbon of Bhagar rice husk, bio-adsorbent, Freundlich, and Langmuir isotherm, Adsorption constant

Introduction:-

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, and groundwater caused by human activities, which

can be harmful to organisms and plants. So the water reservoirs be treated carefully and wastewater treatment be done.¹ Adsorption appears to be good for the treatment of effluents.² The first thing for an efficient adsorption process is the search for a low cost adsorbent with high adsorption capacity and second it should be biodegradable.³ The activated carbon has been till now the most used adsorbent but inexpensive to use on a large scale⁵ and the idea of using natural adsorbents gives very good results⁴.

Many researchers have done the research on using agricultural waste in adsorption of heavy metals. They had reported that the modified rice husks are a potentially useful material for the removal of lead from aqueous solutions⁵. The rapid uptake and high adsorption capacity make it very attractive alternative adsorption material. Rice husks contain a high proportion of cellulose (28-36%), thus it appears to be a good candidate for modification with carboxylic acids. The addition of carboxyl functional groups may enhance the sorption capacities of the rice husks. It showed that tartaric acid modified rice husks had the highest binding capacities for lead.

In previous studies the adsorption of succinic acids on orange pills adsorbents has been done by the phenomenon of accumulation of one species on the surface of other is called as adsorption. It verifies the Freundlich and Langmuir isotherms of acetic⁶.

The efficiency of technique depends on the nature of adsorbent. The adsorbent such as activated carbon were used for heavy metal removal.

Exchanging ions and creating chemical bonds. There are a wide variety of adsorbent materials such as silica gel, zeolites, synthetic adsorbents

(resins), clays, activated alumina, industrial wastes, bio adsorbents and activated carbon⁷. Activated carbon (AC) adsorbents are frequently used in the extraction of chemical species in both gas and aqueous phases⁸. This is because of their high adsorption capacity, their porous structure and accessibility of their surface.⁹ they are used in water treatment and in industrial applications such as in the extraction of metal ions, air handling, and purification, the discolouration of food in the food industry and in the pharmaceutical industry.¹⁰

Milind R. Gidde, Julie Datta, Snehal Jadhav et al: Activated Rice Husk (ARH) and Rice Husk Ash (RHA) were used as adsorbents for decolourisation. ARH was prepared from rice husk treated with nitric acid and RHA was collected directly from mill.¹¹ Their adsorption capacity was evaluated for the decolourisation of wastewater containing methylene blue. The effect of system variables such as pH, contact time, initial concentration and adsorbent dose were investigated.¹² The result shows that efficiency varies with the variation in adsorbate concentrations and adsorbent.¹³ Colour removal efficiency was found to be 88 % to 94 % at the dose of 20 g/l for ARH and 80 % to 95 % at the adsorbent dose of 2.5 g/l for RHA. The studies were carried out at methylene blue concentration of 50 mg/l, 30 mg/l and 10 mg/l. On the basis of adsorption isotherm graphs, R-square values were determined and found to fit the adsorption data. The Linear, Langmuir and Freundlich adsorption isotherms are good fitted for the experimental data.¹⁴

3.3 Adsorption isotherms

The adsorption isotherm investigates when the adsorption process reaches an equilibrium state, how the adsorption molecules distribute between the liquid phase and the solid phase. The analysis of equilibrium adsorption data by fitting them to different isotherm models is an important step in finding a suitable model that can be used for design purposes. Adsorption isotherm study was carried out well-known isotherms, Langmuir, Freundlich¹⁵ and Temkin. The Langmuir isotherm is based on assumption that the monolayer adsorption onto a surface containing a finite number of adsorption sites with uniform forces of adsorption with no migration of adsorbate in the plane of surface. The Freundlich isotherm model assumes heterogeneous adsorption, in which the energy term in Langmuir equation varies as a function

of the surface coverage.

Langmuir isotherm The Langmuir isotherm model is given by the following linear form by the equation.

$$C_e/q_e = 1/q^m + C_e/q^m$$

Where C_e is the equilibrium concentration of Succinic Acid (mg/L), q_e , the amount of adsorbate adsorbed per unit mass of adsorbent (mg g⁻¹), q_m and K_L are Langmuir constants related to monolayer adsorption capacity and affinity of adsorbent towards adsorbate, respectively. When C_e/q_e was plotted against C_e , straight line with slope $1/q_m$ was obtained (Fig. 2), indicating that the adsorption of succinic acid on activated carbon produced from Bhagar rice husk follow the Langmuir isotherm. The Langmuir constants q_m and K_L were calculated from this isotherm and their values are given in Table.

Freundlich isotherm The well-known linear logarithmic form of Freundlich model is given by the following equation,

$$\log q_e = \log K_F + 1/n \log C_e$$

Where q_e is the amount adsorbed at equilibrium (mg g⁻¹), C_e the equilibrium concentration of the adsorbate (Succinic acid) and K_F and n are Freundlich constants, n giving an indication of how favourable the adsorption

Experimental:-

Materials: Chemicals: Succinic acid, NaOH, oxalic acid, phenolphthalein indicator, distilled water, Bhagar rice husk adsorbent etc.

Instruments: microwave oven, containers mechanical shaker etc.

Preparation of adsorbent:

A weighed amount of Bhagar rice husk charged into the furnace at a temperature of 300, 400, 500 and 600⁰C for 0.5, 1.0, 1.5 and 2 hours. The resulting charred material was collected and cooled at room temperature. The domain of variation of these factors is defined according to Borne Mann et al¹⁶. A known amount of Bhagar rice husk charcoal (10 g) was transferred in a beaker (250mL) and added 100 mL distilled water to it and continued adding water to it up to 200mL to completely soak the charring rice straw in beaker. When the charring rice husk completely settled down then decanted the distilled water and repeated this process for several times until the decanted water become cleared. Bhagar husk charcoal was then filtered

through ordinary filter paper and washed again with distilled water. Cleaned Bhagar rice husk charcoal was dried in an oven to get a constant weight and stored¹⁶.

Method:

Prepare 0.1 N oxalic acid solutions by dissolving 0.63g oxalic acid in 100 ml distilled water.

Standardize the given NaOH solution using phenolphthalein indicator.

Take 6 clean reagent bottles and number them from 1-5.

Weigh out accurately about 1 g finely ground activated charcoal in each of them.

Prepare various systems in these bottles as follows:

Shake these bottles vigorously and keep for one hour.

Filter each solution through filter paper and titrate 10 ml of each of them with 0.1N NaOH solution.

Results & Discussion:-

Similarly, adsorption of succinic acid on activated Bhagar rice husk as a bio adsorbent. Different concentration of succinic acid solution we are prepared and determine the adsorption for 1 hr contact time. From the table 1 we have determined the values of $\log x/m$ and $\log C_e$. The graph 1 of Freundlich adsorption isotherm of succinic acid on Bhagar rice husk the straight line is obtained. From the graph R^2 , n , k values were determine. From the values it was observed that Freundlich adsorption is verified.

Similarly, from graph 2, $C_e/x/m$ vs. C_e of Succinic acid on activated Bhagar rice husk, straight line is obtained. From the graph a , b , R^2 were determining. This value shows the Langmuir adsorption is verified.

Also, from table 3 the values of % adsorption vs. concentration graph 3 were plotted. From the graph it was observed that as the concentration of acid solution decreases % adsorption decreases

From graph 1 the Freundlich adsorption isotherm can be said to be good. And Fit for the given experimental adsorption data, since the linear regression of $\log x/m$ vs $\log C_e$ gave R^2 values in the range of 0.99 for the different concentration of Succinic acid with rice husk adsorbents. To understand the actual application

of this adsorption method on the results obtained the experiments were conducted on different waste water samples collected from different industries. The activated rice husk and rice husk ash can be used as good adsorbent for selected effluent having specific concentration of adsorbate (colour/organic matter).

Similarly, From graph 2 the Langmuir adsorption isotherm can be said to be good fit for the given experimental adsorption data, since the linear regression of $C_e/x/m$ vs C_e gave R^2 values in the range 0.79 for the different concentration of Succinic acid with rice husk adsorbents. Application of adsorbents for different effluent samples. To understand the actual application of this adsorption method on the results obtained the experiments were conducted on different waste water samples collected from different industries. The activated Bhagar rice husk and rice husk ash can be used as good adsorbent for selected effluent having specific concentration of adsorbate (colour/organic matter).

Similarly, for Succinic acid Freundlich constant, 'n' having value 1.039 and 'k' having value 17.82 and Langmuir constant 'a' having value 2.188 and 'b' having value 14.28 indicate that both Freundlich and Langmuir adsorption isotherm is verified.

From graph 3 it is concluded that the adsorption of acids decreases with decrease in concentration of acid. As the concentration of acid decreases from system 1 to 5 the adsorption of acid on rice husk adsorbent also get decreases.

From the above all graphs we can conclude that having R^2 value greater than 0.70 indicate the adsorbent gives better adsorption of acids.

Conclusion:-

The result of present study clearly shows that acid treated rice husk is effective in adsorption of acids. It is evident that experimental adsorption data for the

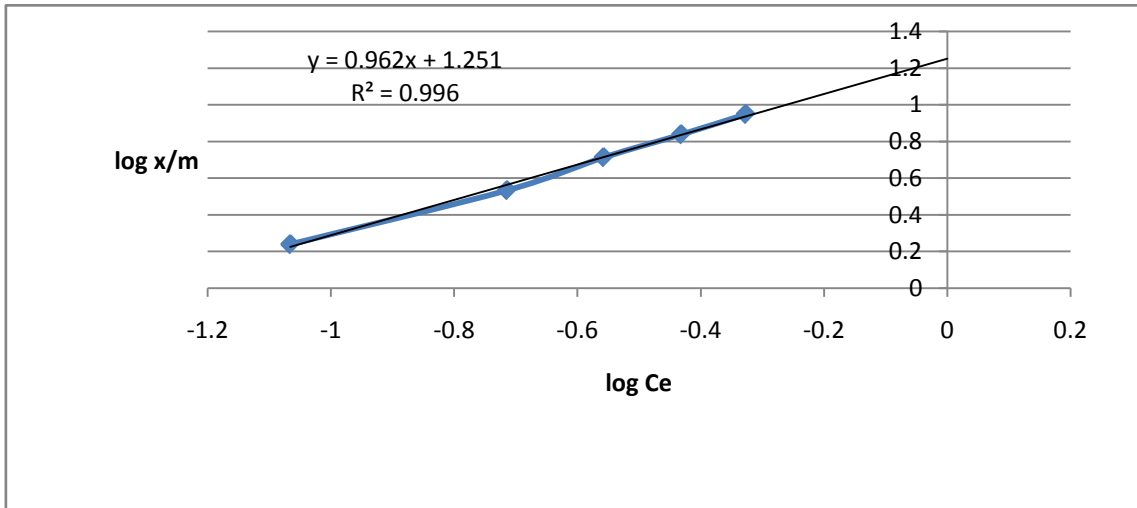
Adsorption of colour in this research can be explained by more than one adsorption isotherms. The result shows that the R^2 values are closer to 1 for all adsorption isotherm plots. Thus, Linear, Langmuir and Freundlich isotherm models are good fitted to the experimental data. Thus full utilization of agro-

waste and treatment of wastewater is one of the good prospective for good environment. The Bhagar rice husk can be proved as good, effective and eco friendly adsorbent. Bhagar Rice husk is cheap, less expensive and easily available in market. As it is a waste

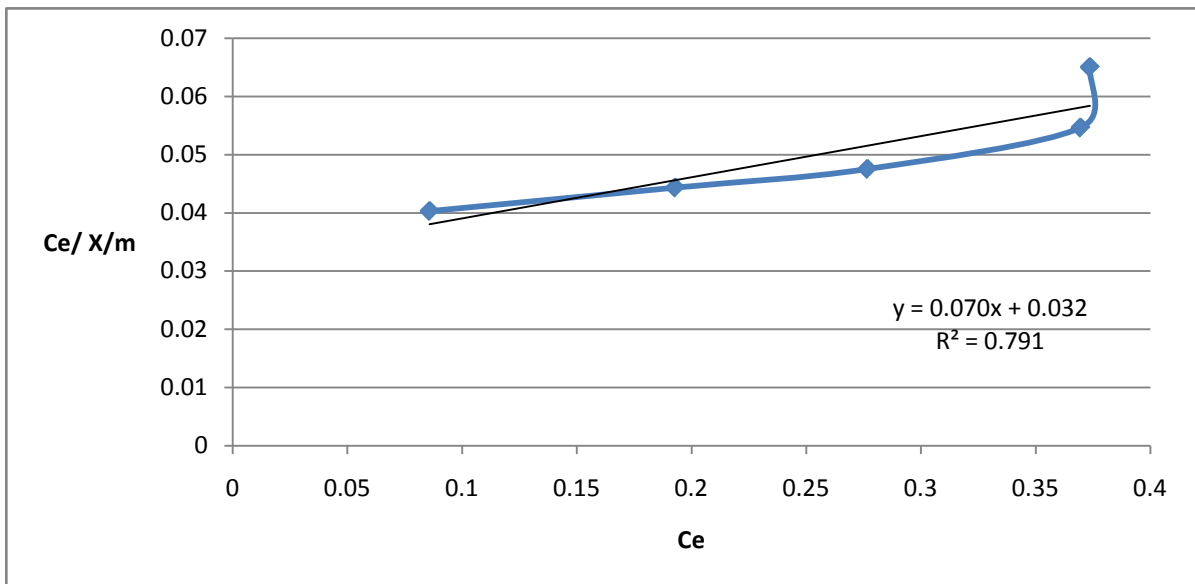
material of Rice after threshing of rice, generally it is available in free of cost. It gives better adsorption of acids so instead of activated carbon it is more beneficial for adsorption as an adsorbent.

1.1. Structures

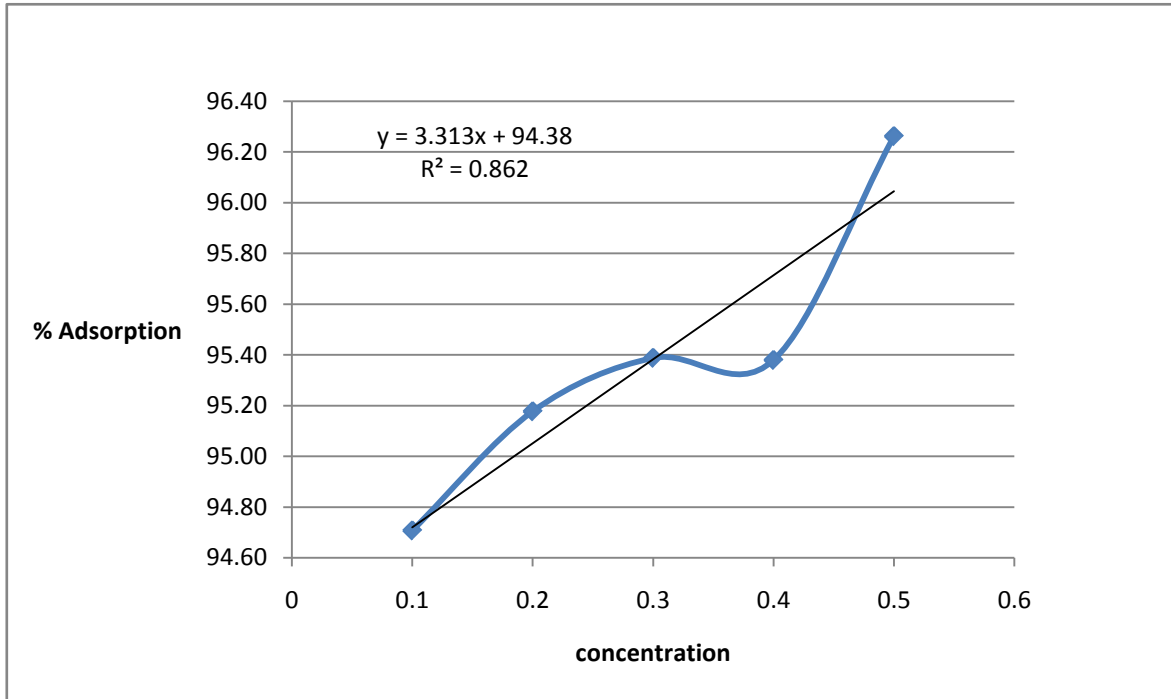
Graph 1: Verification of Freundlich adsorption isotherm of Succinic acid on Bhagar Rice husk adsorbent.



Graph 2: Verification of Langmuir adsorption isotherm of Succinic acid on Bhagar Rice husk adsorbent.



Graph 3: % Adsorption vs Concentration of Succinic acid on Bhagar Rice husk adsorbent.



1.2. Tables

Table no. 1: Observation table for Succinic acid (0.01 N) on Bhagar rice husk.

| Bottle No. | Vol. Of succinic acid solution V (ml) | Vol. Of water (ml) | Amount of charcoal m (g) | Initial conc. Of succinic acid Co | Vol. Of filtrate taken V1 (ml) | Vol. Of NaOH solution required V2 (ml) | Eqn conc. Of succinic acid Ce | Succinic acid adsorbed X (g) | X/M | Log (x/m) | Log Ce | Ce/x/m |
|------------|---------------------------------------|--------------------|--------------------------|-----------------------------------|--------------------------------|--|-------------------------------|------------------------------|--------|-----------|--------|---------|
| 1 | 50 | 0 | 1 | 10 | 10 | 37 | 0.3737 | 8.8789 | 8.8789 | 0.9483 | 0.4274 | 0.065 |
| 2 | 40 | 10 | 1 | 8 | 10 | 36.6 | 0.3696 | 6.8916 | 6.8916 | 0.8383 | 0.3321 | 0.0546 |
| 3 | 30 | 20 | 1 | 6 | 10 | 24.4 | 0.2767 | 5.1699 | 5.1699 | 0.7135 | 0.5579 | 0.0475 |
| 4 | 20 | 30 | 1 | 4 | 10 | 19.1 | 0.1929 | 3.4212 | 3.4212 | 0.5341 | 0.7146 | 0.0443 |
| 5 | 10 | 40 | 1 | 2 | 10 | 8.5 | 0.08585 | 1.7424 | 1.7424 | 0.2401 | 1.0662 | 0.04027 |

Table no.2: Percentage adsorption for Succinic acid on Bhagar rice husk.

| Concentration | co | Ce | Co-Ce | Co-Ce/Co | % adsorption |
|---------------|----|--------|--------|----------|--------------|
| 0.5 | 10 | 0.3737 | 9.6263 | 0.96263 | 96.26 |
| 0.4 | 8 | 0.3696 | 7.6304 | 0.9538 | 95.38 |
| 0.3 | 6 | 0.2767 | 5.7233 | 0.953883 | 95.39 |
| 0.2 | 4 | 0.1929 | 3.8071 | 0.951775 | 95.18 |
| 0.1 | 2 | 0.1185 | 1.8815 | 0.94075 | 94.08 |

Table 3: calculation of Freundlich and Langmuir constant.

| Freundlich constant | Values | Langmuir constant | Values |
|---------------------|--------|-------------------|--------|
| n | 1.039 | a | 2.188 |
| k | 17.82 | b | 14.28 |
| R ² | 0.99 | R ² | 0.79 |

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STRUCTURAL AND CHARACTERIZATION OF Mg-Co SUBSTITUTED BARIUM HEXAFERRITES.

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ABSTRACT:

Structural design of barium hexaferrites $BaMg_xCo_{2-x}Fe_{16}O_{27}$ ($x = 0.0, 1, 2$) has been studied, and the magnetic and electronic structure of that has then been investigated using first principle total energy calculation. All calculations are based on the density functional theory. In order to improve the description of strongly correlated 3d electrons of iron, the general gradient approximation plus Hubbard U (GGA-U) method is used. We found that in the lowest energy configuration Mg and Co ions preferentially occupy the 6g sites. With the increase of Mg content x , the energy gap of $BaMg_xCo_{2-x}Fe_{16}O_{27}$ increases but the lattice constant of unit cell decreases. The magnetic moment of the unit cell for Mg content $x = 0, 1$, and 2 are calculated to be 52, 49 and 46 μ_B /cell respectively, in agreement with previous experimental results. The substitutions of Mg and Co at the $BaFe_{12}Fe_{4}O_{27}$ decrease electrical conductivity and transit it from a half-metal to semiconductor material. Based on our calculations on electronic band structure, the $BaFe_{12}Fe_{4}O_{27}$ (BFFO) is a weak half-metal, but $BaMg_2Fe_{14}O_{27}$ (BMFO), $BaMgCoFe_{15}O_{27}$ (BMCFO) and $BaCo_2Fe_{14}O_{27}$ (BCFO) are semiconductors. The electrical resistivity increases by increasing Mg and Co contents due to increase in porosity which prevents the hopping of charge carriers.

INTRODUCTION:

In the last decades, ferrite magnetic materials have been considered as important electromagnetic wave absorbing materials with interesting magnetic properties because their electric and magnetic properties are suitable for absorbing the ultra-high frequency band [1]. With the arrival of modern electronic, microwave and magnetic devices, the electromagnetic interference has become a critical problem [2]. It is therefore important to design materials that can attenuate electromagnetic radiations. Wave absorbing materials are required to have a large electric and magnetic loss in the frequency range of interest.

Polycrystalline hexagonal ferrites are technologically desirable materials due to their

high resistivity and high permeability make them suitable for various applications. Barium hexagonal ferrites (BHF) are ideal filters for electromagnetic interference attenuation purposes due to their low cost, high stability and high density [3]. The crystal structure of barium hexagonal ferrites (BHF) are divided into six different types, M ($BaFe_{12}O_{19}$), W ($BaMe_2Fe_{16}O_{27}$), Y ($Ba_2Me_2Fe_{12}O_{22}$), Z ($Ba_3Me_2Fe_{24}O_{41}$), X ($Ba_2Me_2Fe_{28}O_{46}$) and U ($Ba_4Me_2Fe_{36}O_{60}$), where Me is Mg or any divalent transition metal such as Mn, Fe, Co, Ni, Cu, and Zn. The electrical conductivity and dielectric behavior of these materials depend on many factors such as preparation method, sintering temperature and type of substitutes [4]. In the series of barium hexagonal ferrites, the W-type Ba hexaferrites have high magnetic

permeability due to their high values of saturation magnetization and exhibiting excellent magnetic anisotropy. Thus compared to the other coordination hexagonal ferrites, their microwave absorption characteristics have potential applications in magnetic and microwave devices [5]. The crystal structure of W-type hexagonal ferrites can be depicted as an alternating taking of S and R blocks in the direction of hexagonal c-axis and the general formula of this type is $SSR \cdot S \cdot S \cdot R$, where the S (spinel block) is at wo-oxygen layer block with the formula of Fe_6O_{2+} and R is a three oxygen layer block with the formula of $BaFe_6O_{11}$. There is a 180 degree rotation about the c axis between S, S \cdot and R, R \cdot [6,7].

Substitution of Ba^{2+} , Me^{2+} or Fe^{3+} ions is an effective method to vary the magnetic properties such as the saturation magnetization [8]. The presence of divalent and trivalent cations distributed among various sublattices makes the W-type hexaferrite very interesting for basic studies and different technical applications [4]. Several research groups have studied the structural, magnetic and electrical properties of the Ba hexaferrite from the first principles [9, 12]. In the present work, the structure and the magnetic properties of the W-type barium hexaferrite $BaMg_{2-x}Co_xFe_{16}O_{27}$ ($x = 0.0, 1, 2$) were studied using first principle method. The electronic ground structure was also investigation.

Calculations details:

We have used the ab initio calculations using the plane wave ultra-soft pseudo-potential scheme within the spin density functional

theory (DFT) [13] in the framework of generalized gradient approximation plus Hubbard U (GGA+U). Each cation (i.e., Mg, Co, Fe) should have different effective U values. With varying U parameters, even the qualitative behavior of the band dispersion as well as the magnetic ordering can be changed. The ultra-soft pseudo-potentials have been used for 3s, 3p, 3d, 4s, and 4p states of Fe atoms, 3d, and 4s states of Co atoms, 3s state of Mg atoms and 2s, and 2p states of O atoms in valence configurations, respectively[14]. Generalized gradient approximation functional in the form of Perdew Burke Ernzerhof (PBE) [15] was used for the electronic exchange-correlation potentials in the DFT calculations. GGA is expected to be more accurate than local density approximation (LDA) for our calculations.

The ultra-soft pseudo-potentials and the exchange- correlation energy are used to represent the interaction between ionic cores and valence electrons. The total energy and electronic structure are determined by solving the Kohn Sham equations [16,17] via the iterative matrix diagonalization scheme based on the Davidson method. The whole set of self-consistent calculations is performed using the plane wave PWSCF code in the QUANTUM-ESPRESSO package [18], which is based on the DFT. The KohnSham single-particle electron wave functions were expanded in a basis of plane-waves setup allocated in very distinctive sublattices, namely 2a, 2b, 4f1, 4f2 and 12k, which are distributed in both blocks. Three of these positions, 2a, 4f2 and 12k have octahedral site, while 4f1 shows tetrahedral

site and 2b occupies a pseudo-tetrahedral site. Furthermore, 4f1 and 4f2 sites have spin down configurations, while other three sites contribute positively to magnetization [3]. On the other hand, the Fe²⁺ ions are positioned at seven crystallography different sites, namely 2d, 4f1(4f1R), 4f2(4f1V), 4f3(4f1S), 6g, 4e and 12k. As shown in Table I, three of these positions, i.e. 4e, 4f1 and 4f2 sites, have spin down configurations, while the configuration of the other four sites, 2d, 4f3, 6g and 12k have spin up.

The number of sampling k-points used in the Brillouin zone (BZ) summation of the electronic density and total energy is increased until the total energy converges to 0.0001 Ry. Their reducible BZ investigations are carried out using the scheme of the Monkhorst Pack [19] with the 8 × 8 × 2k point mesh. The relaxed internal atomic positions have been obtained by total-energy and atomic-force minimization using the Hellmann Feynman theorem. For the force convergence, all atom coordinates and lattice vectors are fully relaxed until the Hellmann Feynman forces acting on each atom were less than 0.001 Ry/a. u. All calculations are spin-polarized with atom spin configuration initialized according to Gorter scheme [20].

RESULT & DISCUSSION:

The crystal unit cell of W-type barium hexaferrites BaFe²⁺₂ Fe³⁺₁₆ O₂₇ contains two formula units i.e. 92 atoms. As shown in Fig. 1, the oxygen atoms are close packed with the Ba and Fe ions in the interstitial sites. The

structure is built up from smaller units, four cubic blocks S, having the spinel-type structure, and two hexagonal blocks R, contain Ba ions. Therefore, the unit cell is composed of the sequence RSSR*S*S*. Fe³⁺ ions allocated in -ve distinctive sublattices, namely 2a, 2b, 4f₁, 4f₂ and 12k, which are distributed in both blocks. Three of these positions, 2a, 4f₂ and 12k have octahedral site, while 4f₁ shows tetrahedral site and 2b occupies a pseudo-tetrahedral site. Furthermore, 4f₁ and 4f₂ sites have spin down configurations, while other three sites contribute positively to magnetization [3]. On the other hand, the Fe²⁺ ions are positioned at seven crystallography different sites, namely 2d, 4f₁(4f₁R), 4f₂(4f₁V), 4f₃(4f₁S), 6g, 4e and 12k. As shown in Table I, three of these positions, i.e. 4e, 4f₁ and 4f₂ sites, have spin down configurations, while the configuration of the other four sites, 2d, 4f₃, 6g and 12k have spin up.

Because of fractional population parameters of Mg and Co locations, several models for Mg and Co locations were used. Depending on the material preparation conditions, the populations of Mg cations located in symmetric sites of the cell are somewhat different and the Mg²⁺ ions have a statistical distribution over tetrahedral and octahedral sites, but mainly prefer to locate at the octahedral sites. The Mg cations of BaMg₂Fe₁₆O₂₇ (BMFO) are mainly distributed in the 6g and 4f₃ sites [21]. Also, the populations of Co cations located in symmetric sites of the BaCo₂Fe₁₆O₂₇ (BCFO) cell are mainly distributed in the 6g sites (octahedral sites SS and S*S* interface) and 4f₃

octahedral sites of S blocks [22]. For simplicity two

Structural arrangement of BMFO and two structure. As shown in Fig.1, the oxygen atoms are close packed with the Ba and Fe ions in the interstitial sites. The structure is built up from smaller units: four cubic blocks S, having the spinel-type structure, and two hexagonal blocks R, contain Ba ions. Therefore, the unit cell is composed of the sequence RSSR-S·S·Fe³⁺ ions arrangement of BCFO was proposed as follows:

Arrangement I: All of the four Mg cations of the unit cell are assumed to be located at 2/3 positions among six positions of 6g sites (Fig.2a).

Arrangement II: All of the four Mg cations of the unit cell are assumed to be located at all four positions of 4f₃ sites (Fig. 2b).

Arrangement III: All of the four Co cations of the unit cell are assumed to be located at 2/3 positions among six positions of 6g sites (Fig.2c).

Arrangement IV: All of the four Co cations of the unit cell are assumed to be located at all four positions of octahedral 4f₃ sites (Fig.2 d)

The initial lattice parameters and detailed ion coordinates of BaFe₂Fe₁₆O₂₇ (BFFO) and BaMg₂Fe₁₆O₂₇ (BMFO) and BaCo₂Fe₁₆O₂₇ (BCFO) were accepted from previous experimental works [20, 22, 23]. Measured lattice parameters and magnetic moments of BFFO are $a=5.88\text{\AA}$, $c=32.845\text{\AA}$, $c/a=5.586$ and $56\ \mu_B/\text{cell}$. Calculation of the BFFO initial cell gives the optimized lattice parameters of: $a = 5.941\ \text{\AA}$, $c = 33.30\ \text{\AA}$, $c/a=5.605$ and the magnetic moment of $56\ \mu_B/\text{cell}$.

The optimized lattice parameters and free energies for BMFO and BCFO calculated using four arrangements are shown in Tables II and III, respectively. Although the symmetry of arrangement I and arrangement III are lower than that of arrangement II and arrangement IV, the structure of Arrangement I is more stable than that of Arrangement II, because there is about 0.3eV/cell of the free energy differences between them. The structure of Arrangement III is also more stable than that of Arrangement IV and the free energy differences between them is about 2.5eV/cell.

Therefore, we calculated the structural and electronic properties of BaMg₂Co_{2- λ} Fe₁₆O₂₇ with different compositions of BMFO (with $\lambda=2$) using Arrangement I, BCFO (with $\lambda=0$) using Arrangement III and BMCFO (with $\lambda=1$) using combinations of the two Arrangements. The results are summarized in Table IV. Since Mg²⁺-cations are found to be in the 6g sites, the substitution of Co²⁺ by Mg²⁺ at BaMg₂Co_{2- λ} Fe₁₆O₂₇ decreases the distance between layers, which leads to a decrease in lattice parameters. This is due to the fact that the ionic radius of Mg²⁺ (0.65Å) is smaller than that of Co²⁺ (0.78Å).

The substitution of the Fe²⁺ in the spin up states (2d,4f₃,6g,12k) appears to cause a reduction in the magnetization, while the substitution in the spin-down states (4e, 4f₁, 4f₂) may lead to an increase in the net magnetization [6]. As we know, Mg²⁺ cation is the diamagnetic cation, and the magnetic moment of Mg²⁺ and Co²⁺ are lower than that of the Fe²⁺ (5.1 5.7 μ_B). Therefore, if the Fe²⁺ in the spin-up states were replaced by Mg²⁺ or Co²⁺,

the net magnetization in upward spin is expected to decrease the total magnetic moment and hence strengthen the magnetization. As we expected the calculated magnetic moments BMFO, BCFO and BM-CFO are lower than BFFO and the calculated magnetic moments are somewhat lower than those experimentally determined. This can be due to the fact that our simple model has not considered some of the Mg and Co atoms which might be located in the tetrahedral positions [22].

The total density of states (DOS) for BFFO, BMFO, BMCFO and BCFO is shown in Fig. 3. Energy gap appears in all materials. There is a half metallic peak in the energy gap of BFFO (Fig.3a), while no peak appears in the energy gap of the other materials BMFO (Fig.3b), BMCFO (Fig. 3c) and BCFO (Fig. 3d). The substitutions of Mg and Co at the $\text{BaFe}^{2+}\text{Fe}^{3+}\text{O}_{27}$ decrease electrical conductivity and transit it from a half-metal to semiconductor material. Based on our calculations, the BFFO is a weak half-metal, but BMFO, BMCFO and BCFO are semiconductors. *c* axis (GA,HK) are very small, while curves along the directions perpendicular to *c* axis (A H, MG) are rather steep. From the electronic band structure one can finds that the BFFO is a weak half-metal, while BMFO, BMCFO and BCFO are semiconductors. Electrical conductivity and transit it from a half-metal to semiconductor material. Based on our calculations, the BFFO is a weak half-metal, but BMFO, BMCFO and BCFO are semiconductors.

For more detailed consideration, the total DOS was dissolved into the partial DOS of symmetric sites and all contribution to this peak were studied. It turns out that the *3d* electrons of Fe at 6g sites have most contribution to the BFFO peak and only a small part of the peak comes from oxygen *2p* electrons at $12k_2$ and $4f_2$ sites, which are located at upper and lower layers nearest to iron 6g sites.

Electronic band structures around energy gap of three materials of BFFO, BMFO, and BCFO are shown in Fig.4. In all of the materials, the changes of eigen energy dispersion curves along the direction parallel to *c* axis (G-A, H-K) are very small, while curves along the directions perpendicular to *c* axis (A_H, M_G) are rather steep. From the electronic band structure one can finds that the BFFO is a weak half-metal, while BMFO, BMCFO and BCFO are semiconductors.

The effective mass of the carrier in solid state physics is related with $\partial^2 E / \partial k^2$, where *E* is eigen energy at a *k* point in BZ. Figure 4, indicates that the elective masses of carrier along *c* axis are much heavier than that perpendicular to *c* axis. As is known, the electrical conductivity is inversely proportional to the carrier elective mass. Because of the anisotropy of carrier density and the elective mass of carrier, all of the materials experimentally demonstrated to possess a strong anisotropy of electrical resistivity. The electrical resistivity along the *c* axis relative to perpendicular to *c* axis is equal to $10^2 10^3$. The electrical resistivity in these ferrites is mainly due to hopping electrons between Fe^{2+} and Fe^{3+} . As Co and Mg ions

prefer to occupy octahedral sites (6g sites) followed by the migration of some Fe^{2+} ions to tetrahedral sites and converting them into Fe^{2+} ions in order to maintain overall electrical neutrality. As a result Fe^{3+} ions concentration is lowered on octahedral sites: the sites responsible for conduction in ferrites. Therefore, the charge of Fe atom at 6g sites increases to the value level of the other Fe atoms.

It can be considered that Co and Mg doping causes valence state of 6g site to change from mixed valence state to 3+ valence state. Hence, the energy of Fe at 6g states raise up and the corresponding peak in the energy gap moves into the conduction band, and the doping states become extinct and the electric carrier density decreases. All these factors would limit the hopping probability between Fe^{3+} and Fe^{2+} ions thereby enhancing the resistivity. Moreover porosity in the investigated samples has been observed to increase so this prevented the motion of charge carriers and as a result, electrical resistivity increases with increasing Co and Mg concentration. This is the main reason why the electrical resistivity of BMFO, BMCFO and BCFO are about 1000 times higher than BFFO.

CONCLUSION:

Our calculations on the optimized crystal structure and electronic ground structure have been performed to understand the anisotropy of the electric conductivities in W-type hexagonal ferrites BFFO, BMFO, BMCFO and BCFO. Due to the presence of Fe mixed valence states at 6g sites in BFFO a half-metallic peak appears in the energy gap and it

results in an electrical conductive layer perpendicular to c axis. Replacement of Fe at 4e and 6g sites of BFFO by Mg and Co, causes the mixed valence states of Fe cations at 6g sites to vanish and the carrier density to be lower. Also, in all materials, effective mass of carrier along c axis is much heavier than that perpendicular to c axis. Therefore, the electrical resistivity of the materials are much different and the electrical resistivity of all materials along c axis are much higher than that perpendicular to c axis. The electrical resistivity increases by increasing Mg and Co contents due to increase in porosity which prevents the hopping of charge carriers.

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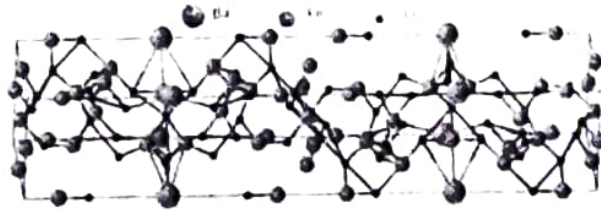


Fig. 1. Crystal structure of BFO contains two formula units i.e. 92 atoms.

TABLE I

Coordinates of Fe^{2+} atoms for barium hexaferrite $BaFe^{2+}_2 Fe^{3+}_{16} O_{27}$ with space group of $P63/mmc$.

| Atom | Wyckoff site | Coordination | Spin | Block | Coordinates | | |
|--------------|--------------|--------------------|------|-------|-------------|-----|-------|
| | | | | | x | y | z |
| $Fe^{2+}(1)$ | 2d | Pseudo-tetrahedral | ↑ | R | 1/3 | 2/3 | 3/4 |
| $Fe^{2+}(2)$ | 4f1 | octahedral | ↓ | R | 1/3 | 2/3 | 0.208 |
| $Fe^{2+}(3)$ | 4f2 | tetrahedral | ↓ | S | 1/3 | 2/3 | 0.092 |
| $Fe^{2+}(4)$ | 4e | tetrahedral | ↓ | S | 0 | 0 | 0.055 |
| $Fe^{2+}(5)$ | 4f3 | octahedral | ↑ | S | 1/3 | 2/3 | 0.575 |
| $Fe^{2+}(6)$ | 6g | octahedral | ↑ | S S | 1/2 | 0 | 0 |
| $Fe^{2+}(7)$ | 12k | octahedral | ↑ | R S | 5/6 | 2/3 | 0.14 |

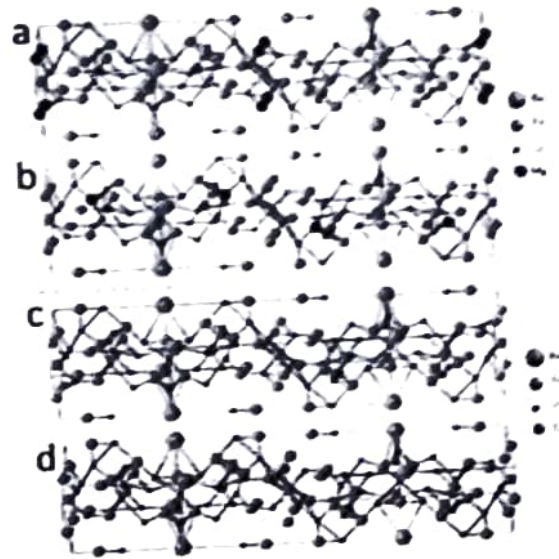


Fig 2. Crystal structure of (a) model I of BMFO, (b) model II of BMFO, (c) model III of BCFO, (d) model IV of BCFO, located in interface of S S or S- S- is 6g sites of Fe.

TABLE II
Lattice parameters, magnetic moment and free energy of the unit cell of $BaMg_2Fe_{16}O_{47}$

| Model | Free energy [ev/cell] | Magnetic moment | a [Å] | c [Å] | c/a |
|-----------|-----------------------|-------------------|-------|--------|-------|
| 6g-Mg | 621.102 | 46 μ B/cell | 5.851 | 32.895 | 5.622 |
| 4f3-Mg | 620.824 | 46 μ B/cell | 5.877 | 32.843 | 5.583 |
| exp. [22] | | 51.6 μ B/cell | 5.892 | 32.85 | 5.575 |

TABLE III
Lattice parameters, magnetic moment and free energy of the unit cell of $BaMg_2Fe_{16}O_{47}$

| Model | Free energy [ev/cell] | Magnetic moment | a [Å] | c [Å] | c/a |
|----------|-----------------------|-------------------|-------|--------|-------|
| 6g-Co | 626.325 | 52 μ B/cell | 5.946 | 33.201 | 5.583 |
| 4f3-Co | 623.824 | 52 μ B/cell | 5.959 | 33.015 | 5.540 |
| exp [22] | | 54.4 μ B/cell | 5.899 | 32.846 | 5.568 |

TABLE IV

Lattice parameters, magnetic moment and free energy of the unit cell of $BaMg_xCo_{2-x}Fe_{16}O_{27}$

| | BFFO | BCFO (x = 0) | BMCFO (x = 1) | BMFO (x = 2) |
|-----------------|---------|-----------------|------------------|-----------------|
| lattice a[Å] | 5.941 | 5.946 | 5.901 | 5.851 |
| parameters c[Å] | 33.30 | 33.201 | 33.025 | 32.895 |
| c/a | 5.605 | 5.583 | 5.596 | 5.622 |
| magnetic moment | 56 | 52 | 49 | 46 |
| free energy | 627.614 | 626.325 | 623.752 | 621.102 |

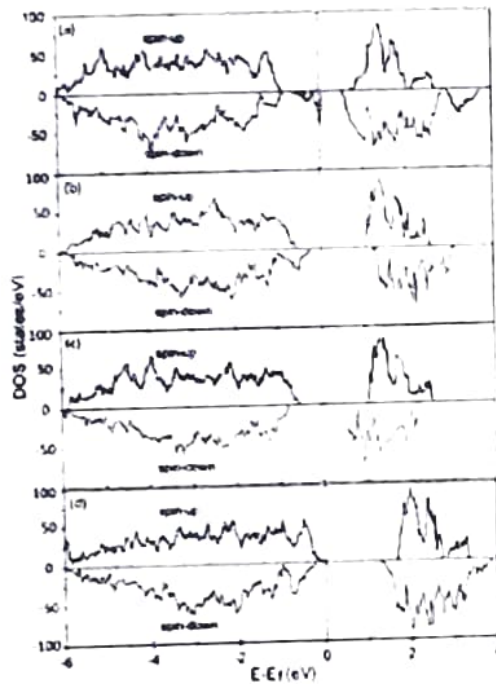


Fig.3. Total DOS of (a) BFFO and (b) BMFO, (c) BMCFO and (d) BCFO. The spin-up DOS is to be positive, while the spin-down part is set to be negative. The spin-up DOS is to be positive, while the spin-down part is set to be negative.

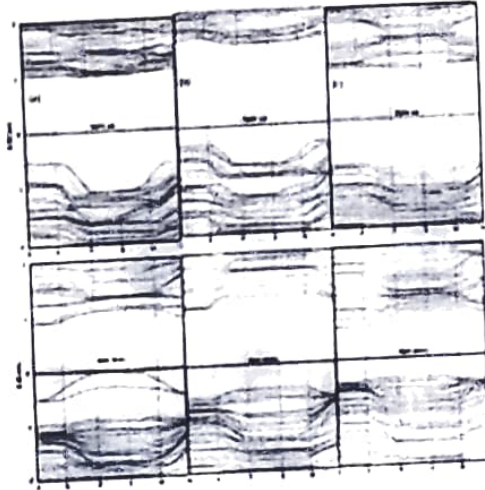


Fig. 4. Energy band structure along the high symmetry directions, G (0 0 0) A (0 0 1/2) H (1/3 1/3 1/2) K (1/31/30) M (1/200). Bands (a) for BFFO,(b) for BMCFO, and (c) for BMFO.

An Analytical Study of Employee Stock Option Scheme of Leading Indian Companies

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Abstract

An Employee Stock Option Plan (ESOP) is a benefit plan for employees which make them owners of stocks in the company. ESOPs have several features which make them unique compared to other employee benefit plans. Most companies, both at home and abroad are utilizing this scheme as an essential tool to reward and retain their employees. Currently, this form of restructuring is most prevalent in IT companies where manpower is the main asset.

ESOP is used largely to motivate employees to put in their best and in turn, help the company enjoy lower employee turnover and retain its talent pool. These two uses probably account for over two-thirds of all ESOPs now in existence, and their numbers are expected to increase with time. This is a new financing technique which is experiencing phenomenal growth in the USA and popular in the emerging markets like India. ESOPs provide a market for the shares of closely held businesses; motivate greater employee productivity, provide tax advantages in the financing of acquisitions, capital improvements, charitable giving and stock purchases from retiring owners.

ESOPs are widely adopted by companies from IT/Software, Banking /Financial Services, Cement, Drugs & Pharmaceuticals, Synthetic Fibers, FMCG and recently E –Business in India. Most companies often use ESOP either to retain talent or plug an employee from its competitors. But ESOP has far more potential than these strategies. ESOPs are relevant where an employee plays an important role in the on-going progressive growth of a

company. (ICICI Bank, Infosys are leading examples recently.)

The main aim of giving such a plan to its employees is to give shares of the company to its employees at a discounted price to the market price at the time of exercise. Many companies (especially in the startup phase) have now started giving Employee Stock Options as this is beneficial to both the employer as well as the employee. The paper highlights the status of ESOP in leading companies of India and what policies they have followed to use it as a tool to attract and retain their employees. It also studies the legal framework governing the ESOPs and various tax issues related to it.

Keywords: ESOP, Employee, Stock, Company, SEBI, Income Tax

Introduction to Esop

ESOP is a generic term for a basket of instruments and incentive schemes that find favour with the new upward mobile salaried class and which are used to motivate, reward, remunerate and hold on to achievers.

The concept was developed in the 1950s by a lawyer and investment banker Louis Kelso, who argued that the capitalist system would be stronger if all workers, not just a few stock holders, could share in owning capital –producing assets. He believed that the capitalist system would function more efficiently if all workers shared in owning capital –producing assets. The concept in USA developed on certain tax

benefits given to the employer for the contribution the employer makes. In UK, it was seen that the shareholders had a direct interest in improved company performance. But only few employees had such direct incentives. So an ESOP scheme encouraged the employees to participate in the share ownership of the company.

India has accepted and adopted ESOP in a manner and to an extent which was unimaginable just 5 years ago. Beginning with the info-tech sector, ESOP has spread across the services and manufacturing sector. Regulatory development had kept pace with the speed of ESOP in India. The legislations related to ESOP are now part of Income Tax and Corporate Laws. SEBI has issued revised guidelines on the issue of ESOP in the light of continuous evolution in India and abroad.

Therefore, taking into consideration about all the three important countries, it can be clearly understood that how the importance of ESOP was felt and what the rules and regulations formed for it.

DEFINITION:

An Employee Stock Option Plan (ESOP) is a benefit plan for employees which make them owners of stocks in the companies.

OBJECTIVE OF ESOP

- To analyze the ESOP policies of leading companies of India.
- To study the legal framework, of ESOP in India.
- To study the tax implication of ESOP in India.

RESEARCH METHODOLOGY

1. Theoretical and exploratory research is used in this study in order to obtain proper knowledge regarding how ESOP practices are implemented by various companies, main focus is on four selected companies.
2. Data collected is mainly secondary in nature. The source of data includes research papers and books dealing with current scenario of esop in India.

LIMITATIONS OF PRESENT STUDY

The study is undertaken by the use of secondary data collected from various sources which may have some deficiencies.

REVIEW OF LITERATURE

SEAN M. ANDERSON AND ANDREW STUMPF MORRISON[2018] in his

“Proposal For A Non-Subsidized, Non-Retirement-Plan, Employee-Owned Investment Vehicle To Replace The Esop”, observed that The rationale for permitting employee ownership vehicles is particularly strong in the case of smaller companies where the founding or sole owner is withdrawing or has died, and our proposal would actually expand the incentives for employee ownership in that context. One advantage of the proposal is that it seems potentially (slightly) more politically viable than simple repeal of ESOPs with no replacement.

FITRI ISMIYANTI, PUTU ANOM MAHADWARTHA, FITRI ISMIYANTI,PUTU ANOM

MAHADWARTHA [2018] *“Does Employee Stock Ownership Plan Matter? An Empirical Note”* observed that the company’s performance is measured by using return on assets, return on equity and Tobin’s Q, while productivity is measured by using sales per employee, cash flow per employee, and total assets turnover. Based on the results, it can be concluded that Employee Stock Ownership Program (ESOP) has a positive and significant impact on productivity.

SHENGXIONG WU AND JOHN HARRIS THORNTON [2018] in his study, *“ESOPs and Firm Risk”*

observed that the relation between the percentage of firm shares controlled by Employee Stock Ownership Plans (ESOPs) and firm risk as measured by stock return volatility. We find a negative relation between percentage ownership and

firm risk. This relation is statistically and economically much stronger in smaller firms. The negative relation between ESOP ownership and risk in smaller firms holds for both systematic and unsystematic risk as well as total risk. These findings are consistent with the view that risk-averse employees with a substantial portion of their wealth in their ESOP discourage firm risk taking.¹

ISALIAH AGUILAR [2016] in his study “ESOP Sustainability and Stock Price the Value of Being Proactive” observed that an ESOP’s long-term sustainability depends on a proactive management team that understands the value of strategic planning. By performing interactive repurchase obligation studies, a company and its advisors can formulate an appropriate strategy to satisfy and fund future stock repurchases. It is important that companies recognize that the relationship between a company’s stock price and the ESOP’s sustainability should not be about limiting repurchase obligations. Companies should understand how their stock price can maximize the period during which the ESOP provides a fair and meaningful benefit to employees.

PAVAK VYASI²[2016] in his study “Evaluation Of Various Methods Of Accounting For Employee Stock Options” observed that an the Evolution of Employee Stock Options, various ways of accounting of stock options granted to employees as remuneration and evaluation of such methods of valuation of such stock options, global perspective thereon and the Indian practice. Employee Stock Options it can be concluded that the fair valuation method offers better accounting treatment thought there exist a scope of development of more accepted method of valuation of models ESOPs, also reporting requirement can be clarified further so as to bring more transparency in financial statements.

TYPES OF ESOP

| | |
|---|--|
| <p>Employee Stock Option Scheme (ESOS)</p> | <p>Under this scheme, the company grants an option to its employees to acquire shares at a future date at a pre-determined price. Eligible employees are free to acquire shares on vesting within the exercise period. Employees are free to dispose of the shares subject to lock-in-period if any. Generally exercise price is lower than the prevalent market price.</p> |
| <p>Employee Stock Purchase Plan (ESPP)</p> | <p>This is generally used in listed companies, wherein the employees are given the right to acquire shares of the company immediately, not at a future date as in ESOS, at a price lower than the prevailing market price. Shares issued by listed companies under ESPP will be subject to lock-in-period, as a result, the employee cannot sell the shares and/or the employee has to continue with the employer for a certain number of years.</p> |
| <p>Share Appreciation Rights (SAR)/ Phantom Shares</p> | <p>Under this scheme, no shares are offered or allotted to the employee. The employee is given the appreciation in the value of shares between two specified dates as an incentive or performance bonus, that is linked to the performance of the company as a whole, as reflected in its share value.</p> |

USES OF ESOP

- TOP MANAGEMENT COMMITMENT
- EMPLOYEE RETENTION
- COMPENSATION

NEED OF ESOP

- To buy the shares of a departing owner.
- To borrow money at a lower after-tax cost.
- To create an additional employee benefit.
- Capital appreciation.
- Incentive based retirement.

- Tax advantage.
- Company reduces its tax liability.

PURPOSE OF ESOP

- To attract, reward, motivate and retain employees.
- To enable employees to acquire beneficial ownership in their company without having to invest.
- To improve the overall performance of the company.
- To enhance job satisfaction of the employee due to ownership incentive.

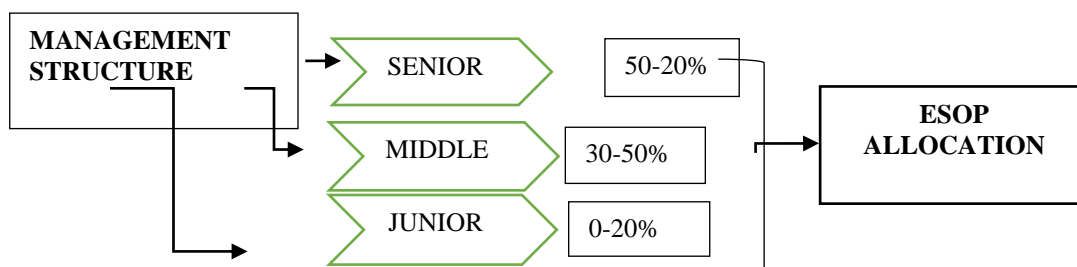
- To help in wealth creation for employees.

CRITERIA TO ISSUE ESOP

- Generally the following criterion are taken into consideration:

- Performance
- Length of Service

WHOM TO GIVE



REGULATORY FRAMEWORK IN INDIA

1. Companies Act, 2013 section 2(37)
2. Rule 12 of the Companies (Share Capital and Debentures) Rules, 2014
3. Securities and Exchange Board of India (Share Based Employee Benefits) Regulations, 2014.
4. Income Tax Act, 1961 •clause (iii) of sub-section (2) of section 17 •Section 49(2B)

Scenario under erstwhile Companies Act, 1956. Provisions related to ESOPs were not documented.) Allotment to the Employees was considered under the ambit of Section 81(1A) related to issuance of shares. There was no other Regulatory framework for unlisted companies. However, Listed Companies were been regulated by SEBI (Employee Stock Option Scheme and Employee Stock Purchase Scheme) Guidelines, 1999

ESOPs- Now covered under the ambit of

Companies Act, 2013 Unlisted Companies, Listed Companies Regulated by Section 62(1)(b) of the Act read with SEBI (ESOS and ESPS) Guidelines, 1999 Regulated by Section 62(1)(b) of the Act read with Rule 12 of Companies (Share Capital and Debentures) Rules, 2014.

Scenario under New Companies Act, 2013.

Highlights of Rule 12 of the Companies (Share

Capital and Debentures) Rules 2014. Approval from Shareholders via Special Resolution Permanent Employees of Company, Holding Company, Subsidiary Company and Associate Company can be covered. All Directors excluding Promoter Directors and Independent Directors can be covered under the ESOP Plan. Freedom to determine Exercise Price. Freedom to determine lock-in period. Separate resolution to be passed in case of grant to employees of holding/subsidiary company. Explanatory statement shall disclose material details as prescribed.

Mandatory Annual disclosures in Directors Report. Minimum period of one year between grant and vesting of options. Options granted cannot be pledged, hypothecated or otherwise transferred. In case of death, all options granted shall vest in the legal heirs. In case of resignation, all unvested options shall lapse. Register to be maintained as per format prescribed by ROC.

TAX TREATMENT FOR EMPLOYEES:—

According to the Finance Bill 2009 - FBT on ESOPs has been abolished. ESOPs have been included in the purview of Perquisites under Section 17 (2). -Where the capital gain arises from the transfer of such shares referred to in sub-clause (vi) of clause (2) of

section 17, the cost of acquisition of such security or shares shall be the fair market value which has been taken into account for the purposes of the said sub-clause”.

TAX TREATMENT FOR THE

COMPANY:—As per SEBI guidelines listed companies have to account for ESOP by treating the same as an expense. As yet there is no clarity whether this expense will be allowed as deductible expense by the Income Tax authorities. SEBI Guidelines Promoters and the part-time directors will not be entitled to receive the securities under the ESOPs even if the promoter(s) is/are employee(s) of the company. The issue of shares/convertible instruments under an ESOP shall not exceed 5% of the paid-up capital of the company in any one year. Clause 4 of the guidelines on preferential issues providing for pricing shall be also applicable to the ESOPs. A company introducing ESOPs shall submit a certificate to the concerned stock exchange at the time of the listing of the securities. If the exercise-price is at a discount to the market price, the discount will be treated as a cost. A minimum lock-in period of 1 year from the date of issue.

CASE STUDIES OF ESOP

1. RELIANCE JIO

COMPANY PROFILE:

Reliance Industries Limited (RIL) is an Indian conglomerate holding company headquartered in Mumbai, Maharashtra, India. Reliance owns businesses across India engaged in energy, petrochemicals, textiles, natural resources, retail, and telecommunications. Reliance is the most profitable company in India, the largest publicly traded company in India by market capitalization, and the second largest company in India as measured by revenue after the government-controlled Indian Oil Corporation. The company is ranked 203th on the Fortune Global 500 list of

the world's biggest corporations as of 2017. It is ranked 8th among the Top 250 Global Energy Companies by Platt's as of 2016.

ESOP POLICY

According to 10th August, 2017 Mukesh Ambani owned Reliance Jio Infocomm had planned to roll out stock options for its employees, which could be a reward for the pace at which subscribers are being added as well as a talent retention and attraction strategy.

All leading Telco's such as Bharti Airtel, Idea Cellular and Vodafone India have employee stock option plans (ESOPs). Mukesh Ambani-owned Reliance Jio Infocomm was planning to roll out stock options for its employees, which could be a reward for the pace at which subscribers are being added as well as a talent retention and attraction strategy.

The biggest challenge for Reliance Jio would be to ensure that subscribers who have signed up do not migrate to rival Telco's, once the free offer ends. And this is where ESOPs will come in handy, especially, in retaining key people tasked with customer retention.

In India, and indeed globally, telecom majors offered ESOPs to senior ranks. That move would help Jio retain employees for a longer period.

In October, Jio had handed out 7-15% increments to junior and middle-level employees and 5-10% to seniors — slightly better than industry average of 7-12.

2. INFOSYS

COMPANY PROFILE:

Infosys is the second-largest Indian IT company of 2017 by revenues and 596th largest public company in world in terms of revenue. On June 30, 2017, its market capitalization was \$34.33 billion. The credit rating of the company is A (rating by Standard &

Poor's). IT industry like Infosys was the first to use this ESOP feature in India. In 1993 – Infosys Introduced Employee Stock Options (ESOP) program. Infosys- pioneered the concept of ESOP in India in 1994.

ESOP POLICY

According to July 15, 2016 Infosys has relaunched its employee stock option plan (ESOP) for junior to middle-level management staff as it looks to rein in rising attrition that stood at 21% in the April-June 2016 quarter . They have rewarded about 7,500 of their employees from junior to middle level management with restricted stock options and they extend it to middle management to senior leaders and title holders subsequently .The company continues to focus on reskilling employees and has also revamped its leadership development programs.

ESOPs allow employees to own equity in the company, which was seen as a morale booster for company.

Infosys added 13,268 (gross) and 3,006 (net) people in the said quarter, taking its headcount to 1,97,050 at the end of June 2016.

That year, Infosys has given wage hikes of 6-12% to its employees in India and about 2% to onsite workers, apart from offering equity to incentivize top performers.

Infosys has rewarded - plumbers, peons, electricians drivers with Infosys stock. Narayana Murthy's Chauffeur Kannan is a millionaire -His portfolio is worth 20 million rupees. Sixty-seven others drivers are among 2000 Infosys millionaires.

3. BHARTI

COMPANY PROFILE:

Bharti Airtel Limited is an Indian global telecommunications services company based in New Delhi, India. It operates in 16 countries across South Asia and Africa. Airtel provides GSM, 3G, 4G LTE and VoLTE mobile services, fixed line broadband and voice services

depending upon the country of operation. Airtel had also rolled out its VoLTE technology across seven telecom circles namely Mumbai, Maharashtra and Goa, Madhya Pradesh, Chhattisgarh, Gujarat, Andhra Pradesh & Telangana, Karnataka, Tamilnadu and Kolkata in India and should roll out the technology in rest circles by end of March 2018. It is the largest mobile network operator in India and the third largest in the world with over 386 million subscribers. Airtel was named India's second most valuable brand in the first ever Brandz ranking by Millward Brown and WPP plc

ESOP POLICY

According to August 10, 2017 Gopal Vittal, MD & CEO, Airtel was selling a part of his ESOPs and BTL offered to buy the same, a Bharti Airtel spokesperson said. Shares of the telecom major ended the day 0.08 per cent up at Rs. 416.40 on the NSE. With a number of start-ups collapsing mid-way, many employees are now preferring bonuses instead of Employee Stock Option Plans (ESOPs) as part of their compensation package, industry experts said they had seen a change where the ESOP component in compensation packages has dropped in start-up companies. This is because they never reach the valuations they initially project and in the past year, a lot of start-ups also had to close businesses. "Since around the end of 2016, they had been witnessing a change from ESOPs to variable bonuses in terms of compensation in these companies," Mohit Bharti, Director of professional recruitment consultancy Michael Page India, told PTI here. This trend is seen across the start-up industry, including e-commerce, food, technology, logistics and financial services, Bharti added. Echoing a similar view, GlobalHunt Managing Director Sunil Goel said, with many start-ups collapsing gradually, employees started relying on cash component.

“Bonuses are generally short-term component, paid either yearly or quarterly, and is becoming an attractive option even if it is one-third or one-fourth of the value as compared to the ESOPs,” they pointed out. Start-ups are now at a consolidation phase with lot of buyouts, mergers and acquisitions, so ESOPs might be more beneficial in the long run. This has been the trend in the last 1-2 years with declining valuations of e-commerce and tech start-up performance.

ESOPs will form a lower component in the compensation of top talent going forward, as earlier top talent would agree to a 30-50 per cent salary cut and opt for ESOPs, but not these days.

DDI India Member, Key Leadership Team, Amogh Deshmukh, said industries like pharmaceuticals, banking and IT companies are the few who offered ESOPs to employees.

Telecom major Bharti group began its ESOP journey in 2001. In 2005 - Everybody was covered and ESOPs were linked to the employee's loyalty and performance. In 2006, it offered performance share plan to senior executives. But by 2008 – They realized 2005 wide-base ESOP strategy wasn't working as the younger staff preferred deferred bonus plan or cash. Now the company has restricted the plan to the middle management and above.

4. **AXIS BANK**

Company Profile

Axis Bank Ltd is the third largest of the private-sector banks in India offering a comprehensive suite of financial products. The bank has its head office in Mumbai and Registered office in Ahmedabad. It has 3304 branches, 14,003 ATMs, and nine international offices. The bank employs over 55,000 people and had a market capitalization of ₹1.28 trillion (US\$20 billion) (as on March 31, 2017). It offers the entire spectrum of financial services large and mid-size corporates, SME, and retail businesses.

ESOP POLICY

Axis Bank UTI Bank, which changed its name to Axis Bank in 2007, was one of the earliest in the banking sector to experiment with employee stock options. It launched a scheme as early as 2001, starting with the unreserved objective of covering all employees, based on performance. Over the years, the scheme has undergone changes, teaching the bank an important lesson: Not everybody in the organization wants ESOPs and even for those who do, the current market price is an important consideration. When Axis Bank first designed the ESOP scheme, there was much debate about how broad-based it should be. The bank chose to include all employees except the poorest performers. In surveys, they were below their competitors on cash performance bonuses. Also, they did not have an aggressive variable pay plan. So, they decided ESOPs would be a good way to compensate employees, even at lower levels. At first, employees didn't take well to the new plan. Only when the stock price started climbing, they saw the point and embraced the scheme. The first major change came in 2004. Axis Bank had been accounting the difference between the price at which options were granted and the prevailing market price as an expenditure on the books. They noticed they were taking a hit. So, the company changed the formula for pricing the options. It switched from the 52-week average to the previous day's close as the basis for the grant price. This helped the company eliminate its accounting expenditure, and also wiped out the arbitrage the employees enjoyed between the two prices. The next year dealt a bigger blow to ESOPs. The government brought them under the ambit of fringe benefit tax (FBT). Any difference between the fair market value and the vesting price came to be taxed at 33.99 percent. The industry was enraged at what it saw as an unfair levy, but the government did not budge. At Axis Bank, the management decided to pass on the FBT burden to employees, taking advantage of a clause in the tax laws. This and the

new pricing formula had a telling impact on the popularity of ESOPs.

Employees have exercised far fewer options from 2005 to the present than they did in the first four years of the plan. In April 2004, more than three million options were exercised, up from one million at the start in April 2001. However, in April 2007, that number had dropped to less than 3 lakhs. The amount of wealth created had exceeded Rs. 100 core in April 2004, but had dropped to just Rs. 10 core in the same month three years later. The year 2008 saw a big shift in Axis Banks ESOP strategy. In April, the company decided to narrow the scope of the plan to only employees in the middle management and above. Staff in the lower rungs was excluded. There were two reasons for this. Previously, the company was growing at an exponential rate, but growth slowed down and they could not give options to everyone anymore. Axis is now toying with ideas such as phantom stocks and restricted stock units. These options may result in cash outflow. They want wealth creation without impacting the bank. But in these conditions, they may be forced to explore options for better compensation of employees.

CONCLUSION

The wealth creation potential of ESOPs has not been fully explored in India. ESOPs are not considered part of compensation in many Indian organizations. In some cases we saw that Companies are offering a bonus in lieu of ESOPs. But bonus option cannot replace ESOPs as they bring in an element of ownership, which cannot be created by bonuses. However, in the current scenario, instead of ESOPs, many organizations are looking at multiple avenues to develop and retain their leaders. Some of them include business school degrees, certifications, providing a career path and purposeful development. It was also noticed that bonuses are restricted to top and middle management employees and lower level employees preferred cash bonus more than Esop. The organization looks at the ESOP as a wealth creation exercise but the employees don't.

However it is an advantage for both employee and company. It is used by the companies to reward, retain, attract talent, create a sense of ownership in the company and a retirement benefit scheme. Hence, it improves the corporate performance as a whole.

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AN ANALYTICAL STUDY OF ROLE OF FINANCIAL LITERACY IN RURAL DEVELOPMENT WITH SPECIAL REFERENCE TO KALMESHWAR DISTRICT IN MAHARASHTRA STATE

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ABSTRACT

India has around 6 lakh villages, and 7933 towns. The total rural population of India accounts for almost 70 % of the total population of the country. Therefore, a huge part of India lives in its villages. This population contributes for more than 50% of the nation's total GDP. Therefore, owing to its size, its ability to supply raw materials, its GDP contribution, its literacy rate and rate of computer literacy, huge developmental measures are to be focused on the rural India's population for the overall development of the nation. Literacy cannot always be measured in terms of educational qualification, but even the fact that the people have a basic understanding of managing their needs, expenses and most importantly 'money'. Many people are seen to have no knowledge of managing their money, where to invest and many such problems. This results in them being deceived. It even hampers their development. Financial literacy is nothing but the knowledge about finance. Financial literacy involves imparting knowledge about the risk and return of financial products to the users and providers of these products. The paper highlights the role and contribution of financial literacy in the development of rural areas and analyzes the level of financial literacy in a specific area and the impact it has had on the development of that specific area.

KEYWORDS

financial literacy, rural development, financial products, financial knowledge.

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INTRODUCTION

Since rural economy in India faces problems of poverty, unemployment, poor and inadequate infrastructure, lack of basic minimum facilities, etc., rural development is a process which aims at improving the well being and standard of living of people living in the rural areas. In simple words, it can be said that rural development is a process of bringing a change in the rural areas from the traditional way of living to a progressive one. The Ministry of Rural Development in India is the apex body for formulating policies, regulations and acts pertaining to the development of the rural sector. Agriculture, handicrafts, fisheries, poultry and dairy are the primary contributors to the rural business and economy.

MEANING OF FINANCIAL LITERACY

Financial Literacy is the possession of the set of skills and knowledge that allows an individual to make informed and effective decisions with all of their financial resources. Financial Literacy is often ignored, underrated, but is an essential life skill. It is the result of an individual's capacity to combine the financial knowledge, skills, attitude and behavior necessary to make sound financial decisions that provide short term and long term benefits. These financial decisions vary based on personal circumstances, which change along the different stages of life. Yet, when the financial decisions are made appropriately from an informed perspective, these decisions enable one to improve their financial and personal wellbeing.

IMPORTANCE OF FINANCIAL LITERACY

Financial Literacy is an essential ingredient in every individual's life-skills toolkit. The capacity to assess and understand what will have positive and negative financial outcomes in a fast-paced consumer society is crucial. Ensuring that you have the know-how to manage your money and financial risks effectively will not only help you to avoid financial pitfalls, but also will give you a solid foundation which will help making confident choices about how to live your life. Financial Literacy has secured a vital role in rural development. Development is only possible if the population is aware of the financial aspects and financial knowledge. With proper financial literacy, it becomes possible for the individuals to know how to use the money that is available with them. Not only the supply of financial products is important for the development, but the demand of financial products also plays a crucial role. Thus, financial literacy is the base for rural development.

OBJECTIVES

1. To study the present level of financial literacy in Rural India with special reference to Kalmeshwar District.
2. To analyze the initiatives undertaken by the government towards financial literacy in Rural India.
3. To determine the role of financial literacy in rural development and the impact of change in financial literacy levels on rural development.
4. To suggest some measures for improving the level of financial literacy in rural areas.

RESEARCH METHODOLOGY

To study the level of Financial Literacy in Kalmeshwar, a survey was conducted among 100 citizens of different villages under Kalmeshwar. The survey was conducted amongst respondents of various age groups, Professions and income levels. To collect the primary data a small schedule containing 20 questions was designed and data was collected. The questionnaire consisted of basic financial questions about their knowledge of the financial services and products and their preferences for saving their income, if the financial services were available to them. For this purpose, researchers have applied convenience sampling method.

LIMITATIONS OF THE STUDY

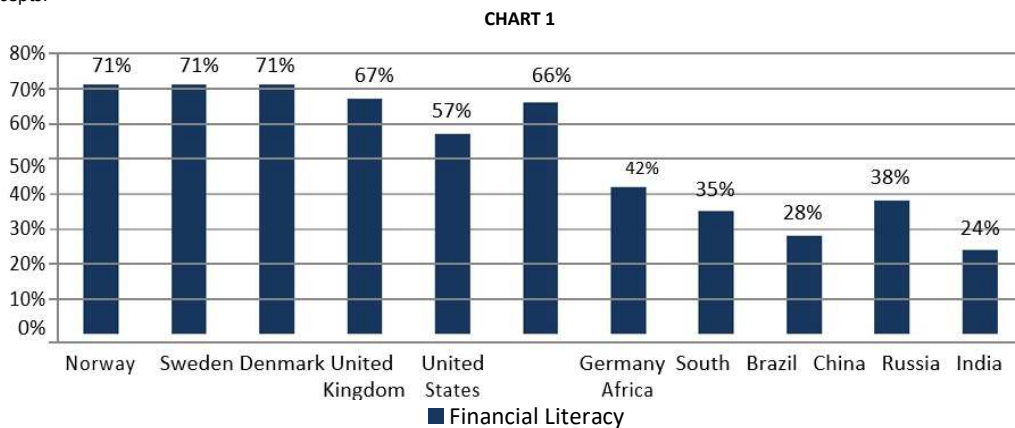
1. The study is limited to the area of Kalmeshwar district of Maharashtra.
2. The sample size is limited to 100 respondents.
3. The literacy level of respondents may not be high resulting into unawareness about government policies and agendas.

REVIEW OF LITERATURE

- Financial Literacy in India by Dr. J. Gajendra Naidu. (Source- International Journal of Research in Business Studies and Management, Volume 4, 2017) It was found that even though many initiatives regarding financial literacy improvement were taken by the RBI, the level of financial literacy was still low. New initiatives should be taken to mend the same.
- Assessment of Financial Literacy in rural areas of Sonapat district of Haryana by Madhulata. (Source- International Journal of Research in Finance and Marketing, November, 2016)
The overall literacy in the area was found to be very low and many respondents were not even able to calculate simple interest.
- Analysis of the Level of Financial Literacy and Financial Inclusion among Rural Households in Krishna District: Andhra Pradesh by Dr. P. Raja Babu. (Source- IOSR Journal of Economics and Finance (IOSR-JEF), July-August, 2015)
It was found that Financial Literacy enhances peoples’ skills and abilities to make more informed economic choices.
- Financial Literacy: The Indian Story by Lavanya Rekha Bahadur. (Source- World Journal of Social Sciences, September, 2015)
Stated that financial literacy is the way to a strong financial system. Financial literacy and financial education should be given special attention by the educators, government agencies, NGOs and policy makers at national level.
- Relationship between Financial Literacy and Investment behavior of Salaried Individuals by Bhushan Puneet. (Source- Journal of Business Management & Social Sciences Research, 2014)
It concluded that the individuals with higher financial literacy have a higher awareness about the available financial products.

DATA ANALYSIS AND INTERPRETATION

Considering the level of financial literacy across the globe, the figure below shows that financial literacy stands the highest in Norway, Sweden and Denmark i.e. 71 percent. In BRICS (Brazil, Russia, India, China and South Africa) countries, the level of financial literacy is as low as 28 percent. Among the BRICS countries, India has the lowest rate of financial literacy (24 percent). According to the survey conducted by Standards & Poor’s, over 76 percent Indian adults lack basic financial literacy and they don’t understand the most basic and key financial concepts.



(Source: S&P Global Financial Literacy Survey)

As per a global survey by Standard & Poor’s Financial Services LLC (S&P) only 25 per cent of adults or less are financially literate in South Asian countries. For an average Indian, financial literacy is yet to become a priority. India is home to 17.5 per cent of the world’s population and nearly 76 per cent of its adult population does not understand even the basic financial concepts. The survey confirms that financial literacy in India has consistently been poor compared to the rest of the world. It can be detrimental to India’s ambition of becoming an economic super power in the coming years. Moreover, around 70% of the Indian population lives in rural areas where the facilities are poor as compared to those in the urban areas. The literacy rate in these rural areas is even lower. This acts as a barrier when it comes to the overall development of the rural areas.

In accordance with the Data compiled from the National Centre for Financial Education Report, 2015 Kerala being the highly literate state in India has the second highest level of financial literacy i.e. 36 percent. States like Goa, Manipur and Gujarat stands the highest level of financial literacy at 50 percent, 36 percent, 33 percent respectively, which is still considered very low. Whereas states like Chhattisgarh, Mizoram, Bihar, Nagaland, Sikkim, Odisha, Arunachal Pradesh, Uttar Pradesh, Punjab, Jharkhand, Himachal Pradesh and Maharashtra have the lowest level of financial literacy i.e. below 20 percent.

Similarly, in case of Union territories, Chandigarh has the highest level of financial literacy with 38 percent followed by Delhi, Dadra and Nagar Haveli with 32 percent and 31 percent respectively, whereas Andaman and Nicobar Islands shows the lowest level of financial literacy.

A study was conducted in Kalmeshwar Taluka in Maharashtra state. Kalmeshwar is a Taluka in Nagpur District of Maharashtra State, India. Kalmeshwar consist of 100 Villages and 52 Panchayats. Dorli (bhodji) is the smallest Village and Bramhni is the biggest Village. In terms of development, Kalmeshwar has seen tremendous growth. Starting from the earlier days where Kalmeshwar lacked some of the basic facilities, now it is equipped even with the advanced ones. Kalmeshwar has not only seen emerging of new schools, colleges, hospitals and banking facilities, but also a multiplex is being constructed which is a sign of huge development.

As per census 2011, the population of Kalmeshwar is 19578 with around 97 villages coming under the Kalmeshwar administrative division.

Of the total respondents in the survey, 54% were male and 46% were female. The age groups were evenly distributed between the ages of 26 and 65 with a slightly higher concentration of people aged 36 to 55. Women were more represented in the age group between 18 and 45 and men were more represented in the age group above 46 years of age.

The following table shows the association between gender and basic financial literacy:

TABLE 1

| | | Basic Financial Literacy | | Total |
|--------|--------|--------------------------|----------|-------|
| | | Illiterate | Literate | |
| Gender | Male | 16 | 38 | 54 |
| | Female | 27 | 19 | 46 |
| Total | | 43 | 57 | 100 |

(Source- Primary Data)

In the data collection process, it was seen that almost every individual had knowledge about the basic financial products like bank accounts, loans, etc. But it was seen that many were not aware about the investment methods, some better loan opportunities, etc. This scenario was more common among the females. Males comparatively had a better understanding of the financial products and services. Also, one fact observed was that some of the respondents preferred keeping cash at home inspite of having bank accounts. Similarly, many were unaware about the rate of interest on their savings bank accounts and most of them were females.

The following table shows the association between age and basic financial literacy:

TABLE 2

| | | Basic Financial Literacy | | Total |
|-------|------------|--------------------------|----------|-------|
| | | Illiterate | Literate | |
| Age | 18-35 | 9 | 25 | 34 |
| | 36-50 | 14 | 21 | 35 |
| | 51 & Above | 20 | 11 | 31 |
| Total | | 43 | 57 | 100 |

(Source- Primary Data)

It was seen that the literacy among the age group 18-35 was the highest. Almost everyone had a bank account and they knew how to operate it. But some had a little less awareness about the rate of interest and some of the investment methods and options. Considering the age group 36-50, it was seen that they had financial literacy but it was not good among females and some had their literacy level restricted to bank accounts. The age group of 51 and above had the least financial literacy and it was poor among females.

The following table shows the association between profession and basic financial literacy:

TABLE 3

| | | Basic Financial Literacy | | Total |
|----------------|------------|--------------------------|----------|-------|
| | | Illiterate | Literate | |
| Nature of Work | Unemployed | 9 | 8 | 17 |
| | Farmer | 17 | 20 | 37 |
| | Service | 5 | 12 | 17 |
| | Business | 7 | 11 | 18 |
| | Retired | 5 | 6 | 11 |
| Total | | 43 | 57 | 100 |

(Source- Primary Data)

In the data collection process, it was found that farmers were comparatively less financially literate and the same with those who were unemployed. In the areas which were less developed, it was seen that some of the farmers preferred keeping cash at home inspite of having bank accounts. The literacy among those in service and business was good. But they lacked knowledge about investment opportunities and some other factors.

The above survey is a perfect measure to say that the villages in Kalmeshwar have shown a good development and it can be said that the major credit for this development goes to the increase in financial literacy in the villages. Kalmeshwar has always been receptive to the changes with the advancement in technology and modernization. It is seen that the people there in the villages indulge in various drives undertaken by the government or even the private organizations for financial literacy. Thus, Kalmeshwar has seen tremendous growth. From the above, it can be said that the increase in financial literacy among the individuals has played a vital role in the development of the area.

MAJOR FINDINGS AND CONCLUSIONS

- From the analysis of the data above and various inferences, it can be concluded that financial literacy has a role in rural development. It can be seen that when the financial literacy in the rural areas was very low, the rate of development was also low. Whereas, as in case of Kalmeshwar, the rate of financial literacy is rising and so the rate of development of the area is also good.
- Financial Literacy has association with gender, income, nature of work, level of education. It was seen that men are more financially literate as compared to the females in that area. Similarly, it was seen that those who were engaged in service and business were comparatively more financially literate than those engaged in farming and even those who were unemployed.
- The level of financial literacy was a bit related to the level of education of the respondents. The respondents who had a higher level of education had a good basic understanding of financial literacy.

SUGGESTIONS

- It is suggested that schools should consider including financial literacy in their curriculum and also encourage their students to participate in financial literacy contests. To seep the efforts to the grass root level, the delivery channels for financial education can be summed through school curriculum, social marketing, resource persons, adult education, self-help groups, microfinance institutes, helpline and other channels.
- Government should focus more on these rural areas as the basic financial literacy is not achieved by many of them. More of campaigns are required, financial educations weeks or months to be organized.
- The plans and policies formulated by the government should be well implemented as and when decided.
- Measures should target the family as a whole and include elements which are targeted at women specifically. As women are in a disadvantaged position in several of the above mentioned points, measures to improve financial literacy and to raise awareness should always seek to reach them.

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ANNEXURE

QUESTIONNAIRE

Please fill the details given below. The data collected will be used purely for academic purpose. (Tick wherever applicable)

1. Name of the Respondent:
2. Age:
18-35 36-50 50+
3. Gender:
Male Female
4. Marital Status:
Married Unmarried
5. What level of education you have completed?
None Primary Lower Secondary
Higher Secondary Graduation Informal
6. Occupation?
Unemployed Farmer Business
Service Retired
7. How many people live in your household including yourself?
8. How many people in your household are earning?
9. What is your annual income? (Optional)
10. What is your most important form of saving?
Keep it Cash Save it in Bank Others (Please specify)
11. Do you have a bank account? Which?
Yes No don't know
12. Do you know the interest rate in your bank account?
Yes No
13. Do you keep a note of your income and/or expenditures? (Tick the appropriate code)
a) No, I am not able to keep track of my expenditures and income
b) Yes, I have a broad idea of my expenditures and earnings
c) Yes, I keep a written record of important expenses and earnings
14. Do you maintain Fixed Deposits or Recurring Deposits?
Yes No Don't Know
15. What is the safest place to keep your money?
Bank Microfinance Institution Back at Home
Don't know
16. Do you have information about the schemes for financing or loans?
Yes No Don't Know
17. Do you have an Insurance Policy?
Yes No Don't Know
18. Has any financial literacy campaign organized in your village?
Yes No Don't Know
19. Have you attended the Financial Literacy Program?
Yes No Don't Know
20. Are you aware of SHG's? Are they approachable?
Yes No Don't Know

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In this age of Commerce, Economics, Computer, I.T. & Management and cut throat competition, a group of intellectuals felt the need to have some platform, where young and budding managers and academicians could express their views and discuss the problems among their peers. This journal was conceived with this noble intention in view. This journal has been introduced to give an opportunity for expressing refined and innovative ideas in this field. It is our humble endeavour to provide a springboard to the upcoming specialists and give a chance to know about the latest in the sphere of research and knowledge. We have taken a small step and we hope that with the active co-operation of like-minded scholars, we shall be able to serve the society with our humble efforts.

Our Other Journals





AN ANALYTICAL STUDY OF GREEN BUSINESS PRACTICES IN INDIA WITH SPECIFIC REFERENCE TO SELECTED INDIAN COMPANIES.

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Abstract

Sustainable business, or a green business, is an enterprise that has minimal negative impact on the global or local environment, community, society, or economy—a business that strives to meet the triple bottom line. The notion of “green business” emerged at the end of the 20th century in the wake of the ever-increasing public concern about the sustainability of economic development. The latter, in turn, was roused up by the growing awareness of environmental issues such as the accelerating depletion of natural resources and the deterioration of environmental quality. While the origins of the modern “green movements” can be traced down to the middle of the 1960s, it took almost 20 years for business to adapt to the “greening” trends and adopt them into its ideology and practice, coining the term “green business” for that purpose. However, even today, the substance of the green business concept is rather ambiguous as demonstrated by the variety of its definitions that could be found in different sources. Green business practices are still far from being universally embraced and applied by business entities around the world, with perceptible differences of business penetration by the “green” ideas in various countries. This is due to several reasons, one of them being the fact that the “greening of business” is still largely perceived as an extra burden (in terms of cost increase or revenue loss), and the other reason being related to the national specifics in terms of cultural, political, and economic differences. The paper highlights the relevance of green business practices in current scenario and analyzes how these practices are implemented by selected reputed companies in India and what impact it has on their performance and efficiency.

Keywords: Green Business, sustainability, environmental quality, greening of business.



Introduction

Often, sustainable businesses have progressive environmental and human rights policies. In general, business is described as green if it matches the following four criteria:

- It incorporates principles of sustainability into each of its business decisions.
- It supplies environmentally friendly products or services that replace demand for non green products and/or services.
- It is greener than traditional competition.
- It has made an enduring commitment to environmental principles in its business operations.

A sustainable business is any organization that participates in environmentally friendly or green activities to ensure that all processes, products, and manufacturing activities adequately address current environmental concerns while maintaining a profit. In other words, it is a business that “meets the needs of the present [world] without compromising the ability of future generations to meet their own needs.” It is the process of assessing how to design products that will take advantage of the current environmental situation and how well a company’s products perform with renewable resources.

Need of Green Business

Going green may seem to be the latest trend, but it is a trend with a variety of benefits for business owners. Applying green processes to the workplace creates a healthy environment for employees, reduces unnecessary waste and recognizes the role that businesses play in leading the way for social change. For the business that is thinking about going green, a variety of reasons exist to take the plunge.

- ✓ **Reduced Waste:** Going green can improve the overall efficiency of a business. Reducing unnecessary waste can trim operating costs for the business.
- ✓ **Improved Workplace:** Providing green options within a company can offer overall workplace improvements. Green cleaning supplies can help employees who suffer from respiratory and other health-related conditions, because green products contain fewer



chemicals—such as sodium hypochlorite and nitrobenzene—that are connected to physical problems.

- ✓ **Public Response:** While public response alone is not necessarily the best motivation for going green, it might be a good side effect. With green initiatives increasing in popularity, economic studies have shown that companies utilizing green technology and selling green products are seeing an increase in profits.

Importance of Green Business

Green businesses adopt principles, policies and practices that improve the quality of life for their customers, employees, communities, and the planet. The members of the Green Business Network are changing the way India does business.

- ✓ **Green businesses are socially and environmentally responsible:** Green companies adopt principles and practices that protect people and the planet. They challenge themselves to bring the goals of social and economic justice, environmental sustainability, as well as community health and development, into all of their activities -from production and supply chain management to employee relations and customer service.
- ✓ **Green businesses care for their workers:** Green businesses ensure they don't use sweatshop or child labor. Everyone who works directly for them or their suppliers earns a living wage and works in healthy conditions. They create jobs that empower workers and honor their humanity.
- ✓ **Green businesses protect their customers and clients:** Green businesses ensure that they use the safest ingredients, to keep their customers and clients and their families healthy. They also provide green living alternatives to improve quality of life, with products and services that help in areas like affordable housing, sustainable agriculture, education, clean energy and efficiency, fair trade, healthy air, clean water, and more. And they reduce, reuse and recycle, setting a good example.
- ✓ **Green businesses improve their communities:** Along with ensuring their facilities aren't polluting their local communities, many green businesses take steps to make the places that they call home better. Green businesses often spring up in marginalized communities— inner cities, rural and indigenous communities.



- ✓ **Sustainability:** The larger value of going green relates to maintaining the health of the environment. Utilizing sustainable methods can prevent the waste of natural resources, helping reduce the risk of depletion on the long run.

OBJECTIVES

1. To study the importance and need of Green business practices in India.
2. The paper studies and compares various Indian companies where green business practices are applied and performance of various companies on the scale of efficiency in relation with green business practices.

RESEARCH METHODOLOGY

1. Theoretical and exploratory research is used in this study in order to obtain proper knowledge regarding how green business practices are implemented by various companies, main focus is on five selected companies.
2. Data collected is mainly secondary in nature. The source of data for this thesis include the literature published online by various companies websites, various acts, newspapers, journals including research papers and books dealing with current scenario of green business practices in India.

LIMITATIONS

The study is undertaken by the use of secondary data collected from various sources which may have some deficiencies.

REVIEW OF LITERATURE

In context of green business, there are various guidelines and strategies available for corporate has been studied and analyzed in restricted sense by many Scholars, Researchers, Business person and Organizations etc.

Many initiatives are taken by Government of India and Systematic reviews of such available literature are stated as under:



John R. Rathgeber (2007) has said in his research that many business leaders are embracing Corporate Sustainability and Green Business practices as a way to improve their operations and enhance their competitiveness.

According to Justin Victor (2008), in his research one half of HR professionals indicated that their organizations have a formal or informal environmental responsibility policy. Top Three green practices reported by HR professionals were encouraging employees to work more environment friendly, offering recycling programs and donating / discounting used furniture supplies

According to José F. Molina Azorín, Enrique Claver Cortés, Maria D. López Gamero, Juan J. Tari(2009) in their research paper “Green management and financial performance”: findings are derived from an exhaustive literature review of quantitative studies that have studied the green management-financial performance link. In addition, ideas for improving future research in this field are provided

Chaturvedi (2010) reviewed that increasing green awareness among Indian hotel companies indicates that going green not only enhances the brand worth but also underlines the core values. Since following green practices does not need much maintenance, hotels reduce their expenses and improve the image of the hotel. Expenses incurred on diesel and energy can be reduced with the help of materials that can be recycled and drip irrigation system.

According to Douglas W.S. Renwick(2012) in his research paper “Green Human Resource Management: A Review and Research Agenda” makes a case for the integration of the largely separate literatures of environmental management (EM) and human resource management (HRM) research. The paper categorizes the existing literature on the basis of Ability–Motivation–Opportunity (AMO) theory, revealing the role that Green human resource management (GHRM) processes play in people-management practice.



GREEN BUSINESS STRATEGIES

Green business strategies can aim to take advantage of sustainable revenue opportunities, while protecting the value of business against increasing energy costs, the costs of meeting regulatory requirements, changes in the way customers perceive brands and products, and the volatile price of resources.

Not all eco-strategies can be incorporated into a company's Eco-portfolio immediately. The widely practiced strategies include: Innovation, Collaboration, Process Improvement and Sustainability reporting.

Here we will study and analyze Green Business practices of companies such as:

1. TCS
2. ONGC
3. ITC
4. WIPRO
5. MRF

Companies That Practices Green Business in INDIA

1. Tata Consultancy Services:

TCS has a globally recognized Sustainability practice and has already topped the Newsweek's top World's Greenest Company title. It also has a global green score of 80.4% and this has mainly happened due their initiative of creating technology for agricultural and community benefits. Following are the measures taken by TCS:

- i. ***Conservation of energy, technology absorption, foreign exchange earnings, and outgo***
Conservation of energy: The Company is committed to reduce its energy consumption through four key levers: green buildings, efficient operations, green IT and the use of renewable energy. Green buildings are energy efficient by design and hence help us reduce energy footprint. Over half of the Company's real estate portfolio is green buildings. Some 80% of all the TCS-owned offices are LEED/IGBC certified. The Company's Remote



Energy Monitoring and Control initiative has enabled real-time energy monitoring and performance optimization, including that of data centers. All the owned campuses have onsite solar photo voltaic power generation. The Company has significantly increased its use of renewable power year on year.

- ii. **Energy Conservation:** As part of their remote energy monitoring and control initiative, TCS has completely digitized the energy monitoring process for over 135 locations in India and 23 key data centers. A centralized Resource Operations Center at Kochi helps monitor and streamline energy consumption with real-time analysis of usage patterns.
- iii. **Water Conservation:** All of their facilities are built for water conservation to ensure 100% treatment of sewage and rainwater harvesting. Implementation of roof top collection systems, storage tanks, and recharge trenches and pits has led to a 25% increase in the rainwater harvesting potential at TCS sites in FY17 over the previous year.
- iv. **Waste Reduction and Reuse:** The emphasis is on reducing municipal solid waste, as well as electronic and electrical waste. TCS' waste management practices (Exhibit 3) seek to ensure that less than 5% waste is sent to landfills by 2020 by ensuring segregation at source, reuse, and recycle wherever possible.

2. Oil and Natural Gas Company:

ONGC, India's largest oil producer is all set to change the way with the invention of green crematoriums, that would serve as a perfect replacement for the funeral pyres that emit so much smoke and uses up excess oxygen. Towards making ONGC a 'Carbon-Neutral' Company, several initiatives such as 'Paperless Office' and optimizing water foot print in operations have been rolled out. The Company has 15 registered CDM projects with UNFCCC with potential to yield about 2.1 million Certified Emission Reductions (CER) annually. In terms of the share of green energy forms in the energy portfolio, the Company presently has two operational wind farms with a combined capacity of 153 MW. ONGC is among few Indian corporate to feature in the Newsweek Global 500 Green Energy Rankings. The company has taken following initiatives:



i. Measures taken for Carbon Management & Sustainable Development:

The Company's hydrocarbon exploration & production (E&P) operations are being carried out in varied climate and environment are as ranging from deserts to coastal areas, hilly terrains to forest areas, shallow water to deep waters and also in ultra-deep water areas. The Company adopted Environmental Policy in Commissions meeting no 2(1)/9 dated 16th May, 1983 and declared Environment Protection as one of the prime objectives in July, 1988. A policy was framed to conduct Environment Audits.

ii. Measures taken for Mitigating Air Pollution:

There is no major risk for air pollution in process industry. The source of air emissions are flaring of natural gas, exhaust from running of DG sets, use of heavy equipments, construction activities, movement of vehicles etc. In order to reduce the gas flaring, generators have been installed in the field to utilize low pressure gas for generation of electricity for internal consumption. The measures undertaken are:

- Gaseous Emissions Control through Box Flare
- Smokeless Flaring
- Real Time Monitoring Stations (RTMS)
- Turbines and DG Sets. Vapour Recovery System
- De-sulphurization of Sour Gas

iii. Measures taken for Mitigating Water Pollution and its Management Conservation of

fresh water: Towards conservation of an important natural resource 'fresh water' through its replenishment in the aquifer to prevent its further depletion and to sustain ground water table. Six wells to collect the discharge water at different locations of the KDMIPE campus are active. The measures undertaken are:

- Waste Water Management
- Water Conservation through Rain Water Harvesting
- Effluent Treatment Plants.
- Oil Spill Management - Response and Combat



- iv. **Measures taken for Soil Pollution control: Bio-remediation:** The oil is recovered from the oily waste produced during drilling operation as far as possible. The remaining waste and oil contaminated soil is subjected to Bioremediation where the oil content is reduced to less than 1% TPH
- v. **Measures taken for Noise Pollution Control:** Following mitigation measures to control noise impacts:
 - Regular noise monitoring is done to measure and monitor sound levels around equipments and machineries and high noise areas are demarcated.
 - Acoustic enclosures are provided around gen sets to reduce noise pollution.
 - Personnel Protective Equipment (PPE) like ear muff/plugs is provided to personnel working in noise prone areas.

3. ITC:

ITC has adopted a Low Carbon Growth Path and a Cleaner Environment Approach and has already introduced ozone treated elemental chlorine free bleaching technology that has improved the lives of millions worldwide. ITC is today a global exemplar in sustainability. ITC's businesses have generated sustainable livelihoods for 6 million people, many of whom represent the weakest in society. It is the only enterprise in the world to be carbon positive (12 years), water positive (15 years), and solid waste recycling positive (10 years). Over 48% of the total energy requirement of ITC is met from renewable sources. ITC has pioneered the green building movement in India, establishing 22 green buildings. All its premium luxury hotels have the unique distinction of being LEED® Platinum certified. ITC's Afforestation Programme provides marginal and tribal households with a commercially viable land use option for their low productivity lands by assisting them to convert these into pulpwood plantations. The renewable plantations cultivated as part of this initiative enable ITC to offer the greenest paper and paperboards products manifest in stationery brands such as Classmate and Paperkraft. These plantations also provide a competitive source of wood pulp to ITC's Paperboards and Specialty Paper Business. Spearheading a journey of growth that has led the Harvard Business Review to rank its CEO Mr. Sanjiv Puri as the 7th Best Performing CEO in the world, his stewardship



has guided ITC to become India's foremost FMCG marketer, the country's largest and greenest Paperboards and Packaging Business, a globally acknowledged pioneer in farmer empowerment through its wide-reaching Agri Business, the second largest Hotel Chain in India and a trailblazer in 'green hoteling'. The Company's wholly owned subsidiary, ITC Infotech India Limited, is also a player of promise in the Information Technology sector. Today, ITC is a global exemplar in sustainability and is the only Company in the world of comparable dimensions to be 'carbon positive', 'water positive' and 'solid waste recycling positive' for over a decade. The Company's businesses generate livelihoods for around 6 million people, many of whom represent the poorest in Rural India. The pioneering farmer empowerment initiative, ITC e-Choupal, is today the world's largest rural digital infrastructure and is a case study at the Harvard Business School besides receiving several global awards.

4. Wipro:

Wipro, has not only helped in the creation of technology that helps in saving energy and preventing wastes, but its corporate headquarters in Pune is the most eco friendly building in this sector all over India. Ecological sustainability is a cornerstone of their charter on natural capital stewardship. Our approach is built on the pillars of Energy efficiency and Green House Gases (GHG) mitigation, Water efficiency and Responsible Water management, Pollution and Waste management, and Biodiversity. The increasing centrality of issues like climate change and water stress in the last few years has led organizations to look beyond their boundaries. While internal business drivers like resource efficiency, waste management and pollution mitigation have been the primary levers of any corporate environmental program, organizations have come to realize that in order to make a real impact at a larger, systemic level, one can no longer ignore the externalized costs of ecological damage. At Wipro, our community programs on water and waste are two examples of such interventions.

Scope of Reporting India: 55 locations (includes 3 operational data centers) representing 79% of their workforce. The majority of operations are based out of 23 owned locations.



Overseas: 163 locations, which include 7 customer data centers. A majority of the office locations overseas are leased. They have been following the guidelines of the ISO 14001 framework for more than a decade now as one of the cornerstones of our Environmental Management System (EMS). 18 of their campus sites in India and 2 in Australia are certified to ISO 14001:2004 standard. They take the following measures for it:

- **Energy efficiency & GHG mitigation**

They undertook a target setting exercise to propose targets. They used the science based target setting framework from WRI (World Resource Institute) that tries to align itself with the 2 degree imperative i.e. global emissions by 2050 to be 20% of 1990 levels so as to stay within the threshold of 2 degree rise in average surface temperature. They have adopted targets for 2025 and 2030 also and these will be revisited at the next target review exercise in 2020.

- **Energy Intensity:** EPI for office spaces, measured in terms of energy per unit area is flat at 2015 figures of 195 units per sq. meter per annum. While absolute India offices energy consumption has decreased by 4% due to energy efficiency, operating area shows a sharper reduction of 6.3% as of March 2017 due to consolidation of operations.
- **Emissions Intensity:** Their India office space emissions intensity (Scope 1 and Scope 2) is at 128 Kg Co2 eq. per Sq. Mt. per annum, an increase of 4.7% from last year, largely due to a decrease of 6.3% in operating area due to consolidation of operations throughout the year.

5. MRF

Conservation of energy is a key focus area in operations at MRF they have an ongoing program to reduce specific consumption of fuel and power. Benchmarking of best performance of previous year and identification of losses is used in setting targets. Energy management systems are being introduced in plants. Focus on renewable energy and alternate sources of energy are being explored. Several power saving projects and fuel saving projects have been undertaken. Some of the key initiatives are given below:



(i) Steps taken or impact on energy conservation: The following measures were implemented to reduce specific fuel consumption:

- a) Identification of the areas of energy loss in steam consuming areas and immediate corrective measures.
- b) Parallel deployment of energy management system in various units to monitor & benchmark steam consumption at sub plant and equipment level.
- c) Parallel deployment of all the successful energy saving projects across all units of the Company.
- d) Ensuring the quality of steam generated by boiler.
- e) Reduced steam consumption by modifying the process parameters.
- f) Increased productivity ensured in curing by modifying the existing curing presses.
- g) Usage of improved insulation to reduce the radiation losses.

(ii) Steps taken by the company for utilizing alternate source of energy: In order to reduce its carbon footprint the Company is continuously exploring.

- a) Power purchase from open access using power exchanges ensures significant portion of power drawn from renewable hydroelectric and wind based power.
- b) Usage of skylight in structures ensures reduction of day time lighting consumption.
- c) Rain water harvesting ponds planned in all units to conserve water.
- d) Recycling of waste water for the process by introducing second pass reverse osmosis plant to reduce water consumption.

(iii) Capital investment on energy conservation project: Investments have been carried out for implementing energy conservation proposals which have long term saving impact and reduction of losses in the system.



CONCLUSION

1. First, keep in mind that there is no easy one-step approach to becoming sustainable; sustainability is a continuous process that requires critical self-analysis, honesty, innovation, and risk. That is, before beginning this journey toward sustainability, a business should be prepared to be self-reflective, critical, and honest about all its operations and associated impacts, and a business should be ready to take risks and be innovative, moving beyond its comfort zone, or business as usual.
2. Second, consider that green business sustainability encompasses the operations of the entire business: every process, every activity, and every function. A business will not be able to implement one or a few changes and proclaim that the business has achieved sustainability. A business should be prepared to apply the aforementioned critical self-analysis, honesty, innovation, and risk across all processes, all activities, and every function of the business. Sustainability is a company-wide change in mindset, philosophy, views, and practices related to how the business operates.
3. Lastly, realize that green business incorporates a triple bottom line in evaluating company performance: the environmental, social, and economic impact of the business (also referred to as planet, people, and profit). Though a lot of companies are going green in India and have shown exemplary initiatives for practicing green business, it still has a long way to go to be at par with the rest of the world.

SUGGESTIONS

Marketers should play crucial role since they have the responsibility to make the consumers understand the need for and benefits of green products as compared to non-green ones. In these times, Green business assumes even more importance and relevance in developing countries like India.

Along with Private sector, Government initiatives are most important, intense efforts should be made by Government for following these practices for wellbeing of next generations.

Firms should give best vendor award for initiation and implementation of green business practices. Study reveals that government regulations and competitors forces plays crucial role in green endeavors, so government should spend some more amount on research and development for innovating eco friendly technologies, and should give subsidies to those who are practicing. There is close association between green business practices and market performance. Hence, Companies should focus more on to develop environment friendly products and put an endeavor for eco-friendly modification in product design which will increase market share and give competitive advantage.



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प्रस्तावना :

'संयुक्त राष्ट्र की 'बल्ड पापूलेशन प्रोस्पेक्टस - २०१५' के अनुसार वर्तमान में विश्व की जनसंख्या ७.३ अरब है। जो वर्ष २०३० तक बढ़कर ८.५ अरब हो जाएगी, सन २०५० तक विश्व की जनसंख्या ९.६ अरब होगी। सन २०५० तक विकसित देशों की जनसंख्या में तो कोई परिवर्तन नहीं होगा। लेकिन विश्व के सबसे कम विकसित ५९ देशों (LDCS) की जनसंख्या वर्तमान में ०.९ अरब से दो गुनी होकर सन २०५० में १.८ अरब के लगभग होगी। इसी रिपोर्ट के अनुसार सन २०२८ के बाद भारत की जनसंख्या चीन से भी अधिक हो जाने का अनुमान लगाया गया है।

भारत का भौगोलिक क्षेत्रफल विश्व के १३५.७९ मिलियन वर्ग किमी का लगभग २.४ प्रतिशत (३२.८७ लाख वर्ग किमी) है, जो विश्व की १७.५ टके जनसंख्या निवास करती है। भारत में सन १८७२ में पहली बार जनगणना की गई थी, किन्तु जनसंख्या का आकलन सन १८८१ से किया जा रहा है और ११ जूलाई को प्रतिवर्ष विश्व जनसंख्या दिवस के रूप में मनाया जाता है।

वर्तमान शताब्दी में भारत की जनसंख्या

| जनसंख्या वर्ष | जनसंख्या (वर्ग. में) | दशक में परिवर्तन (वर्ग. में) | दशक में वृद्धि की दर (प्रतिशत में) | औसत वार्षिक वृद्धि दर (प्रतिशत में) | एडी-गुण (दरिद्र इन्डेक्स पर प्रतिवर्ष) | एडी-गुण में परिवर्तन |
|---------------|----------------------|------------------------------|------------------------------------|-------------------------------------|--|----------------------|
| 1891 | 23.60 | - | - | - | - | - |
| 1901 | 23.84 | + 0.24 | - | - | 972 | 972 |
| 1911 | 25.21 | + 1.37 | + 5.75 | 0.56 | 964 | 964 |
| 1921 | 25.13 | - 0.08 | - 0.31 | - 0.09 | 955 | 955 |
| 1931 | 27.90 | + 2.77 | + 11.00 | 1.04 | 950 | 950 |
| 1941 | 31.87 | + 3.97 | + 14.22 | 1.33 | 945 | 945 |
| 1951 | 36.11 | + 4.24 | + 13.31 | 1.25 | 946 | 946 |
| 1961 | 43.92 | + 7.81 | + 21.64 | 1.96 | 941 | 941 |
| 1971 | 54.82 | + 10.90 | + 24.80 | 2.22 | 930 | 930 |
| 1981 | 68.33 | + 13.51 | + 24.66 | 2.20 | 934 | 934 |
| 1991 | 84.64 | + 16.30 | + 23.87 | 2.14 | 927 | 927 |
| 2001 | 102.87 | + 18.23 | + 21.54 | 1.95 | 933 | 933 |
| 2011 | 121.08 | + 18.15 | + 17.7 | 1.64 | 943 | 943 |

यहां यह उल्लेख करना आवश्यक है कि यह वृद्धि अल्पविकसित और विकासशील देशों में अधिक है। विश्व की लगभग तीन-चौथाई जनसंख्या विकसित देशों में निवास करती है। विश्व के अल्पविकसित विकासशील देश जनसंख्या अतिरेक से ग्रसित है। संसाधनों की कमी और जनसंख्या आधिक्य के कारण ऐसे देशों में गरीबी, अभाव, असंतोष आदि भी पर्यावरण संकट के कारण बन गए हैं।

निर्धन देश असमर्थता के कारण संसाधनों का दोहन अति तीव्र ढंग से करते हैं जिसका कुप्रभाव यहां के पर्यावरण पर पड़ता है। इन देशों में बढ़ती जनसंख्या के लिए समुचित भोजन, वस्त्र और आवास तथा अन्य उपभोग्य वस्तुओं के लिए विकसित देशों के निर्धन संसाधन दोहन करना पड़ता है। जिससे पर्यावरण संकट और गंभीर हो रहा है।

है जिससे देश का वैदेशिक व्यापार संतुलित बना रहे। नेपाल और भूटान भी आर्थिक पिछड़ेपन के कारण लकड़ी निर्यात के लिए बाध्य है। विश्व के विकासशील देशों दक्षिण अमेरिका, आफ्रिका एवं एशिया में संसाधन दोहन से बंजर भूमि का विस्तार अधिक हो गया है।

अर्धविकसित देशों में अज्ञानता और प्रकृति के प्रति उपेक्षापूर्ण व्यवहार से पर्यावरण अवनयन और अधिक हो गया है। जनसंख्या वृद्धि के कारण भूमि, खनिज, जल आदि प्राकृतिक संसाधनों की प्रति व्यक्ति उपलब्धता निरन्तर घटती जा रही है। कुपोषण, भूकमरी, बेकारी, गरीबी, आयुष्य की कमी, आदि समस्याएँ जनसंख्या वृद्धि के कारण ही उत्पन्न हुई हैं। प्राकृतिक संसाधनों के अंधाधुंध दोहनसे अकाल, बाढ़ इत्यादी प्राकृतिक आपदाओं की पुनरावृत्ति बढ़ी है।

पर्यावरण संकट बढ़ने के कारण :

1. जनविनाश का पर्यावरण पर प्रभाव
2. उत्खनन का पर्यावरण पर प्रभाव
3. औद्योगिकरण का पर्यावरण पर प्रभाव
4. तीव्र तकनीकी विकास
5. अनियोजित विकास
6. नगरीकरण

इन सब कारणों के वजह से पर्यावरण संकट आ रहे हैं। वैसा जनसंख्या वृद्धि भी एक कारण महत्वपूर्ण है।

निष्कर्ष :

इन सब कारणों से पर्यावरण संकट समस्या बढ़ रही है। इन के साथ-साथ जनसंख्या वृद्धि भी एक महत्वपूर्ण कारण है इन सब बातों पर या पर्यावरण संकट कम करना है तो जन मतों में परिवर्तन करना अत्यंत आवश्यक है।

संदर्भ :

1. भारतीय अर्थव्यवस्था, प्रतियोगिता टाईम, २०१८



Design and Implementation of Fuzzy Logic Technique for Aircraft Control System

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Abstract:-

This research paper is about a Design and Implementation of Fuzzy Logic technique for Aircraft control system. In this study we describe an aircraft control system and landing of an aircraft are considered. An aircraft control system is a totally non-linear system when the final approach and landing of an aircraft are considered. It involves maneuvering flight in an appropriate course to the airport and then along the optimum glide path trajectory to the runway. We know that this path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. These orthogonal radio beams are known as the localizer and the glide slope and are transmitted from the ends of the runway in order to provide the approaching aircraft with the correct trajectory for landing. The pilot executing such a landing must monitor cockpit instruments that display the position of the aircraft relative to the desired flight path and make appropriate corrections to the controls.

In this research work the fuzzy logic technique has been explained with reference to the real world problems. The problem of Aircraft control system for Fuzzy logic technique is solved using the MATLAB programming software. The Fuzzy Logic methods are used for solving the Aircraft control system problems are Fuzzy Sets, Fuzzy Relation, membership function, non-transitive method etc. This paper is totally based on software implementation of MATLAB.

Keywords: Membership function, fuzzy set, Non-transitive method, Aircraft control system, decision making, and uncertainty.

Introduction:

Fuzzy Logic:

The real world is complex, complexity arises from uncertainty in the form of ambiguity. "as the complexity of the system increases, our ability to make precise and yet significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive characteristics." These are the words of the LOTFI ZADEH who introduced fuzzy logic in 1965. "The closer looks at a real world problem, the fuzzier becomes its solution", observed Dr. Zadeh who published his seminal work "FUZZY SETS" in the journal of information and control.

When there is imprecision (more uncertainty) and inadequate data the fuzzy logic technique is useful. Secondly, the cost of information increases with precision. But the cost of fuzzy information is far less than the perfect or imperfect information. Thus, there are two-fold advantages of the fuzzy logic technique: Understanding of complex systems becomes easier and analysis makes the system costs effective. He used the linguistic

variable and further suggested that set membership function is the key to decision making when there is uncertainty.

The attention currently being paid to fuzzy logic is most likely the result of present popular consumer products such as washing machine, cameras, elevators, air conditioners, rice cookers, automobile, dishwashers etc. The nature of uncertainty in a problem is a very important point that engineers should ponder prior to their.

Fuzzification:

Fuzzification is the process of making a crisp quantity fuzzy. We do this by simply recognizing that many of the quantities that we consider to be crisp and deterministic are actually not deterministic at all. They carry considerable uncertainty. If the form of uncertainty happens to arise because of imprecision, ambiguity or vagueness then the variable is probably fuzzy and can be represented by a membership function.

In the real world such as, digital voltmeter generates crisp data, but these data are subject to experimental error. The below fig 1.1 shows one possible range of errors for a typical voltage reading and associated membership function that might represent Such imprecision.

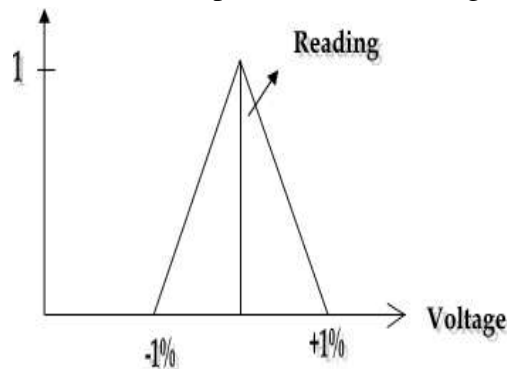


Fig 1.1 Membership function of crisp voltage reading

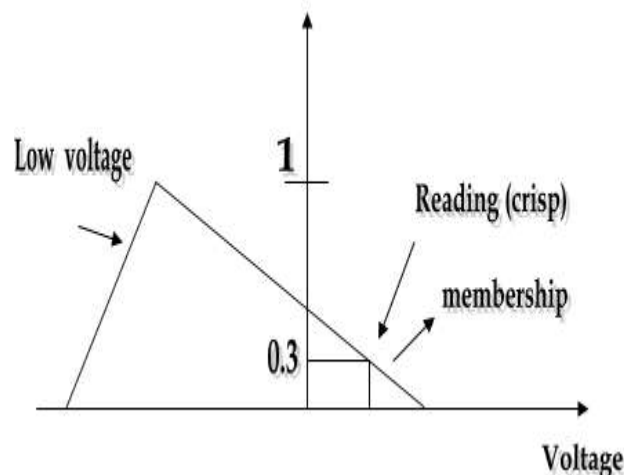


Fig.1.2 Fuzzy sets and crisp reading

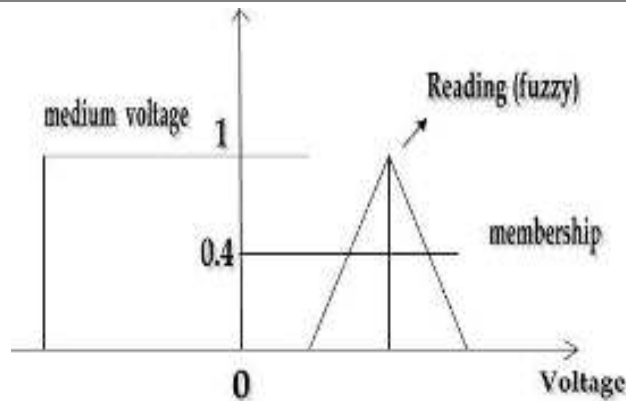


Fig. 1.3 Fuzzy set and fuzzy reading

Defuzzification:

It is the conversion of fuzzy quantity to a precise quantity. The output of a fuzzy process can be the logical union of two or more fuzzy membership functions defined on the universe of discourse of the output variable.

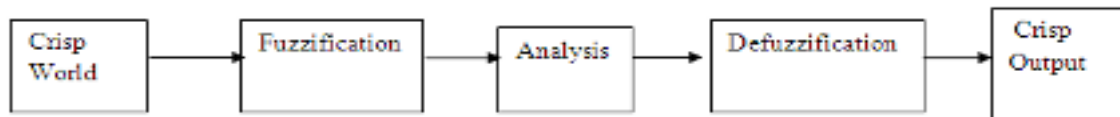


Fig (4) Block diagram of Fuzzy to Crisp Conversion

Aircraft Control System:

An aircraft control system is a totally non-linear system when the final approach and landing of an aircraft are considered. It involves maneuvering flight in an appropriate course to the airport and then along the optimum glide path trajectory to the runway. We know that this path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. These orthogonal radio beams are known as the localizer and the glide slope and are transmitted from the ends of the runway in order to provide the approaching aircraft with the correct trajectory for landing. The pilot executing such a landing must monitor cockpit instruments that display the position of the aircraft relative to the desired flight path and make appropriate corrections to the controls.

Methodology:

For solving the Aircraft control system problem using fuzzy logic technique number of methods are available like Fuzzy Sets, Fuzzy relation, Cartesian product, alpha- cut, Non-transitive ranking methods etc. Among this method we have selected the Non-transitive method for solving the power transistor problem.

Nontransitive Ranking Method

When we compare objects that are fuzzy, ambiguous, or vague, we may well encounter a situation where there is a contradiction in the classical notions of ordinal ranking and transitivity in the ranking. To accommodate this form of nontransitive ranking, we introduce a special notion of relativity.

Let x and y be variables defined on universe X . We define a pairwise function $f_y(x)$ as the membership value of x with respect to y



And we define another pairwise function

$f_x(y)$ as the membership value of y with respect to x

then the relativity function is given by

$$f(x/y) = f_y(x) / \max[f_y(x), f_x(y)] \tag{1}$$

is a measurement of the membership value of choosing x over y . The relativity function $f(x/y)$ can be through of as the membership of preferring variable x over variable y .

To develop the genarl case for many variables, define variables $x_1, x_2, \dots, x_i, x_{i+1}, \dots, x_n$. All defined on universe X , and let these variables be collected in a set A i.e $A = \{x_1, x_2, \dots, x_{i-1}, x_i, x_{i+1}, \dots, x_n\}$. We then define a set identical to set A except this new set will be missing one element x_i , and this set will be termed A' . The relativity function then becomes

$$f(x_i/A') = f(x_i / \{x_1, x_2, \dots, x_{i-1}, x_{i+1}, \dots, x_n\}) \\ = \min\{f(x_i/x_1), f(x_i/x_2), \dots, f(x_i/x_{i-1}), f(x_i/x_{i+1}), \dots, f(x_i/x_n)\} \dots \dots \dots (2)$$

Which is fuzzy measurement of choosing x_i over all elements in the set A' . The expression in equ(2) involves the logical intersection of several variables; hence the minimum function is used. Since the relativity function of the variable with respect to itself is identity.

$$f(x_i/x_i) = 1 \dots \dots \dots (3)$$

then

$$f(x_i/A') = f(x_i/A) \dots \dots \dots (4)$$

We can now form a matrix of relativity values. $f(x_i/x_j)$, where $i, j = 1, 2, \dots, n$, and where x_i and x_j are defined on a universe X . This matrix will be square and of order n , and will be termed the c matrix (c for comaprision). The c matrix can be use to rank many different fuzzy sets.

To determine the overall rnkng, we need to find the smallest value in each of the rows of the C matrix; that is,

$$C_i' = \min f(x_i/X), i = 1, 2, \dots, n. \tag{5}$$

Where C_i' is the membership ranking value for the i th variable.

Experimental Work

Presume that four positions are available to the pilot and that four corrections P1, P2, P3, and P4 from the actual position P are required to put the aircraft on the correct course. The pair wise comparisons for the four positions are as follows;

| | | | |
|-------------|-------------|-------------|-------------|
| Fp1(P1)=1 | Fp1(P2)=0.5 | Fp1(P3)=0.6 | Fp1(P4)=0.8 |
| Fp2(P1)=0.3 | Fp2(P2)=1 | Fp2(P3)=0.4 | Fp2(P4)=0.3 |
| Fp3(P1)=0.6 | Fp3(P2)=0.4 | Fp3(P3)=1 | Fp3(P4)=0.6 |
| Fp4(P1)=0 | Fp4(P2)=0.3 | Fp4(P3)=0.6 | Fp4(P4)=1 |

In this example, the non-transitive method is very useful.

Let x and y be two variables defined on universe X . We define a pair wise function $f_y(x)$ as the membership value of x with respect to y and we define another pair wise function $f_x(y)$ as the membership value of y with respect to x

Now, the relativity function given by

$$f(x/y) = f_y(x) / \max [f_y(x), f_x(y)] \dots \dots \dots 3.1$$

The relativity function $f(x/y)$ can be thought as the membership of preferring variable x over variable y . To determine the overall ranking, we need to find the smallest value in each of the row of the matrix; that is,

$$C = \min f(x/y) \dots\dots\dots 3.2$$

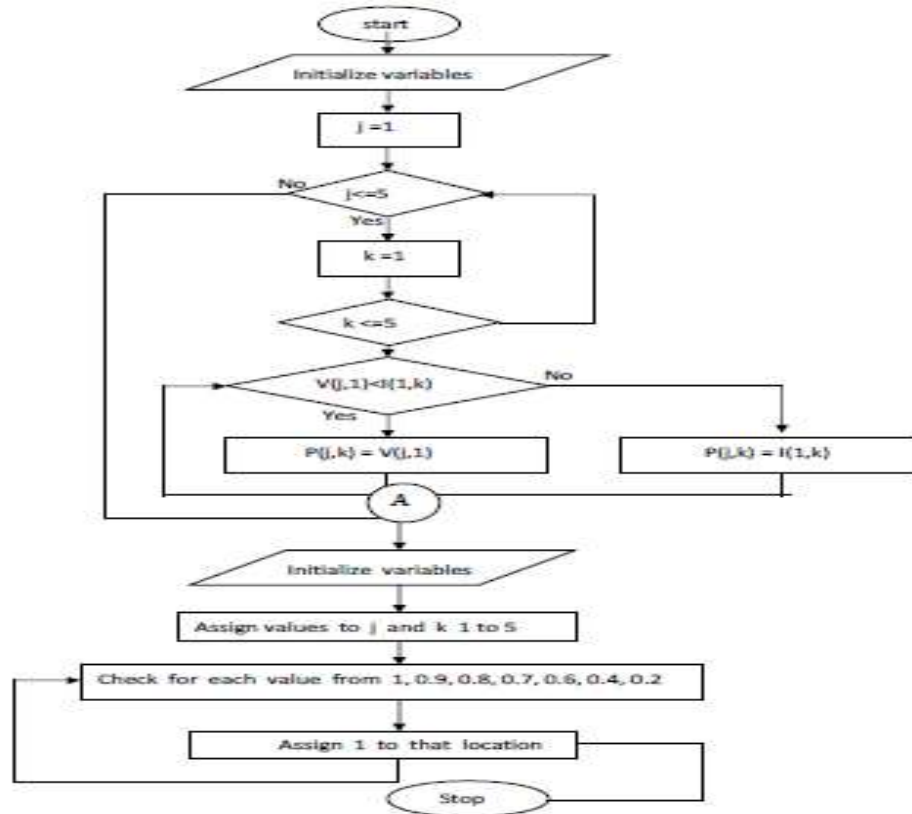


Fig: Flowchart for Aircraft control System

Programming in MATLAB:-

```

% program based on nontransitive method
% program for aircraft control system
% The pairwise comparisons for the four positions are as follows
% Fp1(p1)=1   Fp1(p2)=0.5   Fp1(p3)=0.6   Fp1(p4)=0.8
% Fp2(p1)=0.3   Fp2(p2)=1   Fp2(p3)=0.4   Fp2(p4)=0.3
% Fp3(p1)=0.6   Fp3(p2)=0.4   Fp3(p3)=1   Fp3(p4)=0.6
% Fp4(p1)=0   Fp4(p2)=0.3   Fp4(p3)=0.6   Fp4(p4)=1

P=[1 0.5 0.6 0.8;0.3 1 0.4 0.3;0.6 0.4 1 0.6;0 0.3 0.6 1]
F=zeros(4,4)
A=zeros(1,4)
for j=1:4
    for k=1:4
        F(k,j)=P(j,k)/max(P(j,k),P(k,j))    % formula of non-transitive ranking
    end
end
% Minimum of above function F in row wise and result stored in A
    
```




$$A(1,1)=\min (F(1,j))$$

$$A(1,2)=\min(F(2,j))$$

$$A(1,3)=\min(F(3,j))$$

$$A(1,4)=\min(F(4,j))$$

Result and Discussion

In the problem of Aircraft control system, the landing of an aircraft is considered. The path is usually provided by an instrument landing system, which transmits two radio signals to the aircraft as a navigational aid. In this problem, four positions are available to the pilot and those four corrections P1, P2, P3, and P4 from actual position P. The method used in this problem is nontransitive ranking. The relativity function of nontransitive ranking is given by,

$$f(x/y)= f_y(x)/\max[f_y(x),f_x(y)]$$

From this method we could solve the actual position of the aircraft.

This problem is solved using MATLAB programming and the result is displayed given below in matrix form.

Output:

```
P= 1.0000 0.5000 0.6000 0.8000
    0.3000 1.0000 0.4000 0.3000
    0.6000 0.4000 1.0000 0.6000
    0.0000 0.3000 0.6000 1.0000
```

```
F= 0 0 0 0
    0 0 0 0
    0 0 0 0
    0 0 0 0
```

```
A= 0 0 0 0
```

```
A= 0 1 0 0
```

```
A= 0 1 1 0
```

```
A= 0 1 1 1
```



Discussion

One area in which fuzzy set theory has a great potential that in psychology; in particular the psycho logistics which is essential for studying the connection between human communication and decision machines. Today, close to four decades after the artificial intelligence (AI) was born. It can finally be said that intelligent systems are becoming a reality. The soft computing has direct bearing on machine intelligence. Neuro fuzzy soft computing has a special role in the design of modern intelligent systems.

Applications Of Fuzzy Logic

- Control systems
- Pattern recognition
- Robotics
- Consumer electronics
- Automobiles
- Intelligent systems



Fuzzy Logic In Consumer Goods

Cameras , Washing machine , Air conditioners , Luxury cars , Elevators , Rice cookers , Automobile , Dishwashers , Refrigerator , Camcorders , Vac. Cleaner etc.

Scope Of Work

The scope of further research work is to develop and design some electronic circuits such as speed control motor, automatic control system and some decision making problem like weather forecast. This has been recently used for user-oriented verification of probability forecasts, but there is applied to aid forecast users in optimizing their decision making from probability forecasts.

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Application of Manifold Sensors in Wireless Digital Thermometer

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ABSTRACT

This paper describes the application of a manifold sensors in wireless digital thermometer for measuring temperature from different sensors using single wireless digital thermometer. In this paper primarily temperature sensor LM35 is used. ADC0808 is used to convert analog signal obtained from temperature sensor into digital format so that the special parallel to serial encoder will transmit the signal using Tx module to remote receiving end. At the receiving end the transmitted signal is received by receiver module. Reverse action is carried out on the signal to what happened at the transmitting end and temperature detected by sensor is displayed on digital multi-meter on mV scale.

Keywords: Temperature Sensor, ADC, Encoder

I. INTRODUCTION

Temperature is certainly among the most commonly measured parameters in industry, science, and academia. Recently, the growth of wireless instrumentation technology, along with some clever innovations, has provided new ways to apply temperature measurement sensors combined with personal computers to collect, tabulate, and analyse the data obtained.

Wireless monitoring system is, as their name suggests, monitoring systems that can be installed without the need to run cabling or wires. Wireless monitoring systems are the ultimate in quick, easy and neat monitoring installation solutions. Because they are wireless they are very discreet and unobtrusive, there is no buildings' decoration spoiling nor is there an unsightly wire highway on wall surfaces. Wireless monitoring systems are more convenient than hard wired systems and it means that even the most unlikely places can have a

wireless monitoring a system installed and in a fraction of the time.

Temperature measurement in today's industrial environment encompasses a wide variety of needs and applications. To meet this wide array of needs the process controls industry has developed a large number of sensors and devices to handle this demand. Temperature is a very critical and widely measured variable for most applications. Many processes must have either a monitored or controlled temperature. The paper deals with measurement of temperature using temperature sensor LM35. In all eight LM 35 sensors are been used in the current work.

II. METHODOLOGY

Temperature measurement can be done using temperature sensor LM35 but the problem arises when one has to measure more than one temperature at a time. To overcome this problem an approach has

been shown in the paper to sense temperature from eight sensors at a time.

At the transmitting end, we have temperature sensor LM35, ADC 0808, Encoder HT12E2, Sequential Data Selector and Transmitter Module. An 8 bit ADC continuously scans and converts signals from eight different temperature sensors. The sensors are selected sequentially by a 3 bit binary addressing system. At any instant of time an 8 bit ADC generates an 8 bit binary number equivalent to the analog signal obtained at the output of a particular temperature sensor, being selected by 3 bit binary addressing system. By using special parallel-to-serial encoders, this 8-bit data, along with the binary address of the sensor, is sent serially to the remote receiving end. Communication between the two ends are met with the help of a pair of 433MHz UHF transmitter and receiver modules operating in ASK/OOK mode. At the receiving end, the transmitted signal is received by a 433MHz ASK/OOK RF receiver module. The received 8-bit serial signal is then converted back to its original parallel form, by using special data decoders HT 12E. An equivalent analogue signal is then developed from this data by an 8-bit digital-to-analogue converter (DAC). A digital multimeter connected at the output of the DAC is used to show the temperature on mV scale.

III. EXPERIMENTAL SETUP & WORKING

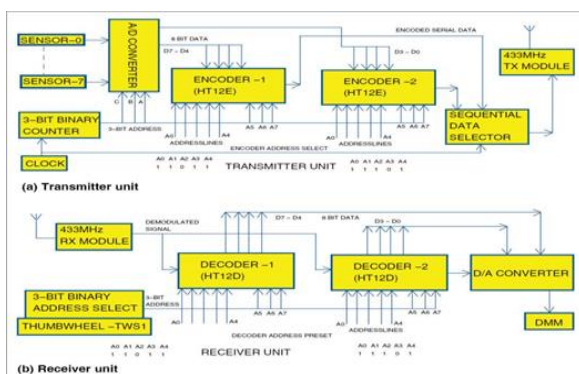


Figure 1. Block Diagram Of Manifold Sensors In Wireless Digital Thermometer

Figure 1.a shows the block diagram of the transmitter unit for the wireless addressable digital thermometer. Eight LM35 IC temperature sensors are connected to ADC 0808. Although the ADC is capable of accepting a total number of eight sensors through its eight input lines, less number of sensors could be used as well as, whenever desired. IC 7404 configured as a CMOS oscillator with the help of resistors and capacitor feeds the ADC with necessary clock pulses required for conversion processes.

Output voltage of LM35 series IC temperature sensors follows linearly ($@10\text{mV}/^\circ\text{C}$) the centigrade temperature of its surroundings, taking 0mV at 0°C temperature. The ADC continuously scans its eight input lines. The scanning process is governed by a 3-bit binary up counter built around CD4029. The counter places a continuously-changing 3-bit binary number on A-B-C input lines of the ADC. Scanning rate is dependent upon the clock constructed around timer NE555, and is 8Hz , approximately. Hence, each of the eight sensors is allowed to send data to the ADC for approximately one-eighth of a second, irrespective of whether all sensors are connected or not.

Here, IC 0808 is configured in continuous operational mode. So, whenever a particular sensor is addressed, output lines of the ADC reflect the present analogue output status of the sensor. Output of the ADC goes to data input lines of special encoders HT12E; higher nibble to first HT12E and lower nibble to second HT12E, respectively. As TE input of encoders is permanently grounded, the encoders are configured to produce encoded data continuously. These two encoded digital outputs are alternately steered to TX1 (TX-433MHz), a UHF RF transmitter module, to modulate UHF carrier wave generated by the module.

Encoder output: Whenever IC 555 output pulse goes high, output of HT12E is steered to TX1 through

diode. At the same time, due to the presence of transistor inverter, output of HT12E is inhibited to reach TX1 through the gate. As soon as the clock pulse returns to logic 0, output of HT12E gets its passage to TX1 through gate of 7408.

So, in essence, analogue data of a sensor is converted and the resultant 8-bit digital data is sent to the remote end using ASK/OOK modulation, in a complete clock cycle of IC 555.

Modulated signal is radiated into space through a wire, acting as an antenna, connected at the antenna point of the module.

Figure 1.b shows the receiving unit of the wireless addressable digital thermometer. RX1, a 433MHz RF receiver module, is used to receive and demodulate ASK-modulated RF signal transmitted by TX1 of the transmitter unit. Demodulated output is a train of rectangular pulses comprising a 4-bit data nibble and destined for a particular decoder as explained earlier. Transistor BC547 is used as a pulse amplifier to amplify the signal output from RX1 and, hence, raises the pulse height to CMOS compatible logic -1 (>3.5V at 5V). This compatible output is then fed to CMOS NAND gate 4011. NAND gate helps to get pulses of perfect rectangular-wave shape. Output of IC 4011 is fed to decoders HT12D. Address lines of the decoders are preset to receive data from two encoders HT12E, respectively.

LEDs connected at their outputs flicker to indicate reception of valid data. Decoding speed is 200kHz (approximately). Decoded data is then fed to DAC 0808. Analogue current output of the DAC is loaded. Voltage developed across it is fed to a digital multimeter, which shows the temperature on mV scale. A thumbwheel switch is used to change the preset address of the decoders. The switch changes the last three LSB of the address.

III. RESULT AND DISCUSSION

Table 1. Temperature recorded by different techniques and deviation

| Sr. No | Actual | Experimental | Deviation |
|--------|--------|--------------|-----------|
| 1. | 37.4 | 37.2 | 0.2 |
| 2. | 37.6 | 37.3 | 0.3 |
| 3. | 37 | 37.1 | -0.1 |
| 4. | 36.8 | 36.9 | -0.1 |
| 5. | 37 | 36.8 | 0.2 |
| 6. | 36.5 | 36.3 | 0.2 |
| 7. | 37.5 | 37.3 | 0.2 |
| 8. | 36.7 | 36.4 | 0.3 |
| 9. | 37.5 | 37.3 | 0.2 |
| 10. | 36.9 | 37 | -0.1 |
| 11. | 37.2 | 37 | 0.2 |
| 12. | 37.6 | 37.4 | 0.2 |
| 13. | 36.7 | 36.9 | -0.2 |
| 14. | 36.8 | 36.5 | 0.3 |
| 15. | 37.5 | 37.3 | 0.2 |
| 16. | 36.9 | 37 | -0.1 |
| 17. | 37 | 37.2 | -0.2 |
| 18. | 37.3 | 37.1 | 0.2 |
| 19. | 37.4 | 37.2 | 0.2 |
| 20. | 36.5 | 36.3 | 0.2 |

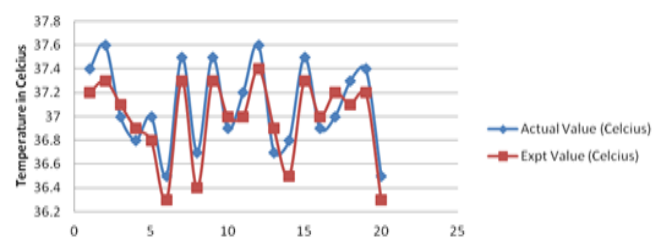


Figure 2. Graph representing the comparison of data for Temperature by different techniques.

For proper operation of this wireless thermometer, reference current (to pin 4 of DAC0808) of the receiver unit should be pre-adjusted. To do this, follow the steps below:

Connect a known voltage source (not exceeding +5V) to any input of the ADC, say, at pin 4 of the ADC.

Switch on the transmitter unit. Connect a DMM across Resistor of the receiver unit. Set the range switch to DC 200mV range, positive lead to ground and negative lead to top of Resistor. Switch on the receiver unit. LEDs at decoder outputs should start glowing to indicate the received voltage data. If source voltage is 1.5V, status of LEDs should be as listed in Table I. So, received voltage = $(D \times 5)/256 = (76 \times 5)/256 = 1.50$

where D is the weight of the binary numbers represented by LED7 through LED14. Now, adjust trim potmeter to get 150.00mV on the dial of the multimeter. Connect another voltage source at the input and see that the multimeter shows it correctly. If required, re-adjust the trim potmeter. After proper calibration, enclose the circuit in two separate boxes with suitable connections of input and LED indicators.

| STATUS OF LEDS IN THE RECEIVER UNIT | | | | | | | | |
|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| LED | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Data | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| Weight | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Status | OFF | ON | OFF | OFF | ON | ON | OFF | OFF |

IV. CONCLUSION

Although the system can be used best to measure temperatures in hazardous or inaccessible areas (like a radioactive zone), the same can also be used by a hospital doctor to monitor, from a fixed location, the body temperatures of multiple patients lying in different rooms without visiting each patient in person.

A hotel control room can monitor temperatures of all the rooms at the same time by using multiple units. The unit can also be used (with certain modifications) as a wireless digital voltmeter.

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DESIGN AND DEVELOPMENT OF AN EMBEDDED SYSTEM FOR AUTOMATIC BLOOD PRESSURE MONITORING

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Abstract-

This paper presents a design and development of an Embedded System for Automatic blood pressure Monitoring. The real-time blood pressure biomedical vital signal is measured using an optical measurement circuit based Plethysmography technique (PPG) continuously for a long period of time. The blood pressure sensing system will give the diastolic and systolic pressure reading on the display. The automatic Blood pressure numerical reading values of systolic and diastolic blood pressure calculated is then displayed on a LCD. For measurement of BP a special BP sensor MPS 3117 and BP pump is used. The result is calculated and then it is sent to central location system using RF module. The results were compared with existing devices data as a Sphygmomanometer technique to verify the accuracy of the developed instrument.

Key Words:- Blood Pressure, Embedded, Wireless, photoplethysmography, LCD etc.

I. INTRODUCTION

Blood pressure measurement is one of the basic clinical examinations. The origin of blood pressure is the pumping action of the heart and its value depends on the relationship between cardiac output and peripheral resistance. Therefore, blood pressure is considered as one of the most important physiological variables with which to assess cardiovascular hemo-dynamics.

It is the force created by the heart as it pushes blood into the arteries through the circulatory system. Each time the heart contracts or “beats” the blood is pumped out and creates a surge of pressure in the arteries. Blood pressure is the force exerted by circulating blood on the walls of blood vessels.

Blood pressure is the most often intensively studied parameters in medical and physiological practice. The determination of only its maximum and minimum levels during each cardiac cycle supplemented by information about other physiological parameters is a valuable diagnostic aid to access the vascular condition and certain other aspects to cardiac performance. Blood is pumped by the left side of the heart into the aorta, which supplies it to the arterial circuit. Due to the load resistance of the arterioles and the precapillaries, it losses most of its pressure and returns to the heart at low pressure via highly distensible veins. The right side of the heart pumps it to the pulmonary circuit, which operates at lower pressure. The heart supplies blood to both circuits as simultaneous intermittent flow pulses of variable rate and volume. The maximum pressure reached during cardiac ejection was called systolic pressure and the minimum pressure occurring at the end of ventricular relaxation is termed as diastolic pressure. The mean arterial pressure over one cardiac cycle is approximated by adding one third of the pulse pressure (difference between systolic and diastolic values) to the diastolic pressure.[1]

II. METHODOLOGY

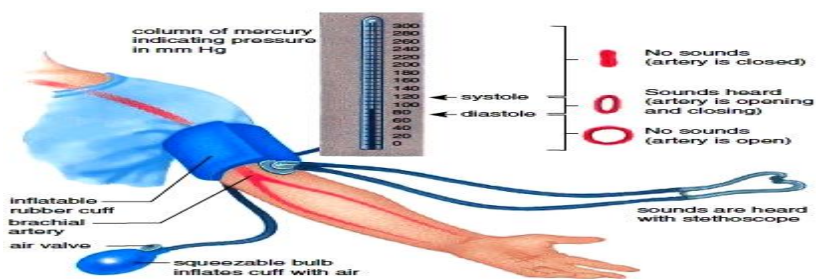


Fig 2.1 Blood pressure Measurement using Sphygmomanometer

A Sphygmomanometer worked on the principle that when the Cuff was placed on the upper arm and was inflated, the arterial blood flowed past the Cuff only when the Arterial Pressure exceeds the Pressure in the cuff. When the Cuff was inflated to a Pressure that occluded the Brachial Artery only partially, turbulence was generated in the blood as it spurted through the tiny arterial opening during each Systole. The sounds generated by the turbulence, Korotkoff sounds, was heard through a Stethoscope placed over the Artery downstream from the Cuff.[2]

III DETAIL ANALYSIS OF SENSORS USED

A. Variations in Blood Pressure

Normal BP for adults is defined as 120/80 mmHg. But this changed with different activities and due to various reasons. The measurements were different when the person was asleep, awake, active, nervous or excited. Once the activity stopped, BP returned to the baseline range. Blood Pressure normally rose with age and body size. Newborn babies often had very low Blood Pressure numbers, considered normal for babies, while older teens had numbers similar to adults.

| Approximate Age (in years) | Systolic mmHg | Diastolic mmHg | Heart Rate per min | Respiratory Rate per min |
|----------------------------|---------------|----------------|--------------------|--------------------------|
| 1 – 11 (months) | 74-100 | 50-70 | 120-160 | 30-60 |
| 1 - 3 | 80-112 | 50-80 | 90-140 | 20-40 |
| 4 - 5 | 80-110 | 50-78 | 90-140 | 22-34 |
| 6 - 12 | 84-120 | 54-80 | 75-100 | 18-30 |
| 13 - 18 | 94-140 | 62-88 | 60-90 | 12-16 |

Table 1. Common Range of BP, Respiratory Rate and Heart Rate in Children

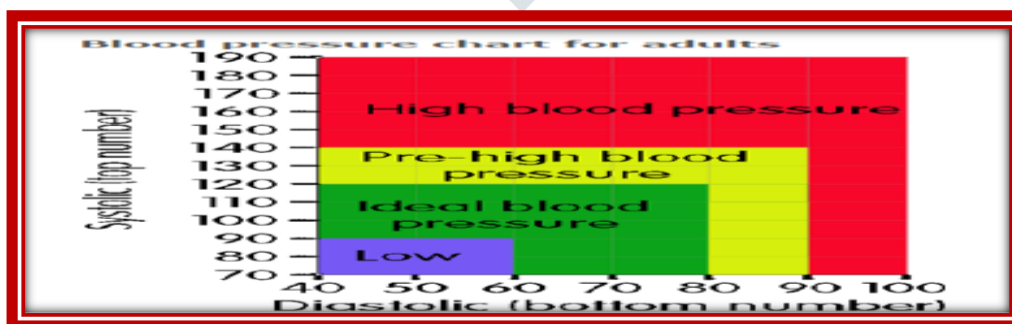


Fig 3.2 Blood Pressure Chart for Adults

B. Blood Pressure sensor

In choosing the sensor for the blood pressure monitoring device many sensors were considered. Many factors were taken into account including the voltage input range for operation, current range for operation, as well as what is actually being sensed. Blood pressure through electronic means was often done in an indirect method in which information was derived from a signal and information known about signals and pressure. Therefore what is actually being sensed directly is not blood pressure. The signal received from the sensor starts as a mechanical signal and a transducer changes it into a voltage to be fed into a processor for deducting information. For the Circuit design we have used a MPS 3117 sensor.

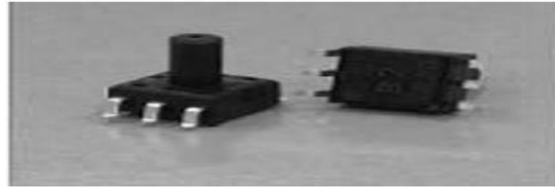


Fig 3.3 Blood pressure sensor MPS-3117

The MPS-3117 pressure sensor from Taiwan Metro dyne System Corporation, utilizes a special case of the Wheatstone bridge, the Wien Bridge which was driven by a constant current source of 1mA to 3mA and requires 2-5V of supply voltage. Utilizing the Wien Bridge allows the capacitance of two capacitors to be compared because the resistance values of the circuit were known. The pressure sensor was therefore able to send the double-ended output differential signals depending on profile of the air pressure wave. The signal was an analog mixed signal with an output voltage in the range of 0-40mV that is proportional to the differential input mechanical air pressure.[3]

C. BP pump and Motor



Fig 3.4 BP pump

Product Description

- Mini Air Pump 6V
- Air flow: 1liters per minute to 2.2liters per minute.
- Current: Under 100mA to 600mA
- Volt: DC 6V
- Power consumption: about 2.4W.
- Noise: Under 55DB
- Can work with WV120-6V solenoid valve the keep pressure and release pressure

D. Cuff

The cuff is an integral part of the blood pressure is normally placed smoothly and snugly around an upper arm, at roughly the same vertical height as the heart while the subject is seated with the arm supported. It is essential that the correct size of cuff is selected for the patient. When too small a cuff results in too high a pressure, while too large a cuff results in too low a pressure, so it comes in four sizes, for children up to obese adults. Also, it is made of a non-elastic material, and the cuff used is about 20% bigger than the arm. The cuff is inflated until the artery is completely occluded. Then, the sensor takes action sensing the brachial artery at the cuff; the microcontroller controls the valve which slowly releases the pressure in the

cuff. As the pressure in the cuffs falls, a pulsation sound is heard when blood flow first starts again in the artery. The pressure at which this sound began was known and recorded as the systolic blood pressure. Furthermore, the cuff pressure was further released until the sound can no longer be heard. This was recorded as the diastolic blood pressure. There were two main blood pressure flows such as systolic blood pressure and diastolic blood pressure. Below are the definitions of each blood flow.

Systolic blood pressure - is the amount of pressure that blood exerts on vessels while the heart is beating. In a blood pressure reading (such as 120/80), it is the number on the top.

Diastolic blood pressure – is the pressure in the bloodstream when the heart relaxes and dilates, filling with blood. In a blood pressure reading (such as 120/80), it is the number on the bottom.



Fig 3.5 D ring Cuff

D-ring cuffs come in different sizes of small, standard and large. It was important to pick out the right size cuff based on your individual arm circumference. Expandable Cuff was a pre-formed upper arm cuff that expands to fit both regular and large sized arms. It was designed to ensure more comfortable, accurate readings. There was a reasonable standard expandable D-Ring cuff which had a circumference between 9” to 13” – 22 to 32 cm which was being used for this research work. It was very important to use the appropriate size cuff for your arm in order to get accurate measurement results when using your home blood pressure monitor. If you use the wrong sized cuff, you were likely experiencing inaccurate readings, inconsistent readings and error messages from the device. To determine the arm size, we used a cloth tape measure and place midway between the elbow and the shoulder around the circumference of the upper arm.[4]

IV. EXPERIMENTAL WORK

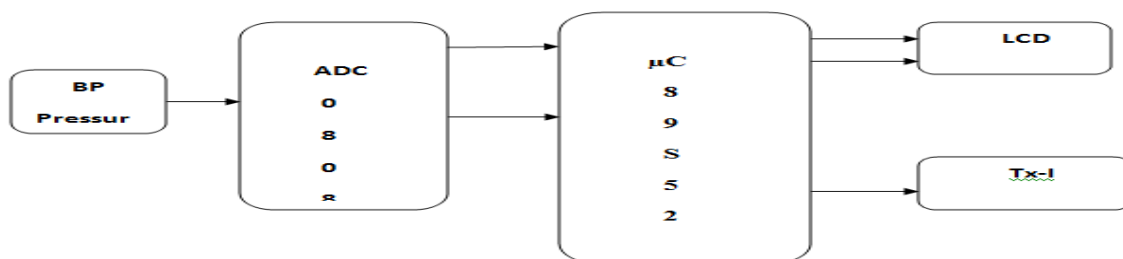


Fig 4.1 Block diagram BP system

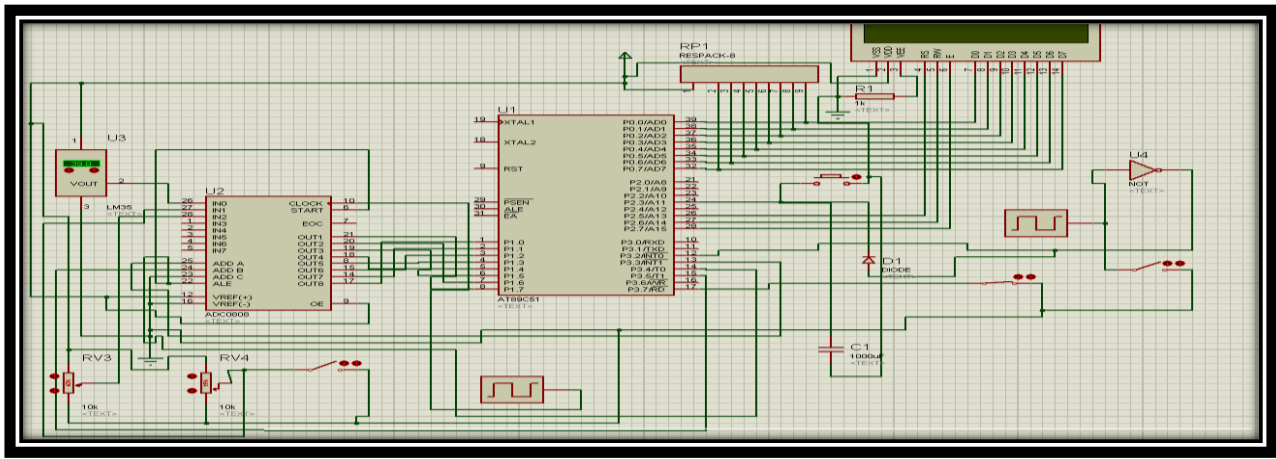


Fig 4.2 Circuit diagram of BP Measuring system

ADC 0809 is used to convert analog signals from temperature sensor, and pressure sensor to digital values to read by microcontroller. Heart beats are monitored in any digital pin of microcontroller. Here we are using pin 12 of microcontroller. A switch is provided to measure the BP. In this mode only BP will be measured and the values are stored in memory. And by changing position of switch all parameters will be measured and send to receiver. Data pins of ADC are connected to pin 1 to 8 of microcontroller. Select pin 25 of ADC is connected to pin 13 of microcontroller for selecting channels. Pin 24 is connected to pin 16 of microcontroller. And third select pin is grounded. Start of conversion pin 6 and 22 are shorted and used as start of conversion and is connected to pin 14 of microcontroller. clock at pin 10 is provided by IC555, and this IC is used as astable multivibrator and provide 20KHz clock. LCD data pins are connected to pin 32 to 39 of microcontroller. RS pin is connected to pin 26 of microcontroller, RW pin is connected to pin 27 and Enable pin to pin 28 of microcontroller.

Microcontroller measures Temperature then pressure from pressure sensor in BP switching. And then measure the pulse stop to pump motor. And measure higher blood pressure. And when again pulse starts that time it measures lower pressure. The data will be continuously transmitted using RF transmitter. The parameters measured are displayed on LCD display

A. BP amplifier circuit

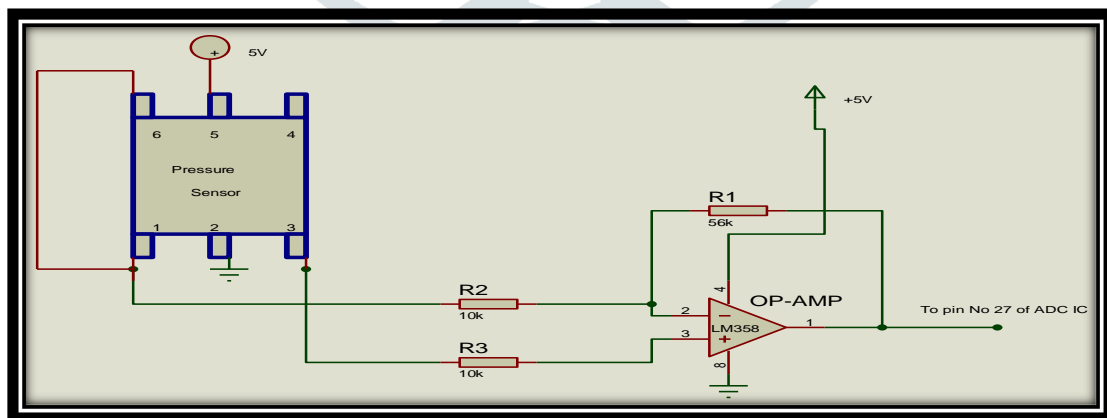


Fig 4.3 BP amplifier Circuit



Fig 4.4 Hardware ckt of BP Amplifier Ckt

The signals from pressure sensor were very weak so it was necessary to amplify the signals to read by ADC. So for this we were used an op- amp circuit constructed with LM 368 IC. The inputs from sensor were connected to pin 2 and pin 3 of this op-amp IC. Amplification factor was selected by using 96K resistor connected at pins 2 and pin 1 of this IC so at the output amplified signals were available and it was connected to pin 27 of ADC to read pressure.

B. Microcontrollers: (AT 89S52)

A microcontroller is a dedicated computer in electronics that was used to perform specific tasks. For the purpose of this research, a microcontroller was used because, besides being a low-power device, it has a low cost and it was designed to be as compact as possible. The microcontroller would take input from the device that it was controlling and it would be sending signals constantly to different components of the device so it performs the desired tasks. Among all the microcontrollers available at the market, the research uses the 89S52.

It is a Low-power, high-performance CMOS 8-bit microcontroller with 8KB of ISP flash memory. The device uses Microchip high-density, nonvolatile memory technology and is compatible with the industry-standard 89S52 instruction set and pinout. On-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. This powerful microcontroller is suitable for many embedded control applications.

In this research work the Embedded C language programming is done in microcontroller IC 89S52 to controlling the Blood pressure. The software aspects i.e Proteus and Ride software is used for designing and programming.

V. RESULT AND DISCUSSION

The Systolic and Diastolic Blood Pressure for Seventy two different patients were recorded using the designed hardware instrument and were compared with the values obtained by standard means. The values recorded were tabulated and is shown in the tables given below.

| BP - Systolic | | | |
|----------------------|------------------------|------------------------------|------------------|
| Sr No | Patients Data | | Deviation |
| | Standard Device | Experimental Measures | |
| 1 | 80 | 77 | 3 |
| 2 | 81 | 79 | 2 |
| 3 | 83 | 79 | 4 |
| 4 | 85 | 80 | 5 |
| 5 | 86 | 85 | 1 |
| 6 | 88 | 72 | 6 |

| | | | |
|----|-----|-----|----|
| 7 | 89 | 85 | 4 |
| 8 | 92 | 91 | 1 |
| 9 | 93 | 93 | 0 |
| 10 | 95 | 91 | 4 |
| 11 | 96 | 97 | -1 |
| 12 | 98 | 93 | 5 |
| 13 | 98 | 96 | 2 |
| 14 | 100 | 102 | -2 |
| 15 | 102 | 97 | 5 |
| 16 | 103 | 98 | 5 |
| 17 | 104 | 103 | 1 |
| 18 | 106 | 106 | 0 |
| 19 | 108 | 102 | 6 |
| 20 | 113 | 107 | 6 |
| 21 | 116 | 114 | 2 |
| 22 | 118 | 120 | -2 |
| 23 | 124 | 121 | 3 |
| 24 | 126 | 125 | 1 |
| 25 | 126 | 127 | -1 |
| 26 | 129 | 125 | 4 |
| 27 | 130 | 128 | 2 |
| 28 | 134 | 131 | 3 |
| 29 | 138 | 132 | 6 |
| 30 | 141 | 141 | 0 |
| 31 | 143 | 139 | 4 |
| 32 | 143 | 142 | 1 |
| 33 | 144 | 139 | 5 |
| 34 | 145 | 143 | 2 |
| 35 | 146 | 147 | -1 |
| 36 | 146 | 145 | 2 |
| 37 | 148 | 140 | 8 |
| 38 | 149 | 147 | 2 |
| 39 | 150 | 144 | 6 |
| 40 | 152 | 143 | 9 |
| 41 | 152 | 148 | 4 |
| 42 | 154 | 154 | 0 |
| 43 | 155 | 145 | 10 |
| 44 | 157 | 150 | 7 |
| 45 | 158 | 153 | 5 |
| 46 | 160 | 161 | -1 |
| 47 | 162 | 159 | 3 |
| 48 | 162 | 163 | -1 |
| 49 | 163 | 160 | 3 |
| 50 | 164 | 160 | 4 |
| 51 | 165 | 161 | 4 |
| 52 | 166 | 163 | 3 |
| 53 | 168 | 168 | 0 |
| 54 | 168 | 166 | 2 |
| 55 | 169 | 161 | 8 |
| 56 | 170 | 166 | 4 |
| 57 | 171 | 175 | -4 |
| 58 | 173 | 167 | 6 |
| 59 | 173 | 172 | 1 |
| 60 | 174 | 168 | 6 |
| 61 | 176 | 178 | -2 |
| 62 | 177 | 171 | 6 |
| 63 | 178 | 174 | 4 |
| 64 | 180 | 172 | 8 |
| 65 | 180 | 178 | 2 |

| | | | |
|----|-----|-----|----|
| 66 | 184 | 182 | 2 |
| 67 | 185 | 180 | 5 |
| 68 | 186 | 180 | 6 |
| 69 | 188 | 174 | 14 |
| 70 | 189 | 196 | -7 |
| 71 | 192 | 186 | 6 |
| 72 | 192 | 193 | -1 |

Table 2 .BP- Systolic data Recorded by Different Means and the Deviation

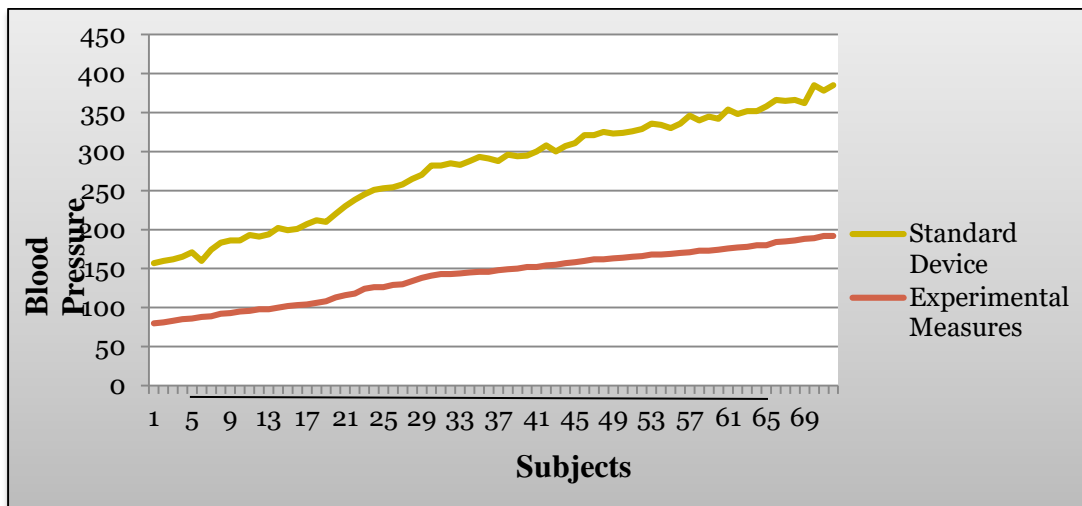


Fig 5.1 Plot Showing the BP for Various Patients

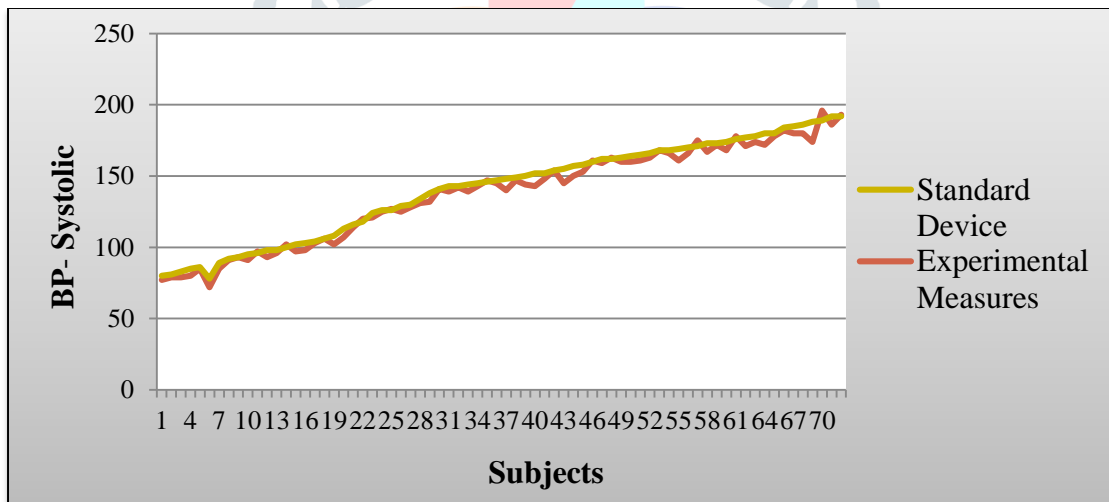


Fig 5.2 Plot Showing the Comparison of Data for BP - Systolic

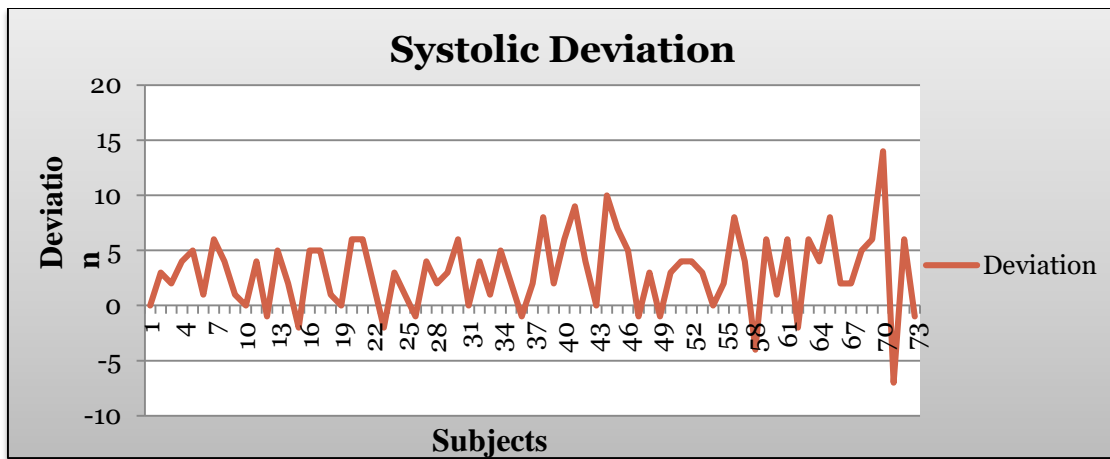


Fig 5.3 Plot Showing the Deviation for BP - Systolic

| BP - Diastolic | | | |
|----------------|-----------------|-----------------------|-----------|
| Sr No | Patients Data | | Deviation |
| | Standard Device | Experimental Measures | |
| 1 | 52 | 49 | 3 |
| 2 | 53 | 48 | 5 |
| 3 | 53 | 51 | 2 |
| 4 | 54 | 51 | 3 |
| 5 | 55 | 55 | 0 |
| 6 | 56 | 54 | 2 |
| 7 | 56 | 53 | 3 |
| 8 | 57 | 56 | 1 |
| 9 | 57 | 58 | -1 |
| 10 | 57 | 53 | 4 |
| 11 | 58 | 56 | 2 |
| 12 | 59 | 58 | 1 |
| 13 | 60 | 62 | -2 |
| 14 | 61 | 57 | 4 |
| 15 | 61 | 60 | 1 |
| 16 | 63 | 60 | 3 |
| 17 | 63 | 58 | 5 |
| 18 | 65 | 63 | 2 |
| 19 | 66 | 62 | 4 |
| 20 | 68 | 67 | 1 |
| 21 | 68 | 65 | 3 |
| 22 | 69 | 67 | 2 |
| 23 | 70 | 69 | 1 |
| 24 | 70 | 66 | 4 |
| 25 | 72 | 68 | 4 |
| 26 | 73 | 67 | 6 |
| 27 | 73 | 74 | -1 |
| 28 | 74 | 71 | 3 |
| 29 | 76 | 75 | 1 |
| 30 | 78 | 74 | 4 |
| 31 | 82 | 79 | 3 |
| 32 | 82 | 82 | 0 |
| 33 | 83 | 78 | 5 |
| 34 | 84 | 87 | -3 |
| 35 | 86 | 81 | 5 |

| | | | |
|----|-----|-----|----|
| 36 | 87 | 86 | 1 |
| 37 | 88 | 86 | 2 |
| 38 | 88 | 90 | -2 |
| 39 | 89 | 83 | 6 |
| 40 | 90 | 86 | 4 |
| 41 | 92 | 89 | 3 |
| 42 | 93 | 91 | 3 |
| 43 | 93 | 94 | -1 |
| 44 | 94 | 92 | 2 |
| 45 | 96 | 94 | 2 |
| 46 | 97 | 92 | 5 |
| 47 | 97 | 96 | 1 |
| 48 | 98 | 95 | 3 |
| 49 | 99 | 96 | 3 |
| 50 | 101 | 95 | 7 |
| 51 | 101 | 97 | 4 |
| 52 | 102 | 100 | 2 |
| 53 | 103 | 102 | 1 |
| 54 | 104 | 105 | -1 |
| 55 | 106 | 99 | 7 |
| 56 | 106 | 106 | 0 |
| 57 | 107 | 102 | 5 |
| 58 | 108 | 105 | 3 |
| 59 | 108 | 100 | 8 |
| 60 | 110 | 107 | 3 |
| 61 | 112 | 108 | 4 |
| 62 | 112 | 111 | 1 |
| 63 | 114 | 115 | -1 |
| 64 | 117 | 114 | 3 |
| 65 | 118 | 124 | -6 |
| 66 | 120 | 118 | 2 |
| 67 | 121 | 121 | 0 |
| 68 | 122 | 116 | 6 |
| 69 | 122 | 118 | 4 |
| 70 | 124 | 121 | 3 |
| 71 | 126 | 126 | 0 |
| 72 | 126 | 128 | -2 |

Table 3. BP - Diastolic Recorded by Different Means and the Deviation

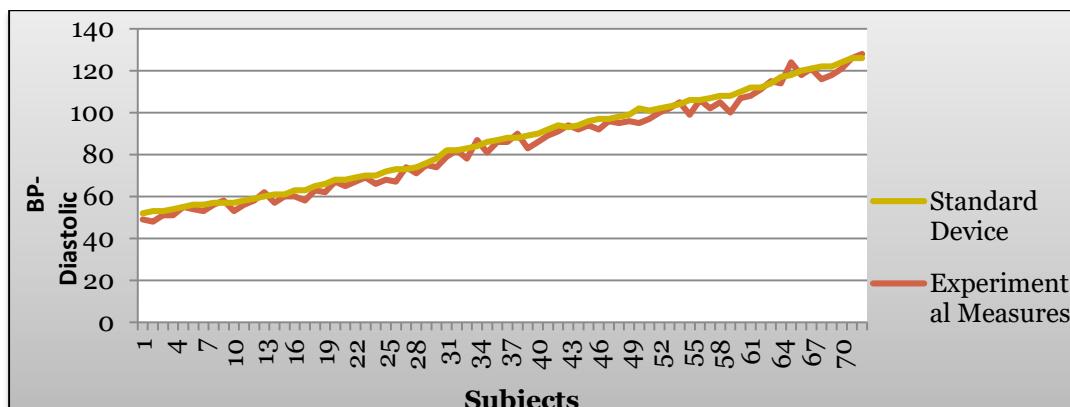


Fig 5.4 Plot Showing the BP for Various Patients

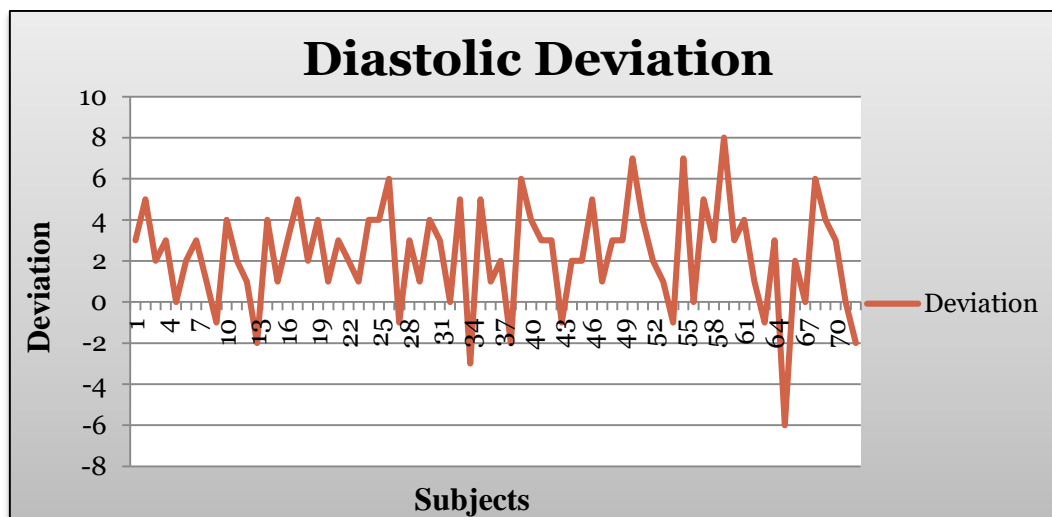


Fig 5.5 Plot Showing the Deviation for BP – Diastolic

The percentage of deviation for each subject was calculated. It was found that the percentage ranged between 0 and 8. Three different ranges were set between 0 and 8% – 0 to 2%, 3 to 5% and 6 to 8%.

VI. CONCLUSION

With this kind of approach and resource simple and very cost effective automatic blood pressure monitoring system using wireless technology can be designed which will be very useful in medical field, laboratories and industries where we can get better and more accurate result as compared to other biomedical devices.

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DESIGN AND IMPLEMENTATION OF LOW COST BLOOD PRESSURE & BODY TEMPERATURE MONITORING SYSTEM USING WIRELESS TECHNOLOGY

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Abstract

The objective of this research work is to design and implementation of a non-invasive, accurate, and low cost biomedical sensor interface for processing and monitoring blood pressure and body temperature using wireless technology. In present development, the real time blood pressure biomedical signal is measured using an optical measurement circuit based plethysmography technique (PPG) continuously monitor the systolic and diastolic blood pressure for a long period of time & Body temperature is dealt with a LM35 sensor. The detected measured signal amplified using an operational amplifier circuit and interface with the microcontroller. The numerical reading values of systolic and diastolic blood pressure remotely recorded and displayed with the help of LCD and stationary computer.

Key Words: Blood Pressure, Body temperature, Wireless, Non-invasive, monitoring system etc.

I. INTRODUCTION

“Health is Wealth”, is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing accurate reproduction of body signals

and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research.

Knowing the physical status of a person is very important for understanding the body condition of a person. Vital signs that play an important role for understanding the condition of human system are heart rate, temperature and blood pressure of a person. In this method we had made use of three sensors LM35, blood pressure sensor which has the sensing element as SPD100G.

A. Blood Pressure:

Blood pressure is the most often measured and most intensively studied parameter in medical and physiological practice. Pressure measurements are a vital indication in the successful treatment and management of critically ill patients in an intensive cardiac care unit or the patients undergoing cardiac catheterisation.

The measurement of BP are of great importance because it is used for detection of hypertension (high blood pressure). Hypertension is a continuous, consistent, and independent risk factor for developing cardiovascular disease. Hypotension can cause the blood supply to the brain, heart and other tissues to be too low, and hypertension is strongly correlated with higher risk for cerebral stroke and heart infarct. Blood pressure measurement is also important for particular disease patients, such as hemodialysis patients. Hence, in the daily life, blood pressure measurement and management is very useful

for handling health situation and plays a preventive function.

B. Temperature: Temperature is measured using LM35 sensor. The human body temperature is measured by placing hand on the sensor LM 35 it reads the value and gives an ADC value which is converted to the Celsius degrees

II. METHODOLOGY

A. Photoplethysmography Unit (PPG):-



Fig 1. Photoplethysmography Technique

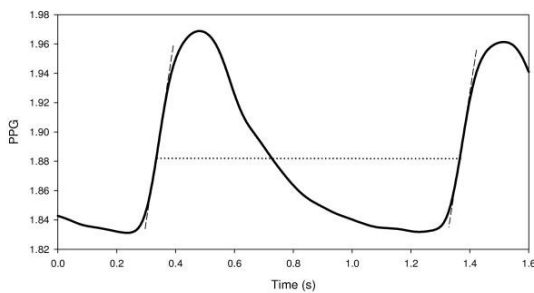


Fig 2. PPG Waves

pressure monitors are based on oscillometric method accepted and widely used mobility, they require suitable for home-care and long-term monitoring of BP for homecare inexpensive method that is and does not require These requirements can be which will be designed using technique. method used to measure volume in the tissues. It utilizes contains an infrared light a part of the tissue photo-detector receives the obtained from this technique which can be used to is shown in fig. 1 where used as the source and a phototransistor is used as the detector.

More to the point, a developed technique based on a noninvasive continuous blood pressure measurement using volume oscillometric method and photoplethysmograph technique has been investigated , and the study uses high intensity LED and a LDR (Light Dependent Resistor) and placed them at the edge of a finger. The concept is that the resistance of the LDR changes according to the light intensity received by the LDR. The change in resistance is proportional to the change of blood volume and as well as blood pressure in the finger. The result showed the systolic and diastolic blood pressure on a mini LCD. In

addition, a non-invasive blood pressure monitor was developed using photoplethysmograph method.

B. Body Temperature

The body temperature is measured by LM35, a precision integrated-circuit temperature sensor whose output value is proportional to the Celsius temperature. It's a three pin IC where we have supply output and ground connections

Temperature is a measure of the degree of heat intensity. The temperature of a body is an expression of its molecular excitation. The temperature difference between two points indicates a potential for heat to move from the warmer to the colder point. The human body's core temperature varies from day to day, and from time to time, but these fluctuations are small, usually no more than 1.0°C. Humans are homoeothermic and body temperature is regulated at about 37°C ±1°C. The thermoregulatory center in the hypothalamus plays a very active role in keeping body temperature in the normal range. External and internal heat sources influence body temperature.

LM35 generates higher output voltage than thermocouples and may not require that the output voltage be amplified. The scale factor is 0.01V/OC.LM35 does not require any external calibration or trimming and maintains an accuracy of 0.4C at room temperature and 0.8c over a range of 0 to 100.



Fig 3. Temperature sensor circuit

III. EXPERIMENTAL WORK

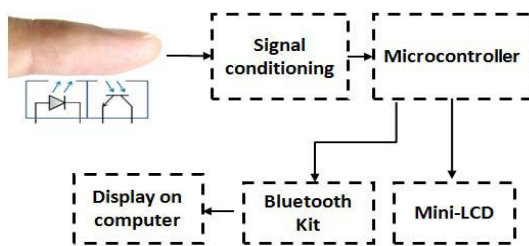


Fig 4. Circuit diagram of system.

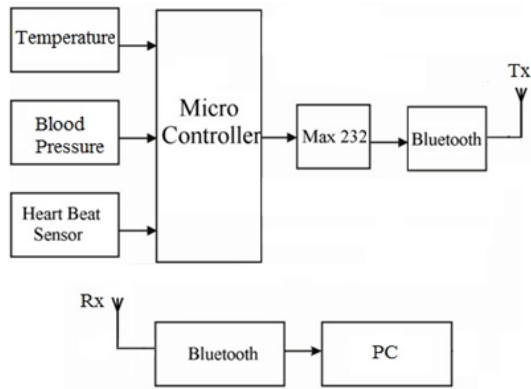


Fig 5. Blood Pressure and Body temperature monitoring

A. Sensing Stage

The detection of the blood pressure signal is based on using optical measurement technique called photoelectric plethysmography (PPG). This technique has the ability to detect the volume of blood pressures in the arteries. The PPG basic form utilizes two components: a light source to illuminates a part of the tissue (e.g. fingertip) and a photo detector to receive the light. Transparency of living tissue to light makes it possible for some part of the light from the source to pass through the tissue to the photo-detector. However, some part of the light is absorbed by the blood, bone, muscle and skin in the tissue. The volume of the blood in the vessel varies while the volume of other part remains constant. Therefore the light absorption is varied only by the change of volume of blood (increases or decreases) and the returning light to the photo-detector changes according to the change of blood volume. The electrical resistivity of the photo-detector changes depending on the amount of light falling on it. This change of resistivity results is the change of electrical current flowing in the detector which is converted into PPG signal.



Fig 6. Optical Sensor

The LM35 temperature sensor is proposed in this work for measuring the human body temperature. It is a precision integrated circuit

Temperature Sensor which is small and can be placed anywhere on the body.

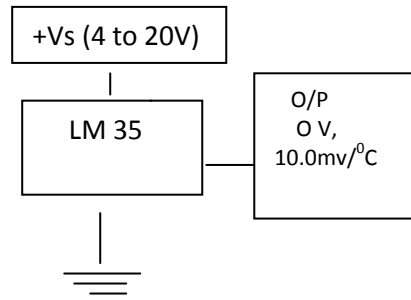


Fig 7. Temperature sensor

The LM35 output voltage is linearly scalable to the measured temperature, which is 10 mV per 1 degree Celsius as shown in fig 8. So if $V_{out} = 0.37V$ then the measured temperature is $37^{\circ}C$. It does not require external calibration and maintains an accuracy of $\pm 0.4^{\circ}C$ at room temperature and $\pm 0.8^{\circ}C$ over a range of $0^{\circ}C$ to $+100^{\circ}C$ [26,

A. Signal Conditioning Stage:

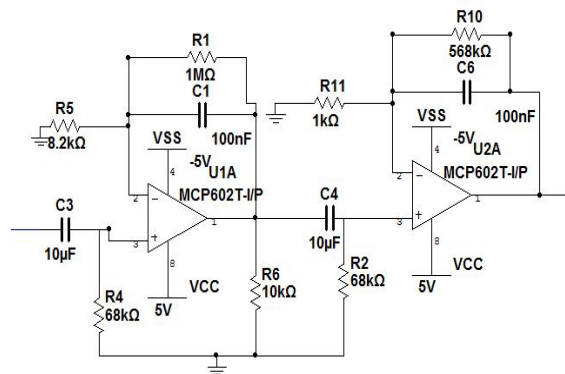
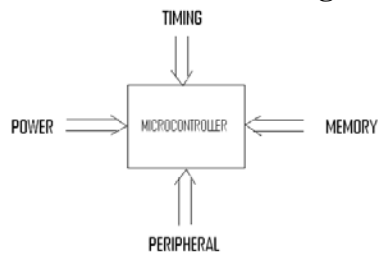


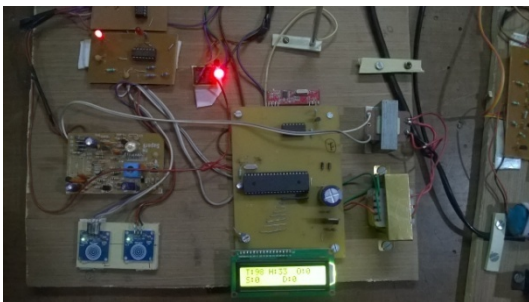
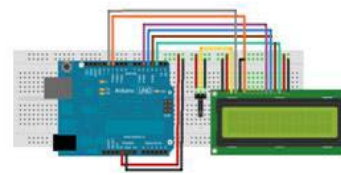
Fig 8 . Circuit Diagram

After the sensor detected the changes in the volume of blood pressures, a low frequency and low magnitude biopotential signal is received by the photodiode. As the detected PPG signal is so weak, it must undergo some signal conditioning (e.g. amplifying and filtering) so that it can be used for further processing. Since the output voltage of the photo-detector has a large amount of dc component which requires a filter to suppress out the dc component. A good filter choice will be the use of an active bandpass filter because its first cut off frequency can be used to remove direct current (DC) and its second cutoff frequency can be used to remove unwanted high frequency components in the signal like power line interference (50 Hz). In addition, the filter is also used with a very high gain for amplifying the signal. Two stage bandpass filter are used and each stage has different gain.

B. Microcontroller Stage:**Fig.9 Essential block of microcontroller requirement (PIC18F252)**

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. The output of the signal conditioning stage is fed into a microcontroller where it is processed (sampling and quantizing). The PIC18F252 microcontroller is used in this system where it has a built-in ADC. The PIC18F252 device family can operate at speeds up to 12MIPS and has a hardware multiplier for faster calculation of control algorithms. The microcontroller finds out the smallest (represents DBP) and the largest (represents SBP) value form the output voltage using a program written in MPLAB X IDE.

The microcontroller then displays the measured blood pressure information in mini LCD and transmits them through a Bluetooth device to any stationary enabled computer device. Buzzer alert of the system helps the patient itself to be aware of his/her condition and can take necessary steps towards medication. At the same time, physician can also diagnose the patient from a remote location as system provides SMS alert at critical situations. The Bluetooth interface provides a convenient and low power consumption method for data transmission. This system provides users an easy-to-interface interface and simple blood pressure management environment.

**Fig . 10 Experimental Work****D. LCD (Liquid Crystal Display) with Driver.****Fig 11 . LCD (Liquid Crystal Display)**

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

E. Bluetooth Technology

By using Bluetooth (SKKCA-21) Remote Control. SKKCA-21 module offers simple yet compact Bluetooth platform for embedded applications. It has a surface mount layout which makes the process of development and application easier. The Bluetooth transmits the reading to the PC equipped with Bluetooth. The display on computer is acquired using special software called Parallax-Serial-Terminal. It is simple terminal software which allows users to display results through predefined serial ports.

F. RF Transceiver Module.**Fig.12 RF Module**

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

IV. RESULT AND DISCUSSION



Fig 13. Circuit Result

This system monitors the blood pressure and the temperature in the PC screen by using the Bluetooth technology. This entire system requires less power which can even implemented in remote (mobile) patients too. We can add some another parameters as per our necessary.

When the power is turned on, all the LEDs on PCBs starts glowing, indicating that circuit is working properly. Here there is a use of the industrial temperature sensor i.e. LM 35 which gives us room temperature in °C. That temperature is displayed on the LCD.

| <u>Age</u> | <u>Gender</u> | <u>PPG(reading)</u> |
|------------|---------------|---------------------|
| 20 | Female | 79 |
| 26 | Female | 78 |
| 38 | Male | 84 |
| 56 | Male | 65 |
| 60 | Male | 70 |

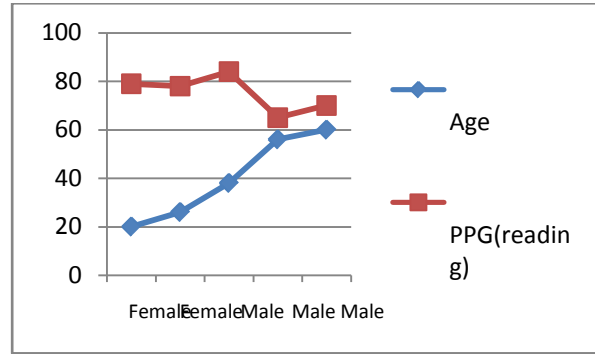


Fig. 14 Graph in between Age, Gender and PPG readings.

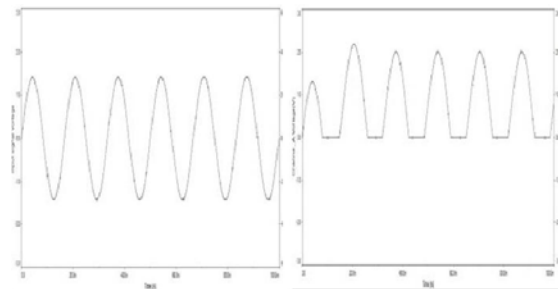


Fig. 15 Input and output waveform of amplifier in Multisim

V. CONCLUSION

With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The small embedded system can display the systolic and diastolic blood pressure on a mini LCD as well stationary computer which is a Bluetooth enabled device though Bluetooth wireless technology. In case of any abnormal changes in the blood pressure readings, the system alerts using a buzzer and it also send a message to the predefined number(i.e. a physician number) using GSM. Furthermore, the obtained results will be compared with existing devices data like a sphygmomanometer to verify the accuracy of the developed instrument. This system provides users an easy-to-use interface and simple BP management environment. The Bluetooth interface provides a convenient and low-power consumption method for data transmission. This work may further be extended in future to include more number of physiological parameters like heart rate, oxygen saturation, respiration rate etc. to be monitored for a long period of time. GPS system can be used to spot the exact position of the patient and thus can provide immediate help if required.

V. FUTURE SCOPE

The Scope of research work intended to design and construct an blood pressure and body temperature measurement using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

The device can be connected to PC by using serial output so that measured heartbeat and temperature can be sent to PC for further online or offline analysis.

Warning for abnormalities of health condition can be displayed.

Sound can be added to the device so that the device makes a sound each time a pulse is received and alarm is started for abnormal health condition.

The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.

More parameters (like blood pressure) can be added to

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Technological Resources in Language Teaching and Learning Beyond the Box: ICT and Weblinking as New forms of ELS

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Abstract:

As the traditional methods of teaching-learning are becoming obsolete at an alarming rate, we are forced to look for some additional or supplementary arrangements that can help improve and enhance the process. There is an additional feature central to it and that is empowerment of the total process of education. There can be but some basic issues that hold our attention towards addressing it. These issues can be related with the pattern of syllabus, the methods of teaching that are subject and content oriented as well as are suitable and appropriate, availability of tools that help and facilitate the teaching-learning, evaluations process that may be written and oral, its appropriate form and also evaluation and assessment of outcomes at the end of the term and session. There can be some more issues and topics still holding extreme importance for the course of education such as suitability of course content and its delivery as per the needs of outside world. We can also think about those aspects that are student centric and leading him to the areas of development by all aspects that a good learning includes and not just the pedagogic issues of general importance.

Keywords: New Methods of Teaching-Learning, ICT, Instructional Technology, Web Apps, LSRW, Effectiveness, Cost, Impartiality and Sustainability, Digital Literacy, Productive and Receptive Factors, etc.

Introduction: We observe that there is a constant moving ahead in course of time regarding the teaching methods, methodology, patterns, tools, environment and culture as well as the target groups. This all is supported by those aspects of language that have not been visited till with a serious concern. And these issues are of technological intervention. As the means of communication are being operated by mobile gadgets including the first generation of PAGERS and then to MOBILE PHONES first generation leading to second and third generation phones, there are more changing patterns of use of mobile language. Before and after even the regional language could have been introduced for users, the use of English language did not see any decline and fall. Even after the incoming regional language softwares in mobile phones, there are varied usages of English language and that is preferred for communication. There is also a shift in its

usage, it is becoming more and more informal. Today we observe that even the simplest occurrences are called as great and this could be anything as simple as a new hairstyle picked up from a new generation. The oral expressions do not demand the right spelling and etymology of the word... and nor the written one as great is written as gr8 or g8. The number is in crores where the usages are simple, knowing and not knowing it to its fullest extent. A text message to express 'great' does not require knowing the spelling, it is made possible with shortened crypted words.

There is a positive impact of all this... the word 'great' for its feelings is used widespread, increasing the number of English language users. But the other side is not that much pleasant, it develops usage of words without knowing its health and appearance. To a larger extent, of time and use, it remains unknown, it loses its significance in case of letters and becomes informal. The IVRs (Interactive Voice Response System) used commercial companies have created a special example how language can be used in a mechanical way. When we dial a mobile networking company or a bank or any other organization with this facility, we get automatically leading promptings according to which we lead ourselves. The total promptings are not heard and understood clearly but with a mere one or two words, we are prompted again what number to press and get things done. This is all miraculous! This is a model of e-learning or learning with mechanical and technological intervention. We can imagine ourselves in a classroom where students can be given assignments on learning LSRW. The first techno-based LSRW as developed for commercial purposes has been still working and that is Medical Transcription. It's here they teach and train the executives or staff what they shall be working at. This example can be designed and worked out for language learning in case of English in tertiary education.

As the coverage of networking is improving day by day, there are more number of users connected to each other and at every stage they are facing features of English language. The gadget in users' hand can be made into a learning device and things are done on a click. Internet connection used to be an extra thing or an assignment outside, but now it's all personal, that has also improved the chances of learning but they are not yet discovered to its potential. As we all know that the Indians have accepted English as a means of communication faster than others. Half a century after Indian independence, English remains the language of higher education, national media, the upper judiciary and bureaucracy and corporate business. English speakers in India outnumber those in all of Western Europe, and Indian English-speakers are more than twice the UK's population. And to our surprise, Hindi, the official language of central government is now being replaced by the upcoming generations with English as a means of communication. This all is happening because there is an excessive intervention of English language in almost every field right from advertising kitchen wares to higher education and grooming of professionals.

The Instructional Technology:

Instructional technology stands for anything that can be called as instruction with the Technological Resources in Language Teaching and Learning with the help of technology in its simplest forms and execution. It is said simplest for the reason that needs to be handy and user-friendly.

Technology should not make it worse or difficult as it should be designed for facilitation and maximum utility. There are several instruments that can be covered under this but they are not easy to handle and operate both for instructors and learners. There come in those aspects of learning with the help of such technological gadgets and assisted objects that can really facilitate learning as a pleasant experience, it should make the pupils curious to learn all they want in academics or though the prescriptions of syllabi. Instructional technology has been very carefully picked up and taken up for deeper research & foreign countries and we observe that they are producers and sellers of such gadgets, softwares etc. the inland machinery is not that much developed and does not also focus on long term functioning. There is no denying the fact that the maintenance of such gadgets and significance we award to it are all matters of concern. These issues need to be enforced through the apex bodies like UGC and then only the true impact can be seen.

Information Communication Technology:

ICT is a foremost issue that can be seen as a flagship initiative. This started from simple CD ROMs where there was storage of information and it could be retrieved as and when you want it. This is related with the learners as well as teachers. This facilitated the availability of resources even in absence of a fully occupied classroom and teacher. Principally, ICT stands for information and communication technologies and can be defined as 'a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, manage information.' There are four broad issues that are integral factors of its appearance case of teaching learning process. They are EFFECTIVENESS, COST, IMPARTIALITY SUSTAINABILITY. Though these are not yet handled so ably, there are some approaches that can be primarily studied.

- i. Learning about computers and the internet, in which technological literacy is end goal: this includes: Fundamentals, basic terms, concepts and operations, Use keyboard, mouse, Use of tools-word processing, spreadsheets, database, Collaboration tools: Search engines and e-mails.
- ii. Learning with computers and the internet, in which the technology facilitates learning across the curriculum: this includes step further: Presentations, Educational games, drills and practice, visualization, online Information and resources.
- iii. Learning through computers and the internet, integrating technological skills development with curriculum applications: the core area is learning about these learning with them.

This is systematic representation of how ICT can be developed among centre of learning and that to facilitate English Language Learning across tertiary education. Some ICT tools such as Internet and broadcasting are used for online courses also added with some more ventures viz., web based collaboration tools-e mails, message boards, real-time chat, etc. There is a new concept 'Telecollaboration' where people from different locations work together for curriculum based improvements. This is all wonderful to understand first and execute for all.

What do we need first:

The establishment and development after execution of such matters is not but that much easy. Every time it's a language class, it all begins with a fear of grammar with many of the learners, they somewhat don't like this subject for the reasons that have had hampered their scores in different examinations. They need to be given what are the levels of a language study that needs to be undertaken. We can begin with the Micro and Macro levels of languages. These four language skills LSRW are called the 'macro-skills' and this is in contrast to the micro-skills', things like grammar, vocabulary, pronunciation and spelling. We must also teach them what comes first and leads to another. These language skills are related to each other in two ways as follows:

- i. The direction of communication (in or out)
- ii. The method of communication (spoken or written)

This can be supported with relationship among these skills as:

Receptive-oral: Listening

Receptive-written: Reading

Productive-oral : Speaking

Productive-written: Writing

If these issues are taken with the help of ICT tools, they shall help us to examine factors, affecting ELS, assess the level of awareness about Internet, explore gender differences, assess the use of internet by students of various disciplines, identify the problems they encounter in using and searching web and to put forward a practical solution to the problems of the users of various disciplines.

Digital Literacy:

MALT: In University of Brighton (UK), this course explores the role of media in the in the teaching and learning of languages. Students consider and create teaching resources which exploit digital technologies. Typical areas for investigation include interactive multimedia, the use of social software such as blogs and wikis, and the use of interactive electronic whiteboards. Participants develop analytical and investigative skills in relation to language learning and teaching generally. Students engage in preparatory reading for weekly seminars, which offer opportunities for discussion. They may also be asked to present their ideas formally to fellow students. In addition, students are expected to work independently, reading around their subject, identifying relevant areas for further enquiry, and undertaking a small-scale research study. Students are supported through individual tutorials and the university's online virtual learning environment student-central. There is a practical element enabling students to develop the skills needed to work with the digital tools required for materials design and production.

TELL: An alternative term, Technology-Enhanced Language Learning also emerged around the early 1990s: e.g. the TELL Consortium project, University of Hull.

CALL: The current philosophy of Computer Assisted Language Learning (CALL) puts a strong Emphasis on student-centred materials that allow learners to work on their own. Such materials

may be structured or unstructured, but they normally embody two important features interactive learning and individualised learning. CALL is essentially a tool that helps teachers to facilitate the language learning process. It can be used to reinforce what has already been learned in the classroom or as a remedial tool to help learners who require additional support.

What do we have for immediate and free use:

There is an ENGLISH LANGUAGE SKILLS APP developed by THE BRITISH COUNCIL. It is available for free and includes various topics such as Listen and watch, Stories and poem Grammar and vocabulary, Quick grammar, Grammar exercise, Vocabulary games, etc. These are some more apps such as 'Learn English Mobile App' by LEARN ENGLISH GRAMM-(UK EDITITON) and Grammar- Educational mobile app. 'IELTS Word Power', this is a vocabulary practice app for IELTS test takers. 'Sounds Right' is the British Council's for pronunciation App for learners and teachers worldwide.

Advantages of ICT Tools:

- Learning becomes more personalised.
- Learning becomes more independent as well as collaborative and interactive.
- Learning can happen at any place at any time.
- Learning is enriched with more updated materials and immediate according to the needs of the students.
- Learning becomes more varied and dynamic with the help of multimedia tools.
- ICT enabled learning increases learner satisfaction and motivates supportive atmosphere among various disciplines.

Advantages of ICT for ELS:

- Students can develop four basic language skills.
- Students are exposed to real English.
- ICT motivates students' senses.
- It supports different learning styles.
- Prescribed text can be made more interesting for students.
- Students develop real-life communication.
- It expands students' memory to remember things in an easier way.
- Both teachers and students can have extra chances of improving and polishing the active part of language, i.e. communication as & when needed.

There are some Excellent Google Drive Resources for Teachers that can perform wonders to make English classroom a favourite place. They come with 'Speak with a video Character and get instant

feedback', 'Improve your English speaking skills', 'From Beginners to Business and Academic Needs', etc. There are more than 100 levels, 1000 different dialogs, 1800 sentences, 1300 vocabulary and hundreds of quiz questions.

Mentioning Learn Languages Free (Duolingo), English Grammar Book (Appsoftindia), (English Conversation Practice (Miracle FunBox), English Tenses (Coderz), Speak English Fluently (Focus Soft), English Conversation Courses (MagikHub) and free websites such as english4 u, Grammmar-monster.com, Yale centre for Language Study, British Study Centre, etc. makes this article complete by all means.

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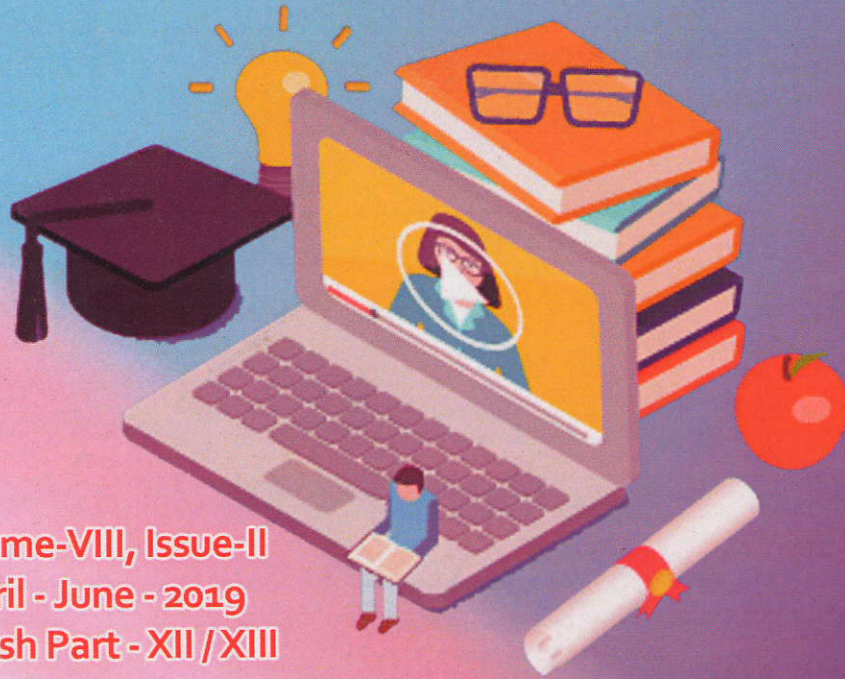


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18. Digital Dissimilarity: Looking Gender-Wise into the Mirror

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The primitive century led itself to an agrarian order and then to industrial revolution. This revolution in industrial sector targeted commerce throughout the world supported by technology. The present century found itself very soon on the strong hold of wired communication, then to wireless and now to virtual. There have been various areas of human existence and habitat which are monitored and controlled by technology.

The digital age we are now in is perhaps the best gift of researchers and scientists who put together their best efforts to create a seamless and hassle free world. And likewise every coin has its two sides, the digital revolution too has its benefits and losses too. Comparatively, but the ease is more in much and larger of all the cases we deal on routine basis and difficulties in very less areas.

This paper focuses on yet another aspect and that is the digital gap often found either among states, nations and races. Within nation there are various initiatives taken right from awareness creation to the realization of a particular policy or mechanism to drive simplicity in civic operations. In India only there are more than 451 million monthly active internet users and that is huge number. Comparing this (2019) we are only stand second only to China in terms of internet users and this has been positively reported by Internet and Mobile Association of India (IAMAI). Not only this but there are further things for sure to happen and that is there is a wider scope for the growth of this number. If we check out the details, it is found that there 385 million users are over 12 years of age and 66 million are in between 5 to 11 years. The active use is on multiple number of devices by the users like desktops, mobile phones, laptops and other gadgets. In case of urban users, the number is 192 millions and surprisingly the number is equal to the users in rural India. The IMAI report also has thrown opened a detailed scope to know that there is a clear gender disparity among the users reported. Taken into consideration the total

users of internet, less number of women users has been reported as compared to the male users and that questions the neutrality of a free and fair use of technology.

Earlier there have been cases of disparity based on gender in case of earnings. Though it still continues but with a difference of amount earned as salary and wages and the actual employment per gender. In case of use of technology that doesn't recognize gender at all, it is surprising to know that there are gaps even in the 21st century. It is noticed that, the female internet users' population is half of the 258 million male Internet users, and the partiality is more apparent in rural India. States like Kerala, Tamil Nadu and Delhi have a higher proportion of female Internet users as compared to male users.

Let's have a look at the few of many initiatives taken by the government of India. A few and popular ones are mentioned below:

Aadhaar: *The largest biometrics based identification system in the world, Aadhaar is a strategic policy tool for social and financial inclusion, public sector delivery reforms, managing fiscal budgets, increase convenience and promote hassle-free people-centric governance.*

Aadhaar Enabled Payment System: *AEPS is a bank led model which allows online interoperable financial inclusion transaction at PoS (MicroATM) through the Business correspondent of any bank using the Aadhaar authentication.*

BHIM (Bharat Interface for Money): *Bharat Interface for Money (BHIM) is an app that makes payment transactions simple, easy and quick using Unified Payments Interface (UPI).*

Crime and Criminal Tracking Network & Systems (CCTNS): *Crime and Criminal Tracking Network & Systems (CCTNS) is a plan scheme conceived in the light of experience of a non-plan scheme namely - Common Integrated Police Application (CIPA).*

Digilocker: *DigiLocker is the Indian Government's flagship program aimed at transforming India into a digitally empowered society and knowledge economy. DigiLocker ties into Digital India's visions areas of providing citizens a shareable private space on a public cloud and making all documents/certificates available on this cloud.*

Digital Saksharta Abhiyaan (DISHA): *The Digital Saksharta Abhiyan or National Digital Literacy Mission (NDLM) Scheme has been formulated to impart IT training to 52.5 lakh persons, including Anganwadi, ASHA workers and authorised ration dealers in all the States/UTs across the country. The initiative aims at training non-IT literate citizens to become*

IT literate to enable their active and effective participation in the democratic, developmental process, and enhance their livelihood too.

ePATHSHALA: *Developed by NCERT, ePathshala for showcasing and disseminating all educational e-resources including textbooks, audio, video, periodicals and a variety of other print and non-print materials through website and mobile app.*

eSAMPARK: *e-Sampark is a mechanism to connect the government directly with citizens across India by running mailer, outbound dialing and SMS campaigns. The platform is used for sharing informational and public service messages.*

eVISA: *The Ministry of Tourism supported the initiative regarding the implementation of Tourist Visa on Arrival enabled with Electronic Travel Authorisation. (Source: <https://digitalindia.gov.in/di-initiatives>)*

Gender Equality

Gender equality can be better understood as a hopeful journey to empowerment of half of the population in the world irrespective of geographical locations and social, economical classes and categories because every individual deserves an equal opportunity for growth. If digital world is a reality and holds a key for forward growth of folks around the world then it should be given to everyone as a tool free of cost and create mechanism so that it is realized in a proper time frame. There are some issues that have a strong connection with the realization of gender equality. We should also take into consideration the amount of control they have over the available resources and their utility. In addition to this the decision making powers are also a criteria to understand the truths behind the terms. Related are the terms of race, social class, economical status, ethnicity, religion, age and factors of disability.

We are but to consider that the age we live in is an age of transformation where there is lot of technological progress and a shift beyond time that is eager to catch all kinds of changes. Some of them are vulnerable for the present and coming generations too but that all is unstoppable.

Not let us check the quantitative data the world has to present us when we compare the digital literacy of the population.

Digital India is a flagship programme that seeks to transform India into “a digitally empowered society and knowledge economy” by 2018 (Government of India Cabinet, 2014). It was approved by the Union Cabinet in August 2014 with the objective of providing “intensified

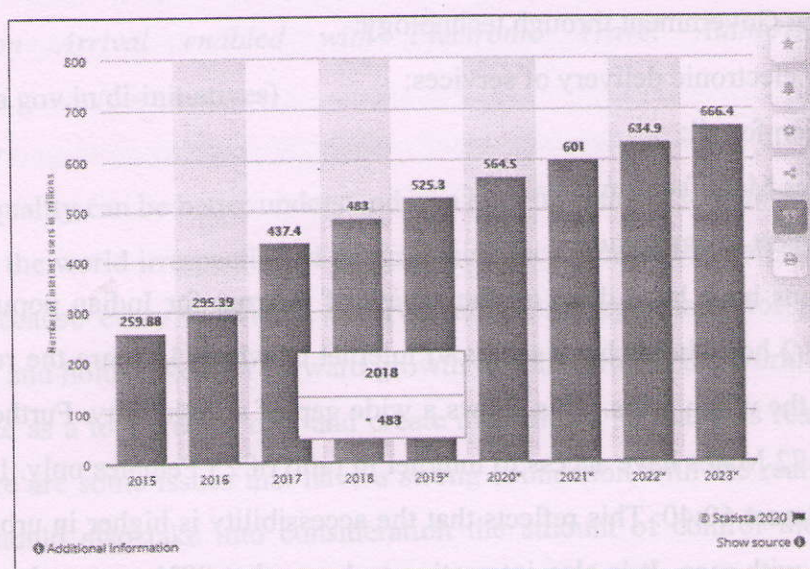
impetus” to existing e-governance initiatives and promoting “inclusive growth” by leveraging new manufacturing and job opportunities, especially in electronic manufacturing and IT-enabled services (ibid). The focus of the programme is defined in terms of nine key areas, termed the “programmatic pillars”. They are summarised below (Department of Electronics and Information Technology, 2014). The efforts by the Government of India mentioned below are commendable in the case if the digital gap is to be overcome. It has following nine pillars to go by:

1. Building national broadband highways
2. Universal access to mobile connectivity
3. Public Internet access programme:
4. Reforming Government through technology:
5. E-kranti / electronic delivery of services:
6. Information for all:
7. Electronics Manufacturing
8. Early Harvest Programmes

Investigations have been done on the access of internet for Indian population and it is found that only 15.2 households have access to internet of which 15.6 are the rural households and 72.5 are from the urban areas. This shows a wide gap of accessibility. Further compared, in case of rural india 72 Males have access to internet in ratio of 25 Females only. In case of urban area this ratio is almost 60:40. This reflects that the accessibility is higher in urban womenfolks but still not at par with men. It is also interesting to know that 98% women have reported that Facebook is a commonly used platform. It does show that where there is ease of accessibility, it is used for trending and common causes of being found on social media platforms. Only 49% women have found links outside Facebook, 17% are seeking information on health, rights, development projects, etc; 4% have reported that they have found important information about seeking a job and only 1% have found a support through online available networks. This data is enough to reflect that mere availability of internet access is not a sufficient area to discuss rather the factual position of what kind of benefits the user has received.

| WORLD INTERNET USAGE AND POPULATION STATISTICS | | | | | | |
|--|------------------------|-----------------------|-----------------------------|---------------------------|------------------|------------------|
| 2019 Mid-Year Estimates | | | | | | |
| World Regions | Population (2019 Est.) | Population % of World | Internet Users 30 June 2019 | Penetration Rate (% Pop.) | Growth 2000-2019 | Internet World % |
| Africa | 1,320,038,716 | 17.1 % | 522,809,480 | 39.6 % | 11,481 % | 11.5 % |
| Asia | 4,241,972,790 | 55.0 % | 2,300,469,859 | 54.2 % | 1,913 % | 50.7 % |
| Europe | 829,173,007 | 10.7 % | 727,559,682 | 87.7 % | 592 % | 16.0 % |
| Latin America / Caribbean | 658,345,826 | 8.5 % | 453,702,292 | 68.9 % | 2,411 % | 10.0 % |
| Middle East | 258,356,867 | 3.3 % | 175,502,589 | 67.9 % | 5,243 % | 3.9 % |
| North America | 366,496,802 | 4.7 % | 327,568,628 | 89.4 % | 203 % | 7.2 % |
| Oceania / Australia | 41,839,201 | 0.5 % | 28,636,278 | 68.4 % | 276 % | 0.6 % |
| WORLD TOTAL | 7,716,223,209 | 100.0 % | 4,536,248,808 | 58.8 % | 1,157 % | 100.0 % |

Source: <https://www.internetworldstats.com/stats.htm>, accessed on 25 December 2019



Source <https://www.statista.com/statistics/255146/number-of-internet-users-in-india/> 25 December 2019

The rising number actually gives us a complete picture of the present situation in India. The growth is also because of the rising number of handy gadgets that are available to everyone. Sometimes it is felt that it is the user who is persistently searching the internet rather than the service providers searching for users. We are second to China in case of using internet as a means for different purposes but the statistical data has enough to tell us about the gender parity.

Efforts are required to improve the use for fruitful reasons and the gender disparity can be really defeated. A few taken up by the Government of India again needs to be popularized.

Initiatives like, Helplines and panic buttons, Web channels for reporting sexual harassment at workplace, #Helpme WCD Twitter campaign Email ids and social media accounts for addressing online gender-based violence, MIS for incentive-based payments for ASHAs, Digital Gender Atlas for Girls' Education, Digital monitoring systems in employment and

welfare schemes are a great support that additionally helps women to go active internet users and technology enabled citizens.

We can yet support some of the best and often thought initiative by organizing brainstorming session on the topic. We will have to avoid that Males do not take control over the resources and are a part of such sessions where they are the masters of mind. Let Females think over what best suits to them from a 'gender-based' point of view and come up with the fresh and new solutions on bridging the gap. Let them be the decision makers of their live and aspects related to their own empowerment and this will actually bring the desired results.

Lets Begin at Home

We can always think of Digitally Enabled Information Outreach System For Women, E-Learning And Knowledge Intervention System For Women, Digitally Monitoring System For Women Directed Services, Technology Supported Crisis Support System are some of those vital areas where there is always a scope to think of having a transformation. Unless the bridging is done there would never be half of the population supporting the growth of the nation neither the world.

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SIN, SHAME, GUILT AND REDEMPTION IN HAWTHORNE'S THE SCARLET LETTER

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ABSTRACT

The New England Puritans considered sin as a direct result of the Fall and sinners were detracted from the society. Unrepentant sinners damaged the community's soul and were sometimes ex-communicated or banished from the society as is the case with Hester the heroine of *The Scarlet Letter* by Hawthorne. Sin is an act which violates a known moral code. It is a rebellion against, or resistance to, the direction of supreme authority, and enmity toward, avoidance of, or hatred of the good. Guilt results in being responsible for committing an offense. According to Hawthorne, guilt is a stain upon the soul. In *The Scarlet Letter*, Hawthorne delves deep into man's moral nature thoroughly exploring the effects of sin on the major characters Hester Prynne and the Reverend Mr. Dimmesdale. The character of Dimmesdale is used to show the conflict and Hester's to depict how a person's actions should be taken into consideration for salvation.

Key words: Puritans, Fall, moral, sin, guilt, soul, rebellion,

The role of sin is deeply considered by both the New England Puritans and Nathaniel Hawthorne. According to the Puritans, sin was a direct result of the Fall and sinners detracted from society. Covenants made with God proposed a collective guilt that the Puritans were eager to avoid. Unrepentant sinners damaged the community's soul and were sometimes ex-communicated or banished from their society. As a way to avoid sin, ministers preached against the various sins and threatened damnation for the degenerate. Hawthorne called himself 'the most obscure man of letters in America'. *The Scarlet Letter* is his most celebrated and outstanding piece of work, both in its theme and in its style. It is one of the most amazing and disturbing novels in the American literary genre. The root conception of *The Scarlet Letter* had already been expressed in his tale of *Endicott and the Red Cross*. The setting of the novel is the Puritan society of the mid seventeenth century Boston. According

to Morgan, "Sin was a violation of order, grace and restoration of order" (*The Puritan Family* 15). Morgan simply wants to tell about sin and how to turn away from sin. God is supposed to have created order from the existing chaos. The puritans, in the hope of emulating their creator attempted to lead lives of order within a chaotic world. Therefore, sin, is an act which violates a known moral code. The term sin may also refer to the state of having committed such a violation. Commonly, the moral code of conduct is ordered by a divine entity, also known as the divine law. Fundamentally, sin is rebellion against, or resistance to, the direction of supreme authority, and enmity toward, avoidance of, or hatred of the good. Guilt results in being responsible for committing an offense. It is an emotional experience that that happens when a person realizes or believes that he or she has violated a moral standard, and bears significant responsibility for that violation. It is closely related

to the concept of repentance. Hawthorne himself defined guilt as a stain upon the soul, and raised the question whether even the thought of sin, without its being carried out, will not draw down the full weight of a condemning sentence, in the supreme court of eternity. His conclusion is that the mere thought of seduction, or murder, or legal chicanery is a positive sin. Hawthorne called himself 'the most obscure man of letters in America'. The *Scarlet Letter* is his most celebrated and outstanding piece of work, both in its theme and in its style. It is one of the most amazing and disturbing novels in the American literary genre. The root conception of *The Scarlet Letter* had already been expressed in his tale of *Endicott and the Red Cross*. The setting of the novel is the Puritan society of the mid seventeenth century Boston. In *The Scarlet Letter*, Hawthorne delves deep into man's moral nature. Describing it as "a hell fired story" and "a tale of human frailty and sorrow", the novel is a searching study of sin and its effects on human personality. The novel thoroughly explores the effects of sin on the major characters Hester Prynne and the Reverend Mr. Dimmesdale. It also portrays the conflict between predestination and individual redemption as a result of actions carried out by the person. The character of Dimmesdale is used to show the conflict and Hester to depict how a person's actions should be taken into consideration for salvation.

The adultery is over and done with before the book begins; it is "a triangle after the event" as Herbert German calls it. An old scholar by the name of Roger Chillingworth already dehumanised by the abstruseness of his studies makes the mistake of marrying a young wife. He sends her to America, to the Puritan colony of Massachusetts, with instructions to live quietly until he comes. But he does not come until the day when she is being publicly exposed as an adulteress, for she has borne a child, and she will not name its father. She, Hester Prynne, must stand on the scaffold, holding the child until her shame is thoroughly known; and even after she must wear the letter A, embroidered in scarlet on her bosom. The entire community has assembled to make a public spectacle of Hester's private sin. The iron-visaged good women of the settlement pour malice and abuse on her and feel

that she deserves a greater punishment (TSL 8). As for the governor, the magistrates, and the ministers,

Out of the whole human family, it would not have been easy to select the same number of wise and virtuous persons, who should be less capable of sitting in judgement on an erring woman 'a heart, and disentangling its mesh of good and evil than the sages of rigid aspect towards whom Hester Prynne now turned her face. She seemed conscious, indeed, that whatever sympathy she might expect lay in the larger and warmer heart of the multitude. Not one of the judges sees any virtue in her refusal to reveal the name of her lover. Even the kindly old John Wilson berates this token of her loyalty as unregenerate hardness and obstinacy: while the unrecognised lover himself, with curious moral hypocrisy, calls upon her from his elevated stand with the other dignitaries to denounce the companion of her sin and not deny to him "the bitter, but wholesome, cup that is now pressed to thy lips!" (TSL 9)

The effect of the scene – of its cruelty, and the general absence of pity and understanding in it – is heightened rather than dispelled by the occasional soft words of the young mother, the one sympathetic observer in the hostile crowd, who tries ineffectually to remind her neighbours that Hester's suffering does not need this added inhumanity to make it an adequate atonement for her sin.

Man had marked this woman's sin by a scarlet letter ...God, as a direct consequence of the sin which man thus punished had given her a lovely child, whose place was on this same dishonoured bosom, to connect her parent forever with the race and descent of a blessed soul in heaven. (TSL 10)

This sacred obligation of motherhood keeps her from plunging headlong into that abyss of sin towards which society's punishment would naturally impel her. As Hester suffers public shame and contempt, she is determined to recognize only the letter and not the living embodiment of her guilt,

and her release from confinement immediately follows. Hester has thus gained only a partial insight from her plunge into the pit and her consequent ascent. Although she is free to leave the colony altogether, she does not do so, but instead takes her stand at the farthest edge of the settlement. The reason is that even though society has cast her off, she has not lost hold of the magnetic chain of humanity. "The chain that bound her was of iron links, and galling to her inmost soul, but could never be broken". (TSL 11) the deeper reason was her own consciousness of sin. Being an outcast and with her own judgement of society's institutions, she neither seeks nor is allowed a full place in it. Uniting the perspective gained from the pillory with the word, the letter branded upon her, she puts off the old garments and finds a new self in her art of needlework which is seen an act of penance. In fact, Hester accepts her position in the Puritan community with proud humility. According to Turner, "her sin taught her to recognize sin in others and to look more warmly and sympathetically into the hearts of sinners." Her salvation lies in truth. In her conversation with Dimmesdale she says: "Oh Arthur!" cried she, forgive me! In all things else, I have striven to be true! Truth was the one virtue which I might have held fast, and did hold fast through all extremity; save when thy good – thy life – thy fame -- were put in question! Then I consented to a deception. But a lie is never good, even though death threaten on the other side! Dost thou not see what I would say? That old man! – The physician! – he whom they call Roger Chillingworth! – he was my husband!". (TSL 27) It seems that Hester "handles her guilt more successfully than Dimmesdale because her conscience is less highly developed than his" Crews 143).

The sin of sin is not so much sin as the concealment of that sin, for to pretend sinlessness is to assume superhuman goodness or holiness. To acknowledge the sin only to God may be far short of absolution, because a good reputation may be what the culprit most desires as was the case with Dimmesdale. To acknowledge the truth before men is indeed to acknowledge it before God, for the human conscience is God's presence in man. Physically Dimmesdale is delicate, morbidly

conscientious, very sensitive, and very intellectual but "in no state of society would he be called a man of liberal views; it would always be essential to his peace to feel the presence of a faith about him, supporting while it confined him within its iron framework. He was a follower of creeds, norms and law. He was not speculative like Hester. The framework of his priestly position supported him. He had never gone through crucial experiences calculated to make him question generally received laws, although in a single instance he had transgressed one of the most sacred of them. His delicate, sensitive nature shrank from confession and yet, without confession his tortured soul could find no rest. Hawthorne also wants to drive home the point that while sin which is exposed and confessed, frees the sinner's mind and often brings about a transformation in the life, sin which is concealed and cherished tends to cause ruin and death. Dimmesdale suffers during the seven years of silence. He regrets his sin and feels anguished at the same. Guilt eats away his very soul and threatens to destroy him. Frederick Crews comments on the devastating effects of guilt:

The breach which guilt has once made into the human soul is never, in this mortal state, repaired. It may be watched and guarded; so that the enemy shall not force his way into the citadel, and might even, in his subsequent assaults, select some other avenue, in preference to that where he had formerly succeeded. But there is still the ruined wall, and near it, the stealthy tread of the foe that would win over again his unforgotten triumph. (TSL 137)

Though suffering from guilt, Dimmesdale loved the approval of his people so much that he could not voluntarily give it up, and yet he knew it must be done. In the forest he tells Hester,

Happy are you Hester, that wear the scarlet letter openly upon your bosom: Mine burns in secret: thou little knowest what a relief it is after the torment of seven years' cheat, to look into an eye that recognizes me for what I am: Had I one friend --- or were it my worst enemy" --- to whom when sickened with the praises of all other men, I

could daily betake myself, and be known as the vilest of all sinners, methinks my soul might keep itself alive thereby. Even this much of truth would save me. But, now, it is all falsehood! -- all emptiness! - all death! (TSL 30)

Dimmesdale has been wrought to a pitiable condition after seven years of hypocrisy. His life is full of lies. Dimmesdale is the most pathetic character in this tragedy of sin. According to Arlin Turner, different types of sin are represented in *The Scarlet Letter*. They are sins of the flesh, sins of weakness, sins of will and the intellect. The transgression of Hester and Dimmesdale stand condemned by the laws of society. (59)

Hester works towards her salvation by becoming involved in performing charitable acts and kindness to the people in the community and also by showing her concern for the sick, the poor and the dying. Sin is precisely what allows Hester to develop and change as a person. As a result of her sin, fall, eventual remorse and penance, she rises higher than she fell. Hawthorne observes that "... in the lapse of the toilsome, thoughtful, and self-devoted years that made up Hester's life, the scarlet letter ceased to be a stigma which attracted the world's scorn and bitterness, and became a type of something to be sorrowed over, and looked upon with awe, yet with reverence". (TSL Chp. 24) Outwardly she has been a penitent sinner, and by her good works she has transmuted the letter into a badge of mercy. To many, the letter has the effect of a cross on a nun's bosom.

Chillingworth is isolated by his guilt which is represented by his fearsome appearance he has grown in the village. He only descends not to re-ascend. As in his injured pride and inhuman curiosity he devotes himself in prying into the minister's heart, whatever goodness had been his had always been negative, the mere absence of overt evil - disappears and pride moves into what had been a merely cold heart: prompting to revenge and displacing intellectual curiosity. He becomes a moral monster who feeds only on another's torment, divorced wholly from the sources of life and goodness. In fact Chillingworth too is guilty of an unforgiveable sin of intellect, and much less

forgivably so. Chillingworth's comments reveal the importance of Dimmesdale's confession: "Hadst thou sought the whole earth over, there was no one place so secret, neither high place nor lowly place, where thou couldst have escaped me,--save on this very scaffold. 'Thanks be to Him who hath led me hither!' answered the minister. Yet he trembled, and turned to Hester, with an expression of doubt and anxiety in his eyes, not the less evidently betrayed, that there was a feeble smile upon his lips. 'Is not this better,' murmured he, 'than what we dreamed of in the forest?' 'I know not! I know not!' she hurriedly replied 'Better? Yea; so we may both die, and little Pearl die with us!' 'For thee and Pearl, be it as God shall order,' said the minister; 'and God is merciful! Let me now do the will which He hath made plain before my sight. For, Hester, I am a dying man. So let me make haste to take my shame upon me!" (TSL 35) For Dimmesdale, salvation and grace come when he casts off the gown of hypocrisy and shows his real personality.

The other characters suffer isolation for their sins. Pearl was born as an outcast remains at war with her world until the expiation of the final confession scene. Hester lives at the edge of the village and years afterward, when Pearl has married, returns to finish out her life at the same spot. The scarlet letter, when she first wore it, "had the effect of a spell, taking her out of the ordinary relations with humanity and enclosing her in a sphere by herself", (TSL 38) and as time passed it became everywhere apparent that she was banished. Hester expiated her evil by means of repentance and a virtuous later life. Hester represents the repentant sinner, and Dimmesdale the half-repentant sinner and Chillingworth the unrepentant sinner. Therefore, Hester individually achieved salvation even though her sin was clear and her dream of freedom impossible. What Hawthorne tries to imply is the fact that individualistic sin has direct effect on the social health of the community in which its members are living. These members find salvation only when they try to purify their souls and try to be moral toward each other.

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स्वातंत्र्यपूर्व काळातील स्त्री शिक्षण व दलित मुक्तीच्या आंदोलनातील स्त्रियांचा सहभाग

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प्राचीन भारताच्या इतिहासावर नजर फिरविली तर स्त्री ही विविध प्रथा, परंपरा, धर्म यांच्या जोखडात अडकलेली दिसते. स्त्रियांना कुठल्याच प्रकारचे स्वातंत्र्य नव्हते. एक उपयोगाची वस्तू म्हणून तिच्याकडे पाहिले जात असे. पति, धर्म, संस्कृती यांच्या ओझ्या खाली स्त्री दबलेली दिसते.

पाश्चिमात्य देशांत स्त्रीमुक्तीचे वारे वाहू लागले आणि या स्त्रीमुक्तीच्या विचारांचे पडसाद भारतातही उमटू लागले. तो पर्यंत राजकीय व सामाजिक चळवळीतील स्त्रियांच्या सहभागाची फारशी कोणी दखल घेत नसे. त्यामुळे दलित मुक्तीच्या आंदोलनातील स्त्री सहभागावर आजवर अभ्यासकांनी दुर्लक्ष केलेले आढळते.

महात्मा फुलेंच्या प्रयत्नांतून स्त्री शिक्षणाकडे थोडे लक्ष वेधले गेले. तिथून स्त्रियांच्या प्रगतीची सुरुवात झालेली दिसते. डॉ. बाबासाहेब आंबेडकर उच्च शिक्षण घेऊन मायदेशी परतले आणि आपल्या बांधवांच्या जागृतीचे कार्य हाती घेतले. बाबासाहेबांनी अस्पृश्यांच्या मनात स्वतःचे हक्क आणि अधिकारांबाबत अस्मिता निर्माण केली. शिक्षणाचे महत्त्व पटवून दिले. त्या आधी थोड्याफार प्रमाण स्त्रिया शिक्षण घेत होते. त्यानंतर स्त्रियांचा चळवळीतील सहभाग वाढल्याचे दिसून येते.

डॉ. बाबासाहेब आंबेडकरांच्या शेजारी राहणारे कोकणातले जाधव हे सैन्यात जमादार होते. त्यांची मुलगी गंगू ही १९१३ मध्ये ४ थ्या वर्गात शिकत होती.^१ मध्य प्रांत व वन्हाडच्या जनगणनेनुसार १९११ च्या सुमारास अस्पृश्यांच्या शिक्षणाचे प्रमाण दर हजारास ३ होते. १९२० च्या सुमारास मिशनरी संस्थांच्या २२ शाळा होत्या व अन्य ४२ शाळा चालविल्या जात होत्या.

त्यामध्ये १४ शाळा खासगी होत्या. उरलेल्या २८ शाळामधून अस्पृश्यांच्या ३४ मुली शिकत होत्या.^२

१९२० मध्ये नागपूर येथे छत्रपती शाहू महाराज यांच्या अध्यक्षतेखाली 'भारतीय बहिष्कृत परिषद' घेण्यात आली होती. या परिषदेत श्री. शिवतरकर यांनी "प्राथमिक शिक्षण मुलांना आणि मुलींना मोफत व सक्तीचे शक्य तितक्या लवकर सुरू करावे." असा ठराव मांडला होता तेव्हा या ठरावावर बोलतांना सौ. तुळसाबाई बंदसोडे म्हणाल्या होत्या की "आमच्या समाजातील बायांना शिक्षण नसल्यामुळे त्या आपली लेकरे घरी ठेवून मजुरीला जातात. त्यामुळे व मुलांनी जोपासना कशी करावी माहीत नसल्याने त्या मुलांचे फारच हाल होतात... वरिष्ठ जातीच्या बायाही आम्हाला दूर लोटतात. म्हणून मुलांबरोबर मुलींच्याही शिक्षणाचा प्रसार झाला पाहिजे आणि मुलींकरिता प्रत्येक जिल्हानिहाय बोर्डींगे पाहिजेत." असे मत व्यक्त केले होते. याच ठरावावर कु. रूक्मिणीबाई कोटांगळे म्हणाली की, "शिक्षण नसल्यामुळे आमचा प्रत्येक ठिकाणी इन्कार केला जातो. त्याबद्दल म्युनिसिपालिटी व सरकार याकडे अर्ज केले असता आमची दाद कोणीच घेत नाही. मुलांप्रमाणे मुलींच्याही शिक्षणाची जरूर काळजी घेतली पाहिजे आणि इतर वर्गाच्या मुलांमुलींबरोबर आमच्या मुलांमुलींस शिक्षण देण्याची सोय झाली पाहिजे." अशी आपली परखड मते व्यक्त केली होती.^३

निपाणी येथे बाबासाहेबांची सभा झाली त्या सभेचा संपूर्ण खर्च मीराबाई नावाच्या एका म्हातान्या अस्पृश्य बाईने केला होता.^४ ही दानवृत्ती पूर्वीपासून आजतयागत चालू आहे.

आपल्या जातीतील मुलींना वाईट मार्गापासून परावृत्त करणे, त्यांना सन्मार्गाला लावणे तसेच त्यांचे रक्षण करण्याचे अनेक ठिकाणी प्रयत्न चालू होते. या प्रयत्नाचा एक भाग म्हणून नागपूर येथे १९२६ मध्ये 'तरूण महार संघ' स्थापन झाला. या संघाने आपल्या जातीतील ज्या २०-२५ अस्पृश्य मुली मुसलमान समाजात गेल्या होत्या. त्यांना आपल्या समाजात परत घेतले व त्यांची लग्ने लावून दिली. महानंदा नावाची वर्षेची महार मुलगी व मैना नावाची गोडाची मुलगी या दोघांना नागपूरच्या गंगाजमुना वेश्यालयातून काढून त्यांना पुण्याच्या सेवासदनला पाठवून शिक्षण देण्यात आले. पुढे त्या दोघी नर्स झाल्या.^५

अंबरनाथ ता. कल्याण, जि. ठाणे येथे अस्पृश्यांची ९-८-१९२७ रोजी सभा झाली. या सभेत लग्नासाठी मुलाचे वय २२ व मुलीचे वय १६ वर्षे असल्याशिवाय आई-वडिलांनी त्यांचे लग्न करू नये असा ठराव पास झाला.^६

१३ नोव्हेंबर १९२७ रोजी अस्पृश्य आणि अस्पृश्येतर पुढाऱ्यांची अमरावतीला परिषद झाली. या परिषदेच्या वेळी हजारो स्त्री पुरुषांची एक मिरवणूक काढण्यात आली त्यात ५० स्त्रिया सहभागी झाल्या होत्या.^७

पुण्याच्या पर्वती मंदिरात प्रवेश मिळावा म्हणून १३ ऑक्टोबर १९२९ ला सत्याग्रह केला. या सत्याग्रहात स्त्रियांची संख्या मोठी होती. काही स्त्रियांनी सत्याग्रहाच्या तुकडीचे नेतृत्वही केले होते. शिवराम कांबळे यांची पत्नी सौ. तानुबाई कांबळे यांनीही एका तुकडीचे नेतृत्व केले होते.^८

२ मार्च १९३० रोजी डॉ. बाबासाहेबांच्या नेतृत्वात काळाराम मंदिरात प्रवेश करण्याचे निश्चित झाले. या सत्याग्रहात भव्य मिरवणूक काढण्यात आली. यात ५०० स्त्रिया उत्साहाने सामील झाल्या होत्या.^९ अधून-मधून मंदिरात प्रवेश करण्याचे प्रयत्न चालू होते. ७ एप्रिल १९३० रोजी शेकडो अस्पृश्य मंदिरात शिरले. त्यावेळी एका अस्पृश्य मुलीस पुजाऱ्याने मागे लोटताच तिने पुजाऱ्याच्या फाडकन तोंडात भडकावली.^{१०}

अखिल भारतीय दलित काँग्रेसचे पहिले अधिवेशन नागपूर येथे डॉ. बाबासाहेब आंबेडकरांच्या

अध्यक्षतेखाली ८ ते १० ऑगस्ट १९३० रोजी घेण्यात आले. या परिषदेत महिलांचे स्वतंत्र अधिवेशन दि. ३० ऑगस्ट रोजी भरले होते.^{११} या परिषदेत महिलांनी आपल्या भाषणातून डॉ. बाबासाहेब आंबेडकरांनी गोलमंज परिषदेत घेतलेल्या भूमिकेला पाठिंबा दर्शविला.

१३ जून १९३६ रोजी परळ येथे दामोदर हॉलमध्ये बाबासाहेबांचे भाषण झाले. या भाषणाचे परिणाम म्हणून अनेक स्त्रिया आपला वेश्या व्यवसाय सोडून बाबासाहेबांकडे गेल्या व "आपण संसार करण्यास तयार आहो" असे त्यांना सांगितले. त्यानंतर बाबासाहेबांनी त्यापैकी अनेक वेश्यांची लग्ने लावून दिली.^{१२}

२० एप्रिल १९४० रोजी उमरेड तालुका महिला परिषद सौ. सुलोचनाबाई डोंगरे यांच्या अध्यक्षतेखाली पार पडली.^{१३} या परिषदेत असेक्लीमध्ये अपृश्य महिलांसाठी राखीव जागा असावी आणि तालुक्यात ठिकठिकाणी अस्पृश्य महिलांची समता सैनिक दल स्थापन करण्यात यावी असे निर्णय घेण्यात आले. या व्यतिरिक्त स्वतंत्र मजूर पक्षातर्फे संपूर्ण महाराष्ट्रात निरनिराळ्या ठिकाणी महिलांची स्वतंत्र अधिवेशने होत होती.^{१४} त्यात दलित स्त्रियांनी मोठ्या संख्येने भाग घेऊन चळवळीला बळकटी प्राप्त करून दिली होती.

१९४२ मध्ये शेड्यूल्ड काॅस्ट फेडरेशन महिला परिषद नागपूरला भरली. या परिषदेत महिलांनी मांडलेले ठराव यांची निर्भीडता, भाषणे, परखड विचार, कर्तव्यदृढ, जागरूक महिला पाहून बाबासाहेबांना अतिशय आनंद झाला. बाबासाहेबांनी या समस्त महिलांचे कौतुक करून त्यांना प्रोत्साहन देणारे भाषण यावेळी केले. ते म्हणाले "स्त्री वर्गात जागृती झाली तर त्या अस्पृश्य समाजाची फार मोठी प्रगती घडवून आणू शकतात याची मला जाणीव आहे. महिलांची संघटित संस्था असावी यावर माझा विश्वास आहे. माझी खात्री झाली आहे. व आनंदही वाटत आहे की, आपण प्रगती केलेली आहे"^{१५}

सामाजिक मागासलेल्या आणि सहशिक्षणाचा गंधही नसलेल्या औरंगाबादसारख्या ठिकाणी डॉ. आंबेडकरांनी महाविद्यालय सुरू करून मुलांच्या बरोबरीने त्यांनी मुलींनाही प्रवेश दिला. इतकेच नव्हे तर मुलींनी मोठ्या प्रमाणात महाविद्यालयात यावे म्हणून शहरापासून

महाविद्यालयापर्यंत एक बसही सुरू केली.^{१५} त्यांनी उभ्या केलेल्या चळवळीच्या माध्यमातून मुलींचे एक स्वतंत्र व्यक्ती म्हणून समाजात असलेले स्थान डॉ. बाबासाहेबांनी आवेडकरांनी सर्वांना दाखवून दिले. तसेच शिक्षणाबरोबर शीलही महत्वाचे आहे असे मुंबई येथील रावळी कॉपमध्ये महिला मंडळासमोर दिलेल्या भाषणात त्यांनी स्पष्ट केले होते.^{१७}

निष्कर्ष :

एकंदर अस्पृश्य महिलांनी शिक्षणात आणि दलित मुक्तीचे जेवढे आंदोलन झाले त्या आंदोलनात पुरुषांबरोबर स्त्रियांनीही भाग घेतला आणि आपणही समाजाचा स्वतंत्र घटक आहोत हे दाखवून दिले. दलित मुक्ती आंदोलनाचा चळवळीत स्त्रियांनी महत्वाचा ठसा उमटवून एकंदरीत स्त्री स्वातंत्र्याची जाणीव संपूर्ण देशाला करवून दिली होती.

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डॉ. अविनाश दिगंबर फुलझेले

सहयोगी प्राध्यापक व इतिहास विभाग प्रमुख, डॉ. आंबेडकर महाविद्यालय, दीक्षाभूमी, नागपूर.

सारांश

डॉ. आंबेडकरांनी दलितांच्या हक्कासाठी अनेक लढे उभारून त्यांचे मोठे संघटन निर्माण केले. त्यांची ही सर्व शक्ति राजकीय क्षेत्राकडे वळविण्यासाठी डॉ. आंबेडकरांनी स्वतंत्र मजूर पक्ष व नंतर शेड्यूल्ड कास्ट्स फेडरेशन पक्ष स्थापन केले. या दोन्ही पक्षाची तत्वे सामाजिक गुलामगिरी नष्ट करून राजकीय समता प्रस्थापित करणारी होती. पण संयुक्त मतदार प्रणालीत दलित वर्ग अल्पसंख्याक असल्याने बहुसंख्याक विरुद्ध अल्पसंख्याक असा लढा निर्माण झाला. तेव्हा डॉ. आंबेडकरांनी समान ध्येय असलेल्या इतर पक्षाशी चर्चा करून एक समर्थ विरोधी पक्ष निर्माण करता यावा म्हणून रिपब्लिकन पक्षाच्या स्थापनेची घोषणा केली होती. तेव्हा या शोधनिबंधात डॉ. आंबेडकरांच्या संकल्पनेतील रिपब्लिकन पक्षाची तात्विक मांडणी केली आहे.

कि वर्ड :- स्वतंत्र मजूर पक्ष, शेड्यूल कास्ट फेडरेशन, रिपब्लिकन पक्ष

संशोधन पद्धती :- ऐतिहासिक संशोधन पद्धतीचा अवलंब उपलब्ध साहित्याचा शास्त्रीय दृष्टीने परिक्षण करून मूल्यमापन केले जाईल.

गृहीत तत्वे :- डॉ. आंबेडकरांचे राजकीय तत्वज्ञान सर्वसमावेशक व भारतीय संविधानाशी सुसंगत होते.

प्रस्तावना

डॉ. बाबासाहेब आंबेडकरांनी १९१९ मध्ये साउथबरो कमिशन समोर अस्पृश्यांच्या समस्या पहिल्यांदा ब्रिटिश सरकार पुढे ठेवल्या येथून त्यांनी भारतीय राजकारणात पहिले पाऊल ठेवले. आज या घटनेला १०० वर्षे पूर्ण झाली. त्यांनी अस्पृश समाजाला संघटित करून मोठे सामाजिक लढे उभारले. या

संघटनेच्या जोरावर त्यांनी अस्पृश समाजाला सामाजिक, आर्थिक व राजकीय हक्क मिळवून दिले. हे राजकीय हक्क मिळविण्या साठी त्यांनी स्वतंत्र मजूर पक्ष, शेडयूल्ड कास्ट्स फेडरेशन हे पक्ष स्थापन केले. पुढे त्यांनी भारतीय रिपब्लिकन पक्ष स्थापनेचा आपला संकल्प जाहिर केला होता. त्याची रूपरेषा व एकंदर पक्ष संघटनेची आखणी त्यांनी केली होती. मात्र त्यांच्या हयातीत हा पक्ष स्थापन होऊ शकला नाही तरी त्यांनी आपल्या हयातित या पक्षाची वाटचाल कशी होईल याची आखणी केली होती. पुढे त्यांच्या महापरिनिर्वाणा नंतर या पक्षाची स्थापना झाली. मात्र लवकरच या पक्षाची वाताहत झाली. तेव्हा या शोधनिबंधाच्या माध्यमातून या पक्षा बाबतची डॉ. बाबासाहेब आंबेडकरांची नेमकी भूमिका काय होती. याचा अभ्यास केला आहे.

उद्दिष्टे

१. डॉ. आंबेडकरांच्या राजकीय वाटचालीचा अभ्यास करणे.
२. स्वतंत्र मजूर पक्ष व शेडयूल्ड कास्ट्स फेडरेशन पक्षाचा अभ्यास करणे.
३. डॉ. आंबेडकरांची भूमिका रिपब्लिकन पक्षाच्या भावी वाटचाली साठी उपयोगी ठरते काय हे तपासणे.

डॉ. आंबेडकरांची राजकीय वाटचाल

अस्पृशता निर्मूलन व सामाजिक हक्काच्या प्राप्ती साठी त्यांनी बहिष्कृत हितकारिणी सभेची स्थापना केली. या माध्यमातून त्यांनी जागृतिचे काम सुरु केले होते. डॉ. आंबेडकर अस्पृश्यांच्या मागासलेपणाचे खरे कारण त्यांच्या जवळ सत्ता व ज्ञान नसल्यामुळे त्यांची उन्नती खूंटल्याचे स्पष्ट करून दारीद्र्यामुळे ज्ञान नाही व ज्ञान नसल्यामुळे बल नाही ' म्हणजे सत्ता नाही हे स्पष्ट करतात. अस्पृश वर्गाचा प्रश्न हा सामाजिक स्वरूपाचा असून तो राजकीय नाही असा सर्व साधारण समज होता. पण हा समज डॉ. बाबासाहेब आंबेडकरांना मुळीच मान्य नव्हता. त्यांच्या मते, ब्राम्हणाना राजकीय सत्तेची जोड मिळाल्या मुळे त्यांची धार्मिक सत्ता टिकून राहिली ' म्हणून सामाजिक व धार्मिक प्रश्नाच्या मुळाशी नेहमी राजकीय

सत्ता असते असे डॉ.आंबेडकरांचे स्पष्ट मत होते म्हणून त्यांनी अस्पृश्यांचा संघटीत लढा उभा केला. त्यासाठी त्यांनी गोलमेज परिषदेत अस्पृश्यांची भक्कम पणे वाजू मांडून स्वतंत्र मतदार संघ अस्पृश्यांसाठी खेचून आणला. गोलमेज परिषदेतील त्यांच्या या प्रयत्नांमुळे अस्पृश्यांचा एक स्वतंत्र घटक म्हणून भारताच्या राजकारणात प्रथम प्रवेश झाला.³ पण म.गांधींनी त्यास विरोध केल्याने पुढे 'पुणे करार' होऊन अस्पृश्यांना संयुक्त मतदार संघ व राखीव जागांना डॉ.आंबेडकरांनी मान्यता दिली.

स्वतंत्र मजूर पक्ष

१९३५ च्या कायदानुसार लवकरच प्रांतिक विधान मंडळाच्या निवडणूका होणार होत्या म्हणून डॉ.आंबेडकरांनी पक्ष उभारणीला वेळ मिळावा म्हणून लवकरच म्हणजे १५ आगस्ट १९३६ रोजी 'टाइम्स आफ इंडिया' वृत्तपत्रातून स्वतंत्र मजूर पक्ष स्थापन झाल्याचे तसेच या पक्षाचा कार्यक्रम व उद्दिष्टे त्यांनी जाहिर केली.⁴ या पक्षामुळे गरिब, कामगार, भूमिहीन, अस्पृश्यांना राजकीय अधिकार मिळवून देण्याचे दालन खुले केले. श्रमजीवी वर्गाच्या प्रश्नांना ऐवढे महत्त्व तो पर्यंत कोणीही दिले नव्हते. ते महत्त्व स्वतंत्र मजूर पक्षाने दिले.⁵ मुंबई कायदे मंडळात पंधरा राखीव जागे पैकी अकरा जागा स्वतंत्र मजूर पक्षाने जिंकल्या होत्या. यावरून या पक्षाचा तळागाळातील लोकांवरचा प्रभाव स्पष्ट दिसून येतो. या पक्षाने मुंबई कायदे मंडळात भरीव कार्य करून सर्वहारा समाजाच्या समस्यांना वाचा फोडण्याचे कार्य मोठ्या हातोटीने केले होते हे दिसून येते. पुढे डॉ.बाबासाहेबांना हा पक्ष मोडून नवा पक्ष निर्माण करावा लागला होता.

शेड्यूल्ड कास्ट्स फेडरेशन पक्ष

जुलै १९४२ मध्ये नागपुरला या पक्षाची स्थापना करण्यात आली. हा पक्ष समानतेचा नेहमी पुरस्कार करेल, प्रत्येक भारतीयांचा धार्मिक, आर्थिक व राजकीय स्वतंत्र्याचा हक्का साठी लढे उभारेल, प्रत्येक भारतीयाच्या समान संधी मिळण्याच्या हक्काचा पुरस्कार करील, दारीद्र्य व भय यापासून प्रत्येकाला मुक्त करण्याचा सदैव प्रयत्न करेल. स्वातंत्र्य, समता व बंधुभाव यांच्या रक्षणाचा सदैव आग्रह धरील हे सर्व या पक्षाचे तत्वे होती.⁶ या वरून दिसून येते की शे.का.फे. पक्ष हा केवळ शेड्यूल्ड कास्ट

लोकांचाच विचार न करता देशातील विविध समूहाचा विचार करून देशामध्ये सामाजिक एकरूपता निर्माण करण्याचा प्रयत्नात होता. १९४६ च्या निवडणूकीत फेडरेशनच्या सभेत डॉ.आंबेडकर म्हणाले होते कि, 'कांग्रेसच्या राज्यात सर्वसाधारण जनतेचे हित होणार नाही. ते राज्य श्रीमंताचे होईल व श्रीमंतासाठी झटेल. अस्पृश्यांना त्यांच्या राज्यात जीवन नकोसे होईल म्हणून अस्पृश्यांनी शे.का.फे.च्या झेंड्याखाली एकत्र येऊन संघटना मजबूत करावी' ५ असा संदेश दिला. त्या दृष्टीने विचार करता त्यांचे संघटन मजबूत होते पण अल्पसंख्यक विरुद्ध बहुसंख्यक असा कांग्रेसने सामना निर्माण केल्याने १९४२ व १९४६ साली झालेल्या निवडणुकांमध्ये त्यांना पराभवाचा सामना करावा लागला. एवढेच नव्हे तर २४ ऑगस्ट १९४६ ला व्हाइसरॉयने हंगामी मंत्रीमंडळात दलित वर्गाचे प्रतिनिधी म्हणून डॉ.आंबेडकरांना न घेता जगजीवनराम यांना घेतले. ६ म्हणजे कांग्रेसने सर्व वाजूनी डॉ.आंबेडकरांना कोंडीत पकडले. तेव्हा या राजकीय परिस्थितीचा डॉ.आंबेडकर गांभीर्याने विचार करू लागले.

रिपब्लिकन पक्षाची संकल्पना

रिपब्लिकन पक्ष बाबासाहेबांच्या महापरिनिर्वाणा नंतर म्हणजे ३ ऑक्टोबर १९५७ ला अधिकृत रित्या जरी स्थापन झाला असला तरी या पक्षाची वैचारिक बैठक डॉ.आंबेडकरांनी निर्माण केली होती. रिपब्लिकन पक्षाला आंबेडकरी चळवळीचा मोठा वारसा लाभला आहे. तेव्हा हा संपूर्ण घटनाक्रम विशेषतः स्वातंत्र्य नंतरचा पाहणे गरजेचे आहे.

१९४७ ला भारत स्वतंत्र झाल्यावर डॉ. आंबेडकरांना घटना समितीवर घेण्यात आल्याने त्यांनी आपले सर्व लक्ष त्यावर केंद्रित केले. घटना निर्मिती साठी डॉ.आंबेडकरांनी अथक परिश्रम घेतले. पुढे १९५० मध्ये भारतात प्रजासत्ताक पद्धतीचा अंमल सुरु झाला.या प्रजासत्ताकात डॉ.आंबेडकरांना भारतीय संविधानाशी सुसंगत व येथील जीवन मुल्याशी सांगड घालून राजकारण करणारा पक्ष हवा होता. या प्रजासत्ताकातील पहिली सार्वत्रिक निवडणूक १९५२ मध्ये होणार होती. या निवडणूकीत डॉ. आंबेडकरांना भारतातील कांग्रेस ट्यतिरिक्त सर्व पक्षाची एकजूट करायची होती पण निवडणूकीस जास्त वेळ शिल्लक

नसल्यामुळे त्यानी निवडणूकीनंतर त्याबाबतीत प्रयत्न करण्याचे ठरविले होते.^१ पण देशाचे संविधान लिहणारे डॉ.आंबेडकर व त्यांचा पक्ष या निवडणूकीत पराभूत झाले. या पहिल्या निवडणूकीत काँग्रेस पक्षाला यश मिळाले. या यशाचे जल्लोषात स्वागत करताना मुंबईतील शिवाजीपार्क वरील सभेत काँग्रेस नेते होमी तल्यार खान म्हणाले होते की, 'काँग्रेसला विजय मिळाल्याचा आनंद तर होतोच आहे,परंतु त्याही पेक्षा डॉ.आंबेडकरांना आम्ही पाडू शकलो याचा जास्त आनंद होत आहे',^२ या वरून काँग्रेस पक्षाची डॉ.आंबेडकर बाबतची भूमिका स्पष्ट होते. इकडे १९५२ च्या निवडणुकीत शे.का.फे.चा पराभव झाल्याने या पक्षाने पुढे कशी वाटचाल करावी असे दादासाहेब गायकवाडानी डॉ. आंबेडकरांना विचारले तेव्हा शे.का.फे. पक्षाच्या भवितव्याबाबत ते म्हणाले होते की, 'शेडयूल्ड कास्ट्स हे शेडयूल्ड कास्ट्स फेडरेशनच्या पाठीमागे आहे. शे.का.फे.आपल्या शक्तीच्या जोरावर कोणत्याच मतदारसंघात निवडणूक जिंकणार नाहीत व जिंकू शकणार नाहीत. अशी परिस्थिति असल्याने शे.का.फे.मोडून टाकावे आणि शेडयूल्ड कास्ट्स फेडरेशनला पाठिंबा असलेल्या शेडयूल्ड कास्ट्स जनतेला त्यांच्या इच्छेप्रमाणे कोणत्याही पक्षांत जाण्याची मोकळीक ठेवावी' "यावरून त्यांच्या मनात नवीन पक्ष स्थापन करण्याचा वेत त्यावेळी घोळत असावा हे दिसून येते. पक्षा बरोबर राजकारणात भाग घेणारा पुढारी कसा असावा या बाबत डॉ. आंबेडकरांचे मत स्पष्ट होते. या बाबत ते म्हणतात की, " राजकारण कोणास करावयाचे असेल तर राजकारणाचा चांगला अभ्यास केला पाहिजे.अभ्यासाशिवाय जगा मध्ये कोणाला काहीच साधता येणार नाही. आपल्या समाजातील प्रत्येक कार्यकर्त्याने राजकीय,धार्मिक आणि आर्थिक या सर्व प्रश्नांचा चांगला बारकाईने अभ्यास करावयास पाहिजे. ज्यांना पुढारी व्हावयाचे असेल त्यांनी पुढार्यांची कर्तव्यकर्म व जबाबदारी काय आहे याची जाणीव ठेवावयास पाहिजे. कारण आपल्या समाजातील पुढार्यांवर अत्यंत मोठी जबाबदारी आहे. इतर समाजाच्या पुढार्यांसारखी आपल्या समाजातील पुढार्यांची स्थिति नाही. इतरपुढार्यांचे काय ? सभेत जाणे, लांबलचक भाषण करणे, टाळ्या मिळविणे आणि शेवटी हार गळ्यात घालून घरी येणे. ऐवढेच काम इतर पुढार्यांकडे असते. आपल्या समाजातील पुढार्यांना हे करून भागणार नाही.चांगला अभ्यास

करणे, विचार करणे, समाजाच्या उन्नतीसाठी स्वतः रात्रंदिवस सतत अंगमेहनत करणे हे गुण आपल्या पुढार्यां मध्ये असतील तरच ते लोकांचे थोडे फार भले करू शकतील. तोच पुढारी ठरू शकेल." ¹² डॉ. आंबेडकर नेहमी म्हणत असत की, 'राजकारण हा दमाचा व धीराचा खेळ आहे. राजकारण कोणास करावयाचा असेल तर त्यांनी राजकीय, आर्थिक, सामाजिक व धार्मिक या सर्व प्रश्नांचा अभ्यास केला पाहिजे' ¹³ एकंदर पक्ष व त्यातील पुढारी कसे असावे याबाबत त्यांची भूमिका स्पष्ट होती. ह्या सर्व गोष्टी त्यांना आपल्या रिपब्लिकन पक्षात अपेक्षित होत्या. पण डॉ. बाबासाहेब आंबेडकरांनी लवकरच बौद्धधर्माची दीक्षा घेण्याचे जाहिर केल्याने पक्ष स्थापन करण्याचा विचार त्यांनी पुढे ढकलला. ठरल्याप्रमाणे म्हणजे १४ ऑक्टोबर १९५६ रोजी डॉ. बाबासाहेब आंबेडकरांनी आपल्या लाखो दलित बांधवाना नागपूर येथे बौद्ध धर्माची दीक्षा दिली. दुसऱ्या दिवशी १५ ऑक्टोबर १९५६ ला सायंकाळी ५.३० वाजता नागपूर येथील श्याम हॉटेल मध्ये मध्यप्रदेश दलित फेडरेशन शाखेच्या वतीने डॉ. बाबासाहेबांच्या सन्मानार्थ छोटीशी चहा पार्टी देण्यात आली होती. त्यावेळी डॉ. आंबेडकर म्हणाले होते की, 'आपला देश स्वतंत्र झाल्यावर राज्यघटना घडविली त्यावेळी आपल्या राखीव जागेचा विचार झाला. काँग्रेसवाल्यांना राखीव जागा करता स्वतंत्र मतदार संघ मान्य नव्हता. तेव्हा जे वारे वहात होते ते संयुक्त मतदार संघाचे होते, त्याचाही प्रयोग करून पहावा असे पुष्कळांना वाटले. चोराची लंगोटी देखील सोडून नये म्हणतात त्याप्रमाणे राखीव जागा सोडून न देता त्याचा संयुक्त मतदार संघाने प्रयोग करावा असे वाटले पण आता असा अनुभव येऊन चुकला आहे की, काँग्रेसच्या तिकिटावर राखीव जागेवर जी माणसे येतात ती आपली तोंडे बंद करून बसतात. अशारितीने संयुक्त मतदार संघामुळे जर गंधे लोक निवडून येत असतील तर निवडणुकांचा व जागांचा उपयोग काय ? त्यांचा काही उपयोग होत नाही हे अनुभवाने आता सिद्ध झाले आहे.' ¹⁴ असे परखड मत राखीव जागे बाबत डॉ. आंबेडकरांनी व्यक्त केले होते. यावरून राखीव जागांचा पक्षाला कोणताच फायदा होत नव्हता. कारण काँग्रेस पक्षाने व स्वतः शेड्यूल्ड कास्ट्स फेडरेशन पक्षाने आपल्या भोवती तटबंदी उभी केली होती. या संदर्भात बोलताना डॉ. आंबेडकर म्हणाले होते की, 'आपल्या

आजपर्यंतच्या फेडरेशनच्या चळवळीने स्वाभिमान अवश्य निर्माण केला आहे. ही गोष्ट फेडरेशनला भूषणावह आहे. त्यामुळे संघटना झाली. तथापि, त्यामुळे एक प्रकारची तटबंदीही निर्माण झाली. दुसरे लोक आम्हाला मत देत नाहीत व आपण लोक त्यांना मत देत नाही, ही एक प्रकारची तटबंदीच होय. दुर्दैवाने आपली लोकसंख्या कमी आहे. आपण केवळ अल्पसंख्यांक आहोत. अशा परिस्थितीत फेडरेशन आहे त्या स्थितीत ठेवणे कठीण आहे.' ¹⁴ कारण शेडयूल्ड कास्ट्स लोकांचा प्रश्न हा केवळ त्यांचाच नसून तो शेडयूल्ड कास्ट्स व उच्चवर्ग यांच्या संबंधातून निर्माण झालेला आहे. त्यामुळे हा प्रश्न सोडविण्यासाठी जसे शेडयूल्ड कास्ट्स लोकांचे संघटन होणे आवश्यक आहे तसेच त्यात समविचारी इतर सर्वर्णही सहभागी झाले पाहिजेत ही आंबेडकरांची राजकीय संघटनाबाबतची दृष्टी होती. ¹⁵ म्हणूनच यासंदर्भात बोलतांना डॉ. आंबेडकर म्हणाले होते की, ' इतर समाजातील आमचे दुःख जाणणारे कोण आहेत हे पाहिले पाहिजे. अशा सर्वांना आपण एकत्रित करून त्यांच्यासह जाण्याची आपली सिद्धता पाहिजे. अशा लोकांना एकत्रित करण्याचा मी प्रयत्न करीत आहे. तो प्रयत्न यशस्वी झाल्यास आपल्याला नवीन पक्ष स्थापावा लागेल व त्या पक्षात आपल्याशिवाय इतरांनाही दार मोकळे राहिल.' ¹⁶ असा सर्वसमावेशक पक्ष त्यांना हवा होता. म्हणूनच या काळात डॉ. आंबेडकर राखीव जागाना विरोध करतात. या संदर्भात ते म्हणतात की, 'राखीव जागा नकोत ... आपल्या समाजाचे ऐक्य ही कोणत्याही गोष्टीपेक्षा अधिक महत्त्वाची गोष्ट आहे. या राखीव जागा गौण आहेत.' ¹⁷ हाच दृष्टीकोन पुढे ठेऊन डॉ. आंबेडकरांनी काँग्रेस विरोधी इतर पक्षांच्या लोकांसोबत पत्रव्यवहार व संवाद करून या दिशेने वाटचाल सुरु केली होती. १९५७ ची सार्वत्रिक निवडणूक जवळ आली होती पण त्यांच्या संकल्पनेतील रिपब्लिकन पक्ष स्थापन न झाल्याने त्यांनी इतर पक्षाशी निवडणुकीत सहकार्य करण्यासाठी दिल्ली येथील त्यांच्या निवासस्थानी नोव्हेंबर १९५६ ला बैठक झाली. या बैठकीत संयुक्त महाराष्ट्र समितीने शे.का.फे. चे उमेदवार जनरल जागेवर उभे करून निवडून आणावेत. सर्व राखीव जागा शे.का.फे.ला द्याव्यात, समितीने अस्पृश्यांवर होणार्या अन्यायाचे निवारण करावे, अस्पृश्यांचा प्रश्न सोडविण्याच्या कामी समितीने प्रयत्न करावे. ¹⁸ अशा अटींवर तडजोड केली होती.

त्यांचा विरोधी पक्षांना एकत्रित करण्याचा पहिला प्रयोग यशस्वी झाला होता. मात्र सर्वसमावेशक पक्ष स्थापन करण्यापुर्वीच डॉ. बाबासाहेब आंबेडकरांचे महापरिनिर्वाण झाल्याने त्यांच्या हयातित त्यांच्या संकल्पनेतील रिपब्लिकन पक्ष स्थापन होऊ शकला नाही. पुढे त्यांच्या अनुयायांनी द्वापक्षाची स्थापना केली पण लवकरच पक्ष्यात फाटाफूटीचे राजकारण सुरु होउन हा पक्ष रसातळाला गेला. तेव्हा डॉ. आंबेडकरांनी सुचविलेल्या मार्गा नुसार रिपब्लिकन पक्षाची नव्याने बांधणी केल्यास हा पक्ष सक्षम विरोधी पक्ष होऊ शकतो अशीच परिस्थिति आज देशात निर्माण झाली आहे.

मूल्यमापन

तत्वावर उभ्या असलेल्या रिपब्लिकन पक्षाची स्थापना करून मजबूत विरोधी पक्षाची स्थापना करणे हे डॉ. संसदीय लोकशाहीच्या मार्गाने समाजवादी समाजरचनेची स्थापना करणे हे डॉ. बाबासाहेब आंबेडकरांच्या एकुणच राजकीय विचारांचे ध्येय होते. प्रौढ मताधिकारावर आधारित असलेल्या कायदेमंडळाच्या निवडणूका केवळ दलितांच्या मतांवर जिंकणे अशक्य होते म्हणून एका व्यापक अशा बाबासाहेब आंबेडकरांचे स्वप्न होते. त्यासाठी त्यांनी प्रयत्न केले. त्यांच्या हयातित त्यांच्या संकल्पनेतील हा पक्ष उभा राहिला असता तर भारतातील आजचे राजकारण फार वेगळे राहिले असते यात मुळीच शंका नाही.

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12. Violent Extremism and its Impact on the Human Rights of Women

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Abstract

Violent extremism is becoming a global phenomenon. There are many radical or extremist groups operating from different parts of the world having different modus operandi. Violent extremism poses threat to peaceful enjoyment of the basic human rights like right to life, right to dignity, right to development. It is also antithesis of democracy. Women and children are found to be more vulnerable to these extremist movements. They are not only the victims of violent extremism but in some cases, they are coerced to be the perpetrators. Violent extremism often leads to unprecedented, grave and blatant violation of the basic human rights of women. Feminists claim equal access of women to the resources and the assets. However, due to such extremist movements, women are often denied access to the available opportunities and are often forced to live in distress. Thus, in the present paper, the Researcher is trying to connect the dots and to view the problem of Violent extremism from feminist perspective so as to suggest holistic and pragmatic solution to prevent the instances of Violent extremism. The Researcher has also evaluated the possibility of women acting as a catalyst and also a potential factor in countering violent extremism.

Introduction

Violent extremism poses great threat to the basic human rights to which a mankind is entitled. It is a threat to the life of an individual and is also antithesis to the dignity of an individual. The reasons behind violent extremism may be political ideology, religious belief, discontent and desire to bring social change. Violent extremism is becoming a menace today as youth, women and children are also falling prey to this.

Many International Extremist groups like ISIS, Boko Haram, Al Qaeda, AlShabab are there which are operating in different parts of world creating unrest and instability. It has been found that these groups have targeted many innocent people. Women, young girls and children are mainly vulnerable to these attacks.

Women and girls are differentially affected by violent extremism. They are often the first victims of violent extremist groups, experiencing horrific violations of their rights. Women are also impacted by counterterrorism policies, which can curtail their rights and impact their quality of life. Increasingly, they are themselves being recruited, forcibly or willingly, to these groups and are also playing a role in recruiting other men and women.

But women are not just victims or perpetrators of this phenomenon. Many have been and continue to be on the frontlines of prevention efforts. Their roles are multifaceted and include shaping community and family values, influencing decision making of potential recruits, identifying and intervening at early signs of radicalization that lead to terrorism, female imams preaching religious tolerance, women using different forms of media to promote counter narratives, and female police officers engaging with local communities to collect information¹

Difference between extremism, radicalism and terrorism

The terms violent extremism, radicalization, and terrorism are frequently used interchangeably. While they are closely connected concepts, they should not be understood as simple linear processes. While radicalism, connected to radicalization, has been said to seek making changes to the existing political and social structure, it does not necessarily lead to violence. Radicalization has also been described as a context-bound phenomenon with several common 'push' and 'pull' factors but no single determining feature.

'Extremism', on the other hand, has been referred to as the adoption of a particular ideology with the intention to use violence to remove the state or ruling structure and its elites. The terminology of violent extremism has been used to construe a concept broader and more expensive than terrorism, because it accommodates any kind of violence (even non-violent) so long as its motivation is deemed extremist.²

Violent extremism and Human rights of women

Feminists plead that women shall be given equal status like that of men. They claim equal rights like that of men. They want equal access to the resources and the assets. The stereotype roles of the men and women are getting blurred particularly in the aftermath of the feminist movements across the globe.

Women empowerment is empowering women by providing with all kinds of opportunities. It is expected that they are empowered economically, emotionally, educationally

and socially. However, sometimes women empowerment is misunderstood as curtailing and curbing the rights of their male counterparts.

Today, Violent extremism has become a global phenomenon. It is present in all its forms across the globe spreading its tentacles to engulf every possible thing that comes its way. Terrorism can be defined as "The systematic use of violence to create a general climate of fear in a population and thereby to bring about a particular political objective. Terrorism has been practiced by political organizations with both rightist and leftist objectives, by nationalistic and religious groups, by revolutionaries, and even by State institutions such as armies, intelligence services and Police.³

It has adverse impact on almost everything. It not only causes loss of life and property but at the same time has wider implications on the economy of a country. The Researcher wishes to throw light on how terrorism adversely affects the human rights of women. Every legitimate government across the globe including the International organizations are taking relentless efforts to tackle with the problem of extremism, terrorism by evolving certain counter terrorism measures. Today, women are coming out of the shackles, fetters of age old customs and traditions and they are trying to compete in every field of life. Right to development is a basic human right.

The human person is the central subject of development and should be the active participant and beneficiary of the right to development. All human beings have a responsibility for development, individually and collectively, taking into account the need for full respect for their human rights and fundamental freedoms as well as their duties to the community, which alone can ensure the free and complete fulfillment of the human being, and they should therefore, promote and protect an appropriate political, social and economic order for development. States have the right and the duty to formulate appropriate national development policies that aim at the constant improvement of the well-being of the entire population and of all individuals, on the basis of their active, free and meaningful participation in development and in the fair distribution of the benefits resulting therefrom.⁴

Nevertheless, due to terror attack and other criminal activities, the girls from backward areas are not ready to come out of their comfort zone to earn. These women can act inspiration for other girls to help them to come to the metro cities to earn and to support their families or at least to be independent. But one incidence of terror attack somewhere completely takes away

their chances of growth and development as the parents are not ready to send these girls to far off places.

Extremism has wider ramifications in the sense that it also promotes the organized crimes like human trafficking, drug trafficking, arms trafficking etc. The ill gotten money or as it is rightly called the 'Proceeds of crime' are then used to further promote Violent extremism or terrorism. It has been found that the victims of terror attack are the civilians who are called non combatants and more particularly women and children.

The International Instruments like **Universal Declaration of Human Rights, 1948, International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights** have ensured that the women are given basic human rights. If we talk about India then the Constitution of India which is the law of land and which is considered as an organic document has also given fundamental rights to women. The Supreme Court which is considered as the guardian of our fundamental rights has given many dynamic judgments reiterating the importance of the rights of women.

Women as suicide bombers

Women are recruited in the Terrorist organizations. They are first radicalized, allured and then recruited. They are also active on the battle fields as combatants but they may also be indirectly involved in the acts of terrorism by supporting their family members to join the terrorist organizations.

Various terrorist organizations also use women as suicide bombers, eg. Boko Haram. Women or girls are also abducted for this purpose. Some are coerced to join the terrorist organizations but some may accept to be a part of it voluntarily. Since there is less likelihood that women will be doubted or checked by the security personnel, they are actively involved by the terrorist organizations. Mostly, these women are those who have suffered marital turmoil, violence, gender inequality with no emotional and financial support. They are often brain washed in the name of religion and radicalized by recruiting them in the terrorist organization. They are also encouraged to give birth to next generation combatants in the terrorist organizations. Many times, they are also used for sexual gratification by the men of these radical groups. This is nothing but blatant violation of the human rights of women all over the world.

Human rights are also placed as a red thread throughout the UN Secretary-General's Plan of Action on Preventing Violent Extremism, in which the following links between human rights and violent extremism are made:

- I. Violent extremism poses a direct threat to the enjoyment of human rights;
- II. Grievances at the community level may contribute to the rise of violent extremism, and for example, repressive policies and practices that violate fundamental rights and the rule of law can heighten the lure of violent extremism;
- III. Individual experiences of human rights violations, such as torture or violations of due process can play a role in an individual's path to radicalization;
- IV. States that embrace international human rights norms and standards, and uphold the rule of law, create an enabling environment for civil society and reduce the appeal to violent extremism.⁵

Role of Women in preventing Violent Extremism

The roles of women in relation to violent extremism have remained less explored by policy makers and practitioners, despite the participation of women in violent extremism and their critical roles in its prevention. Women are often viewed as being highly influential in families, communities, and governments, and owing to this, they can play critical roles in detecting and preventing violent extremism. Since women are strategically positioned at the center of the family, it has been suggested, for example, that they can help build resilience within their communities starting from their own families and respond to children's early signs of violent extremism. Critics have, however, observed that efforts to include women have tended to focus more on women's engagement at the informal level (e.g. as mothers and wives) and less on women's roles as policy shapers, activists and educators.⁶

Conclusion and Suggestions

In the present paper, the Researcher has tried to draw attention towards the vulnerability of women to Violent extremism leading to unprecedented and blatant violation of the basic human rights of women like right to life, right to development, right to dignity. Many researches have shown that the women are radicalized and allured to join the terrorist organizations which further lead to grave violation of their human rights. Many women are also abducted or raped by the men of these radical groups.

It should be taken into consideration that these women have great potential to respond to violent extremism and act as a catalyst to prevent violent extremism as they also act gateways to their families and communities.

Suggestions

1. Gender sensitive National and International Policy framework to prevent Violent extremism has to be there which should be driven and motivated by the experiences of women.
2. Women should be educated so as to make them independent emotionally and financially. It will prevent them from falling prey to adverse conditions and they cannot be then easily allured to join any terrorist organization or any extremist group.
3. Women should be thoroughly empowered by involving them in policy making.
4. Women should not only be seen as victims of Violent extremism but also be seen as potential actors to fight and prevent Violent extremism.
5. More research should be conducted to further explore gender dimension involved in perpetration and also in prevention of Violent extremism.

FootNote

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Democratic ideals inculcated in Buddhism

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(5)

Democracy is understood as a way of thinking and acting implies a lucid commitment to freedom and equality of a population to choose their representatives to rule/govern them. Lord Buddha saw that life's very purpose is happiness. Modern democracy is based on the principle that all human beings are essentially equal, that each of us has an equal right to life, liberty, and happiness. Buddhism too recognises that human beings are entitled to dignity, that all human beings have an equal and inalienable right to liberty, not just in terms of political freedom, but also at the fundamental level of freedom from fear and want.

Buddhism has many principles that fit with democracy such as individualism, allowing people to develop their own mind to the fullest. This is very much in consonance with democracy. Buddhism teaches each person to have the opportunity to develop their own being towards enlightenment, to the fullest extent in life.¹

Lord Buddha never resorted to the influence of political power to introduce His teaching, nor allowed His Teaching to be misused for gaining political power. The basis of every religion is morality, purity and faith, while that for politics is power. In the course of history, religion has often been used to give legitimacy to those in power and their exercise of that power. Buddhist philosophy can be used for good governance. The plunge of the Buddha Dhamma is not directed to the creation of new political institutions and establishing political arrangements. Basically, it seeks to approach the problems of society by reforming the individuals constituting that society and by suggesting some general principles through which the society can be guided towards greater humanism, improved welfare of its members, and more equitable sharing of resources.

Many recent scholars have analysed from, the historical context of Gautama Buddha's life that he was both a 'social reformer' and political thinker. Lord Buddha had always been an advocate of the republican system. His preference of state can be analysed by the indication that He emphasised the sangha or 'tribal republic' such as Vajja. In his fourth sermon to Ananda bhikku and Vasakara, the Minister of King

against corruption and how a government should act on humanitarian principles. The Buddha once said, "When the ruler of a country is just and good, the ministers become just and good; when the ministers are just and good, the higher officials become just and good; when the higher officials are just and good, the rank and file become just and good; when the rank and file become just and good, the people become just and good."⁸

The Buddha's emphasis is on the moral duty of a ruler to use public power to improve the welfare of the people had inspired Emperor Asoka, a sparkling example of this principle, resolved to live and preach the Dhamma and to serve his subjects and all humanity accordingly.

Conclusion:

It is only in the human mind that true reform can be affected. Reforms imposed by force upon the external world have a very short life because they have no roots. Only those reforms, which spring as a result of the transformation of man's inner consciousness, remain rooted. So it depends on individual to individual as well as from ruler to ruler to reform himself and its subjects according to the basic values and attributes given in Buddhist philosophy

The society, where there exists the justice, is assured to enjoy peace, tranquillity and equality as well. In such society, the law can be enforced in the full scale, and the religious teachings can be applied effectively. But how justice arises and how justice can be achieved and implanted in the global community are the 'everlasting' questions pending solution by the religions, legal instruments, education systems as well as by human beings themselves.

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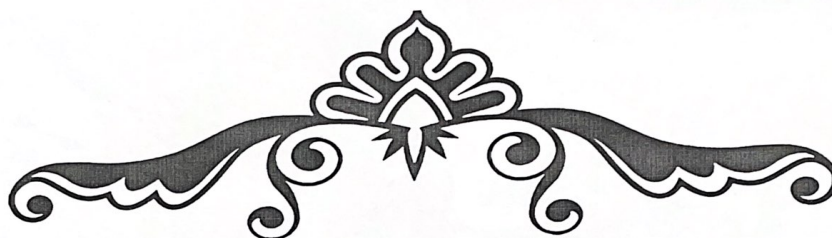
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10. The Implications and Importance of Genetics in Criminal Behaviour

Dr. Sandhya P. Kalamdhad

Introduction

Surendra Koli from Uttar Pradesh killed many innocent girls in a horrifying and barbaric manner. He used a definite methodology in committing these murders. He would see small girls passing by the house, and taking advantage of their weakness lure them inside the house. There he would strangle them and after killing them he tried to have sex with the body and then would cut off their body parts and eat them.¹

The case in hand was far from ordinary. The conduct of the accused, mode of commission of crimes and subsequent behaviour of eating on the dead bodies called for further investigation and enquiry into the genetic disposition of the person. While neither the court nor the counsel sought any evidence in this regard and sentencing, an apt process would have been an examination of genetic abnormalities and probable treatments, if any.

There are few offenders who are more cruel and persistent repeaters. What sets them apart from the rest of the criminal population may be an abnormal biochemical makeup, brain structure or some other human trait and all these mostly depend upon the genetic composition of the individual. Even if crime is a choice, the fact that some people make that choice repeatedly could be linked to their physical and mental makeup.²

Though most of the work relating genetics to human characteristics has so far been more concerned with linking genetics with particular diseases, rather than with criminal behaviour, the recent genetic advances clearly have possible implications for criminology. Therefore role and impact of genetics in criminal behaviour could be one important tool to prevent crimes in future and it shall be accepted as evidence before the court. However, yet it has not been adopted in India. Therefore to understand the role and impact of forensic DNA profiling in the criminal justice system, there is a need of pragmatic evaluation.

1. Historical and Contemporary view on Cause of Crime

The aim of this paper is to focus on the biological explanations of crime in terms of genetics. Henceforth, it becomes imperative to study from both an historical and contemporary viewpoint, the assertion that there are biological explanations for crime.

1.1 Classical School Eighteenth Century

Before turning to the biological theories, in the late eighteenth century a large body of theory known as the enlightenment began to emerge that led to the beginnings of classical criminology. Classical criminology focuses on the administration of justice. The prevention of crime was the central idea and therefore they see human behaviour is governed by free will and thus criminal activities are a manifestation of choice, not the devil. And therefore their belief was, as criminals are voluntarily entered into the wrong choice they should be punished to teach to amend their ways (individual deterrence) and to show others what will happen if they misbehave (general deterrence). There was a small amount of scientific calculation in assessing the free will and the harm caused so determining the amount of punishment to be faced, it was intended to be an exact calculation as this would increase the deterrence.³

Thus the classical school had led to all sorts of behaviour being monitored, unacceptable attitudes or actions being punished, both to control the moral fibre of society and to deter possible transgressions. According to this school, all sorts of people and activities were being controlled by being removed from society – e.g. drunkards, the mentally ill, the poor, immigrants, those moving from one parish to another, prostitutes, those suffering from sexually transmitted diseases, pity offenders, blasphemers and hardened criminals.⁴

1.2 Positivist School Early Nineteenth Century

In critical opposition to classical criminology the positivist school began in the early nineteenth century. The positivists started to look at what made some individuals criminals and thus many theories spoke of 'born criminal'. Some, however look at social theories.

The idea of 'born criminals' started to emerge at the beginning of the nineteenth century and soon became attractive. Their claim of a relationship between the size and the shape of the skull, the brain and social behaviour was for a time very fashionable and served to focus attention and the individual criminal. This was a link which was made more explicitly and effectively by Lombroso.⁵

Earlier classical writings urged that the punishment should fit the crime, a positivist approach could argue that if the individual was inherently criminal a much larger sentence could be justified to prevent future offences and to protect society. Therefore, it becomes all the more imperative to study Cesare Lombroso and his theory of 'atavism'.

1.2.1 Cesare Lombroso: A Quick look

Cesare Lombroso has been called the father of modern criminology. Lombroso's theory assumes the existence of a distinct anthropological type, 'the born criminal' – who is likely or

bound to commit a crime. According to this idea, a criminal is supposed to be a throwback in the evolutionary chain, a reversion to an earlier and more primitive being who was both mentally and physically inferior. In other words, the criminal reflected our lower and more ape-like ancestors, their physical characteristics, he claimed, resembled those of apes. His theory used physical characteristics as indicators of this degeneracy or inadequacy and therefore as indicators of criminality. The physical characteristics measured by him included, peculiar size or shape of head, peculiarities of the eyes, asymmetry of the face, enlarged jaw and cheekbones, ears which are too large, too small or too handle shaped, nose twisted, upturned or flattened, abnormal teeth, abundance of wrinkles, abundance of hairs which is often black and frizzled, excessive length of arms, dark skin etc.

From time to time the list was changed, but it was always made up of similar types of physical anomaly. If a person portrayed five or more of these atavisms or anomalies, the individual was a born criminal. In his earlier works he always claimed that all criminals fell into the category of born criminals, a claim which he later revised. As his actual findings, that there was a 'born criminal' type, have been more or less rejected. Therefore in his later work Lombroso (1906) included many other variables which could impinge on criminality: climate, rainfall, grain prices, sex and marriage customs, education, religious and government structures. This has increased his reputation as the father of modern criminology⁶.

One natural extension of Lombroso's approach was into Somatotyping which purports to relate the behaviour and constitution of a person to the shape of their body. This was first systemised by William Sheldon (1949) who identified three basic body types: endomorphic (stocky, rounded, fat); mesomorphic (hard, muscular, athletic); and ectomorphic (thin, weak, frail), each with its associated personality traits (e.g. friendly, sociable for endomorphic). In a study comparing young male delinquents with a control group of students he concluded that most delinquents tended towards mesomorphic. Later more sophisticated studies to test this finding found some support for such an association but, more crucially, found that delinquency was related to a combination of biological, environmental and psychological factors.⁷

Lombroso and Somatotypist theorists considered that biological traits were a useful means of identifying criminals or potential criminals, and today some claim the same for genetics. More generally, many studies and much evidence point towards the need to include social, biological and psychological aspects: but these additions are not necessarily incompatible with the overall positivist approach.⁸

1.3 Contemporary View

Modern biologist consider that genes are relevant because they have a strong influence on brain function and therefore, it is believed, on behaviour and criminality. Since all human beings (except identical twins) are genetically unique this can help explain differences in behaviour by individuals who had been subjected to similar environmental and social influences. However, most modern researchers do not view the part played by biology in any explanation in criminality as indicating an illness or a dysfunction, rather it suggest the possibility of slightly different configuration of normal genes giving rise to a temperament which is more receptive to anti-social types of behaviour. Furthermore, many do not view such differences as immutable, recognising instead that biological and genetic differences can be altered.

Modern biologist generally acknowledge the importance of environmental and social influences on criminal behaviour and suggest that they should be studied in parallel with genetics- they call this a bio-social perspective by which they recognise that biological characteristics will not determine whether an individual will take part in criminal behaviour but they may increase its likelihood.⁹

Some claims that no research can be properly made in isolation from other social factors for e.g. If criminality is soon to be linked to, say, genetics, this, does not mean that genes are the sole cause of criminality. It may be that an individual has inherited the potential to act in a criminal manner, but whether or not that potential is realised may depend upon the interaction of the physical and social environment with those individual traits, and finally on individual choice. Thus one may appreciate that neither biological nor social explanations offer anything like a complete solution, but that their interaction may provide a more balanced perspective, then it may be possible to arrive at the better understanding of crime and its prevention.

2. Linkage between Genes and Criminal Behaviour

Genetics, behaviour, and the law are used as a framework for exploring the implications of behavioural genetics research for individual, family, community and society.¹⁰ There are certain genes which have been identified as a responsible element associated with criminal and anti-social behaviour. One of the most important among them is "Scarlet gene" that marks the individual, his family and his racial and ethnic community as "flawed, compromised and somewhat less than fully human".¹¹

Recent years have seen huge advancement in DNA research, with researchers now able to identify specific genes that are linked to anti-social or aggressive behaviour. In particular the monomorph oxidase 'MAO-A' gene nicknamed "the warrior gene"¹² which

⁹ See *Behavioral, Biological and Legal Issues Journal* No. 1 (2017)

appears to be hereditary and which controls the amount of serotonin in the brain. People with the version of that produces less of the enzymes tend to be significantly more impulsive and aggressive but the effect of the gene is triggered by stressful experiences.¹³

University of Texas published a study in the *Criminology Journal* found that, there are probably a wide range of genes which play an important part in raising or lowering our chance of offending.¹⁴ According to Dr. J. C. Barnes, Asst. Prof. of Criminology, at UT Dallas, "There are likely to be hundreds if not thousands, of genes that will incrementally increase your likelihood of being involved in a crime".

A genetic analysis of almost 900 offenders in Finland has revealed two genes associated with violent crime. Those with the genes were 13 times more likely to have a history of repeated violent behaviour. The authors of the study, published in the *Journal Molecular Psychiatry*, said at least 5-10% of all violent crime in Finland could be attributed to individuals with these genotypes. But they stressed the genes could not be used to screen criminals. Many more genes may be involved in violent behaviour and environmental factors are also known to have a fundamental role. Even if an individual has a "high-risk combination" of these genes the majority will never commit a crime, the lead author of the work Jari Tiihonen of the Karolinska Institutet in Sweden said. Prof Tiihonen added, 'genetic profiling should not yet be used in criminal courts'.

Brett Haberstick from the University of Colorado, Boulder in the US, said that, "finding genes for criminal behaviour is going to be difficult", despite a long tradition of biological work in the area of criminology. He further commented that, "To call these alleles 'genes for violence' would therefore be a massive exaggeration. In combination with many other factors these genes may make it a little harder for you to control violent urges, but they most emphatically do not predetermine you for a life of crime."

However, there are certain studies like the twin studies¹⁵ and adoption studies¹⁶, which conclude that one should not ignore a genetic link when studying reasons for criminality. Genetics does play a role in combination with environmental and sociological elements in contributing to delinquency and criminal activity.

3. Gene Mapping in Crime Prevention

There is broad support in both the U.S. and Europe for applying scientific methods and data to crime prevention. One potentially promising and exceptionally controversial zone of engagement is "prediction." The effort to predict "future dangerousness" is motivated by the

belief that we can reduce antisocial behaviour by identifying those people most likely to commit crimes.

Scientists have claimed that the seeds of criminal and anti-social behaviour can be found in children as young as three. Therefore it is argued that, by predicting which children have the potential to be trouble, treatment could be introduced timely to keep them upright. No civilised or matured criminal justice would like to brand people by birth. However, the more we know about what lies behind violent behaviour, the better we can target our preventive interventions. It has already been established that parenting, training aimed at parents of problem children is effective and could even pay for itself by diminishing the costs caused by antisocial behaviour. However there are many who disapprove this method to be followed in legal proceedings due to enormous invariability, uncertainty and consequences.

4. Admissibility of Genetic Evidence in India- The Road Ahead

Genetic evidence has never come before the courts in India till date, either as a defence request or on observations of the Courts. The only scientific data which has been admitted within the court pertains to results from DNA fingerprinting, which mostly relates to identification of whether a person was present at the scene of the crime or in issues relating to paternity disputes. However, the Indian Evidence Act, 1872 does not delimit the extent and scope of scientific and technological evidence that may be introduced in a case.

The application and admissibility of genetic evidence will have significant implications on criminal law. Genes play a large role in determining the propensities of behaviour and the determination of criminal responsibilities. For example, people with genetic predisposition to aggressiveness would be treated differently than those who do not have such genetic abnormalities. Genetic determination could lead to acquittal of people based on the psychological disposition. The degree of aggressiveness evidenced in a person's genetic predisposition coupled with other "abnormal" genetic traits or "mental abnormalities", would play a major role in questions of pre-trial releases, characters evidence at trial, post-trial release, sentencing and parole. Acting as mitigating factors during sentencing such data would make courts to evaluate how much of a person's behaviour was attributable to genetics and how much volitional, before determining culpability. They might also offer a means of preventing repeat crimes. In this regard, family history would gain increasing importance as the prosecution and defence would evaluate the family history not only in the context of sentencing but also for determinations of dangerousness, charging decisions and genetic defences at trial. Rehabilitation would be of higher priority and would be oriented towards those individuals whose genes

indicate that they could be influenced by external factors. Imprisonment would be recognized merely as a means of separating dangerous individuals from the rest of the society and generally a step courts would be discouraged from taking.¹⁷

Conclusion

The different studies shows the relationship between genetics and criminal behaviour. Forensic science and criminal justice system are complementary to each other. New scientific advancement (genetic science) shall be used for the quest of justice. However it is evidenced that still science has not reached up to the complete accuracy required by administration of criminal justice system. But the search for born criminals is not surrendered. As the science has taken the belief of 'born criminal' beyond philosophy and efforts of scientists may give answer to this debate. Nevertheless, criminal justice system should take within its fold established scientific data which may have larger implications on Culpability, sentencing and prevention.

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- 16) A study conducted by Crowe in the year 1972, whereby he studied 52 adopted children whose natural mothers had criminal records, established that among the 52 children of criminal mothers, eight had been arrested (some of them more than once), and seven of them had been convicted. Only two of the control group had been arrested (each on one occasion) and only one had been convicted. Crowe reported the impression that there was some similarity in the types of crimes committed by the biological mother and the adoptee. Hutchings and Mednick (1977) conducted the study and discovered that boys with criminal biological fathers were more likely to be criminal than those with law-abiding fathers. Further, they found that those with criminal adoptive fathers were also more likely to be criminal than those with law-abiding adoptive fathers, but that the effects of a criminal biological father were more noticeable than a criminal adoptive father. This finding suggested that genes were in this respect more important than environment.
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डॉ. बाबासाहेब आंबेडकर आणि राष्ट्रीय एकता

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सारांश :-

डॉ. बाबासाहेब आंबेडकर हे लोकशाही भारताची 'राष्ट्र' म्हणून उभारणी करणारे महामानव होते. स्वातंत्र्य, समता, बंधुता, न्याय या मुलतत्वांच्या प्रस्थापनेसाठी त्यांनी १९२० पासूनच सामाजिक कार्यास सुरुवात केली. कोणतीही अनुकूल परिस्थिती नसतांना त्यांनी विषमतामूलक समान व्यवस्थे विरुद्ध आपल्या आंदोलनास सुरुवात केली. केवळ दलितांच्या हितरक्षणासाठी त्यांनी कार्य केले नाही तर भारताला स्वातंत्र मिळावे म्हणून १९३१ मध्येच गोलमेज परिषदेत इंग्रजांना 'चालते व्हा' म्हणून सांगितले. जोपर्यंत भारताला स्वातंत्र्य मिळत नाही, तोपर्यंत आमच्या परिस्थितीत कोणताच फरक पडणार नाही. आमची दुकखे आमच्याशिवाय कुणीही निवारू शकणार नाही. आमच्या हातात त्यासाठी सत्ता हवी आहे. या सोबत— सोबतच बाबासाहेबांनी देशहिताच्या दृष्टीने सुद्धा कार्य केले. संविधान निर्मितीचे कार्य, लोकसंख्या वाढ नियंत्रणात आणण्याचे कार्य, नदीवरील बंधारे, कामगारांविषयी कार्य, स्त्रियांच्या उन्नतीविषयी कार्य, विदेश नीतीविषयी कार्य, बौद्ध धम्म स्वीकाराचे कार्य इत्यादी हे सर्व कार्य बाबासाहेबांचे देश प्रेम उजागर करणारे कार्य आहेत.

बीजसंज्ञा:- राष्ट्र, मुलतत्व, समाज व्यवस्था, दलित, हितरक्षण, गोलमेज परिषद, इंग्रज, संविधान, बौद्धधम्म

उद्दिष्टे :-

बाबासाहेबांनी जी काही सामाजिक आंदोलने उभारलीत त्यामागचा मुख्य उद्देशच हा होता की,

दलित, शोषित, पिडीत, आदिवासी, बहुजन समाजाला ईश्वराच्या गुलामीतून अंधश्रद्धेतून, धर्मांधतेतून मुक्त करणे आणि विज्ञानवादी, मानवतावादी विचारांचे त्यांच्यामध्ये बीजारोपण करणे, म्हणून राष्ट्राला उन्नत करणारा हा बाबासाहेबांचा विचार समाजापर्यंत पोहोचविणे आजच्या परिस्थितीत अत्यावश्यक आहे.

अभ्यास पद्धती :- शोधनिबंधासाठी उपयोगात आणलेली माहिती द्वितीय स्वरूपाची आहे.

प्रस्तावना:-

स्वातंत्र, समता, बंधुता, न्याय या मानवी मूल्यांनाच स्वताच्या हृदयाशी कवटाळणा. या डॉ. बाबासाहेब आंबेडकरांच्या मनात अस्पृश्यता निर्माण करणा.या, तिचे पालन करण्यास उद्युक्त करणा.या हिंदु धर्माविषयी आपुलकी आणि सहानुभूती असणे केवळ अशक्य होते, कारण बाबासाहेबांच्या प्रत्येक कृतीत राष्ट्रहित सामावलेले होते. ज्या-ज्या कृती राष्ट्रहिताच्या आड येत असतील त्या-त्या कृतीत राष्ट्रीय एकता कायम ठेवण्यासाठी त्यांनी सडेतोड विरोध केला. कारण राष्ट्रीय एकता, बंधुत्वाची भावना समाजा-समाजामध्ये असल्याशिवाय देशाच्या प्रगतीच्या दिशेने कोणतीच पाऊले टाकता येणे शक्य नाही म्हणून ख-या अर्थाने जर देशाची सर्वांगिन प्रगती साध्य करावची असेल तर देशामध्ये एकात्मतेची भावना असणे अत्यावश्यक आहे, त्यावर डॉ.बाबासाहेब आंबेडकर यांनी विशेष भर दिला. त्यानुसारच त्यांनी आपले राष्ट्रीय ऐक्य प्रस्थापित करणारे विचार समाजात रुजविण्याचे निरंतर प्रयत्न केले. परंतु संविधान लागू होऊन ७० वर्षांचा काळ लोटून सुद्धा स्वातंत्र्य, समता, बंधुता, न्याय या मुलभूत तत्वांना आपण कितपत न्याय देऊ शकलो, हा अजूनही एक प्रश्नच आहे.

विषय विश्लेषण:-

डॉ. बाबासाहेब आंबेडकर आणि राष्ट्रीय एकता: उत्तम पुरुषाचा जन्म दुर्लभ आहे. तो सर्वच ठिकाणी उत्पन्न होत नाही परंतु ज्या कुळात उत्पन्न होतो त्या कुळात सुखाची वृद्धी होते. डॉ. बाबासाहेब आंबेडकर यांचा जन्म हा उत्तम पुरुषाचा जन्म होता. त्यांच्या जन्मामुळे केवळ त्यांच्या कुळाचाच उद्धार झाला नाही तर संपूर्ण भारतीयांच्या कुळाचा उद्धार

झाला आहे. डॉ.बाबासाहेब आंबेडकरांच्या व्यक्तिमत्त्वाचा अभ्यास जर केला तर आपल्या असे लक्षात येते की, बाबासाहेबांना त्यांच्या बालवयापासूनच इथल्या भारतीय समाज व्यवस्थेने अतिशय हिन आणि तिरस्कृत अशी वागणूक दिली. त्याचे कारण हे होते की, त्यांचा जन्म धर्मव्यवस्थेने ठरविलेल्या नीच जातीत झाला. परंतु अशा विपरीत व्यवस्थेतही बाबासाहेबांनी सर्व आव्हानांना सामोरे जात, त्यामधून तावून सलाखून निघून आपल्या व्यक्तिमत्त्वाला अतिशय कणखर बनविले. ज्या समाज व्यवस्थेने त्यांना पशुतुल्यच नाही तर त्यापेक्षाही नीपट्टर वागणूक दिली, त्या व्यवस्थे विरुद्ध त्यांच्या मनात कटुतेची भावना आली असती तर ती एक स्वाभाविकच असती परंतु त्यांनी मात्र आपल्या मनामध्ये कधीच अशी कटुतेची भावना येऊ दिली नाही. उलट ते अस्पृश्यता जातिभेद पाळणाऱ्यांना दोष देत नाहीत तर ज्या धर्मशास्त्रांनी त्यांची अंशी मानसिकता बनविली त्या धर्मशास्त्रांना ते दोष देतात.

म्हणून बाबासाहेब आंबेडकर ही धर्मशास्त्रे मानवी समाजाच्या दृष्टीने कशी अहितकारक आहेत याविषयी समाजचे प्रबोधन करतात म्हणतात, 'जो एकाला सज्ञान बनविण्यासाठी दुसऱ्याला अज्ञानी ठेवतो तो धर्म नसून लोकांना बौद्धिक गुलामीमध्ये ठेवण्याचे एक षडयंत्र आहे, जो धर्म एकाच्या हातामध्ये शस्त्र देऊन दुसऱ्याला निशस्त्र करतो तो धर्म नसून एकाद्वारे दुसऱ्याला परधीनतेमध्ये ठेवण्याची चालाखी आहे. जो धर्म काही लोकांना धनप्राप्ति करण्याचा मार्ग खुला ठेवतो आणि बाकी लोकांना जीवनभरासाठी दुसऱ्यावर अवलंबून राहण्याची आज्ञा देतो तो धर्म नसून स्वार्थपरायनता आहे. हिंदू धर्माची चातुर्वर्ण व्यवस्था अशी आहे. यामध्ये बहुजन समाजाच्या उन्नतीचा मार्ग अजिबात नाही, या धर्मामध्ये सहानुभूती नाही, समता नाही आणि स्वतंत्रता सुद्धा नाही. अशी व्यवस्था जर असेल तर त्या समाजाच्या विकास होणार नाही आणि समाजाचा विकास झाला नाही तर देश रसातळाला जाईल कारण समतेचे, बंधुतेचे तत्त्वच सामाजिक एकता कायम ठेऊ शकते आणि सामाजिक एकतेतूनच राष्ट्रीय एकता निर्माण होऊ शकते म्हणून या राष्ट्रीय एकतेच्या आड येणारे जे हिंदुधर्मातील तत्त्वे आहेत, त्यांना ते विरोध

करतात. त्या तत्वांवर ते टीका करतात, त्यांचे धर्मग्रंथ जाळतात परंतु हिंदु धर्मातील समाजाचा विकास व्हावा याची त्यांना किती तळमळ होती हे कुणीच समजून घेण्याचा प्रयत्न केला नाही.

राष्ट्रीय एकात्मतेच्या आड येणारे घटक :-

डॉ.बाबासाहेब आंबेडकर यांनी 'अॅनिहिलेशन ऑफ कास्ट' या ग्रंथाच्या सुरुवातीला सुप्रसिद्ध विचारवंत एच.ड्युमांड यांचे एक अवतरण दिले आहे. त्यात ड्युमांड म्हणतात की, 'जो माणूस आपल्या सद्सद् विवेक बुद्धीचा वापर करणार नाही त्याला हटवादी समजले पाहिजे, जो आपल्या सद्सद् विवेक बुद्धीचा वापर करीत नाही त्याला मूर्ख समजले पाहिजे आणि जो आपल्या सद्सद् विवेक बुद्धीचा वापर करण्याचे धैर्य दाखवित नाही त्याला गुलाम म्हटले पाहिजे. हटवादी व मूर्खता ह्या परिवर्तनवादी संकल्पना आहेत. कळत-नकळत हा हटवादीपणा नष्ट होतो, परंतु अनादि काळापासून आपले अस्तित्व अबाधित ठेवित आहे ती म्हणजे गुलामी-ही गुलामी भारतीयांच्या हाडीमासी भिनलेली आहे, याचे कारण सद्सद् विवेक बुद्धी वापरण्याचे धैर्य भारतीयाना होत नाही, हे धैर्य दाखविले जात नाही. असे का व्हावे? कारण सद्सद् विवेक बुद्धीचा वापर केला तर आपल्याला मुक्ती मिळणार नाही ही शिकवण धर्मग्रंथांनी दिली आहे. धर्मग्रंथाना आव्हान दिले जाऊ नये म्हणून एक षडयंत्र रचल्या गेले ते म्हणजे ग्रंथ हे अपौरुषिये आहेत, धर्मग्रंथ हे मानवनिर्मित नसल्यामुळे त्या ग्रंथावर आक्षेप घेतल्या गेले नाहीत. भारतीय माणूस धर्मनिष्ठ असल्यामुळे धर्मग्रंथाना आव्हान देणे त्यांच्या कुवती बाहेर होते. भारत देश त्यामुळे स्वता अनेक शतके गुलाम राहिला आणि देशांतर्गत गुलामी घट्ट करू शकला. सद्सद् विवेक बुद्धीचा वापर करून त्याने धर्मग्रंथाना आव्हान देण्याचे धैर्य दाखविले असते तर भारत देश बलिष्ठ ठरला असता डॉ. बाबासाहेब आंबेडकर यांनी १९२७ साली धर्मग्रंथाना आव्हानच नाही तर त्यांनी विषमता मूलक धर्मग्रंथांची सार्वजनिक होळी केली. बाबासाहेबांच्या या कृतीमध्ये समतामूलक सशक्त भारताची निर्मिती करणे हा राष्ट्रीय दृष्टिकोण होता.

राष्ट्रीय एकात्मता:

राष्ट्रीय एकात्मतेच्या संदर्भात डॉ.बाबासाहेब आंबेडकर यांचे राष्ट्रप्रेम आणि निष्ठा ह्या अतुलनीय आहेत. वंचित जनसमूहाला बाबासाहेबानी आपल्या कायनि आणि चळवळीने, राष्ट्रीय प्रवाहात सहभागी करून घेण्याचे मोठे कार्य केले. राष्ट्रवाद ही ख.या अर्थाने लोकांची एकात्मिकतेची भावना आहे. ती मनुष्याच्या विचारांची उपज आहे. वंचित वर्ग हा साधारणता आपल्या हक्काकारिता सशस्त्र क्रांतिकडे वळत असतो. परंतु डॉ. बाबासाहेब आंबेडकरानी या वंचित वर्गाला कायदा आणि सुव्यवस्था याचे पालन करण्याचे बाळकडु पाजले आहे. राष्ट्रीय सम्मान आणि सामाजिक एकता हे त्यांच्या राष्ट्रवादाचे मूलाधार होते. शोषित आणि वंचित वर्गाच्या हिताकारिता चळवळ करणे हा त्यांच्या राष्ट्रीय कार्याचाच भाग होय. आपल्या अनुयायांना मार्गदर्शन करतांना ते सतत सांगत असत की, भारतीयत्वाच्या चौकटीत राहूनच आपण आपल्या सामाजिक, राजकीय आणि आर्थिक मागण्या पुढे ठेवावयास पाहिजेत. सामाजिक एकात्मतेशिवाय राजकीय एकता प्राप्त करणे कठीण आहे. ती प्राप्त जरी झाली तरी दीर्घकाळ टीकु शकणार नाही.

देशाप्रति सन्मान, सामाजिक एकता व मानवी मूल्याची जपवणूक हे राष्ट्रवादाचे मूळ आधार आहेत म्हणूनच जाती,वर्ण,वंश,पोटजाती कायम ठेवून राष्ट्रवादाची गोष्ट करणे म्हणजे मूर्खता आहे. वर्ण,जात,वंश,भाषा आणि विषमता यावर आधारित राष्ट्रवाद पोकळ,ढोंगी आणि अमानविय आहे. सर्व देशवाशीयांना समान नागरिक हक्क व अधिकार हे कोणत्याही समर्थ राष्ट्राचे आधार स्तंभ आहेत. हे हक्क डावलून कोणताही देश महान होऊ शकत नाही. आज ही आपल्या भारत देशात जातीचा प्रश्न सुटलेला नाही,आज ही फार मोठ्या प्रमाणात जातीचेच राजकारण,समाजकारण होत असल्याचे जाणवते, आज ही जातीवादने प्रेरित होऊन उच्च जातीतील अधिकारी वर्ग आपल्या हाताखालील कनिष्ठ जातीतील कर्मचा.यांना त्रस्त करण्याच्या मानसिकतेचा आहे,ही प्रवृत्ती राष्ट्रीय एकात्मतेला धोकादायक आहे.

राष्ट्रवाद आणि सांप्रदायिकता :-

डॉ. बाबासाहेब आंबेडकरानी नेहमी जातीवादवर टीका केली कारण जातीवाद तथा सांप्रदायिकता हिन प्रवृत्तीची उपज आहे, त्यामुळे राष्ट्रीयतेचे पाळेमूळे कमजोर होतात, सामाजिक दुष्कृत्यांना वाव मिळतो आणि राजनैतिक उदंडता प्रकट होते. जातीवादामुळे, सांप्रदायिकतेमुळे संकुचित हित जोपासल्या जाते, हिन धार्मिक कट्टरता निर्माण होते, समाज विरोधी क्रियांचा जन्म होतो. सांप्रदायिकतेमध्ये विश्वास करणाऱ्या जाती किंवा धर्म आपआपसामध्ये घृणा व वैरची भावना उत्पन्न करतात. अशा प्रवृत्तिमुळे एक-दुस.या विषयी भय व शत्रुत्वाची भावना निर्माण होते व पर्यायाने सामाजिक प्रगतीच्या वाटा खुंटतात, त्यामध्ये अडसर निर्माण होतो. सर्व जातीमध्ये एक-दुसऱ्याचे दमन करण्याच्या प्रवृत्तिमुळे राष्ट्रवादाच्या भावनेला, राष्ट्रीय एकतेला धक्का लागण्याची भीती निरंतर राहते. म्हणूनच डॉ. बाबासाहेब आंबेडकरानी नेहमी पृथक्तावाद, क्षत्रियवाद, जातिवाद, भाषावाद तसेच सांप्रदायिकते विरुद्ध, संघर्ष करण्यावर अधिक भर दिला. सर्व समाज विरोधी तसेच राष्ट्राविरोधि कृतींवर रोक लावली पाहिजे आणि त्यांना शिघ्र अतिशिघ्र भारतीय समाजामधून मूळापासून उखडून फेकले पाहिजे, कारण जातिवाद, सांप्रदायिकता हे फार गंभीर आजार आहेत त्यामुळे बंधुत्वाची भावना नष्ट होऊन जाते आणि देशाचे सुद्धा अहित होते, त्यामुळे शक्तीशाली वर्ग समाजाचे शोषण करतात, आपल्या स्वार्थासाठी ते समाजाच्या आणि देशाच्या विरुद्ध सुद्धा कार्य करतात. ह्या सर्व हिन भावना आहेत, ज्यामुळे आपल्या देशाच्या नैतिकतेचा न्हास होतो.

राष्ट्रीय भावना :-

आम्ही सर्व एक आहोत, ही भावना म्हणजेच 'राष्ट्र'. भारतातील फारमोठा जनसमूह हा जातीच्या आणि अस्पृश्यतेच्या नावाखाली जर वेगळा पडलेला असेल तर तो समुह देशाच्या प्रमुख प्रवाहात कसा येईल? म्हणजेच खऱ्या अर्थाने याला राष्ट्र म्हणता येण्यासाठी आमची विविधतेतील एकता केवळ घोषणा होईल. म्हणूनच २६ नोव्हेंबर १९४७ रोजी घटना समितीपुढे केलेल्या भाषणात डॉ. बाबासाहेब आंबेडकर

म्हणतात, "संविधानाच्या उद्देशप्रतिकेत समाविष्ट करण्यात आलेल्या 'आम्ही भारताचे लोक' या शब्द प्रयोगाला राजकीय दृष्टिकोण ठेवणाऱ्याला अनेकानी विरोध केला. याऐवजी 'भारतीय राष्ट्र' असा शब्द प्रयोग करावा असे अनेकांचे मत होते. मात्र माझ्या मते, आम्ही एक राष्ट्र आहोत असे माणणे म्हणजे फार मोठे भ्रम उराशी बाळगणे आहे ते प्रश्न उपस्थित करतात की, कित्येक हजार जातीत विभागले गेलेले लोक राष्ट्र कसे होऊ शकतात! त्यांच्या मते, जाती या राष्ट्रनिर्मितीसाठी फार मोठा अडसर आहेत, कारण जातीमुळे सामाजिक जीवन विभाजीत होते. त्याबरोबरच जातीमुळे एकाच भू-प्रदेशातील व्यक्ती-व्यक्तीमध्ये द्वेष व दुर्भावना वाढीस लागते. त्यामुळे भारताला खरोखरच राष्ट्र बनायचे असेल तर जातींचा विनाश करावा लागेल.

राष्ट्रीय एकात्मतेच्याप्रती तळमळ व्यक्त करताना बाबासाहेब म्हणतात, 'माझ्या मनाला अतिशय दुःख होते ते या गोष्टीचे की, भारताला आपले स्वातंत्र्य गमावण्याची वेळ एकदाच येऊन गेली असे नाही. भारतीय लोकांच्या स्वतःच्याच विश्वासघातामुळे आणि देशद्रोहीपणा मुळे त्याला आपले स्वातंत्र्य गमवावे लागले. आता ह्या इतिहासाची पुनरावृत्ती होईल की काय? या विचाराने माझे मन ग्रासले आहे. जातिभेद, पंथभेद या आपल्या जुन्या शत्रुमध्ये परस्पर विरुद्ध असलेल्या नवीन पक्षाची अधिकची भर पडली आहे, जर आम्ही आमचा पक्ष, पंथ, धर्म आणि भाषाना आपल्या देशा पेक्षा व राष्ट्रहिता पेक्षा अधिक महत्त्व दिले तर भारताचे स्वातंत्र्य दुसऱ्यांदा धोक्यात येईल आणि कदाचित कायमचे नष्ट होण्याची भीती आहे, म्हणून आपण आपल्या शरीरगत रक्ताचा शेवटचा थेंब असेपर्यंत आपल्या देशाच्या स्वातंत्र्य रक्षणासाठी लढण्याची प्रतिज्ञा केली पाहिजे. हा देशभक्तीचा अति सावधगिरीचा व धोक्याचा इशारा डॉ. बाबासाहेब आवेडकरांनी घटना समितीत भाषण करताना २५ नोव्हेंबर १९४९ रोजी भारताच्या संसदेत दिला होता.

उपसंहारः—

बाबासाहेबांचे या देशावर एवढे प्रेम असताना सुद्धा बाबासाहेबांना या देशातील जनतेने पाहिजे त्या प्रमाणात समजूनच घेतले नाही उलट त्यांना इंद्रजांचे

हस्तक, देशद्रोही या सारखी कटु वचने त्यांच्या विषयी वापरली परंतु बाबासाहेबांनी आपल्या मनाचा संयम ढळू दिला नाही आणि म्हणूनच बाबासाहेबांनी म्हटले होते, 'आज मला हिंदु भारतात सर्वाधिक तिरस्कृत व्यक्ती समजले जाते परंतु खात्री बाळगा, काही काळांतर जेव्हा धूळ खाली बसेल आणि इतिहासकारांकडून गोलमेज परिषदेचे निःपक्षपातीपणे मूल्यमापन केले जाईल तेव्हा हिंदुच्या भावी पिढ्या मी केलेल्या राष्ट्रसेवेबद्दल माझा जय जयकार करतील आज आपण पहातो काही प्रमाणात का होईना बहुजन समाजाकडून बाबासाहेबांच्या विचारांचा स्वीकार होवू लागला. आपली दिशाभूल कोण करित होते, धर्माच्या नावावर आपल्याला कोणत्या प्रवृत्ती उकसावित होत्या? याविषयी सद्सदविवेक बुद्धीने विचार बहुजन समाजात होवू लागला, आपला शत्रु कोण आणि मित्र कोण ? हे त्यांच्या लक्षात येऊ लागले आहे म्हणून आपल्याला असे म्हणता येईल की, बाबासाहेबांनी हिंदुच्या भावी पिढ्याविषयी जी भविष्यवाणी केली होती ती हळू हळू खरी ठरत आहे. तो दिवस दूर नाही, ज्या दिवशी संपूर्ण बहुजन समाजाचे हृदयपरिवर्तन होऊन ते बाबासाहेबांचा जयजयकार करतील. ही कुण कुण विषमतावादी प्रवृत्तींना लागलेली आहे म्हणून असे घडून येऊ नये यासाठी ते अतिशय सजगतेने प्रयत्नरत आहेत, त्यातच सत्तेचे पाठबळ सुद्धा असल्यामुळे ते आक्रमकपणे या मानवतावादी विचारांच्या विरोधात कृती करणार आहेत. त्याची सुरुवात त्यांनी अनुसूचित जाती-जमाती प्रतिबंधक कायद्याचे स्वरूप कमकूत करून केलेली आहे, त्यांचा नंतरचा प्रयत्न हा आरक्षणाविषयी असणार आहे, कारण या आरक्षणामुळे एस.सी, एस.टी, ओ.बी.सी समाज प्रगती करू लागला आहे, कर्मकांड, अंधश्रद्धा, देवभोळेपणा सोडून विज्ञानवादी, मानवतावादी विचार स्वीकारू लागला आहे. त्यामुळे ज्यांनी देवा-धर्माच्या नावाने आतापर्यंत राजकारण केले आहे, त्यांच्या पायाखालची वाळू निसटू लागली आहे. ज्यांना आपण आजपर्यंत त्यांच्या हक्क आणि अधिकारांपासून वंचित ठेवले, त्या समाजाला जर त्यांच्या हक्क व अधिकारांविषयी जाणीव झाली आणि हा संपूर्ण बहुजन समाज जर परिवर्तनवादी विचारसरणीच्या

बेनरखाली संघटित झाला तर आपल्या मूठभर लोकांची सत्ता आपल्या हातातून जाऊन बहुजन समाजाच्या हातात जाईल आणि कदाचित मग ती सत्ता कधीही आपल्या हातात येणार नाही अशी साधार भीती या मूठभर लोकांच्या मनात आहे, म्हणूनच साम,दाम,दंड या नीतीने आपली सत्ता कशी शाबुत ठेवता येईल, याचा ते पुरेपुर प्रयत्न करित आहेत म्हणून बहुजन समाजातील प्रत्येकाने सजग राहण्याची आवश्यकता आहे, संघटित आणि ऐकोष्याने राहून डॉ.बाबासाहेब आंबेडकरांनी सांगितलेल्या राष्ट्रीय ऐकात्मतेच्या भावनेला वृद्धिंगत करून राष्ट्राला बलशाली करायचे आहे. हे कार्य बुद्ध,फुले,शाहू,आंबेडकरी विचारांना मानणा.या समता मूलक समाजाकडून होऊ शकते, त्या दिशेने आपण वाटचाल करू या आणि राष्ट्रीय ऐकात्मतेच्या आड येणा.या धर्माध्यांना त्यांची जागा दाखवू या असे केले तरच आपला भारत देश हा 'राष्ट्र' या संकल्पनेस खरा उतरणार आहे, पात्र ठरणार आहे.

संदर्भ सूची :-

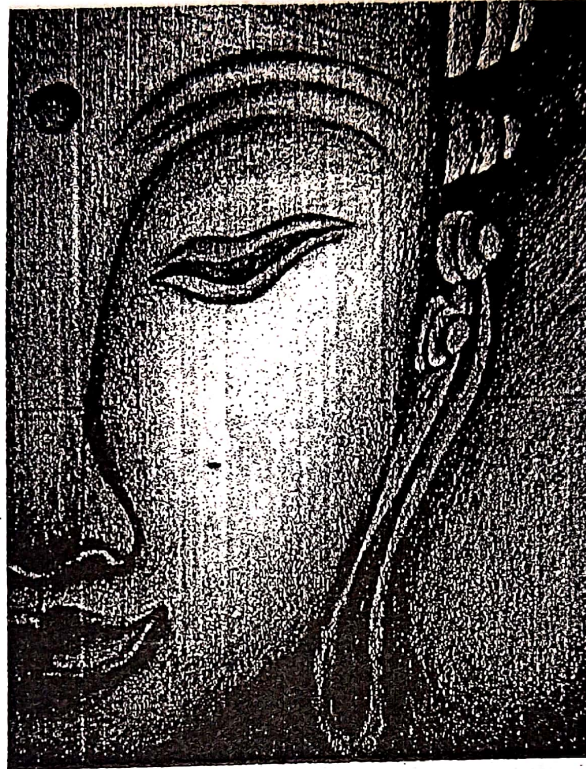
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डॉ.मोहन दे.वानखडे

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सारांश :

आज तथागत बुद्धांची ओळख केवळ एक धर्मसंस्थापक म्हणून केली जाते परंतु ही ओळख पर्याप्त नाही. ख-या अर्थाने त्यांची ओळख जगामधला पहिला तत्वज्ञानी, मनोवैज्ञानिक, पहिला वैज्ञानिक अशी असली पाहिजे. तथागत बुद्धाचे हे दर्शन प्रख्यात वैज्ञानिक अल्बर्ट आईन्स्टाईन पासून तर आजच्या डॉ. अमर्त्य सेन सारख्या नोबेल पुरस्कार विजेते तसेच नविन तत्वचिंतकांना झाले, परंतु काय तथागत बुद्धाची ख.या अर्थाने ओळख आपल्या देशाला झाली, हा प्रश्न आज सुद्धा आपल्या मानसपटलावर निरंतर येतो. आज आपला देश जगामध्ये बुद्धाचा देश म्हणून ओळखला जातो, ज्या पवित्र भूमीतून तथागत बुद्धांना बुद्धत्व प्राप्त झाले, त्या भूमीवर आज ही पंड्या-पूरोहितांचा कब्जा आहे. ब्राह्मणी विचारसरणी आणि बुद्धाची विचारसरणी अत्यंत विरोधाभासी आहे. ब्राह्मणी विचारसरणी विषमतामूलक आहे तर बुद्धाची विचारसरणी समतामूलक आहे. या विषमतामूलक विचारसरणीने या देशाचे अतोनात नुकसान केले आहे तर बुद्धाच्या विचारसरणीने अंधःकाराने झाकलेल्या भारतीय इतिहासाला प्रकाशित केले आहे. श्रमण संस्कृतीमधील मानवी मूल्ये बौद्ध तत्वज्ञानानेच जतन केलेली आहेत म्हणून बौद्ध तत्वज्ञान हे बौद्ध संस्कृतीचा आरसा आहे, असे आपल्याला म्हणता येईल.

प्रस्तावना :

तथागत बुद्धाची संपूर्ण देसना समाजामध्ये शांती आणि सुव्यवस्था प्रवर्तित करण्यासाठी आहे. त्यांनी आपल्या प्रज्ञाचक्षुने सर्व लोकांना पाहिले की, समस्त प्राणी अज्ञानवश दुःखाला प्राप्त होत आहेत. सम्यक प्रज्ञेच्या अभावाने दुःखापासून मुक्ती शक्य नाही म्हणून तथागत बुद्धांनी द्वितीय आर्यसत्य दुःख समुदायाच्या रूपांमध्ये दुःखांच्या कारणांचा निर्देश केला आहे. या कारणांच्या निरोधाने दुःखाचा निरोध सांगितला आणि दुःख निरोध पटीपदाची देसना करून मनुष्याला सन्मार्गावर चालण्याचा निर्देश दिला.^१ त्यांनी ज्या मार्गाचे निरूपण केले तो मार्ग प्रज्ञा, शील, समाधीची शिकवण देणारा आहे. या मार्गाच्या अनुसरण्यामध्ये मंगलमयतेचे आश्वासन आहे म्हणूनच त्यांच्या या मार्गाला सुरुवातीला कल्याणकारक, मध्याला कल्याणकारक आणि शेवटी सुद्धा कल्याणकारक म्हटले आहे.^२ तथागतांचा हा मार्ग सर्व मानवांसाठी आहे, मानवी समाजाच्या उन्नतीचा हा मार्ग आहे. तथागतांच्या या मार्गामध्ये अंधश्रद्धेला, कर्मकांडाला, ईश्वराला, आत्म्याला किंचितही जागा नाही.^३ प्रतित्यसमुत्पाद सिद्धांतामुळे ईश्वर, आत्मा ह्या कल्पना निरर्थक ठरतात. ईश्वर असलाच तर प्रश्न पडतो की, ईश्वराला कोणी निर्माण केले. कारण प्रतित्यसमुत्पादसारख्या सिद्धांताप्रमाणे कोणतेही अस्तित्व हे

त्याच्या प्रयत्नामुळेच अस्तित्वात आलेले असते. बी पासून झाड उत्पन्न होते त्याप्रमाणे आपल्या भोवतालच्या सर्व वस्तू कारणांमुळे अस्तित्वात येतात. अस्तित्वात आलेल्या सर्व वस्तू कारणाशिवाय अस्तित्वात आलेल्या नाहीत. या प्रकारे तथागतांनी धर्मान्ध तत्वज्ञानाची वैज्ञानिक चिरफाड केली आणि आपल्या मानवतावादी मूल्यांची समाजामध्ये रुजवणूक केली.

की वर्ड्स : तथागत, देसना, शांती, प्रज्ञा, मुक्ती, पटिपदा, शील, समाधी, प्रतित्यसमुत्पाद.

संशोधन पद्धती : पाली साहित्यामधील मूळ ग्रंथांचे भाषांतरित दुय्यम संसाधनावर आधारित विश्लेषणात्मक पद्धती

उपयोगिता : मानवी समाजाला ईश्वर, आत्मा, कर्मकांड, अंधश्रद्धा, जातीवाद यासारख्या अमानवीय रूढी परंपरातुन मुक्त करून त्याला स्वातंत्र्य, समता, बंधुता, न्याय ही मानवी मूल्ये प्रदान करून समतामूलक समाजाची निर्मिती करणे

विषय विश्लेषण :

भारतामध्ये बौद्ध संस्कृती आणि सभ्यतेचा प्रारंभ इ.स.पूर्व सहाव्या पाचव्या शतकापासून होतो. तथागत बुद्धाने बुद्धत्व प्राप्तीनंतर ४५ वर्षे, महापरिनिर्वाणाला प्राप्त होईपर्यंत या संस्कृती आणि सभ्यतेचा निरंतर प्रसार केला आणि या देशामध्ये विज्ञानवादी, समतावादी, मानवतावादी तत्वज्ञानाचा एक चिंतनशील आदर्श ठेवला, जो मानवी विकासाच्यादृष्टीने निश्चितरूपाने महत्वपूर्ण आहे. कारण तथागत बुद्धाचे तत्वज्ञान मनुष्य केंद्रित आहे. मनुष्य निर्मित दुःखाचा अंत करणे मनुष्याच्या हातातच आहे. अकुशल कर्मापासून, आसक्तीपासून जर मनुष्य दूर राहिला तर मनुष्य दुःखापासून मुक्त होऊ शकतो. म्हणूनच तथागत बुद्ध म्हणतात, "कोणत्याच प्रकारचे पाप न करणे, कुशल कर्मांचा संचय करणे आणि चित्ताला परिशुद्ध करणे." हेच बुद्धाचे अनुशासन आहे. तथागत बुद्धाच्या या उपदेशाचे पालन जर जीवनामध्ये केल्या गेले तर मनुष्य सुखी, समाधानी, मैत्रीयुक्त जीवन जगू शकतो.

मनुष्य हा ज्ञानाने संपन्न प्राणी आहे. इतर पशु-प्राणी यांच्यामध्ये तर भूक-तहान याव्यतिरिक्त दुसरी कोणतीच संवेदना दिसून येत नाही. पारस्परिक हल्ला आणि एक दुस-याशी हिंसेने जीवन निर्वाहच पशु प्राणांचा धर्म आहे. परंतु मनुष्य जीवनामध्ये चेतना आहे, विवेकबुद्धी आहे. मानवता काय आहे? अमानवता काय आहे? हे तो आपल्या विवेकबुद्धीने ठरवू शकतो. परंतु ही विवेकबुद्धी असतांना सुद्धा जर मनुष्य 'मनुष्या' प्रमाणे जर वागत नसेल तर तो मनुष्य पशु-प्राण्यांमध्येच गणल्या जातो. शरीराने जरी तो मनुष्य असला तरी तो आचरणाने पशुवत असतो. अशा मनुष्यांमध्ये हा जो अविवेकीपणा, अमानवता दिसून येते, त्याचे मूळ हे धर्मशास्त्रांमध्ये दिसून येते. मनुष्य-मनुष्यांमध्ये कुठलाच शारीरिक भेद नसतांना त्याच्या जाती-धर्माच्या आधारावर त्याच्याशी पशुवत व्यवहार करणे हे जो धर्म सांगत असेल तर तो धर्म 'धर्म' या संकल्पनेत बसूच शकत नाही, ते केवळ बहुजन

समाजाचे शोषण करणारे षडयंत्रच आहे. हे षडयंत्र ओळखूनच तथागत बुद्धांनी तत्कालीन व्यवस्थेला आव्हान दिले आणि म्हटले, 'जन्माने कुणी नीच होत नाही किंवा श्रेष्ठ होत नाही तर तो त्याच्या कर्मानेच नीच किंवा श्रेष्ठ होत असतो.' उच्च जातीचा अभिमान बाळगणे आणि कनिष्ठ जातीची अवहेलना करणे हे मनुष्याच्या पराभवाचे एक कारण आहे, अशी देसना तथागत बुद्धांनी केली. मनुष्य जीवनाची परिपूर्णता, पवित्रता ही मानवी समाजाची आधारशिला आहे. अज्ञान, क्रोध, हिंसा, कौर्य, व्यभिचार, हाव यामुळे पवित्रतेची जळे नष्ट होऊन जातात म्हणून सम्यक जीवन जगण्यासाठी तथागतांनी पंचशीलाची शिकवण दिलेली आहे. हिंसा, चोरी, व्यभिचार, असत्यवादी, मादक पदार्थाचे सेवन करण्यापासून अलिप्त राहणेच पंचशीलाचे पालन करणे होय. सर्व प्राणिमात्रांना दुःख देणारी नित्य व्यवहाराची जी जीवन पद्धती आहे त्यापासून अलिप्त राहण्यासाठी हे शील त्या प्रकारची शिकवण देते.^९ पंचशीलाचा स्वीकार करणे म्हणजे निरुपद्रवी जीवनाचा अंगिकार करणे आहे.

नीती हा धम्माचा प्राण आहे, नीतिशिवाय धम्म नाही. मनुष्याने मनुष्यावर प्रेम केलेच पाहिजे हेच धम्माचे अधिष्ठान आहे. धम्मामध्ये नीतीचा संबंध मनुष्याशी आहे. इतरांची आज्ञा आहे म्हणून, धर्मशास्त्राची आज्ञा आहे म्हणून नीतीमान बना असे धम्म म्हणत नाही, आपल्या हितासाठी मनुष्याने नीतीमान बनले पाहिजे हेच धम्म सांगतो. या धम्माचा मुख्य आधार आहे प्रज्ञा आणि शील. प्रज्ञेशिवाय शील आणि शिलाशिवाय प्रज्ञा अधुरी आहे.

चमत्कार, अंधविश्वास, ईश्वरवाद इत्यादी मानवी विकासाच्या विरोधी आहेत, यामुळे केवळ अंधश्रद्धेची उत्पत्ती होते म्हणून तथागत बुद्धांनी या चमत्काराचे, धर्माधतेचे खंडन केले. यामध्ये त्यांचे तीन हेतू होते. प्रथम हेतू हा मनुष्याला बुद्धिवादी बनविणे. दुसरा हेतू मनुष्याला स्वतंत्रतापूर्वक सत्याच्या शोधासाठी सिद्ध करणे आणि तिसरा हेतू जी भ्रामकता मनुष्याची शोध करण्याच्या प्रवृत्तीला मिटवितो त्याच्या उत्पत्ती स्थानालाच नष्ट करणे. यावरून हे स्पष्ट होते की, तथागतासमोर केवळ मनुष्याचा विकास साधने हा एकमेव उद्देश होता, ज्याला त्यांनी आपल्या अथक प्रयत्नांनी सिद्ध करून दाखविले.

मनोवैज्ञानिकाप्रमाणे उपदेश :

भगवान बुद्ध एखाद्या मनोवैज्ञानिकाप्रमाणे उपदेश देत असत. ते आधी पाहायचे कि, आपल्याकडे आलेला व्यक्ती कोणत्या क्षेत्राशी संबंधित आहे आणि त्यानंतर त्याच्या क्षेत्राशी संबंधित उदाहरणे देऊन त्याला धम्म समजावून सांगायचे. उदा. सुत्तनिपातामध्ये कसिभारद्वाज ब्राह्मणाला दिलेला उपदेश याचे उत्तम उदाहरण आहे. कसिभारद्वाज ब्राह्मण तथागतांना म्हणतो, ' माझ्याप्रमाणे नांगर, वखर आणि पेरणी आणि त्यातून आलेल्या उत्पन्नावर उदरनिर्वाह कर.' तथागत म्हणतात, ' मी सुद्धा नांगरतो, वखरतो, पेरतो आणि त्यातून आलेल्या उत्पन्नावर मी माझा उदरनिर्वाह करतो.' कसिभारद्वाज

ब्राह्मणाला वाटले की, श्रमण तर खोटे बोलत नसतात म्हणून तो तथागतांना विचारतो की, तुम्ही कोणत्या प्रकारची शेती करता? त्यावर तथागत म्हणतात, 'हे ब्राम्हण ! तू जेव्हा शेतात बी पेरतो आणि ते उगविते , त्यासोबतच गवत ही उगविते. ते गवत जर उपटून फेकून दिले नाही तर ते त्या रोपट्याला वाढू देणार नाही, त्याचा विकास खुटेल म्हणून तू ते गवत उपटून फेकून देतो. त्याच प्रमाणे मी सुद्धा व्यक्तीच्या मनातील अकुशल रूपी, क्लेशरूपी जे गवत आहे ते मी मुळासकट उपटून फेकून देतो. त्यानंतर त्या व्यक्तीचे मन निर्मळ होते, विकार रहित होते आणि त्यानंतर त्यावर आलेल्या उत्पन्नावर मी माझा उदरनिर्वाह करतो. ब्राम्हणाने तथागातला म्हटले, "तथागत! आपण श्रेष्ठ प्रतीची शेती करता." नंतर तो तथागाताचा उपासक झाला.

ईश्वराचे अस्तित्व नाकारणे :

ईश्वराचे अस्तित्व नाकारताना त्यांनी अतिशय समर्पक तर्क दिला. त्यांनी प्रतीत्यसमुत्पाद सिद्धांताद्वारे ईश्वरावादाच्या स्थापनेला, तथाकथित सृष्टी निर्माणकर्त्या ईश्वराला एक निरर्थक आणि पुरोहित वर्गाद्वारा निर्मित मिथ्या कल्पना म्हणून सिद्ध केले, कारण तथागत बुद्धाच्या प्रतीत्यसमुत्पाद सिद्धांतानुसार ईश्वराचे अस्तित्व एकदम असिद्ध आहे. तथागत बुद्धांनी सृष्टीच्या नियमामध्ये ईश्वरवादाला नाकारून एकप्रकारे पुरोहित वादाचे खंडन केले आहे. तथागत बुद्धाच्या धम्माला अईश्वरवादी, अनात्मवादी, अनित्यवादी, परिवर्तनशील म्हटल्या जाते, म्हणून बुद्धाचा धम्म पुरोहीतवादाचा अस्वीकार करतो. पुरोहित वादाचा जन्म ईश्वरवादाच्या संकल्पनेतून झाला आहे. त्यामध्ये पुरोहित वाद आहे आणि पुरोहित वादामुळेच सामाजिक असमानतेला ईश्वरनिर्मित म्हटले आहे. परंतु तथागत बुद्धाचा धम्म ईश्वरवादी नाही बौद्ध साहित्यामध्ये ईश्वर वादाचे खंडन केलेले आहे म्हणून या धम्मामध्ये पुरोहित वादाला कोणतेच स्थान नाही.

समानता :

बौद्ध धम्माचे तत्वज्ञान हे मनुष्यासाठी आहे. तो मनुष्य कोणत्या धर्माचा आहे, कोणत्या जातीचा आहे, कोणत्या संस्कृतीचा आहे याविषयी या धम्म तत्वज्ञानाला काहीही घेणे-देणे नाही म्हणूनच आपण पाहतो की, बुद्धाच्या संघात वेगवेगळ्या जाती-धर्माच्या लोकांनी प्रवृज्जा घेतली होती. ज्याप्रमाणे एखाद्या समुद्रामध्ये वेगवेगळ्या नद्याचे पाणी मिळाल्या नंतर आपण सांगू शकत नाही की, हे कोणत्या नदीचे पाणी आहे त्याच प्रमाणे तथागताच्या संघामध्ये वेगवेगळ्या जाती-धर्माच्या लोकांनी प्रवेश घेतल्यानंतर त्यांचे आधीचे धर्म, जात, गोत्र हे नष्ट होतात आणि त्यांची एकमेव ओळख राहते ती म्हणजे शाक्य पुत्रीय श्रमण. यावरून असे दिसून येते की, तथागतांनी आपला धम्म सर्वांना दिला, त्यामध्ये कुठलाही भेदभाव त्यांनी केला नाही. जगातील जो-जो मनुष्य अविचाराने इच्छाशक्तीच्या अभावाने पिडीत असेल, मानुसनिर्मित शोषणाचा, अन्याय अत्याचाराचा बळी असेल,

त्या-त्या प्रत्येक मानवी घटकासाठी तथागताचे धम्म तत्वज्ञान आहे. कारण तथागताचा धम्म मानवी समाजाला गुलामीच्या मानसिकतेतून मुक्त करून स्वतंत्र विचारांची, सत्य विचाराची प्रेरणा देणारी शक्ती आहे. म्हणूनच तथागत बुद्धांना समतेचे पुरस्कर्ते म्हटल्या गेले आहे. जो पुरुष आपल्या जातीचा, धम्माचा किंवा गोत्राचा वृथा अभिमान करतो आणि आपल्याच बंधूचा जातीच्या आधारे अनादर करतो तो पराभवाकडे जातो. जात,धर्म,गोत्र, धम्म यांचा गर्व करणे अहितकारक असल्याचे तथागतांनी सांगितले आहे. तथागताची शिकवण अशी की, कुणी ही असे वाईट कृत्य करू नये की, ज्याने दुस-यांना त्रास होईल. जर एखादा मनुष्य स्वताच्या स्वार्थासाठी इतरांना त्रास देत असेल तर त्याला सदाचारी म्हणता येणार नाही, परंतु ज्याच्या मनात जीवसृष्टी वरील सर्व प्राणीमात्रांविषयी प्रेमभावना असेल त्यालाच ख-या अर्थाने सदाचारी म्हणता येईल, म्हणूनच बुद्ध म्हणतात, " सर्व प्राणीमात्रांवर दया करा, सर्व माणसांना बुद्धत्वाच्या, समतेच्या भावनेने पहा."

मानवतावादी धम्म :

मानवता वादाचा अर्थ असा आहे की, सर्व मनुष्य प्राण्यांप्रती मानवीय दृष्टीकोनातून विचार करणे, कोणत्याही भेदभावनाशिवाय त्यांच्या कल्याणाची इच्छा करणे, त्यासाठी तसा प्रयत्न करणे . मानवतावाद मनुष्याच्या कल्याणाचा वाद आहे. मानवता वादाचा केंद्र बिंदू मनुष्यच आहे. अर्थात मनुष्याच्या कल्याणाविषयी विचार करणारा जो वाद आहे, त्याला मानवतावाद म्हटल्या जाते. त्याचप्रमाणे मानवतावाद मनुष्याच्या कर्मावरच विश्वास ठेवतो तो एखाद्या अलौकिक शक्तीवर, दैवी शक्तीवर विश्वास ठेवीत नाही. मानवतावादाचे सर्व तत्व,सिद्धांत,मुल्ये बुद्धाच्या विचारांमध्ये आहेत. बुद्धाचे संपूर्ण विचार मनुष्याच्या मुक्तीसाठी आहेत, विशुद्धीसाठी आहेत.प्रत्येक प्रकारच्या विकारांपासून मुक्त करण्यासाठी आहेत. मानवतावाद बुद्धाच्या उपदेशांचा मूळ आधार आहे. कोणते तत्वज्ञान मानवतावादी आहे आणि कोणते तत्वज्ञान मानवतावादी नाही याला जाणण्याचा सर्वात मोठा आधार त्या तत्वज्ञानाची मनुष्याप्रती काय मान्यता आहे यामध्ये आहे. तथागत बुधाने मनुष्य असो का स्त्री कुणालाच ईश्वराच्या हातचे खेळणे मानले नाही.बुद्ध तर आत्मा परमात्माच्या अस्तित्वाला स्वीकारच करीत नाहीत. त्यांच्या तत्वज्ञानात मनुष्यालाच उच्चतम स्थान प्राप्त आहे, म्हणून बुद्धाच्या धम्म आणि तत्वज्ञानाला मानवतावादी म्हटल्या जाते. परंतु या मानवतावादाच्या आड भारतामध्ये प्रचारित असलेल्या जातिवाद आड येतो. मानवतावाद हा समतेचा पुरस्कार करतो तर जातीवाद हा विषमतेचा पुरस्कार करतो. या विषमतामुलक जातीव्यवस्थेमुळे समाजाचा विकास हा खुंटीत होतो, म्हणून तथागत बुद्धांनी मानवतावादाच्या स्थापनेसाठी त्यांनी जातीवादाचा विरोध केला. तथागताच्यादृष्टीने सर्व प्राणी समान आहेत, त्यांनी सर्व मनुष्यांसोबत समान व्यवहार केला. तथागत बुद्धाचे तत्वज्ञान हे मानवी कल्याणासाठी आहे, जीवनाचा योग्य मार्ग दाखविण्यासाठी आहे. त्यांनी मानवी समाजाला जीवनाचा

यथार्थ मार्गच दाखविला नाही, तर सर्व प्रकारच्या आसक्ती पासून मुक्त होऊन परम सुख प्राप्त करण्याचा संदेश ही दिला आहे. आणि हा संदेश देत असतांना ते स्पष्ट करतात की, "मी फक्त मार्गदाता आहे, मोक्ष दाता नाही. जो या मार्गानुसार जाईल, त्याचे कल्याण होईल, तो याच जीवनात सुगतीला जाईल परंतु जो या मार्गानुसार जाणार नाही तो इथेच नरकमयजीवनात खितपत पडेल. म्हणूनच भिक्खुंना उपदेश देतांना तथागत म्हणतात की, "भिक्खुनो ! प्रयत्न तुम्हालाच करावे लागणार आहेत. उपदेशाच्या केवळ श्रवणाने दुःख निरोध शक्य नाही. तथागताचे कार्य तर मार्ग दाखविणे आहे आणि त्या मार्गावर चालणे तुमचे कार्य आहे आणि हे असंभव नाही. मनुष्याने जर ठरविले तर तो निश्चितच दुःखापासून मुक्त होऊ शकतो. धम्मपदाच्या अत्तवग्गात म्हटल्याप्रमाणे, "व्यक्ती स्वताच स्वताचा मालक आहे, त्याचा दुसरा कुणीही मालक होऊ शकत नाही, त्याने जर स्वतःला संयमित केले तर तो दुर्लभ यशाला प्राप्त होऊ शकतो. यावरून हे स्पष्ट होते की, व्यक्ती स्वताच स्वताचे कल्याण करू शकतो. तो आपल्या विशुद्ध आचरणानेच विकारांपासून मुक्त होऊन आपले कल्याण साधू शकतो. हाच बुद्धाच्या जगाच्या मानवी समाजासाठी सुखाचा, कल्याणाचा मार्ग आहे."

उपसंहार :

आज आसक्तीने युक्त मनुष्य दुःसायांना पीडीत आणि त्रस्त करण्यामध्ये लागला आहे. संपूर्ण विश्वसृष्टीत ईर्ष्या, द्वेष, घृणा, अतिरेकीपणा, हिंसा, प्रतिहिंसा, शत्रुता, बलात्कार, दहशतवाद, अविश्वास, कुपोषण, भ्रष्टाचार, बेरोजगारी, महागाई, बॉम्बस्फोट, धर्मवाद इत्यादी गोष्टी नित्याच्या झालेल्या आहेत. आज ज्यांच्याकडे आशेने पहिले जाते ते लोकप्रतिनिधीच भ्रष्टाचाराने बरबटलेले आहेत. वर्तमानपत्रे लोकशाहीचा चौथा खांब म्हणून समजण्यात येतात. परंतु हा खांब जातीयवादी विकृतीने सडत चाललेला आहे, निरपेक्षभाव त्यांच्यामध्ये दिसून येत नाही, सत्ताधारी नाराज होऊ नये म्हणून परखडपणा ते दाखवीत नाहीत. यामुळे आज कठीण परिस्थिती निर्माण झाली आहे. स्वातंत्र्य, समता, बंधुता, न्याय हे संविधानिक मानवी मुल्ये धोक्यात आलेली दिसून येतात. ईश्वर, धर्म यावर संघर्ष होत आहे, यामुळे मानवतावाद प्रस्थापित होऊ शकत नाही, म्हणून राजकारण्यांनी केवळ मतांचे राजकारण न करता सर्वसामान्य माणूस सुख-शांतीने जीवन जगू शकेल, राजकारणाचा दुष्परिणाम समाजावर होऊ नये याचा विचार करावा. या करिता निरपेक्ष दृष्टीने सर्वांनी तथागत बुद्धाच्या मानवतावादी विचारांचा अभ्यास करून त्याप्रमाणे आचरण करावे तरच आज समाजामध्ये बंधुभावाचे, मानवतावादाचे वातावरण निर्माण होऊ शकेल आणि यामुळेच जगामध्ये देशाची प्रतिमा उंचावू शकेल.

संदर्भ सूची :

१. विनयपिटक, महाबग्ग
२. धम्मचक्र पर्वतनसूत्त
३. आंबेडकर, डॉ. भी. रा. भगवान बुद्ध आणि त्यांचा धम्म (अनु. तळवटकर/चिटणीस, रेगे, शा.श)
पा. ९७
४. मोरे, मा.श. बुद्ध धम्माचे मूळ सिद्धांत, पा. ११
५. धर्मरक्षित, भिक्खू, धम्मपद, बुद्धवग्ग
६. धर्मरक्षित, भिक्खू, सुत्तानिपात, वसलसुत्त
७. कौशल्यायन, डॉ. भदंत आनंद, संक्षिप्त बुद्धचर्या
८. आंबेडकर, डॉ. भी. रा. भगवान बुद्ध आणि त्यांचा धम्म
९. धर्मरक्षित, भिक्खू, धम्मपद, अत्तवग्ग

Pointers to institutionalize processes such as peer review and publication to mirror ethics in science

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Abstract

The paper discusses first science and its conflict. Then the paper discusses Dr. Robert Merton's essay on an ethos of science in "A Note on Science and Technology in a Democratic Order. The paper also discusses some pointers on 'How can institutionalize processes such as peer review and publication be improved to reflect the values of the scientific ethos?' In the end the paper also throws light upon guidelines for potential reviewers.

Keywords : Science; Conflict; Peer Review; Publication; Ethos

Introduction

Science is a deceptively inclusive word which refers to a variety of distinct though interrelated items. It is commonly used to denote:

- a set of characteristic methods by means of which knowledge is certified;
 - a stock of accumulated knowledge stemming from the application of these methods;
 - a set of cultural values and mores governing the activities termed scientific; or
- any combination of the foregoing.

Science, like any other activity involving social collaboration, is subject to shifting fortunes [1]. Difficult as the notion may appear to those reared in a culture that grants science a prominent if not a commanding places in the scheme of things; it is evident that science is not immune from attack, restraint, and repression. The revolt from science which then appeared as improbable as to concerns only the timid academician who would ponder all contingencies, however remote, has not been forced upon the attention of scientist and layman alike. Local contagions of anti-intellectualism threaten to become epidemic.

Conflict becomes accentuated whenever science extends its research to new areas toward which there are institutionalized attitudes or whenever other institutions extend their control over science. In modern totalitarian society, anti-rationalism and the centralization of institutional control both serve to limit the scope provided for scientific activity.

There is competition in the realm of science, competition that is intensified by the emphasis on priority as a criterion of achievement, and under competitive conditions there may well be generated incentives for eclipsing rivals by illicit means. But such impulses can find scant opportunity for expression in the field of scientific research. Cultism, informal cliques, prolific but trivial publications – these and other techniques may be used for self-aggrandizement. But, in general, spurious claims appear to be negligible and ineffective. The translation of the norm of disinterestedness into practice is effectively supported by the ultimate accountability of scientists to their compeers. The dictates of socialized sentiment and of expediency largely coincide, a situation conducive to institutional stability [2].

In 1942, sociologist Dr. Robert Merton articulated [1] an ethos of science in “A Note on Science and Technology in a Democratic Order.” He argued that, although no formal scientific code exists, the values and norms of modern science can nevertheless be inferred from scientists’ common practices and widely held attitudes. Merton discussed four idealized norms: Universalism, Communalism, Disinterestedness, and Organized Skepticism. Here we define and explore each of these norms:

- 1) **Universalism** - The idea that scientific claims must be held to objective and “preestablished impersonal criteria.” This value can be inferred by the scientific method or the requirement of peer review before publication in the vast majority of academic journals.
- 2) **Communalism** - Merton actually calls this norm “Communism,” but scientists tend to refer instead to “communalism” or “communalism” due to Communism’s political-economic connotations. The ideas, however, are similar – that the findings of science are common property to the scientific community and that scientific progress relies on open communication and sharing.
- 3) **Disinterestedness** - Science should limit the influence of bias as much as possible and should be done for the sake of science, rather than self-interest or power. Merton says that
- 4) **Organized Skepticism** - The necessity of proof or verification subjects science to more scrutiny than any other field. This norm points once again to peer review and the value of reproducibility. If a study cannot be replicated, can we say that its results are robust or credible?

How can institutionalized processes such as peer review and publication be improved to reflect the values of the scientific ethos?

Peer review is intended to serve two primary purposes [2]. Firstly, it acts as a filter to ensure that only high quality research is published, especially in reputable journals, by determining the validity, significance and originality of the study. Secondly, peer review is intended to improve the quality of manuscripts that are deemed suitable for publication. Peer reviewers provide suggestions to authors on how to improve the quality of their manuscripts, and also identify any errors that need correcting before publication.

Peer review in the systematized and institutionalized form has developed immensely since the Second World War, at least partly due to the large increase in scientific research during this period [3]. It is now used not only to ensure that a scientific manuscript is experimentally and ethically sound, but also to determine which papers sufficiently meet the journal's standards of quality and originality before publication. Peer review is now standard practice by most credible scientific journals, and is an essential part of determining the credibility and quality of work submitted.

How To Peer Review Effectively

The following are tips on how to be an effective peer reviewer as indicated by Brian Lucey, an expert on the subject [4]:

Be professional: Peer review is a mutual responsibility among fellow scientists, and scientists are expected, as part of the academic community, to take part in peer review.

Be pleasant : If the paper is of low quality, suggest that it be rejected. There is no benefit to being ruthless.

Be helpful : Suggest how the authors can overcome the shortcomings in their paper. A review should guide the author on what is good and what needs work from the reviewer's perspective.

Be scientific: One should focus on adding value with scientific knowledge and commenting on the credibility of the research conducted and conclusions drawn.

Be timely: One should stick to the timeline given when conducting a peer review.

Be realistic: The peer reviewer must be realistic about the work presented, the changes they suggest and their role.

Be empathetic: Ensure that the review is scientific, helpful and courteous. Be sensitive and respectful with word choice and tone in a review.

Be open: Remember that both specialists and generalists can provide valuable insight when peer reviewing.

Be organized: A review requires structure and logical flow. A reviewer should proofread their review before submitting it for structural, grammatical and spelling errors as well as for clarity.

Science and Society

Incipient and actual attacks upon the integrity of science have led scientists to recognize their dependence on particular types of social structure. Manifestos and pronouncements by associations of scientists are devoted to the relations of science and society. An institution under attack must reexamine its foundations, restate its objectives, and seek out its rationale. Crisis invites self-appraisal. Now that they have been confronted with challenges to their way of life, scientists have been jarred into a state of acute self-consciousness: consciousness of self as an integral element of society with corresponding obligations and interests [5]. A tower of ivory becomes untenable when its walls are under prolonged assault. After a long period of relative security, during which the pursuit and diffusion of knowledge had risen to a leading place if indeed not to the first rank in the scale of cultural values, scientists are compelled to vindicate the ways of science to man. Thus they have come full circle to the point of the reemergence of science in the modern world. Three centuries ago, when the institution of science could claim little independent warrant for social support, natural philosophers were likewise led to justify science as a means to the culturally validated ends of economic utility and the glorification of God. The pursuit of science was then no self-evident value. With the unending flow of achievement, however, the instrumental was transformed into the terminal, the means into the end. Thus fortified, the scientist came to regard himself as independent of society and to consider science as a self-validating enterprise which was in society but not of it. A frontal assault on the autonomy of science was required to convert this sanguine isolationism into realistic participation in the revolutionary conflict of cultures. The joining of the issue has led to a clarification and reaffirmation of the ethos of modern science.

We are here concerned in a preliminary fashion with the cultural structure of science, that is, with one limited aspect of science as an institution. Thus, we shall consider, not the methods of science, but the mores with which they are hedged about. To be sure, methodological canons are often both technical expedients and moral compulsives, but it is solely the latter which is our concern here. This is an essay in the sociology of science, not an excursion in methodology. Similarly, we shall not deal with the substantive findings of sciences (hypotheses, uniformities, laws), except as these are pertinent to standardized social sentiments toward science.

Peer Review of Science Publications

Scientific progress depends on the communication of information that can be trusted, and the peer review process is a vital part of that system [10]. As a peer reviewer for *Science* magazine, you are part of a valued community.

Some Ethical Guidelines for Reviewers

- Reviews should be objective evaluations of the research. If one cannot judge a paper impartially, one should not accept it for review or you should notify the editor as soon as you appreciate the situation.
- If, as a reviewer, you believe that you are not qualified to evaluate a component of the research, you should inform the editor in your review.
- The reviewer should not reveal his or her identity to outsiders or members of the press.
- One should be aware of *Science*'s policies for authors regarding conflict of interest, data availability, and materials sharing

Inference

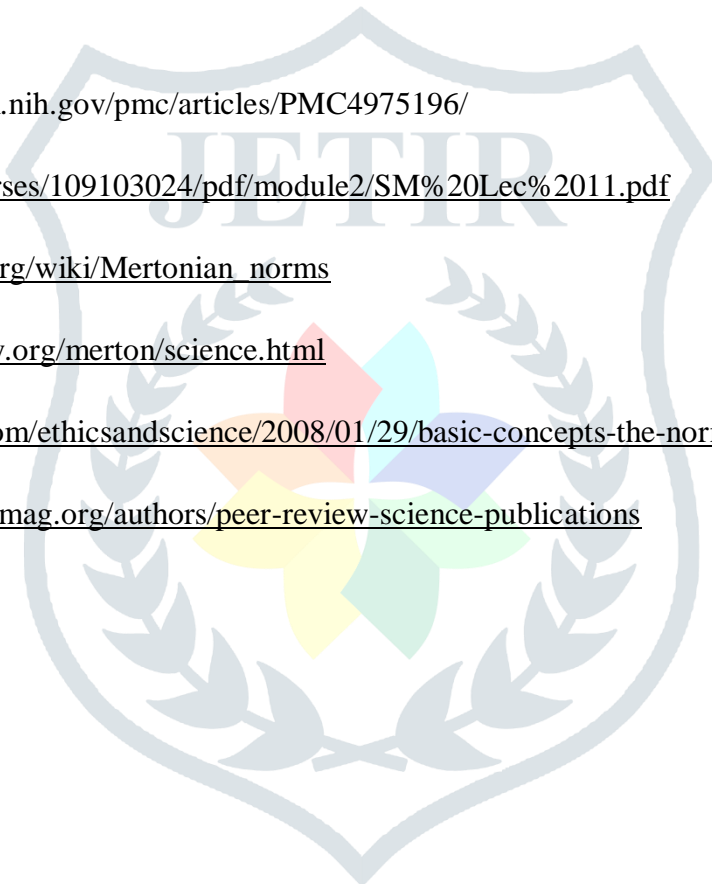
As a sociologist, Merton was interested in understanding science as a social group. He wasn't primarily concerned with providing some independent justification for how scientists conduct their research. It's worth noting, though, that he seemed to think the norms of science were good ones to have if you're interested in building good knowledge about the world.

Though the peer review process still has some flaws and deficiencies, a more suitable screening method for scientific papers has not yet been proposed or developed. Researchers have begun and must continue to look for means of addressing the current issues with peer review to ensure that it is a full-proof system that ensures only quality research papers are released into the scientific community.

The mores of science possess a methodological rationale but they are binding, not only because they are procedurally efficient, but because they are believed right and good. They are moral as well as technical prescriptions.

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INNOVATIVE PRACTICES ADOPTED BY INSTITUTIONS FOR QUALITY ENHANCEMENT

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Abstract: A lot of initiatives can be programmed to maximize quality of educational institutions. Some of them that can be implemented are : professional development activities for teaching faculty members, Teaching excellence awards and competitions for remarkable improvements, Teaching methodology innovation awards, Teaching recruitment criteria for better quality teachers, Incentives to innovative pedagogy, Emphasis on learning environments like libraries, computing facilities, grooming students for competitive examinations, introduction of value based programs, soft skilled enhancement for students, generation of employment and career guidance cell, generate and execute programs to make students more employable are just to name a few. In this paper, a lot of these factors are discussed which contribute to enhance the quality of the institutions. Also some of the challenges that are faced which comes in way of enhancing the quality of the institutions are also discussed.

Keywords: Innovative, Teaching, Institutions, Quality, Improvement

Introduction : The Quality Assurance Agency describes quality assurance as “the means through which an institution ensures and confirms that the conditions are in place for students to achieve the standards set by it or by another awarding body” (QAA 2004), and quality enhancement as “the process of taking deliberate steps at institutional level to improve the quality of learning opportunities.... Quality enhancement is therefore seen as an aspect of institutional quality management that is designed to secure, in the context of the constraints within which individual institutions operate, steady, reliable and demonstrable improvements

in the quality of learning opportunities” (QAA 2006) [1]. Some institutions may define enhancement as 'continuous improvement while many others as 'innovation'.

Role of Teachers in ensuring quality of Higher Education: Today, most of the institutions have become factory of degrees only. Students / teachers are running after attaining or providing degrees and not towards gaining knowledge and wisdom. Attendance in the institution has dropped drastically and class room teaching is becoming only a ritual, to be followed mechanically. Though, it is said that the destiny of nation is shaped only in class rooms, very little importance is being given to class room teaching. The present education system also does not match with the needs and expectations of the employment sector [2]. Hence teachers and faculty members play a pivotal role in enhancing and contributing to the quality of any institution. In fact they are the pillars and backbone of any institution.

Technology as a booster to Higher Education: The higher education landscape is undergoing a massive change as a result of technological innovations. It also reflects in the way higher education is taught and in the way students learn. While the conventional setting of the lecture hall will continue to form the bedrock of higher education systems, it will be enhanced by the integration of new tools and pedagogies, and it will be complemented by many more online learning opportunities and a greater variety of providers in higher education. Online technologies provide opportunities to learn anywhere, anytime and from anyone. This flexibility is essential for non-traditional learners and will enable a change in the engagement of higher education institutions in lifelong learning and continuing professional development.

Challenges Faced: Emphasis on research performance – for both institutions and individual academics – has traditionally overshadowed teaching and learning for students. Some institutional decision making bodies might consider it almost incidental to the mission of higher education or may not have realized that their institutional policies send that message to their faculty. Academics themselves understandably place a very high value on research and are often acutely aware of the “publish or perish” challenge that plays a large role in determining a successful career path: they may worry that time spent on teaching would undermine their capacity to compete effectively in their research field. This in turn may affect the teaching time and teaching and in turn have impact on the quality of the Institutions.

Overuse of Technology: The widespread use of technology is having both positive and negative effects on students' attention and memory systems. Modern media, particularly networked computers, are endangering our capacity to think, to remember clearly, and to read and write with concentration; they also imperil creativity. There are numerous social, cultural and psychological side effects of technology-enhanced or technology-based education, among them placing unrealistic hopes on technology, which leads to weakening a student's effort.

Online Learning as a means to quality Education: Finally, we need a solid, innovative, theoretical foundation for online learning. This foundation would help teachers do a better job in both classroom and online environments than simply integrating computers and other gadgets into learning. It would help enrich students' otherwise almost entirely independent online experiences.

Online learning concerns: The question remains whether online education has helped improve teaching and learning. With the popularity of online education and enormous investment, do online college programs now prepare better specialists? Innovative technology may bring performance enhancement in some ways but does not necessarily produce a direct benefit to education expressed by increased learning productivity. Are the secondary benefits, like convenience or fun with technology, worthy of heavy investment? What, then, is needed to raise the quality of education? The real question here is, as always, do we control technology, or do we let ourselves be controlled by it and those who have created it?

Strengthening links between teaching and research: Following points may pave a way to strengthen the link between teaching and research.

- Exploring how the research activities of the institution affect the policies supporting teaching and learning (e.g., in terms of learning environment, curriculum design, students assessment).
- Provide support for faculty involved in fostering quality teaching so that their engagement does not undermine their careers as researchers.
- Build research capacity through the promotion of research-teaching linkages, such as: Demonstration of how research informs teaching Engagement in research-inspired teaching, Development of undergraduate students' research-skills.

- Engage undergraduate students in carrying out research as part of the teaching and learning, strategy and encourage and support undergraduate students to publish their research.
- Cross-fertilize professional development for teaching and research so as to increase mutual learning.

There are a lot of innovative practices that can be inculcated to enhance the quality of institutions. Some of the innovative practices that can be adopted by various institutions for quality enhancement are listed below:

- Some students learn how to practice science from Museum geologists, astrophysicists, and paleontologists through fieldwork, laboratory investigations, and training in secondary research methods.
- Some colleges offer online Seminars on Science as well as extensive onsite programs. This has reflected on an increased focus on testing innovative approaches to preparing, supporting, and retaining science teachers, whose impact in the classroom is integral to improving science education. Some innovative practices adopted by other institutions for quality enhancement are listed as follows.
- Some colleges offer a competency-based curriculum and don't hand out traditional grades but instead use a narrative transcript as a way of assessing students. In some colleges First-year students are required to take an interdisciplinary seminar designed to stimulate "critical thinking and active learning at the college level."
- Some colleges focus on the yearlong first-year seminars that prepare students for rigorous intellectual exploration, in some colleges, students annually undertake a seven-week Field Work Term where, with help from the College, they pursue jobs and internships in their field of interest.
- Some colleges have an interdisciplinary program for high school seniors, enabling students to obtain their high school diploma while finishing their first year of college.
- While in some colleges, in order to prepare its students to "make a difference in the world," the College offers interdisciplinary classes and independent study projects.
- In some colleges, students spend eight days on campus followed by 16 weeks of self-reflection and independent work with an advisor.
- Some colleges' focus is exemplified by its adventure programming and the Farm and Food Project, which both provide hands-on learning.

- In some colleges, students design their own curriculum. The only required course is the first-year tutorial designed to expand students' writing, critical thinking, analysis, discussion, and oral presentation skills.
- Some College's open curriculum allows students to zero in on their passions. "Pro seminars," small classes that provide interaction and collaboration with faculty and other students, are designed to promote student writing.
- Some colleges offer students a framework for taking responsibility for their own learning and customizing their curriculum. Rather than declare a major, students build a concentration, choosing courses from among five interdisciplinary schools.
- Some Colleges features an integrated, cross-disciplinary curriculum of small core classes (with no tests) as well as opportunities for research, travel, and internships. To promote friendships and provide support for one another, all first-year Honors College students live together in a single residence hall.
- Oriented around a "consciousness-based curriculum" in which students are immersed in one full-time course a month, some institutions promote active learning, transcendental meditation, and self-exploration and inner growth.
- Each student completes a self-designed Plan of Concentration that explores interdisciplinary subjects, incorporates tutorials and consistent faculty advising, and culminates in a major work of scholarship in some colleges.
- In addition to a curriculum exploration requirement encouraging students to broaden their interests, some colleges require that students demonstrate writing ability as well as quantitative and formal reasoning and take three courses with a cultural diversity designation.
- Some colleges operate on a block plan (i.e., students take one course at a time) so that an area of interest can be thoroughly explored. The flexibility of the block plan also facilitates experiential learning in environments outside the classroom.

Conclusion : Various innovative factors are responsible to improve the quality standards of institutions : Perceptions, values and beliefs of individual teachers; - Teachers' motivational factors (including potential goal conflicts); - Professional development activities related to teaching and learning; - Leadership styles ; Support from institutional leadership; Communication; Data driven reflection of enhancement activities; Design of enhancement instruments; Decision-making structures; Provision of sufficient resources/staff development, student centric programs initiated, support through mentoring to students. Many more such

activities can be initiated at the institutional level to enhance the quality of education at the institutional level.

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ICMAM-2018

Structural and Magnetic Studies of Zn Doped Nickel Nanoferrites Synthesize by Sol-gel Auto Combustion Method

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Abstract

A series of nanoferrites with chemical composition $Ni_{1-x}Zn_xFe_2O_4$ ($X=0.0$ to 1.0) have been prepared by novel microwave assisted sol-gel auto-combustion method. Structural study was performed using XRD technique revealed prepared samples has single spinel phase. Precise value of lattice parameter was determined by plotting lattice parameters versus Nelson-Riley function. The value of lattice parameter shows increasing trend with content of Zn. This behaviour of lattice parameter is due to difference in ionic radii of Zn and Ni. The values of crystallite size, experimental density, theoretical density, porosity, ionic radii, bond length and hopping length at tetrahedral (A) and octahedral (B) sites were measured from XRD data. The crystallite size of nanoparticles form XRD data is in the range 17 - 25 nm. The microstructure was also characterized by scanning electron microscopy. The magnetic behaviour was understood from B-H loop obtained using Vibrating Sample Magnetometer (VSM). It is observed that the magnetic properties change with the increase of Zn content and can be interpreted on the basis of Neel's two sub lattice model

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Keywords: Microwave assisted sol gel, XRD, SEM, Saturation magnetization, Coercivity.

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1.0 Introduction

Polycrystalline nano ferrites presently are the matter of immense interest. They have attractive magnetic and electronic properties, so they are strong candidate for application in electronics, microwave, computer technologies etc. The properties of spinel ferrites could be tuned and controlled easily, as they depend on the change in compositions and the cation distribution at tetrahedral (A) and octahedral (B) sites [1-3]. Particles in the nano-scale range exhibit unique physical and chemical properties. Due to combine electrical and magnetic properties, ferrites introduce new area in material science and requirement of high resistivity ferrites leads to preparation numerous ferrites. It is widely appreciated that the physical and chemical properties mainly depends on cation distribution, method of preparation, calcination temperature, calcination time and chemical composition. The spinel ferrites with low loss and high permeability in the radio frequency region make them suitable for inductors, reflection coils, modulators, pulse transformers and antennas [4]. The NiZn ferrites are treated as the most versatile materials for their high value of resistance and low eddy losses. The miniaturization of magnetic components validate the utility of Ni-Zn ferrites in the high frequency applications, since it has high resistivity and can miniaturize magnetic components without a bobbin [5].

In present paper we have prepared nanocrystalline Ni-Zn ferrites with composition $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ ($X = 0$ to $X = 1$) by microwave assisted sol-gel auto combustion route. The structural and surface morphology studies were performed by XRD and SEM. Room temperature magnetic parameters of compounds were obtained using VSM. The aim of research work is to investigate the influence of zinc substitution on the structural and magnetic behaviour of NiZn mixed nano ferrites.

2.0 Experimental Method

Ni-Zn nano ferrites powder having chemical formula $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ ($X = 0.0$ to 1.0 and $\Delta X = 0.2$) were synthesized by microwave assisted sol gel auto-combustion route. Raw materials used are AR grade nitrates i.e. Ni $(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Zn $(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, Fe $(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ and urea ($\text{CH}_4\text{N}_2\text{O}$) is used as a fuel and all from Merck of 99 % purity. Starting chemicals were taken in stoichiometric proportion and put one by one in 30 ml of triple distilled water with continuous stirring on magnetic stirrer, so that all chemicals dissolved in it, then heat the solution at 80°C with continuous stirring to obtain uniform brown gel. It is then kept into the microwave oven, within five minutes brown fumes were begins coming out of oven and finally thick solution formed get fired to get dark brown floppy powder. Obtained powder are milled in pestle mortar for about 2 hours and calcinated at 800°C for 4 hours and again milled for 1 hour to get nano ferrites sample ready for characterization.

3.0 Results and Discussion

3.1 Structural Studies

Determination of crystal structure and lattice parameter will play significant role in the study of structural, electrical and optical properties of the nano ferrites. Fig.1 shows the powder X-ray diffraction patterns of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ ($X = 0.0$ to 1.0) nano ferrites. All the reflection peaks were index as (220), (311), (222), (400), (422), (511) and (440) confirmed that prepared samples have single phase cubic spinel structure. All observed peaks matched with the standard characteristic reflections of nickel zinc ferrite (JCPDS Card No. 019- 0629) confirmed the successful replacement of Ni^{2+} by Zn^{2+} ions. The samples were clean because no impurity characteristic peaks are observed in the XRD patterns. In addition, the patterns were also the same for all values of x, indicating that the crystal structure of the zinc substituted samples remained the same as $x = 0$. The broadness of the peaks shows nano-meter size of particles.

The standard equations were used to calculate structural parameters such as lattice parameter, theoretical density, bulk density, unit cell volume and porosity from the XRD data [6]. Precise lattice constant was determined by plotting lattice parameter (a) against Nelson-Riley function and using a least square fit method [7]. Table 1 shows linear rise in lattice parameter with zinc concentration. The expansion in lattice is responsible for this rise in lattice parameter. Since the ionic radius of substitute zinc atom (0.074 nm) is greater than the displaced nickel atom (0.069 nm), the expansion in lattice takes place. This results into enhancement in the lattice parameter. Similar results were reported earlier [8, 9]. The volume of unit cell also found to rise from 580.99 to 599.95 Å³ with the rise of Zn²⁺ concentration. This rise in unit cell volume confirms the successful and entire substitution of larger Zn²⁺ ions replacing relatively smaller Ni²⁺ ion. Further successful substitution and simultaneous replacement of ions can be confirmed from variation trend in theoretical density, bulk density and porosity with Zn²⁺ concentration. The theoretical density is comparatively larger than bulk density. This shows pores are generated as a result of evolution of gas from nano ferrite samples during synthesis process [10]. The values of porosity are in the range 19.62–32.96 %.

The crystallite size *t* has been calculated from most intense diffraction peak (311) using Debye Scherrer formula and listed in Table 1.

$$t = \frac{kx\lambda}{\beta \cos\theta}$$

Where *k* = 0.94, *λ* is the wavelength, *β* is full width half maximum of peaks, and *θ* is the angle of diffraction. The crystallite size is in range 17-25 nm.

The tetrahedral and octahedral sites ionic radii (*r_B*, *r_A*) and bond length (A-O, B-O) of cubic spinel structure have been obtained from XRD data by using Standely's equations [11].

$$r_A = \left(u - \frac{1}{4}\right)\alpha\sqrt{3} - r(O^{2-})$$

$$r_B = \left(\frac{5}{8} - u\right)\alpha - r(O^{2-})$$

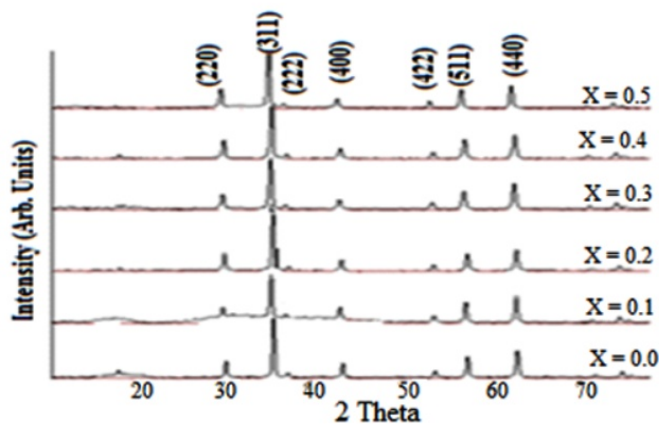


Fig.1 XRD patterns of Ni_{1-x}Zn_xFe₂O₄

Table 1 - Structural parameters of Ni_{1-x}Zn_xFe₂O₄

| Sr. No. | Content of Zn | Lattice constant "a" Å | X-Ray density Dx gm/cm ³ | Experimental density D gm/cm ³ | Unit cell Volume Å ³ | Crystallite size t in nm | Molecular weight | Porosity |
|---------|---------------|------------------------|-------------------------------------|---|---------------------------------|--------------------------|------------------|----------|
| 1 | X=0.0 | 8.34 | 5.3593 | 3.586 | 580.99 | 25.36 | 234.38 | 33.08 |
| 2 | X=0.2 | 8.36 | 5.3592 | 4.322 | 584.31 | 25.02 | 235.72 | 19.35 |
| 3 | X=0.4 | 8.37 | 5.3644 | 4.05 | 587.07 | 24.06 | 237.06 | 24.50 |
| 4 | X=0.6 | 8.40 | 5.3314 | 4.232 | 594.03 | 17.25 | 238.40 | 20.62 |
| 5 | X=0.8 | 8.42 | 5.3303 | 3.973 | 597.50 | 20.48 | 239.74 | 25.46 |
| 6 | X=1.0 | 8.43 | 5.3382 | 3.535 | 599.95 | 23.51 | 241.08 | 33.77 |

Cation – anion distance at A- site (Tetrahedral bond length)

$$A-O = \left(u - \frac{1}{4}\right)a\sqrt{3}$$

Cation – anion distance at B- site (Octahedral bond length)

$$B-O = \left(\frac{5}{8} - u\right)a$$

Where a is lattice parameter; $r(O^{2-})$ = Oxygen anion radius = 1.35 Å; u = Oxygen positional parameter = 0.375 for ideal spinel ferrite. Hopping length which is the distance between the magnetic ions were calculated for tetrahedral A-sites (L_A) octahedral B- sites (L_B) using the equations,

$$L_A = a \left(\frac{\sqrt{3}}{4} \right)$$

$$L_B = a \left(\frac{\sqrt{2}}{4} \right)$$

The anion-anion distance can be calculated using equation

$$d_{TE} = a\sqrt{2}\left(2u - \frac{1}{2}\right) \text{ (Tetrahedral edge)}$$

$$d_{OE} = a\sqrt{2}(1 - 2u) \text{ (Shared octahedral edge)}$$

It can be seen from Table 2, that the ionic radii (r_A , r_B) and bond length (A-O, B-O) increases with rise in Zn concentration, which in turn causes increase in lattice parameter. Hopping lengths in the tetrahedral A-site (L_A) and octahedral B-site (L_B) also found to rise with Zn concentration [11]. This indicates that more energy is necessary for hopping of electrons between A and B-sites, which in turn decreases the conductivity. Since there is direct relation between hopping lengths and lattice parameter. So rise in lattice parameter consequently increases the hopping length [12].

Table 2 - Ionic radii, bond length and hopping length on octahedral and tetrahedral sites of Ni_{1-x}Zn_xFe₂O₄

| Sr. No. | Content of Zn | r_A Å | r_B Å | A-O Å | B-O Å | L_A Å | L_B Å | d_{TE} Å | d_{OE} Å |
|---------|---------------|---------|---------|-------|-------|---------|---------|------------|------------|
| 1 | X=0.0 | 0.454 | 0.736 | 1.804 | 2.086 | 3.613 | 2.949 | 2.949 | 2.949 |
| 2 | X=0.2 | 0.457 | 0.740 | 1.807 | 2.090 | 3.620 | 2.955 | 2.955 | 2.955 |
| 3 | X=0.4 | 0.460 | 0.743 | 1.810 | 2.093 | 3.625 | 2.959 | 2.959 | 2.959 |
| 4 | X=0.6 | 0.467 | 0.751 | 1.817 | 2.101 | 3.639 | 2.971 | 2.971 | 2.971 |
| 5 | X=0.8 | 0.471 | 0.755 | 1.821 | 2.105 | 3.647 | 2.977 | 2.977 | 2.977 |
| 6 | X=1.0 | 0.473 | 0.758 | 1.823 | 2.108 | 3.652 | 2.981 | 2.981 | 2.981 |

3.2 Scanning Electron Microscopy

The morphological studies of prepared samples were carried out by scanning electron microscope (SEM) by selecting 100,000 magnification ranges. The SEM micrographs of representative samples with $x = 0.0, 0.2, 0.6$ and 1.0 are shown in Fig.2, representing irregular shape and size of prepared crystallites. The particles show agglomeration tendency, the high calcinations temperature is responsible for agglomeration of particles due to forces like Vander walls, electrostatic and capillary forces which generate mutual interaction between particles [13]. The average grain size of all the prepared samples calculated from SEM instrument is in the range of 29–200 nm.

3.3 Magnetic Properties

Room temperature magnetic parameter of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$ nanoferrites were measured using vibrating sample magnetometer (VSM) by applying a magnetic field of 10kOe. The M-H plots (hysteresis loop) of prepared samples ($x = 0.0, 0.2, 0.6, 1.0$) are shown in Fig.3. The values the saturation magnetization (M_s), coercivity (H_c), remnant

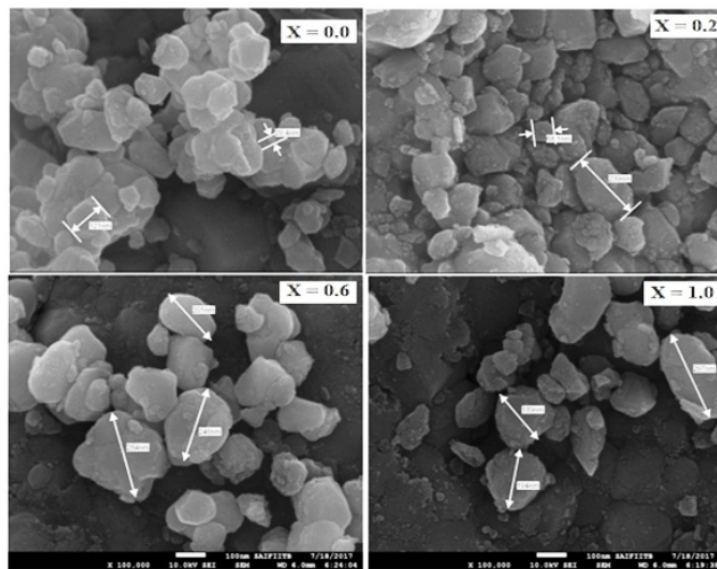


Fig. 2 SEM images of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$

magnetization (M_r), loop squareness ratio (M_r/M_s) and magnetic moment were determined from $M-H$ loops and listed in Table 3. The magnetic properties of ferrites depend on chemical composition, grain size and interaction between tetrahedral and octahedral sites. Magnetic moment per formula unit was measured by using expression [12].

$$n_B = (MxM_S) / 5585$$

Where, n_B is magnetic moment in Bohr Magnetons, M is the molecular weight and M_s is the saturation magnetization in emu/cc.

It has been observed that with rise in zinc content, the saturation magnetization increased for $x=0.2$, then decreases with further rise in zinc content. It is well known that Zn^{2+} ion occupy only tetrahedral A-site, while Ni^{2+} prefer octahedral B-site [13]. However, Fe^{3+} ions prefer both A and B-sites. The increase in saturation magnetization for $x=0.2$ is because of antiparallel alignment of the spin. The substitution of Zn^{2+} a diamagnetic divalent metal ion in ferrites decreases the content of Ni^{2+} ions at octahedral site. This loss at octahedral site is compensated by

transferring Fe^{3+} ions from A site to B site is accountable for increase in saturation magnetization. The holding of Zn^{2+} ion at tetrahedral site consecutively transfers Fe^{3+} ions from A site to B site. This decreases magnetic moment of tetrahedral site due to reduction of Fe^{3+} ions at A site and increases the magnetic moment of B site, so net magnetic moment increases. The Neel's two sub lattice model also explains the increase of saturation magnetization for $x = 0.2$. This model states that there are three types of exchange interactions (i.e. A–A, B–B and A–B). Among this A–B interaction is effective and strong. The intensity of A–B interaction enhances with the substitution of Zn^{2+} ion at A site and with consecutive moving of Fe^{3+} ions from A to B site is accountable for the rise in saturation magnetization [14]. Further rise of zinc content $x > 0.2$ makes A–O–B interaction too feeble and B–O–B interaction start dominating. At this instant in place of a collinear, anti-parallel alignment a canted structure appears where the spins at B sites are no more parallel results in decreasing magnetization [15].

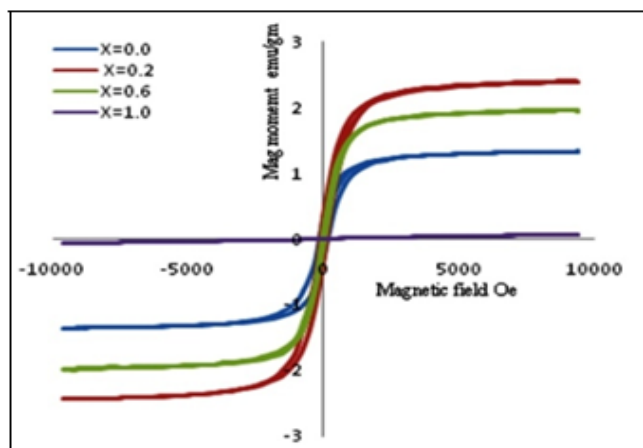


Fig. 3 - M-H hysteresis loops of $\text{Ni}_{1-x}\text{Zn}_x\text{Fe}_2\text{O}_4$

It is observed that the coercivity also first increases for $x = 0.2$, after that decreases with rise of Zn^{2+} concentration. The shape anisotropy, stress anisotropy and crystal anisotropy are the major contributors to coercivity. The equation correlating coercivity to saturation magnetization for these three cases are given by,

$$\text{Shape anisotropy } H = h(N_a - N_c)M_S$$

$$\text{Stress anisotropy } H = h(3\lambda_s x \sigma) / M_S$$

$$\text{Crystal anisotropy } H = h(2K_1 / M_S)$$

Where 'h' is a constant, σ is stress, λ_s the magnetostriction constant, N_c and N_a are de-magnetizing coefficients parallel to both c and a axes. Table 3 shows that changes in coercivity are directly proportional to saturation magnetization. This shows that in prepared nickel zinc nano-ferrites, the coercivity is not because of stress anisotropy and crystal anisotropy but shape anisotropy is the main contributor. In the case of nano-crystalline Ni-Zn ferrite compounds the presence of an easy axis of magnetisation is not known. Therefore we may consider that the share from the shape anisotropy is dominant in the coercivity mechanism. It is also well-known that factors such as grain size, size of domains and nature of domains have a strong impact in finding the coercivity of the material. It is also observed from Table 3 that the coercivity and porosity shows similar variation which is in agreement with the earlier reported results [16]. As the porosity is due to presence of voids it could be said that shape anisotropy is dominant factor responsible for the coercivity. The variation of retentivity and magnetic moment of with Zn concentration is similar to variation of saturation magnetization. The small values of loop squareness ratio indicate the presence of multi-domain particles in all compounds [14].

Table 3 - Saturation magnetization (M_s), retentivity (M_r), Coercivity (H_c) and loop Squareness ratio (M_r/M_s) and magnetic moment of $Ni_{1-x}Zn_xFe_2O_4$

| Sr. No. | Concentration of Zn | M_s | M_r | Coercivity H_c (Oe) | M_r/M_s | n_B (Bohr magneton) |
|---------|---------------------|--------|-------|-----------------------|-----------|-----------------------|
| 1 | X = 0.0 | 1.333 | 0.281 | 163.5 | 0.211 | 0.0559 |
| 2 | X = 0.2 | 2.407 | 0.335 | 196.7 | 0.139 | 0.102 |
| 3 | X = 0.6 | 1.948 | 0.128 | 189 | 0.066 | 0.0832 |
| 4 | X = 1.0 | 0.0668 | 0.001 | 57.14 | 0.015 | 0.0029 |

4.0 Conclusions

Ni-Zn nanoferrites having chemical formula $Ni_{1-x}Zn_xFe_2O_4$ were prepared by sol-gel auto combustion technique through microwave. The X-ray diffraction pattern confirmed the prepared compounds have single phase cubic spinel structure. The lattice constant linearly increases with Zn content. The crystallite size determined by XRD is in the range 17 - 25 nm and different from the size observed from SEM images indicating that grains seen in the SEM are the domains formed by aggregation of nanocrystallites. The magnetic properties indicates that with increase in Zn concentration the M_s , M_r , H_c and n_B increases for $x = 0.2$ then decreases. The increase in M_s is due to moving of Fe^{3+} ions from A site to B site. The Neel's two sub lattice model is also used to explain variation in magnetic parameter. The shape anisotropy is dominant term to contribute coercivity mechanism.

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XRD, EDX and thermal analysis of glycine doped ammonium dihydrogen phosphate crystal

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XRD, EDX and Thermal Analysis of Glycine Doped Ammonium Dihydrogen Phosphate Crystal

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Abstract. Glycine doped Ammonium Dihydrogen Phosphate (ADP) Crystals were grown in different molar concentrations. Addition of glycine has increased the quality of the crystal by yielding highly transparent crystals. The grown crystals were subjected to XRD, EDX and TGA-DTA studies. The powder XRD study was conducted to verify the single phase nature of the samples. The powder XRD results reveal that the obtained diffracted peaks are same as pure ADP crystal. All elements present in the sample were confirmed by their respective energy peak observed in the EDX spectrum. From DTA, it is observed that the decomposition temperature is decreased by the addition of glycine. The TGA curve for all the doped crystals exhibited negligible weight loss in the region 40°C to 200°C showing the thermal stability in this temperature range.

INTRODUCTION

Crystals are the pillars and backbone of advanced technology. Without crystals, we cannot think of electronic industry, photonic industry, fiber optic communications, which depend on materials/crystals such as semiconductors, superconductors, polarizers, transducers, radiation detectors, ultrasonic amplifiers, ferrites, magnetic garnets, solid state lasers, non-linear optics, piezo-electric, electro-optic, acousto-optic, photosensitive, refractory of different grades, crystalline films for microelectronics and computer industries. Crystal growth is an interdisciplinary subject covering physics, chemistry, material science, chemical engineering, metallurgy, crystallography, mineralogy, etc.

Ammonium Dihydrogen Phosphate (ADP) is a representative of hydrogen bonded materials that have excellent dielectric, piezoelectric, antiferroelectric, electro-optic and nonlinear optical properties. Growth and studies of ammonium dihydrogen phosphate is a centre of attraction to researchers because of its unique properties and wide applications. Single crystals of ADP are used for frequency doubling and frequency tripling of laser systems, optical switches in inertial confinement fusion and acousto-optical devices [1]. ADP crystallizes in a body centered tetragonal structure with the space group $I 4 2d$ and has tetra molecular unit cell [2] with unit cell parameters $a = b = 7.510 \text{ \AA}$ and $c = 7.564 \text{ \AA}$. Amino acids contain a deprotonated carboxylic acid group (COOH) and protonated amino groups (NH₃⁺). This dipolar nature exhibits peculiar physical and chemical properties in amino acid, thus making them ideal candidate for NLO application. The SHG studies confirmed the NLO behavior of Glycine doped ADP crystals [3]. The optical transparency of the ADP crystal is increased by the addition of Glycine. That means addition of the glycine dopant in the optimum conditions to the solution is found to suppress the inclusions and improve the quality of the crystal with higher transparency [4]. In the light of research work being done on ADP crystals, to improve their growth and other characteristics, it was thought interesting and worthwhile to investigate the effects of amino acid Glycine on growth and properties of ADP crystals for both academic and industrial uses.

EXPERIMENTAL

The starting materials namely ADP and Glycine were of GR grade (Merck) and the growth process was carried out in aqueous solution. The calculated amount of ADP was dissolved in Millipore water of resistivity 18.2M Ω cm. Solubility affects the growth rate and quality of the crystal [5-7]. Hence solution was prepared according to solubility curve of ADP at the constant growth temperature under saturation condition. This solution was then stirred well for more than six hours using a magnetic stirrer and filtered using Whatman filter paper of pore size 11 μ m. The solution was then poured into a 500 ml beaker cover with a lid with small holes in it and allowed to evaporate at room temperature in a dust free environment. The procedure was repeated for different mole percentage of Glycine as a dopant in ADP. Optically good quality single crystals of pure ADP and glycine doped ADP crystals were harvested in a period of 15 - 25 days.

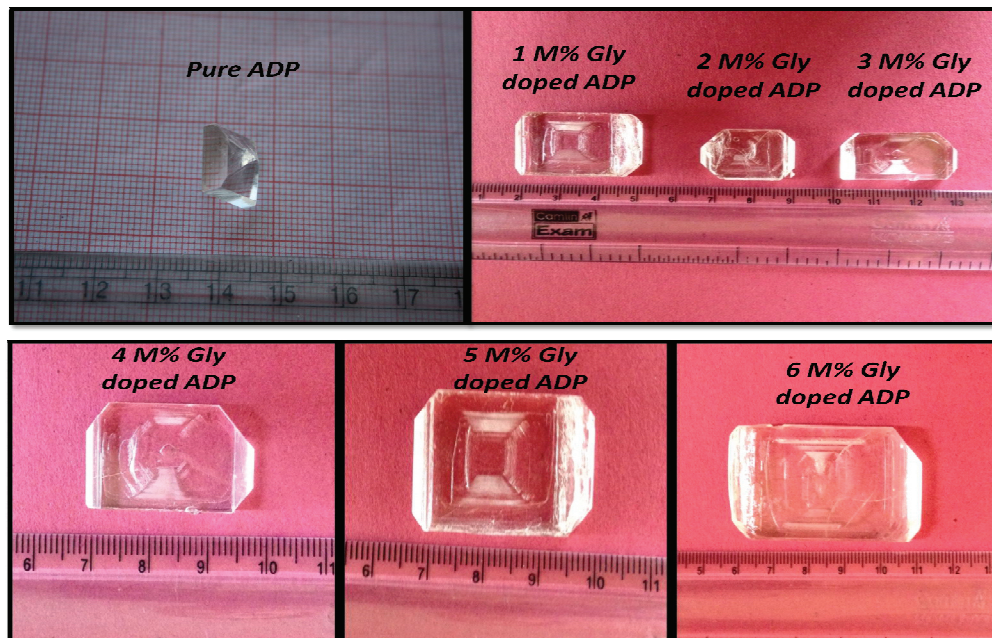


FIGURE 1. Photographs of pure and glycine doped ADP (GADP) crystals with different concentration (1 mole% to 6 mole%)

RESULTS AND DISCUSSION

XRD Analysis

The powder XRD study was conducted to verify the single phase nature of the samples. Powder XRD was carried out using a Bruker AXS D8 Advance ($\lambda=1.5406$ Å) X-ray diffractometer. The powder sample was scanned over the range 5-80° at a scan rate of 1°/min. The recorded Powder X-ray diffraction patterns of pure and doped ADP crystals for different concentration of Glycine dopant as 1 mole %, 2 mole %, 3 mole %, 4 mole %, 5 mole% and 6 mole % are shown in the figure 2. Well defined Bragg peaks are obtained at specific 2 θ angles indicating that crystals are ordered. The powder XRD results reveal that the obtained diffracted peaks are same as pure ADP crystal. The observed prominent peaks of pure and glycine doped ADP are (101), (200), (112), (202), (103), (312), (332), (424) but the intensities of the diffracted peaks are found to be varied [8].

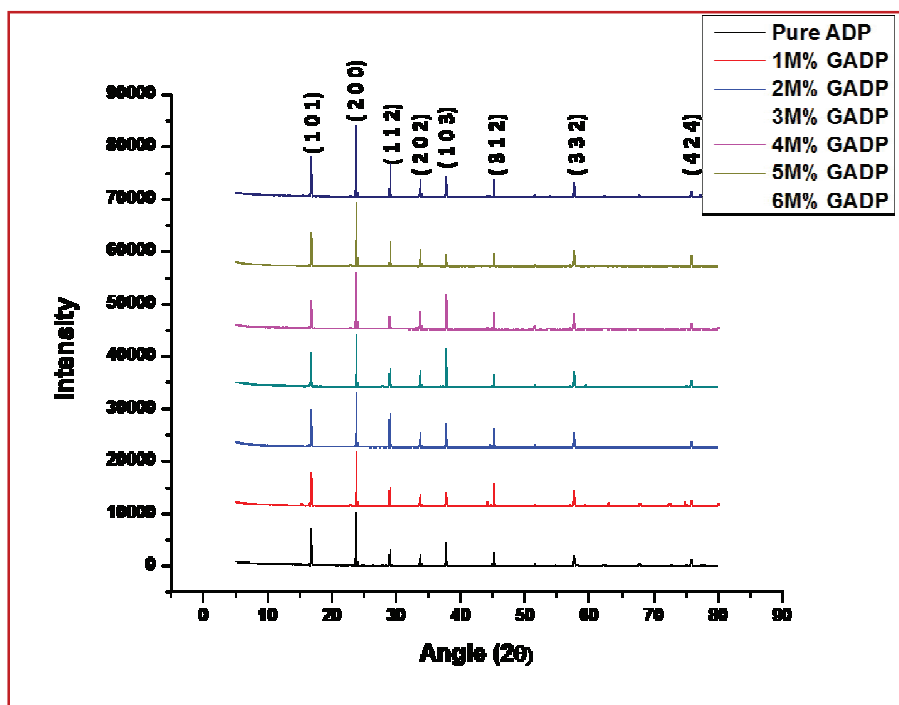
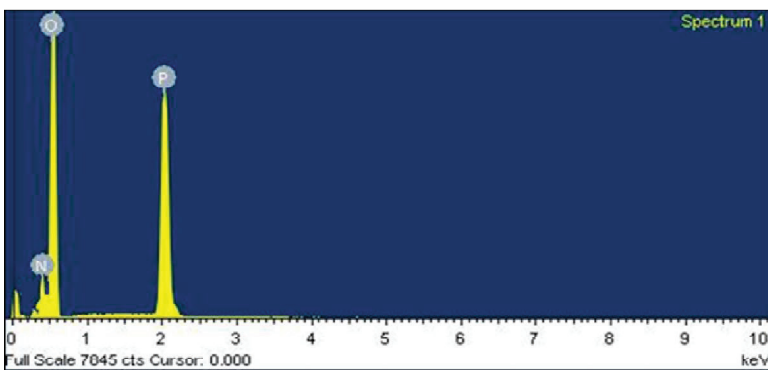


FIGURE 2. Powder XRD pattern of pure and Glycine doped ADP crystals.

EDX Analysis

Energy dispersive X-ray analysis (EDX) is a micro-analytical technique, used to obtain information about the chemical composition of the grown crystal. In order to confirm the presence of Glycine into pure ADP crystals, the samples were subjected to EDX analysis using JSM 7600F Scanning Electron Microscope. Elements are identified and presented in the respective figure. The EDX spectrum of the pure and 2 mole %, 4 mole %, 6 mole % glycine doped ADP crystals and the weight percentage (wt %) of C, N, O and P as obtained from EDX analysis are shown in figure 3, 4, 5 and 6 respectively.



| Element | Weight% | Atomic% | KeV |
|---------|---------|---------|-------|
| NK | 13.69 | 16.68 | 0.392 |
| OK | 62.80 | 66.96 | 0.525 |
| PK | 23.50 | 16.36 | 2.013 |
| Totals | 100.00 | 100.00 | |

FIGURE 3. EDX spectrum and weight % of pure ADP

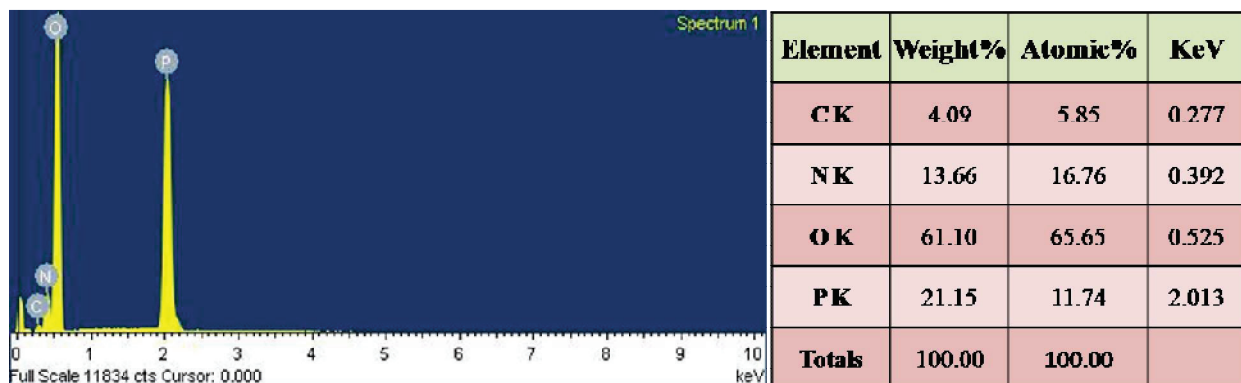


FIGURE 4. EDX Spectrum and weight % of 2M% Glycine doped ADP

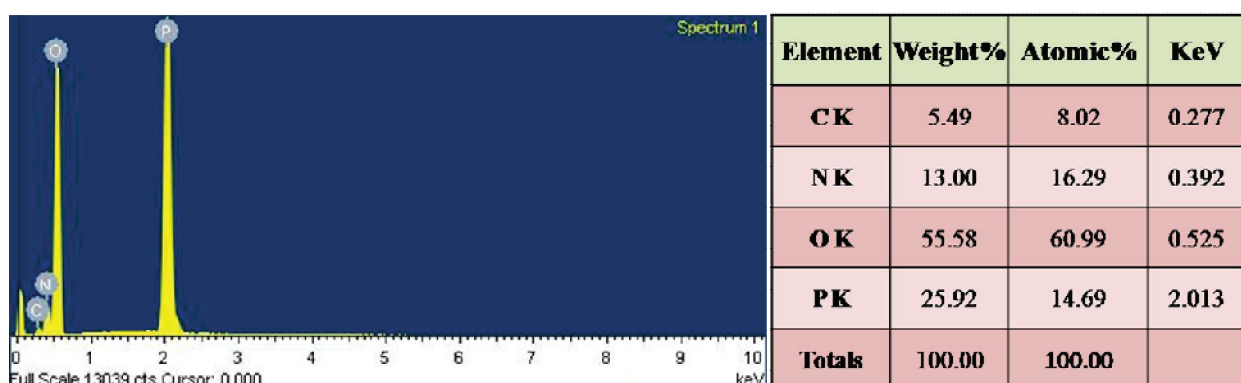


FIGURE 5. EDX Spectrum and weight % of 4M% Glycine doped ADP

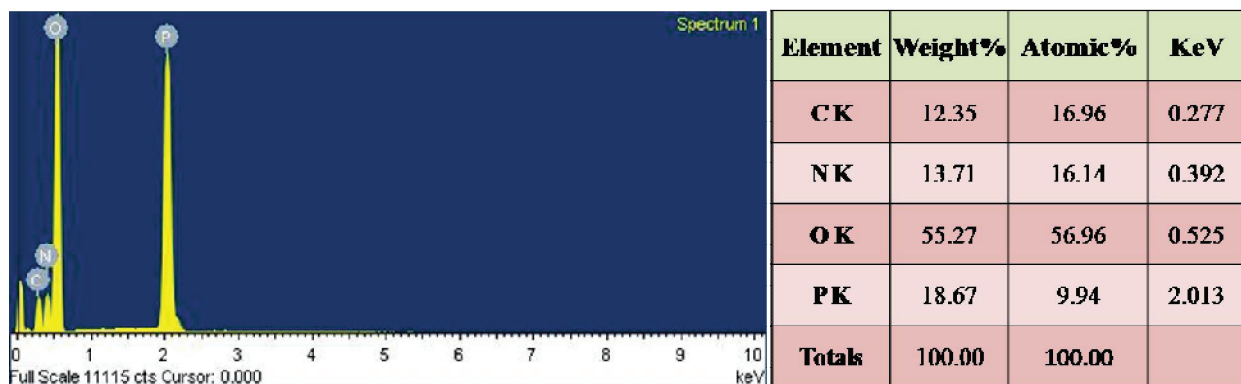


FIGURE 6. EDX Spectrum and weight % of 6M% Glycine doped ADP

All elements present in the sample are confirmed by their respective energy peak observed in the spectrum. The energy peaks of the elements like Oxygen (0.525 keV), Nitrogen (0.392 keV) and Phosphorous (2.013 keV) were observed in EDX spectrum of pure ADP. An additional energy peak of Carbon (0.277 keV) was found to present in all the Glycine doped ADP crystals. Carbon is a constituent of glycine hence we can say that organic amino acid Glycine is incorporated into the ADP crystal. The dopant Glycine are expected to substitute the ammonium ions in the ADP lattice compared to pure ADP reported due to their valency as well as proximity of ionic radius. Similar results were obtained for boron doped KDP crystals [9].

Thermal Analysis (TGA-DTA)

To analyse the thermal stability and to confirm the melting point of the material, the thermo gravimetric analysis (TGA) and differential thermal analysis (DTA) were carried out with the help of an instrument Perkin Elmer, Diamond and Perkin Elmer STA 6000 in the range of 15°C - 400°C. The effect of Glycine doping (2M%, 4M% and 6M%) on thermal stability of ADP crystals is studied from the simultaneous TGA & DTA curves. In order to study the influence of dopant on the thermal stability of ADP, the temperature corresponding to the first stage of decomposition is taken into account for comparison.

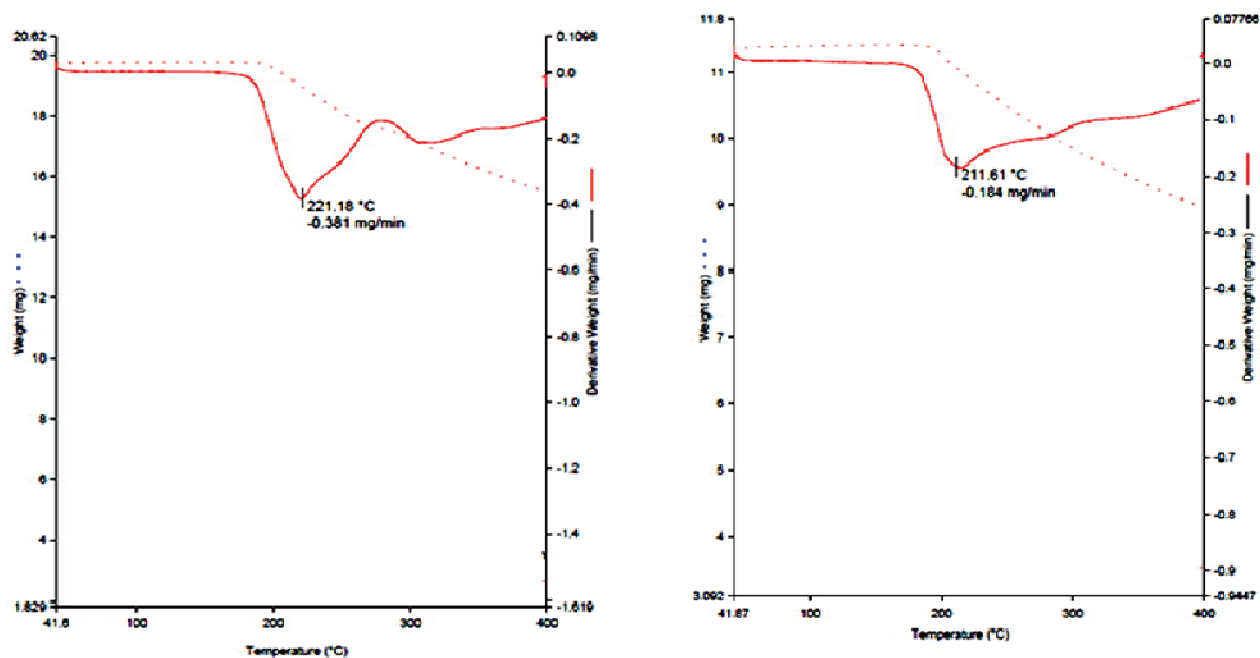


FIGURE 7. TGA-DTA Curve for pure and 2 mole% glycine doped ADP

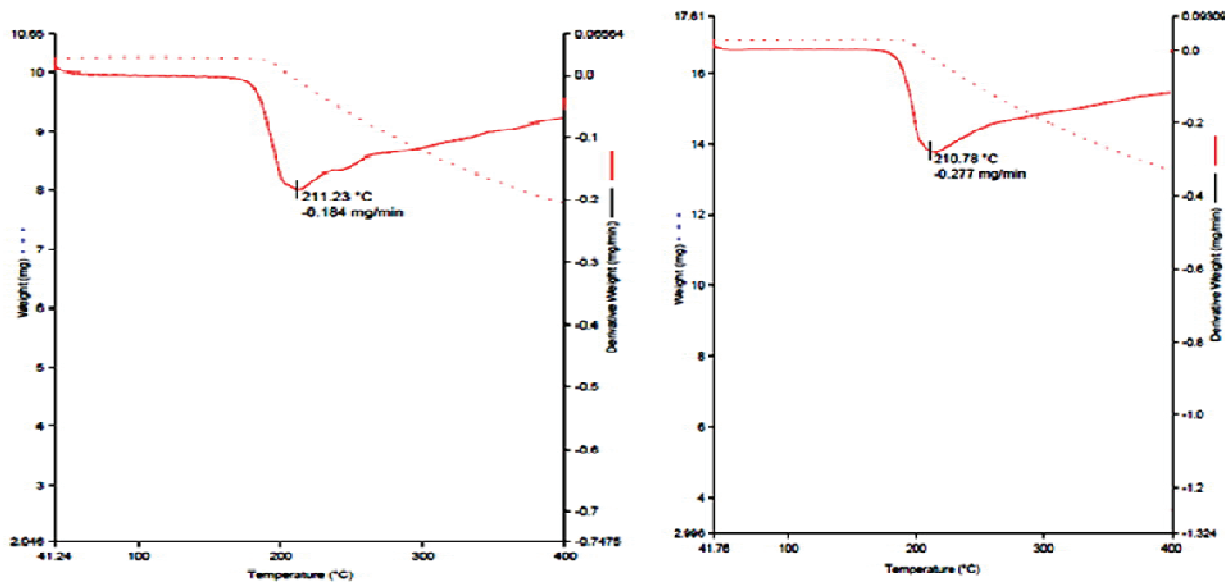


FIGURE 8. TGA-DTA Curve for 4 mole% and 6 mole% glycine doped ADP

The DTA curve (figure 7) shows an endothermic peak at 221.18°C for the pure ADP (Reported value is 215°C by P. Rajesh 2009). The endothermic peaks of the DTA curves for Glycine doped ADP crystals for 2M%, 4M% and 6M% is found out to be at, 211.61°C, 211.23°C and 210.78°C respectively (figure 7 and 8). These endothermic peaks correspond to the decomposition temperature of the crystals. It is observed from the figure that the decomposition temperature of the ADP decreases with increasing concentration of glycine. Hence we can say that the presence of glycine decreases the decomposition temperature of the ADP single crystals [10]. The similar results have been obtained in DL-Malic acid doped ADP and L-Lysine monochloride dehydrate ADP single crystals [11-12].

The TGA curve for all the doped crystals exhibited negligible weight loss in the region 40°C to 200°C as shown in the figure 7 and 8. This indicates that there is no inclusion of water in the crystal lattice, which was used as the solvent for crystallization. The weight loss observed from TGA graph for glycine doped ADP from the temperature 200°C. The weight loss of the crystal might be devoid of any physically entrapped water or water of crystallization, which confirms the absence of water molecules in the grown crystals. The weight loss in these temperatures is consistent with the decomposition temperature of the compounds. Similar results were reported in L-arginine-doped KDP crystals [13].

CONCLUSIONS

In this report, powder XRD results reveal that the obtained diffracted peaks are same as that of pure ADP crystal but the intensities of the diffracted peaks are found to be varied. The observed values are in good agreement with the reported values. This suggests that the crystals retain almost the same structure on doping of Glycine. An additional energy peak of Carbon (0.277 keV) was found to present in all the Glycine doped ADP crystals and is in concomitant with the reported values. From TGA-DTA graphs, it is observed that the decomposition temperature of the ADP is decreased by the addition of glycine. The TGA curve for all the doped crystals shows that the thermal stability in this temperature range. The weight loss in the temperatures shown in the TGA curve is consistent with the decomposition temperature of the compounds as seen from the DTA curves. Addition of Glycine could be helpful in growing high quality large size single crystals and enables it to be a good candidate for electro-optic and NLO applications.

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भारतातील स्वातंत्र्यपूर्व काळातील महिला समाजसुधारक

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प्रस्तावना

भारत देशासारख्या पुरुषप्रधान देशात नेहमीच पुरुषांनी केलेले कर्तव्य आणि सेवा अधोरेखित केली जाते तर महिलांची कामगिरी नेहमीच झाकोळली जाते. पण आज भारतीय महिला कोणत्याही क्षेत्रात मागे नाहीत हे वेळोवेळी सोदाहरण प्रत्ययास येत आहे. पूर्वीच्या काळी महिलांना शैक्षणिक, राजकीय, आर्थिक आणि सामाजिक क्षेत्रात नाममात्र संधी मिळत होती त्यामुळे त्यांच्यातील सुप्त गुणांचा फारसा विकास होत नसे पण तरीही ज्या महिलांना संधी मिळाली त्यांनी संधीचे सोने केलेले त्यांच्या कर्तृत्वावरून दिसून येते. या संशोधन पेपर मध्ये भारतातील काही महिला समाजसुधारकांच्या कार्याचा उहापोह करण्याचा प्रयत्न करण्यात आला आहे



1. सावित्रीबाई फुले

सावित्रीबाई फुले या भारतातील पहिल्या स्त्री शिक्षिका होत. सावित्रीबाई फुले यांचा जन्म महाराष्ट्रातील नायगाव येथे 3 जानेवारी 1831 ला झाला. त्या नऊ वर्षांच्या असताना त्यांचा विवाह महात्मा ज्योतिबा फुले यांच्याशी झाला. सावित्रीबाई फुले यांचा भारतातील ब्रिटिश काळात महिलांचा दर्जा सुधारण्यात आणि जातीय दडपशाही नष्ट करण्यात मोलाचा

वाटा होता. सावित्रीबाई फुले या खंबीर समाज सुधार होत्या. त्यांचा असा विश्वास होता की शिक्षणाचा उपयोग समाजातील वाईट गोष्टी दूर करण्याकरता एक शस्त्र म्हणून केला पाहिजे. ज्या काळात मुलींना शिक्षण घेणे शक्य नव्हते त्या काळात त्यांनी लिंगादिष्टीत भेदभावविरुद्ध लढा दिला आणि मुलींच्या शिक्षणाकरिता एक मजबूत असा पाया तयार केला. मुलींना शिक्षण देण्याचे कार्य करित असताना प्रसंगी त्यांना समाजा द्वारे होणारा अपमान,

शेण आणि दगड विटांचा मारा यांचा सामनाही करावा लागला. ऑगस्ट 1948 मध्ये सावित्रीबाई फुले आणि ज्योतिराव फुले यांनी भारतातील मुलींसाठी पहिली शाळा स्थापन केली. 1851 पर्यंत सावित्रीबाई आणि ज्योतिराव फुले यांनी पुणे शहरात तीन शाळा स्थापन केल्या. याद्वारे त्यांनी शिक्षणाचे महान असे कार्य केले. सावित्रीबाई यांनी बालविवाहाच्या विरोधात लढा देत महिलांच्या हक्कासाठीही लढा दिला आणि अखेरीस त्यांचा हा उपक्रम

यशस्वी झाला. सावित्रीबाई फुले यांनी मृत्यूपर्यंत पती ज्योतीराव फुले यांचे जाती आणि लिंगभेद दूर करण्याचे प्रयत्न सुरू ठेवले त्यांनी 'बालहत्या प्रतिबंधक गृहाची' स्थापना केली. याद्वारे त्यांनी स्त्रीभ्रूणहत्या रोखण्याचा आणि बलात्कार पीडित महिलांची प्रसूतीबाबत न्याय देण्याचा प्रयत्न केला. सावित्रीबाई फुले यांचा मृत्यू 10 मार्च 1897 मध्ये झाला.

2. ताराबाई शिंदे

ताराबाई शिंदे यांचा जन्म महाराष्ट्रातील बुलढाणा येथे 1850मध्ये झाला. त्या जोतीबा फुले यांच्या 'सत्यशोधक समाजाच्या 'कार्यकर्त्या होत्या. तत्कालीन महाराष्ट्रातील स्त्री समाजसुधारक म्हणून त्याचा उल्लेख केला जातो.

ताराबाई शिंदे यांनी अत्यंत प्रतिकूल परिस्थितीत देखील सामाजिक सुधारणांच्या क्षेत्रात योगदान दिले. त्यांनी स्त्रियांच्या शोषणाविरोधात दिलेला लढा हा सामाजिक परिवर्तनाच्या प्रक्रियेस चालना देणारा होता. त्यांचा स्त्री-पुरुष तुलना नावाचा निबंध १८८२ मध्ये प्रसिद्ध झाला. या निबंधात त्यांनी हिंदू विश्वास प्रणालींना आव्हान दिले आणि हिंदू संस्कृतीत खोलवर रुजलेल्या पुरुषसत्ताक मूल्यांचे समाजावर झालेले विध्वंसक परिणाम उघड केले. ताराबाई या पहिल्या स्त्री वाद्यांपैकी एक होत्या ज्यांनी स्त्रियांच्या विरुद्ध लिंग भावावर आधारित होणारा भेदभाव आणि जातीयअसमानता यावर टीका केली. समाजात स्त्रियांवर होणाऱ्या अत्याचारात हिंदू धर्माची असणारी भूमिका यावर त्यांनी प्रकाश टाकला त्यांनी. केशवपनासारख्या दुष्ट रूढी, तसेच पुरुषांना अनेक लग्न करण्याची असलेली मुभा या सर्व प्रश्नांवर टीका केली. ताराबाईंच्या मते, स्त्री ही पुरुषपेक्षा अधिक शोषिक, अल्पसंतुष्ट, पुरुष प्रेमाची भुकेली असते. तरी सुद्धा स्त्रीच्या वाट्याला उपेक्षा, वंचना, शोषण व यातना येतात. हे सर्व दूर व्हावे व समाजात स्त्री-पुरुष समानता यावी अशी अपेक्षा त्या व्यक्त करतात. आधुनिक भारतातील जातीय दडपशाही आणि लैंगिक असमानता यांची व्याख्या करण्यासाठी त्यांच्या लेखनाचा वापर करण्यात येत आहे.

3. रमाबाई रानडे

25 जानेवारी 1862 रोजी जन्मलेल्या रमाबाईंचे बालपण महाराष्ट्रातील सांगली जिल्ह्यात गेले. रमाबाई यांनी 19 व्या शतकाच्या मध्यात भारतातील पुणे येथे मुलींचे उच्च माध्यमिक विद्यालय स्थापन केले. रमाबाईंच्या वडिलांना मुलीच्या शिक्षणात रस नव्हता कारण त्यावेळी मुलींना शिक्षण घेणे निषिद्ध होते. तथापि, त्यांचे पती महादेव गोविंद रानडे यांनी त्यांना शिकविले.

माफक पार्श्वभूमी असूनही रमाबाईंनी सामाजिक क्षेत्रात विविध प्रकारचे कर्तृत्व गाजवले. त्यांनी पहिली भारत महिला परिषद सुरू केली आणि भारतीय महिला परिषदेच्या पहिल्या सत्राचे अध्यक्षपद भूषवले. या कामात त्यांना न्यायमूर्ती रानडे यांचे प्रचंड सहकार्य आणि प्रोत्साहन मिळाले.

महिलांच्या हितासाठी त्यांनी मोठे कार्य केले. महिला कैद्यांमध्ये आत्मसन्मान जागृत करण्यासाठी त्या कारागृहातील महिला कक्षात जात असत. त्यांनी दुष्काळग्रस्त लोकांसाठी मदतीचे आयोजन केले आणि त्यांची काळजी घेतली व त्यांना मदत केली. त्या सेवासदन संस्थेच्या अध्यक्षताही राहिल्यात. महिलांना विविध जीवन कौशल्ये शिकवण्याचा सेवासदन संस्थेचा मानस होता.

सेवासदन संस्थे अंतर्गत महिला प्रशिक्षण महाविद्यालय आणि तीन वसतिगृहे विकसित करण्यात आली होती. येथे रमाबाई रानडे यांनी गरीब महिला आणि विधवांना मदत केली आणि त्यांना आर्थिकदृष्ट्या स्थिर होण्यासाठी प्रशिक्षण दिले. त्यांच्या प्रयत्नांमुळे संस्थेचा महाराष्ट्रातील आठ शाखांमध्ये विस्तार झाला.

4. फातिमाशेख

भारतातील महिला समाजसुधारकांपैकी एक असणाऱ्या फातिमा बेगम शेख ह्या आपल्या इतिहासाच्या पुस्तकांमध्ये फारशा ज्ञात नाहीत. फातिमा बेगम शेख ह्या पुण्याच्या रहिवासी होत्या, त्यांचा जन्म 9 जानेवारी 1831

रोजी झाला होता .फातिमा या समाजसुधारक ज्योतिराव फुले आणि सावित्रीबाई फुले यांच्या सहकारी होत्या .ज्योतिराव आणि सावित्रीबाई फुले यांच्या सामाजिक सुधारणेच्या यशात त्यांचा मोलाचा वाटा होता .

1848मध्ये, फातिमा शेख यांनी फुले यांच्या समवेत भारतातील पहिल्या मुलींच्या शाळेची सह-स्थापना केली . लिंगभावावर आधारित सामाजिक भेदभावाचे अडथळे मोडून फातिमा शेख भारतात शिकवणारी पहिली मुस्लिम महिला ठरली .सामाजिक अडथळे पार करणाऱ्या आणि पूर्वग्रहांना आव्हान देणाऱ्या महिलांसाठी त्या एक आदर्श आहेत . खालच्या जातीतील लोकांना शिक्षण देण्यासाठी त्यांनी अथक परिश्रम घेतले.

शेख या भारताच्या स्त्रीवादी चळवळीच्या नेत्या होत्या .भारतीय समाजातील महिलांना दर्जेदार शिक्षण मिळवून देण्याचे त्यांचे कार्य देशाच्या कायम स्मरणात राहिले.

5. स्वर्णकुमारीदेवी

स्वर्णकुमारी देवी बंगाली लेखिका, कवयित्री, सामाजिक कार्यकर्त्या आणि सखी समितीच्या संस्थापक आहेत . त्यांचा जन्म 28 ऑगस्ट 1855 रोजी झाला .1896 मध्ये त्यांनी सखी समिती सुरू केली .या संस्थेने वंचित महिलांना मदत करण्याचे काम केले .सखी समितीने विधवा आणि अनाथांच्या संगोपनाची संपूर्ण जबाबदारी घेतली .त्यांना आवश्यक कौशल्ये शिकवून त्यांना शिक्षित करून स्वावलंबी आणि आर्थिक दृष्ट्या स्थिर करण्याची काळजी घेतली . संस्थेसाठी निधी उभारण्यासाठी समिती प्रदर्शने भरवत असे.

त्यांनी भारतीय राष्ट्रीय काँग्रेसच्या वार्षिक अधिवेशनात भाग घेतला 1929 .मध्ये, त्यांची वांगी साहित्य संमेलनाच्या अध्यक्ष पदासाठी निवड झाली.

लेखिका म्हणूनही त्या लोकप्रियता होत्या. कलकत्ता विद्यापीठातून जगतारिणी सुवर्णपदक मिळवणाऱ्या त्या पहिल्या बंगाली महिला लेखिका होत्या .भारतीय राष्ट्रीय काँग्रेसच्या पहिल्या महिला प्रतिनिधी स्वर्णकुमारी आणि कादंबिनी गांगुली होत्या.

विशेषतः स्त्रियांमध्ये, वैज्ञानिक शिक्षणाचा प्रसार करण्यासाठी त्यांचे भरीव योगदान आहे. लेखिका म्हणून यश मिळवणाऱ्या बंगालमधील महिलांपैकी पहिल्या एक म्हणून त्यांना भारतीय इतिहास काँग्रेस कडून मान्यता मिळाली आहे.

6. कादंबिनी गांगुली

कादंबिनी बोस गांगुली यांचा जन्म 18 जुलै 1861 रोजी भागलपूर येथे झाला. त्यांना भारतात औषधोपचार करणाऱ्या, डॉक्टर म्हणून व्यवसाय करणाऱ्या पहिल्या भारतीय महिला मानले जाते. 1884 मध्ये कलकत्ता मेडिकल कॉलेज मध्ये प्रवेश मिळवणाऱ्या त्या पहिल्या विद्यार्थिनी होत्या. नंतर त्यांनी स्कॉटलंड मध्ये प्रशिक्षण पूर्ण केले आणि भारतात वैद्यकीय सराव सुरू केला .त्यांनी भारतीय राष्ट्रीय काँग्रेसच्या पहिल्या महिला वक्त्या म्हणूनही काम केले.

कादंबिनी यांच्या बालपणावर बंगालच्या पुनर्जागरणाच्या चळवळीचा जोरदार प्रभाव होता .तिचे वडील ब्रजकिशोर बसू हे ब्राह्मोसमाजाचे प्रसिद्ध कार्यकर्ते होते 1863 .मध्ये त्यांनी भागलपूर महिला समितीची सह-स्थापना केली, जी महिलांच्या मुक्तीसाठी प्रयत्न करणारी पहिली संस्था होती.

कादंबिनी यांनी बंग महिला विद्यालयातील प्रसिद्ध ब्राम्हो समाज नेते द्वारकानाथ गांगुली यांच्याशी लग्न केले, जे त्यांच्यापेक्षा 20 वर्षांनी मोठे होते.

दोघांनी मिळून पूर्व भारतातील महिला कोळसा कामगारांसाठी त्यांच्या कामाची परिस्थिती सुधारण्यासाठी प्रयत्न केले .भारतीय राष्ट्रीय काँग्रेसच्या पाचव्या अधिवेशनात त्या पहिल्या महिला प्रतिनिधी मंडळाच्या सदस्या होत्या .

बंगालच्या फाळणीच्या वेळी ऐक्य दाखवण्यासाठी कादंबिनी यांनी 1906 मध्ये कलकत्ता येथे महिला परिषद भरवली आणि 1908मध्ये तिचे अध्यक्षपद भूषवले .त्यांनी सक्रियपणे सत्याग्रहाचा प्रचार केला, कामगारांच्या कल्याणास्तव पैसा उभा करून त्यांच्या हक्कासाठी लढा दिला.

7. भगिनी निवेदिता

सिस्टर निवेदिता या भारतीय समाजसुधारक आणि महिला राजकीय कार्यकर्त्या होत्या 28 ऑक्टोबर 1867 रोजी आयर्लंड मध्ये जन्मलेल्या मार्गरेट एलिझाबेथ नोबल या ख्रिश्चन महिलेने स्वामी विवेकानंदांनी दिलेले “निवेदिता” हे नाव स्वीकारले. त्या 28 जानेवारी 1898 मध्ये स्वामी विवेकानंदांच्या विचाराने प्रभावित होऊन भारतात आल्या. त्या ब्रिटीश राजवटीच्या प्रखर विरोधक होत्या आणि भारतीय सार्वजनिक प्रतिकाराला त्यांनी पाठिंबा दिला होता.

शैक्षणिक दृष्ट्या वंचित मुली-महिलांसाठी त्यांनी कलकत्ता येथे ‘निवेदिता बालिका विद्यालय’ शाळा सुरू केली . त्या घरोघरी जाऊन महिला व मुलींना शिक्षणाचे महत्त्व पटवून देत असत .त्यांच्या शाळेत फक्त मुलीच होत्या असे नाही तर प्रौढ महिला आणि विधवा देखील होत्या .त्यांनी कोणत्याही जातीपाती चा विचार न करता सर्व महिलांच्या उन्नतीसाठी काम केले.

1899 मध्ये कलकत्ता येथे आलेल्या प्लेगच्या साथीच्या काळात त्यांनी स्वताच्या जीवाची परवा न करता रुग्णांसाठी अथक काम केले .भगिनी निवेदिता यांनी अनेकदा स्वच्छता मोहीम राबविली आणि या उपक्रमात तरुणांना स्वयंसेवक होण्यासाठी प्रोत्साहित केले .

त्यांनी सामाजिक सुधारणांना नेहमी पाठिंबा दिला, राष्ट्रीय कला आणि संस्कृतीचा पुरस्कार केला आणि त्याचा प्रचार प्रसार केला. भगिनी निवेदिता स्त्री वादी म्हणून प्रसिद्ध होत्या .त्या भारताच्या स्वातंत्र्याच्या खंबीर समर्थक होत्या . त्या स्वातंत्र्यवादी चळवळीत सक्रिय होत्या आणि महात्मा गांधींसारख्या अनेक प्रमुख नेत्यांसोबत त्यांनी काम केले. 13 ऑक्टोबर 1911 ला दार्जीलिंग येथे त्यांचे निधन झाले.

8.पंडिता रमाबाई

सध्याच्या कर्नाटकात जन्मलेल्या पंडिता रमाबाई या संस्कृत विद्वान म्हणून पंडिता ही पदवी मिळविणार्या पहिल्या महिला ठरल्या .पंडिता रमाबाईंचा जन्म 23एप्रिल 1858 रोजी एका श्रीमंत आणि विशेषाधिकार प्राप्त अशा डोंगरे नामक कुटुंबात झाला .त्यांच्या प्रगतीशील पालकांनी मुलींच्या शिक्षणावर मर्यादा घालणार्या पारंपारिक सामाजिक नियमांना धुडकावले आणि रामाबाईला शिकविले .

रमाबाईंनी आपले संपूर्ण आयुष्य एक शिक्षक आणि समाजसुधारक म्हणून व्यतीत केले .वडिलांकडून त्या संस्कृत शिकल्या .नंतर त्यांनी भारतभर प्रवास केला आणि कलकत्ता विद्यापीठाने त्यांना पंडिता आणि सरस्वती ही पदवी बहाल केली.

महिलांच्या शिक्षणाला प्रोत्साहन देण्यासाठी आणि बालविवाहाच्या विरोधात काम करण्यासाठी आणि पीडितांची सुटका करण्यासाठी त्यांनी आर्य महिला समाजाची स्थापना केली .ब्राह्मोसमाज, हिंदूसुधारक आणि ख्रिश्चन मिशनरीझ या सर्वांच्या समाज कार्यांचा आणि त्यांच्या ध्येय्याचा पंडिता रमाबाई वर खूप मोठा प्रभाव होता.

महिलांना डॉक्टर बनवण्यासाठी महिला शिक्षण आणि वैद्यकीय शिक्षणाची कास धरणारे एक महत्वाचे व्यक्तिमत्व म्हणून रमाबाई यांना ओळखले जाते .त्यांच्या समाजकार्याचा प्रभावच असा होता की त्यांचा आवाज राणी व्हिक्टोरिया पर्यंत पोहोचला आणि महिलांसाठी वैद्यकीय शिक्षणाची सोय लेडी इफरिनने भारतात सुरू केली.

व्याख्याने देऊन आणि अनुयायांचे एक मोठे नेटवर्क तयार करून, रमाबाईंनी अंदाजे 60,000 रुपये गोळा केले आणि बालविधवांसाठी शाळा सुरू केल्या.

त्यांनी 1889 मध्ये अनेक हिंदू सुधारकांच्या मदतीने पुण्यात बालविधवांसाठी ‘शारदासदन’ नावाची संस्था स्थापन केली आणि नंतर त्या संस्थेला ‘एम.जी .रानडे मुक्तीमिशन’ हे नाव दिले .

1896 मध्ये भीषण दुष्काळात त्यांनी हजारो गरजूंना वाचवले आणि मदत केली . अबला स्त्रियांची हलाखीची परिस्थिती, पुरुष व अन्य महिलांकडून त्यांची होणारी पिळवणूक, अनिष्ट रूढी व परंपरा या विरुद्ध त्यांनी आवाज उठविला. कुमारी मातांसाठी केंद्र, स्त्री सहाय्यता केंद्र, गरीब मुलांसाठी शाळा, असे अनेक उपक्रम राबवून त्यांनी स्त्री शिक्षणाची चळवळ पुढे चालू ठेवली.महाराष्ट्रात नऊवारी ऐवजी पाचवारी साडी नेसण्यास महिलांनी सुरुवात करण्यामागे

पंडिता रमाबाई यांचे प्रयत्न होते. त्यांनी मूळ हिब्रू आणि ग्रीक भाष्येमधील बायबलचे मराठीत भाषांतर केले. त्यांचे सात भाषांतर प्रभुत्व होते. त्यांचे 5 एप्रिल 19 22 रोजी केडगाव ,पुणे येथे निधन झाले.

9. उषा मेहता

25 मार्च 1920 रोजी सुरत जवळील एका खेड्यात जन्मलेल्या उषा मेहता या भारतीय स्वातंत्र्यसैनिक आणि गांधी समर्थक होत्या. उषा यांनी, वयाच्या 8 व्या वर्षी, 1928मध्ये सायमन कमिशनच्या निषेध मोर्चात भाग घेतला. त्यांनी लहानासताना महात्मा गांधींना पहिल्यांदा पाहिले आणि तेथूनच त्यांना खादी परिधान करण्याची आणि देशसेवा करण्याची प्रेरणा मिळाली.

त्यांनी मुंबई विध्यापिठातून तत्वज्ञान या विषयातून स्नातक ची पदवी प्राप्त केली आणि त्यानंतर कायद्याच्या पदवीचा अभ्यास सुरू केला, पण भारत छोडो आंदोलनात सामील होता यावे म्हणून 1942 मध्ये शिक्षण सोडले.

ज्येष्ठ नेते राम मनोहर लोहिया यांनी मदत केलेल्या 'गुप्त काँग्रेस रेडिओशी' संबंध असल्याबद्दल पोलिसांनी उषा मेहता यांना ताब्यात घेतले आणि त्यांना चार वर्षांसाठी येरवडा तुरुंगात डांबले. त्यावेळचे अंतरिम सरकारचे गृहमंत्री मोरारजी देसाई यांनी त्यांची सुटका करण्याचा आदेश दिला, ज्यामुळे त्या कैदेतून सुटलेल्या पहिल्या महिला राजकीय कैदी बनल्या. स्वातंत्र्य प्राप्तीनंतर त्यांनी गांधीजींच्या सामाजिक आणि राजकीय विचारांवर मुंबई विध्यापिठातून पी.एच.डी. पदवी मिळवली. त्यांनी इंग्रजी आणि गुजराती भाषांमधून अनेक पुस्तके लिहिली. मध्ये त्यांना पद्मविभूषण पुरस्काराने सन्मानित करण्यात आले. भारतछोडो आंदोलनाच्या प्रत्येक वर्षापनदिनात मेहतास हभागि होत असत 11 . ऑगस्ट 2000 रोजी त्यांचे वयाच्या 80 व्या वर्षी निधन झाले.

निष्कर्ष

समाजसुधारणा आणि स्वातंत्र्यलढ्यात भारतीय महिलांचे भरीव असे योगदान राहिले आहे. सध्याच्या परिस्थितीत भारतीय महिलांनी देशातील काही प्रतिष्ठित पदे भूषवून सौंदर्य, सामर्थ्य आणि बुद्धिमत्तेचे उदाहरण प्रस्थापित केले आहे. समाज सुधारणा आणि विकासाच्या प्रक्रियेला चालना मिळण्याच्या हेतूने भारतीय समाजातील पुरुषांप्रमाणेच महिलांच्याही सामाजिक योगदानाची माहिती समाजाला होणे अतिशय आवश्यक ठरते. भारतात अशा अनेक स्त्रिया झाल्यात ज्यांनी जीवनातील विविध क्षेत्रात उल्लेखनीय अशी कामगिरी केली आहे. भारतीय समाज सुधारण्याच्या कार्यात पुरुष समाजसुधारकांप्रमाणेच महिला समाजसुधारकांचेही मोलाचे योगदान राहिले आहे.

संदर्भ

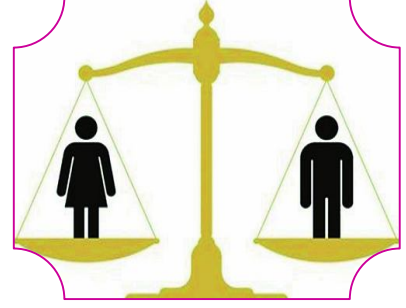
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लिंगभाव आणि धार्मिक आचारसंहिता (Gender and Religious Ethics)

मिलिंदकुमार खेळकर

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सारांश

धर्म आणि संस्कृती यांच्यात मोठ्या प्रमाणात सहसंबंध आहे. जेव्हा एखाद्या विशिष्ट संस्कृतीतील लोक विशिष्ट धर्म स्वीकारतात तेव्हा त्यांची संस्कृती त्या धर्मात स्वीकार्य असलेल्या आचारप्रणालीला आणि प्रथांना आत्मसात करू लागते. तसेच जेव्हा विशिष्ट धर्म एखाद्या विशिष्ट संस्कृतीमध्ये स्थापित होतो आणि रुजतो, तेव्हा त्या धर्माची आचारसंहिता, धार्मिक कर्मकांड व्यवस्था आणि नीतिमत्ता यासारख्या बाबी सामान्यतः त्या संस्कृतीच्या तत्वांवर आधारित असतात. अशाप्रकारे, धर्माचा त्या त्या समाजाच्या संस्कृतीवर आणि संस्कृतीचा धार्मिक अचारप्रणालीवर प्रभाव पडत असतो. पितृसत्ताक आणि पुरुषकेंद्रित संस्कृती असणाऱ्या समाजामध्ये केवळ राजकारण आणि व्यापारातच नव्हे तर धार्मिक आणि सामाजिक जीवनातही स्त्रियांपेक्षा पुरुषांना अधिक पसंती देण्यासाठी भूमिका आणि दर्जाच्या निश्चितीमध्ये स्त्री आणि पुरुष या जैविक भेदाला श्रेष्ठ आणि कानिष्ठत्वाचा आधार दिल्या गेला आहे. जगातील विविध धर्मांच्या धर्मसंहितेत पुरुष आणि स्त्रियांच्या अधिकार, वागणूक, कर्तव्ये इत्यादीबाबत भेदावमूलक बाबी असलेल्या स्पष्टपणे दिसतात. या संशोधन कार्याचा उद्देश विविध धर्मांच्या अध्यात्मिक मुल्यांवर प्रकाश टाकण्याचा नसून विविध धर्मांच्या आचारसंहिता आणि व्यवहारपद्धतीवर लिंगभावाचा कसा प्रभाव पडला हे अधोरेखित करण्याचा आहे.

अंतिमहत्वाचे शब्द (Keywords) : लिंगभाव, धार्मिक आचारसंहिता, धार्मिक, पितृसत्ताक, भूमिका .

प्रस्तावना (Introduction)

स्त्री आणि पुरुष या दोघांमध्ये धार्मिक बांधीलकीबाबत भेद का आहे हा शेकडो वर्षांपासून वादाचा विषय आहे. आज देखील या भेदाबाबत वेगवेगळे विचारवंत आणि सामाजिक संशोधक आपापली मते मांडत असतांना दिसतात.. या मतांमधून आणि वादविवादातून एक बाब निश्चितपणे समोर येते आणि ती म्हणजे जगातील बहुतांश धर्मांचे संस्थापक हे पुरुष आहेत आणि बहुतांश धर्मांचे ग्रंथ आणि त्यातील संहिता या मुख्यता पुरुषांकडे झुकलेल्या किंवा स्त्रियांपेक्षा पुरुषांच्या वर्चस्वाला आणि श्रेष्ठत्वाला मान्यता देणाऱ्या दिसतात. त्यामुळे जगातील बहुतांश समाजात पुरुषांच्या तुलनेत स्त्रियांना जीवनाच्या प्रत्येक क्षेत्रात दुय्यम वागणूक मिळत असल्याचे दिसते. कोणत्याही समाजातील धार्मिक आचारसंहिता व पर्यायाने होणारी वर्तणूक ही जर स्त्री आणि पुरुष यांच्यात भेदभाव करणारी असेल तर त्याला धर्मातील लिंगाधिष्ठीत भेदभाव

(Discrimination in Religion) असे म्हणता येईल. धार्मिक तत्वांचा ज्याप्रमाणे समाजाच्या संस्कृतीवर प्रभाव पडतो त्याचप्रमाणे समाजाच्या संस्कृतीचा, त्यातील घटकांचा धार्मिक तत्वांवर, आचार साहित्येवर देखील प्रभाव पडत असतो. म्हणूनच अनेक धार्मिक तत्वांमध्ये महिलांना दुय्यम स्थान देण्यात आलेले दिसते.

लिंगभावाची संकल्पना आणि अर्थ (Concept and Meaning of Gender)

लिंग आणि लिंगभाव यामध्ये फरक आहे. लिंग ही जीवशास्त्रीय संकल्पना आहे तर लिंगभाव ही सामाजिक-सांस्कृतिक संकल्पना आहे. लिंग या संकल्पनेतून प्राणी, पक्षी, वनस्पती इत्यादीमधील नर आणि मादी, स्त्री आणि पुरुष यामधील फरक लक्षात येतो. यात श्रेष्ठत्व आणि कनिष्ठत्व अभिप्रेत नसते. परंतु लिंगभाव ही सामाजिक-सांस्कृतिक संकल्पना असल्यामुळे यातून मात्र श्रेष्ठत्व आणि कनिष्ठत्व हा भाव व्यक्त होतो.

स्त्रिया आणि पुरुष यांच्या शरीररचनांमध्ये फरक आहे, पण समाजामध्ये स्त्रिया आणि पुरुषांबाबत जे भेदभाव केले जातात, त्या भेदभावाचे कारण आपल्याला त्यांच्या शारीरिक फरकांमध्ये सापडेलच असे नाही. लिंग हे शारीरिक आहे तर लिंगभाव समाजात घडवला जातो. स्त्रिया आणि पुरुषांना विशिष्ट प्रकारे वाढवले जाते; यात स्त्रियांनी व पुरुषांनी कसे वागावे हे शिकवले जाते. ह्याच स्त्रीत्व आणि पुरुषत्व ह्या कल्पना होत. ह्या कल्पना माणसांच्या वागणुकीवर खोलवर प्रभाव टाकतात. स्त्रीत्व आणि पुरुषत्वाच्या रूढ कल्पना ह्या स्त्रिया आणि पुरुषांना साचेबद्ध करून एकमेकांविरोद्ध उभे करतात. उदा. स्त्रीने सहनशील, नम्र असावे, आज्ञाधारक असावे, सर्वांशी जुळवून घ्यावे अशी अपेक्षा असते. तर पुरुषांना आक्रमक बनायला मुभा असते. ह्या कल्पना स्त्री-पुरुषांवर अवास्तव ओझे लादतात. एखादी स्त्री जोरजोरात बोलली, हसली तर तिच्याकडे पुरुषी म्हणून बघितले जाते. घरकाम, चूल-मूल ही बाईची जबाबदारी तर घराबाहेरच्या जबाबदारी पुरुषांच्या मानल्या जातात. मुलींना लहानपणी खेळायला बाहुली, भातुकली तर मुलांना सायकल, कार, बंदूक अशी खेळणी दिली जातात. प्रौढ वयात येणार्या जबाबदारीचे प्रशिक्षण लहान वयातच सुरु होते. स्त्री-पुरुषामधला शारीरिक फरक हा प्रामुख्याने त्यांच्या पुनरुत्पादनासंदर्भातील भिन्न जबाबदारी हा आहे. पुरुषाकडे रेतन तर स्त्रीकडे गर्भारपण, बाळंतपण आणि स्तनपान अशा प्राकृतिक जबाबदारी आहेत मात्र या पलीकडे कोणतीही कामे स्त्री/पुरुष कोणीही करू शकतात. उदा. स्वयंपाक, घरसफाई, शिवण-टिपण, शेतातले काम, डॉक्टर, नर्स, इंजिनिअर, शिक्षक इ.इ. मात्र घरकाम आणि बालसंगोपन ह्या आजही स्त्रीच्याच प्राथमिक जबाबदारी मानल्या जातात. इतक्या की बाहेरच्या जगातही स्त्रियांना बहुतेकदा घरकामाची विस्तारीत कामे मिळतात उदा. शिक्षिका, नर्स, स्वागतिका अशा प्रकारच्या कामात स्त्रियांचा अधिक भरणा असतो. या लिंग भावाचा उल्लेख जेंडर असाही केला जातो. थोडक्यात असे म्हणता येईल की लिंगभाव म्हणजे स्त्रियांचा वेगळा विचार नव्हे तर लिंगभाव म्हणजे एखाद्या समाजातील स्त्रिया आणि पुरुषांची सापेक्ष सामाजिक स्थिती होय.

अशा तऱ्हेने लिंगभाव हा सामाजिक -सांस्कृतिक संरचनातून घडवला जातो उदा. जात, धर्म, वय इ. वेगवेगळ्या संस्कृतींनुसार लिंगभाव बदलत राहतो. पुरुषप्रधान समाजात लिंगभावाची जडणघडण पुरुषांना झुकते माप देणारी असते आणि तुलनेने स्त्रियांना पक्षपाताला अधिक तोंड द्यावे लागते. पुरुष कुटुंबप्रमुख, पुरुषाकडे मालमतेची मालकी, लग्न झाल्यावर स्त्रियांनी सासरी जाणे, पितृवंशीय व्यवस्था ह्या सामाजिक प्रक्रिया आपली समाजव्यवस्था पुरुषप्रधान असल्याचे दर्शवतात. अशा समाजात स्त्रीचे स्थान दुय्यम बनते. ह्याचा एक गंभीर

परिणाम म्हणजे स्त्रियांवर होणारे अत्याचार. बहुतेकदा स्त्रियांना आपल्या दुय्यम स्थानामुळे अत्याचारांना तोंड द्यावे लागते. धार्मिक बाबतीतही पुरुषांना श्रेष्ठत्व तर स्त्रियांना गौणत्व प्राप्त झालेले आहे.

धार्मिक आचारसंहिता आणि आचरण

सामान्य शब्दात, आचारसंहिता म्हणजे एखाद्या व्यक्तीला निर्देशित आणि नियंत्रित करणारी नियामनांची व्यवस्था. किंवा मानवी कृतीला योग्यतेशी किंवा अयोग्यतेशी जोडणारी नियामांची चौकट म्हणजेच आचारसंहिता होय.

डिक्शनरी नुसार, 'देवावरील श्रद्धा आणि त्यासाबंधीचे विधी किंवा कर्मकांड म्हणजेच धर्म होय.'. विशिष्ट ईश्वरावर श्रद्धा ठेवून त्यावर आधारित तत्वप्रणाली, जीवनप्रणाली असणे म्हणजे धर्म होय. आदिम काळापासून मनुष्याची नैसर्गिक प्रवृत्ती आहे, की जे काही गूढ आहे, अगम्य आहे आणि जी एक अनामिक शक्ती या विश्वात आहे, त्यावर विश्वास ठेवायचा. त्याची पूजा-अर्चना करायची. मग ती निसर्ग देवता असो, अथवा देवतेचे मूर्त स्वरूप असो किंवा देवाची आराधना करायची एखादी जागा असो, मनुष्यातील शक्ती, सृजनशीलता, नवनिर्मितीची शारीरिक आणि मानसिक क्षमता असो. कोणासमोर नतमस्तक व्हायचे याचे स्वरूप वेगवेगळे; पण उद्देश एकच, त्या शक्तीने, देवाने आपले भले करावे, आयुष्यात दुःख कमी द्यावे किंवा देऊच नये किंवा येऊ घातलेले दुःख हरावे आणि आपल्या सार्या मनोकामना पूर्ण व्हाव्यात. धर्मानुसार आचरण केल्याने मोक्ष प्राप्ती होते आणि जन्म-मरणाच्या फेर्यातून मनुष्याची सुटका होते, असा सार्वत्रिक समज किंवा विश्वास देवावर, धर्मावर श्रद्धा ठेवणाऱ्यांमध्ये असतो. धार्मिक आचारसंहिता या त्या त्या धर्माच्या धार्मिक ग्रंथात सूचीबद्ध केलेल्या असतात उदा, बायबल, कुराण, त्रिपिटक, गुरुग्रंथ साहिब, इत्यादी तर काही वेळा त्या परंपरेने चालत आलेल्या दिसतात उदा. आदिवासींच्या धार्मिक संहिता किंवा कर्मकांड.

धार्मिक आचारसंहिता आणि व्यवहार यामध्ये लिंगभाव प्रतिमान

(Gender Pattern in Religious Ethics and Practices)

काही उपलब्ध आकडेवारीनुसार (Beit-Hallahmi and Argyle, 1997; Pew Research Center, 2014), स्त्रिया या पुरुषांपेक्षा जास्त धार्मिक असतात, विशेषता ख्रिश्चन धर्मीय स्त्रिया. हे तेव्हा घडते आहे जेव्हा बहुतांश धर्माचे संस्थापक हे दिव्य पुरुषच आहेत उदा. अब्राहम, मोझेस, गौतम बुद्ध, येशू ख्रिस्त, मोहम्मद पैगंबर इ.

'पीव रिसर्च सेंटर' ने 2008 ते 2015 दरम्यान 192 देशांमध्ये विविध धर्मीय लोकांच्या केलेल्या संशोधनामध्ये असे दिसून आले की, पुरुषांपेक्षा स्त्रियामध्ये धर्माबाबत बांधिलकी जास्त प्रमाणात असते, त्या जास्त धार्मिक वृत्तीच्या असतात. धार्मिक संशोधक असे म्हणतात की, याला कारण 'नैसर्गिकता' आणि 'संगोपन' हे दोन घटक जबाबदार आहेत. बेट-हलहामी आणि अर्जील यांनी 1997 मध्ये केलेल्या संशोधनात हे मान्य केले आहे कि, अ) स्त्रिया या पुरुषांपेक्षा अधिक भावनाशील असतात आणि म्हणून दोष, पश्चाताप किंवा कृतज्ञतेच्या प्रसंगी धार्मिकतेकडे वळतात. ब) स्त्रियांचे सामाजीकरण हे धार्मिक मूल्यांनुसार होते तर तुलनेने पुरुषांचे फारच कमी. क) स्त्रिया या धर्माकडे सामाजिक संरचनेचा एक नैसर्गिक परिणाम म्हणून बघतात तर पुरुषमात्र फारच कमी प्रमाणात तसे बघतात.

वरील उल्लेखित काही संशोधनाचे अपवाद मान्य केले तरी धार्मिक संघटनांचे संचालन, नियंत्रण, धार्मिक शिक्षण आणि पूजा-पाठ या सर्व गोष्टींमध्ये स्त्रियांपेक्षा पुरुषांचेच प्रभुत्व राहत आलेले आहे.

एकेश्वरवादी आणि बहुदेववादी अशा दोन्ही प्रकारच्या धर्मात लिंगभाव प्रकर्षाने दिसून येतो. एकेश्वरवादी ख्रिश्चन धर्मात 'ट्रिनीटी' तील दुसरी व्यक्ती म्हणून केवळ एकच पुरुष मसीहा अवतीर्ण झाला आणि तो म्हणजे येशू ख्रिस्त. इतर दोघे, 'फादर' आणि पवित्र आत्मा' यांना पुलिगी ऐवजी नपुसकलिगी मानले जाते. बायबल नुसार, पहिली महिला, 'इव्ह' हीला पहिला पुरुष आदमच्या बरगडी पासून तयार करण्यात आली. ज्यू आणि ख्रिश्चन धर्मीय लोक बरेचदा पितृसत्ताक पद्धतीचा बचाव करण्यासाठी या उदाहरणाचा दाखला देतात. दुसरीकडे, इस्लाम मध्ये मात्र आदम आणि हव्वाह(इव्ह) यांच्या उत्पत्तीबाबत स्पष्ट असे काहीही सांगितलेले नाही.

ज्यू, ख्रिश्चन आणि इस्लाम या धर्मांचे संस्थापक व प्रमुख वारसदार पुरुषच आहेत, ते असे, यहुदी(ज्यू) धर्मात अब्राहम, मोझेस, डेविड, इलीजाह इ., ख्रिस्ती धर्मात जोन बाप्तीस्ट, येशू ख्रिस्त आणि त्याचे शिष्य आणि पाल, इस्लाम धर्मात मोहम्मद पैगंबर आणि त्याचे वारसदार अबू बकर, उथमानिबन अफान, ली नीबन अबी तालिब आणि बारा इमाम. हे सर्व पुरुषच आहेत. हे सर्व धर्म पितृसत्ताक संस्कृतीत स्थपित झाले कि ज्यामुळे त्यांची आराधना तसेच संचालन आणि नियंत्रण पुरुषांपुरतेच मर्यादित झाले, ख्रिश्चन समुदाया मध्ये चर्च फादर आहे, चर्च मदर मात्र नाही. याला अपवाद फक्त कॅथोलिक चर्चमधील महिला संतांचा. अधिपासून धर्मासाठी कार्य करणाऱ्या पुरुष धर्मप्रसारकांच्या तुलनेत महिला धर्म प्रसारकांच्या कामाची तेवढी दाखल घेतली जात नाही आणि त्यांना प्रसिद्धीही दिली जात नाही. आपल्या दोन हजार वर्षांच्या कालखंडात कॅथोलिक चर्चने एकही महिलेला पोप पद दिले नाही. पितृसत्ताक समाजात केवळ पुरुषच प्रबुद्ध-ज्ञानवंत होऊ शकत होते आणि महिला मात्र इतिहासही घडवू शकत नव्हत्या आणि संस्कृतीसाठी काही देऊही शकत नव्हत्या असे खेदाने म्हणावे लागते. महिलांना धर्मच काय तर सामाजिक, आर्थिक, राजकीय इ बाबतीत कोणतेही अधिकार नव्हते. स्त्रीवादी लोकांच्या दबावामुळे अगदी 19 व्या शतकापासून महिलांना काही अधिकार द्यायला सुरुवात झाली.

पारंपारिक ज्यू धर्मीय लोकांत दर्जा श्रेणीमध्ये महिलांना असणार्या संधी नाकारल्याच जात नाही तर त्यांना हीन पानाची वागणूक दिली जाते. 'लक्ष विचलित करणाऱ्या वस्तू' म्हणून प्रार्थनेच्या वेळी महिलांना पडदा किंवा भित्त याद्वारे पुरुषांच्या नजरेपासून दूर ठेवले जाते

इस्लाममध्ये महिलांना इमाम किंवा धर्मगुरू होता येत नाही. ज्यू प्रमाणेच इस्लाम धर्मीय स्त्रियांनाही लक्षत विचलित करणाऱ्या वस्तू समजून प्रार्थना आणि उपासनेच्या प्रसंगी त्यांना पुरुषांशी कोणत्याही प्रकारची आंतर्क्रिया करण्याची परवानगी नाही. एवढेच नव्हे तर कुराननेही त्यांना थेट असे कोणतेच अधिकार दिलेले नाहीत त्यांना इस्लामिक धर्मगुरूंच्या फतव्या नुसार, महिलांनी अत्तर लावणे, नेल पौलिश लावणे, लिपस्टिक लावणे म्हणजे पुरुषांच्या लैंगिक भावना चाळवणे होय असे म्हटले जाते. नमाज पठण हा प्रामुख्याने पुरुषांचा मक्ता मनाला जातो, महिला बुरखा घालून पुरुषांच्या मागे राहून किंवा दुसऱ्या खोलीमध्ये नमाज पठण करतात. इस्लामिक संहितेद्वारे प्रार्थना आणि सामाजिक जीवन यात स्त्री आणि पुरुषांमध्ये आंतर्क्रिया किंवा संवादाच होणार नाही याची पुरेपूर काळजी घेण्यात आली आहे. अफगाणिस्तान सारख्या देशात महिलांनी एकटीने घराबाहेर पडणे, शिक्षण घेणे, नोकरी करणे, खेळ खेळणे इ. वर बंदी घातली आहे. 25 सप्टे. 2011 ला सौदी अरेबियाचे राजे अब्दुल्लार यांनी महिलांना मतदान आणि निवडणुकीत उभे राहण्याचा अधिकार देण्याची घोषणा केली तेव्हा जगणे त्या चे स्वागत केले पण अजूनही काही देशात असे अधिकार नसल्या बाबत काहींनी आश्चर्य ही व्यक्त केले. मुस्लीम धर्मात मुस्लीम व्यक्ती मुस्लीम, ज्यू आणि ख्रिश्चन धर्मीय मुलीशी विवाह करू शकतो पण मुस्लीम मुलगी मुस्लीम व्यक्तीशिवाय अन्य कोणाशी विवाह करू शकत नाही.

पतीच्या साध्या तीन तलाक म्हटल्याने मुस्लीम स्त्रीचा विवाह तुटतो. हिंदू धर्मात देखील शुद्ध पशु आणि नारी हे तदानाचे अधिकारी म्हटले आहे ,मासिक पाळीमुळे महिलांना मंदिरात जाण्याचा मज्जाव केला जातो. सतीप्रथा , केशवपन , बालहत्या, शिक्षण बंदी ,विधवा पुनःविवाह बंदी इ धार्मिक रूढी होत्या ज्या काळाच्या ओघात नष्ट होत च्यालाल्या आहेत. आजही महिलांना धर्मगुरू होता येत नाही.

एकंदर, धार्मिक जीवनात महिलांना पत्नी, आई आणि घर सांभाळणारी या भूमिकेतच पाहावे लागते.

निष्कर्ष

धार्मिक आचारप्रणाली आणि प्रथा ह्या समाजातील सर्व लोकांची अभिवृत्ती आणि वर्तनावर प्रभाव पाडतात. धार्मिक प्रथा संस्कृतीला आकार देतात आणि संस्कृती धार्मिक प्रथांना आकार देते.

धर्मानुसार आचरण म्हणजे मोक्षाचा राजमार्ग. पुरातन धर्मकारांच्या मतानुसार स्त्रीजातीला मोक्ष नाहीच. थोडक्यात, स्त्रीचा एक माणूस म्हणून विचार धर्मकारांनी केलेला नाही. स्त्रीचे शारीरिक वेगळेपण तिच्या मोक्ष मार्गाच्या आड येते. तिला एकतर देवी, माता अशा उच्चपदावर ठेवायचे किंवा पुरुषाला मोहात पाडणारी, म्हणून तिच्या अस्तित्वाला दुय्यम ठरवून, हीन दर्जाचे आयुष्य जगण्यास भाग पाडायचे. धर्माच्या नावाने स्त्रीविश्वाचा आवाका संकुचित करण्यास धर्मकारांनी, धर्मगुरूंनी, समाजाने आणि कुटुंबियांनी कुठलीही कसर ठेवली नाही. शतके लोटली, स्त्रिया धर्माच्या सावलीत घुसमट सहन करीत राहिल्या. ही सावली सुखावह नव्हे हे निश्चित.

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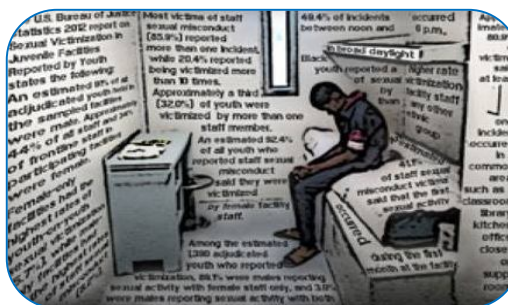
JUVENILE DELINQUENCY IN INDIA: CAUSES AND REMEDIES

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ABSTRACT :

The nature of juvenile delinquency is different from that of general delinquency. In legal terminology, it is a crime to conduct against the prescribed laws of the country, but juvenile delinquency is a sociological and psychological concept. All those behaviors done by juvenile children which are not only legal but are harmful to society and the individual from any point of view, come under the purview of juvenile crime. For example, running away from school is not a crime from a legal point of view, but it is harmful from a social and psychological point of view. On the one hand, this trend teaches to run away from all kinds of responsibilities and on the other hand, it diverts the child from proper work and motivates them towards improper work. Thus, the scope of juvenile delinquency is much wider. The environment has a lot to do with the formation of personality and behavior in adolescence; Therefore, it is not the adolescent child himself but his environment that is responsible for his appropriate or inappropriate behavior. For this reason, many countries have separate jurisprudence for juvenile offenses; Their judges and other judicial officers are knowledgeable in child psychology. There, juvenile delinquents are not punished but based on their life history (case history), by studying them and their environment, efforts are made to reform the children by improving the unsatisfactory elements in the environment, which result in crimes. In India too, children's courts and children's homes have been established in some states. In this research paper, the causes, and remedies of juvenile delinquency in India have been studied.



KEYWORDS : Juvenile Crime, Social and Psychological Perspective, Juvenile, Inappropriate Behavior, Juvenile Court, Juvenile Home

INTRODUCTION:

When an anti-law or anti-social act is done by a juvenile, it is called juvenile crime or child crime. Juvenile crime from the legal point of view is an anti-legal act done by a child above 8 years of age and below 16 years of age, which is presented before the Children's Court for legal proceedings. According to the Juvenile Justice Act 1986 (amended 2000) in India, boys up to the age of 16 years and girls up to the age of 18 years have been included in the category of juvenile delinquents. The maximum age limit for juvenile delinquency varies from state to state. On this basis, the anti-legal act done by a juvenile under the age limit prescribed by any state is a juvenile offence. It is not only age that determines juvenile delinquency, but the seriousness of the crime is also an important aspect. A boy of 7 to 16 years and a girl of 7 to 18 years has not committed any such crime for which the state gives the

death penalty or life imprisonment like murder, treason, deadly assault, etc., then they will be considered juvenile delinquents.

From the sociological point of view, age is not given much importance for juvenile delinquency, because the mental and social maturity of a person is not always affected by age, so some scholars consider the behavioral tendency manifested by the child as the basis for juvenile delinquency, such as loitering. Being absent from school, disobeying parents and guardians, using obscene language, keeping contact with people of character, etc. But until a valid method is accepted unanimously, age will be considered as the determining basis of juvenile crime. According to Gillin and Gillin, from a sociological point of view, a juvenile delinquent is a person whose behavior is considered harmful by society and therefore prohibited by it. In this way, the anti-social behavior of teenagers is taken into juvenile crime or such behavior of children which is harmful from the point of view of welfare, the person who commits such acts is called a juvenile delinquent. According to Robinson, vagrancy, begging, wandering, and delinquency is the characteristics of juvenile delinquents.

Psychology has proved that crime is neither related to heredity nor physical appearance; Only physical characteristics are inherited, and they do not have a direct relationship with a person's feelings, aspirations, tendencies, and intelligence. Sociologists say that the originator of crime is a contaminated environment, such as poverty, ruined family, criminal partner, etc. But it has been known by modern psychological research that not only in the same environment but also in the same family, only half of the children of the same parents are criminals, not all. If there is an atmosphere that gives birth to crime, then other brothers and sisters should also become criminals. Modern psychology finds the origin of juvenile delinquency in psychological conditions. According to him, every child has certain desires, aspirations, and needs. He tries to fulfill them. There are many obstacles in his endeavor, which he tries to win. He is either satisfied or dissatisfied or indifferent to the result of his efforts. But the feelings of indifference are rarely reduced. Satisfaction and dissatisfaction are not related to success or achievement, but satisfaction is a relative concept.

RESEARCH METHODOLOGY:

The research paper has depended on secondary data.

OBJECTIVE OF RESEARCH:

- 1) To study the causes of juvenile delinquency in India.
- 2) To study the remedies of juvenile delinquency in India.

THE CAUSES AND REMEDIES OF JUVENILE DELINQUENCY IN INDIA:

The rate of juvenile delinquency in Indian society is increasing day by day, as well as its nature is also becoming complex. The reason for this is that in present times urbanization, industrialization and social media have created such an environment in which most families are proving unsuccessful in controlling their children. Moral values have started disintegrating due to an increase in personal freedom, along with this excessive competition has created deviation in children. The availability of computers and the internet has separated them from society. As a result, they are becoming victims of depression and are indulging in crime. According to the National Crime Records Bureau (NCRB), since the beginning of recording these crimes in 2017, there was an increase of over 700 percent till 2019. NCRB registered 278 cases of crimes committed by CCI in-charge across India in the year 2017 in which 328 child victims were involved. By the year 2019, these cases increased to 1,968, of which 2,699 were child victims. Juvenile crime statistics According to the statistics of "The National Crime Records Bureau", according to the statistics of the year 2014, a total of 38,455, according to the year 2015, 33,433 and according to the year 2016, 35,849 cases of juvenile crime were registered. Which is very thoughtful. According to research, about 19 percent of girls in the age group of 12 to 17 years have been involved in some kind of fight in their school. This research was done on a total of 5467 teenagers and youth from 6 major places in India. Adolescents and youth from Delhi, Bangalore, Jammu, Indore, Kerala, Rajasthan, and Sikkim were involved in this research.

Juvenile crime is a social problem, so most of its reasons also exist in society itself. Family is the first school of the child, where he is influenced by the behavior of his parents and siblings. When parents are unable to fulfill their responsibilities towards their children, then the children also cannot be expected to become the best citizens. Many reasons related to the family are responsible for making the child a criminal. Former criminal tribes in India have also declared criminals based on heredity, the scholars who considered criminals to be a product of heredity were influenced by Mendel's theory of heredity. But at present, this concept was boycotted in criminology. In their studies, Burt and Gillin did not find juvenile delinquency to be related to heredity. Children are exemplary, they learn every good and bad deed based on imitation from elders, if elder brothers and sisters in the family are criminals and misbehave with them, then the personality of the children gets distorted, and the voice of the rebellious spirit in them. become outspoken, they stay out of the polluted environment and become criminals by getting ill-culture, or the parents do not give equal affection to the children, then also in such a situation the children separate themselves from the family and their feeling of guilt awakens in the mind.

Parents have a direct impact on the development and conscience of the child. Lack of conscience combined with feelings of hostility gives rise to aggression, Andrey (1960) has also observed that juvenile delinquents get less parental love than delinquents. Peterson and Becker pointed out that families of delinquents are often materially impoverished, which can affect a juvenile delinquent's perception of himself and may contribute to his escape from home. As a result of urbanization in modern society, a person does not get enough space to live, even a large family must live in a very small space. Because of this, parents are neither able to pay full attention to the children, nor do they get any internal security, so the children tend to commit crimes, the parents themselves prefer to send them outside, where the children become criminals. Get the company of children and become criminals themselves.

Apart from family reasons, there may be such shortcomings in the person himself, due to which he may reveal criminal behavior. When a juvenile is a victim of some kind of physical disability, he develops a sense of inferiority, he tends towards crime, Cyril, Burt, Healey and Bronner, and Gluck, etc. found this in the study of juvenile delinquents, Hutton Many types of physical defects like deafness, permanent disease, physical disability, lack of intelligence have been considered as the reason for juvenile delinquency. Children become criminals due to emotional instability, Cyril Burt, Healey, and Bronner found in studies that often juvenile delinquents feel insecure and suffer from mental conflict, due to which they tend to commit crimes.

The community in which the child lives, if its environment is unsuitable, it can make the child a criminal. The effect of the neighborhood is more visible in urban areas, apart from the family, the child spends most of his time with the children of the neighborhood, and the neighborhood helps in crime by interfering with personality needs, cultural conflict, and nurturing antisocial values. Overcrowded neighborhoods with inadequate recreational facilities ignore children's natural urges to play and encourage the formation of criminal gangs, neighborhood homes, cheap hotels, etc., are also breeding grounds for criminal activity.

The school environment has a great influence on the children. The behavior of teachers, their relation with school fellow students and teachers, the rigor of courses, the promotion of ineligible students, etc. are some of the reasons which affect the soft mind of children and make them criminals. Children are expelled from school for getting low marks or failing, or they are harassed by teachers or ridiculed by students, due to which they suffer from an inferiority complex and become prone to crime. Movies full of immorality, drinking, smoking, and erotic books leave a deep impression on the mind of children. Many times, they also learn the methods of crime, in many parts of our country many children are caught for the crime of using methods of cinema like theft, burglary, and kidnapping. They claim that they learned the methods of crime either from cinema or social media. Movies also develop an interest in criminal behavior in children by arousing the desire to get easy money, suggesting methods for these achievements, and instilling a sense of adventure, inciting sexual feelings.

Residence in the criminal area is also closely related to criminal tendency, there are more opportunities for children to become criminals if there is a place of residence near prostitutes, gamblers, and alcoholics, because due to high imitation and suggestion-receptivity in children, criminal tendencies increase. There is a possibility of learning. Influenced by the prevalent patterns of crime, the children of slums commit crimes. In addition to the above-mentioned factors, some other factors are also responsible for juvenile delinquency such as confusion of values, cultural differences, and conflicts, moral decline, increase in independence, economic recession, etc. Only one factor does not have a hand in making a child a criminal, rather the co-presence of many factors contributes to making a child a criminal.

Psychotherapy diagnoses emotional and personality-related problems by psychological means, it treats by changing the feelings and concepts about some important persons in the past life of the juvenile delinquent. When children do not have a good relationship with their parents in the early stages, their emotional development is stunted, as a result of which they are often impulsive in trying to satisfy their childish aspirations, not being satisfied by normal means within their own family. The satisfaction of these aspirations and impulses can take the form of antisocial behavior. Through psychotherapy, the criminal is allowed to move in an atmosphere of affection and acceptance by the therapist. Reality therapy is based on the idea that individuals who are unable to meet their basic needs behave irresponsibly, the goal of reality therapy is to help the delinquent child act responsibly, that is, to avoid antisocial activities. This method studies the present behavior of the individual. Behavior therapy seeks to improve the learned behavior of juvenile delinquents by developing innovative learning procedures. When behavior is changed by rewards or punishments, negative reinforcement will reduce negative behavior (criminal actions) while positive reinforcement (such as rewards) will maintain positive behavior. Both types of factors can be used to change behavior.

Many children cannot verbally communicate effectively in group situations, in the activity therapy method children are made to do some tasks or the other in a free environment. Where he can express his sense of aggression in creative work, play, or mischief. The ambient therapy method, which creates an environment that facilitates meaningful change and fostering adjustment, is used for people whose deviant behavior is a reaction to aversive life situations.

In addition to the above-mentioned methods, the treatment of juvenile delinquents involves individual social work ie helping the maladjusted child deal with his problems. The particular social worker may be the probation officer or career counselor. Individual counseling helps the delinquent juvenile to understand his immediate situation and rehabilitate him to solve his problem, whereas vocational counseling ie helping the juvenile delinquent to choose his future life.

At present, two types of measures have been taken to prevent child crimes, first, new laws have been created for them and second, reform institutions and schools have been created. Children's Act and Reformatory Act have been made to give special facilities to juvenile offenders and adopt proper justice systems. Children's courts have been established in India under the Children's Act of 1960. The Children's Act of 1960 has been replaced by the Juvenile Justice Act of 1986. At present, there are Children's Courts in all the states of India. The Juvenile Justice (Care and Protection of Children) Amendment Bill, 2019 was passed to amend various provisions of the Juvenile Justice Act, 2015. The Act allows juveniles between the age of 16-18 years involved in heinous crimes to be tried at par with adults. Another effort has been made to establish correctional institutions and correctional homes, where training is imparted to child criminals by keeping them for some time. This work is done by remand areas or observation, certified or reformatory schools, boarding schools, and probationary hostels.

CONCLUSION:

No single factor has a hand in making a juvenile delinquent, rather the co-presence of many factors contributes to making a juvenile delinquent. The Juvenile may suffer from physical weakness, his intelligence is low, their parents are criminals, his environment is bad, and he has a low level of achievements, still, he will not become a criminal unless he is dissatisfied with his condition. And his

socially accepted efforts to remove the dissatisfaction have not been unsuccessful. Crime is a kind of self-revelation and behavior. Juvenile crimes are also a way of natural behavior, only their result is harmful to society and the individual. Therefore, to save society from this inauspicious situation, parents, and teachers with the help of psychologists have to see which unsatisfactory conditions exist due to the delinquent behavior of the juveniles. Remove the cause of the disease, the disease will go away, this is the principle of medicine. Criminal behavior is also a social disease. Due to this, on removing the unsatisfactory situation, the delinquent behavior will automatically end and the delinquent juvenile will grow up to become an able member of society and a responsible citizen of the country.

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ORIGINAL ARTICLE

**Histo-morphological Studies of Olfactory System in the Hill Stream
Cyprinidae, *Garra mullya* (Sykes)**

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Abstract

Olfaction is primarily produced by the stimulation of receptor cells on the olfactory organ's neuroepithelial surface. It is olfactorily innervated. Fish use olfactory cues and signals for a variety of life processes, including migration, communication, nutrition, schooling, defence, and reproduction. In this study, we report the light-microscopy structure of the olfactory system in *G. mullya*. The olfactory bulb's morphology is rather constant throughout the evolution of vertebrates. The olfactory organ, which is paired in *G. mullya* and connected to the forebrain by medial and lateral olfactory tracts, is the most highly valued organ for chemosensation (smell and taste). As a result, it is pedunculated. This fish's olfactory rosette is oval in shape and has a centre raphe from which the lamellae on both sides radiate in a parallel pattern. The outer olfactory nerve layer, glomerular layer, mitral cell layer, and innermost granular cell layer are the four concentric layers that make up the olfactory bulb. Glomerular layer, mitral cells, granular cells, and nervus terminalis cells are all visible in the olfactory bulb. The olfactory bulb is pedunculated because it ends on the first telecephalon through two fibres.

Keywords : Olfactory rosette, olfactory bulb, hill stream fish; *Garra mullya*

INTRODUCTION.

Chemoreception mainly depends on the sense of taste (gustation) and on smell (olfaction). These are the major pathways for detection and identification of chemical stimuli in the environment (Hara, 1994).

Olfaction is accomplished principally by the stimulation of receptor cells on neuroepithelial surface of the olfactory organ. It is innervated by the olfactory nerve (Hansen and Zeiske, 1998). Olfactory signals and cues serve a crucial role for several life functions in fish such as migration, communication, feeding, schooling, defense, and reproduction (Wilson, 2004; Camacho et al., 2010). In higher vertebrates, the olfactory system can be divided into functionally distinct systems; the main and accessory olfactory systems (Raisman, 1972). In teleosts, principal organ is olfactory system consists of a pair of olfactory rosette, olfactory bulbs, olfactory tracts and olfactory lobes.

The olfactory receptor cells are located in the olfactory epithelium which covers much of the surface of olfactory rosette, a structure found within the olfactory chambers on the fish rostrum. Although the size and shape of the rosette varies greatly across different species, in most instances it has a longitudinal ridge (raphe) with two rows of olfactory lamellae radiating from it, thus increasing its surface area enormously (Zeiske et al., 1992). Olfactory epithelium is a complex tissue comprising sensory and non-sensory

epithelia. Sensory epithelium is located on the raphe and central region of the olfactory lamella in majority of the species. The sensory epithelium is present in patches in some species also (Yamamoto, 1992).

Studies of the olfactory organ and bulb are carried out by some investigators (Hara, 1975; Ichikawa, 1976; Ichikawa and Ueda, 1977; Kosaka and Hama, 1979 a, b; Zeiskie *et al.*, 1979; Kleerekoper, 1982; Schreiber *et al.*, 1986; Hansen and Zeiske, 1998). In this work we are reporting the structure of olfactory system in *G. mullya* by light microscopy. Morphology of the olfactory bulb is rather consistent across vertebrate lineage. In teleosts, olfactory bulb comprises following concentric layers:(1) outer olfactory nerve layer (ONL),(2) glomerular layer (GL),(3) mitral cell layer (MCL) and(4) internal cell layer i.e. granular cell layer (GCL). In teleosts, only primary receptor cells are located in the olfactory mucosa i.e., axons of these cells represent the primary olfactory projections (fila olfactoria, olfactory nerve) and reach the glomerular layer of the olfactory bulbs (Nieuwenhuys and Meek, 1990). Secondary olfactory projections originate in the large mitral cells and run in the lateral and medial olfactory tracts. While the medial olfactory tract (MOT) appears to carry information related to sexual behavior, lateral olfactory tract (LOT) mediates feeding behavior and alerting responses (Hara, 1993).

MATERIALS AND METHODS

G. mullya is a migratory fish shows potamodromous migration. It is a macrosmatic fish with a predominantly developed olfactory organ (Singh, 1978). This fish is an annual breeder and breeds naturally in running water and is available throughout the year, can be transported and maintained under laboratory conditions easily and better suited for experimental purposes; therefore it was selected for the present study.

Histological methods:

The fishes were anesthetized with 0.2% paraldehyde and ovaries were dissected out and some parts were immediately fixed in aqueous Bouin's fixative. Tissues fixed in Bouin's fixative were transferred to 70% alcohol and dehydrated in ascending graded series of alcohol, cleared in xylene and embedded in paraffin wax at 58°C to 60°C. The olfactory organs were cut on microtome at 10µm thickness in transverse as well as sagittal planes and processed for histological studies. Sections were deparaffinized in xylene and were passed through descending grades of alcohol and brought to water and stained with Haematoxyline-Eosin technique to study the structure at light microscopic level.

OBSERVATIONS

1. Morphology, Histology and Neuroanatomy of olfactory organ

In *G. mullya* (Fig. 01), a pair of olfactory chambers is situated dorso-laterally on the snout region, anterior to the eyes. Olfactory chambers are connected with external environment through two separate nasal apertures (Fig. 02).

Olfactory system is composed of olfactory rosette (OR) caudally connected by a short olfactory nerve (ON) to the olfactory bulb (OB). Olfactory bulb is caudally attached to the forebrain (Telencephalon) by a long medial olfactory tract (MOT) and a lateral olfactory tract (LOT) thus olfactory bulb is pedunculated in this fish (Fig.03).

Each olfactory rosette is oval in shape and has a central raphe, from which radiate the lamellae on both the sides in parallel fashion (Fig. 04). The olfactory epithelium is folded to form the lamellae. 18 to 26 lamellae are observed. Each lamella is crescentic in shape and bears a linguiform process along its concave margin (Fig.03).

Each lamella is composed of epithelium which shows sensory and non-sensory regions (Fig.04). Sensory region is at the basal area having columnar pseudo-stratified cells and consists of ciliated olfactory receptor cells (cORC), microvillous olfactory receptor cells (mORC), columnar ciliated non-sensory cells (cNSC), polygonal columnar supporting cells (SC), small sized scanty mucous secreting goblet cells (GC) and oval basal cells (BC) (Fig.05 & 06). Non-sensory region is at apical area with stratified squamous type cells and consists of columnar ciliated non-sensory cells (cNSC), flattened, less cuboid epidermal cells (EC), large sized numerous mucous secreting goblet cells (GC) and basal cells (Fig.07). In the lamellae, epithelium encloses a central lumen called central core (Stromal sheet), which is separated by a basal lamina (BL) from the epithelium and is filled with loose fibers, blood vessels (BV), connective tissue (CT) and bundles of axon arising from the bottom of the receptor cells (Fig.07).

The lamellae receive fascicles or fibers from basal end and extend into olfactory nerve. The olfactory nerve is short and connected caudally to olfactory bulb. The olfactory bulb is concentrically laminated four layered structure. Outer layer is olfactory nerve layer (ONL) which has axons of olfactory receptor cells (cORC). Below ONL, axons group together, forming glomeruli, called as glomerular layer (GL). The glomeruli innervate bigger sized neurons called mitral cells which constitute mitral cell layer (MCL). In the centre, densely packed small sized neurons are present, constituting internal cell layer also called as granular cell layer (GCL) (Fig.08 & 09).

The fibers (axons) from the olfactory bulb forming primary olfactory nerve layer are intensely stained and innervate profusely forming glomerular structure to the large sized mitral cells which show moderate Nissl staining. Smaller cells found in the innermost granular cell layer (GCL) show intense Nissl staining (Fig. 09 & 10). Some cells are placed dorsomedial and ventromedial in position and exhibit intense staining. These are the giant cells of nervus terminalis (NT) (Fig.11).

DISCUSSION

Histologically, in *G. mullya*, a central lumen called stromal sheet is enclosed in the epithelium of lamellae. A thin stromal sheet separated by a basal lamina from the epithelium is filled with loose nerve fibers, blood vessels, connective tissue as in *Etroplus suratensis* (Ghosh and Chakrabarti., 2014).

In *G. mullya*, from the median raphe lamellae radiate on both sides. Sensory and nonsensory regions are located on the sensory epithelium olfactory lamellae. Location of these regions varies in different species (Yamamoto, 1982). Sensory region is at basal area and non sensory region is at apical area, both are irregularly interspaced. However in the cyprinid *L. rohita* sensory region at the middle of lamella and non sensory region is at the proximal and basal region of lamella (Bhute *et al.*, 2007), in *Rhodeses amarus*, sensory region is at the base and middle of lamella and non sensory region is at the proximal end (Baby *et al.*, 2000), in *H. fossilis*, sensory region occupies middle of the lamellae (Masram, 2010) and in *O. striatus* (Khaparde, 2010) sensory region is at the proximal part of lamellae.

As in other teleosts, olfactory bulb comprises four layers from superficial to deep most: olfactory nerve layer (ONL), glomerular layer (GL), mitral cell layer (MCL) and innermost granular cell layer (GCL) in *G. mullya*. Similar as in *L. rohita* (Bhute, 2004),

H. fossilis (Masram, 2010) and *N. notopterus* (Patle and Baile, 2014). Olfactory fibers entered the olfactory bulb and peripherally form the olfactory nerve layer in *L. rohita* (Baile et al, 2008), *H. fossilis* (Masram and Baile, 2014) *N. notopterus* (Patle and Baile, 2014). These axons march inward and synapse with the dendrite of mitral cell in glomerular layer (Kosaka and Hama, 1982; Oka, 1983; Khan *et al.*, 1999; Bhute *et al.*, 2007 and Baile and Patle, 2014). Glomeruli are histologically distinct units that serve as the basic modules in the information processing (Shepherd, 1994) and as a relay station to several higher brain areas. Axons of mitral cells originate in the basal part of the soma, become myelinated after some distance (Kosaka and Hama, 1982) and project in the medial and lateral olfactory tracts (Fujita *et al.*, 1988). They terminate on various telencephalic areas (Satou, 1992). Same pattern of organization is observed in the present study. In the olfactory bulb of *G. mullya*, on ventromedial and dorsomedial side, giant cells of the nervus terminalis have been identified. These ganglion cells are also noted in *I. punctatus* (Bass,1981); *C. butrachus* (Khan *et al.*, 1998, 1999), *C. mrigala* (Biju *et al.*, 2003), *L. rohita* (Bhute *et al.*, 2007 and in *Channa gachua* (Baile and Patle, 2011).

The most highly appreciated organ for chemosensation (smell and taste) is the olfactory organ which is paired in *G. mullya*, connected to the forebrain by medial and lateral olfactory tracts and thus it is pedunculated. Olfactory rosette in this fish is oval in shape and has a central raphe, from which radiate the lamellae on both the sides in parallel fashion. Olfactory bulb comprises concentric four layers i.e outer olfactory nerve layer, glomerular layer, mitral cell layer and innermost granular cell layer. In the olfactory bulb: glomerular layer, mitral cells, granular cells and giant cells of nervus terminalis are observed. The olfactory bulb terminates on the foremost telecephalon by two tracts and is thus pedunculated.

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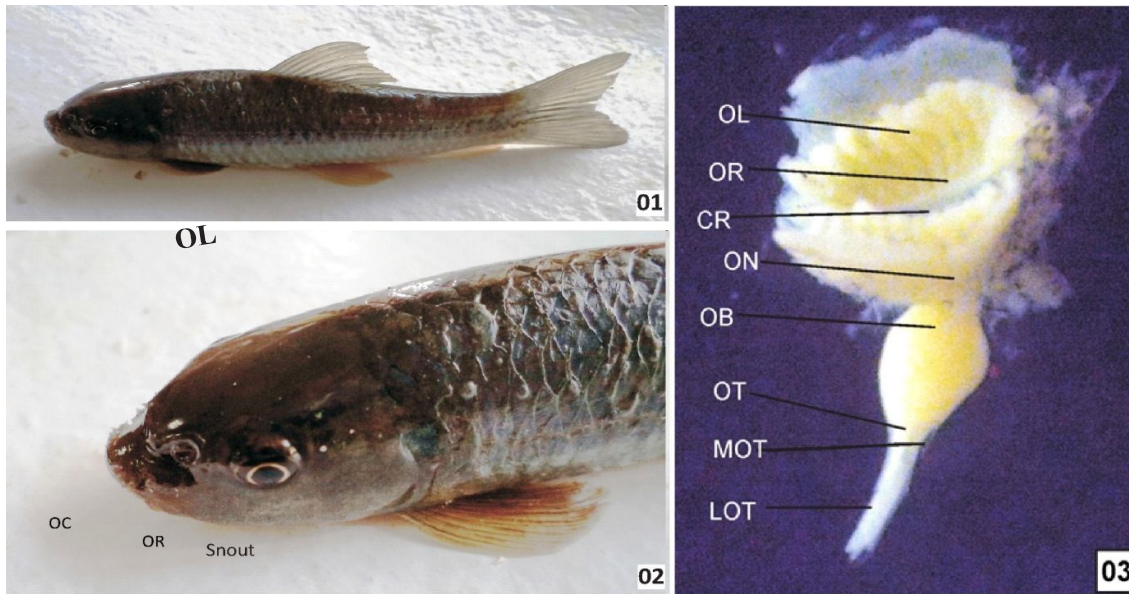
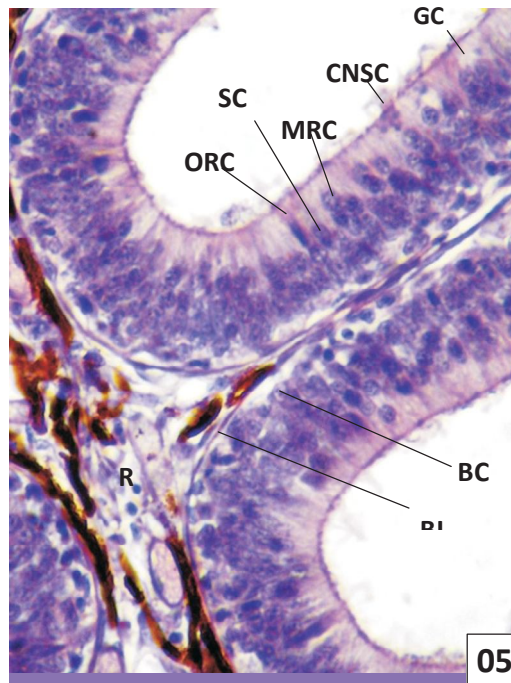
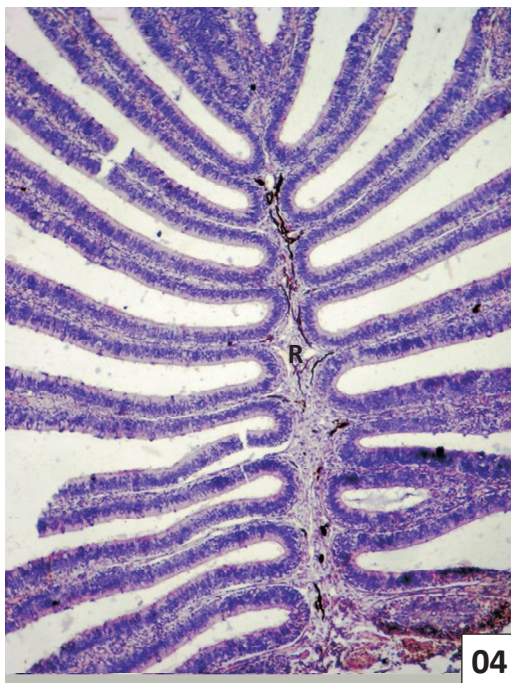


Fig. 1: Lateral view of fish *Garra mullya* (Sykes). **Fig. 2:** Lateral view showing olfactory rosette (OR) in the olfactory chamber (OC). **Fig. 3:** Whole view of olfactory organ showing olfactory rosette (OR) with olfactory lamellae (OL) connected by short olfactory nerve (ON) to the olfactory bulb (OB) and olfactory tract (OT) showing lateral olfactory tract (LOT), medial olfactory tract (MOT).



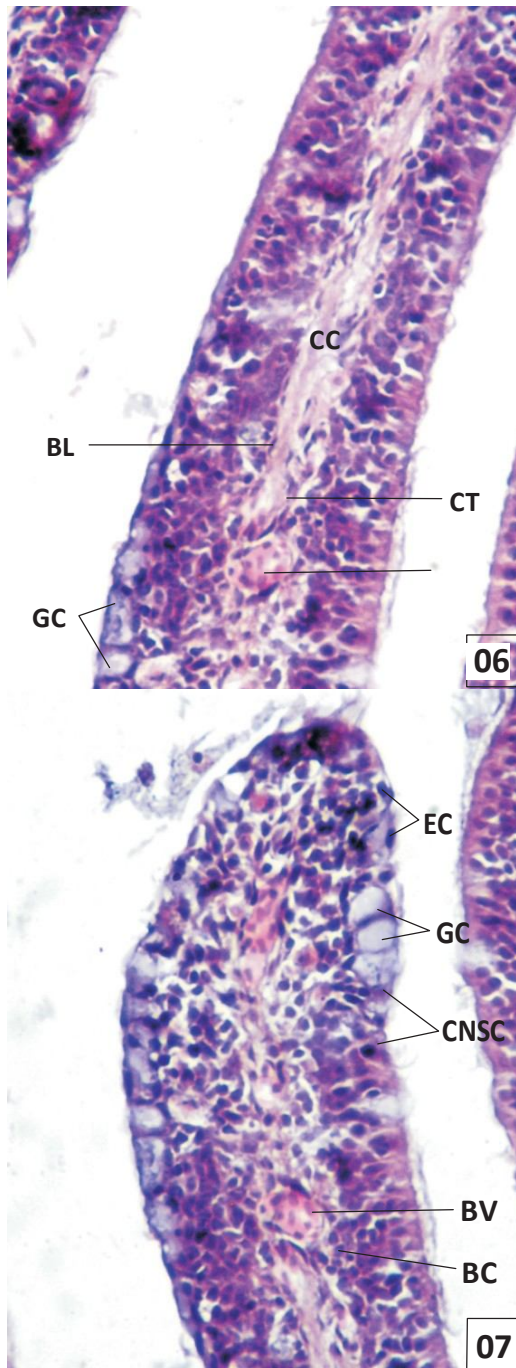


Fig. 04: Transverse section of olfactory rosette showing lamellae receiving a fibre fascicles from the olfactory receptors cells (ORC). **HEx100X.** **Fig. 05 and 06:** Transverse section of sensory olfactory epithelium showing olfactory receptors cell (ORC), microvillus receptor cell (MRC), basal cells (BC), supporting cells (SC), ciliated non sensory cells (CNSC), mucus secreting goblet cells (GC) and central core (CC) is separated by basal lamina (BL) filled with blood vessels (BV). **HEx400X.** **Fig. 07:** Transverse section of non sensory epithelium showing large

sized mucus secreting goblet cells (GC), ciliated non sensory cells (CNSC) and epidermal cells (EC). HEx400X.

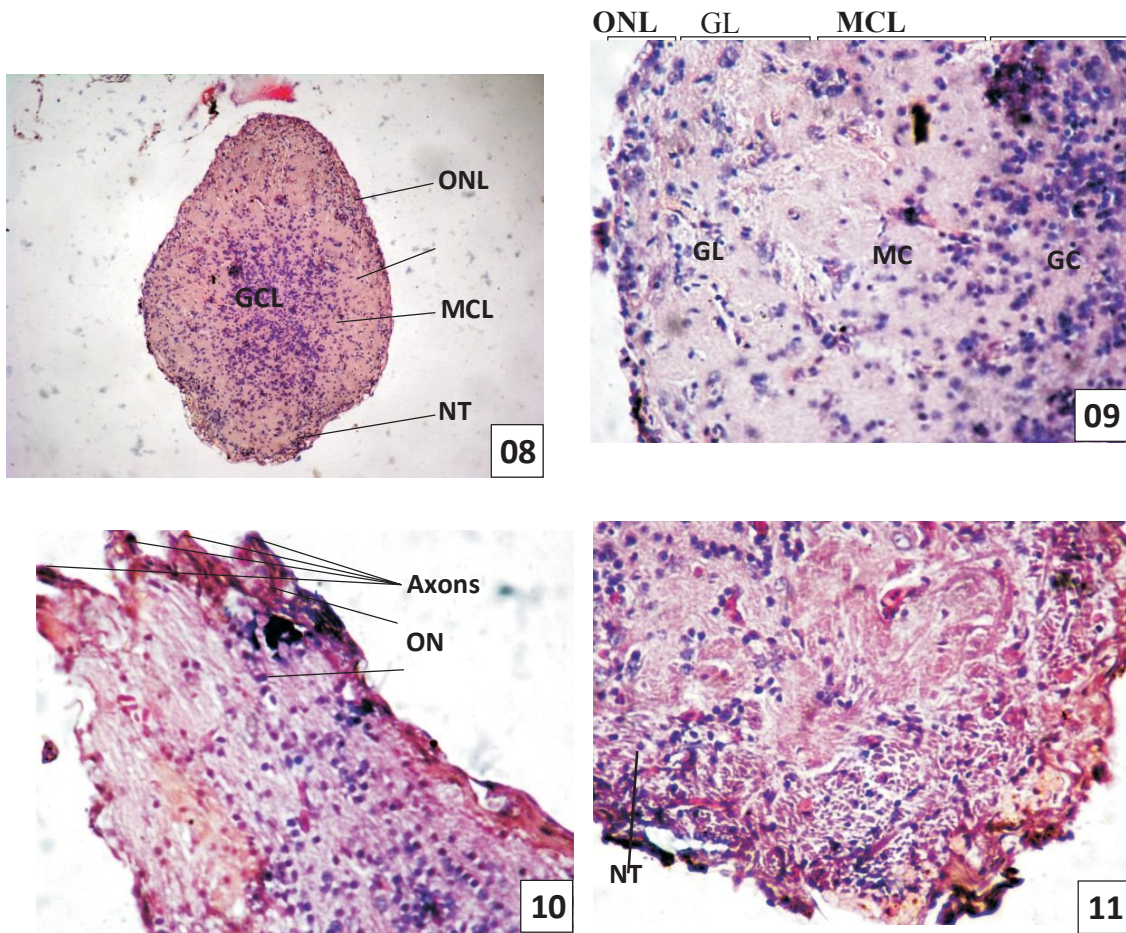


Fig. 08: Saggital section of olfactory bulb showing outer olfactory nerve layer (ONL), glomerular layer (GL), mitral cell layer (MCL) and innermost granular cells layer (GCL).. HEx100X. **Fig. 09:** Saggital section of olfactory bulb showing intensely stained olfactory nerve layer (ONL), moderately stained glomerular cells (GC), moderately Nissl stained large sized mitral cells (MC) and innermost intensely stained small sized granular cell layer (GCL). HEx400X. **Fig. 10:** Saggital section of anterior olfactory bulb showing olfactory fibers (OF) penetrate peripherally in the olfactory bulb. HEx400X. **Fig. 11:** Saggital section of posterior olfactory bulb showing intensely stained nervus terminalis (NT) (arrow). HEx400X.



ORIGINAL ARTICLE

**Histochemical Localization of Proteins in Olfactory System and Ovary
in the Hill Stream Cyprinidae, *Garra mullya* (Sykes)**

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Abstract

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. Olfactory epithelium during resting and preparatory phase show moderate mercury bromophenol blue (MBPB) staining while during prespawning phase it shows intense MBPB staining. During spawning phase and postspawning phase olfactory epithelium show weak MBPB staining. Goblet cells do not show MBPB staining in all phases. Protein cycle in various tissues of *Ophiocephalus punctatus* and showed a correlation between feeding and spawning. 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. In the present study, proteins are histochemically demonstrated in olfactory organ and ovary in *G. mullya* by light microscopy.

Keywords : olfactory, ovary, proteins, hill stream fish; *Garra mullya*

INTRODUCTION

In majority of fish species, reproduction is seasonal and gonadal maturation takes place at a time when conditions for the survival of off-springs are optimum (Hoar, 1969). Reproductive strategies of fish species are diversified into numerous adaptations to a large variety of aquatic environments. This diversity may be concerned with sexuality, spawning and parental behavior, sensitivity to environmental factors and specific features of gametogenesis such as the duration of vitellogenesis and egg morphology (Jalabert, 2005). Basic complimentary tasks of the gonads in teleosts, like those of higher vertebrates are to produce fertilizable gametes (i.e. eggs and sperms) necessary for successful reproduction and the pituitary dependant synthesis and secretion of a variety of steroid hormones which regulate the development of germ cells (Nagahama, 1982). In addition to the neuro-hormonal regulation, many extrinsic factors play a major role in the regulation of reproduction. Rainy season markedly alters the freshwater habitat of tropics bringing with it, changes in the pH and level of water, light intensity, temperature, smell etc, therefore environment and photoperiod are reported to affect gonadal development leading to an increase in gonadosomatic-index (GSI). Reproductive maturity is commonly quantified by gonadosomatic-index (GSI). Determination by size is not accurate because

the size to which the fish grow and at which it mature varies greatly (Lowe-Mc Connell, 1982).

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).

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. In the present study, proteins are histochemically demonstrated in olfactory organ and ovary in *G. mullya* by light microscopy.

MATERIALS AND METHODS

This fish is a annual breeder and breeds naturally in running water and is available throughout the year, can be transported and maintained under laboratory conditions easily and better suited for experimental purposes; therefore it was selected for the present study

Histochemical methods:

The fishes were anesthetized with 0.2% paraldehyde and ovaries were dissected out and some parts were immediately fixed in Carnoy's fixative. Tissues fixed in Bouin's fixative were transferred to 70% alcohol and dehydrated in ascending graded series of alcohol, cleared in xylene and embedded in paraffin wax at 58°C to 60°C. The olfactory organs were cut on microtome at 10µm thickness and ovary was cut at 6-8µm thickness in transverse as well as saggital planes and processed for histological studies. Sections were deparaffinized in xylene and were passed through descending grades of alcohol and brought to water for hydration and stained in Mercury Bromo Phenol Blue, rinsed in 0.5% glacial acetic acid, then differentiated in tertiary butyl alcohol till blue colour appeared. Cleared in xylene and mounted in DPX.

OBSERVATIONS

Presence of proteins in olfactory organ, forebrain, pituitary and ovary is demonstrated by mercury bromophenol blue (MBPB) method (Mazia et al., 1953).

1. Resting phase (late October - mid February).

Histochemically, In the olfactory epithelium, basal lamina, ciliated olfactory receptor cells, microvillous receptor cells, ciliated non sensory cells show moderate staining of Mercury Bromophenol Blue (MBPB). Supporting cells and basal cells show weak staining while mucous secreting goblet cells are unstained (Fig.01).

In the ovary, ovigerous lamellae are moderately stained by MBPB. Oocyte-I shows intensely stained nucleoli in light stained nucleoplasm while ooplasm is intensely stained. Type-II oocyte shows intensely stained nucleoli in lightly stained nucleoplasm. It also shows intensely stained yolk nucleus in moderately stained ooplasm (Fig.06)

2. Preparatory phase (late February - mid April).

Histochemically, in the olfactory epithelium, basal lamina, basal cells, ciliated receptor cells, ciliated non sensory cells and microvillous cells are moderately stained by MBPB (Fig.02). Supporting cells are weakly stained while mucous secreting goblet cells are unstained (Fig.02).

Wall of ovary is moderately stained with MBPB. In type II oocyte, intensity of staining in cytoplasm is reduced, nucleoplasm is light stained but those nucleoli which move to periphery are intensely stained. Type-III oocytes become large in size, shrinking nucleoplasm is light stained. Outline of wavy nucleus with nucleoli are intensely stained. Cytoplasm is moderately stained. Type-IV oocytes become larger in size and exhibit large number of empty yolk vesicles. In this stage, vitelline membrane, cytoplasm is moderately stained while nucleoplasm is weakly stained (Fig.07).

3. Pre-spawning phase (late April - early June) :-

Histochemically, in the olfactory epithelium, basal lamina, basal cells, ciliated olfactory receptor cells (cORC) and microvillous olfactory receptor cells (mORC), ciliated non sensory cells (cNSC) are intensely stained with MBPB (Fig.03). Supporting cells (SC) are lightly stained while mucous secreting goblet cells (GC) remain unstained.

Due to the increasing numbers and size of oocytes, wall of ovary becomes thin. It is lightly stained with MBPB (Fig.08). Ovary is dominated by type V and VI oocytes in addition to few number other oocytes. In type V oocyte, the central chromatin material alongwith nuclear membrane is moderately stained. A definite layer of lightly stained protein material forms a rim (cortical alveoli) in peripheral cytoplasm. Outer zona radiata and zona granulosa is moderately stained. Stained proteinoous material moves inwards in type-VI oocytes and interspersed with unstained material in the cytoplasm. Proteins are intensely stained in the yolk granules. Outer zona radiata and zona granulosa are moderately stained (Fig.08).

4. Spawning phase (June – August end):

Histochemically, in the olfactory epithelium, basal lamina, basal cells, and ciliated non sensory cells are lightly stained with MBPB (Fig.04). Supporting cells (SC) and mORC are weakly and stained, while mucous secreting goblet cells are unstained (Fig.04).

Entire ovary is full of translucent eggs and fish is about to ovulate. Ovarian wall is thin and transparent. Oocytes become big in size and compactly arranged. This phase is dominated by type VI and type VII oocytes. Type VII oocytes are largest in size and their outer zona granulosa and zona radiata are moderately stained with MBPB. Intensely stained protein material occupies in the yolk globules (granules). Cortical alveoli are light stained and empty vesicles are also visible (Fig.09).

5. Postspawning phase (September - mid October).

Histochemically, in the olfactory epithelium, only basal cells are moderately stained with MBPB). Basal lamina, ciliated non sensory cells are weakly stained. Ciliated olfactory receptor cells are intensely stained while mucous secreting goblet cells are remain unstained (Fig.05).

In this phase, ovary is dominated by atretic follicles. They have wavy margin. MBPB positive material is observed in the centre of some oocytes as well as in the peripheral region of oocytes. Wall of ovary shows moderately staining. In the cytoplasm, some yolk droplets exhibit intense staining (Fig.10).

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).

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, *Rhodius 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.*, 2002), 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).

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.

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).

Histochemically, the intensity of Bromophenol blue staining is highest in the spawning phase of ovary. In the pre-spawning phase, olfactory epithelium is intensely stain for proteins and similar moderate intensity was found in the spawning phase of olfactory rosette.

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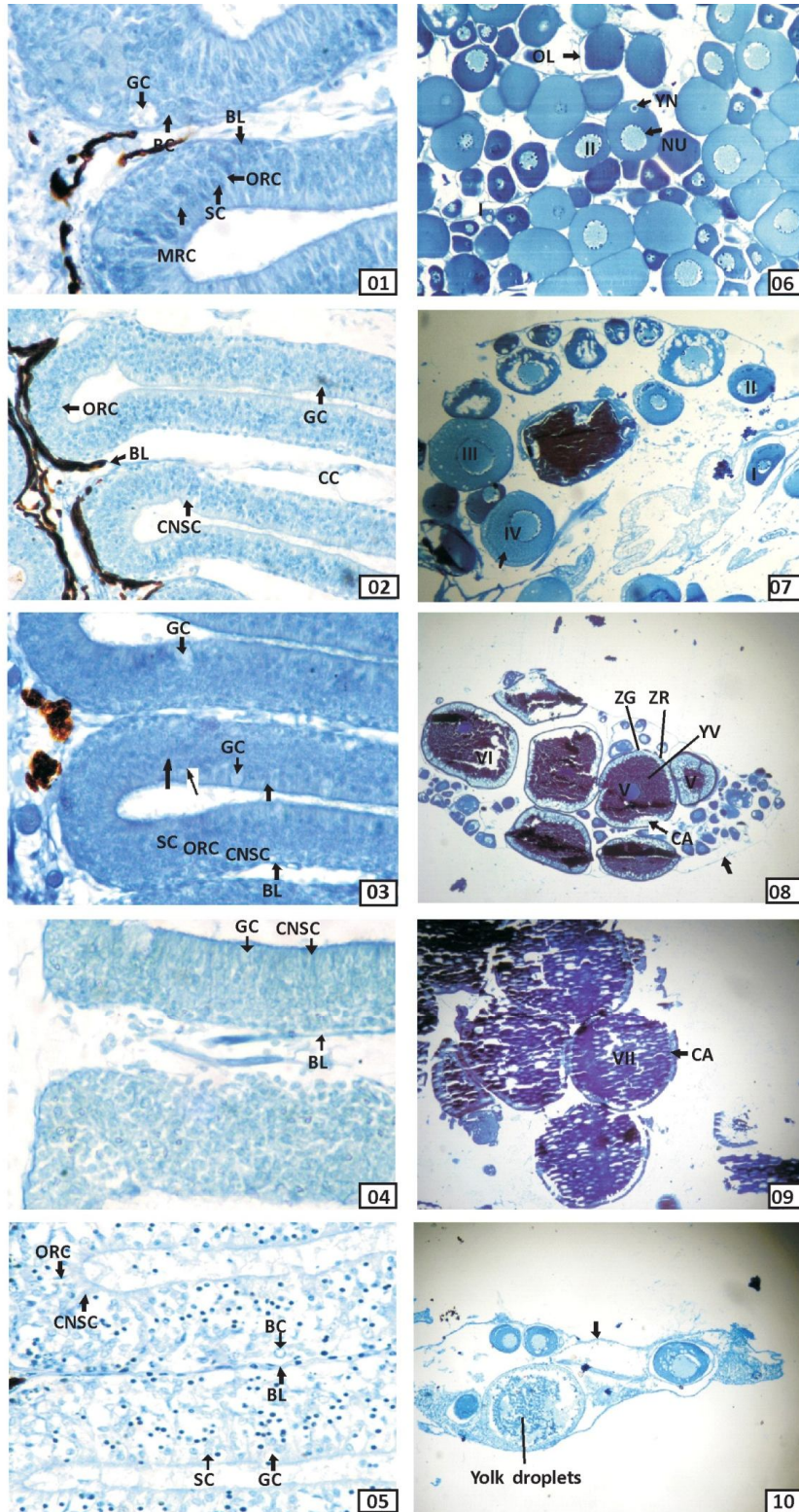


Fig. 01: Transverse section (T.S.) of olfactory epithelium during resting phase showing moderate stained basal lamina (BL), ciliated receptor cell (CRC), microvillous receptor cell (MRC), non ciliated sensory cell (CNSC) and weakly stained basal cell (BC), supporting cell (SC). **MBPBx400X.** **Fig. 02:** T.S. of olfactory epithelium during preparatory phase showing moderate stained basal lamina (BL), basal cell (BC), ciliated receptor cell (CRC), ciliated non sensory cells (CNSC) and weakly stained supporting cell (SC). **MBPBx400X.** **Fig. 03:** T.S. of olfactory epithelium during pre-spawning phase showing intensely stained basal lamina (BL), basal cell (BC), ciliated receptor cell (CRC), ciliated non sensory cells (CNSC) and light stained supporting cell (SC). **MBPBx400X.** **Fig. 04:** T.S. of olfactory epithelium during spawning phase showing light stained basal lamina (BL), basal cell (BC), ciliated non sensory cells (CNSC). **MBPBx400X.** **Fig. 05:** T.S. of olfactory epithelium during post-spawning phase showing weakly stained basal lamina (BL), basal cell (BC), ciliated non sensory cells (CNSC) and intensely stained ciliated receptor cell (CRC). **MBPBx400X.** **Fig. 06:** Transverse section (T.S.) of ovary during resting phase showing intensely stained nucleoli (NU), ooplasm, weakly stained nucleoplasm in oocyte I. In oocyte II, intensely stained nucleoli, yolk nucleus (YN), weakly stained nucleoplasm and moderate stained ooplasm. **Note:** Ovigerous lamellae are moderately stained. **Mercury Bromophenol Blue (MBPB)x100X.** **Fig. 07:** T.S. of ovary during preparatory phase showing intensely stained nucleoli (NU) with outline of nucleus in light stained nucleoplasm and moderate stained cytoplasm in oocyte III. Unstained yolk vesicles (YN) in moderate stained cytoplasm and light stained nucleoplasm. **Note:** Wall of oocyte III, IV are moderately stained. **MBPBx100X.** **Fig. 08:** T.S. of ovary during pre-spawning phase showing moderate stained nucleus with chromatin material, light stained cortical alveoli (CA), intense stained yolk granules (YG), moderate stained zona granulosa (ZG) and zona radiata (ZR). **Note:** Wall of ovary show weak stain. **MBPBx100X.** **Fig. 09:** T.S. of ovary during spawning phase showing intensely stained yolk granules (YG), interspersed with yolk vesicle (YV), light stained cortical alveoli (CA) and moderately stained zona granulosa (ZG) and zona radiata (ZR). **Note:** Wall of ovary show weak stain. **MBPBx100X.** **Fig. 10:** T.S. of ovary during post-spawning phase showing intensely stained yolk droplets and weakly stained peripheral cells in the atresia. **Note:** Wall of ovary show moderate stain (arrow). **MBPBx100X.**



ORIGINAL ARTICLE

**Annual Ovarian Histo-morphological Changes in the Hill Stream
Cyprinidae, *Garra mullya* (Sykes)**

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Abstract

The majority of fish species reproduce seasonally, and gonadal maturation occurs when conditions are ideal for offspring survival. Fish species have a wide range of reproductive methods that are multiple adaptations to a wide range of aquatic conditions. This variation may relate to aspects of gametogenesis such the length of vitellogenesis and egg morphology, as well as sexuality, spawning, and parental behaviour, as well as susceptibility to environmental variables. The tropical freshwater habitat is significantly altered by the rainy season due to changes in the pH and level of the water, light intensity, temperature, smell, etc. Accordingly, environment and photoperiod are reported to have an impact on gonadal development, which increases the gonadosomatic-index (GSI), a measure of reproductive maturity. The fish can grow and mature to a variety of sizes, therefore measuring by size is not an appropriate method. In the current investigation in *G. mullya*, the percentage of various oogenic stages, nuclear and cytoplasmic properties of stained ovarian sections, and their diameters were computed and measured and then reported. The spawning phase is when the GSI is maximum. According to histology information, the ovarian types are discovered to be yolkless, vitellogenic, ripen, and subsequently diminished ovaries, and as a result, GSI substantially decreases.

Keywords : Ovary, GSI, reproductive phase, hill stream fish; *Garra mullya*

INTRODUCTION.

In majority of fish species, reproduction is seasonal and gonadal maturation takes place at a time when conditions for the survival of off-springs are optimum (Hoar, 1969). Reproductive strategies of fish species are diversified into numerous adaptations to a large variety of aquatic environments. This diversity may be concerned with sexuality, spawning and parental behavior, sensitivity to environmental factors and specific features of gametogenesis such as the duration of vitellogenesis and egg morphology (Jalabert, 2005). Basic complimentary tasks of the gonads in teleosts, like those of higher vertebrates are to produce fertilizable gametes (i.e. eggs and sperms) necessary for successful reproduction and the pituitary dependant synthesis and secretion of a variety of steroid hormones which regulate the development of germ cells (Nagahama, 1982). In addition to the neuro-hormonal regulation, many extrinsic factors play a major role in the regulation of reproduction. Rainy season markedly alters the freshwater habitat of tropics bringing with it, changes in the pH and level of water, light intensity, temperature, smell etc, therefore environment and photoperiod are reported to affect gonadal development leading to an increase in gonadosomatic-index (GSI). Reproductive maturity is commonly

quantified by gonadosomatic-index. Determination by size is not accurate because the size to which the fish grow and at which it mature varies greatly (Lowe-Mc Connell, 1982).

Female Reproductive Organs

Fishes are mostly unisexual (sexes are separate) and have one pair of bilateral gonads. Gonads are generally symmetrical, suspended from dorsal body wall by mesentery, located in close association with the kidneys. The mesentary in females is called as mesovarium. Female reproductive organs are the ovaries. Each ovary contains numerous oocytes in different stages of development and degeneration (Saidapur, 1978). The differentiated development is detected in both the sexes as anatomical and cytological differentiation proceed in parallel. In this work, the gonadal cycle in female of *G. mullya* is reported by calculating GSI and by studying histo-morphological details of the ovaries.

MATERIALS AND METHODS

This fish is a annual breeder and breeds naturally in running water and is available throughout the year, can be transported and maintained under laboratory conditions easily and better suited for experimental purposes; therefore it was selected for the present study.

Collection and Maintenance of fish:

Fishes were collected from natural water bodies in and around Nagpur city. They were brought to the laboratory in plastic containers and acclimatized in well aerated glass aquaria (Size 3×2×1.5) for a week. Adult females were selected with body weight ranging between 7 to 20 gms and length 7.5 to 14.8 cms. There is no sexual dimorphism noticed in this fish. After dissecting, the sex was noted for the studies.

Gonadosomatic index (GSI):

To ascertain gonadal status, fishes were collected regularly from January to December fortnightly for three years. After acclimatization fishes were anesthetized with an aqueous solution of 2% Paraldehyde, weighed and length was measured. Ovaries were removed, weighed and gonadosomatic index (GSI) was calculated by following formula to ascertain the gonadal activity throughout the year.

$$\text{GSI} = \frac{\text{Weight of gonads} \times 100}{\text{Weight of fish}}$$

On the basis of histomorphological changes of ovary, nuclear and cytoplasmic characteristics of stained ovarian sections, percentage of different oogenic stages was calculated, their diameters were also measured. Depending upon the dominance of particular stages and GSI, the reproductive cycle of fish *G. mullya* is reported.

Histological methods:

The fishes were anesthetized with 0.2% paraldehyde and ovaries were dissected out and some parts were immediately fixed in aqueous Bouin's fixative. Tissues fixed in Bouin's fixative were transferred to 70% alcohol and dehydrated in ascending graded series of alcohol, cleared in xylene and embedded in paraffin wax at 58°C to 60°C. Ovaries were cut at 6 to 8 µm thickness in transverse as well as saggital planes and processed for histological studies. Sections of ovaries were deparaffinized in xylene and were passed through descending grades of alcohol and brought to water and stained with Haematoxylene-Eosin technique to study the structure at light microscopic level.

OBSERVATIONS

Ovarian histo-morphology:

Hill stream fish *G. mullya* (Fig. 01) is a annual breeder. In *G. mullya*, the ovaries are paired, elongated closely flanking the air-bladder with their inner margins lying in the

abdominal cavity, ventral to the kidneys. These are attached to the body wall by means of mesovarium. Anterior ends of two ovaries are free but posteriorly it become united into one. The hinder end of each ovary is continued posteriorly into a short oviduct. Two oviducts fuse together and open outside by a common aperture.

To report the reproductive cycle of *G. mullya*, gonadosomatic index (GSI) is calculated (Table.1 & Graph.1) and histological details of the ovary are studied throughout the year. In all, eight stages of oocytes are recorded throughout the cycle. Depending on their histological details, they are categorized in type I to type VIII oocytes. The cycle is reported in resting phase (late October - mid February), preparatory phase (late February - mid April), pre-spawning phase (late April - early June), spawning phase (June - August) and post spawning phase (September - mid October). On the basis of cell diameter and nuclear structure, staining intensity of the cytoplasm and yolk formation, following developmental stages of oocytes are identified. These are as follows (Table.2). Chromatin nucleolus stage.; Peri-nucleolar stage.; Oocyte III stage; Yolk vesicles Stage; Cortical alveolar stage; Vitellogenic stage; Ripe egg stage and Atretic oocyte stage

1. Chromatin nucleolus stage:- Type I oocyte (Fig.02)

Type I oocytes are smaller in size about 3 to 16µm in diameter. They show large nuclei with 2 to 5 nucleoli and darkly stained cytoplasm. They are triangular to pentagonal in shape.

2. Peri-nucleolar stage:- Type II oocytes (Fig.03)

Type II oocytes slightly increase in size as compared to type I oocytes having 21.5 to 39 µm diameter and are characterized by slightly faint cytoplasm. Nucleoli are arranged at the periphery of nuclear membrane. Many oocytes at this stage, possess a yolk nucleus in the cytoplasm.

3. Oocyte III stage:- Type III oocyte (Fig.04)

They are still larger in size 35 to 140 µm diameter. They are marked by the formation of a thin layer of follicular cells around the cytoplasm. Few nucleoli extrude out of the nuclear membrane into cytoplasm and some nucleoli arrange themselves near nuclear membrane. Type III oocytes show lightly stained cytoplasm. Yolk nuclei (yolk vesicles) are seen frequently at this stage.

4. Yolk Vesicles Stage:- Type IV oocyte (Fig.05)

Type IV Oocytes increase in size having 42 to 156 µm diameter. They have large number of empty vacuoles (yolk vesicles) which fill the entire cytoplasm. Few nucleoli can be seen out of the undulating nuclear membrane. In this stage, a vitelline membrane is recognizable between the ooplasm and the follicular layer. Zona radiata and Zona granulosa are also visible.

5. Cortical alveolar stage:- Type V oocytes (Fig.06)

Oocytes Type V Oocytes increase in size having 135 to 197 µm diameter. Yolk vesicles (YV) increase in number filling entire ooplasm (intra-vesicular yolk). Yolk granules are accumulated in central part of cytoplasm. Cytoplasm is faintly stained. Zona granulosa (ZG) and zona radiata (ZR) become visible clearly. Accumulation of lipid droplets (Oil droplets) in cytoplasm begin and scanty yolk granules are seen centripetally in the form of yolk globules.

6. Vitellogenic stage: Type VI oocyte (Fig.07)

This stage is characterized by the appearance of yolk granules or yolk globules. Oil droplets are visible. Yolk vesicles increase in size and gravitate towards periphery. A thin layer of fibroblast (theca) appears outside the follicular layer. Zona granulosa (ZG) and

zona radiata (ZR) are also distinct. Oocyte VI is larger in size having 150 to 221 μm diameter.

7. Ripe egg stage: Type VII oocyte (Fig.08)

It is the largest in size having 150 to 262.5 μm diameter. Yolk granules are fused in a homogeneous mass, creating “Hyaline Oocyte” or hydrated oocyte. Nucleus is not visible due to disintegration of nuclear membrane and dispersion of its contents in the cytoplasm. This stage shows external layer of theca (Th), followed by zona radiata (ZR). Oocytes are full of large amount of yolk globules and scattered yolk vesicles (YV) alongwith cortical alveoli (CA) at the periphery of egg.

8. Atretic Oocytes: Type VIII oocyte (Fig.09)

These are characterized by intense cellular disorganization. Such oocytes, although occur in maturation stage, are common in ripe stage also. They are irregular reflecting different stages of disintegration, these are 150 to 240 μm in diameter.

Annual reproductive phases

Wall of the ovary is fairly thick during non-breeding season but becomes thin and highly vascular during spawning period. Ovary has three distinct layers, an outermost thin peritoneum, a thicker tunica albuginia made up of a connective tissue, muscle fibres and blood capillaries and the innermost layer is germinal epithelium which projects in the cavity (ovocoel) of ovary to form ovigerous lamellae in which the development of oocytes is visible in various stages. This is therefore a cystovarian condition. On the basis of histomorphological changes, the ovarian cycle of *Garra mullya* has been divided into following phases (Table.3).

1. Resting phase (late October-mid February):

It extends from October to February. In this phase, ovaries are paired, flattened, ribbon like, elongated, pale in colour and granular in appearance (Fig.10). Gonadosomatic index (GSI) is 0.83 ± 0.135 (Table.1&Graph.1). Histologically, ovary shows ovigerous lamellae, packed with oocytes which are budded off from the germinal epithelium and are arranged in nests (Fig.11). Ovaries appear immature and show the oocytes having cytoplasm and large rounded nucleus which is designated as type I oocytes. Type I oocytes are smaller in size containing single centrally located nucleus with identical sized nucleoli. Some type II oocytes are at the peri-nucleolus stage. The ovary is dominated by type I and type II oocytes which constitute (64%) and (36%) of the total oocytes respectively (Table.3).

2. Preparatory phase (late February – mid April):-

In this phase, ovaries increase in size, opaque and light yellowish in colour and bulky (Fig.12). Type I oocytes decrease in number (21%). GSI is 1.27 ± 0.089 . Ovigerous lamellae are greatly swollen and laden with developing oocytes of different stages. Histologically (Fig.13), ovary is dominated by type II (41%), III (32%) and type IV (6%) oocytes. Type II oocytes are larger in size and round in shape, with centrally located nucleus. Nucleoli move to the periphery of the nucleus. Cytoplasm is comparatively less stained. In type III oocytes, the outline of nucleus becomes wavy. In the indentation of these, nucleoli move. Some yolk nuclei and line of vesicles are seen periphery to the cytoplasm. A thin layer of follicular cells appear around the cytoplasm. In type IV oocytes, large number of small, clear, empty vacuoles appear called yolk vesicles. In the ooplasm, on the peripheral side, basophilic cytoplasm is less stained.

3. Pre-spawning phase (late April – early June) :

In this phase, Ovaries become deep yellow in colour with increase in size and occupy $2/3^{\text{rd}}$ to $3/4^{\text{th}}$ of the body cavity (Fig.14). There is increase the weight of ovary. GSI is

5.011±0.640. Vascularization increases and the blood capillaries become conspicuous. Development of oocytes is visible in various stages. Type I (2%), II (4%), III oocytes (3%) and IV oocytes (5%) are greatly reduced . Ovary is dominated by type V oocytes (48%), and type VI (36%) oocytes. Some type VII oocytes (2%) also appear (Fig.15). Type V-oocyte is lipid vitellogenesis stage. Here lipid droplets grow larger and cortical vesicles (cortical alveoli) get organized at the periphery of oocyte. This stage is granular in nature. The central nucleus is convoluted, nucleoli are larger in size but less in number. In the ooplasm, on peripheral side, basophilic inclusions appear. Later strongly acidic small yolk globules increase in size with increase in numbers. These are basophilic with lipid droplets. Yolk globules are strongly basophilic initially but in the pre-spawning phase, they have both acidophilic and basophilic components. Type VI oocyte shows accumulation of oil droplets (yolk vesicles) and yolk granules (globules). Nucleus migrates to the periphery of oocytes and nuclear brake down occurs. In the cytoplasm , some yolk granules occupy the entire area, some acquire polygonal shape. Globules show different staining affinities, some contain acidophilic material, some have densely granulated matrix and some are formed of homogenous material. A thin layer of fibroblast appears as distinct layer called theca. A follicular layer, zona radiata is highly basophilic in nature and all other oogenesis stages are also visible . As the oocytes grow further, yolk vesicles increase in number and size and fill up the entire ooplasm. A vitelline membrane: zona radiata is clearly visible between the outer granulosa layer and ooplasm.

4. Spawning phase (June to August):

In this phase, ovaries are yellowish and turgid due to the presence of a large number of translucent eggs. Ovarian wall is transparent. Volume and size of eggs increase and weight of ovary is found to increase (Fig.16). GSI is highest than previous phases 12.097±1.115. Tunica albugenia becomes extremely thin and inter follicular space is greatly reduced. The ovigerous lamellae are inconspicuous. Type I alveoli). Nucleus is invisible. (Fig.17).

5 Post-spawning phase (September – mid October):

In this phase, ovaries become thin, flacid, delicate, and dull (red or orange) in colour. There is decrease in the volume and weight of the ovary. The vascular supply is highly reduced (Fig.18). oocytes (01%), type II (02%), III (01%), type IV (03%) and type V (04%) are reduced. This phase is dominated by VI (19%) and type VII (70 %) oocytes. In type VI oocyte large number of yolk vesicles are prominently seen. Nucleus migrates gradually towards the periphery. Some yolk vesicles are pushed towards the periphery of the oocyte and form cortical alveoli. Type VII oocyte is the largest in size called as ripe egg stage. It shows large amount of yolk globules and scattered yolk vesicles (cortical A sharp decline in the GSI is observed in this phase (0.79±0.099). Histologically (Fig.19), ovary shows atretic and discharged follicles along with nest of oogonia among the ovigerous lamellae. Type I and type II oocytes are seen. It also shows many deteriorating oocytes which are reabsorbed. Type VIII oocytes are atretic and characterized by intense cellular dis-organization. Hypertropic atresia is seen. Due to breakdown of zona radiata, they are irregular in diameter reflecting different stages of disintegration with wavy margin. Oocytes are surrounded by follicular cells.

Table 1: Gonadosomatic index (GSI) in female *G. mullya*. n=05 (NS P≥0.05, * P=0.01 to 0.05, ** P=0.001 to 0.01, *** p<0.0001)

| Phase | GSI (Mean±SEM) |
|---------------|--------------------------|
| Resting | 0.83±0.135 |
| Preparatory | 1.27±0.089* |
| Pre-spawning | 5.011±0.64*** |
| Spawning | 12.097±1.115*** |
| Post-Spawning | 0.79±0.099 ^{NS} |

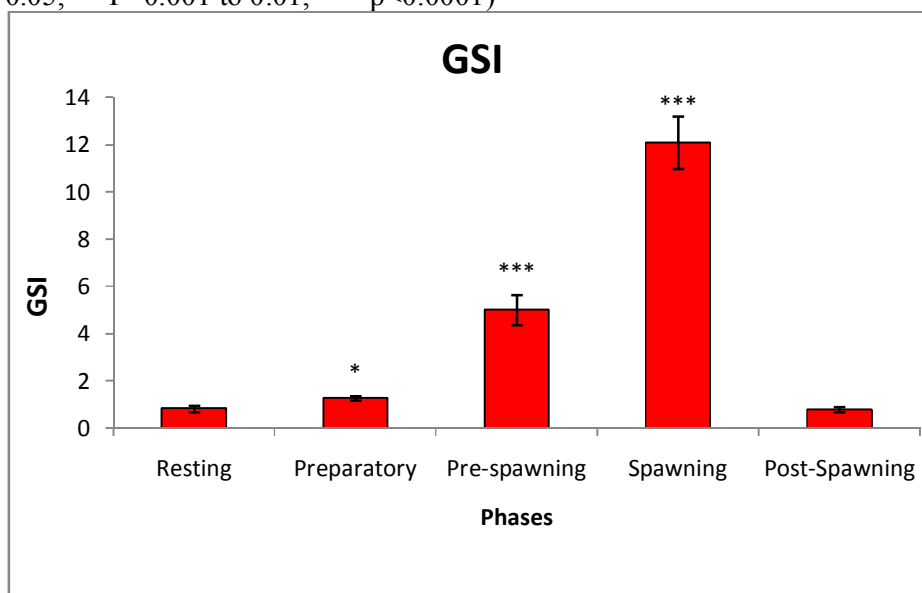
Table 2: Size of oocyte in different stages.

| Types of oocyte | Range of oocyte (in µm) |
|---------------------------|-------------------------|
| Chromatin nucleolus stage | 3-16 |
| Perinucleolar stage | 21.5-39 |
| Oocyte III stage | 35-140 |
| Yolk vesicle stage | 42-156 |
| Cortical alveolar stage | 135-197 |
| Vitellogenic stage | 150-221 |
| Ripe egg stage | 150-262.5 |
| Atretic oocyte stage | 150-240 |

Table 3: Percentage of oocyte in different reproductive phases.

| Type of oocyte Phase | I | II | III | IV | V | VI | VII | VIII |
|----------------------|----|----|-----|----|----|----|-----|------|
| Resting | 64 | 36 | - | - | - | - | - | - |
| Preparatory | 21 | 41 | 32 | 06 | - | - | - | - |
| Pre-spawning | 02 | 04 | 03 | 05 | 48 | 36 | 02 | - |
| Spawning | 01 | 02 | 01 | 03 | 04 | 19 | 70 | - |
| Post-Spawning | 02 | 01 | 01 | 02 | 01 | 01 | 03 | 89 |

Graph 1: Graphical presentation of GSI in different phases. (NS P≥0.05, * P=0.01 to 0.05, ** P=0.001 to 0.01, *** p<0.0001)



DISCUSSION

Garrya mullya (Sykes) is a fresh water hill stream fish, benthopelagic, inhabiting mountain streams. It is a common food fish of this region specially in the rural areas. It is an annual breeder and breeds naturally in running water. Reproductive cycle of this fish is divided into five phases: resting (late October-mid February), preparatory (late February-mid April), pre-spawning (late April-early June), spawning (June – August) and post-spawning (September-mid October). Similar condition is noted in some other annual breeder teleosts mainly in This is determined after evaluating the gonadosomatic index (GSI), dominance of particular type of oocytes and histological details of the ovaries. Similar condition is noted in some other annual breeder teleost mainly in Salmonids and Cyprinid fishes (Peter, 1981; Dodd and Sumpter, 1983); *H. fossilis* (Hunge and Baile, 2003); *N. notopterus* (Ingole, 2009); *Ophiocephalus striatus* (Khaparde, 2010); and *L. rohita* (Gadekar and Baile, 2013). Pathan (2004) reported that, *Oreochromis mossambicus* is a continuous and prolific breeder.

Gonadosomatic index is a ratio between body weight and the weight of gonads showing status of the ovary and testes in terms of maturity and denotes the phase of reproductive cycle. GSI increases with the maturation of fish. It is lowest during post-spawning phase and highest at the peak of spawning phase (Pande and Shukla, 2012). GSI in *G. mullya* is found to be high in spawning phase and low in post-spawning phase. Increase in size and weight of ovaries is mainly due to the accumulation of large quantity of yolk in ripe ova. Similar observations have been reported by some investigators in various fishes (Brackevlt and McMillan, 1967; Lehari, 1968; Wourms and Evans, 1972; Hoque and Hossain, 1993; Roy and Hossain, 2006; Alam and Pathak, 2010). Highest values of gonadosomatic index are due to accumulation of active somatic energy and lowest GSI value is due to depletion of somatic energy. In *G. mullya*, ovary is of cystovarian type because the lumen of ovary is continues with oviduct as in *Clarias batrachus* (Lehri, 1968); *O. striatus* (Khaparde, 2010); *Xenotodon cancila* (Subba and Mehata, 2012); and *L. rohita* (Gadekar and Baile, 2013). Ovary has three distinct layers, an outer most thin peritonium, a thicker albuginia made up of a connective tissue, muscle fibers and blood capillaries. Innermost layer is germinal epithelium which projects into the ovocoel of ovary to form ovigerous lamellae. Each lamella holds ova at different stages of development. All oocytes in the ovary do not mature at one time in *G. mullya* as in Salmonidae (Saidapur, 1989) and *O. striatus* (Khaparde, 2010).

During resting phase, ovary of *G. mullya* is predominated by immature oocytes (type I and type II) which are yolkless. Type I oocytes are characterized by darkly stained ooplasm with nucleoli in the nucleoplasm of nucleus and are smallest in diameter. Yolk nuclei are noted frequently in the ooplasm of type II oocytes. Sokolowska and Kulczykowska (2006) confirmed such oogonia being reservoirs for the next breeding season as these are present throughout the cycle in three spined sticklebacks *Gasterosteus aculeatus*. These findings are supported by Khanna (2009) and Kagawa (2013). Type II Oocytes are larger than type I and cytoplasm is faintly stained. Multiple nucleoli are located around the periphery of the nucleus in association with increase in the nucleus and cell sizes. Similar observation is recorded by Kagawa (2013). Yolk nucleus is also seen in the cytoplasm. It gradually disappears in the maturing oocyte. It may be involved in the process of vitellogenesis. A similar view has been expressed by Khanna and Sanwal (1971) in *Channa gachua*, Bisht and Joshi (1975) in *Schizothorax richardsoni* Subba and Mehata (2012) in *Xenotodon cancila*. During preparatory phase

in *G. mullya*, there is gradual increase in GSI. Ovary is predominated by type II, type III, and type IV oocytes. New sets of oogonia grow to become oocytes at different stages. Nucleoli of various sizes are seen in oocytes type II. As oocytes reach maturity, the nucleoli are seen increasing in number but their size goes on diminishing. This result is agreement with the findings of Khanna (2009). In type III oocytes, the outline of nucleus become wavy. In the indentation of these nucleoli move. Some yolk nuclei and line of vesicles are seen periphery to the cytoplasm. A thin layer of follicular cells appears around the cytoplasm as noted by Khanna (2009), Pande and Shukla (2012). As oocytes grow their size is increases, this growth is generally called first or primary growth. During the primary growth, organelles and molecules used at later stages are synthesized; intriguing temporal expression of important genes in oogenesis and embryogenesis, (Le Menn *et al.*, 2007). In the type IV oocytes, number of empty vesicles are observed. Zona radiata and zona granulosa are also recognized. It is confirmed by Khanna (2009), Pande and Shukla (2012). This phase of growth however does not seem to bring any marked fluence on the ovarian weight in *G. mullya*. Nucleolar extrusion is seen the ooplasm. The extrusion of nucleoli into the ooplasm has attracted attention of many workers (Khanna, 2009; Subba and Mehata, 2012). The functional significance of nucleolar extrusion is reported to be the formation of proteins (Khanna, 1996). According to Guraya (1986), described nucleolar extrusion give rise to ribosomes which accumulate in the ooplasm of oocytes. The growth of pre-vitellogenic oocytes is characterized by multiple nucleoli become located around the periphery of the nucleus in association with increase in cell and nucleus sizes (Kagawa, 2013). In *G. mullya* zona granulosa layer is distinctly visible in type IV oocytes. It may be involved in the elaboration of hormones. During pre-spawning phase, *G. mullya* shows rapid increase in the GSI. Ovaries increase in size and occupy almost 2/3 to 3/4th of the body cavity. Various cytological changes are observed in the oocytes indicating rapid growth and maturation. Growth of oocytes is mainly due to the formation of yolk vesicles and deposition of yolk. Such changes have been reported in the ovaries of several teleosts species (Jadhao and Bapat, 1983; Burtain and Idler, 1984; Khaparde and Baile, 2010; Gadekar and Baile, 2013). In *G. mullya*, oocytes proliferate and are visible in various stages of development except the matured ones. It is the secondary growth phase characterized by prominent oocyte growth associated with the synthesis and incorporation of yolk material. It is also reported in rainbow trout, *Oncorhynchus mykiss* (Kagawa, 2013). As the oocytes grow, yolk vesicles increase in number and size and are eventually displaced to the periphery in cytoplasm called as cortical alveoli. These are seen in type V oocytes, similar as in *O. mykiss* (Kagawa, 2013). Guraya (1978a, 1986) in his extensive work has described the vitellogenic oocytes characterized by the formation of cortical alveoli and yolk which consist mainly of proteins, yolk bodies and fatty yolk globules. Yolk nuclei initially arise in the vicinity of nuclear membrane in young oocytes but later on migrate in distorted form towards the periphery of cytoplasm and acquired the vitelline and follicular layer. According to some investigators vitelline membrane originates from follicular cells or from oocytes itself (Chilke, 2006). Zona radiata and zona granulosa which are the layers of vitelline membrane are clearly visible in type V oocyte and type VI oocyte of *G. mullya*. During spawning phase, GSI is highest. Vascularization of the ovary reaches its peak and the ovary is said to be in running phase. Ova ooze out in the oviduct with slight slight pressure on the ovary (Khanna, 2009). Ovaries are filled with yolk laden oocytes (type VII) which become so large that inter-follicular space is obliterated and septa are stretched to their fullest capacity. Few immature oocytes are also visible along the

peripheral region of the ovary and fully mature hydrated oocytes are observed where spawning is imminent. These findings occur during the process of oocyte maturation and ovulation studied on maturational competence (Patino *et al.*, 2001), oocyte maturation (Nagahama and Yamashita, 2008; Lubzens *et al.*, 2010) and ovulation (Goetz and Grczynski, 1997). Towards the end of this phase, ovary decreases in weight not only due to ovulation or discharge of eggs but also due to degeneration of oocytes which is referred to as atresia. Similar condition is also reported in many other teleosts species such as *Mystus bleekeri* (Kasture, 2008) and *O. striatus* (Khaparde, 2010). The process of atresia of oocytes involves stages such as the zona pellucida, hypertrophy of cytoplasm and its contents and breakdown of muscular theca. In *G. mullya*, atresia is characterized by hypertrophy of granulosa cells or both granulosa and theca cells as demonstrated by Chan *et al.*, (1967) in *A. anguilla*. Follicular atresia (type VIII oocytes) in the fish ovary is of common occurrence in pre-spawning, spawning, and post-spawning phases (Guraya *et al.*, 1978). In *G. mullya*, hypertropic atresia is observed during post spawning period. In hypertropic area occupied by the oocyte is filled with a loose mass of follicular cells which possess yellow or orange granules. It is reported by (Khanna, 2009). During post-spawning phase, GSI sharply decline and initiation of new group of follicles is apparent. Some immature type-I follicles are observed close to the oocytes wall. According to Guraya (1993), these eggs must have actually developed atresia during the pre-spawn period but failed and continued to persist in the post-spawning ovaries. Histological characteristic are shrinkage and distortion of entire folding of zona pellucida, liquifaction of yolk, cytoplasm, hypertrophy and phagocytic property of follicle thecal cells. Almost same features are observed in the atretic follicles of *G. mullya* in post-spawning phase. Same findings are noticed in the *H. fossilis* (Hunge, 2004). There is an increase in the temperature and photoperiod from the month of May in this region which contributes for successful maturation of gonads. The GSI of *G. mullya* is found to be highest in August and least in mid October. In this fish, spawning occurs from mid June to end August. Seasonal changes in the ovaries are studied by number of authors of many teleosts including *H. fossilis*, *Glyptothorax pectinopterus*, *Channa punctatus*, *C. gachua*, *Cirrhinus reba*, *Schizothorax richardsoni* etc (Khanna, 2009).

CONCLUSION

Hill stream fish *G. mullya* is a annual breeder and selected for the present study. Its reproductive cycle is reported by calculating the GSI and noting the histomorphological details in different phases of ovaries. GSI is highest during spawning phase. The cycle is divided into five phases: resting phase (late October-mid February), preparatory phase (late February - mid April), pre-spawning phase (late April - early June), spawning phase (June - August end) and post spawning phase (September - mid October). Depending on histological details, eight different types of oocytes (Type I to Type VIII) are identified over the entire period of reproductive cycle. In the ovary, type I to type IV oocytes are found to be yolkless Vitellogenesis commences in type V oocytes. When ripe eggs are discharged out of the body, the ovaries get reduced in size. GSI falls drastically. Atretic follicles are visible in subsequent post spawning phase.

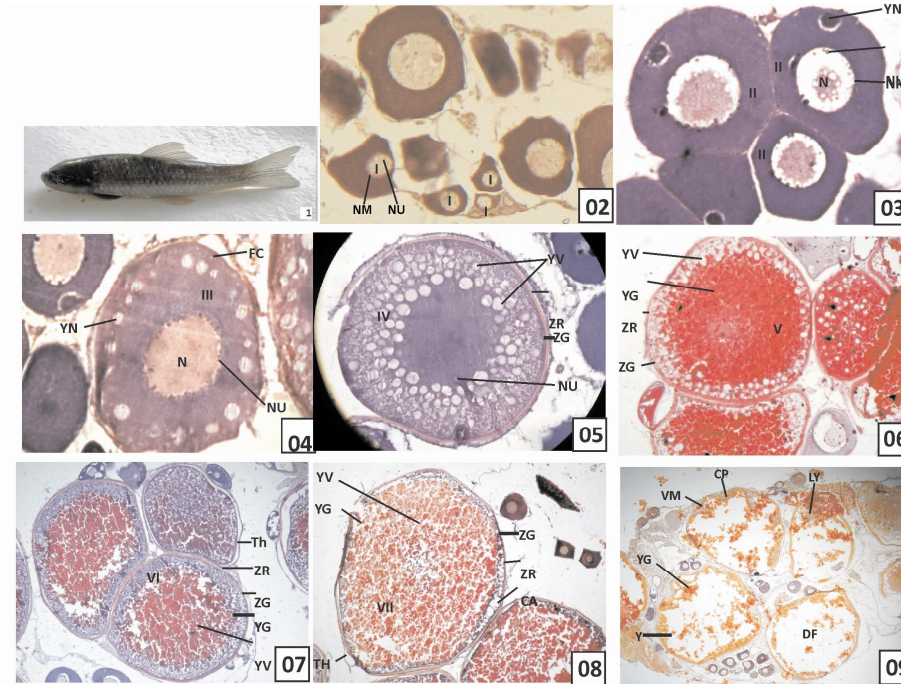


Fig. 1: Lateral view of fish *Garra mullya* (Sykes). **Fig. 02:** Transverse section of ovary through chromatin nucleolus stage showing weakly stained large nucleus (N) and darkly stained cytoplasm. **HEX400X.** **Fig. 03:** Transverse section of ovary through perinucleolar stage showing darkly stained yolk nucleus (YN) in the cytoplasm and light stained nucleoli (NU) arranged at the periphery of nucleus (N). **HEX400X.** **Fig. 04:** Transverse section of ovary through type III oocyte stage showing unstained yolk nuclei (YN) in light stained cytoplasm and nucleolar (NU) extrusion started. **HEX400X.** **Fig. 05:** Transverse section of ovary through yolk vesicle stage showing many empty yolk vesicles (YV) and zona radiata (ZR) recognized between the cytoplasm and zona granulosa (ZG). **HEX400X.** **Fig. 06:** Transverse section of ovary through cortical alveolar stage showing lipid droplets in cytoplasm and yolk granules (YG) are seen centripetally in the form of yolk globules. Zona granulosa (ZG) and zona radiata become visible. **HEX100X.** **Fig. 07:** Transverse section of ovary through vitellogenic stage showing yolk globules (YG), yolk vesicles (YV) and zona granulosa (ZG), zona radiata (ZR), theca (Th) are distinct. **HEX100X.** **Fig. 08:** Transverse section of ovary through ripe egg stage showing large amount of yolk globules (YG), scattered yolk vesicles (YV) along with cortical alveoli (CA) and theca (Th), zona radiata (ZR), zona granulosa (ZG). **HEX100X.** **Fig. 09:** Transverse section of ovary through atretic oocyte showing irregular reflecting stages and hypertropic atresia. **HEX100X.**

PHYTOCHEMICAL SCREENING OF ROOT OF *ORTHOSIPHON RUBICUNDUS* (D. DON) BENTH

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Key Words: *Orthosiphon rubicundus* (D. Don) Benth, Phytochemical Screening, Lamiaceae.

Secondary metabolites in the plants are chemically active compounds (*viz.* flavonoids, alkaloids, terpenoids, steroids, saponins etc.), which are produced in response to stress. They are known for complexity in the structure with restricted distribution in various plant parts (Keeling and Bohlmann, 2006; Visweswariet. et al., 2013). Present communication deals with the occurrence of phytochemicals present in the root of *Orthosiphon rubicundus* (D. Don) Benth, a well-known medicinal plant.

Roots of *Orthosiphon rubicundus* were collected from wild habitat of Chandrapur. The roots were dried under shade. It was pulverized to a coarse powder and its extract was prepared using Soxhlet extractor, using hexane, ethyl acetate, dichloromethane, ethanol and methanol as solvents. Presence of phytochemicals *viz.* volatile oils, alkaloids, glycosides, flavonoids, tannins and polyphenolic compounds, carbohydrates, terpenoids, fixed oils/fats, saponins, coumarine, gum and mucilages and cartenoids in the root samples of *Orthosiphon*

rubicundus were assessed following Trease and Evans (2002) and Sharaibi and Osuntogun (2017).

The results showed presence of flavonoid, steroid, alkaloid, volatile oils and carotenoids in ethyl acetate extract. Flavonoid, steroid, alkaloid and volatile oils were extracted in non polar hexane. Highly polar methanol solvent extracted phenol, tannins, flavonoid and steroids. Flavonoid, alkaloid and carotenoids were extracted in dichloromethane. Phenol, flavonoid and steroids were extracted in ethanol. Thus, *Orthosiphon rubicundus* showed presence of phytochemicals such as flavonoids, steroids, alkaloids, volatile oils and carotenoids through extractions in various non-polar to polar solvents.

Acknowledgments

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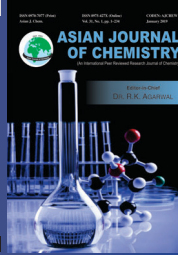
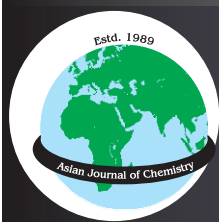
Table 1. Phytochemical screening of *Orthosiphon rubicundus* in different solvents.

| Solvent/ Phytochemical | Hexane | Ethyl Acetate | Dicholoromethane | Ethanol | Methanol |
|-----------------------------------|---------------|----------------------|-------------------------|----------------|-----------------|
| Phenols | x | x | x | √ | √ |
| Tannins | x | x | x | x | √ |
| Flavonoid | √ | √ | √ | √ | √ |
| Steroids | √ | √ | x | √ | √ |
| Terpenoids | x | x | x | x | x |
| Alkaloids | √ | √ | √ | x | x |
| Saponins | x | x | x | x | x |
| Coumarins | x | x | x | x | x |
| Mucilage | x | x | x | x | x |
| Volatile oils | √ | √ | x | x | x |
| Fixed oils & fats | x | x | x | x | x |
| Carotenoids | x | √ | √ | x | x |

√:Present; x : Absent.

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Knoevenagel Condensation Shadowed by Michael Addition & O-Alkylation of Resorcinol, Malononitrile and Benzaldehyde to form Pyrrolidine, Piperidine and Morpholine Substituted Benzopyran Derivatives in Dry K_2CO_3

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A condensation reaction of resorcinol, malononitrile and benzaldehyde in presence of sodium carbonate at room temperature on vigorous stirring gives 2-amino-7-hydroxy-4-phenyl-4H-1-benzopyran-3-carbonitrile which on alkylation in presence of dry potassium carbonate in dry acetone at 70-80 °C with 1,2-chloroethyl pyrrolidine, 1,2-chloroethyl piperidine, 1,2-chloroethyl morpholine gives corresponding novel compounds.

Keywords: Knoevenagel condensation, Michael addition, 1,2-Chloroethyl pyrrolidine, Piperidine, Morpholine.

INTRODUCTION

It is well known that one pot multicomponent reactions are always better than multi-step synthesis, as they require minimal workup and desired product can be obtained in one pot often in quantitative yields [1,2]. Water is easily available solvent, use of water as solvent in the organic synthesis give rise to green chemistry. It is less pollutant, non-hazardous, non-combustible solvent these properties of water promote it in organic synthesis [3,4]. We report pyridine, piperidine and morpholine substituted 2-aminobenzopyran moiety which is very active and possess many biological activities. Formation of this moiety undergone Knoevenagel condensation, in which malononitrile (an active methylene compound) react with benzaldehyde in presence of tracing amount of methanol and aqueous solution of sodium carbonate and formed benzyldine propane dinitrile on loss of a water molecule. A Knoevenagel condensation is a nucleophilic addition of an active hydrogen compounds to a carbonyl group followed by dehydration reaction in which a molecule of water is eliminated [5,6]. Active hydrogen compounds *viz.* diethyl malonate, Meldrum's acid, ethylacetoacetate, malonic acid, cyanoacetic acid, malononitrile, *etc.* [7-9].

In the same multi-component reaction second turn of the reaction undergone by Michael addition, in which benzyldine propanedinitrile reacts with 1,3-resorcinol and to form [(2,4-dihydroxyphenyl)(phenyl)methyl]propane dinitrile which on cyclization and bond shifting formed 2-amino-7-hydroxy-4-phenyl-4H-1-benzopyran-3-carbonitrile [10]. Michael addition is appropriate to the larger class of conjugated addition and the most useful method for C-C bond formation. The Michael addition is thermodynamically controlled; the reaction donors are active methylene's such as malonates and nitroalkanes, and the acceptors are activated olefins such as α,β -unsaturated carbonyl compounds [11,12]. The second step reaction undergone O-alkylation in which 1,2-chloroethylpyrrolidine, 1,2-chloroethylpiperidine or 1,2-chloroethylmorpholine act as alkylating agent and -OH part of substrate alkylate and given ether as product. The alkyl group may be transferred as an alkyl carbocation, a free radical, carbanion or a carbene or their equivalents [13,14]. When the alkylating agent is an alkyl halide, the conversion is known as Williamson ether synthesis. Alcohols are also considered as good alkylating agents in the presence of suitable acid/base catalysts [15].

The interest in benzopyrans and their derivatives increased since many years because these compounds are components

of many naturally occurring products and have also been subjected to structural modifications for potential medicinal properties. 2-Amino-7-hydroxy-4-phenyl-4*H*-1-benzopyran-3-carbonitrile (**1a**) had reported as *in vitro* cytotoxic activity on a human breast tumor cell line (MCF7, IC₅₀8 nM) [16,17].

EXPERIMENTAL

Laboratory grade chemicals and solvents were purchased from Sigma Aldrich and Merck and used without any further purification. The reactions were monitored by TLC using Merck's silica gel 60F254 aluminium sheets. Infrared spectra were recorded neat on Agilent Cary 630 spectrophotometer. High resolution mass spectra were recorded on Agilent 6520 (Q-TOF). NMR spectra were recorded on a Bruker Avance 400 (FT NMR) DPX300MHz NMR spectrometer.

Synthesis of 2-amino-7-hydroxy-4-phenyl-4*H*-1-benzopyran-3-carbonitrile (1a**):** A mixture of benzaldehyde, malononitrile and resorcinol in 2:2:2 dissolved in 1 mL methanol in round bottom flask. A 20 mL solution of 10 % Na₂CO₃ was added in round bottom flask and the resulting suspension kept on vigorous stirring for 10 h at 25 °C. After the completion of reaction filter the solution and residue washed with water then cold methanol and dried in oven at 100 °C (Scheme-I).

2-Amino-4-phenyl-7-[2-(pyrrolidin-1-yl)ethoxy]-4*H*-1-benzopyran-3-carbonitrile (1b**):** A mixture of 2-amino-3-cyano-7-hydroxy-4-phenyl-4*H*-chromene (**1a**) (0.264 g, 1 mmol), 1-(2-chloroethyl)pyrrolidine-HCl (0.255 g, 1.5 mmol) dry K₂CO₃ (0.276 g 2 mmol) dissolved in 25 mL dry acetone in 50 mL round bottom flask and refluxed the solution for 8 h at 60-70 °C. Cooled the solution at room temperature and work-up with ethyl acetate and water, evaporate the solvent with rotatory evaporator and collected the yellow crystalline compound. Monitored the compound by TLC with methanol and chloroform (5:5).

2-Amino-4-phenyl-7-[2-(piperidin-1-yl)ethoxy]-4*H*-1-benzopyran-3-carbonitrile (1c**):** A mixture of 2-amino-3-cyano-7-hydroxy-4-phenyl-4*H*-chromene (**1a**) (0.264g, 1 mmol), 1-(2-chloroethyl)piperidine-HCl (0.276 g, 1.5 mmol) dry K₂CO₃ (0.276 g, 2 mmol) dissolved in 25 mL dry acetone in 50 mL round bottom flask and refluxed the solution for 8 h at 60-70 °C. Cooled the solution at room temperature and work-up with ethyl acetate and water, evaporate the solvent with rotatory evaporator and collected the bright pink crystalline compound. Monitored the compound by TLC with methanol and dichloromethane (DCM) (4:6)

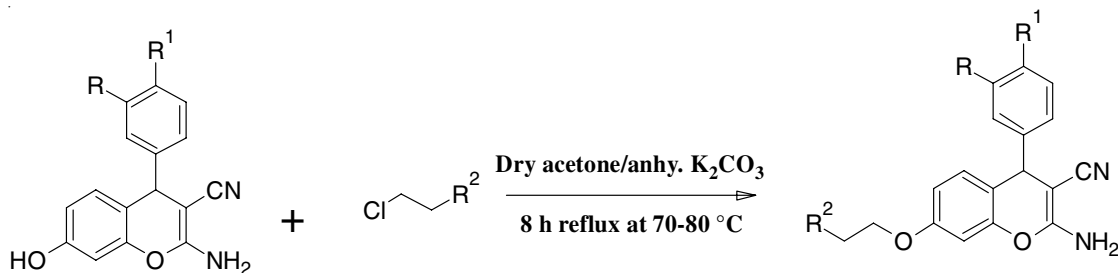
2-Amino-4-phenyl-7-[2-(morpholin-1-yl)ethoxy]-4*H*-1-benzopyran-3-carbonitrile (1d**):** A mixture of 2-amino-3-cyano-7-hydroxy-4-phenyl-4*H*-chromene (**1a**) (0.264 g, 1 mmol), 1-(2-chloroethyl)morpholine-HCl (0.279 g, 1.5 mmol) dry K₂CO₃ (0.276 g, 2 mmol) dissolved in 25 mL dry acetone in 50 mL round bottom flask and then refluxed the solution for 8 h at 60-70 °C. Cooled the solution at room temperature and workup with ethyl acetate and water, evaporate the solvent with rotatory evaporator and collect the yellow crystalline compound. Monitored the compound by TLC with methanol and dichloromethane (DCM) (4:6)

Spectral data of selected compounds

2-Amino-7-hydroxy-4-phenyl-4*H*-1-benzopyran-3-carbonitrile (1a**):** Yield 85 %; white amorphous solid, m.p. 230-235 °C; IR (KBr, ν_{max}, cm⁻¹): 3495 (R-OH), 3332(R-NH₂), 2193 (R-CN), 1652 (C=C vinyl nitrile), 1588-1406 (C-C arom.); ¹H NMR (400 MHz, DMSO δ ppm): 9.76 (s, Ar-OH), 7.36-7.33 (t, *J* = 12 Hz), 7.26-7.20 (q, *J* = 8 Hz) 6.90-6.84 (t, *J* = 12 Hz) 6.55-6.52 (dd, *J* = 4 Hz), 6.478-6.472 (d, *J* = 2.4 Hz), 4.66 (s). ¹³C NMR (100.60 MHz, DMSO δ ppm): 160.23-160.20, 156.98, 148.82, 146.31, 129.88, 127.33, 126.62, 113.75, 112.34, (C-C arom.), 120.60 (CN), 102.14 (C=C vinylic), 56.28 (C-O). HRMS-EI (*m/z*) calcd. for C₁₆H₁₂N₂O₂: 264.2786, found 264.2886. Elemental analysis % calcd. (found): C 72.72 (72.69), H 4.58 (4.60), N 10.60 (10.60).

2-Amino-4-phenyl-7-[2-(pyrrolidin-1-yl)ethoxy]-4*H*-1-benzopyran-3-carbonitrile (1b**):** Yield 75 %; brown color solid, m.p. 265-272 °C; IR (KBr, ν_{max}, cm⁻¹): 3334 (R-NH₂), 2188 (R-CN), 1649 (-C=CN), 1579-1400 (C-C arom.), 1336 (-C-OR, OR = ethoxypyrrolidine); ¹H NMR (300 MHz, CDCl₃ δ ppm): 7.24-7.23 (t, *J* = 1.2 Hz), 7.21-7.20 (d, *J* = 1.5 Hz), 7.18 (s), 7.15-7.14 (t, *J* = 1.35), 7.13-7.12 (t, *J* = 5.4), 7.105-7.100 (d, *J* = 1.5 Hz), 6.76 (s), 6.73 (s), 6.54-6.53 (d, *J* = 2.4 Hz), 6.519-6.510 (d, *J* = 2.7 Hz), 6.47-6.46 (d, *J* = 2.7 Hz), 4.18 (s), 4.56 (s), 4.00-3.96 (t, *J* = 11.7 Hz), 2.83-2.79 (t, *J* = 11.7 Hz), 2.57-2.53 (t, *J* = 12.9 Hz), 1.96 (s), 1.89 (s), 1.77-1.68 (m, *J* = 7.5 Hz). ¹³C NMR (75.49 MHz, CDCl₃, δ ppm): 159.50, 158.67, 149.31, 145.06, 130.34, 129.31, 128.90, 128.02, 127.29, 120.26, 115.16, 112.25, 102.13, 77.65, 77.23, 67.29, 60.67, 59.29, 54.96, 54.72, 40.61, 23.60, 1.16. HRMS-EI (*m/z*) calcd. for C₁₆H₁₂N₂O₃: 361.43692; ESI-SCAN-MS: + 362.18. Elemental analysis % calcd. (found): C 73.11 (73.15), H 6.41 (6.45), N 8.16 (8.16).

2-Amino-4-phenyl-7-[2-(piperidin-1-yl)ethoxy]-4*H*-1-benzopyran-3-carbonitrile (1c**):** Yield 70 %; bright pink color



Where R= H,Br, OCH₃, OH R¹= H,OH,OCH₃ R²= Pyrrolidine, Piperidine, Morpholine

Scheme-I

solid, m.p. 275-280 °C; IR (KBr, ν_{\max} , cm^{-1}): 3350 (R-NH₂), 2240 (R-CN), 1639 (C=CN vinyl nitrile), 1589-1450 (C-C arom.), 1302 (C-OR, OR = ethoxypiperidine); ¹H NMR (300 MHz, CDCl₃ δ ppm): 7.26-7.24 (t, J = 3 Hz), 7.214-7.209 (d = 1.5), 7.189 (s), 7.15-7.14 (d, J = 3 Hz), 6.77 (s), 6.75 (s), 6.547-6.539 (d, J = 2.4 Hz), 6.519-6.510 (d, J = 2.7 Hz), 6.472-6.462 (d, J = 2.7 Hz), 4.819 (s), 4.565 (s), 4.009-3.966 (t, J = 6.9 Hz), 2.98 (s) 2.833-2.794 (t, J = 5.7 Hz), 2.576-2.533 (q, J = 6.45 Hz), 1.96 (s), 1.89 (s). ¹³C NMR (75.49 MHz, CDCl₃, δ ppm): 157.31, 155.55, 155.20, 131.06, 129.33, 129.10, 119.99, 115.16, 114.25, 104.25, 77.44, 77.23, 62.88, 61.86, 57.88, 55.09, 42.22, 34.55, 31.96. HRMS-EI (m/z) calcd. for C₂₃H₂₅N₃O₂: 375.4635; ESI-SCAN-MS: +376.09. Elemental analysis % calcd. (found): C 71.79 (71.83), H 6.43 (6.44), N 11.16 (11.19).

2-Amino-4-phenyl-7-[2-(morpholin-1-yl)ethoxy]-4H-1-benzopyran-3-carbonitrile (1d): Yield 68 %; yellow color solid; m.p. 275-280 °C; IR (KBr, ν_{\max} , cm^{-1}): 3335 (R-NH₂), 2198 (R-CN), 1644 (C=CN vinyl nitrile), 1599-1442 (C-C arom.), 1335 (C-OR, OR = ethoxymorpholine); ¹H NMR (300 MHz, CDCl₃ δ ppm): 7.255-7.241 (t, J = 4.2 Hz), 7.112-7.090 (d, J = 6.6 Hz), 7.009 (s), 6.990-6.987 (d, J = 0.9 Hz), 6.88 (s), 6.76 (s), 6.455-6.454 (d, J = 0.3 Hz), 6.424-6.420 (d, J = 1.2 Hz), 4.908 (s), 4.670 (s), 4.098-4.086 (t, J = 3.6 Hz), 2.992 (s), 2.883-2.862 (t, J = 6.3 Hz), 2.588-2.537 (q, J = 7.65 Hz), 2.003 (s), 1.962 (s), 1.884 (s). ¹³C NMR (75.49 MHz, CDCl₃, δ ppm): 159.66, 156.31, 153.55, 152.20, 135.96, 129.33, 129.10, 120.99, 115.16, 114.85, 104.25, 77.98, 77.23, 65.88, 61.86, 57.88, 55.70, 42.22, 39.33, 35.65, 31.22. HRMS-EI (m/z) calcd. for C₂₂H₂₃N₃O₃: 377.43632; ESI-SCAN-MS: +377.47509. Elemental analysis % calcd. (found): C 70.01 (70.83), H 6.14 (6.22), N 11.13 (11.15).

2-Amino-4-(3-bromophenyl)-7-hydroxy-4H-1-benzopyran-3-carbonitrile (2a): Yield 80 %; off white color solid; m.p. 265-270 °C; IR (KBr, ν_{\max} , cm^{-1}): 3443 (R-OH), 3335 (R-NH₂), 2192 (R-CN), 1640 (C=CN, vinyl nitrile), 1587-1410 (C-C arom.), 720 (R-C-Br); ¹H NMR (400 MHz, DMSO δ ppm): 8.35 (s), 7.47-7.39 (t, J = 22 Hz), 7.35-7.31 (t, J = 16 Hz), 7.24-7.22 (d, J = 8 Hz), 6.99 (s), 6.88-6.86 (d, J = 8 Hz), 6.577-6.480 (ddd, J = 2.4 Hz), 4.73 (s). ¹³C NMR (100.60 MHz, DMSO δ ppm): 160.34, 160.30, 157.20, 149.06, 148.78, 130.89, 129.94, 129.88, 129.58, 126.55, 121.81, 120.412, 112.97, 112.51, 102.24, 55.65. HRMS-EI (m/z) calcd. for C₁₆H₁₁N₂O₂Br, 343.1747, found 343.1751. Elemental analysis % calcd. (found): C 56.00 (56.11), H 3.23 (3.26), N 8.16 (8.15).

RESULTS AND DISCUSSION

In the present work, a multi component reaction in which active methylene compounds (malononitrile) reacted with carbonyl compounds (benzaldehyde and substituted benzaldehyde) in presence of tracing amount of methanol and weak basic medium (aq. Na₂CO₃) and formed benzyldine propanedinitrile. The benzyldinepropanedinitrile reacted with resorcinol and formed [(2,4-dihydroxyphenyl)(phenyl)methyl]propanedinitrile which on cyclization given 7-hydroxy-2-imino-4-phenyl-3,4-dihydro-2H-1-benzopyran-3-carbonitrile by hydrogen shift it converted into 2-amino-7-hydroxy-4-phenyl-4H-1-benzopyran-3-carbonitrile. In the second step, above formed

compounds reacted with pyrrolidine, piperidine and morpholine substituted alkyl halide, in presence of dry. K₂CO₃ and dry acetone as medium to form novel benzopyran derivatives. Simple reaction conditions and easy available catalyst made it favourable for synthesis in high yields.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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PHYTOCHEMICAL SCREENING OF ROOT OF *ORTHOSIPHON RUBICUNDUS* (D. DON) BENTH

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Key Words: *Orthosiphon rubicundus* (D. Don) Benth, Phytochemical Screening, Lamiaceae.

Secondary metabolites in the plants are chemically active compounds (*viz.* flavonoids, alkaloids, terpenoids, steroids, saponins etc.), which are produced in response to stress. They are known for complexity in the structure with restricted distribution in various plant parts (Keeling and Bohlmann, 2006; Visweswariet. et al., 2013). Present communication deals with the occurrence of phytochemicals present in the root of *Orthosiphon rubicundus* (D. Don) Benth, a well-known medicinal plant.

Roots of *Orthosiphon rubicundus* were collected from wild habitat of Chandrapur. The roots were dried under shade. It was pulverized to a coarse powder and its extract was prepared using Soxhlet extractor, using hexane, ethyl acetate, dichloromethane, ethanol and methanol as solvents. Presence of phytochemicals *viz.* volatile oils, alkaloids, glycosides, flavonoids, tannins and polyphenolic compounds, carbohydrates, terpenoids, fixed oils/fats, saponins, coumarine, gum and mucilages and cartenoids in the root samples of *Orthosiphon*

rubicundus were assessed following Trease and Evans (2002) and Sharaibi and Osuntogun (2017).

The results showed presence of flavonoid, steroid, alkaloid, volatile oils and carotenoids in ethyl acetate extract. Flavonoid, steroid, alkaloid and volatile oils were extracted in non polar hexane. Highly polar methanol solvent extracted phenol, tannins, flavonoid and steroids. Flavonoid, alkaloid and carotenoids were extracted in dichloromethane. Phenol, flavonoid and steroids were extracted in ethanol. Thus, *Orthosiphon rubicundus* showed presence of phytochemicals such as flavonoids, steroids, alkaloids, volatile oils and carotenoids through extractions in various non-polar to polar solvents.

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Table 1. Phytochemical screening of *Orthosiphon rubicundus* in different solvents.

| Solvent/ Phytochemical | Hexane | Ethyl Acetate | Dicholoromethane | Ethanol | Methanol |
|-----------------------------------|---------------|----------------------|-------------------------|----------------|-----------------|
| Phenols | x | x | x | √ | √ |
| Tannins | x | x | x | x | √ |
| Flavonoid | √ | √ | √ | √ | √ |
| Steroids | √ | √ | x | √ | √ |
| Terpenoids | x | x | x | x | x |
| Alkaloids | √ | √ | √ | x | x |
| Saponins | x | x | x | x | x |
| Coumarins | x | x | x | x | x |
| Mucilage | x | x | x | x | x |
| Volatile oils | √ | √ | x | x | x |
| Fixed oils & fats | x | x | x | x | x |
| Carotenoids | x | √ | √ | x | x |

√:Present; x : Absent.

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