

# Synthesis, Spectral Characterization and Biological Evaluation of Schiff Base Metal Complexes derived from 5-Nitrosalicylaldehyde

## Abstract

Two new series of Copper(II) and Nickel(II) complexes with two Schiff bases 2-(2,4-dimethylphenylimino)methyl-4-nitrophenol and 2-(3,4-difluorophenylimino)-methyl-4-nitrophenol ligands have been prepared. The Schiff base ligands were synthesized by the condensation of 2-hydroxy-5-nitrobenzaldehyde with 2,4-dimethylaniline or 3,4-difluoroaniline. The ligands and their metal complexes have been characterized by IR, <sup>1</sup>H NMR, mass, electronic spectra, TG analysis and magnetic moment. The Schiff base ligands and their metal complexes were tested for antimicrobial activity against Gram positive bacteria Staphylococcus aureus, Streptococcus pyogenes and Gram negative bacteria Escherichia coli, Pseudomonas aeruginosa and fungus Candida albicans, Aspergillus niger and Aspergillus clavatus using Broth Dilution Method.

**Keywords:** 2-hydroxy-5-nitrobenzaldehyde, Schiff base metal complexes, Antimicrobial activity



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## Introduction

PVP The use of Schiff bases as ligands has enjoyed a very rich history with importance of metal complexes in a variety of industrial and biological applications <sup>1-3</sup>. Stereochemical flexibility is well documented among Schiff-base complexes arising from central metal, the source of the carbonyl function, the amine, as well as substituents on and steric bulkiness around the Schiff base. Schiff bases accommodate different metals with various coordination modes allowing synthesis of stable complexes with varied stereochemistry. Numerous Schiff bases and their transition metal complexes have been investigated by various techniques for different purposes <sup>4-6</sup>. Schiff-base metal complexes have been widely studied because they have industrial, antifungal and biological applications. Chelating ligands containing O and N donor atoms show broad biological activity and are of special interest because of the variety of ways in which they are bonded to metal ions <sup>7-10</sup>.

## Experimental

### Materials

2-hydroxy-5-nitrobenzaldehyde was synthesized according to the method reported in literature <sup>11</sup>. Copper (II) and Nickel (II) were used as nitrate salts and were obtained from Rankem. All amines were used from merck, organic solvents EtOH, MeOH, DMF and DMSO were reagent grade.

### Physical measurements

IR spectra (4000-400 cm<sup>-1</sup>) of the ligands and metal complexes were obtained using KBr discs, on 8400 FT-IR SHIMADZU spectrometer. Mass spectra were recorded on QP 2010 SHIMADZU GCMS spectrometer. <sup>1</sup>H NMR spectra of ligands were recorded on Bruker Avance-II 400 MHz FT-NMR spectrometer using TMS as an internal standard and CDCl<sub>3</sub> as a solvent. Electronic spectra of the metal complexes in DMF were recorded on a Perkin Elmer Lambda 19 spectrophotometer, molar conductance of the metal complexes was determined on Systronics direct reading conductivity meter type CM-82T. A simultaneous TG/DTA was recorded on Perkin Elmer Pyris-1 model. DSC was carried out on Perkin Elmer Pyris-7 instrument. Elemental analysis (C, H and N) were carried out on elemental analyzer PERKIN ELMER 2400, while analysis of metal was also carried out by EDTA titration method, in which the metal complex first evaporate in conc. nitric acid and prepare a stock solution. This solution with ammonia then titrates against EDTA by using appropriate indicator. The M.P. of ligands was carried out by standard laboratory thermometer.

### Preparation of Schiff base ligands

*Synthesis of 2-(2,4-dimethylphenylimino)methyl-4-nitrophenol [MPM]*

Equimolar (10 mmol) ethanolic solution (50 mL) of 2-hydroxy-5-nitrobenzaldehyde and 2,4-dimethylaniline was refluxed for 6 h in round bottom

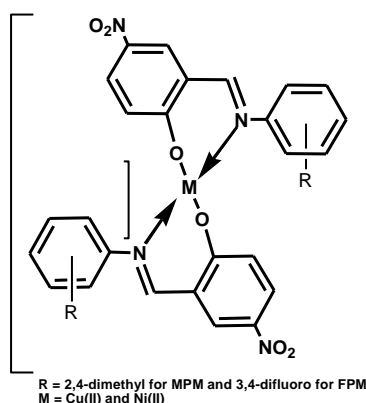
flask. During the reflux a microcrystalline yellow compound was separated, which was isolated by filtration and dried in air and finally purified by crystallized in appropriate solvent. m.p.: 210°C and % of yield 91%

*Synthesis of 2-(3,4-difluorophenylimino)-methyl)-4-nitrophenol [FPM]*

Equimolar (10 mmol) ethanolic solution (50 mL) of 2-hydroxy-5-nitrobenzaldehyde and 3,4-difluoroaniline was refluxed for 6 h in round bottom flask. During the reflux a microcrystalline yellow compound was separated, which was isolated by filtration and dried in air and finally purified by crystallized in appropriate solvent. m.p.: 180°C and % of yield: 87%

### Preparation of metal complexes

All the metal complexes of Schiff base were prepared by the following method. The metal salt was dissolved in water and the solution was added to a hot ethanolic solution of the corresponding Schiff bases. After the complete addition little amount of ammonia was added and the mixture was refluxed for 4 h. A crystalline solid was obtained, which was isolated by filtration, washed with hot water and dried in air. % of yield: 80-85%. The general structure of the metal complexes can be summarized in Scheme-I.



Scheme I: General structure of Schiff base metal complex

Table-1 Physical and Analytical data of Schiff Base ligands and their Metal Complexes

Ligand or complex	Formula	M.W.	Elemental analysis, % Found/(Calcd.)			
			C	H	N	M
MPM	C <sub>15</sub> H <sub>14</sub> N <sub>2</sub> O <sub>3</sub>	270	66.60 (66.66)	5.14 (5.22)	10.41 (10.36)	-
FPM	C <sub>13</sub> H <sub>8</sub> F <sub>2</sub> N <sub>2</sub> O <sub>3</sub>	278	56.19 (56.12)	2.87 (2.90)	10.02 (10.07)	-
[Cu(MPM) <sub>2</sub> ]	C <sub>30</sub> H <sub>26</sub> CuN <sub>4</sub> O <sub>6</sub>	602	59.76 (59.84)	4.30 (4.35)	9.37 (9.31)	10.63 (10.55)
[Ni(MPM) <sub>2</sub> ]	C <sub>30</sub> H <sub>26</sub> N <sub>4</sub> NiO <sub>6</sub>	597	60.39 (60.33)	4.41 (4.39)	9.31 (9.38)	9.90 (9.83)
[Cu(FPM) <sub>2</sub> ]	C <sub>26</sub> H <sub>14</sub> CuF <sub>4</sub> N <sub>4</sub> O <sub>6</sub>	617	50.49 (50.53)	2.30 (2.28)	9.12 (9.07)	10.33 (10.28)
[Ni(FPM) <sub>2</sub> ]	C <sub>26</sub> H <sub>14</sub> F <sub>4</sub> N <sub>4</sub> NiO <sub>6</sub>	613	60.00 (50.93)	2.27 (2.30)	9.17 (9.14)	9.64 (9.57)

### Characterization of Schiff base ligands

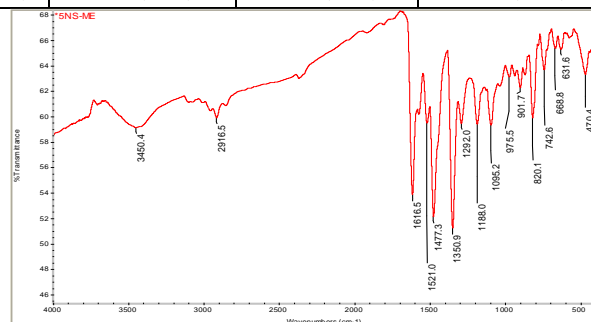
The IR spectrum of the ligands shows a broad band at 3430-3460 cm<sup>-1</sup> due to the stretching vibrations of phenolic hydroxyl group. The broadness is due to intermolecular hydrogen bonding between the phenolic group and the azomethine group. The strong band observed at 1616 cm<sup>-1</sup> is assigned to the stretching vibrations of the azomethine group. Two moderately intense bands observed at 3046 and 2916 cm<sup>-1</sup>, are due to aromatic and aliphatic ν(C-H), respectively<sup>12,13</sup>. An IR spectrum of the ligand is presented in Fig. 1.

### Antimicrobial screening

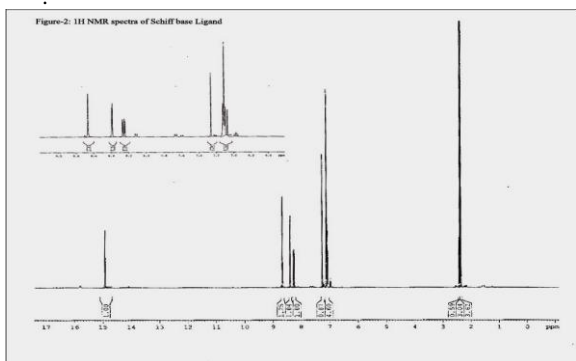
All newly synthesized compounds were tested for their antibacterial activities against Gram positive bacteria *Staphylococcus aureus*, *Streptococcus pyogenes* and Gram negative bacteria *Escherichia coli*, *Pseudomonas aeruginosa* and antifungal activity against *Candida albicans*, *Aspergillus niger* and *Aspergillus clavatus*. The method used to evaluate the antimicrobial activity was 'Broth Dilution Method'. It is one of the non-automated *in vitro* susceptibility tests. The MIC (minimal inhibitory concentration) of the control organism is read to check the accuracy of the drug concentrations. The lowest concentration inhibiting growth of the organism is recorded as the MIC. The MIC values of the newly synthesized compounds have been compared with the standard drugs ampicillin, chloramphenicol, nystatin and greseofulvin<sup>16</sup>. (Table-2(a) & 2(b))

### Results and Discussion

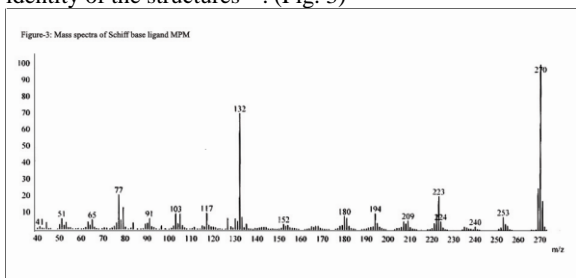
The Schiff base ligands, MPM and FPM were prepared by the condensation of 2-hydroxy-5-nitrobenzaldehyde with 2,4-dimethylaniline and 3,4-difluoroaniline in molar ratio 1:1. The formation of Schiff base and their metal complexes were confirmed by various analytical techniques such as IR, <sup>1</sup>H NMR, mass, electronic spectra, conductance and TG-DT-DSC analysis. Table-1 lists the physical and analytical data of the Schiff bases and their metal complexes. The antimicrobial activities of Schiff base ligands and metal complexes are listed in Table 2(a) & 2(b).



The  $^1\text{H}$  NMR spectra of ligands were recorded in  $\text{CDCl}_3$ . The proton NMR spectrum of one of the ligand is shown in Fig. 2. The signal due to methyl protons (Ligand MPM) appeared as singlet at  $\delta$  2.40 ppm. In the aromatic region, a few doublets and in few cases some overlapping doublets/multiplets are observed in the range  $\delta$  6.97-8.39 ppm. These signals are due to aryl protons of benzene rings, while the signal due to azomethine proton ( $-\text{CH}=\text{N}-$ ) appeared as singlet at  $\delta$  8.66 ppm. Another singlet corresponding to one proton is observed in the range  $\delta$  14.00-14.92 ppm. This signal disappeared in the complexes 13,14.



The mass spectra of ligands MPM & FPM revealed the molecular ion peak at  $m/e$  270 for the former ligand and  $m/e$  278 for the latter ligand, which are coincident with the formula weights and support the identity of the structures <sup>15</sup>. (Fig. 3)



### Characterization of metal complexes

The IR spectra of metal complexes show sharp band in the range  $1607\text{--}1603\text{ cm}^{-1}$ , which is shifted to lower frequency as compared to ligand, suggesting coordination of the azomethine nitrogen to the metal ion. The disappearance of  $\nu(\text{O-H})$  shows the deprotonation of the  $-\text{OH}$  group and its subsequent coordination to the central metal atom. Two new bands observed at  $578\text{--}564$  and  $481\text{--}470\text{ cm}^{-1}$  are characteristic of  $\text{M-O}$  and  $\text{M-N}$  absorptions, respectively <sup>16</sup>.

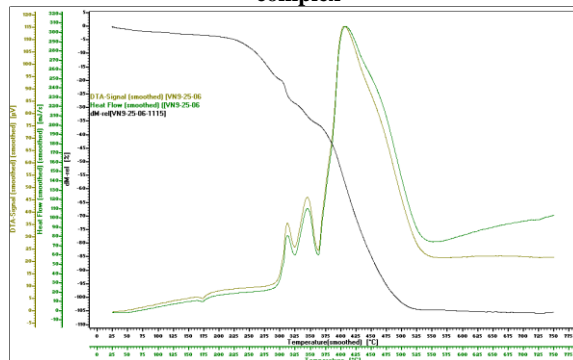
The observed molar conductances of the metal (II) complexes in  $10^{-3}$  molar DMF solution are in the range  $19\text{--}27\ \Omega^{-1}\text{ cm}^2\text{ mol}^{-1}$ . The molar conductance values are consistent with the non-electrolytic nature for all metal complexes <sup>17</sup>.

Electronic spectra of all the complexes were recorded in dimethylformamide (DMF). For square planar  $\text{Cu(II)}$ , the expected transitions are  $^2\text{B}_{1g} \rightarrow ^2\text{A}_{1g}$  and  $^2\text{B}_{1g} \rightarrow ^2\text{E}_g$  with respective absorptions at  $505\text{--}520$  and  $665\text{--}650\text{ nm}$ . Due to Jahn-Teller (J-T) distortions, square planar  $\text{Cu(II)}$  complexes give a broad absorption between  $600$  and  $700\text{ nm}$  and the peak at  $505\text{--}520\text{ nm}$  merges with the broad band, and thus only one broad band is observed. The  $\text{Ni(II)}$  complexes showed one strong band at  $550\text{ nm}$ , which is

assigned to the square planar  $^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$  transition. This value lies within the range ( $600\text{--}450$ ) nm region <sup>6,15,18</sup>.

Thermal analyses of all the complexes were carried out by the TG, DTA and DSC techniques. The experimental results revealed that the degradation occurred in multiple stages, following a complex mechanism (Fig. 4). For each stage the kinetic parameters and the thermo gravimetric characteristics have been estimated. Thermal behavior of all complexes explains as follows. The TG curve follows the decrease in sample mass with increase in temperature. In the present investigation heating rates were suitably controlled at  $5^\circ\text{C min}^{-1}$  and mass loss followed up to  $25\text{--}800^\circ\text{C}$ . The complexes slowly started decomposition between  $200\text{--}320^\circ\text{C}$ . The first mass loss up to  $312^\circ\text{C}$  is attributed to the removal of two  $\text{NO}_2$  molecules. This process is accompanied by exothermic process at around  $200\text{--}320^\circ\text{C}$  in DTA curves of all complexes. The mass loss occurring at temperature  $330\text{--}550^\circ\text{C}$  corresponds to the decomposition of the ligand molecules. The final product of the thermal decomposition at  $550\text{--}800^\circ\text{C}$ , metal oxide was determined by elemental analysis <sup>19,20</sup>.

Figure 4: TGA-DTA-DSC curve of Schiff base metal complex



### Antimicrobial activities

The Minimal inhibitory concentration (MIC) against bacteria and fungi of Schiff base ligands and their metal complexes were compared with the MIC values of standard drugs. The results of the biological screening of the ligands and their metal complexes reveal that the antimicrobial activities of the chelated ligands are enhanced as compared to the free ligands <sup>16,21</sup>. (Table 2(a) & 2(b)).

TABLE 2(a): Antibacterial activity of Schiff bases and their metal complexes

MINIMAL INHIBITION CONCENTRATION (MIC) ( $\mu\text{g/ml}$ )				
Ligand/Complex	<i>E. Coli</i>	<i>P. Aeruginosa</i>	<i>S. Aureus</i>	<i>S. Pyogenes</i>
	MTCC-443	MTCC-441	MTCC-96	MTCC-442
MPM	250	250	250	250
FPM	250	100	250	250
[Cu(MPM) <sub>2</sub> ]	50	100	150	100
[Ni(MPM) <sub>2</sub> ]	500	500	100	250
[Cu(FPM) <sub>2</sub> ]	125	250	250	100
[Ni(FPM) <sub>2</sub> ]	250	100	50	125
Standard Drugs				
Ampicillin	100	100	250	100
Chloramphenicol	50	50	50	50

**TABLE 2(b): Antifungal activity of Schiff base ligands and their metal complexes**

MINIMAL INHIBITION CONCENTRATION (MIC) ( $\mu\text{g/ml}$ )			
Ligand/ Complex	<i>C. Albicans</i>	<i>A. Niger</i>	<i>A. Clavatus</i>
	MTCC-227	MTCC-282	MTCC-1323
MPM	1000	100	500
FPM	250	250	250
[Cu(MPM) <sub>2</sub> ]	500	100	500
[Ni(MPM) <sub>2</sub> ]	100	100	250
[Cu(FPM) <sub>2</sub> ]	250	250	100
[Ni(FPM) <sub>2</sub> ]	100	100	250
Standard Drugs			
Nystatin	100	100	100
Greseofulvin	500	100	100

### Conclusion

On the basis of above studies, the general structure of the metal complexes are proposed as shown in Scheme 1. The Schiff base ligands are behaving as O, N donor bi-dentate for Cu(II) and Ni(II) metal ions. The ligands and their metal complex screen for antimicrobial activity and results show good in comparison with standard drugs.

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# Pharmacokinetic Studies of Some Leading Anti-inflammatory Drugs

## Abstract

The phenomenon of pharmacokinetics includes metabolism, excretion and the kinetics of elimination. The main function included in pharmacokinetics is the response of body to the drug. It refers to the movement of the drug in the body and the alteration of drug by the body. Thus a pharmacokinetic study involves absorption, distribution, bio-transformation and excretion of the drug.

In the present study four non-steroidal drugs having anti-inflammatory and analgesic character have been selected. The pharmacokinetic studies conclude that such behavior of these drugs is a function of the nature of the medium (aqueous and non-aqueous) pH and the temperature.

**Keywords:** Solubilization period, anti-inflammatory, pharmacokinetic studies.

## Introduction

Anti-inflammatory drugs mostly consist of salicylates, salicylamide, aryl alkanolic acid and oxycoms. Out of these the drugs under study involving salicylates are quite common and very popular. Methacetin, phenacetin, paracetamol and aspirin are non-steroidal anti-inflammatory drugs in addition to antipyretic and analgesic in nature. All of these drugs exhibit analgesic, anti-inflammatory and antipyretic action but differ in degree of action under different conditions. These drugs have superiority over other traditional drugs such as morphine in the sense that they do not produce physical dependence. These drugs are moderately weak analgesics. The pathway of the action of these drugs takes place as follows:-

1. These drugs act primarily confined to the peripheral pain mechanism.
2. These drugs act on CNS to elevate the pain threshold value.

Due to these reasons such anti-inflammatory drugs are preferred over others based on the properties of these drugs. They are called non-steroidal anti-inflammatory drugs abbreviated as NSAID. Along with these drugs some inhibitors e.g. Cox-1 and Cox-2 have been used which play an important role in the mechanism of action for the pharmacokinetic studies of these drugs. The mechanism and rate of action is based on the property of these drugs called the solubilization period. The rate of drug action is inversely related to its solubilization period. Longer the solubilization period of a drug, slower will be the rate of its action. On the other hand the rate of drug action is enhanced if the solubilization period is short. Thus for a drug expecting quick action the solubilization period must be reduced. The solubilization of poorly water soluble drugs has been increased by mixed solvency<sup>1-6</sup> phenomenon. The drug interaction activity of different components has given interesting results. The solubilization behaviour<sup>7-13</sup> has been studied for several drugs in common use. A part from biochemical uses the process and degree of solubilization finds innumerable applications<sup>14-20</sup>. Some workers have focused special attention on salicylic acid<sup>21</sup> for its solubilization behaviour and pharmaceutical applications<sup>22</sup>. The solubilization period of any drug depends on its composition, constitution, temperature, dielectric constant and pH of the medium. In this dissertation the effect of these factors on solubilization period of some methacetin type compounds has been studied.

## Materials & Method

It involves two main steps.

- (I) The following compounds of the interest were obtained in the pure form (E. merck quality) and their purity was confirmed by the melting point method.
  - A. Salicylic acid
  - B. Methyl Salicylate
  - C. Phenyl Salicylate
  - D. Sodium Salicylate
  - E. Acetyl Salicylic acid

## (II) Determination of solubilization period

In a clean beaker of 50 mL, 25 mL distilled water was taken. A weighed quantity (100 mg) of every material (A, B, C, D, E) was dropped into the beaker at the desired temperature keeping the stirrer on. The same was repeated by taking 25 mL ethanol in the beaker. Note down the time of complete solubilization for each compound respectively. The same observations were made by taking buffer

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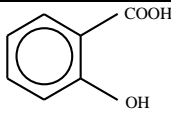
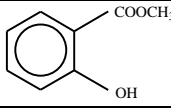
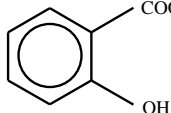
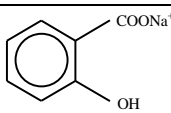
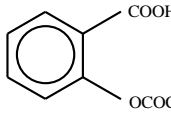
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solutions of desired pH in which the compounds under study were put & complete solubilization times under

identical situations were noted.

### Effect of solvent on solubilization period:

**Table-1: Effect of the solvent [Aqueous (Water) & non-aqueous solvent (alcohol)] on solubilization period**

S. No.	Compound	Solubilization period (at 20°C)				Structural Formula
		Water		Alcohol		
		min.	sec.	min.	sec.	
1	Salicylic acid (A)	3	27	1	05	
2	Methyl salicylate (B)	3	56	1	50	
3	Phenyl salicylate (C)	4	21	1	31	
4	Sodium salicylate (D)	2	15	3	40	
5	Acetyl salicylate (E) (Aspirin)	3	35	2	52	

**Table-2: Effect of temperature on solubilization period of A, B, C, D & E in water.**

S. No.	Temperature Unit °C	Solubilization period of compounds									
		A		B		C		D		E	
		min	sec	min	sec	min	sec	min	sec	min	sec
1	15	3	56	4	15	5	10	5	55	5	25
2	25	3	28	4	05	4	56	5	35	5	05
3	35	3	05	3	52	4	25	5	10	4	41
4	45	2	42	3	20	4	05	4	35	4	10
5	55	2	27	2	35	3	32	3	46	3	46
6	65	2	10	2	07	3	10	3	25	3	15
7	75	1	35	1	40	2	40	2	56	2	50
8	85	1	10	1	18	2	05	2	32	2	18

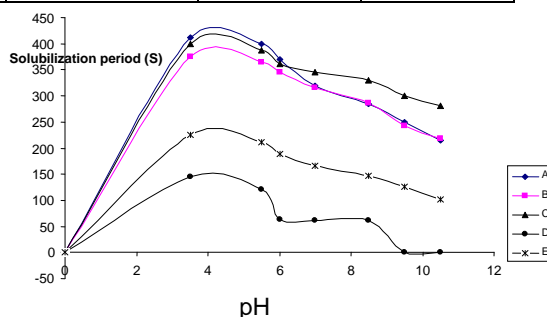


**Table-3: Effect of pH on solubilization period of A, B, C, D, E.**

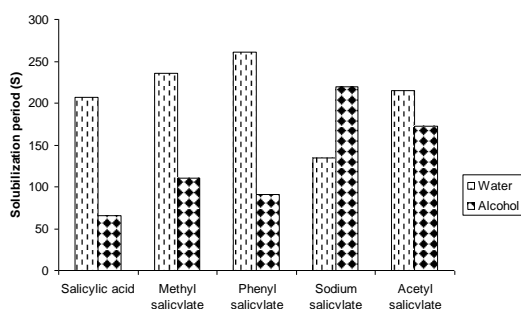
S. No.	pH	Solubilization period of compounds									
		A		B		C		D		E	
		min	sec	min	sec	min	sec	min	sec	min	sec
1	3.5	6	52	6	15	6	40	2	25	3	45
2	5.5	6	40	6	05	6	28	2	01	3	32
3	6.0	6	10	5	45	6	02	1	03	3	08
4	7.0	5	20	5	15	5	45	1	21	2	46
5	8.5	4	45	4	46	5	30	1	01	2	27
6	9.5	4	10	4	02	5	1	0	0	2	06
7	18.5 not Possible	3	35	3	03	4	41	0	0	1	42

**Results and Discussion**

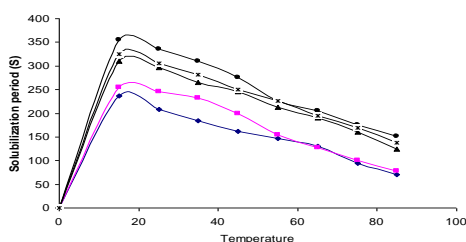
For any drug its solubilization period plays a vital role during the treatment of the patient. Before digestion and assimilation of a drug by the body its solubilization is the basic step. The solubilization period depends upon the structure, conformation and the physicochemical properties of the drug. The effect of the nature of solvent, temperature and pH of the medium on solubilization period has been measured and computed in bar diagram (fig.1) and graphs (fig. 2 & 3). The results obtained from the experimental data and demonstrated by diagrams are discussed as below.



**Fig.3: Effect of pH on solubilization period (S) of A, B, C, D & E in water**



**Fig. 1: Aqueous (Water) & non-aqueous solvent (alcohol)**



**Fig.2: Effect of temperature on solubilization period (S) of A, B, C, D & E in water**

The bar diagram indicates that except for compound D the solubilization period of all the compounds is longer in aqueous medium as compared to the alcoholic

one. For compound D the solubilization period in aqueous medium is shorter than that in alcoholic medium. The variation in solubilization period of these compounds is a function of its ionic character, degree of ionization and the molecular mass of the material. It has been demonstrated by the bar diagram. For compound having in significant or almost nil enthalpy of solution, the solubilization period is anticipated to decrease with the rise of temperature of course as the temperature rises the solubilization period of all the compounds under study shortens, though with varying magnitudes. This has been demonstrated by graph in fig.2 for all the compounds the variation is qualitatively alike but differs in quantity. This may be due to difference in the thermal nature of enthalpy of ionization enthalpy of hydration and the enthalpy of hydrolysis of compounds as pointed out.

The solubilization period of compounds A, B, C, D and E is effected by the acidic or alkaline nature of the medium. During solubilization due to hydrolysis the nature of the medium gets changed. In case of sodium salicylate due to hydrolysis alkalinity develops. Due to this fact the solubilization period of this compound shortens with the increase of pH. In other compounds the phenomenon is not so significant. This has been shown with the help of graph in Fig.3.

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# Synthesis, Characterization, antimicrobial study and Spectrophotometric determination of Mn (II) ion by Pyridine 2, 3 dicarboxylic acid.



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## Abstract

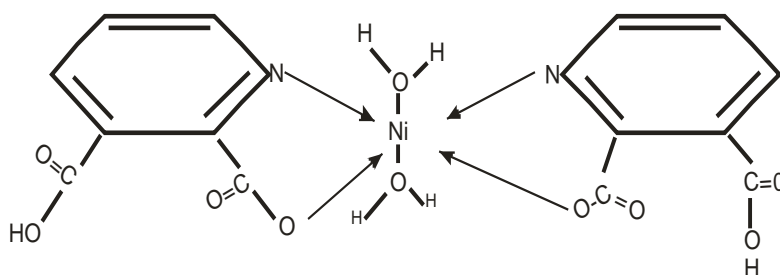
A new spectrophotometric method is developed for the determination of Mn (II) in an aqueous solution. The metal ion forms a pink coloured complex with pyridine 2, 3 dicarboxylic acid in acidic medium i.e. at pH 1.5 to 2.5. The complex shows maximum absorbance at 500 nm. Job's method for continuous variation and mole ratio method shows metal ligand ratio in the complex to be 1:2. The complex is stable after 20 minutes. The pink coloured complex obeys the Beer's law in the concentration range of 55 to 250  $\mu\text{g/l}$  of manganese. The molar absorptivity ( $\epsilon$ ) is found to be  $1.25 \times 10^2 \text{ l mol}^{-1} \text{ cm}^{-1}$ . The method has been used for the determination of Mn<sup>+2</sup> in synthetic samples. The complex was obtained from the aqueous solution by slow evaporation for a weak. The FTIR study was carried out for structural determination. The antimicrobial activity of pyridine 2, 3 dicarboxylic acid and Mn – PDC complex have also been checked.

## Introduction

PVP Pyridine 2, 3-, 2, 4-, 3, 4-, 2, 5-, 2, 6- dicarboxylic acids have proved to be interesting and important ligands and may exhibit various co-ordination modes. Pyridine 2, 3- dicarboxylic acid can act as partly or fully deprotonated and shows diverse coordination modes. The complexes of Mn(II) with pyridine 2, 3- dicarboxylic acid have been prepared and characterized by spectroscopic, structural and thermogravimetric methods. These reports indicate that Pyridine 2, 3- dicarboxylic acid acts as monodicarboxylate N, O- chelating complex i.e.  $[\text{Mn}(\text{H}_2\text{O})_6][\text{Mn}(2,3\text{-pydcH})_3]_2$  or a doubly deprotonated three-dentate – N, O, O dicarboxylate complex i.e.  $[\text{Mn}(\text{H}_2\text{O})_3(2,3\text{-pydc})]_n$ . In these complexes Mn is considered to have distorted octahedral geometry.<sup>1</sup>

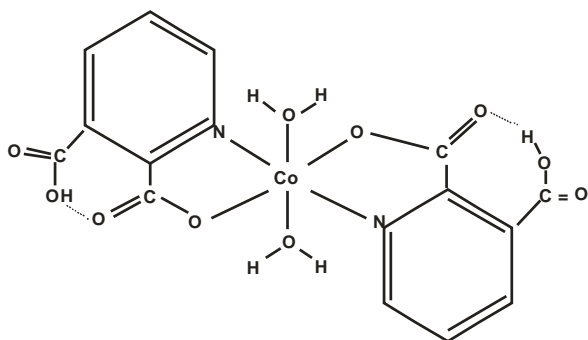
The complex of copper with pyridine 2, 3- dicarboxylic acid i.e.  $[\text{Cu}(2,3\text{-pydcH})_2]$  has been reported<sup>2</sup>. It is a chain polymer. Two ligands occupy the equatorial plane of each tetragonally elongated  $\text{Cu}^{+2}$  coordination sphere, chelating through the pyridine nitrogen and one oxygen of the deprotonated 2- carboxylic acid group, the axial positions are occupied by long bonds to a 3-carboxylic acid oxygen of adjacent  $\text{Cu}(2,3\text{-pydcH})_2$  repeat unit. The coordination polymer of Mn with pyridine 2, 3 dicarboxylate has been synthesized and crystal structure has been proposed based on the experimental data<sup>3</sup>. According to this report  $\text{Mn}^{+2}$  ion is coordinated in a distorted octahedral environment by the O atoms of two water molecules, one N and one O atoms of the chelating pyridine 2, 3- dicarboxylate (PDC) dianion, and two axial bridging carboxylate O atoms from two adjacent PDC ligands<sup>3</sup>.

The complexes of the type  $\text{M}(\text{H-Quin})_2 \cdot 2\text{H}_2\text{O}$  ( $\text{M} = \text{Mn}, \text{Co}, \text{Ni}$  and  $\text{Zn}$ ) where  $\text{H}_2\text{-Qin} = \text{Quinolinic acid}$  i.e. Pyridine 2, 3 dicarboxylic acid have been prepared and characterized<sup>4</sup>. All these reported complexes have octahedral distorted structure. The nickel atom in  $\text{Ni}(\text{H-Quin})_2 \cdot 2\text{H}_2\text{O}$  is octahedrally coordinated by two nitrogen atoms and two oxygen atoms belonging to the two  $\text{H-Quin}^-$  anions and two trans-aqua molecules<sup>4</sup>. The structure of Ni(II) with quinolinic acid can be represented as.

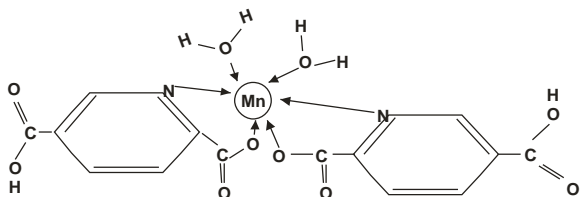


The complex  $Mn(H\text{-}Quin)_2 \cdot 2H_2O$  has been formulated as  $[Mn(H_2O)_6][Mn(H\text{-}Quin)_3]_2$ . The octahedral  $[Mn(H\text{-}Quin)_3]^-$  and  $[Mn(H_2O)_6]^{2+}$  units lie on different three fold axis.<sup>(4)</sup> Lanthanide (III) quinolate complexes have been prepared and reported and evidence is presented which indicates that these complexes may be six-coordinated.<sup>(5)</sup> calcium (II) complexes with pyridine 2, 3-dicarboxylate (Quinolinic acid) has been synthesized and crystal structure has been reported<sup>(6)</sup>. The complexes of uranium (IV) with quinolinic acid has been synthesized and reported<sup>(7)</sup>. Two types of complexes of cadmium with quinolinic acid has been synthesized and reported<sup>(8)</sup>. They are  $[Cd(2, 3\text{-}pydcH_3)]_2[Cd(H_2O)_6]$  and  $[Cd(2, 3\text{-}pydc)(H_2O)_3]_n$ . The chromium (III) – quinolinato complexes  $[Cr(quinH)_3]^{+3}$   $[Cr(QuinH)_2(H_2O)_2]^+$  and  $[Cr(quinH)(H_2O)_4]^{2+}$  have been obtained and characterized in solution<sup>(9)</sup>.

The structure of some Cu(I), Ag(II) and Cu(II) compounds with quinolinic acid have been established based on X-ray crystallographic studies<sup>10-12</sup> in each case, quin is bonded as a monoanion through pyridine nitrogen and carboxylate oxygen atoms forming the 5-membered chelate ring. The same coordination mode is postulated for other quin-complexes with Cr(III), Cd(II), Fe(II) (13-16), though no structural studies were conducted. The spectrophotometric evaluation of iron (II) quinolinic acid complex (1:2) metal ligand system has been reported<sup>(17)</sup>. The complex of cobalt with quinolinic acid has been synthesized and structure has been reported<sup>(18)</sup>. The following structure of hydrated cobalt (II) complex of quinolinic acid has been reported<sup>(18)</sup>.



The complex formed by Mn(II) and pyridine 2, 5 dicarboxylic acid has been synthesized and characterized by elemental analysis, IR, electronic spectra, thermogravimetric analysis and x-ray diffraction techniques<sup>(19)</sup>. The Mn(II) ion is coordinated by two water molecules and two chelated Pyridine 2, 5 dicarboxylic ligands. Water molecules coordinate with Mn(II) ion in cis mode.



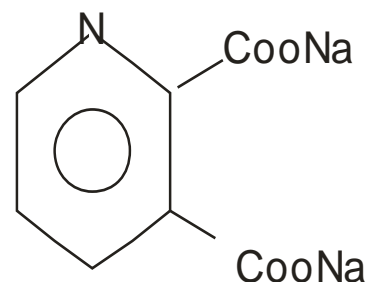
Literature survey shows that the solution studies and spectrophotometric studies of Mn(II) with quinolinic

acid has not been reported. Therefore, we have made an effort to study the solution properties.

### Materials and Methods

An UV-VIS spectrophotometer-108 equipped with 1cm quartz cell was used for spectrophotometric measurements. The pH measurements were made with an Elico LI 120 pH meter.

The reagent used was pyridine 2, 3 dicarboxylic acid. The substance was dissolved in minimum amount of NaOH and its sodium salt solution was used.



A 0.01 M solution of the ligand was used.

Mn (II) solution :- A 0.01 M stock solution of  $MnCl_2 \cdot 4H_2O$  prepared by dissolving in distilled water and was made acidic by adding HCl. The pH was maintained by using dilute NaOH and dilute HCl.

**Procedure :** In each set of different 50 ml standard flasks, various volumes of Mn (II) and reagent solution were taken, the pH was maintained (1.5 to 2.5) and made up to the mark with distilled water. The absorbance was measured at 500 nm against the reagent blank. The calibration curve was prepared by plotting absorbance against the amount of Mn. (II)

### Results and Discussions

#### 1. Determination of $\lambda_{max}$ of the complex,

The absorption spectra of pink coloured complex solution were recorded in the wavelength region 400-900nm as shown in the fig. It was observed that the complex showed the maximum absorbance at 500 nm where as the reagent blank is colourless solution and does not absorb in the visible region. The absorption spectra of  $MnCl_2 \cdot 4H_2O$  has also been recorded. The  $\lambda_{max}$  of  $MnCl_2 \cdot 4H_2O$  occurs at 472 nm. The  $\lambda_{max}$  of complex is shown in Fig 1.

#### 2. Effect of pH

Studies on the effect of variation in pH shows that the complex has maximum absorption in the pH range. 1.5 to 2.5 pH. This is shown in Fig – 2.

#### 2. Effect of time

The Manganese (II) – Pyridine 2, 3 dicarboxylate complex takes 20 minutes to complete the reaction and there after It is stable.

#### Effect of Temperature

The Mn (II) complex is stable in the temp. range of 30 – 70<sup>0</sup> C Fig - 3.

#### The effect of the reagent concentration (PDC) on the complex.

It seems that the complex formation requires the double concentration of the ligand This is shown in Fig – 4.

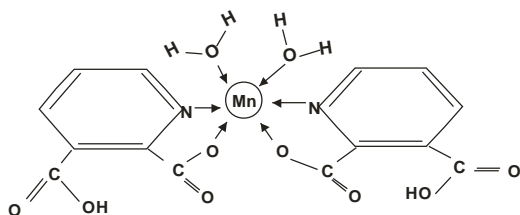
## 6. Job's Method

Composition of the complex as determined by the job's method and the mole ratio method was found to be 1:2. This is shown in Fig – 5.

## 7. The Beer's Law

The beer's law is obeyed in the concentration range 55 to 250  $\mu$  gms of Mn (II). The method that has been developed has moderate sensitivity. Calibration graph Fig – 6.

Solution studies of Mn(II) shows that it forms pink coloured complex in the acidic pH with pyridine 2, 3 dicarboxylic acid. The reaction is pH sensitive. The complex formed is stable for days. Pyridine 2, 3 dicarboxylic acid has proved to be interesting and versatile ligand and may exhibit various coordination modes. Pyridine 2, 3 dicarboxylic acid (2, 3 Pydc H<sub>2</sub>), being a potential polydentate ligand, has aroused considerable interest of many groups and the literature cites numerous examples of different metal complexes. The Ligand can act as partly or fully deprotonated and shows diverse coordination modes such as monodentate or bridging. It may be due to this reason that contradictory reports for the crystal structure appears in the literature<sup>1, 3, 4, 19</sup>. It is reported that Pyridine 2, 5 dicarboxylic acid forms 1:2 complex in solution<sup>19</sup>. Based on all such references following structure may be assigned in solution.



## Synthesis of the complex

A 0.01 M MnCl<sub>2</sub>·4H<sub>2</sub>O solution was prepared Five ml of this solution was taken in a container. To this solution 10ml of 0.01 M quinolinic acid solution (prepared by dissolving the acid in minimum amount of NaOH) was added. The acidic pH of 1 – 5 to 2.5 was maintained Pink coloured complex is formed within few minutes. After 20 days pink coloured needle shaped crystals were obtained by slow evaporation. (Room temp – 40<sup>0</sup>C)

## Antimicrobial studies

Quinolinic acid and Mn – quinolate complex were screened for their antibacterial activity against *Bacillus Megatarium* with different dilution using cup-plate agar diffusion method. Both Quinolinic acid and Mn-Quin complex showed poor antibacterial activity. The FTIR studies indicates the presence of metal- nitrogen and metal oxygen bonds. The respective frequencies are 420 and 600 Cm<sup>-1</sup>.

## Effect of foreign ions in the spectrophotometric studies

The effect of various anions and cations on the determination of Mn(II) under optimum conditions was studied. It was noticed that Cu<sup>+2</sup>, Fe<sup>+2</sup>, Ni<sup>+2</sup> and Ba<sup>+2</sup>

interfere only when present in the same concentration range. They do not interfere when present in ten fold less concentration than the analyte solution. Ions such as V<sup>+3</sup>, Sn<sup>+2</sup>, K<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, Zn<sup>+2</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, SO<sub>4</sub><sup>-2</sup>, CO<sub>3</sub><sup>-2</sup>, F<sup>-</sup> does not interfere even when present in large excess. (i.e. ten fold excess)

## Validity of the method

A number of synthetic samples were prepared for the analysis. Spectrophotometric determination was carried out by the proposed method. The results are given in the table.

Sample	Mn(II) taken $\mu$ g s	Abs Average	Mn(II) found $\mu$ g s	Relative error %
Synthetic Sample – 1	55	0.098	54	-1.8
Synthetic Sample – 2	110	0.205	113	+2.5
Synthetic -3	220	0.41	225	+2.2

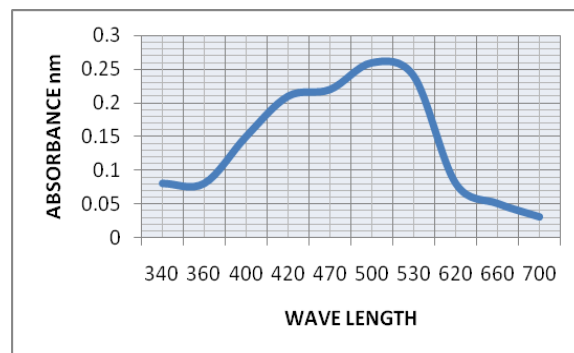


FIGURE-1: Absorption spectra

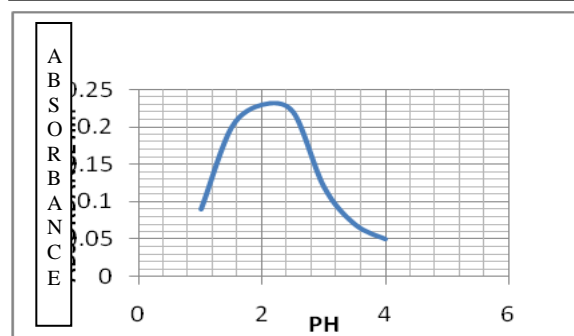


FIGURE-2: EFFECT OF pH

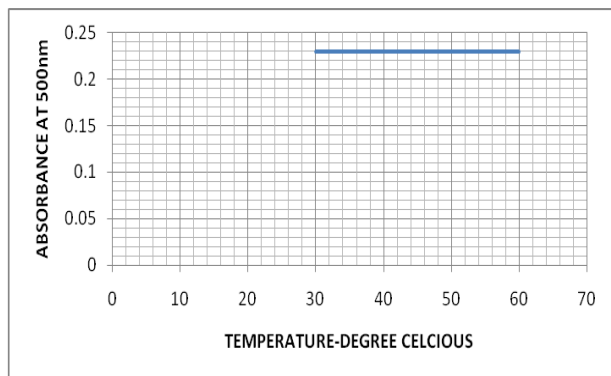


FIGURE -3: EFFECT OF TEMP

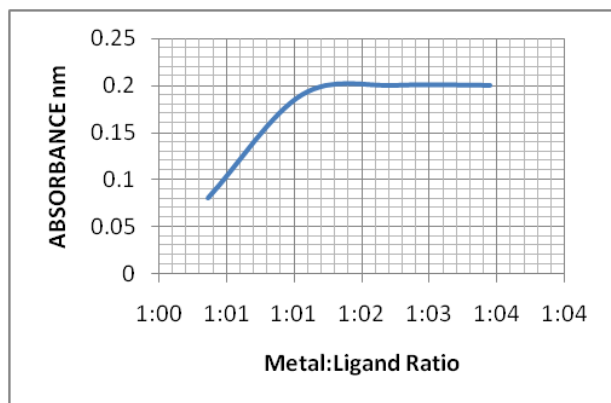


FIGURE-4:EFFECT OF M:L RATIO

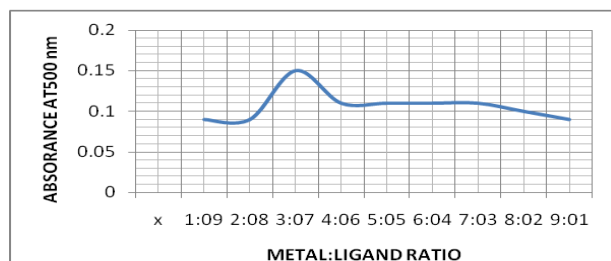


FIGURE-5:JOB'S METHOD

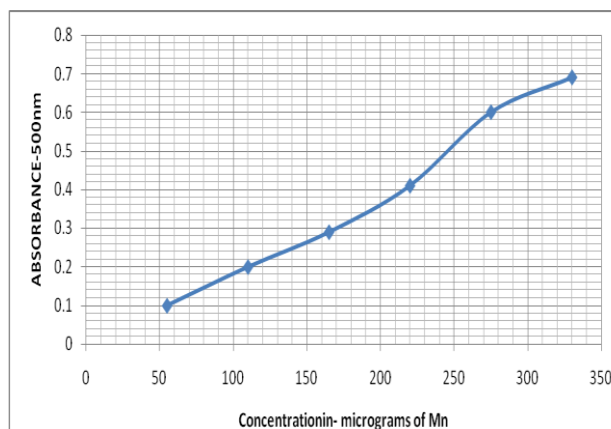


FIGURE-6:BEER'S LAW GRAPH

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# Study on Reproductive Performance, Survivability and Mortality of *Lymnaea stagnalis* by Plant Glycoside of *Abrus precatorius*

## Abstract

*Lymnaea stagnalis* is the common pest of aquatic plants and also a prolific breeder. It is commonly known as pond snail. In the present investigation glycoside of *Abrus precatorius* was tested for lethal toxicity against *Lymnaea stagnalis*. In the present investigation has also been taken to study the effect of glycosides extracted from *Abrus precatorius* on the life cycle of *Lymnaea stagnalis*. It is very essential to control the fertility, hatchability, viability by increasing the rate of mortality and decline the rate of longevity of these snails, so this investigation was made to know about the intoxication of glycosides on the mortality and reproductive performance of this experimental pest snail.

**Keywords:** *Lymnaea stagnalis*, *Abrus precatorius*, Toxicity.

## Introduction

*Lymnaea stagnalis* Is the pest of paddy crop, aquatic garden vegetation, coffee, tea, money and ornamental plants. Family Lymnaeidae is abundant in our lakes and ponds. They also happen to live in many garden ponds, as well as in aquarium tanks or troughs, where they were either introduced along with water plants or placed intentionally. Lymnaeids are distributed worldwide as observed by Godan (1983). They can be easily procured from any fresh water body. These pestiferous snails are also prolific breeders. Albeit their living in water, pond snails are lung breathers, they surface to breath fresh air.

The reproductive biology of *Lymnaea* has been well studied. It is a hermaphrodite but during mating behavior one individual acts as the male and the other female. The snail lays eggs in strips of troughs is transparent jelly on various surfaces under water. These are most often seen on the underside of floating vegetation such as water lily leaves.

These snails are harmful pests of various valuable crops and directly decline the productivity/acre (hectare) area and indirectly decline the economy of the country. Severe damage caused to standing crops resulted into scarcity of raw material and create serious problem of food scarcity in that particular area. To save our valuable crops from the disaster of these pestiferous snails it is very essential to control their fecundity and viability.

A lot of research work has been done on the neurons of *Lymnaea stagnalis* by using plant glycosides but little attention has been on the development of pond snail *Lymnaea stagnalis* with the effect of plant glycosides. Therefore, different types of glycosides have been used in this investigation to control the progeny of *Lymnaea stagnalis*, the pest of aquatic plants. The glycoside have been extracted from the plants of *Abrus precatorius*.

## Materials and Method

The materials and methods used in this present investigation are as follows:

### Procurement of experimental plant seeds and extraction of glycoside by soxhlet method

Seeds of *Abrus precatorius* were procured from M/s. Shidh Seeds Sales Corporation, Dehradun, India.

The seeds (*Abrus precatorius*) were washed, shadow dried, mechanically grinded into coarse pieces weighed 100g and then extracted with petroleum ether (B.P. 60-80°C, procured from B.D.H.) and methanol (B.P. 645-655°C, procured from B.D.H.) by Soxhlet method (adopted after Sharma, 1988). After completion of 35 cycles in the Soxhlet, the extracts were filtered.

After evaporation of solvent the extracted antifertility agents were weighed 4.0g in *Abrus precatorius* seed extraction. The colour of the extracts is Brownish colour semi-liquid is state after extracted from *Abrus precatorius* seeds.

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1% stock solution was prepared in distilled water and kept in dark coloured tightly closed glass bottles and stored in refrigerator (at 4°C).

The stock solution was further diluted and used at room temperature for the detection of LC values and after calculated the sublethal concentrating the experiments were done in triplicate.

Glycosides are a diverse group of compounds. Many of which are coloured fluorescent and others are chromogenic. They are very reactive and hydrolysed easily by enzymes, acids, base or undergo auto-hydrolysis at higher temperature to give aglycones and sugars. The aglycone are usually triterpenoids, steroids, phenols, aldehydes, alcohols, acids, anthraquinones or flavonoids and the sugars are pentoses or hexoses. Thus, the term 'glycosides' is often used to describe a compound which gives rise to one or more sugar units (glycones) along with aglycone unit on hydrolysis.

The seeds of *Abrus precatorious* have been analysed to find out the glycosides.

The defatted seed powder (100 gm) of each plant was extracted with 95% ethanol for 20 hrs separately in a Soxhlet apparatus. The ethanolic extract on concentration gave a brownish syrupy mass. It was then successively extracted with acetone. The process of dissolving and precipitation was repeated several times and finally through a bed of activated charcoal. On removal of the solvent a brownish mass of glycoside was obtained in an yield of 7.08%.

**General Description of *Abrus precatorious*:**

**Vernacular Name:** Rakti, Ratti, Eng - Crabs Eye

**Family:** Papilionaceae

**Known Medical Use:** Plant used in fever, rheumatism, skin diseases and eye diseases.

▪ Decoction of fresh roots is used 3 times daily in abortion.

▪ Seed paste with water and salt applied on boils to promote suppuration.

**Useful Part:** Root, leaf and seed.

**Local Name** Gunchi

**Locality:** Throughout India.

## 1. Procurement and rearing of Snail

Sexually mature *Lymnaea stagnalis* were collected from Botanical garden of Dr. H.S. Gour University, Sagar and Sagar lake by net. They were reared in troughs and fed regularly with aquatic vegetation e.g. *Hydrilla* to avoid the stress of starvation. The collected snails were acclimatized for 7 days under laboratory conditions (Subbarao, 1989). The young ones hatched from egg masses of *Lymnaea stagnalis* were used for the experimental purpose. The young ones snails were introduced to different concentration of plant glycosides through media. Each group was in triplicate of 50 snails.

## 2. Experiments with different dosage of plant glycoside

Newly young *Lymnaea stagnalis* were introduced via media to different concentrations of plant glycoside and data was summarized in Table no.1 (Probit analysis method adopted after Finney, 1971).

## Results

### 1. Behaviour in the control groups

In control groups after immersion in water the snails *Lymnaea stagnalis* retracted body inside the shell. After a lapse of 3.5 minutes they extended the foot and body and crawled along the bottom and the walls of the container. While crawling the foot was well expanded, probasis and epipodial as well as tentacles were completely protruded out of the shell. The snails in this condition showed the movement of radula for feeding and a current of water through epipodial lobe for respiratory purposes.

### 2. Behaviour in Experimental Groups

Marked behavioural changes were observed when adult snails were introduced to the higher concentration of the plant glycoside as follows.

- (i) After immersion the gastropods retracted the body in the shell.
- (ii) The snails slightly protruded foot.

The treated snails showed dullness throughout the experimental duration. They were apathetic during the experimental period.

### 3. Mortality

In the present investigation in the control groups mortality started on 25<sup>th</sup> days and the percentage of mortality range from 8% to 12% in *Lymnaea stagnalis* but it was observed that mortality started on 5<sup>th</sup> day in all treated groups.

### 4. Shell, Visceral Hump and Respiration

The control snails were found submerged while the treated snails showed only pulmonary respiration. The shell became thin, fragile and semi-transparent owing to decalcification.

### 5. Mating and Oviposition

There was no hard and fast rule regarding the start of mating. While in the control groups mating was started after 1 or 2 days and it range from 6-30 hrs. while it varied in mating snails treated with different concentration of the plant glycoside.

### 6. Ovulation, Egg Masses and Egg Capsules

Ovulation took place but the egg masses showed fewer egg capsules in treated groups in comparison to the control groups where the number of egg capsules was generally 50-60 in *Lymnaea stagnalis* with some amount of gelatinous substance.

### 7. Fecundity

The dose and duration of treatment dependent a decrease in the rate of fecundity was observed in case of all the treated groups.

### 8. Percentage Viability

Normally in the control group's percentage viability was 96-98% in *Lymnaea stagnalis* but it decreases with the increase in concentration of plant glycoside intoxication. The data on fecundity, viability and mortality was recorded and summarized in Table No. 2.

#### Discussion:

In the present investigation the snails were apathetic during the experimental period and shown the decline rate of growth as reported by Subbarao (1975) in - some pestiferous snails after some pesticides treatment and Joshi (1987) reported that the growth of *Lymnaea luteola* has been hampered significantly by more than 25% at 1 ppb

and more than 50% at 5% and 1 ppb of DDT. The decline in growth has been executed by the thinning of shell as the flesh weight did not differ significantly in the control and treated groups as also observed in the present investigation.

In the present investigation it was observed that, higher concentration of plant glycoside, resulted into the fecundity and viabiliting zero percent as also reported by Bhide (1998) in *Lymnaea stagnalis* after thiourea, nuvan, methyl parathion exposure, Jain (2007) in *Lymnaea* spp. and *Gyalulus* spp after molluscicides exposure and Mahobiya (2012) in *Lymnaea* spp. after antitubuline drug exposure respectively.

In the experimental snails *Lymnaea stagnalis* were observed with plant glycoside and toxicity proved to be antifertility agents which decrease the fecundity of the snails in the present investigation.

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**Table1:** Data on Toxicity of *Abrus precatorius* Plant glycoside on the Adult Specimen of *Lymnaea stagnalis*.

S.No.	Name of the plant seed extract	Concentration of the plant seed extract	Duration (hrs.)	Mortality (%)	Lethal Conc. value
1.	<i>Abrus precatorius</i>	0.5%	96	100%	LC <sub>100</sub>
2.		0.25%	96	50%	LC <sub>50</sub>
3.		0.13%	96	Nil	LC <sub>0</sub>
4.		0.12%	96	Nil	Sublethal concentration

**Result:** 0.12% Concentration of seed extracts of *Abrus precatorius* was considered as sublethal concentration throughout the experiments.

**Table-2:** Developmental data of *Lymnaea stagnalis* after treatment with different concentrations of seed extract of *Abrus precatorius*

Groups	Conc. Of the Plant seed extract	Total No. of egg capsules	No. of Egg capsules completed cleavage	No. of Egg capsules completed blastula	No. of Egg capsules completed gastrula	No. of trochophore formed	No. of veliger formed	No. of veliger completed torsion	Total No. of young snails hatched	No. of young snails survived upto adulthood	Percentage survival of young snails
Control	No. of trace of any plant seed extract	50	50	50	50	50	50	50	50	49±1	98-100%
Experimental groups treated with seed extract of <i>Abrus precatorius</i>	1.0% (LC <sub>100</sub> )	50	14±1	12±1	10±1	8±1	6±1	4±1	3±1	None	0.00%
	0.5% (LC <sub>50</sub> )	50	36±1	34±1	32±1	30±1	29±1	28±1	27±1	24±1	48-50%
	0.28% (LC <sub>0</sub> )	50	49±1	49±1	49±1	19±1	49±1	49±1	49±1	49±1	96-98%
	0.26% Sublethal concentration	50	50	50	50	50	50	49±1	49±1	49±1	98-100%



# Assessment of the Water Quality of Rihand Reservoir, Sonbhadra (U.P.), Using Selected Physico-Chemical Parameters

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## Abstract

Rihand reservoir, a largest inland reservoir of Asia located in district Sonbhadra (U.P.) and some part of Singrauli district (M.P.) is constructed over Rihand River, in the tributary of Sone River. The variations in selected physico-chemical factors were investigated for two years to determine the water quality of Rihand Reservoir, for Industrial, Agricultural, and Drinking and fish production. Five stations were chosen on the reservoir to reflect the effect of human activities, lacustrine and lotic habitats. Temperature, transparency, pH, dissolved oxygen, nitrate, phosphate, biological oxygen demand, chemical oxygen demand, total alkalinity, Sulphate, were analyzed monthly between June 2008 and May 2009 using standard methods and procedures. Unacceptable, high levels of assessment parameters were observed in many cases for other Indian reservoirs except for turbidity, dissolve oxygen, Alkalinity, pH, nitrogen and phosphate which were found in higher concentration above freshwater limits. Runoff of nitro-phosphate and sulphate fertilizers from nearby farm lands and washing of domestic animals, dungs from the watershed into the reservoir were found to have caused cultural eutrophication in the reservoir. The eutrophication was pronounced at Sampling Station due to impact of human activities on the reservoir, and with time, it will affect the water quality and fish production in the reservoir. The study concludes that Rihand reservoir has excellent water quality, high ecological status and passes chemical status. Eutrophication which was noticed to be a threat to the water quality should be arrested at the nick of time through denitrification and nutrient control to halt the degradation of the water.

**Key words:** Eutrophication, Fertilizers, Ecology.

## Introduction

Water is an elixir of life. It governs the evolution and function of the universe on the earth hence water 'mother of all living world'. Majority of water available on the earth is saline in nature; only small quantity is fresh water. Expanding human population brought about by the opportunities of good water supply, irrigation, fish production recreation and navigation offered by Reservoirs has put enormous pressure and stress on the quality of water impounded by the reservoir. The impact of human activities in and around the reservoir is felt on the unique physical and chemical properties of water on which the sustenance of fish that inhabit the reservoir is built as well as to the functions of the reservoir. Water quality is determined by the physical and chemical limnology of a reservoir (Sidnei *et al.*, 1992) and includes all physical, chemical and biological factors of water that influence the beneficial use of the water. Water quality is important in drinking water supply, irrigation, fish production, recreation and other purposes to which the water must have been impounded.

Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. The effects of these "imports" into the reservoir do not only affect the socio-economic functions of the reservoir negatively, but also bring loss of structural biodiversity of the reservoir. Djukic *et al.* (1994) have used the physico-chemical properties of water to asses the water quality of a reservoir. The use of the physico-chemical properties of water to assess water quality gives a good impression of the status, productivity and sustainability of such water body. The changes in physical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, chemical oxygen demand, nitrate and phosphate provide valuable information on the quality of the water, the source of the variations and their impacts on the functions and biodiversity of the reservoir.

This study aimed at assessing the water quality of Rihand reservoir for drinking and fish production using some selected physico-chemical properties. The results will form the baseline for monitoring and tracking changes in the water quality as a result of the reservoir's natural dynamics over time or impact of men's activities on the reservoir.

## Materials and Methods

### Description of the Study Site

The Rihand reservoir is located in between 24°N, 83°E and 24°2'N, 82°48'E, with a surface area having 30 × 15 km. with the maximum depth of 25 m. (Fig. No. 1). The area of present study belongs to the district of Sonbhadra of Uttar Pradesh state. Sonbhadra is the largest district having an area of 6788 Sq.Km. It lies in the extreme south-east of the U.P. state and north east of M.P., and is bounded by Mirzapur district to the northwest, Chandoli district to the north, Bihar state to the northeast, Jharkhand state to the east, Chhattisgarh state to the south and Madhya Pradesh state to the west. The district head quarter is in the town of Robertsganj.

### Stations and Sampling

Water samples were collected from the different selected sampling site from the June 2008 to May 2009. Samples were collected in the middle hours of the day. Some physical characteristics of the water have been analysed at the sampling site itself. For analysis of other physico-chemical characteristics such as pH, alkalinity, Turbidity, conductivity, T.D.S., T.S., T.S.S. calcium hardness, total hardness, magnesium, chlorides, sulphate, nitrate, phosphate, sodium, potassium, dissolved oxygen, COD, BOD, were analyzed in the laboratory.

Physico-chemical characteristics of the water samples were done in accordance with the procedures described in standard methods for the examination of water and waste water (APHA, 1985), practical methods in water ecology and environmental sciences (Trivedi et al., 1987), water quality in warm water fish pond (Boyd, 1981) and work book on limnology (Adoni et al., 1985 and Neeri 1979).

### Statistical Analysis

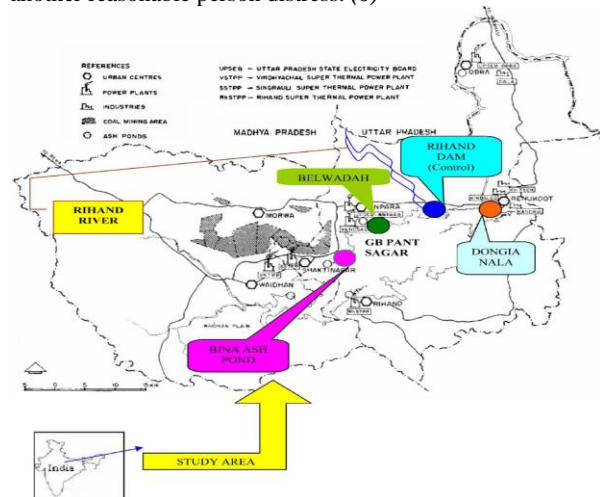
The observation data of physico-chemical parameters during the entire period of the study were treated statistically to determine the significant levels of their seasonal and spatial variations. Results are presented as means ± standard deviation (S.D.) and the one way ANOVA tests were used to evaluate differences between means (confidence interval=95%).

Stalking is a continuous process, consisting of a series of actions, each of which may be entirely legal in itself. Technology ethics professor [Lamber Royakkers](#) writes that:

*"Stalking is a form of mental assault, in which the perpetrator repeatedly, unwantedly, and disruptively breaks into the life-world of the victim, with whom he has no relationship (or no longer has), with motives that are directly or indirectly traceable to the affective sphere. Moreover, the separated acts that make up the intrusion*

*cannot by themselves cause the mental abuse, but do taken together (cumulative effect)." (5)*

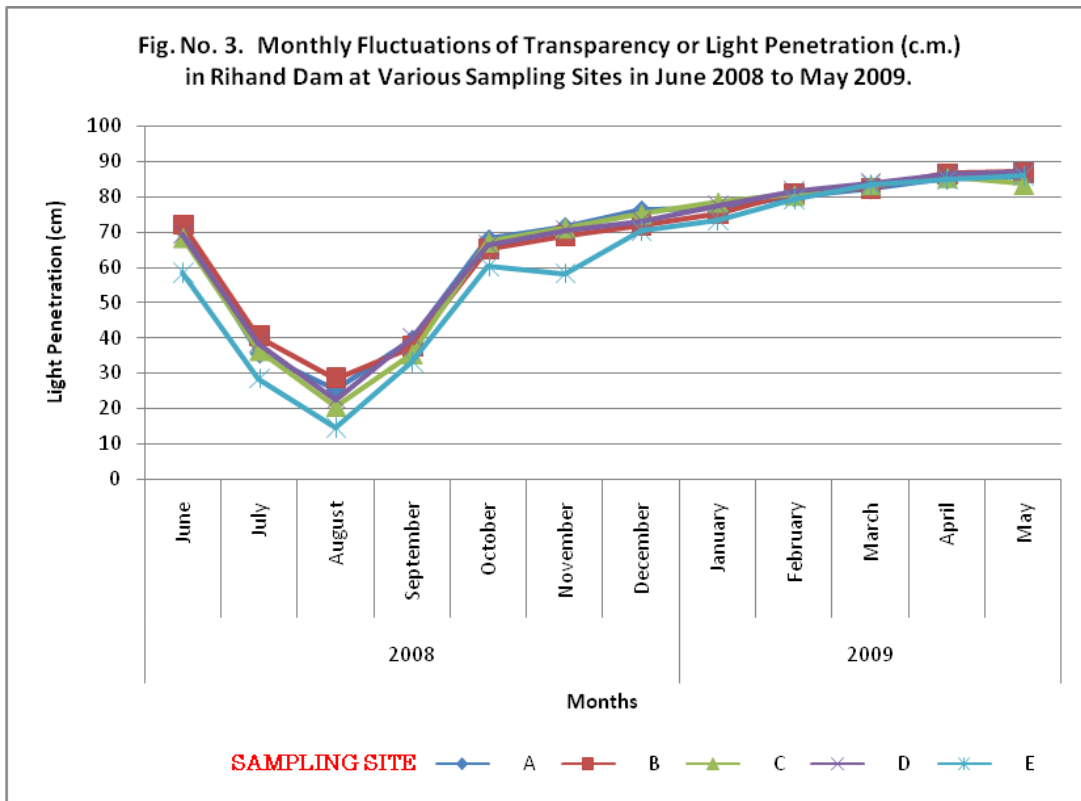
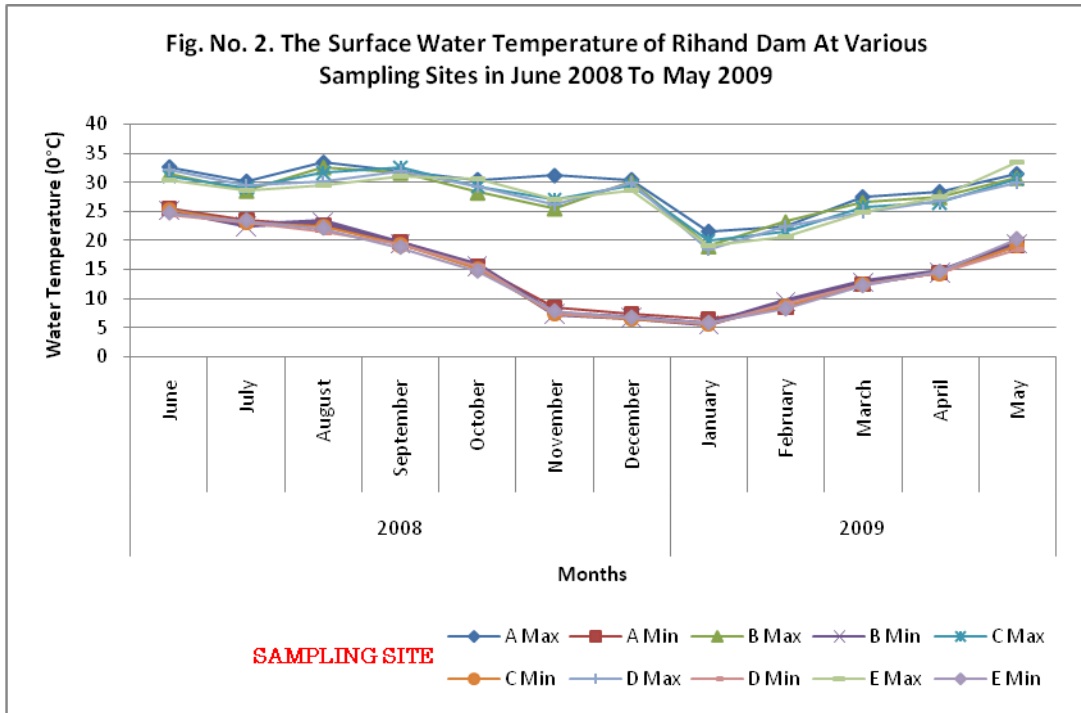
From the above, we can say that Cyber stalking is the use of the Internet or other electronic means to stalk or harass an individual, a group of individuals, or an organization. It may include false accusations, monitoring, making threats, identity theft, damage to data or equipment, the solicitation of minors for sex, or gathering information in order to harass. The definition of "harassment" must meet the criterion that a reasonable person, in possession of the same information, would regard it as sufficient to cause another reasonable person distress. (6)

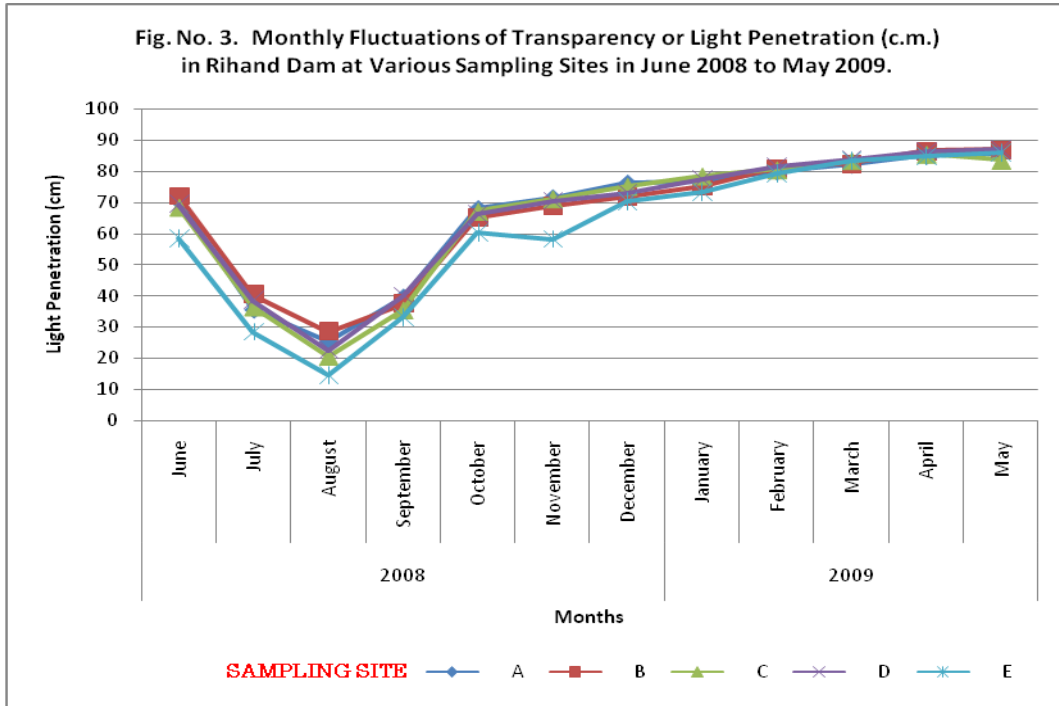


**Fig.No. 1 Rihand Dam Map and Around the Industries**

The mean monthly variation in the surface water temperature of the five sampling stations is presented in Figure 2. The temperature ranged between the lowest values of 5.82±0.40°C obtained from mean values of five sampling Station in January 2009 and the highest of 31.56±0.92°C obtained from mean values of five sampling Station June, 2008. Dry season temperature was significantly higher (P<0.05) than the wet season. No significant difference was seen among the sampling station and in one year. Secchi disc transparency was the highest mean value of sampling station 85.88±1.49 c.m obtained in May 2009 and lowest mean value recorded 22.26±5.26 c.m. in August of 2008 (Figure 3). During the dry season, Station 2 and year 2009 not significantly higher transparency (p=0.965).

Dissolved oxygen fluctuated between the lowest monthly mean of sampling sites 6.98±0.90 mg/L obtained in May 2009 and the highest monthly mean of sampling sites 10.86±3.16 mg/L recorded in July 2008 from (Figure 4). Statistical difference at P<0.0001 was noticed in the dissolved oxygen concentration among the stations. Chemical oxygen demand (COD) varied between 12.60±2.41 mg/L and 45.40±7.40 mg/L COD was not significantly higher in the dry season with mean of Sampling Station recording (Figure 5). There was no statistical difference in COD between the one year of study. Total alkalinity fluctuated between the lowest monthly mean of sampling sites 69.40±4.04 mg/L obtained in December 2008 and the highest monthly mean of sampling sites 167.00±6.40 mg/L recorded in May 2009 from (Figure 6). Total alkalinity showed there is a not significant difference between sampling sites (p=0.997).





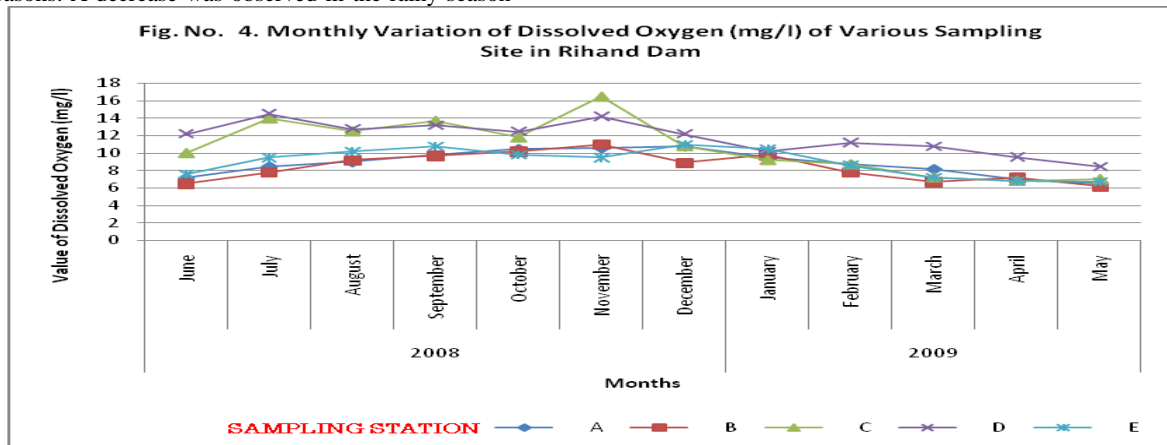
The Hydrogen ion concentration fluctuated between the lowest monthly mean of sampling sites  $7.74 \pm 0.19$  mg/L obtained in January 2009 and the highest monthly mean of sampling sites  $8.98 \pm 1.21$  mg/L recorded in April 2009 from (Figure 7). There was no significant difference in the concentration of hydrogen ions between sampling site and months of year.

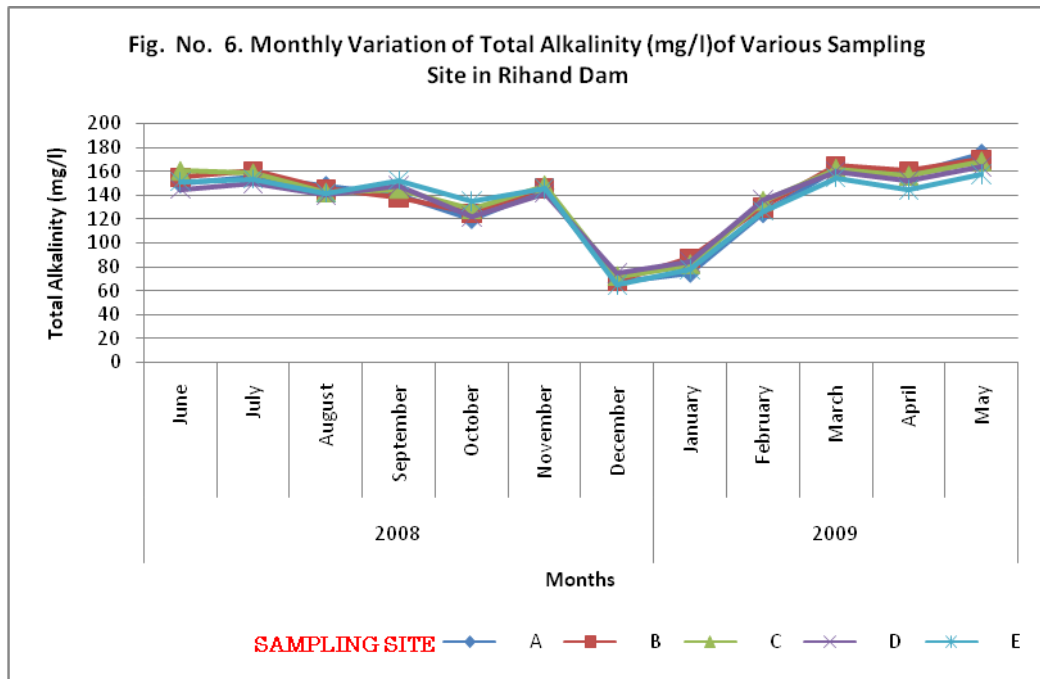
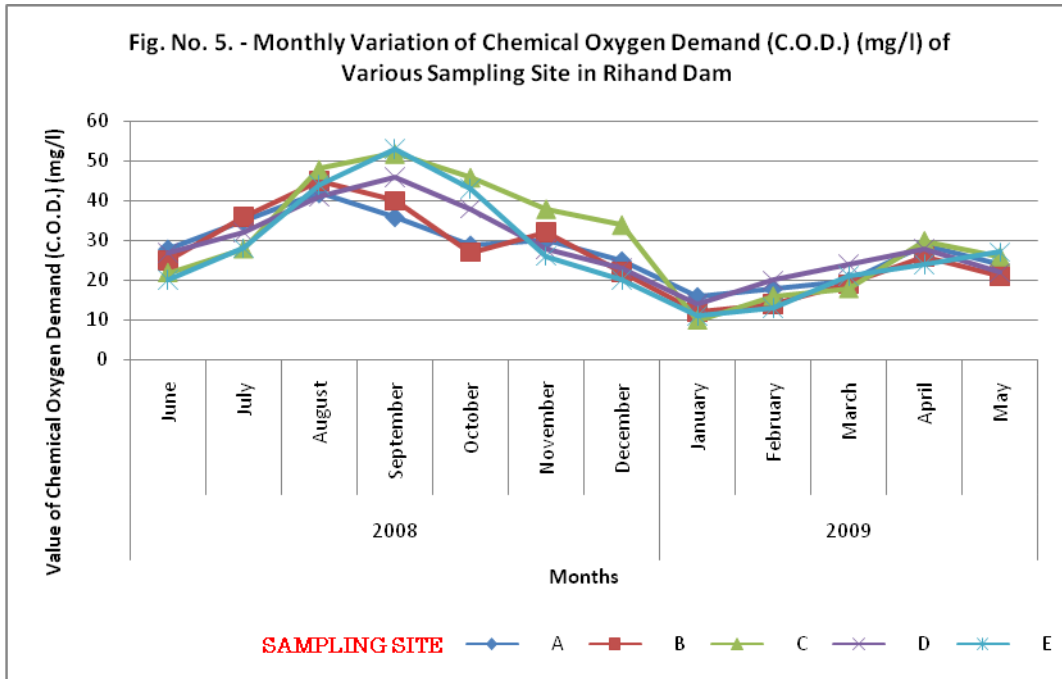
The highest monthly mean concentration of nitrate recorded was  $0.060 \pm 0.01$  mg/L which was obtained from mean of sampling stations at the peak of the cold seasons January 2009. A decrease was observed in the rainy season with the lowest concentration of  $0.048 \pm 0.02$  mg/L recorded from mean of sampling sits in August 2009 (Figure 8). ANOVA at  $P=0.0001$  shows significant difference in the nitrate concentration during the seasons and within the stations.

The highest monthly mean concentration of phosphate recorded was  $0.33 \pm 0.01$  mg/L which was obtained from mean of sampling stations at the peak of the cold seasons. A decrease was observed in the rainy season

with the lowest concentration of  $0.19 \pm 0.08$  mg/L recorded from mean of sampling sits in July 2008 (Figure 9). ANOVA at  $P=0.24$  shows no significant difference in the phosphate concentration during the seasons and within the stations.

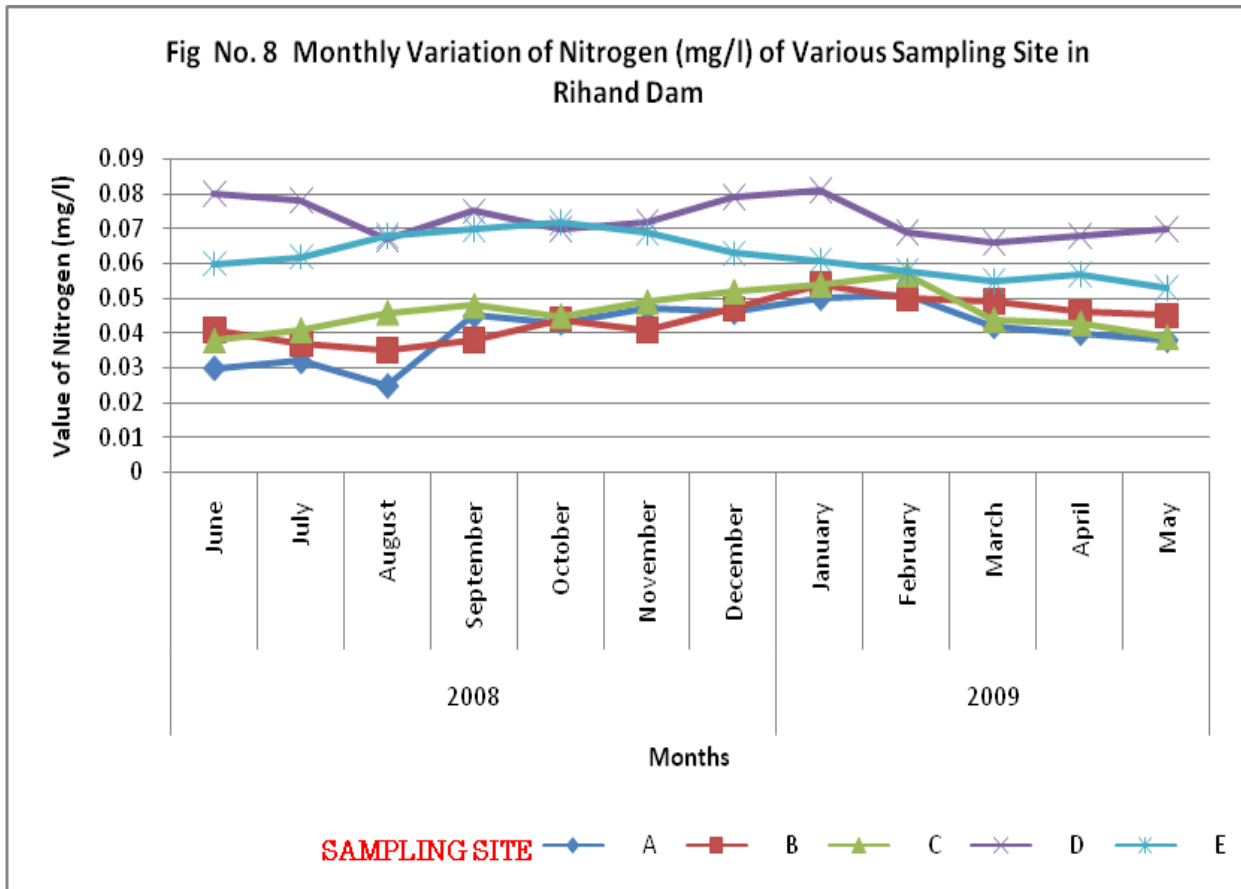
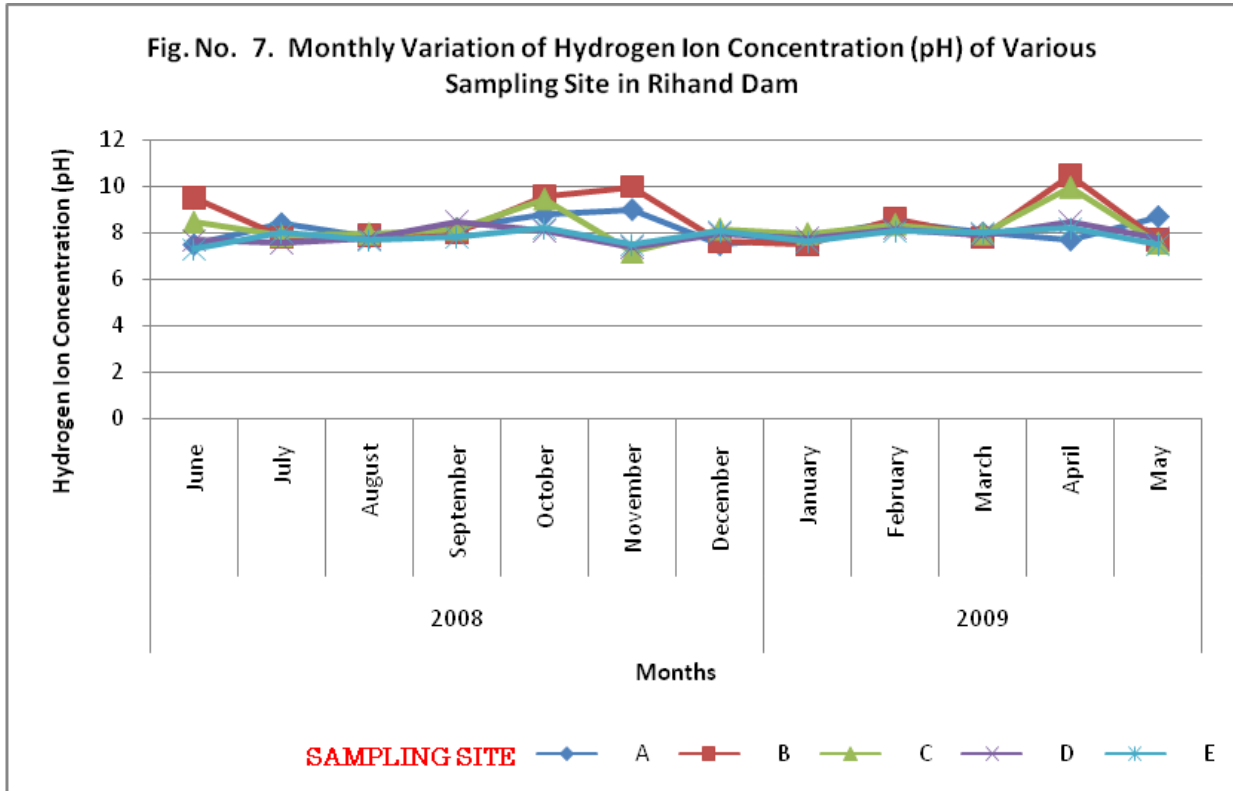
The highest monthly mean concentration of sulphate recorded was  $33.80 \pm 12.21$  mg/L which was obtained from mean of sampling stations at the peak of the cold seasons. A decrease was observed in the rainy season with the lowest concentration of  $19.20 \pm 7.66$  mg/L recorded from mean of sampling sits in July 2008 (Figure 10). ANOVA at  $(p=0.0001)$  shows significant difference in the sulphate concentration during the seasons and within the stations.

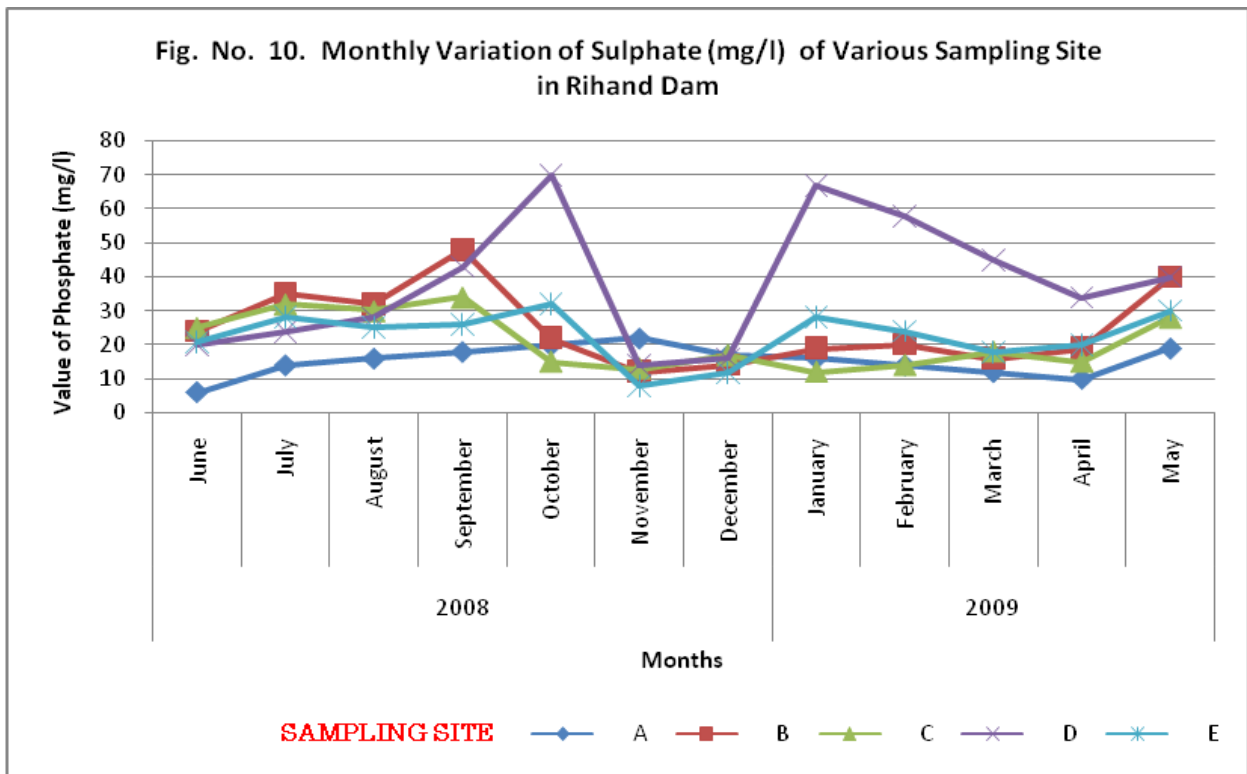
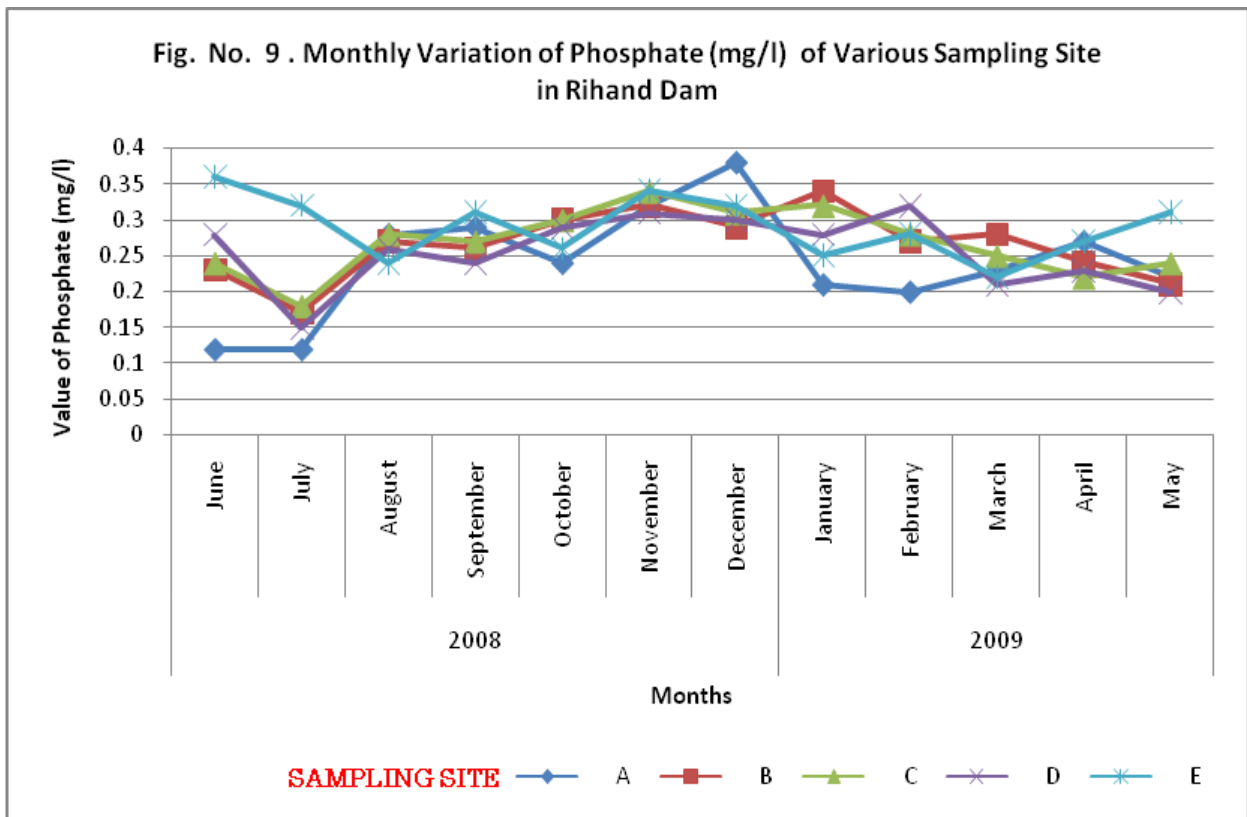




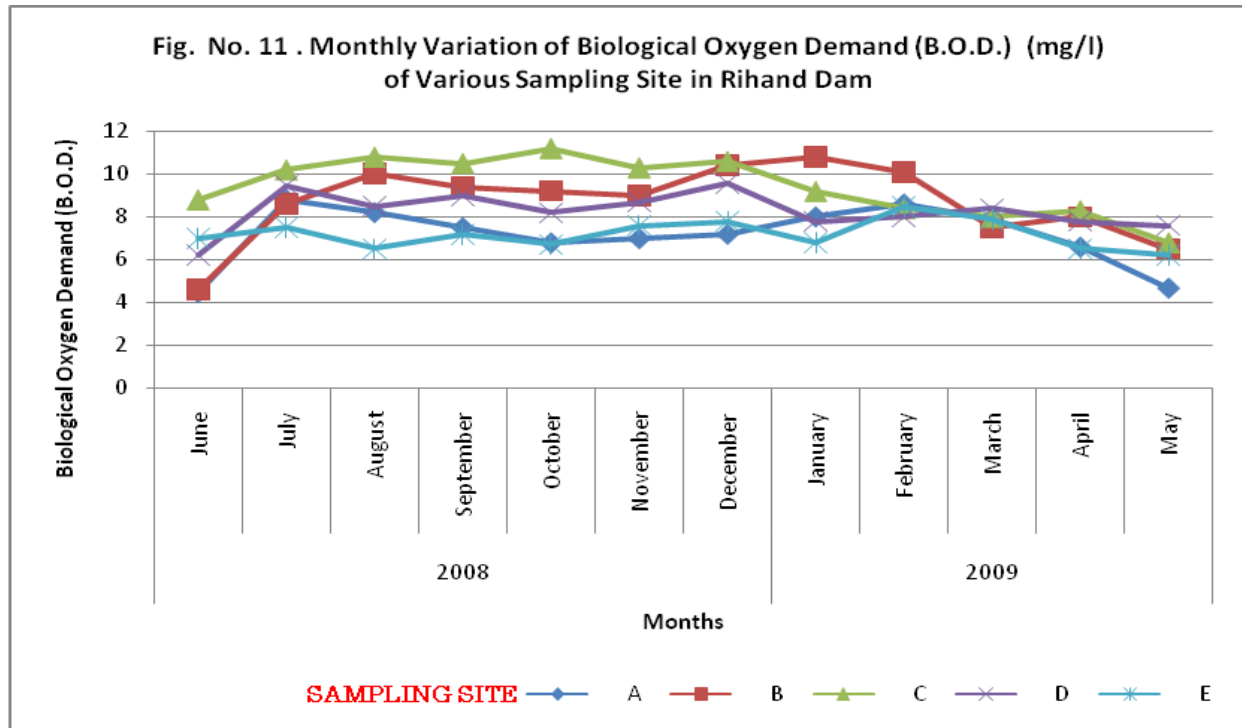
The highest monthly mean concentration of B.O.D. recorded was  $9.12 \pm 1.54$  mg/L which was obtained from mean of sampling stations at the peak of the cold seasons. A decrease was observed in the rainy season with the lowest concentration of  $6.22 \pm 1.79$  mg/L recorded from mean of sampling sits in August 2009 (Figure 11). ANOVA at  $P=0.0001$  shows significant difference in the

B.O.D. concentration during the seasons and within the stations.









## Discussion

The physical and chemical factors investigated in this research have been used to assess the water quality of some African reservoirs (Nhiwatiwa and Marshall, 2007). The surface water temperature range was similar and compares well with the ranges reported for other African reservoirs (Talling, 1969). Meteorological conditions such as trade winds, sunshine durations and absorption of the solar radiation by the shallow reservoir water body might be responsible for the monthly variations and significant differences seen between the seasons. The temperature variations in the reservoir were normal for metabolic activities of organisms such as fish as reported by Boyd and Lichtkoppler (1979) and will not affect the water quality for drinking or fish production.

Secchi disc transparency was low in the rainy season at sampling site. This could be due to the washing of silts, sediments, debris, organic and inorganic suspended particles into the reservoir of which Stations received the highest run-off of these particles. High flood water of 2008-09 which brought in more sediment may account for the significant difference in transparency of the two years. Gliwicz (1999) noted that increased turbidity is associated with rainy seasons that bring in clay and other particles from the water shed. Higher transparency in the dry season may be due to settling of the particles at the bottom of the reservoir, while the highest transparency recorded in sampling site could be attributed to the stations' transition state between lentic and lotic habitations. The range of secchi disc visibility, 14.5 c.m to 87.5 c.m, reflects the depth of light penetration and this is good for a shallow reservoir as plankton and fish will thrive in this pelagic region, thus making food available to fish.

Dissolved oxygen is an important indicator of water quality, ecological status, productivity and health of a reservoir. This is due to its importance as a respiratory gas, and its use in biological and chemical reactions. Higher dissolved oxygen recorded in the rains could be as a result

of low temperature and increased mixing of water. Tepe and Mutlu (2005) linked increase in dissolved oxygen in a reservoir in India to high run-offs occurring during the rainy season. The highest dissolved oxygen concentration recorded at Station B was a good pointer to the fact that the station is the most productive, with the highest water quality parameters and will support diverse organisms. Significantly lower dissolved oxygen in 2009 might be due to higher turbidity and increased suspended materials which affected dissolution of oxygen. This occurred from the high flood water of 2009 which brought in so much sediment. Human activities and high rate of decomposition at Station A might be accountable for the low dissolved oxygen concentration of the station. High temperature coupled with high rate of decomposition in the dry season may explain the low dissolved oxygen concentration recorded in the dry season. The range of dissolved oxygen recorded 6.2 mg/L – 14.5 mg/L shows the water to be of good quality and will support fish production. Boyd (1979) reported that dissolved oxygen concentration of 3 mg/L to 12 mg/L will promote the growth and survival of fish in reservoirs.

The mean range of chemical oxygen demand for (10 mg/L – 53 mg/L) fell within permissible level for drinking water and fish production (Hach, 2003). APHA (1995), however, recommended COD levels of <2 mg/L in drinking water. High COD has been linked with pollution (Tepe *et al.*, 2005). The high COD level at Station E and in the dry season could have occurred due to high rate of organic decomposition resulting from human activities on the dam water which produce sewage and agricultural run-offs into the reservoir and this have negative impact on the water quality.

The total alkalinity of the reservoir is a reflection of its carbonates and bicarbonate profiles (Wetzel, 2001) with the likelihood of silicates and phosphates contributing to it. This is so; because phenolphthalein alkalinity was absent in the reservoir (Campbell and Wildberger, 2001). Higher concentration of total alkalinity in the dry season

and at Station A could be due to higher carbon dioxide concentration and release of bicarbonates ions by sediments. The mean range of the total alkalinity (65–175 mg/L) compared favorably well with the range given for lakes and reservoir by USEPA (1976), and is an indicator to the good quality of the reservoir water. Suguna (1995) reported that total alkalinity above 40 mg/L is indicative of high productivity. Thus the reservoir will support good fish production.

Effects of human activities on the reservoir are much reflected on the variations seen in nitrate, phosphate and possibly sulphate concentrations. The high concentration of nitrate (0.081 mg/L) and phosphate (0.025 mg/L) recorded in Station D&A and that of sulphate (6-70 mg/L) could have come from leaching and run-off of nitro-phosphate and sulphate fertilizers from nearby farmlands. The concentrations of these ions were higher during the rainy season; because the period is usually the peak of agricultural activities around the reservoir. Washing of cow dung and bathing and washing with phosphate based detergents and soaps into the reservoir could have also caused the high concentration of the ions. These events led to cultural eutrophication of the reservoir with subsequent bloom in algae and changes to the water quality. Carpenter *et al.* (1998) and Carignan *et al.* (2000) reported that non-point source nutrients inputs from watershed are leading cause of eutrophication and water quality problems while Armengol *et al.* (1999) implicated sulphate in the eutrophication of reservoirs. Eutrophication is more pronounced in this reservoir due to its shallowness (Ekholm *et al.*, 1997). The eutrophication could affect the water quality of the reservoir by giving rise to unpleasant taste and odour, colours the water, and affects the dissolution of other gases, most especially dissolved oxygen as a result of algal bloom. The eutrophication could also pose threat to fish production in the reservoir, because it may destroy food web, decreases biodiversity at higher trophic levels (Hanson and Butler, 1994), lead to disappearance of population (Gliwicz and Warsaw, 1992) and induces changes in yield and species composition (Miranda, 2008).

The fluctuations in surface water pH indicate the buffering capacity of total alkalinity. The slight basic (pH=7.2) in the dry season may be due to high carbon dioxide concentration occurring from organic decomposition. High water volume, greater water retention and good buffering capacity of total alkalinity may have been the reason why pH was in neutral or moderate alkaline medium during the wet season and for most part of the study. Using the pH as a water quality index, the Rihand Reservoir has poor water quality with the pH range of 7.2–10.5, since most natural waters have pH between 6.5 and 8.5 (Tepe *et al.*, 2005). The pH range will allow survival of fish and its use as drinking water.

The surface water quality of Rihand Reservoir could be classified as excellent under class 1 of Prati *et al.* (1971) index and its ecological status of the reservoir is high, while its chemical status could be described as pass using the recently proposed Environmental Quality Standards (EQS) (WWI, 2005). Station B was the most productive one and its water quality was very high while Station C showed very high chemical status but with high turbidity and low transparency. In all, the ranges of physico-chemical properties of Rihand Reservoir are comparable to those found in polluted Indian reservoirs, and are within the allowable limits recognized by WHO (1997) for drinking water supply as well as fish production.

The only visible threat to the water quality and fish production is cultural eutrophication which was more pronounced at Station A as a result of human activities on the site. There is an urgent need to arrest the problem of cultural eutrophication in this reservoir to protect the water body, maintain its water quality and enhance fish production. This could be done through denitrification and nutrient control, which is one of today's focuses on applied limnology.

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# *In vitro* adventitious shoots regeneration from *in vitro* raised hypocotyls in *Aegle marmelos* (L.) corr.



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## Abstract

An efficient mass propagation method for *Aegle marmelos* was developed from *in vitro* raised hypocotyls of *in vitro* grown seedlings. In the present investigation, multiple adventitious shoot buds could be induced directly from *Aegle marmelos* hypocotyls explants inoculated on Murashige and Skoog (MS) medium containing BAP and IAA alone or in combination. Highest number of adventitious shoots and better plant growth were obtained on MS medium supplemented with 2.21  $\mu\text{M}$  BAP + 11.41  $\mu\text{M}$  IAA in combination with 67.87  $\mu\text{M}$  ADS. The regenerated shoots were successfully rooted on MS  $\frac{1}{2}$  medium supplemented with 4.92  $\mu\text{M}$  IBA. The *in vitro* raised plantlets were successfully transplanted to soil with 93% survivability under *ex vitro* condition.

**Key words:** Hypocotyls; *Aegle marmelos*; Murashige and Skoog; Propagation; Adventitious shoot, ADS.

## Introduction

The genus *Aegle* (Rutaceae) is native to India and distributed in all over India, from sub Himalayan forests, Bengal, Central and in Burma (Nadkarani, 1927). *Aegle marmelos* is the only member of the monotypic genus *Aegle* (Swingle 1943). The tree commonly known as *bael* is an important fruit tree belonging to the family Rutaceae with extensive medicinal uses in the indigenous medicine systems of India. The leaves are astringent, febrifuge, expectorant, and are reported to have hypoglycaemic and antiasthmatic properties (Nambiar *et al*, 2000). Leaf extract of *A. marmelos* is used as an antispermaticogenic (Sur and Pramani, 1999) to cure jaundice (Gupta and Sharma, 1999). It also enhances the wound healing activity (Jaswanth *et al*, 2001). The unripe and ripe fruits are useful for curing diarrhoea, dysentery, and stomachalgia (Warrier *et al*, 1996). *A. marmelos* root is one of the ingredients of the popular ayurvedic preparations such as *Dasamula* and *Vilvadi lehya*. Compounds purified from bael have been proven to be biologically active against several major diseases including cancer, diabetes and cardiovascular diseases (Maity *et al*, 2009).

*A. marmelos*, being essentially cross-pollinated and seed propagated. Seeds have short viability. Vegetative propagation is not known except by root suckers are very slow and difficult. The germination percentage of seed was very low under natural and controlled conditions so an *in vitro* regeneration system from adventitious shoot formation are considered most suitable for genetic transformation to obtain transgenic plants.

Here, we present an adventitious shoot regeneration system for producing large number of plants from *in vitro* hypocotyls of *Aegle marmelos*.

## Materials and Method

Fresh seeds of *Aegle marmelos* were collected from a single ripe fruit obtained from a matured tree situated at Pushkar (Rajasthan). The hard shell of the fruit was broken and seeds taken out. They were washed thoroughly in running tap water for 15 minute to remove the mucilagenous sheath. Seeds were Surface sterilized with Mercuric chloride ( $\text{HgCl}_2$ ) 0.1% (w/v) for 10 minutes and subsequently rinsed 4-5 times with autoclaved distilled water (Islam *et al*, 2010). After this, cut the seed coats of seeds with the help of sterilized scalpel blade, inoculated in media and then shifted in a culture room. After 30 days sterile hypocotyls were decapitated just below the first pair of cotyledonary leaves and above the tap root to serve as explants.

Murashige and Skoog's (1962) basal medium (MS medium) containing 3% sucrose and gelled with 0.8% agar was used for all experiments. The hypocotyls explants were inoculated aseptically on MS semisolid medium containing different concentration of BAP concentration ranging between 1.11  $\mu\text{M}$  to 4.43  $\mu\text{M}$  (Table 1) with control. The culture were maintained incubated in a culture room maintained at  $25 \pm 2^\circ\text{C}$  under 16/8 h light/dark cycle, 2000-2500 lux or lower light generated by cool white flourescent tubes (Philips, Mumbai, India) with 55-60% RH. After establishment of explants aseptically in culture media

these will be subcultures on optimum concentration of BAP, 67.87  $\mu\text{M}$  ADS with IAA in the concentration ranging between 0.57  $\mu\text{M}$  to 11.41  $\mu\text{M}$  (Table 1).

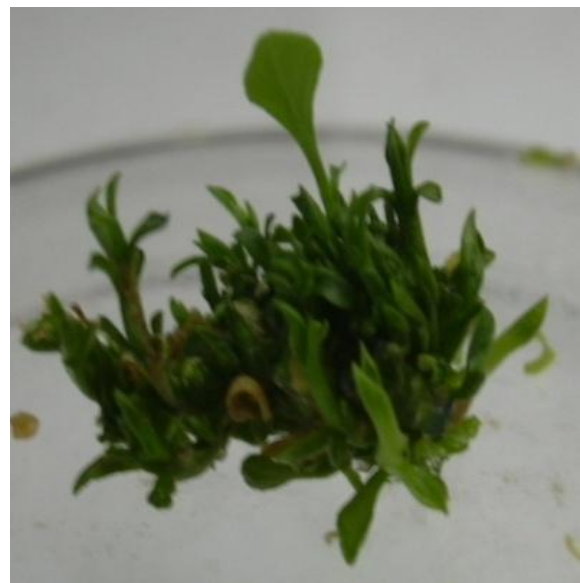
The regeneration of roots from micro-shoots was achieved on IBA in the concentration ranging between 0.49  $\mu\text{M}$  to 14.76  $\mu\text{M}$  was added in MS  $\frac{1}{2}$  medium (Table 2). The rooted plantlets were gently washed to remove the agar sticking to them. Transfer the rooted plantlets into culture bottles containing autoclaved soilrite™. Keep them under standard culture room condition for 15 days and their caps were gradually opened. After 15 days, transfer plants in green house, where humidity and temperature are maintained by using cooling fan and pad system. Keep bottles initially under high humidity region and then gradually expose them to low humidity region. Finally after one month the hardened and acclimatization plantlets were transferred to the field. Each experiment was repeated at least twice. Statistical analysis was performed on the results of each experiment and data were compared using analysis of variance.

### Result and Discussion

Histological study showed high frequency adventitious shoot regeneration in *Aegle marmelos* hypocotyls segments. Shoot buds grew as normal shoots on multiplication medium in the same manner as did shoots derived from axillary buds. Cytokinins especially BAP was necessary for shoot induction in *Aegle marmelos* explants lacking pre-existing meristem. The role of BAP in adventitious shoot bud differentiation has been demonstrated in a number of cases using a variety of explants (Dong *et al.*; 1991, Hossain; 1992, Islam *et al.*; 1994 and 2006). Effectiveness of BAP to induce adventitious meristem organogenesis has been well documented in some other plant species, for example *Citrus aurantifolia* and *C. reticulata* (Perez *et al.* 1997), cumin (Tawfik and Noga 2001).

The role of auxins incorporated in the medium individually or in combination with cytokinins for shoot bud induction has been reported in a number of cases (Caboni *et al.*, 2002; Qu *et al.*, 2002; Koroch *et al.*, 2003). Multiple adventitious shoot buds could be induced directly from the hypocotyl explants in *Aegle marmelos* with a variety of treatments. Hypocotyl segments inoculated on MS medium without any growth regulator produced only two shoots in 63% of explants. The hypocotyl segments on primary culture medium supplemented with BAP alone remained green and showed enlargement during first week in culture and developed small protuberances in next week. Further these protuberances developed into adventitious shoots within 3-4 weeks. Hypocotyl segments inoculated on a concentration range of BAP and 85.9  $\pm$  0.14 % explants showed shoot regeneration on BAP 2.21  $\mu\text{M}$  and each explant produced 12.5  $\pm$  0.35 shoots in 2-3 week incubation period (Table 1). On this medium regenerated shoots were strong but leaf curling is occurred during the incubation period. Hossain *et al.* (1995) reported the adventitious shoot development from hypocotyl on MS medium supplemented with BAP (1.5 mg/l) and IAA (0.2 mg/l) and 79 % of explants produced shoots. In our experiments we observed incorporation of cytokinin and auxin (BAP and IAA) with 67.87  $\mu\text{M}$  ADS were more effective to enhance percentage response of explants for adventitious bud induction *in vitro*. It was found that 85.1  $\pm$  0.42 % explants showed adventitious bud regeneration on BAP (2.21  $\mu\text{M}$ ) + IAA (11.41  $\mu\text{M}$ ) and each explant

produced 27.1  $\pm$  0.60 micro-shoots (Fig. 1) in 2-3 week incubation period (Table 1). Little to moderate callus also developed on cut ends of the explants but callus development did not hinder the development of shoots.



**Fig. 1** Adventitious bud regeneration on MS medium + BAP (2.21  $\mu\text{M}$ ) + IAA (11.41  $\mu\text{M}$ ) + ADS (67.87  $\mu\text{M}$ )

**Table 1.** Effects of various concentrations and combinations of cytokinins and auxins on adventitious shoot regeneration from hypocotyl explants of *Aegle marmelos*.

PGR ( $\mu\text{M/l}$ )	% response of explants (Mean $\pm$ SD)	No. of adventitious bud/ explants (Mean $\pm$ SD)	Length of adventitious shoot (mm) (Mean $\pm$ SD)
BAP			
0.0	63.0 $\pm$ 0.39	2.3 $\pm$ 0.49	11.66 $\pm$ 0.09
1.11	66.1 $\pm$ 0.38	8.1 $\pm$ 0.59	13.33 $\pm$ 0.49
2.21	85.9 $\pm$ 0.14	12.5 $\pm$ 0.35	16.66 $\pm$ 0.24
3.32	76.8 $\pm$ 0.64	10.1 $\pm$ 0.59	15.0 $\pm$ 0.35
4.43	73.5 $\pm$ 0.57	8.1 $\pm$ 0.11	13.33 $\pm$ 0.21
BAP + IAA			
0.57	66.1 $\pm$ 0.38	12.3 $\pm$ 0.23	18.0 $\pm$ 0.14
1.42	69.2 $\pm$ 0.56	12.5 $\pm$ 0.40	21.0 $\pm$ 0.07
2.85	73.0 $\pm$ 0.26	13.1 $\pm$ 0.60	23.57 $\pm$ 0.24
8.56	78.2 $\pm$ 0.31	14.2 $\pm$ 0.19	24.78 $\pm$ 0.05
11.41	85.1 $\pm$ 0.42	27.1 $\pm$ 0.60	30.71 $\pm$ 0.19

Each value represents Mean  $\pm$  SD of five replicates.



**TABLE 2. Effect of different concentrations of IBA in MS half medium on rooting of adventitious shoots raised from hypocotyls of *Aegle marmelos*.**

S. no.	IBA ( $\mu$ M)	IBA (mg)	Rooting % of shoots (Mean $\pm$ SD)
1.	0.1	0.49	39.37 $\pm$ 0.44
2.	0.5	2.46	24.77 $\pm$ 0.16
3.	1.0	4.92	81.73 $\pm$ 0.05
4.	1.5	7.38	29.14 $\pm$ 0.60
5.	2.0	9.84	21.13 $\pm$ 0.76
6.	2.5	12.30	10.55 $\pm$ 0.39
7.	3.0	14.76	9.55 $\pm$ 0.31

Each value represents Mean  $\pm$  SD of five replicates.

Regenerated shoots excised 3 cm or more were cultured on MS  $\frac{1}{2}$  medium supplemented with IBA in the concentration ranging between 0.49  $\mu$ M to 14.76  $\mu$ M (Table 2). The maximum percentage of root induction (81.73  $\pm$  0.05 %) was found in the MS  $\frac{1}{2}$  medium supplemented with IBA 4.92  $\mu$ M (Fig 2). When all rooted plantlets were transferred into culture bottles containing autoclaved soilrite™ and plantlets were well established in the soil. The rooted micro-plants from all the combinations were transferred to field conditions and their survival status were recorded separately.

The micro-plants rooted on MS  $\frac{1}{2}$  strength medium with IBA 4.92  $\mu$ M showed highest –survival under *in vitro* (95 to 96 %) and *ex vitro* hardening (93 to 94 %) stages. About 89% micro-plantlets successfully survived under field conditions.



Fig. 2 Rooting on MS  $\frac{1}{2}$  + IBA 4.92  $\mu$ M.

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# Estimation of Air Pollution: A case study of Kanpur city in India



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## Abstract

In the present study ,ambient air quality of Kanpur city was monitored by High volume sampler .The selected Parameters to judge the quality of air were sulphur dioxide ( $SO_2$ ) , Nitrogen dioxide ( $NO_2$ ) , Respirable suspended particulate (RSPM) and suspended particulate matters (SPM). Monthly air sampling was done for a period of 24 hours which gives a fair idea of pollution load carrier by the air. The monitoring data was collected from five sites randomly selected in Kanpur city.

**Keywords :**  $SO_2$ ,  $NO_2$ , SPM, RSPM

## Introduction

Air pollution is a common problem and has acquired great concern globally due to manifestation of technological and scientific innovations in various fields in addition to diverse activities of human beings for their sophistication. Every year large quantities of toxic waste are discharge into the Environment from the ever increasing production of goods and from the burning of fossil fuels to generate the energy needed to sustain Industrial and domestic activities .The unplanned growth development and vehicular boom have deteriorated the ambient air quality . Problem of vehicular pollution is rising due to increase in their number. Sulphur dioxide, Nitrogen dioxide and Suspended particulate matter is regarded as major air pollutant in India ( Agarwal and Singh,2000).The urban population is mainly exposed to high levels of air pollution including metals because of high level of motor vehicles emissions, which is also the main source of fine and ultra fine particles ( Sharma et al.,2006) ,which influence the air quality These particles can penetrate deep into respiratory system, and studies indicate that the smaller the particle, more severe the health impact (pope et al.,1995).

Kanpur is the largest and second most polluted city in the state of Uttar Pradesh in India. All the important industries such as textiles , heavy engineering, tanneries, fertilizer and leather are situated in the heart of the city .High industrial activity and the fleet of mixed vehicles are the two main contributing factors for urban air pollution in the city. Badly maintained roads , a mixed traffic pattern, and road encroachment aggravate the impact of vehicular pollution in the Kanpur. Diesel driven tempos are the major portion of the public transport system , causing heavy noise pollution as well as smoke emission in the city. Another source of air pollution in Kanpur is domestic fuel. Use of coal, wood, cow dung etc., in the slum settlements and low income group (LIG) colonies along the railway yard generate localized smoke problem, which effect visibility and cause eye irritation. Such situation needs continuous monitoring of ambient air quality and looking at the graveness of the situation the present study has been carried out.

## Materials and Method

Five sampling sites were selected in Kanpur city on the basis of different direction

- **Jajmau** (located in the east of Kanpur)
- **Bada chauraha** (located in the centre of Kanpur)
- **Kalyanpur** ( located in west of Kanpur)
- **Tilak Nagar** (located in the north of Kanpur)
- **Kidwai Nagar** (located in the south of Kanpur)

## Sampling and Procedure

In the present study ambient air quality is monitored using high volume sampler was (packwill Multistage sampler) Eight hour daily for suspended particulate matter (SPM)and gaseous pollutant in winter, summer ,monsoon with frequency of once in a week. For suspended particulate matter, the ambient air was filtered through glass microbe filter paper GF/A(20.3x25.4cm).The SPM present in the air thus got deposited on the surface of filter paper. The filter paper was reweighed after sampling, which gives the amount of SPM in the air during that



time period and this concentration of particulate matter in ambient air was then computed on the net mass collected, divided by the volume of air sampled.

For gaseous pollutant ( $\text{SO}_2$  and  $\text{NO}_2$ ), sampling was done at an interval of four hr in a day.  $\text{SO}_2$  concentration was analyzed by modified west and gaeke method (1956) parosaniline method. In this method  $\text{SO}_2$  was absorbed in absorbing solution of tetrachloromercurate solution and form a complex of dichlorosulphitomercurate. The complex was made to react with parosaniline and formaldehyde to form intensely coloured parosaniline methyl sulphonic acid. The absorbance of the solution is measured at wavelength of 560nm.  $\text{NO}_2$  concentration in ambient air was monitored by modified Jacobs and hochheiser method  $\text{NO}_2$  was absorbed in the absorbing solution of sodium hydroxide and sodium arsenite to form a stable solution of sodium nitrite and the absorbance of the solution is taken at 540nm.

### Results and discussions

The study has shown variation in the pollutant levels during winter, summer, and monsoon season in the city ambient air quality.

**Sulphur dioxide ( $\text{SO}_2$ ):** The mean value of  $\text{SO}_2$  at Jajmau, Bada chauraha, Kalyanpur, Tilak nagar and Kidwai nagar was 38.65, 29.87, 29.65, 14.00, 22.28  $\mu\text{g m}^{-3}$  in winter, 32.23, 28.59, 22.76, 12.27, 18.18  $\mu\text{g m}^{-3}$  in summer, 30.92, 25.62, 20.26, 11.25, 18.26  $\mu\text{g m}^{-3}$  in monsoon seasons respectively. According to NAAQS the permissible limit of  $\text{SO}_2$  is ( $80\mu\text{g m}^{-3}$ ) and data's of all sites shows that the average level of  $\text{SO}_2$  is below the prescribed limit.

**Nitrogen dioxide ( $\text{NO}_2$ ):** The mean value of  $\text{NO}_2$  at Jajmau, Bada chauraha, Kalyanpur, Tilak nagar, Kidwai nagar is 40.46, 41.72, 35.16, 44.50, 45.16 in winters, 41.4, 39.8, 38.3, 37.5, 38.1 in summers, 38.17, 37.02, 32.94, 37.36, 37.78 in monsoon seasons respectively

The average level of  $\text{NO}_2$  was below the prescribed limit of NAAQS ( $80\mu\text{g m}^{-3}$ ). The mean concentration of  $\text{NO}_2$  was observed maximum in kidwai nagar in winters and minimum in Bada chauraha in monsoon.

**Suspended particulate matter (SPM):** The mean value of SPM at Jajmau, Badachauraha, kalyanpur, Tilaknagar, Kidwainagar is 493.69, 503.42, 469.01, 482.70, 492.61 in winters, 487.91, 497.67, 460.45, 472.90, 473.2 in summers, 439.5, 427.5, 432.17, 455.02, 464.89 in monsoon season respectively. SPM was found to be highest in Bada chauraha in winter and minimum in kalyanpur in monsoon season.

In the above study the concentration of SPM,  $\text{NO}_2$  and  $\text{SO}_2$  was maximum in winter in comparison to summer and monsoon season. During winter season there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant masses. It prevents an upward movement of air, hence atmospheric mixing is retarded and pollutants are trapped near the ground. Secondary, cold starts in winter lead to longer period of incomplete combustion and longer warm up times for catalytic converter, which generates more pollution (Faiz et al., 1995).

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# Role of Wireless Technologies in e-commercialization of Indian Rural Market - A Hope for Rural Market

## Abstract

When discussing the impact of e-commercialization among Indian Rural Market there is a need to equally look at the process and the access issues. Access is related to machines, communication tools and technologies such as Win MAX, GSM, and IP because the e-commercialization is implemented with the help of these technologies. Process is about participant, communication and people and issues such as their needs, content and language and computer knowledge. In this paper we focused on the issues related to e-commercialization of Indian rural market as well as the technologies that are used in this implementation and also what is the role of these technologies in the progress of e-commercialization. There are lots of technical challenges are associated with the implementation of these technologies so how wireless technologies implemented in rural areas such that it can use in the e-commercialization of Indian rural market.

**Keywords:** e-commercialization, WI-FI, Spectrum, Rural market, Ze Big.



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## Introduction

Inclusiveness is a growth mantra for policy makers not in the India but all across the world. There are huge gap between Indian rural and urban markets. Elimination of this divide is needed so that to have balanced growth of country. "Rural commercialization" for the purposes of this symposium refers to a virtuous cycle in which rural Indian intensify their use of productivity-enhancing technologies on their farms, achieve greater output per unit of land and labor expended, produce greater farm surpluses (or transition from deficit to surplus producers), expand their participation in markets, and ultimately raise their incomes and living standards. This is the vision of commercialization explored in this paper. This paper examines multiple aspects of the linkages of Indian rural households to national and international markets and how to improve these linkages to sustain improved rural livelihoods. Supportive government investments and well-functioning private and public market institutions, together with foresight in the design of agricultural policies, are required to take advantage of market opportunities to sustain increased agricultural output and raise rural incomes. Our analysis supports a multi-dimensional agenda to address the constraints that keep markets from serving the rural population and to enhance their participation in the domestic and global economy. Key policy issues and research needs are identified for effective policy design of domestic infrastructure and institutional development and for the performance of international agricultural and food markets. Complementary analysis is also needed addressing a wider set of markets affecting the poor, particularly those for labor, credit and land. E-commercialization plays an important role in the development of the rural market.

## 1: e-commercialization in the Indian Context:

e-commerce has become a dynamic force changing all kinds of business operations worldwide. The related concepts and business practices not only influence communications, the routines of daily life, and personal relationships, they represent opportunities for initiating new international and domestic business ventures. But exploiting these opportunities challenges conventional notions of business management, because e-commerce changes the characteristics and rules of business competition through electronic flows of information and money. Organizations should seek and embrace these opportunities, employing effective strategies and scarce resources, along with technological and managerial expertise, to position themselves in the increasingly Internet-influenced world. Revolutionary changes had occurred in the agrarian property relations towards the end of the 18th century. This was over a period of time, followed by a commercial revolution in the agricultural sector. Commercialization of agriculture became prominent around 1860 A.D. This brought about a change from cultivation for home consumption to

cultivation for the market. Cash transactions become the basis of exchange and largely replaced the barter system. A significant feature of commercialization of agriculture in India was the substitution of commercial non-food grains in place of food grains. George Byn records that between 1893-94 to 1945-46, the production of commercial crops increased by 85 percent and that of food crops fell by 7 percent. This had a devastating effect on the rural economy and often took the shape of famines. Coming to the impact of the commercialization of agriculture, normally speaking, it should have acted as a catalyst in increasing agricultural productivity. But, in reality this did not happen due to poor agricultural organization, obsolete technology, and lack of resources among most peasants. It was only the rich farmers; who benefited and this in turn, accentuated inequalities of income in the rural society. Further, increasing demand for some of the commercial crops in other foreign countries gave impetus to commercialization of agriculture.

## 2: Need of e-commercialization:

Mahatma Gandhi said "India lives in villages". Most of the people in village are depend on agriculture allied agriculture activities. Although agriculture contributes one fifth of the gross domestic product in India but in this age all the villagers cannot earn their livelihood from the agriculture. Other sources of employment are limited in Indian rural areas so e-commercialization provides new platform to the rural population for employment and reorganization in the global market. ICT can play an important role in the proper development of e-commercialization of rural market. The basic factors that generates the need of e-commercialization are given as-

1. About 70% people are living in 638588 villages in India but this rural population cannot match the fast pace of economic growth because of income disparities and continuing high level of poverty.
2. Rural masses are information ally poor e-commercialization provides information at right time which enhances productivity and bring prosperity in rural areas of India.
3. By providing latest information about the agriculture, market, education, and knowledge about various schemes and projects launched by the government for the welfare of rural areas social economic conditions of Indian rural areas can be improved.

## 3: Why this e-commercialization becomes popular:

A network infrastructure with pure connectivity alone is not enough to enhance the socio-economic class of a community. Therefore, simultaneous development of innovative applications and new service models are needed. As ubiquitous wireless technologies and services continue to expand, it is necessary to design new and appropriate applications. The social goal of ubiquitous connectivity is to provide increased access to information for all members of the community; its economic goal is to develop information as a commodity along with knowledge products and services<sup>[5]</sup>. The confluence of these two goals brings together people, information infrastructure, content, and applications India for long has been favorite destination for e-commercial centers over past several years. The various reasons behind it are explained below-

3.1: **More opportunities:** There are many opportunities in rural shoring, because of this fact the e commercial company are moving for rural shoring. It is because of the youth in the rural areas it offers great opportunities to serve in the rural area with better packages.

3.2: **Low attrition rate:** The second important factor behind the need of e- commercialization is its low attrition rate. This has encouraged many e- commerce centers to shifted towards the rural areas.

3.3: **Low infrastructure cost:** Because of cheap resources are available in rural areas it has becomes the important factor that generates the need of e-commercialization in Indian rural market.

3.4: **Other factors:** some other important factors are given as-

- a) Cost efficiency.
- b) Corporate social responsibility.
- c) Generate employment in rural areas.
- d) Skill development.
- e) Leverage talent of women of rural areas.
- f) Scalability.

## 4: Additional Challenges of Rural e-commercialization

Rural populations in most developing countries are mainly engaged in small-scale agriculture or Agriculture-related activities and are generally poorer than their urban counterparts. The characteristics of rural markets are largely determined by the spatial, temporal, and covariant nature of most rural economic settings, and include the following inherent impediments to efficient markets:

- Low population density, small average loans, and low household savings, which increase the transaction costs per monetary unit of financial intermediation.
- Lack of infrastructure (communications, electricity, transportation, etc.), limited social services (education, health, etc.), and low integration with complementary markets result in highly fragmented financial markets that involve high costs of overcoming information barriers and limit risk diversification opportunities.
- Seasonality of agricultural production and susceptibility to natural disasters (such as flood, drought and disease) heighten the probability of covariant risks (in prices and yields) affecting client incomes and add to the costs of rural financial intermediation.

The combination of these specificities leads to increased transaction costs and risks for any wireless service provide which wanting to serve rural clients. For these reasons, many e-commerce institutions have largely avoided serving rural areas.

## 5: Using ICTs More Strategically for Rural Market Development

According to India's first Social Development Report a large proportion of Indians are still below the poverty line: 26% or about 260 million (193 million in rural and 67 million in urban areas). The poverty is increasingly concentrated in a few geographical locations and among

specific social groups. The incidence of poverty as per 2009-2010 figures, Punjab state has the lowest of 6.16%, followed by Haryana at 8.74% and Kerala at 12.72%. Orissa state has the highest incidence of poverty of 47.15%, followed by Bihar at 42.60% and Assam at 36.09%.

Though, poverty levels have shown a decline, there is huge disparity among social classes with percentage of the poor among Scheduled Tribes being 43.8, Scheduled Castes 36.2 and Other Backward Classes 21 (Dhar, 2010).

**Table 1: Rural-Urban Distribution of Population – India and Select States**

India/State/Union Territory*	Population			% Rural population
	Total	Rural	Urban	
<b>India</b>	<b>1,027,015,247</b>	<b>741,660,293</b>	<b>285,354,954</b>	<b>72.22</b>
Jammu & Kashmir	10,069,917	7,564,608	2,505,309 <sup>1</sup>	75.12
Punjab	24,289,296	16,043,730	8,245,566	66.05
Delhi*	13,782,976	963,215	12,819,761	6.99
Uttar Pradesh	166,052,859	131,540,230	34,512,629	79.22
Bihar	82,878,796	74,199,596	8,679,200	89.53
Assam	26,638,407	23,248,994	3,389,413	87.28
West Bengal	80,221,171	57,734,690	22,486,481	71.97
Orissa	36,706,920	31,210,602	5,496,318	85.03
Madhya Pradesh	60,385,118	44,282,528	16,102,590	73.33
Maharashtra	96,752,247	55,732,513	41,019,734	57.60
Andhra Pradesh	75,727,541	55,223,944	20,503,597	72.92
Karnataka	52,733,958	34,814,100	17,919,858	66.02
Kerala	31,838,619	23,571,484	8,267,135	74.03
Tamil Nadu	62,110,839	34,869,286	27,241,553	56.14
Pondicherry*	973,829	325,596	648,233	33.43

<sup>1</sup> Global Information Technology Report (2010), Oxford University Press, Oxford. , pp. 58-59

India, over the past decade, has become a test bed for innovations in information and communication technologies (ICT) serving the rural user. Various reasons explain this emergence. The most obvious is the search for a solution to what has long been an intractable problem: that rural India has remained poor while the rest of the country has moved ahead. The hope that ICT can surmount at least some of rural India's social, political, and administrative challenges and create a viable technology for the provision of health, education, and other social services is thus ICT's strongest calling card. An additional expectation is that ICT can be used innovatively to improve access to the large, underserved market that rural India's 700 million people represent, especially considering that India has the resources to build an ICT infrastructure, i.e., its large, skilled, cost-efficient IT workforce.

### **6: Scope of e-commercialization**

Rural markets in India constitute a wide and untapped market for many products and services which are being marketed for the urban masses. There is a demand for telecommunication services to be provided to in these areas. Till now it was government which was trying to reach the villages through various initiatives, but the rural tele-density is very poor and can be improved only through the introduction of modern and suitable technology along with participation from the private operators. The paper here would like to make a strong case for the use of mobile technology for rural areas versus the land line, and that the initiative has to come from the private telecom operators rather than the government end. The various marketing issues related to marketing of telecommunication services in rural areas area seen through the 4 as framework and the experiences of other countries studied for learning e-commercialization permits the fast sharing of ideas and techniques through the means of information technology. A new product will only succeed if-

1. It satisfies a customer's needs, wants and desires.
2. It can be economically produced and sold at the right price.
3. delivered to the market through appropriate distribution channels within the window of market opportunity.
4. Satisfies applicable safety or performance criteria and delivers lasting values.

E-commercialization helps in sharing the ideas, innovations and market demand to manufactures and researchers who want to make reputation in market and earn profit by selling their basic ideas. However patents, copy writers and other standards limit their free flow use in market. New policies should be formed to make the feasibility of part copying the ideas for public interest.

### **7: Role of Wireless technologies in e-commercialization**

The world of wireless telecommunications is rapidly evolving. Technologies under research and development promise to deliver more services to more users in less time and it helps the e-market in rural areas. The role of wireless technologies in the process of e-commercialization can be studied under following points-

- India has emerged as a significant force around the world fueled by its rapid growth last decade. The economic growth has taken place concurrent to its explosive growth in communication sector. The

wireless technologies play an important role in this economical development.

- The latest wireless technologies have capability required to get broadband to all villages so that e-commercialization rate can be increased and rural market of India will become the important part of global market.
- Some of the rural areas have small cottage industries which produce traditional handicrafts which often have a great demand in the other areas or sometimes in other countries. In our framework, the newer wireless technologies could be used for delivering the demands from outside and also the information about exporting these traditional goods. At the same time, information about other goods and products could be supplied to the rural areas. So, it could be a means of expanding ecommerce even in the rural areas.
- Farmers in India are perennially affected by fluctuations in the commodities market. However, the information needed to manage risk and track price updates and trends in commodity trading in the volatile global market were not available to them. Connectivity will help them check weather forecasts and register the prices of their agro-products at the nearest government market or futures exchange. Farmers can also purchase fertilizers, herbicides, and other raw materials for their agricultural work.

### **8. Issues Related to Implementation of Wireless Technology in Indian Rural areas**

#### **A. Accessibility**

For most rural areas lack of access to advanced voice and data services is a barrier to network readiness. Within the next few years those who do not have access to the next generation of broadband-driven communication technologies, such as Voice-over Internet Protocol (VoIP), video telephony, and Internet protocol television (IPTV), will bear a great disadvantage. The Indian Government need to build a broadband communication infrastructure that is accessible to all, in order to encourage social service and e-government applications.

#### **B. Availability**

Wi-Fi has become the most common use of unlicensed bandwidth for so-called "hotspot" or "hot zone" or "hot city" type of coverage. This is because of the widespread availability of Wi-Fi radios that comply with IEEE 802.11b and the upcoming 802.11g/standards. Wi-Fi has 100% global recognition and has become the single networking standard for all developers, equipment manufacturers, service providers, and end users. The main advantage with Wi-Fi is that large-scale, service-level roaming between different Wi-Fi providers is possible, as Wi-Fi certification has become a de facto standard for IEEE 802.11-based products<sup>[13]</sup>.

#### **C: Affordability**

The benefit of using Wi-Fi in the last mile is that the client device is extremely inexpensive due to the large volume of production. Capital investment is also cost-effective, providing greater flexibility than traditional wired communications, which in turn results in lower prices for Wi-Fi broadband services. Standardization and interoperability between different vendor products have lowered Wi-Fi prices and facilitated its rapid penetration from a niche to a mass market worldwide. For the next few

years at least, Wi-Fi will proliferate rapidly as a last-mile option and deliver wireless broadband access at prices dramatically lower than Win MAX.

### **09: Technical Challenges**

There are some operational and technical challenges for implementing e-commercialization in rural India that are summarized as-

- Primary installation costs might be a bit high for the developing countries to bear.
- Detailed planning is required to decide which areas should have kiosks, which areas should be chosen for deploying wireless sensors etc.
- Computer literate people are required at each village kiosk. So, some of the people should be trained for this.
- Some rural areas don't have good communication facilities. Roads are often not suitable for the movement of heavy vehicles like the wireless access point carrier buses or MAPs.
- In disastrous situations like, storm, heavy rainfall etc. the wireless technology might not come as useful

### **Conclusion**

Any new system is often expensive and has some preliminary installation costs. But, once it is set up, it could run smoothly and serve for the greater benefits. As wireless technologies are growing rapidly to replace wired systems in many sectors and to make life easier, we believe that, our proposed framework could play a key role for the rural development by providing various e-services to the village inhabitants. In comparison with other existing systems, we believe that, this framework would be helpful to provide cost effective tele-medicine facilities to the people in the rural areas. To provide the best connectivity in a short period of time, the emerging wireless technologies should be positioned to reach every village, town, and city in India, thereby enabling a modern high-tech network infrastructure across the country. This kind of fully integrated, modern broadband wireless infrastructure throughout all tiers of the economy will foster equal and sustainable socio-economic development.

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# Need of Work-Life Balance to Manage Job Stress among Indian Women Professionals



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### Abstract

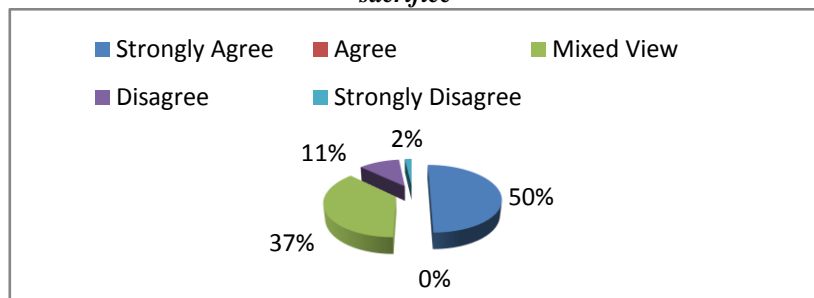
India is a service destination for numerous global business firms and it is evident that the boom in her economy is a more recent phenomenon which puts the workforce in greater stress than ever before. The term work/life balance has become a buzz word of today's era. Most workers today, regardless of gender, have family responsibilities, and most married workers, regardless of gender, have an employed spouse. But jobs are still designed as if workers have no family responsibilities. Most of the Indian professionals find it difficult to cope with the stress levels as many of them are required to work in night- shifts, moreover the entry of a large percentage of women into the workforce is adding to the complexities in Indian Corporations. This article provides an insight on the need of work-life balance to manage stress among Indian women professionals, where their lives become a juggling act that included multiple responsibilities at work and daily routine responsibilities of life and home. This helps to illuminate the work-life imbalance of women employees and their role ambiguities. Work-life balance & stress management strategies if adopted will be valuable tool in this transformation.

**KEYWORDS:** Job stress, Work-life balance, Women professionals

### Introduction

Work-life balance is the term used in the literature to refer to policies that strive to achieve a greater balance between work and home responsibilities. Increasingly, many employees and organizations nowadays are viewing work-life balance as an important issue. In today's world, where every individual has to balance conflicting responsibilities and commitments, work-life balance has emerged as a predominant issue in the workplace. In fact, the frustrating search for work life balance is a frequent topic of conversation among men and women alike. The term is especially significance for Indian women who face a complex set of demands on the roles played by them at different level and places. The Indian way of life is highly saturated with various cultural, religious and societal enigmas and demands, which when the most iron – willed and strong hearted women will find a change to defy. Work-life imbalance usually arises out of a lack of adequate time or support to manage work commitments as well as personal and family responsibilities. Meeting the competing demands of work and family is not only tiring but can be stressful and can lead to sickness and absenteeism. It inevitably affects productivity. Work-life balance, which is considered as a state of well being to handle multiple responsibilities, has become a critical factor for bringing individual and organizational success. Work-life balance is best achieved when an individual's right to a fulfilled life, both inside and outside paid work, is accepted and respected as the norm, to the mutual benefit of the individual, business, and society.

**Fig 1. Women's progress in professional career involves personal sacrifice**



Many people assume that job stress related to work hours, demands, pace and other pressures is on the rise. Stress and work-life conflict are intertwined, and the latter has been documented as both a cause and an outcome of job stress. Stress

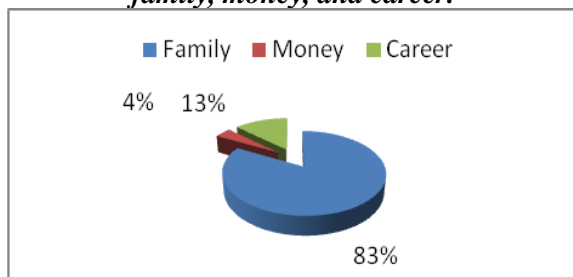


is one of the more commonly documented outcomes of demanding work. Job stress is increasingly recognized as a determinant of employee health and productivity.

## 2. Work Life Balance in the Indian Context

Research conducted by Rout, Lewis and Kagan (1999) finds that women in India experience <sup>2</sup>considerable pressure, in the morning before going out to work and after work, to do all that is necessary for the family. Komarraju(1997) notes that the relative absence of an infrastructure that provides a reliable supply of electricity, water, and time-saving, modern-day kitchen and other appliances, renders the performance of domestic responsibilities a burden, particularly for women in dual career families. In addition, inflexible working hours and the absence of childcare facilities constitute impediments rather than sources of support for employed mothers (Bharat, 2001). Though in urban India, things have started improving, yet they are not adequate. For maintaining work-life balance, social support plays a very significant role for women managers. In societies, where there is low gender egalitarianism, such as in India, spousal support is extremely important for women (Rosenbaum and Cohen, 1999). But unfortunately, even though Indian husbands are supportive of their wives' participation in the workforce, they are yet to assume responsibility for sharing domestic chores (Ramu, 1989). In India, instrumental support for most working women come in the form of hired domestic helps or female members of extended families. Although hired domestic helps in urban areas of India have been noted to be expensive and unreliable, they still continue to be a major source of support for the growing number of nuclear families who live far from their relatives (Sekaran, 1992).

**Fig 2:Top priority for women among the family, money, and career.**



Although conflict between career and family roles can be a potential source of stress for both women and men managers, it affects women in India more than men because of many reasons. While social, legal and economic reforms have helped women to join the workforce in India, the continuing influence of normative attitudes and values have prevented them from altering the perceptions of the society as well as their own regarding their sex-roles. The expectation that women should give priority to their family-needs leads to higher levels of personal role-overload for women than men.

<sup>2</sup> Knight , J (1994). "Motherhood and Management," in Morgan Tanton (Ed.), *Women in Management: A Developing Presence*, New York: Routledge

## 3. What is Work Life Balance?



2:Rout, U R; Lewis, S and Kagan, C (1999). "Work and Family Roles: Indian Career Workmen in India and the West," *Indian Journal of Gender Studies*, 6(1), 91-105.

WLB can be defined as "A state of equilibrium in which the demands of both a person's job and personal life are equal." Work Life balance is a phenomenon that occurs to those who are <sup>3</sup>gainfully employed and have to manage their personal life.WLB does not mean an equal balance. Trying to schedule an equal number of hours for each of our various work and personal activities is usually unrewarding and unrealistic. We are all engaged in a number of roles everyday and we hold a number of roles throughout our life. Life conflict occurs when we are unable to give our "many roles" required time and energy as a result of which participation in one role is made increasingly difficult by participation in another. So, there is a need of Work life balance. Work-life balance is the daily Achievement and Enjoyment in all spheres of life namely work, family, friends, health and spirit. Best individual work- life balance will vary over time, often on a daily basis. The right balance for today will probably be different for tomorrow.

## 4. What is Stress?

The term stress is basically from physical science where it means the force placed upon an object to cause damage, bending, or breaking. In case of human beings stress is often used to describe the body's responses to demands placed upon it, whether these demands are favorable or unfavorable. Anything that causes stress is called a stressor.

## 5. Need for Balancing Work and Life

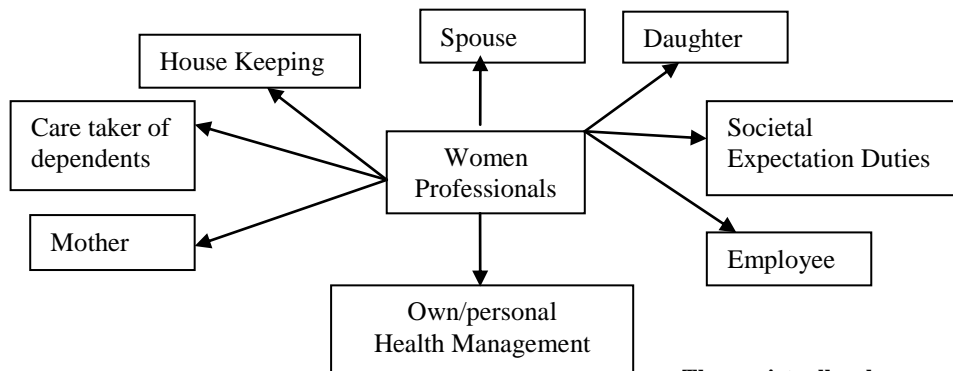
In today's world, where every individual has to balance conflicting responsibilities and commitments, work-life balance has emerged as a predominant issue in the workplace. Work-life imbalance usually arises out of a lack of adequate time and/or support to manage work commitments as well as personal and family responsibilities. Meeting competing demands of work and family is not only tiring but can be stressful and can lead to sickness and absenteeism. It inevitably affects productivity. Work-life balance, which is considered as a state of wellbeing to handle multiple responsibilities, has become a critical factor for bringing individual and organizational success. Work-life balance is best achieved when an individual's right to a fulfilled life, both inside and outside paid work, is accepted and respected as the norm, to the mutual benefit of the individual, business, and society. A balanced life conceives of work and family as mutually reinforcing. Organizations, aware of the positive

implications of balanced life, have begun considering family experiences as part of what workers bring to their workplace to enrich their contributions to work and organizations and *vice versa*. When an employer adopts policies favourable to work-life balance, it is likely to be perceived by the employee as a huge incentive, which can motivate them as much. Past studies indicates that women seem to be more strongly affected by psychosocial stressors related to cardiovascular disease and depression as well as by direct and indirect effects of chronic stress compared to men. Successfully achieving work life balance while ultimately creates a more satisfied workforce that contributes to productivity and success in the workplace.

**6. Role Overload**

A woman plays a multitude of roles in Indian society such as spouse, parent, housekeeper, employee and entrepreneur. These roles come with their own set of expectations and commitments. Working women face more difficulties due to two jobs i.e. paid work outside the home and unpaid domestic labor and child-care inside the home, both of which may occupy many hours each day and energy – once a woman spends this on one role, she has that much less for the other roles. **This led to role overload, which ultimately lead to work life imbalance and finally stress.**

*Fig 3: Professional women and her multidimensional roles*



option. They virtually have no cubicle in their offices

**7. Management Of Stress By Women Professionals**

Women who undergo periods of intense stress need to make sure they have sufficient recovery periods along the way to help replenish lost energy. During high stress periods, build in time for self-care. Take a wellness approach to life. This can be achieved through balancing and integrating different parts of life. Recognizing the connection between mind, body and emotions can also help women manage stress and give them healthy control over their lives. Women need to recognize their own unique makeup and tailor a stress management program with healthy coping skills. Here are some examples:

- **Physical**—regular exercise, relaxation, yoga, healthy eating, leisure time, adequate sleep
- **Emotional**—know/express emotions, positive emotions, healthy self-esteem
- **Mental**—positive outlook, realistic thinking, resilience attitude, creativity
- **Occupational**—prioritize, doable goals, home-work balance, limit setting
- **Social**—loving relationships, healthy boundaries, attentive listening
- **Spiritual**—meaning/purpose, gratitude, present-moment focus, living life fully

**Steps to Maintain a Good Work-Life Balance at Their Workplaces.**

1) **Working from home:** - Not all companies in India offer generous work-life balance options yet, but quite a few surprisingly do. For instance, nearly 50,000 employees at IBM India and about 15,000 tech workers at HP India are taking advantage of their companies’ work-life balance

and are allowed to work from home. Microsoft India too reimburses telephone and broadband usage to their employees for working from home and offers them a variety of flexible working options.

2) **Plan work in a way that you can take the weekend off:** - Unlike western countries a majority of the Indian workforce still functions on a 6 day week routine. However with certain MNCs taking the lead with 5 day work weeks, big corporate houses may very well be seen giving weekend offs to some of their employees.

3) **Opting for split shifts:** - For the uninitiated, a split shift is one of the latest work-life initiatives that India Inc has taken to. In split shifts, employees can work for a few hours in the morning, attend to their personal work during afternoons when business tend to be typically slack and return in the evening to close the day. Aegis, BPO Outsourcing Solutions Company and Apollo Hospitals in Bangalore implemented the Split Shift initiative

4) **Making full use of the company’s facilities:-** Surprisingly many employees who work in corporate houses with sprawling campuses and innumerable facilities don’t actually use it. Many big companies in India offer gym facilities, sport courts, crèches, grocery stores, banking facilities and cafes within their campus. Employees should try to use these facilities.

5) **Optimization of time at work:-** "Work expands so as to fill the time available for its completion" says Parkinson’s Law. Taking a hint, employees should look at maximizing all available resources, including time, to get work done. Pending personal calls, chatting with

colleagues, personal errands and everything else that are not related to work can be finished once work is complete.

### **Conclusion**

For working women, getting caught in the work/life balance trap will continue to be an ongoing challenge. In an increasingly hectic world, the work-life strategy seeks to find a balance between work and home. A sentence that brings the ideas of work life balance to the point is: "work to live. Don't live to work." One must also need to understand that the burden of managing career and family that women professionals face may result in negative mental and physiological health outcomes. In the competitive business environment, when the number of women professionals is steadily increasing, the employers can best utilize the potential of its women employees only if they are sensitive to these issues concerning work-life balance. It is a reality that though Indian organizations are a lot more open to the idea of having more women at their top and senior management levels, the talent pool of women candidates at the top level is very shallow. Indian organizations must understand that societal expectations and family responsibilities do come in the way of the women professionals and their career decisions. In this context, allowing them to manage their family responsibilities without seeking help from their organizations, is a very short-sighted approach. Organizations must ensure and declare that they are ready with various work-life balance provisions which would help the women professionals to balance their professional and family responsibilities. This will act as a competitive advantage for the organizations and also help them in establishing strong employer branding. It is suggested that employers need to come up with various work-life balance-friendly provisions which can help them in attracting and retaining female talent. It is the responsibility of the employers to be sensible while designing the human resource policies of their organizations to best utilize women's potential. In order to have a better work-life balance, the organizations as a whole must be sensitized at all levels to the work-life issues; this will definitely contribute to the larger cause of organizational effectiveness.

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