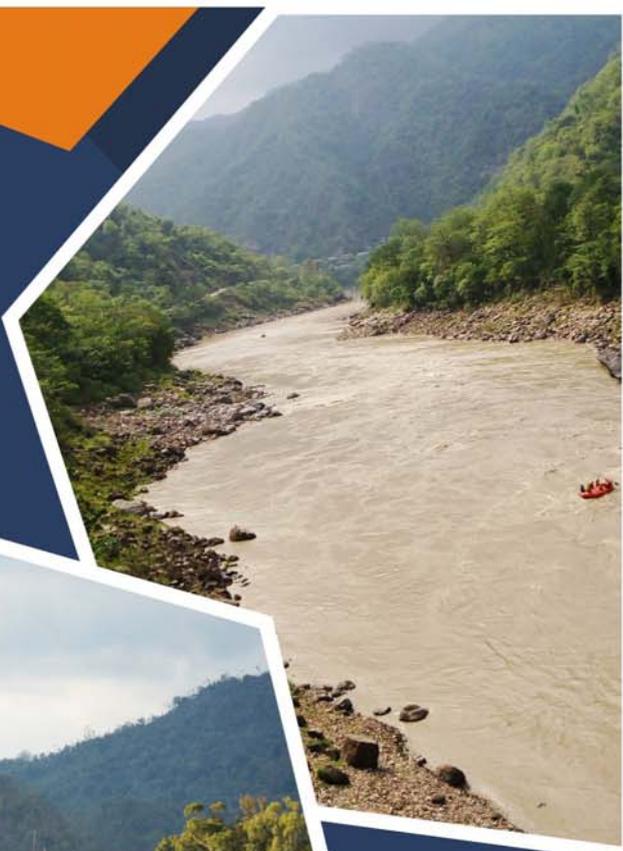




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CONTENTS

- | | |
|---|---------|
| 1. Studies on seasonal variation of some physico-chemical parameters of River Dhamola at Distt. Saharanpur (U.P.) | 1 – 9 |
| Priyanka Rajvanshi | |
| 2. Antioxidant and anticandidal activity of <i>Juniperus communis</i> L. | 10 – 16 |
| Pankaj Kumar, Harish Chandra, Ajay Singh, Rajendra Prasad R.P. Bhatt | |
| 3. Toxicity testing of industrial effluents through freshwater fish <i>Lebistes reticulates</i> (Peters) | 17 – 21 |
| Suresh B. Zade, Shashikant R. Sitre, Shanta Satyanarayan and Sanjeev S. Gandhewar | |
| 4. Deduction of Protein Structure with help of Tree Decomposition | 22 – 27 |
| Sudhir Prakash Srivastava and Neha Srivastava | |
| 5. Comparative evaluation of various chelators for removal of pollutants and heavy metals from distillery effluents | 28 – 34 |
| Namita Tewari, Gagan Matta and Avnish Chauhan | |
| 6. Adaptive modifications in some Hill stream fishes of Betul District | 35 – 38 |
| M.S.Solanki, B.D.Nagle, R.C. Bannatwala and M.Tharani | |
| 7. Studies on sexual dimorphism in the Cyprinidae fish <i>Puntius ticto</i> (Hamilton – Buchanan) from Kumaun Himalaya, India | 39 – 44 |
| Pankaj Bahuguna, Sanjay Kumar, Rakesh Kumar, Hemant Kumar Joshi and Rakesh Verma | |
| 8. The innovation of scientific reality associated with Mahakumbha 2010 - A confluence of faith | 45 – 51 |
| Ram Swarup | |
| 9. Indian pharmaceutical industry and patent amendments | 52 – 58 |
| Meetu Khanduja | |
| 10. Rhizosphere Algae of Paddy in Vidarbha region of Maharashtra State | 59 – 65 |
| K. J. Cherian | |

11. Effect of Paushamycin on Paddy field soil algae of Umrer, Nagpur District, Maharashtra 66 – 72
K. J. Cherian
12. Ethnomedicinal Ferns Species used by Tribals of Gondia District, Vidarbha Region of Maharashtra 73 – 77
K. J. Cherian and D. D. Ramteke
13. Ethnomedicinal Plant Resources from Navegaon National Park Based on Socioeconomic Documentation from Gondia District, Maharashtra, India 78 – 82
K. J. Cherian and D. D. Ramteke
14. Water quality assessment of Vikram Vatika Sarovar, Ujjain degraded due to idol immersion 83 - 90
Vikas Singh, Gaurav Bhadauriya and Gagan Matta

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Studies on seasonal variation of some physico-chemical parameters of River Dhamola at Distt. Saharanpur (U.P.)

Priyanka Rajvanshi

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Abstract

In the present analysis seasonal variation of physico-chemical parameters of river Dhamola at Saharanpur was studied. For this study three sites were selected for water sampling seasonally for a period of one year. Samples were analyzed for various physico-chemical parameters viz. Temperature ($^{\circ}\text{C}$), Turbidity (JTU), Total solids (mg/l), Total dissolved solids (mg/l), Total suspended solids (mg/l), pH, BOD (mg/l), COD (mg/l), DO (mg/l) and Total heavy metals (mg/l). The less concentration of total heavy metals was observed at sampling station A, while at sampling station B and C greater concentration were observed.

Keywords: Water pollution | Physico-chemical parameters | Water quality | River Dhamola.

Introduction

Water is one of the nature's most important gifts to mankind. It is essential and most precious commodity of life. Our natural heritage like rivers, seas and oceans has been exploited, mistreated and contaminated. Today our drinking water, far from being pure contains around two hundred deadly commercial chemicals. Add to that bacteria, viruses, inorganic minerals, and we have a chemical cocktail i.e. unsuitable for human consumption. It means there is no such thing as pure water in the natural environment in the chemical sense. Just a total purity of water is impossible.

In most of the rivers the water is polluted naturally as well as through anthropogenic process. In natural process, water pollution is mainly caused by the decomposition of vegetables, animals and weather products. It affects the colour, odour, and biological properties of water. In anthropogenic process, water pollution is caused by industrial, agricultural, domestic, radioactive, mining sources, use of fertilizer and pesticides by human being. These pollutants are regularly poured into water deterioration. These

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pollutants contain simple nutrients as well as heavy metals. In India all the rivers seem to be polluted. The major part of pollution is due to industrialization and domestic sewage as it contains a number of toxic chemicals and heavy metals. Water pollution of most river is due to millions of liter of sewage, domestic waste and industrial and agricultural effluents containing substances varying from simple nutrient such as total nitrogen, total phosphorus, etc to highly toxic substances such as total heavy metals containing lead, cadmium, mercury etc. At present mostly all Indian rivers seem to be polluted.

Many agro based industries have been developing across the district Saharanpur. Many rivers flow through the district Saharanpur as Krishna, Kalindi, Yamuna, Hindon, Maskara, Pavdhoi, Dhamola etc. River Dhamola originates from Muzzafrabad, and then it goes to Saharanpur and mixed with river Pavdhoi. It is a tributary of river Hindon. In district Saharanpur rapid industrialization is taking place day by day, so most peaceful area is changing in industries and urbanization. Most drain of these industries carries effluents from factories and also from adjacent residential colonies with their domestic sewage which is finally poured into river Dhamola. Thus river water is polluted. As the river passes through Saharanpur its water turns brownish and blackish as small scale industrial effluents and house hold and municipal wastes are discharged in it. Dhamola river work confluence with Panvdhoi near Rakesh Cinema and thereafter it continues up to Tapri. Thereafter it confluence with Hindon river. Its water is polluted by Dhamola river and is used for agriculture purposes causing bad effect on human being and cattle. So it can be well

thought that polluted river water carries a variety of pollutants of equally different physico-chemical nature. Therefore, it was of interest to carry such work.

Materials and Methods

For physico-chemical study of river Dhamola at Saharanpur the water samples were collected seasonally from different sampling stations i.e.

- (A) Near Numaish Camp Bridge
- (B) Near Rakesh Cinema Bridge
- (C) Near Vishwa Karma Chowk Bridge

Studies were carried out during March 2008 to February 2009. The samples were taken in morning hours from 7.00 AM to 10.00 AM in borosil glass bottles of 300 ml, plastic cans of 1 liter from each site. The analysis of samples was done with the standard methods suggested by Sandell (1950), Mathur (1982), Trivedy & Goel (1984), APHA (1998), Khanna & Bhutiani (2004) will be followed. Some parameter like Temperature and pH analyzed at the site and other mentioned parameters as Turbidity, Total Solids, BOD, COD, DO and Total heavy metals were analyzed in the laboratory.

Results and Discussion

The present study is devoted for evaluation of different physico-chemical parameters of the river Dhamola are given in Table 1, 2, 3, and Fig. 1, 2, 3, 4, 5, 6. The value of water temperature was observed $16.0\text{ }^{\circ}\text{C} \pm 0.82$ to $20.5\text{ }^{\circ}\text{C} \pm 0.71$ in winter season, $23.1\text{ }^{\circ}\text{C} \pm 0.71$ to $26.1\text{ }^{\circ}\text{C} \pm 0.41$ in summer season and $25.0\text{ }^{\circ}\text{C} \pm 0.35$ to $28.6\text{ }^{\circ}\text{C} \pm 0.52$ in monsoon season in all three sampling stations. The seasonal average value of temperature varied between $21.37\text{ }^{\circ}\text{C} \pm 4.74$ (at sampling station A) to $25.07\text{ }^{\circ}\text{C} \pm 4.15$ (at sampling station C). The temperature showed an upward trend from winter to summer season

followed by downward trend from monsoon season onwards. More or less similar studies have been observed in the river Yamuna by Chakarbarty *et al.*, (1959) at Allahabad and in the Kallayani (John, 1976). Badola and Singh (1981) also reported similar trend in the river Alaknanda. Same study was made by Singh *et al.*, (1988,1989) in river Ganga, Yamuna and Sangam at Allahabad, Bisht *et al.*, (1989) in river Song in eastern Doon, Khanna (1993) in river Ganga and Gautam *et al.*, (2000) in river Ganga at Rishikesh. Same trend of temperature was observed by Khanna *et al.*, (2003, 2005) of various bathing Ghats of river Ganga at Bulandshahar and in river Panvdhoi at Saharanpur respectively. Dalal and Arora (2008) observed the similar trend in river Hindon at Ghaziabad.

Turbidity in water is caused by the substances not present in the form of true solution. Turbidity of water is actually the expression of optical property (Tyndall effect) in which the light is scattered by the particles present in the water. The seasonal average values of Turbidity in all three sampling stations varied between $382.67 \text{ JTU} \pm 62.50$ and $1116.67 \text{ JTU} \pm 200.52$ in which maximum value at station C and minimum value at sampling station A. Water of river is found turbid throughout the year but goes highest in $1325 \text{ JTU} \pm 120$ in monsoon (sampling station C) and minimum $320 \text{ JTU} \pm 5.1$ in winter season at sampling station A. Same pattern was reported by Badola and Singh (1981), Dobriyal *et al.*, (1983), Bhomick and Singh (1985), Khanna (1993), Seth *et al.*, (2000). Khanna *et al.*, (2005) also found similar trend in river Panvdhoi at Saharanpur.

Total Solids is the terms applied to material left in a beaker after evaporating a well mixed

sample and subsequently evaporating and dried it in a oven. Total solids were found maximum $2706 \text{ mg/l} \pm 250$ at station C and minimum $725 \text{ mg/l} \pm 57.14$ sampling station A. Seasonal average value of total solids varies between $942 \text{ mg/l} \pm 240.14$ and $2010.3 \text{ mg/l} \pm 744.56$. Minimum average value of total solid during investigation found at sampling station A and maximum at sampling station C. Same conditions were shown by Khanna (1993), Verma and Shukla (1969) in their studies. Zingde *et al.*, (1980), Kudesia and Verma (1985) and Reddy and Venkateswarlu (1987) studied that most of the Indian River shows similar tendency with respect to fluctuation of total solids. Khanna *et al.*, (1997) and Seth *et al.*, (2000) also made out the same study. Similar trends were shown by Khanna and Chugh (2004) during study of water quality of river Ganga at Haridwar. Khanna *et al.*, (2005) and Dalal and Arora (2008) also found similar pattern during the physico-chemical study of river Panvdhoi at Saharanpur and river Hindon at Ghaziabad respectively.

pH is a measure of acidity or basicity of solution. Pure water is said to be neutral. The pH of pure water at 25°C is close to 7.0. Solution with pH less than 7.0 is said to be acidic and solution with a pH greater than 7.0 is said to be basic and alkaline. pH measurements are important in medicine, biology, chemistry, food science, environment science and many other applications. During the course of study it was recorded that pH was always alkaline at all the sampling stations. The seasonal average value of pH varied between 8.54 ± 0.31 to 8.68 ± 0.36 . The highest pH value 8.96 ± 0.14 was found in monsoon season at sampling station C and lowest pH value 8.20 ± 0.20 was observed in winter season at sampling station A. More or

less similar results were reported by Singh et al., (1982) in the river Nayar, Sangu and Sharma (1985) in the river Yamuna. Khanna (1993) in river Ganga, Khanna and Bhutiani in river Ganga from Rishikesh to Haridwar. Khanna et al., (2005) showed higher pH value during monsoon season which might be due to increase chemical load in the river and minimum in winter season. Dalal and Arora (2008) found that pH of water Hindon remains slightly alkaline throughout the study period.

Biochemical Oxygen Demand (BOD) is the measure of biodegradable organic matter present in a water sample and can be defined as the amount of oxygen required by the microbes in stabilizing the biologically degradable organic matter under aerobic condition. Thus BOD value can be used as a measure of waste strength. The maximum value of BOD was observed $630 \text{ mg/l} \pm 21.16$ in monsoon season and minimum $205 \text{ mg/l} \pm 6.73$ in winter season. The seasonal average value of BOD ranged between $270 \text{ mg/l} \pm 57.66$ to $548.33 \text{ mg/l} \pm 116.44$. Khanna et al., (1997, 2005) observed peak values in monsoon season in river Ganga at Laljiwala Haridwar and river Panvdhoi at Saharanpur. Singh et al., (2006) and Dalal and Arora (2008) also observed similar trends in river Ganga at Bulandshahar and in river Hindon at Ghaziabad respectively.

Chemical Oxygen Demand (COD) is widely used to characterize the organic strength of waste water and pollution of natural water. The test measures the amount of oxygen required for chemical oxidation of organic matter in the sample to carbon dioxide and water. It was noted highest value $1420 \text{ mg/l} \pm 75.10$ in monsoon season and minimum $671 \text{ mg/l} \pm$

35.14 in winter season. The seasonal average value of COD ranged between $846.67 \text{ mg/l} \pm 161.94$ to $1266.33 \text{ mg/l} \pm 178.19$. Similar trend of COD have shown by Khanna et al., (2003, 2005) in river Ganga and Panvdhoi and Dalal and Arora (2008) in river Hindon at Ghaziabad.

Dissolved Oxygen (DO) is the measure of oxygen concentration present in a given water sample. The concentration of oxygen reflects whether the process undergoing is aerobic or anaerobic. In observation maximum DO was recorded $7.14 \text{ mg/l} \pm 0.62$ in the winter season and minimum value of $0.09 \text{ mg/l} \pm 0.03$ in monsoon season. The seasonal average value varies between $1.14 \text{ mg/l} \pm 1.02$ (at sampling station C) and $5.97 \text{ mg/l} \pm 1.32$ (at sampling station A). This trend of present study was also observed by Badola and Singh (1981) in the river Alaknanda, Khanna (1993) has reported the same trend in the river Ganga. Same study is made by Pandey et al., (2003) in Ganga canal at Haridwar, Khanna et al., (2005) in river Panvdhoi at Saharanpur and Singh et al., (2006) in river Ganga at Bulandshahar.

In the present study total heavy metals were taken for observations. The seasonal average value of total heavy metals range between $13.98 \text{ mg/l} \pm 1.12$ (at sampling station C) to $8.79 \text{ mg/l} \pm 0.82$ (at sampling station A). Results obtained shows that heavy metal accumulation is more in downstream study site C as compared to upstream study site A. Khanna et al., (2003, 2005) reported heavy metals in water of Ganga at Bulandshahar and river Panvdhoi at Saharanpur. Singh et al., (2006) also reported heavy metals in river Ganga at Anupshahar.

Table 1: Seasonal variation in physico-chemical parameters of Dhamola river at Saharanpur at sampling station A (2008-2009)

Physico-chemical parameters	Summer	Monsoon	Winter	Average \pm Sd
Temperature (°C)	23.1 \pm 0.71	25.0 \pm 0.35	16.0 \pm 0.82	21.37 \pm 4.74
Turbidity (JTU)	383 \pm 6.1	445 \pm 2.50	320 \pm 5.1	382.67 \pm 62.50
Total Solids mg/l	901 \pm 30.82	1200 \pm 104.78	725 \pm 57.14	942 \pm 240.14
TDS (mg/l)	460 \pm 25.10	520 \pm 60.81	320 \pm 34.14	433.33 \pm 102.63
TSS (mg/l)	441 \pm 22.31	680 \pm 97.25	405 \pm 51.12	508.67 \pm 149.47
pH	8.80 \pm 0.16	8.62 \pm 0.19	8.20 \pm 0.20	8.54 \pm 0.31
BOD (mg/l)	290 \pm 9.42	315 \pm 21.83	205 \pm 6.73	270 \pm 57.66
COD (mg/l)	879 \pm 54.14	990 \pm 250.10	671 \pm 35.14	846.67 \pm 161.94
DO (mg/l)	6.23 \pm 0.21	4.53 \pm 0.58	7.14 \pm 0.62	5.97 \pm 1.32
Total heavy metals (mg/l)	8.50 \pm 0.52	9.72 \pm 0.14	8.15 \pm 0.10	8.79 \pm 0.82

Fig.1: Seasonal variation in Physico-chemical parameter at sampling station A (2008-2009)

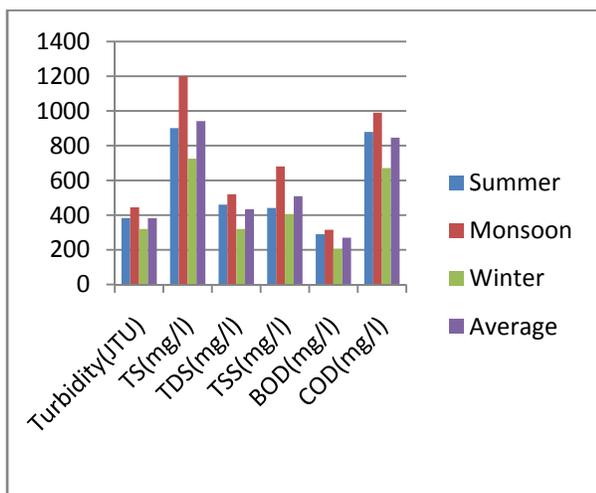


Fig. 2: Seasonal variation in Physico-chemical parameter at sampling station A (2008-2009)

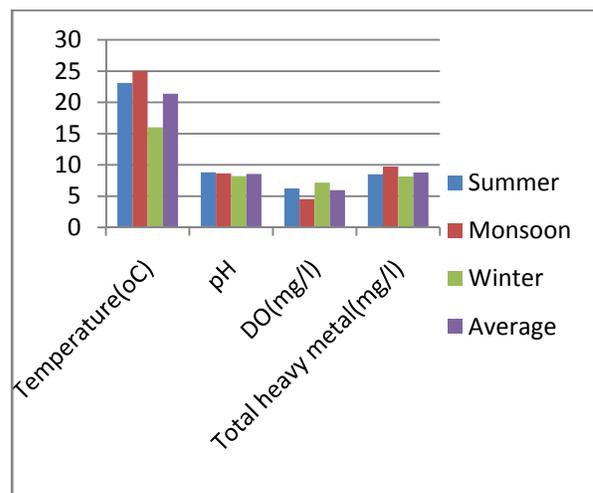


Table 2: Seasonal variation in physico-chemical parameters of Dhamola river at Saharanpur at sampling station B (2008-2009)

Physico-chemical parameters	Summer	Monsoon	Winter	Average \pm Sd
Temperature (°C)	25.3 \pm 0.32	27.5 \pm 0.50	19.1 \pm 0.65	23.97 \pm 4.36
Turbidity (JTU)	790 \pm 6.5	989 \pm 15.40	595 \pm 8.71	791.33 \pm 197
Total Solids (mg/l)	1504 \pm 150.10	2018 \pm 192.10	950 \pm 125.21	1490.67 \pm 534.12
TDS (mg/l)	850 \pm 25.24	923 \pm 120.10	375 \pm 20.50	716 \pm 297.56
TSS (mg/l)	654 \pm 95.71	1095 \pm 87.14	575 \pm 47.14	774.67 \pm 280.21
pH	8.71 \pm 0.17	8.92 \pm 0.16	8.25 \pm 0.14	8.63 \pm 0.34
BOD (mg/l)	509 \pm 30.10	521 \pm 20.10	365 \pm 13.1	465 \pm 86.81
COD (mg/l)	1106 \pm 122.14	1210 \pm 60.12	870 \pm 70.14	1062 \pm 174.22
DO (mg/l)	1.20 \pm 0.75	1.01 \pm 0.01	2.15 \pm 0.47	1.45 \pm 0.61
Total heavy metals (mg/l)	11.51 \pm 0.15	12.40 \pm 0.21	10.09 \pm 0.02	11.33 \pm 1.17

Fig.3: Seasonal variation in Physico-chemical parameter at sampling station B (2008-2009)

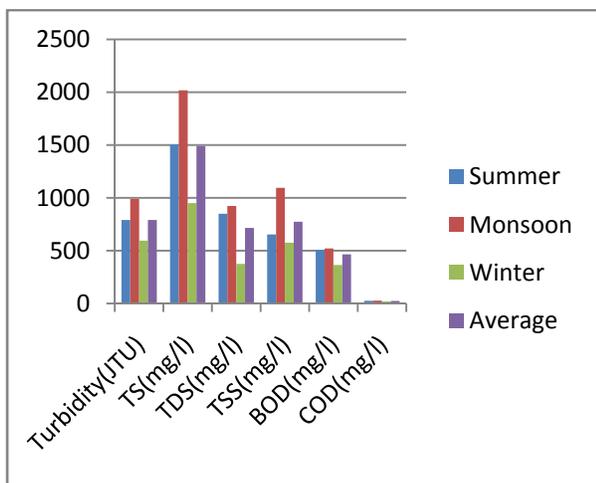


Fig.4: Seasonal variation in Physico-chemical parameter at sampling station B (2008-2009)

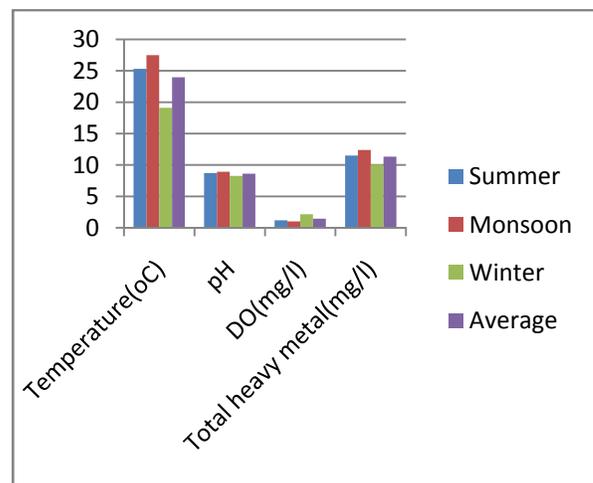


Table 3: Seasonal variation in physico-chemical parameters of Dhamola river at Saharanpur at sampling station C (2008-2009)

Physico-chemical parameters	Summer	Monsoon	Winter	Average \pm Sd
Temperature (°C)	26.1 \pm 0.41	28.6 \pm 0.52	20.5 \pm 0.71	25.07 \pm 4.15
Turbidity (JTU)	1100 \pm 70	1325 \pm 120	925 \pm 30	1116.67 \pm 200.52
Total Solids (mg/l)	2100 \pm 200	2706 \pm 250	1225 \pm 170.14	2010.33 \pm 744.56
TDS (mg/l)	1075 \pm 45.10	1250 \pm 145	512 \pm 32.75	945.67 \pm 385.62
TSS (mg/l)	1025 \pm 150.03	1456 \pm 103.52	713 \pm 61.14	1064.67 \pm 373.08
pH	8.80 \pm 0.12	8.96 \pm 0.14	8.27 \pm 0.18	8.68 \pm 0.36
BOD (mg/l)	600 \pm 35.12	630 \pm 21.16	415 \pm 17.1	548.33 \pm 116.44
COD (mg/l)	1308 \pm 140	1420 \pm 75.10	1071 \pm 81.20	1266.33 \pm 178.19
DO (mg/l)	1.21 \pm 0.72	0.09 \pm 0.03	2.12 \pm 0.35	1.14 \pm 1.02
Total heavy metals (mg/l)	13.71 \pm 0.14	15.21 \pm 0.01	13.01 \pm 0.07	13.98 \pm 1.12

Fig.5: Seasonal variation in Physico-chemical parameter at sampling station C (2008-2009)

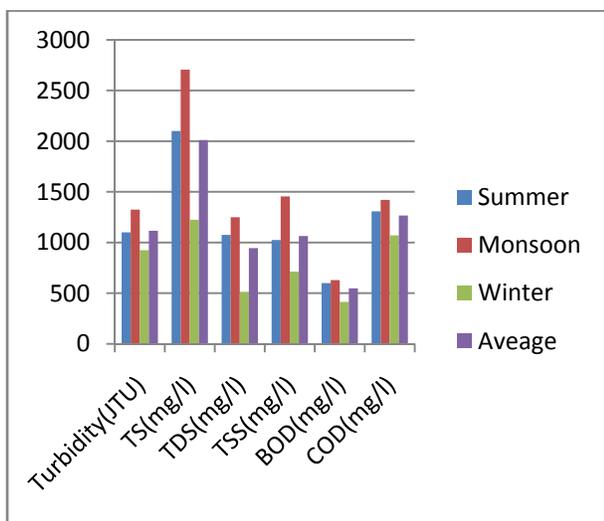
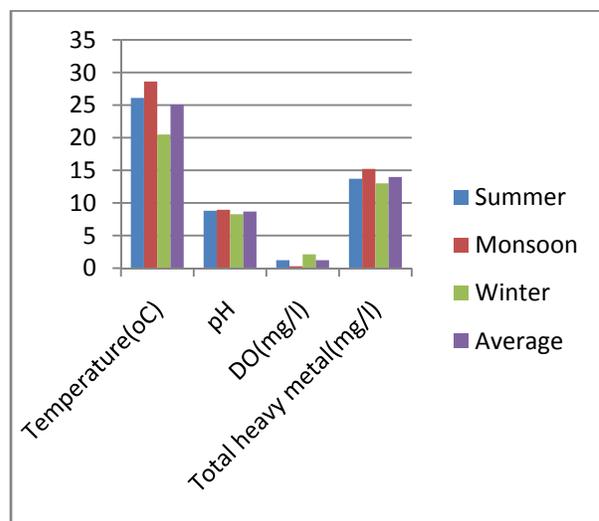


Fig.6: Seasonal variation in Physico-chemical parameter at sampling station C (2008-2009)



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Antioxidant and anticandidal activity of *Juniperus communis* L.

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Abstract

Different solvent extract methanolic, ethanolic, Petroleum ether, Chloroform, Hot and cold aqueous extract of *Juniperus* leaves was tested against *Candida albican*. It was found that all the tested solvent extract Aqueous extract both cold and hot water of *J. communis* showed no activity against *C. albican*. However ethanol and petroleum ether showed maximum inhibitory action against *C. albican*. The MIC value of Petroleum ether extract was 25mg/ml, while in case of ethanol it was 50 mg/ml. Antioxidant activity of *Juniperus* leaves was evaluated by three methods. All method used showed that leaves of *Juniperus* has antioxidant activity.

Keywords: *C. albican* | *J. communis* |

Antioxidant activity

Introduction

Candida albicans, opportunistic pathogen, remains leading cause of fungal diseases, frequently mortal in immunocompromised individuals. There is no licensed vaccine yet, despite the fact that candidiasis occur at 75% of all females during the lifetime (Sobel, 1988). Prolonged antifungal therapy, to prevent recurrence, cannot be without side effects. The serious problem is increased drug resistance (Wingard, 1994). Search for alternative way of fighting with the disease is very necessary. The dimorphic fungus *C. albican* is both a commensal and an opportunistic pathogen in humans. Depending on the underlying host defect, this microorganism is able to cause a variety of infections that range from mucosal candidiasis to life-threatening invasive infections. The frequency of the latter has increased in recent years as a result of an expanding immunocompromised population (Calderone, 2001; Garber, 2001).

The genus *Juniperus* includes 60 to 70 species of aromatic evergreen plants native to North Europe, Asia and North America. The plant bear blue or reddish fruits variously described as berries or berries like cones, juniper widely used as ornamental trees. The cone is a small

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green berry during its first year of growth and turn blue black during the second year. The flower blooms from May to June.

Juniperus communis L. which is known as common juniper is evergreen coniferous shrub or small tree occurring through out the northern hemisphere from Europe to Siberia and grow upto the height of 10m; it can be either prostrate or erect. Its preferred habitat is heath, moorland and chalk downs, but is also found as undergrowth in mixed open forest. Juniper berry oil has been used as diuretic. This activity is due to the presence of terpinen-4-ol, which is known to increase glomerular filtration rate. The effect of Juniper oil has been reported against urinary tract infection (Schilcer, 1995). Pepeljnjak *et al.* (2005) studied the antibacterial activity against sixteen bacterial species seven yeast-like fungi, three yeast and four dermatophyte strains. Juniper essential oil showed similar bactericidal activities against Gram-positive and Gram-negative bacterial species, with *MIC* values between 8 and 70% (V/V), as well as a strong fungicidal activity against yeasts, yeast-like fungi and dermatophytes, with *MIC* values below 10% (V/V). The strongest fungicidal activity was recorded against *Candida* spp. (*MIC* from 0.78 to 2%, V/V) and dermatophytes (from 0.39 to 2%, V/V).

Materials and Methods

Collection of plant material

The leaves of *J. communis* was collected from Alkapuri base region of Garhwal Himalayas, Uttarakhand and identified by Botanical Survey of India, Dehradun. Leaves are shade dried and powdered using mortar pestle.

Extraction of plant material

100 gm of air dried powdered leaves were extracted with different solvent i.e. methanol, Ethanol, chloroform, Petroleum Ether, Cold water and Hot water. After extraction process was completed filtrate, which was obtained by the extraction, were concentrated in Rotary Evaporator (Butchi Type) till all the solvent evaporates. If it is not possible then extract were taken out in pre weighed beaker (100 ml) and evaporate under water bath with porcelain particle or glass bead to avoid bumping of solvent and temperature should be maintained under boiling temperature of the solvent. Before putting the antibacterial activity all plant extract methanolic, Ethanol, Petroleum ether, Ethyl acetate, Chloroform, cold water and hot water extract were stored at the temperature of 4 °C. Bring out all the extract at room temperature when required at the time of antibacterial activity.

Anticandidal activity

Preparation of Inoculum

The ideal inoculum after overnight incubation gives the even semi confluent growth. Too heavy inoculum may reduce the size of inhibition zone by many antimicrobial agents from plant source. Using a straight wire touch 5-10 well isolated colonies of particular microorganism against which antimicrobial activity to be tested. Inoculate on the Nutrient Broth Medium. Incubate at 35-37°C for 4 – 6 hour. The density of the inoculums is adjusted to 10⁸ cfu/ml by comparing with that of 0.5 Mc Farland Standard.

Agar Well Diffusion

0.1 ml of the original cultures (about 10⁶-10⁷ cells) was spreaded with help of sterile non toxic swab on Mueller Hinton Agar (HiMedia,

Ltd) plates. After drying the different solvent extract (0.1ml) was placed in wells (8mm diameter) cut in the agar media and plates were incubated at 37° C (Kivan and Akgül, 1986). The resulting inhibition zones obtained with bacteria were recorded after 24 hour.

Antioxidant activity

Superoxide dismutase (SOD) activity assay

The assay of superoxide dismutase was done according to the procedure of Das *et al.* (2000). In this method, 1.4ml aliquots of the reaction mixture (comprising 1.11 ml of 50 mM phosphate buffer of pH 7.4, 0.075 ml of 20 mM L-Methionine, 0.04ml of 1% (v/v) Triton X-100, 0.075 ml of 10 mM Hydroxylamine hydrochloride and 0.1ml of 50 mM EDTA) was added to 100 ml of the sample extract and incubated at 30°C for 5 minutes. 80 ml of 50 mM riboflavin was then added and the tubes were exposed for 10 min to 200 W fluorescent lamps. After the exposure time, 1ml of Greiss reagent (mixture of equal volume of 1% sulphanimide in 5% phosphoric acid) was added and the absorbance of the color formed was measured at 543 nm. One unit of enzyme activity was measured as the amount of SOD capable of inhibiting 50% of nitrite formation under assay conditions

Peroxidase activity

The assay was carried out by the method of Addy and Goodman (1972). The reaction mixture consisted of 3ml of buffered pyrogallol (0.05 M pyrogallol in 0.1 M phosphate buffer (pH 7.0)] and 0.5 ml of 1% H₂O₂. To this added 0.1 ml enzyme extract and O.D. change was measured at 430 nm for every 30 seconds for 2 minutes. The peroxidase activity was calculated using an extinction coefficient of oxidized pyrogallol (4.5 litres/mol).

Glutathione peroxidase Activity

Glutathione peroxidase was assayed according to the procedure of Rotruck *et al.* (1973) with some modifications. The reaction mixture consisting of 0.4 ml of 0.4 M sodium phosphate buffer (pH 7.0), 0.1 ml of 10mM sodium azide, 0.2 ml of 4 mM reduced glutathione, 0.1 ml of 2.5 mM H₂O₂, 0.2 ml of water and 0.5 ml of enzyme was incubated at 0, 30, 60, 90 seconds respectively. The reaction was terminated with 0.5 ml of 10% TCA and after centrifugation; 2 ml of the supernatant was added to 3 ml of phosphate buffer and 1ml of DTNB reagent (0.04% DTNB in 1% sodium citrate). The color developed was read at 412 nm and the enzyme activity is expressed in terms of mg of glutathione utilized/min/mg protein.

Results and Discussion

Anticandidal activity

In the present study the anticandidal activity of six extracts of *J. communis* (Methanolic, ethanolic, Petroleum ether, Chloroform, cold water and hot Water) was evaluated against *Candida albican* (Table 1). Aqueous extract both cold and hot water of *J. communis* showed no activity against *C. albican*. However ethanol and petroleum ether showed maximum inhibitory action against *C. albican*, zone of inhibition was found 19.0 ± 1.2 mm and 22.0 ± 0.5 mm respectively (Fig.1). The MIC value of Petroleum ether extract was 25mg/ml, while in case of ethanol it was 50 mg/ml. In case of Methanolic and chloroform extract of *J. communis* almost equal inhibition was obtained, zone of inhibition was 16.0 ± 0.5mm and 16.5 ± 1.0 mm respectively. MIC value in both extract was 50 mg/ml (Table 2). Anticandidal activity of *Juniperus sp.* was also reported by Karaman *et al.* (2003).



Fig. 1. Anticandidal activity of Different solvent extract of Juniperus leaves.

1. Methanolic
2. Ethanolic
3. Chloroform
4. Petroleum ether
5. Hot water
6. Cold water

In addition, these results confirmed the evidence in previous studies reported that methanol is a better solvent for more consistent extraction of antimicrobial substances from medicinal plants compared to other solvents, such as water, ethanol and hexane (Ahmad et al., 1998; Eloff, 1998; Lin et al., 1999).

The antifungal activity of the extracts from unground leaves was strong against *Cryptococcus neoformans* and *T. mentagrophytes* from a number of taxa. *Juniperus osteosperma* and both varieties of *J. occidentalis* were particularly active against *C. neoformans* (hexane extract). The hexane extracts of these taxa, which are active against *C. neoformans*, are noticeably ineffective against *T. mentagrophytes*. The methanol (polar) extracts of *J. californica* and *J. osteosperma* showed activity against *T. mentagrophytes* (Clark et al., 1990).

Methanol and dichloromethane extracts of leaves and stems of *Juniperus sp. oxycedrus* (from Spain) have been found to reduce the blood pressure of normotensive rats (Bello et al., 1997), to inhibit the response to histamine, serotonin and acetylcholine (Moreno et al., 1997), and to exhibit significant anti-inflammatory activity (Moreno et al., 1998). Several extracts of leaves, resins, barks and fruits of *Juniperus sp.* (from Turkey) were found to inhibit the growth of several bacteria.

Antioxidant Activity

The antioxidant enzymes and free radical scavengers may provide a defensive mechanism against the deleterious actions of ROS (Reactive Oxygen Species). Some of the antioxidant enzymes that are found to provide a protection against the ROS are superoxide dismutase, catalase, peroxidase, glutathione peroxidase (GPx), glucose-6-phosphate dehydrogenase and ascorbate oxidase (Bandyopadhyay et al., 1990). The non-enzymatic antioxidants which act as scavengers are glutathione, vitamin A, vitamin E, and vitamin C (Acker et al., 1993).

Antioxidant activity of *J. communis* leaves was determined by three enzymatic methods viz Superoxide dismutase (SOD), Peroxidase and Glutathione peroxidase which have been presented in Table 2. Results showed that the leaves of *Juniperus* have significant antioxidant activities. Antioxidant activity of *Juniperus* leaves were observed to be 2.9 unit/mg by Superoxide dismutase enzymatic method and 0.9×10^6 and 160 international units by using, Peroxidase and Glutathione Peroxidase activity methods respectively. Brits et al. (2001) also reported the antioxidant activity of *juniperus sp.*

	Zone of Inhibition (in mm)					
	MeOH	EtOH	CHCl ₃	PtEth	Cold water	Hot water
<i>Candida albican</i>	16.0 ± 0.5	19.0 ± 1.2	16.5 ± 1.0	22.0 ± 0.5	NA	NA

Table 1. Anticandidal activity of *J. communis* leaf extract.

	Minimum Inhibitory Concentration					
	MeOH	EtOH	CHCl ₃	PtEth	Cold water	Hot water
<i>Candida albican</i>	50 mg/ml	50 mg/ml	50 mg/ml	25mg/ml	NA	NA

Table2. Minimum inhibitory concentration of *J. communis* leaf extract

S.No.	Sample	SOD	Peroxidase Activity (IU/L)	Glutathione peroxidase
1	Juniperus communis leaves	2.9 unit/mg	0.9X 10 ⁶	160
			1 unit- micro moles pyragallol oxidized/min	I unit- mg of GSH utilized/min

Table 3. Antioxidant activity of *J. communis* leaves.

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Toxicity testing of industrial effluents through freshwater fish *Lebistes reticulatus* (Peters)

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Abstract

Toxic effects of industrial effluents of an herbal pharmaceutical company to freshwater fish *Lebistes reticulatus* (Peters) were investigated during 96 hours static bioassay tests. LC₅₀ values for raw, neutralized and physico-chemically treated industrial effluents of an herbal pharmaceutical manufacturing company were found out under standard laboratory conditions. The behavior of the fish is also recorded during experiments. It is evident from the toxicological studies that raw industrial effluent was much more toxic as compared to neutralized and physico-chemically

treated effluent and toxicity was reduced by more than 30% with physico-chemical treatment alone. In order to further know the reduction in toxic effect the-physico-chemically treated industrial effluent was subjected to biological treatment by activated sludge system. The effluent after biological treatment revealed no toxic effect to *Lebistes reticulatus* for about a month pointing out that toxicity was fully reduced after biological treatment and the wastewater can be discharged into inland surface waters without harming the aquatic biota.

Keywords: Acute toxicity | *Lebistes reticulatus* | industrial effluent | Activated sludge

Introduction

Today, herbal medicines are popular in India and some of the south East Asian Countries due to very low side effects, cultural acceptability and low cost (Rajashekharan, 2002). The herbal medicines are manufactured from plant materials like roots, stems, barks, gums, resins and certain chemicals like sugars, gums, organic solvents, gelatin, lactose, salts, special minerals, various heavy metals etc.

Herbal medicines generate a lot of waste water (effluent) during manufacturing processes which include washings of medicinal plants to

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remove dust, dirt and microbial contaminants. Apart from general washing the wastewater is generated from different processes like crushing, mixing, extraction, distillation, fermentation, decoction and utensil washing based on market demand (Vanerkar *et al.*, 2002). The organic, inorganic and toxic components present in the effluent have direct impact on aquatic organisms and it is very difficult to correlate the observed effect to specific pollutants as these effluents are complex in nature having highly fluctuating characteristics. Due to fluctuating market demands these medicines are prepared in batches and so the characteristics of effluent are continuously changing. These wastewaters have high Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and very high Suspended Solids (S.S.) with large amount of heavy metals, phenolics etc.

Materials and Methods

The static bioassay tests were performed at room temperature using *Lebistes reticulatus* as test organism. The required fishes for experimentation purpose were procured from a local fish supplier of Nagpur City (Maharashtra State). The length of fish ranged between 1.5 to 2.0 cm. having a weight of 0.20 to 0.30 gms. approximately. Healthy fish were selected for toxicity testing experiments.

The industrial effluents were collected from a local herbal pharmaceutical manufacturing company from Nagpur and composite sample were collected and utilized for toxicity testing. The raw, neutralized and physico-chemically treated effluents were characterized as per Standard Methods (APHA, 1998) and their characteristics are presented in Table 1. For experimentation standard dilution water was prepared and used, Methods for measuring the

toxicity of industrial effluents were followed as per standard protocols (Doudorof, 1951, Sprague, 1969, Rao *et al.*, 1982),

The bioassay studies were carried out in glass aquaria of 10 Lit capacity using ten fishes in each container. Similar control was run parallel with dilution water only. Suitable concentrations were prepared and a range finding test and final confirmatory test were performed and readings on fish mortality were recorded at every 24 hours interval.

LC₅₀ values were calculated as per Litchfield and Wilcoxon (1949). The results were subjected to statistical analysis. Based on LC₅₀ values, 95% confidence limits, slope and regression (R²) are calculated and presented in Table 2. Fish behaviour was also studied during the experiment of 96 hours duration.

Results and Discussion

The toxicity studies revealed that raw and neutralized wastewaters were much more toxic to *Lebistes* as compared to physico-chemically treated effluents. The fishes came to surface frequently due to distress in raw wastewater, with quick opercular movements and moving erratically. The distress to fishes is due to reduction in dissolved oxygen by raw wastewater because of high Biochemical Oxygen Demand (BOD) values and its acidic nature. Somewhat lessened effect was observed in other two wastewaters. Loss of balance of the fish was observed at higher concentration of wastewater. The LC₅₀ values (Table 2) clearly show that raw wastewater was much more toxic and neutralized effluent toxicity was reduced somewhat due to marginal reduction of BOD, COD and Suspended Solids with slight removal of heavy metals.

It is thus inferred that this wastewater needs treatment to reduce toxicity and lime neutralization is effective in reducing the toxicity. So the wastewater was subjected to physicochemical treatment using conventional coagulants like ferric chloride, alum, lime and ferrous sulphate. The cationic polymer Oxyfloc-FL 11 gives good results at a dose of 300:0.25 mg/ liter at optimum combination for reduction in toxicity of the effluent. It was found that the toxicity was reduced by more than 30%. Still it is not safe to discharge the effluent as fishes do not survive for a long duration into it. So the effluent was subjected to further biological treatment by aerobic activated sludge system and toxicity tests were conducted.

It was confirmed from the toxicity tests that the effluent was completely safe for discharge after biological treatment as no fish mortality was observed for a period of one month. The

completely treated effluent is now non toxic to fish as shown by healthy fish.

The herbal pharmaceuticals though age old and referred in our Vedic scripts did not receive much attention till recently but its importance was understood quite late and they gained popularity due to low side effects. Moreover being herbal in nature their toxicity testing aspect was not seriously considered so far and so they were not fully understood.

Today bioassays provide a safe tool for assessing the toxic effects of industrial wastewaters and chemicals and LC₅₀ values play an important role in protecting the fish communities (Basak and Konar 1977). The results obtained from the bioassays will help the industries to take necessary pollution control measures before discharging effluents into natural waters which will help in minimizing the pollution and safeguarding our aquatic organisms.

Parameters	Raw effluent	Neutralized effluent	Physic-chemically treated effluent
Colour	Dark Yellow	Grey	Light Yellow
pH	3.6-4.00	6.9-7.50	6.6
Total acidity	1385	590	192
Total suspended solid	1800	1603	295
Total solids	4169	2536	538
BOD (5 days at 20°C)	6892	4820	1660
COD	12430	9600	3860
Sulphide as S ⁻²	28	20	09
Total Phosphates (PO ₄ ⁻²)	136	98	42
Total Nitrogen	223	132	60
Oil and Grease	82	36	15
Heavy Metals			
Iron	34.40	15.85	8.20
Mercury	0.015	0.006	0.002
Copper	0.5790	0.312	0.222
Manganese	3.540	1.100	0.169
Zinc	0274	0.1624	0.100
Nickel	0.808	0.28	0.142
Lead	1.562	0.92	0.72
Chromium	0.2330	0.1204	0.0721
Selenium	0.211	0.131	0.095
Arsenic	N.D.	N.D.	N.D.

Table 1: Characteristics of Herbal Pharmaceutical Industrial Effluents

Note:

All the values are expressed in mg/Litre except colour and pH. The heavy metals were analyzed on atomic absorption spectrophotometer.

Time in Hrs	Parameter	Raw effluent	Neutralized effluent	Physico-chemically treated effluent
24 hrs	LC ₅₀ 95% Confidence Limit, Slope R ²	6.50 4.2 - 10.7 y= 0.0613x + 3.60 0.962	7.50 5.22-10.90 y=0.04812x+ 5.166 0.966	38.00 33.2-43.00 Y=0.057x + 35.40 0.989
48 hrs	LC ₅₀ 95% Confidence Limit, Slope R ²	6.00 3.05-11.50 Y= 0.0623x + 2.90 0.979	7.00 5.60-8.75 Y= 0.0413x + 4.936 0.974	37.50 33.8-42.2 Y= 0.055x + 35.08 0.984
72 hrs	LC ₅₀ 95% Confidence Limit, Slope R ²	4.90 2.70-8.80 Y= 0.0625x+ 1.794 0.978	6.70 4.82-9.10 Y= 0.0405x+ 4.612 0.972	37.30 33-41.00 Y= 0.057x+ 34.6 0.2785
96 hrs	LC ₅₀ 95% Confidence Limit, Slope R ²	2.45-7.80 2.45-7.80 Y= 0.0558x+ 1.597 0.982	6.30 4.25-9.30 Y= 0.041 x+ 4.261 0.983	36.80 33.50-40.20 Y= 0.061x+ 33.90 0.975

Table 2: LC₅₀ and Other Estimated Values of Acute Toxicity Tests for *Lebistes reticulates* (Peters) Exposed to Industrial Effluents (Herbal Pharmaceutical)

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Deduction of Protein Structure with help of Tree Decomposition

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Abstract

Robertson and Seymour first time defined the notion of tree decomposition together with associated graph parameter tree width; this parameter played an important role in algorithm theory. In this paper we study a tree decomposition based algorithm for proteins structure. The tree based computational models are powerful, flexible and efficient way to modeling many type of proteins structure. We can developed algorithm that explore the fact that contain key parameter have complexity dependent on tree width of protein structure, when tree width is large, we can still use spectral methods to find protein sound solution in an efficient manner

Keywords: *Protein Structure | Tree - Decomposition | Computational models | Protein Side chain packing*

Introduction

The structure of protein play on instrumental role in determining in functional activity. The experimental method like NMR techniques and X-ray crystallography cannot generate protein structure in high through put way. Proteins structure has been used in many pharmaceutical companies to analyze the structure & functional characteristic of a protein. We can classify protein structure into two major steps. One is the predication of the backbone atom coordinates and other is the predication of side chain atom coordinate. A protein is a complex biological system consisting of dozens or hundreds of small molecules (i.e. amino acid) interact with specific shape. It may be possible that proteins also interact with each other to form and protein -protein interaction (PPI) network. A PPI network describes the interaction relationship among protein in cell; each vertex in the network corresponds to a protein and edge indicates a direction physical interaction between two proteins.

In this paper we study about protein structure with help of tree decomposition method. The tree decomposition based algorithm have fund a rich set of application in proteins structure.

Tree -Decomposition Concept

The notions of tree width and tree decomposition are introduced by Robertson and Seymour (1986) in their work on graph minor.

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Graph minor is a branch of graph theory. In graph minor the 'decomposition theorem' describes the structural feature of all graphs excluding a given minor. In order way we can say that decomposition theorem say that sharse graph can be decomposed into a tree of component. Each component contains a small number of vertices from a graph. The width of tree decomposition is the maximum component size minus one. The tree width of a graph is the minimum width over all the tree decomposition. It any graph with tree width then computational problem related to the graph can be solve using dynamic programming with time complexity polynomial in graph size and tree width.

Definition

Let $G = (V,E)$ be a graph. A tree decomposition of G pair (T,X) satisfying the following condition:

(i) $T = (I, F)$ is a tree with a vertex set i.e. node set I and an edges set F ,

(ii) $X = \{ X_i / i \in I, X_i \subseteq V \}$ and $\cup_{i \in I} X_i = V$

That is each node in the tree T represents a subset of V and Union of all the subset is V ,

(iii) for every edge $e = (u, \omega) \in E$, there is at least one $i \in I$ such that both u and ω are in X_i , and

(iv) for all $i, j, k \in I$ if j is anode of the path from i to k then $X_i \cap X_k \subseteq X_j$

The width of tree decomposition is $\max_{i \in I} \{ |X_i| - 1 \}$

The tree width of a graph G , denoted by $tw(G)$ is the minimum width overall the tree decomposition of G .

According to the above definition, the decomposition of a graph into bio-connected component corresponds to a vertex in T . and any two bio-connected component share one vertex of G . Then the width of bio-connected-

component decomposition could be $O(|V|)$. Then $O(|V|)$ is bigger than tree width of G . if G is spars.

For example, when the graph is cycle, this graph has only on bio-connected component, itself and then tree width of cycle is only 2. Fig. 1, 2 & 3 shows on example of an interaction graph, its bio-connected component decomposition with width 6 and a tree decomposition with width 3. The width of the tree decomposition is a main factor determining the computational complexity of all the tree decomposition based algorithm. Smaller value of tree decomposition width algorithm is more efficient. Hence we try to optimize the tree decomposition of residue interaction graph.

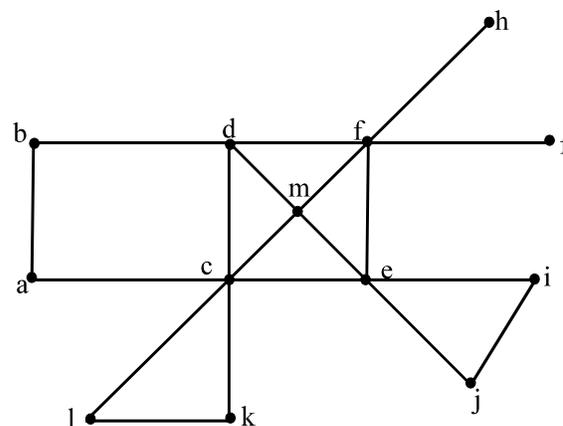


Fig. 1: Example of a residue interaction graph

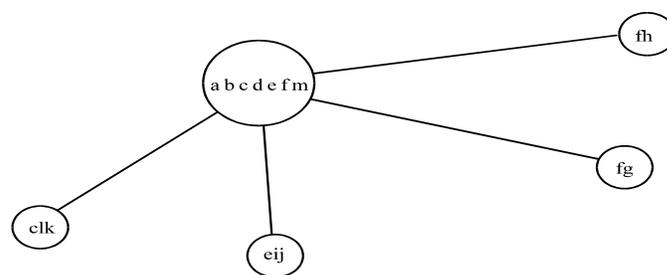


Fig.2: Example of the bio-connected component decomposition of a graph with width decomposition 6

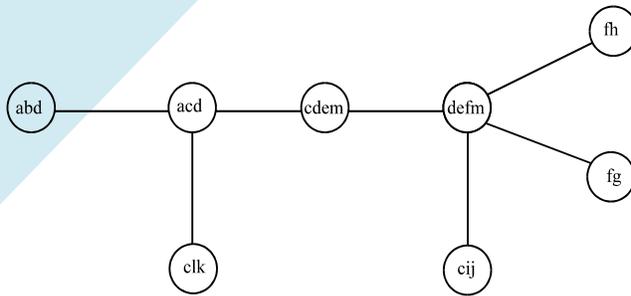


Fig.3: Example of tree decomposition of a graph with width 3

Tree Decomposition Based Algorithm

We can consider tree decomposition based algorithm for so many biological system. For example in the field of proteins structure, we can consider proteins side chain packing [Xu (2007) and Xu and Berger (2006)] and non sequential protein structure alignment (Xu *et al.*, 2005, 2006).

Many biological problem including protein side chain packing and protein structure alignment can be formulated as a problem of assigning a label to each vertex in spares graph $G=(V,E)$ with bounded tree width ω . For any vertex v in V .

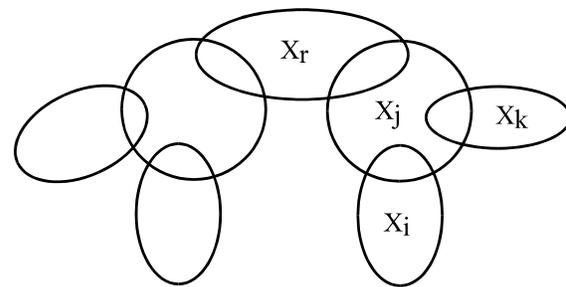
There is a set of candidate labels, denoted by $D[v]$ for this vertex. There may be some restriction on the label assignment of two adjacent vertices that is given edges (v_1, v_2) in E . The feasible labels of v_1 and v_2 are restricted to a subset of $D[v_1] \times D[v_2]$. We want to find a label assignment $A(v)$ ($A(v) \in D[v]$) to vertex $v \in V$ such that the following scoring function is optimized.

$$F(A) = \sum_{u \in V} S_v(A(v)) + \sum_{\substack{u \neq v, \\ (u,v) \in E}} P_{u,v}(A(u), A(v))$$

where $S_v(A(v))$ denoted the preference of assigning a label $A(v)$ to vertex u and $P_{u,v}(A(v), A(u))$ measure how well two labels $A(u)$ and $A(v)$ are simultaneously assigned to u and v respectively.

The general graph labeling problem is computationally hard. However, if the graph has bounded tree width w , the graph labeling problem can be solved using tee decomposition with time complexity. Now we describe a recursive equation, that can be used to calculate $F(A)$, based on tree decomposition of G .

Assume tree decomposition (T,X) of a sparse graph G . For simplicity, we assume that tree T has root X_r . Figure 4 shows an example of tree decomposition in which component X_r is the root.



Let $X_{r,j}$ denote the intersection between X_r and X_j . If we remove all the vertices in $V_{r,j}$; then this tree decomposition become two disconnected sub tree. Let $F[X_j | A(X_{r,j})]$ denote the optimal label assignment of sub-tree rooted at X_j , denoted by $T(X_j)$, given that the label assignment to $X_{r,j}$ is fixed to $A(X_{r,j})$. Then $F[X_j | A(X_{r,j})]$ is independent of $T-T(X_j)$. Let $C(j)$ denoted the set of child component of X_j and score $(X_j | A(X_j))$ denote the assignment score of component X_j with the label assignment being $A(X_j)$. Let $D[X]$ denote all the possible label assignment to the vertices in X . Therefore, we have the following recursion equation.

$$F(X_j | A(X_{r,j})) = \min \{F(X_i | B(X_{j,i})) + Score(X_j | B(X_j - X_{j,i}) \cap A(X_{r,j}))\}$$

According to this recursive equation we can calculate the optional label assignment using a divide strategy. First, we calculate the optional scoring function $F(A)$ from bottom to top of the

tree decomposition and then we extract the optimal label assignment from top to bottom. A detailed account of the tree decomposition based algorithm is present in [Xu and Berger (2006), Xu *et al.*, (2005)].

Application of Tree Decomposition:

We have much biological system which convertible in graph model. A Biological graph model have bounded tree wide can be study with tree decomposition algorithm. In this paper we take some example of tree decomposition based algorithm.

(1) Protein Side Chain Packing:

During the study protein side chain packing Xu, (2007) formulate problem with tree decomposition algorithm as

Let G denote the graph modeling the amino acid residue interaction relationship in a proteins, each vertex in G represent a residue in the proteins and there is one edge between any two rotamers of these two residues the protein side chain packing problem can be formulate to minimize the following scoring function.

$$E(G) = \sum_{i \in V, A(i) \in D(i)} S_i(A(i)) + \sum_{i \neq j, (i,j) \in E} P_{ij}(A(i), A(j))$$

Where $D[i]$ is the set of candidate rotamer for position i and $A[i]$ is rotamer assigned to position i . The score item $S_i(A(L))$ measure the preference of a rotamer occurring at the given position and $P_{ij}[A(i), A(j)]$ measures how well two rotamer can be assigned simultaneously to two interaction residue.

Using the geometrical feature of residue interact graph. We have proved that the residue interaction graph can be tree decomposed into many small components and thus there is an efficient tree decomposition based algorithm.

Protein contact map overlap.

Proteins structure alignment is a fundamental problem in structural bioinformatics. A proteins structure alignment algorithm align two proteins structure and calculates their similarity. In content graph based proteins structure alignment a proteins structure is modeled as contact graph and the similarity between two protein is measure by their maximum common sub graph [Bernstein *et al.*, (1977) and Lathrop (1994)]. Some proteins structure alignment programs only generate sequential alignment [Holm and Sander (1993)] while other generate non sequential alignment [Alexandrov (1996) and Yuan and Bystroff (2005)]

Let $E(A)$ and $E(B)$ denote the set of contacts in proteins A and B respectively. For any residue u in A . let $M(u)$ denote its equivalent residue in B . If there is no equivalent residue for u . then $M(u) = \emptyset$. The contact map overlap problem can be formulated as follows.

$$\max_{(u,v) \in [A], v < u} \sum f(u, v, M(u), M(v))$$

For non sequential alignment

$$f\{u, v, M(u), M(v)\} = \begin{cases} -\infty & M(u) = M(v) \neq \emptyset \\ 1 & \{M(u)\} = M(u) \in E(B) \text{ otherwise} \\ 0 & \end{cases}$$

For sequence alignment $f\{u, v, M(u), N(v)\}$ can be redefined as follows:

$$f\{u, v, M(u), M(v)\} = \begin{cases} 0 & \\ -\infty & M(u) \text{ or } M(v) = \emptyset \\ 1 & \{M(u)\} \geq M(v) \\ 0 & M(u), M(v) \in E(B) \text{ otherwise} \end{cases}$$

General Protein Threading

Protein threading is an important method for proteins structure prediction. About new protein, template protein data Bank more

concept please refer (Xu *et al.*, 2005). Protein threading is computationally complicated, if the scoring function contain pair-wise constant potentials and gaps are allowed in the alignment [Akutsu and S. Miyano (1999)].

Many time many mathematician developed many algorithm for this problem. But none of this exact algorithm is guaranteed to terminate within reasonable theoretical time complexity.

So many publication and some preliminary studies on protein threading using tree decomposition are available we can used template contact graph to model a structural template in the Protein Data Bank. Then Protein threading can formulate as a problem of assigning some labels to a contact graph to minimize a scoring function.

Besides the above mentioned application, tree decomposition can also be applied to Protein complex threading protein complex. Threading problem can be formulated as a problem of aligning two sequence to a bipartite graph. The bipartite graph is geometric and also sparse. So it should have small tree width.

Some publication (Qu *et al.*, 2004) protein. Threading with NMR data problem also formulated with help of tree decomposition algorithm.

Conclusion

This paper describe tree decomposition algorithm. Tree decomposition algorithm is very effective in solving problem in protein structure, because a protein structure usually can be modeled as spare geometric graph which treated as a tree width.

We are conducting a systematic study to identity proteins problem suitable for tree decomposition more non-trivial example, such as solution to other major protein problem should be given to demonstrate its usefulness.

One challenge is to develop an empirically efficient algorithm for the protein problem with medium-sized tree width.

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Comparative evaluation of various chelators for removal of pollutants and heavy metals from distillery effluents

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Abstract

Chelating efficiency of three different chelators (EDTA, DTPA and NTA) has been observed and compared for the removal of various pollutants and heavy metals from distillery effluent. The experiment was brought about at polyhouse conditions and the changes in physico-chemical characteristics i.e. pH, colour, COD, TS, TDS, TSS, Ca, Mg, Na, K, and heavy metals (Cu, Zn, Fe) of distillery effluent using various chelators has been examined. EDTA was found to be best chelating agent in comparison to DTPA and NTA.

Keywords: *Chelation | Distillery effluent | EDTA | DTPA*

Introduction

Water pollution due to discharge of industrial waste water has become a serious problem in most of areas in our country (Sheth and Soni, 2004). Waste generated from various industries includes the effluent from textile, chemical fertilizers, pulp & paper, petrochemical, food processing, pharmaceuticals, dairies, distilleries, and breweries, metal processing, automobile manufacturing, power plants, tannery industries etc (Cox and Kamprath, 1972). Improper disposal methods and inadequate treatment of toxic constituents from different industries have led to widespread contamination of surface and ground water and have made the water resources unfit for usage (Odum, 1967). Hence, there is an urgent need for waste water treatment. The utilization of industrial effluent for irrigation of agricultural crops is one of the highly beneficial propositions of waste water disposal (Chauhan and Tewari, 2009).

Distilleries are one of the major agro-based polluting industries, with about 88% of raw material ending up as wastes (Jain *et al.*, 2000). These industries discharge large volumes of waste water carrying huge pollution load (Odum, 1967). The waste

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released from distillery is a complex, caramelized and recalcitrant in nature and contain high percentage of organic matter and heavy metal ions (Nemade and Shrivastava, 1998; Norvell and Lindsay, 1969), which affects the ground water, soil properties and vegetable plants grown in the area (Shrivastava *et al.*, 1990; Shrivastava *et al.*, 1995). This warrants adoption of safe and effective means of effluent treatment to fulfill both a practical necessity and a social responsibility (Vaidhyanthan *et al.*, 1995). Keeping this in view, the present study therefore is planned to investigate the pollutants removal efficiency of various chelators against distillery effluent.

Materials and Method

The study was conducted with the distillery effluent collected from the Kesar Enterprises, Baheri, Uttar Pradesh State of India. For experiment, three chelators i.e. EDTA (Ethylenediamine Tetra Acetic Acid), DTPA (Diethylene Triamine Penta Acetic Acid) and NTA (Nitrilo Triacetic Acid) were taken. Seven sets of 2 kg plastic pots were filled with equal amount of soil. Wheat (*Triticum aestivum* L. var. UP - 2329) was grown in the pots. After 10 days of growth, 5 gm of various chelators i.e. EDTA, DTPA, and NTA were added separately to 6 sets of pots and irrigated with two different concentrations (50% & 100%) of the effluent. One set of pot was maintained as control in which no chelator was added. On each irrigation date one liter of effluent was poured in each pot. After 6 hours of irrigation the leachate was collected and all the selected parameters i.e. pH, colour, COD, TS, TDS, TSS, Ca, Mg, Na, K and heavy metals (Fe, Cu, Zn) were analyzed to find out the best chelator, which resulted into maximum reduction in pollution load of

distillery effluent. Various physico-chemical parameters viz. pH, colour, COD, TS, TDS, TSS, Ca, Mg, Na, K and heavy metals (Fe, Cu, Zn) were analyzed as per standard method (APHA, 1995).

Statistical analysis

Data were analyzed through two-way ANOVA using SPSS software (SPSS Inc., version 10.0) for assessing the significance of quantitative changes in different parameters due to chelators.

Results and Discussion

Experimental results showed that the distillery effluent was acidic pH - 4.38, colour - 1466.66 CU, COD - 7883.33 ppm, TS - 42166.66 ppm, TDS - 28233.33 ppm, TSS - 13933.33 ppm, Ca - 111.66 ppm, Mg - 20.66 ppm, Na - 110.66 ppm, K - 79.33 ppm, Cu - 1.60ppm, Zn - 1.38ppm, Fe - 6.43 ppm, which is very high than their MINAS values.

Reduction in all physico-chemical parameter (i.e. colour, COD, TS, TDS, TSS, Ca, Mg, Na, K, Cu, Zn, & Fe) was considerably more when effluent was treated with EDTA at 50% effluent concentration followed by DTPA and NTA (Table 1-2, Fig: 1-4).

Values of colour, COD, TS, TDS, TSS was found minimum 228.66 CU, 1406.33, 4686.33, 2843.33 and 1843.33 ppm, respectively, after treated with EDTA at 40th day of irrigation with 50% spent wash (Table 2, Fig 3) and maximum 984.66 CU, 7223.33, 19586.66, 17163.33, and 2423.33 ppm, respectively, after treated with DTPA at 20th day of irrigation with 100% spent wash (Tables 1, Fig 1).

Parameters	Untreated Effluent	EDTA			DTPA			NTA		
		20 days	30 days	40 days	20 days	30 days	40 days	20 days	30 days	40 days
pH	4.38 ±0.10	6.50 ±0.07***	6.60 ±0.11***	6.43 ±0.12***	6.50 ±0.12***	6.73 ±0.10***	6.80 ±0.22***	6.60 ±0.19***	6.70 ±0.20***	6.80 ±1.20***
Colour (CU)	1466.66 ±17.20	833.33 ±8.34***	626.66 ±6.20***	428.66 ±5.40***	984.66 ±11.80***	742.33 ±9.22***	563.33 ±6.12***	886.66 ±9.98***	706.66 ±8.89***	516.66 ±5.84***
COD (ppm)	7883.33 ±33.60	6600.00 ±22.20*	5883.33 ±19.16*	3606.66 ±12.64	7223.33 ±14.52*	6283.33 ±13.06*	4436.66 ±11.08*	6443.33 ±13.88*	5943.33 ±10.78*	4166.66 ±11.06*
TS (ppm)	42166.66 ±164.20	19103.33 ±113.60***	12663.33 ±111.18***	7883.33 ±39.47***	19586.66 ±111.64***	13896.66 ±121.26***	9643.33 ±41.66***	25726.66 ±121.36***	15663.33 ±122.24***	9643.33 ±41.14***
TDS (ppm)	28233.33 ±157.30	16566.66 ±102.40***	8866.66 ±28.40***	4866.66 ±21.13***	17163.33 ±112.48***	9643.33 ±31.54***	5566.66 ±19.48***	17330.00 ±109.36***	9236.66 ±29.53***	5566.66 ±30.06***
TSS (ppm)	13933.33 ±144.06	2536.67 ±12.10***	3796.60 ±17.31***	3016.67 ±14.02***	2423.33 ±8.96***	4253.33 ±18.08***	4076.67 ±17.82***	8376.66 ±25.26***	6426.64 ±22.12***	4076.67 ±13.32***
Ca (ppm)	111.66 ±8.12	92.66 ±6.60***	84.60 ±5.40***	78.33 ±5.80***	95.66 ±2.04***	88.33 ±6.87***	82.66 ±9.54***	94.33 ±10.45***	87.66 ±8.94***	80.33 ±12.12***
Mg (ppm)	20.66 ±0.46	16.66 ±2.20**	12.33 ±1.80**	9.66 ±1.67**	17.66 ±3.30**	14.66 ±4.60**	10.33 ±5.62**	17.33 ±3.30**	14.33 ±1.49**	10.66 ±0.94**
Na (ppm)	110.66 ±8.11	107.33 ±8.33	102.66 ±4.24*	96.66 ±8.70*	109.33 ±10.03*	105.66 ±11.22*	98.66 ±10.25*	108.66 ±12.20*	106.33 ±11.84*	98.33 ±12.29*
K (ppm)	79.33 ±5.12	68.33 ±4.41***	63.66 ±1.60***	61.33 ±6.32***	74.33 ±0.06***	73.66 ±11.04***	71.33 ±8.96***	74.33 ±8.96***	73.66 ±3.30***	70.66 ±4.69***
Cu (ppm)	1.60 ±1.29	1.42 ±0.06**	1.28 ±0.03**	1.16 ±1.60**	1.56 ±0.03**	1.52 ±0.09**	1.42 ±0.22**	1.52 ±0.66**	1.48 ±0.49**	1.42 ±0.22**
Zn (ppm)	1.38 ±1.60	1.25 ±0.04 ^{ns}	1.20 ±0.02 ^{ns}	1.18 ±2.20 ^{ns}	1.36 ±1.40 ^{ns}	1.30 ±0.08 ^{ns}	1.28 ±0.33 ^{ns}	1.35 ±0.21 ^{ns}	1.28 ±0.47 ^{ns}	1.26 ±0.09 ^{ns}
Fe (ppm)	6.43 ±1.40	5.44 ±0.03**	5.02 ±1.14**	4.68 ±0.14**	6.12 ±3.30**	5.96 ±0.67**	5.24 ±1.22**	6.02 ±0.25**	5.82 ±1.41**	5.25 ±0.52**

Significant at: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ns = non significant, EDTA = Ethylenediamine Tetra Acetic Acid, DTPA = Diethylene Triamine Penta Acetic Acid, NTA = Nitrilo Triacetic Acid.

Table 1: Physico-chemical characteristics of 100% distillery spent wash treated with different chelators at varied irrigation period

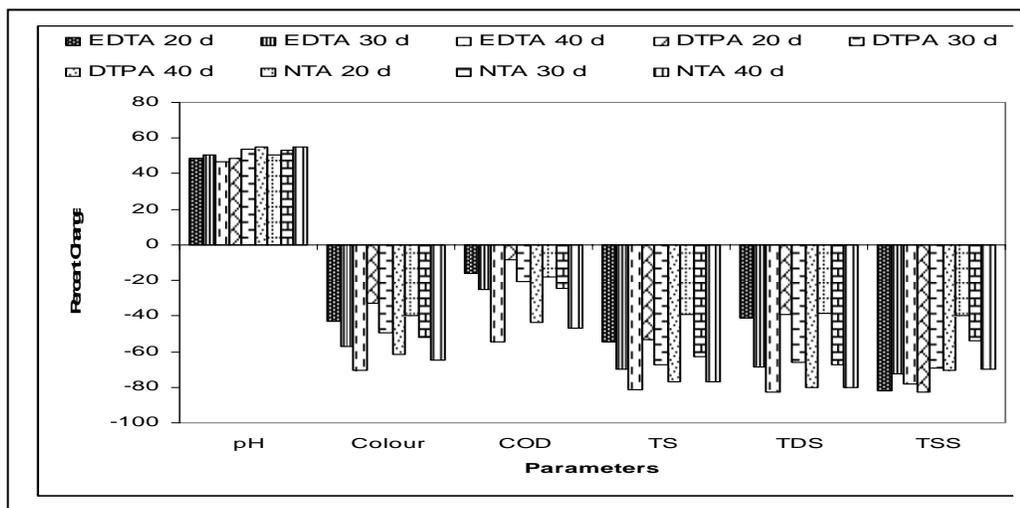


Fig 1: Percent change (+ increase, - decrease) over control in physico-chemical characteristics of 100% diluted spent wash treated with different chelators at varied irrigation

Amount of calcium, magnesium, sodium, and potassium was found minimum 68.33, 8.33, 92.66, and 53.66 ppm respectively after treated with EDTA at 40th day of irrigation with 50 % spent wash (Table 2, Fig. 4) and

maximum 95.66, 17.66, 109.33, and 74.33 ppm respectively after treated with DTPA at 20th day of irrigation with 100% spent wash (Table 1, Fig 2).

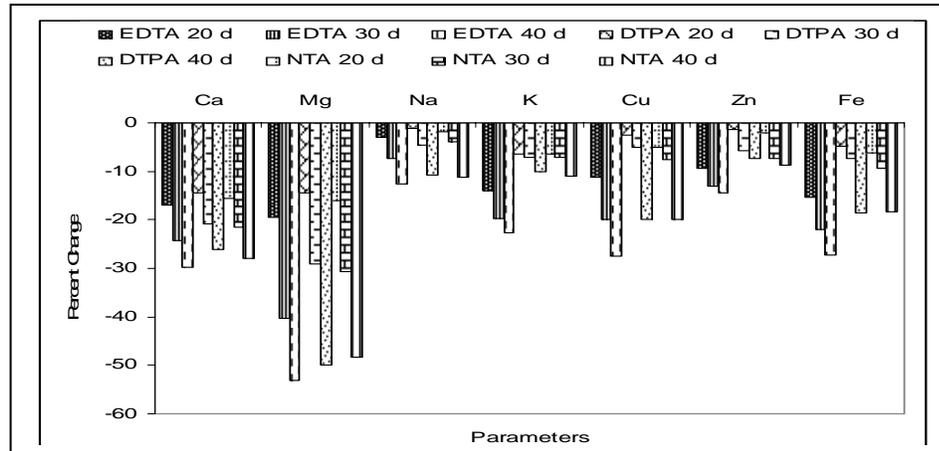


Fig 2: Percent change (+ increase, - decrease) over control in physico-chemical characteristics of 100% diluted spent wash treated with different chelators at varied irrigation.

Heavy metals i.e. Cu, Zn, and Fe was found minimum 1.02, 1.04, and 2.6 ppm respectively in EDTA at 40th day of irrigation with 50% spent wash (Table 2,

Fig.3) and maximum 1.56, 1.36 and 6.12 ppm, respectively, in DTPA at 20th day of irrigation with 100% spent wash (Table 2, Fig 4).

Parameters	Untreated Effluent	EDTA			DTPA			NTA		
		20 days	30 days	40 days	20 days	30 days	40 days	20 days	30 days	40 days
pH	4.38 ±0.10	6.60 ±0.25***	6.40 ±0.12***	6.80 ±0.13***	6.50 ±0.14***	6.30 ±0.11***	6.40 ±0.24***	6.60 ±0.21***	6.80 ±0.25***	6.70 ±1.01***
Colour (CU)	1466.66 ±17.20	456.66 ±8.34***	326.33 ±11.02***	228.66 ±9.06***	492.33 ±10.05**	386.66 ±10.23***	256.66 ±10.16***	466.33 ±12.02***	353.33 ±8.95***	268.66 ±7.89***
COD (ppm)	7883.33 ±33.60	3486.66 ±22.38***	2663.33 ±18.96***	1406.33 ±13.43***	3963.33 ±19.54***	3146.33 ±20.14***	2236.33 ±14.59***	4866.66 ±22.36***	3266.66 ±20.92***	2453.33 ±20.26***
TS (ppm)	42166.66 ±164.20	12900.00 ±29.14***	8606.66 ±21.55***	4686.66 ±20.13***	13663.33 ±31.28***	9443.66 ±22.36***	5643.33 ±19.65***	13966.66 ±33.36***	9886.33 ±22.03***	5886.66 ±12.89***
TDS (ppm)	28233.33 ±157.30	5776.33 ±14.22***	4200.00 ±13.14***	2843.33 ±10.56***	6196.33 ±13.66***	5886.33 ±10.11***	3666.66 ±8.99***	7996.66 ±10.56***	5568.33 ±13.36***	4253.33 ±14.06***
TSS (ppm)	13933.33 ±144.06	7123.67 ±18.10***	4406.66 ±15.18***	1843.33 ±10.66***	7467.00 ±23.36***	3557.33 ±20.12***	1976.67 ±15.82***	5970.00 ±22.23***	4378.00 ±22.24***	1633.33 ±12.47***
Ca (ppm)	111.66 ±8.12	88.99 ±9.69***	78.33 ±8.87***	68.33 ±6.39***	90.33 ±9.04***	82.33 ±12.87***	76.66 ±9.74***	91.33 ±11.25***	85.33 ±8.94***	76.66 ±1.80***
Mg (ppm)	20.66 ±0.46	14.66 ±2.10**	11.66 ±2.37**	8.33 ±2.67**	15.66 ±2.30**	12.33 2.60**	8.66 ±0.62**	16.33 ±3.30**	12.66 ±1.89**	8.66 ±0.94**
Na (ppm)	110.66 ±8.11	106.33 ±8.73*	98.66 ±9.24*	92.66 ±9.24*	108.33 ±11.24*	101.66 ±9.44*	96.33 ±10.33*	106.66 ±11.20*	99.66 ±9.20*	96.33 ±8.55*
K (ppm)	79.33 ±5.12	73.33 ±6.41*	64.66 ±8.60*	53.66 ±5.32*	75.66 ±1.80*	65.66 ±1.98*	58.33 ±3.20*	76.66 ±1.18*	65.66 ±3.30*	55.33 ±3.29*
Cu (ppm)	1.60 ±1.29	1.30 ±0.08**	1.26 ±0.02**	1.02 ±0.05**	1.42 ±0.09**	1.36 ±0.08**	1.30 ±0.04**	1.42 ±0.07**	1.35 ±0.08**	1.28 ±0.09**
Zn (ppm)	1.38 ±1.60	1.18 ±0.06 ^{ns}	1.12 ±0.08 ^{ns}	1.04 ±2.20 ^{ns}	1.24 ±0.06 ^{ns}	1.22 ±0.08 ^{ns}	1.20 ±1.14 ^{ns}	1.30 ±0.23 ^{ns}	1.28 ±0.14 ^{ns}	1.26 ±0.09 ^{ns}
Fe (ppm)	6.43 ±1.40	4.23 ±0.33***	3.30 ±1.14***	2.60 ±0.19***	5.62 ±0.30***	4.80 ±0.67***	4.20 ±0.32***	5.62 ±0.45***	4.90 ±0.39***	3.30 ±0.52***

Significant at: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ns = non significant, EDTA = Ethylenediamine Tetra Acetic Acid, DTPA = Diethylene Triamine Penta Acetic Acid, NTA = Nitrilo Triacetic Acid.

Table 2: Physico-chemical characteristics of 50% distillery spent wash treated with different chelators at varied irrigation period irrigation period

Comparative evaluation of various chelators for removal of pollutants and heavy metals from distillery effluents

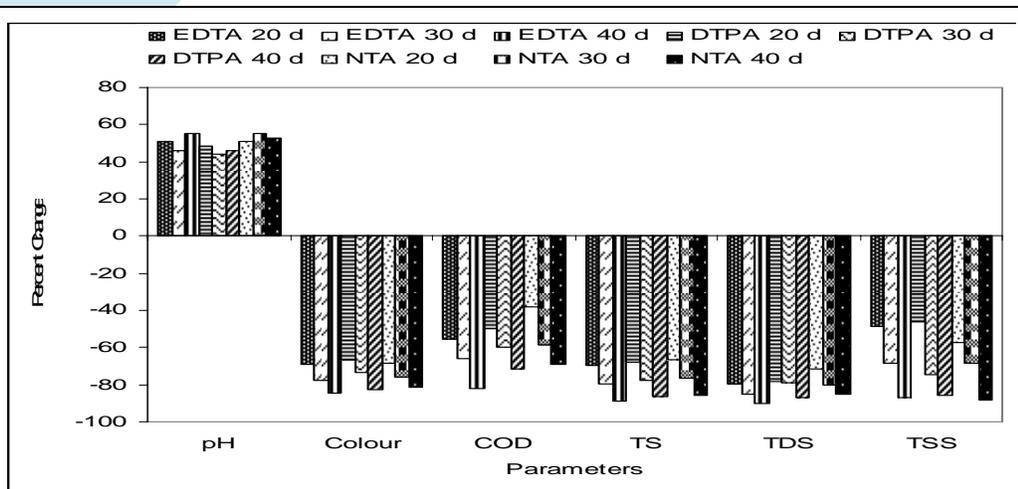


Fig 3: Percent change (+ increase, - decrease) over control in physico-chemical characteristics of 50% diluted spent wash treated with different chelators at varied irrigation

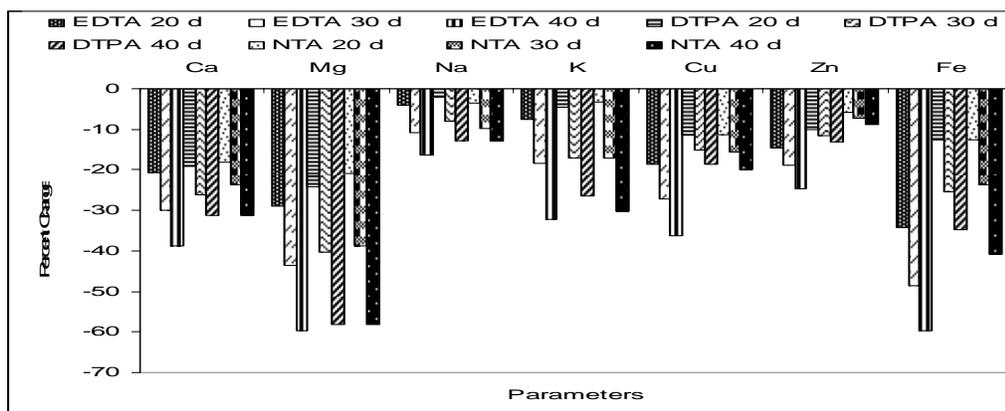


Fig 4: Percent change (+ increase, - decrease) over control in physico-chemical characteristics of 50% diluted spent wash treated with different chelators at varied irrigation

In the present study, among all the three chelators, EDTA was most effective chelating agent removes pollutants and trace metals with less impact on soil properties (Hodgson *et al.*, 1966; Elliott *et al.*, 1989). It is a powerful complexing agent of metals and a highly stable molecules. This is due to the fact that EDTA is organic in nature and has ability to keep metals in soluble form under many conditions in which they would otherwise be precipitated. EDTA solution is far superior for soil washing than either water or an anionic surfactant solution (Davis and Singh, 1995). This chelating agent removes trace metals

with less impact on soil properties than decontamination systems using acids as the flushing agents and is only slowly degradable by microorganisms (Hodgson *et al.*, 1966).

Attachment of EDTA-like chelators to carbon coated metal nanomagnets results in magnetic reagent for the rapid removal of heavy metals from solution or contaminated water (Koehler *et al.*, 2009). Chelation is a chemical reaction. It occurs when more than one bond is formed between a cation and the functional group of the complexing agent. It results in the formation of a ring structure incorporating the metal ion. DTPA and NTA are also used as chelating agent but their pollutant removal

efficiency is less in comparison to EDTA. DTPA is a good chelate for Fe in acidic soils because of the relatively high solubility of soil Fe at low pH and the high stability of Fe-DTPA chelate (Norvell and Lindsay, 1972; Morere *et al.*, 2001; Cox and Kamprath, 1972; Hill and Lloyd, 1957). Polyamine-polyacetate chelates are organic compounds which have the ability to keep metals in a soluble form (Zing *et al.*, 2005; Norvell and Lindsay, 1969; Xu and Xu, 2008).

Conclusion

EDTA has been observed best chelating agent in comparison to DTPA and NTA to remove organic pollutants and heavy metals from distillery spent wash.

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Adaptive modifications in some Hill stream fishes of Betul District

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Abstract

Fishes form the largest group of vertebrates and they serve as best food supplement. It contains protein, fat, vitamins and minerals. District Betul in Madhya Pradesh is situated at the centre of India. It has dense forest and many streams arise from hills. Tapti river and Machna river are originated from this district and Tawa river originated from the neighbouring district Chhindwra enters in Betul district. These rivers are inhabited by many fishes including hill stream fishes. The present study intends to identify the main hill stream fishes of Betul district and to observe their structural modification.

Keywords: Adaptive modification | Chikhlar stream | Hillstream fishes | Tapti River

Introduction

A number of fishes of sluggish water have migrated to hill streams and rivers and developed some special permanent modification to live there. Their modification are integumental and helps in anchoring. Various structural modification found in hill stream fishes have been studied in early part of twentieth century by Hora (1922,1930).

Enough literature exists on the hill stream fishes and adaptive modification in fishes of India (Singh et.al; 1983), but a few reports are available from central India. Studies on the biology and conservation of hill stream fishes especially Mahseer (*Tor*) have also been made by Kulkarni (1971), Tripathi (1978), Pathani (1977 and 1982) and Nautiyal (1984).

The present paper is intended to report the presence of some special hill stream fishes in Betul district and hill stream adaptation found in them. The three hill stream collecting centers during the present investigation are located in the Betul district of Madhya Pradesh. This district is situated approximately 21° 22' to 22° 24' N- latitude and 77° 04' to 78° 33' E longitude and at an altitude of about 653 m above msl. It has dense forest and many stream arise from hills. Three sampling centers were selected namely Tapti ghat (Tapti River), Chikhlar stream

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(Machna River) and Satpura dam (Tawa River). All rivers except Tawa River are originated from this district.

Materials and Method

A survey of hill stream fishes was made in Tapti ghat (Tapti River), Chikhlar stream (Machna River) and Satpura dam (Tawa River) of Betul district, during a period of one year from Feb. 2007 to Jan.2008 (Table-1). Fishes were collected from these spots and were fixed in 5% formalin and identified using Fishes of India by Day F. (1978) and Fishes of U. P. and Bihar by Srivastav (1980).

Results and Discussion

In the present study following hill stream fishes were identified. These fishes are *Barilius bendelisis*, *Garra gotyla gotyla*, *Labeo gonius*, *Tor tor*, *Lepidocephalichthys balgara* and *L. guntea* *Nemacheilus beavani*, *N. botia*, *N. denisunii*, (Table-2). All these fishes possess adaptive modifications in their integument. Some hill stream adaptive modification found in these fishes are as follows: -

1. *Barilius bendelisis* and *Labeo gonius*: Their body shows cylindrical shape with strong muscular tail. They are found in rapidly flowing stream and rivers.
2. *Tor tor*: The body is cylindrical and has a powerful muscular tail. Posterior lip is hypertrophied and it acts as adhesive organ. This species also found in stream and rivers.
3. *Nemacheilus sp.*: In *Nemacheilus beavani*, *N. botia*, *N. denisunii*, the body is elongated. The lips are divided in the middle and are swollen, so that they form a ring like sucker and pulled outward. Paired fins are less horizontally placed and they can easily

adhere to bottom of torrential streams. *Nemacheilus sp.* is also found in pools and ditches.

4. *Garra gotyla gotyla*: This species possesses many adaptive modifications. The highly muscular upper lip is fringed and overhangs the mouth. In the form of a disc behind mouth is found in *Garra gotyla gotyla* and act as adhesive organ. The paired fins are big, muscular and horizontally placed. Their bases are provided with cushion-like thick muscular pads.

5. *Lepidocephalichthys sp.*: In *Lepidocephalichthys balgara* and *L. guntea* the body is elongated and slightly compressed. Barbels are six in number. Dorsal fin is short and commencing opposite of the pelvic fin. Caudal fin is truncate.

The fish fauna of India consists of many species. (Singh *et al.* 1983). Most of the hill stream fishes possess modified structural organization of integument. Day (1978) also documented adaptive modification in these fishes. Hora (1922 and 1930) described a large number of hill stream fishes with respect to their adaptive modification and evolutionary point of view. In various hill stream fishes like *Garra annandalei*, *Glyptothorax madraspatnum*, *Garra lamta*, *Glyptothorax telchilta*, *G.mullya* and *Pseudecheneis sulcatus* presence of adhesive apparatus has been studied by Rauther (1928), Bhatia (1950) and Saxena (1959).

To increase the population of these hill stream fishes, it is vital that the availability of water throughout the year in streams should be made and their habitat, community and food chain be preserved. More studies should be carried out to identify the hill stream fishes found in this district.

S.No.	Collecting Centre	Rivers
1	Tapti ghat	Tapti River
2	Chikhlar Stream	Machna River
3	Satpura Dam	Tawa River

Table:-1. Sampling Station

Name of the Fishes	Name of the Collection Centre		
	Tapti Ghat	Chikhlar Stream	Satpura Dam
Order:- Cypriniformes			
Family:- Cyprinidae			
1. <i>Barilius bendelisis</i> (Ham.)	+	-	+
2. <i>Garra gotyla gotyla</i> (Gray)	+	+	-
3. <i>Labeo gonius</i> (Ham.)	-	-	+
4. <i>Tor tor</i> (Ham.)	+	-	+
Family:- Cobitidae			
5. <i>Lepidocephalichthys balgara</i> (Gunther)	+	+	-
6. <i>L.guntea</i> (Ham)	+	+	+
7. <i>Nemacheilus beavani</i> (Gunther)	-	+	+
8. <i>N.botia</i> (Ham)	-	+	+
9. <i>N.denisonii</i> (Day)	+	-	-

Table 2: Record of fishes collected from different collection centre**References**

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Studies on sexual dimorphism in the Cyprinidae fish *Puntius ticto* (Hamilton – Buchanan) from Kumaun Himalaya, India

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Abstract

The present work is related to the sexual dimorphic nature of ornamental fish *Puntius ticto* (Ham.-Buch.) species from Rocky Rai stream in Kumaun Himalaya, India. This is important for taxonomy, breeding biology and pheromone biology etc.

Keywords: *Sexual dimorphism* | *Puntius ticto* | *Rocky Rai stream* | *Kumaun Himalaya*

Introduction

A large number of rivers, rivulets and streams from a vast network in the Kumaun Himalaya and abode a large number of indigenous fish species. The Rai stream is situated in the Central Himalayan Zone in the Uttarakhand state of India. The study of sexual dimorphism is very important in taxonomy, bionomics and breeding biology related research works. South and South East Asia is rich in small sized, often colorful species currently referred to the catchall Asian Cyprinid genus *Puntius*. *Puntius ticto* (Ham. – Buch.) is the most beautiful and ornamental fish among the *Puntius* species. It has been reported from various parts of Indian Territory (Day, 1878; Talwar and Jhingran, 1991).

Of the large no of fish species, sexual dimorphism has been worked out only in a few species of fresh water fishes. Sexual dimorphism in fish has already been reported in different species by Thabias (1974), Swarup and Swarup (1975), Tilak (1975), Pathani (1978), Rita Kumari and Nari (1979), Badola *et al.*, (1982), Inasu (1993), Tessy *et al.*, (1997) and Dobriyal *et al.*, (2007). Present works deals with the sexual dimorphic nature

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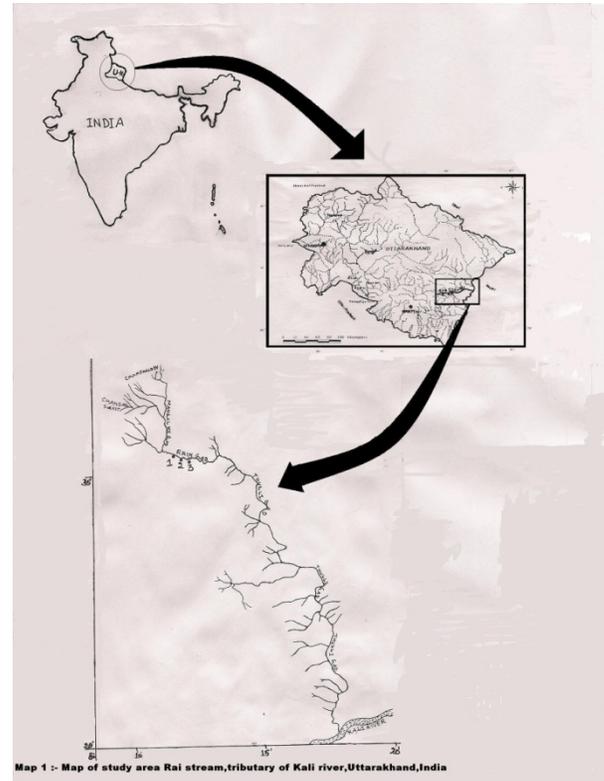
of *Puntius ticto* (Ham. – Buch.) from rocky hill stream of Kumaun Himalaya, India.

Materials and Method

The present sampling site area study was conducted on the hill stream Rai in latitude 29°36' N - 80°12' E at an elevation of about 730 to 750 meters. The Rai spring fed stream is the tributary of river Kali in the upland of Kumaun Himalayan. The present work was done during the period of July 2009 to September 2009. Three sampling sites were selected in the water body of the stream. The personal collections of the fish were from different catching sites along the spring fed streams. They were preserved into 8% formalin solution and identified with the help of keys provided by Day (1878), Talwar and Jhingran (1991) and Jaya Ram (2002). Measurements were taken point to point with rounding to the nearest 0.1 mm. Total length, standard length; head length and snout length were taken from the tip of the snout to the caudal fin base, posterior opercular margin and intera orbital length respectively. Pre-dorsal, pre-pelvic and pre-anal lengths were taken from the tip of snout to the anterior base of the each fin. Lateral line is abbreviated, includes the lateral lines scales and posterior scales in the same horizontal row. Dorsal, ventral, anal and caudal fin counts and other descriptive features were noted in the present study. Local topology is used in descriptions of collecting the sampling sites (Map.1).

Results

During the present study of the fish *Puntius ticto* (Ham.–Buch.) reach a maximum total length of 68mm for male and 70mm for female. Fish small in sized 37mm for male and 38mm for female could not be recorded in the entire study. The morphometric data on



Map 1 :- Map of study area Rai stream, tributary of Kali river, Uttarakhand, India

the some different body measurements is presented in the Table 1.

The meristic analysis of fish was noticed on 118 specimen and the values obtained were as follow: Fin formula D11 (3/8), P13, V9, A8 (3/5), C19, barbals are absent in mouth parts. The sales are small or medium about 20 to 25 in the lateral line; however the lateral line cases after 4 to 10 scales.

There is a dark black blotch on 15-20 scales just above the anal fin on both the sides. During the fish biological investigations on the fish collected from Rai spring fed stream, from Kumaun Himalaya, some impression sexual dimorphism difference were observed. Our observations on the sexual dimorphism in *Puntius ticto* (Ham.–Buch.) is based on the study of 58 females and 60 male specimens, collected between, July 2009 to September 2009. The fish were segregated on the mentioned sexual dimorphic characters and dissected for conformation. We got hundred percent conformations and then decided to

report it for an addition to the specific knowledge based on the study of morphometric characters.

The detailed morphometric and meristic of both male as well as female fish was studied (Table1), but no striking difference was seen. The differences are :- (1). Male with slight black blotch on the dorsal fin and some times in ventral fins, absent in female (fig. 1 and 2). (2.) Upper portion of the body shining light

olive green, middle portion of the body slight blue in both the sexes; but there is dark pinkish color in the lower portion of the male on both the sides, in females there is slightly pinkish and dark yellow colour in the lower portion on both the sides. (3.) Dorsal, ventral and anal fins are dark pinkish and slight orange in male fishes but slight pinkish color shows in female fishes.

Character in ratio	Female	Male
SL in ratio of TL	1.25 - 1.46* 1.30 ± 0.04	1.25 - 1.60* 1.33 ± 0.07
CL in ratio of TL	3.14 - 4.92 4.25 ± 0.37	2.64 - 5.00 4.13 ± 0.49
PAL in ratio of TL	1.64 - 1.85 1.18 ± 0.05	1.76 - 1.95 1.81 ± 0.06
PDL in ratio of TL	1.51 - 2.73 2.40 ± 0.25	2.15 - 2.83 2.53 ± 0.15
PVL in ratio of TL	1.57 - 2.92 2.61 ± 0.28	1.95 - 2.95 2.64 ± 0.22
HL in ratio of TL	6.18 - 10.00 7.35 ± 1.02	6.16 - 9.25 7.48 ± 1.06
ED in ratio of TL	12.60 - 25.50 17.39 ± 3.86	10.25 - 19.00 14.61 ± 2.48
MBD in ratio of TL	2.66 - 4.00 3.24 ± 0.29	3.07 - 3.72 3.43 ± 0.35
Snt.L in ratio of TL	20.00 - 54.00 29.46 ± 10.95	19.00 - 39.00 26.92 ± 7.75
CL in ratio of SL	2.14 - 3.92 3.25 ± 0.37	1.64 - 4.00 3.11 ± 0.48
PAL in ratio of SL	1.20 - 1.44 1.34 ± 0.05	1.09 - 1.43 1.36 ± 0.07
PDL in ratio of SL	1.03 - 2.07 1.83 ± 0.22	1.64 - 2.08 1.90 ± 0.12
PVL in ratio of SL	1.07 - 2.29 1.99 ± 0.25	1.52 - 2.21 1.99 ± 0.15
HL in ratio of SL	4.90 - 7.60 5.61 ± 0.80	4.14 - 7.25 5.62 ± 0.73
ED in ratio of SL	9.66 - 19.50 13.30 ± 3.15	8.00 - 15.00 10.99 ± 1.83
IOL in ratio of SL	5.00 - 18.00 9.47 ± 4.81	3.83 - 7.33 6.16 ± 0.86
MBD in ratio of SL	2.40 - 2.65 2.47 ± 0.23	1.66 - 2.81 2.53 ± 0.35
Snt L in ratio of SL	15.00 - 41.00 22.40 ± 8.15	14.00 - 29.00 20.12 ± 5.44
ED in ratio of HL	1.60 - 3.33 2.31 ± 0.51	1.33 - 2.66 1.97 ± 0.33
Snt L in ratio of HL	2.50 - 8.00 4.01 ± 1.43	2.50 - 7.00 3.61 ± 1.05
IOL in ratio of HL	1.00 - 3.00 1.62 ± 0.83	0.60 - 1.75 1.09 ± 0.25
MBD in ratio of HL	0.40 - 0.63 0.44 ± 0.07	0.33 - 0.60 0.47 ± 1.24

Table-1: Some important taxonomic characters in male and female of *Puntius ticto* (Ham.-Buch)

*Min – Max

Mean ± S.D.



Discussion

Sexual dimorphism is very significant in biodiversity assessments and also very important in biometry, breeding biology, induced breeding, breeding, pheromone biology and other related works. Well-marked structural differences are seen in the two sexes in some species, especially during the breeding season, and these are not related to copulation. In most teleost the female is larger in size than the male, and has a rounded belly during breeding season. The male have brighter color of the body and fins. Dobriyal *et al.*, (2007) reported that in male fish dark black shade the dorsal, ventral and anal fins but is absent in female fishes in *Puntius conchonius*. These characteristics are primary

sexual dimorphic nature of *Puntius conchonius*. The upper portion of the body shining olive green and lower portion silvery in both sexes; but there is pinkish colour in male between these two portions, which is not visible in the female fishes.

Horny tubercles are seen on the head of male in some cyprinids viz. *Tor putitora* and *Tor tor* (Pathani, 1978) and *Barilius bendelisis* (Badola *et al.*, 1982), and these are more prominent during the breeding season, this they of nature is called secondary sexual dimorphic characters. Talwar and Jhingran (1991) noticed that the arching reddish in the dorsal fin of the male *Puntius ticto* easily distinguishes the species and the dorsal fin of the female *Puntius ticto* female is pale, except for a faint rose at breeding time.

Inasu (1993) observed that males are larger than females of the same age group in *Tetradone travencooricus* (Hora and Nair) but Tessy and Inasu (1997) observed that in the edibal perch *Priacanthus hamrus* (Cur. and Val.) females are more than two times larger and heavier than the males of the same age group. Kurian and Inasu (1997) noticed that female are dominance is observed in *Ompak bimaculatus* (Bloch) also, since female is more or less two times larger and five times heavier than the males of the same age group but in *Horabagrus brachysoma* (Gunther) the males are found slightly larger and heavier than the females of the same age group. Arunanchalam and Johnson (2002) observed that sexual dimorphism in *Puntius kannikattiensis*, males deep black, tubercles on front of snout, and extended laterally below the eyes, also on the lower jaw. Black blotches on the body not clear. Fins and lips deep black. In female; snout was plain, and no tubercles found on snout or lower jaw. Lips are white, fins pale yellow to dull white;

entire body blackish –brown, blotches distinct.

In the present study a significant sexual dimorphism was noticed in the fish *Puntius ticto*. The male fish have slight black blotch on the dorsal and ventral fins, which were not found in any of the female fish. There was a well marked dark pinkish colour in lower portion of the male on both the side. In female, there is slightly pinkish and dark yellow color found in both the sides. The dorsal, ventral and anal fins are dark pinkish and slight orange in the male while slight pinkish and dark orange color found in female fishes. In the present investigation, statistical analysis of morphometric data revealed that certain characters slightly differ in male and females.

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The innovation of scientific reality associated with Mahakumbha 2010 - A confluence of faith

Ram Swarup

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Abstract

The MRF-Excitations on Ganga Water yields oscillatory Magneto-Potential records just like ECG of Heart movement to study power characteristics with Ganga Water proving it to be powerful source of energy. The peak and half width characterization of such records enables the computation of movements of various atoms, ions in Ganga water. The mobility factor associated with all motions of these entities reveal that Ganga water is a collision free fluid *i.e.* a harmonious system even in the dull, drowsy, rigid, inert or inactive un anatomic physical matters. When this water is associated with the living species by drinking, bathing or even thinking it disciplines the thought of mental membranes to be harmonious observing our own identity in all human beings thus establishing confluence of faith to be as well established scientific reality at the most pious event of MAHAKUMBH-2010 having vigorous cosmic support also maintaining the principle of an Unified QF-Theory

Keywords: *Kumbhmela | Haridwar | Ganga*

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Introduction

The scientific reality of Ganga water to be supernatural fluid had been established by computational fluid dynamical (CFD) analysis of various theoretical formulations and experimental observations. The Magneto-Radiofrequency (MRF)- Perturbation Theory when applied on Ganga water the deviation of it's electrical carriers in transverse directions under the influence of magnetic field H and radiofrequency f had been formulated. The experimental study of Ganga water with radiofrequency f up to 7MHz and magnetic field H up to 20,000 Gauss generate oscillatory records depicting the tremendous memory structure associated with Ganga Water as intelligent fluid endowed with supernatural electronic gated chips type memory. Ganga water also seems to be receiving solar as well as cosmic signals in an strategic intelligent way with Geo-Solar, Geo-Cosmic couplings to preserve life (both with Geo as well as Bio Anatomy) on earth. This safeguards our Geo-systems from all the Man-Made & Natural Calamities. Theoretically, the conduction, Convection and radiation energy flow processes associated with Ganga water are found to be endowed with an imaginary mathematical term making all these processes to be compels which physically indicate their supernatural couplings of all worldly species associated with it to be influenced by some sort

of so called spiritual signals from cosmic world creating equilibrium i.e. coupling all of them with each other in full harmony. A balance amongst senses, brain, eternal soul and God described in Gita is automatically attained in the vicinity of Ganga. In other words the designation of scientific reality “Unity in Diversity” is automatically attained with Ganga not only in our universe but also in the Dark-Universe made up of more than 85% Dark Matter explained by imaginary parameter of conduction, convection and radiation flows of energy and hence Ganga is biggest wonder in the world.

Theoretical Review

- The x -directional longitudinal current i_x is flown due to voltage $V_x = 2V$ in the sample. The magnetic field H (0-10) kG, when applied in z -direction yields the Hall field E_y in y -direction perpendicular to both x and z -directions as $V_H = E_y \cdot d$. The radio-frequency (RF) application at an angle $\sim 45^\circ$ to x - y directions, pronounces the Hall potential V_H which may be given as

- $$V_H = R_H i_x H_z / b \quad (1)$$

- where the current $i_x = J_x b d$.
- The Hall coefficient R_H may be derived as

$$R_H = \frac{1}{c} \left[\frac{\{(n_i^+ q_i^+ \mu_i^{+2}) \sim (n_i^- q_i^- \mu_i^{-2})\}}{\{(n_i^+ q_i^+ \mu_i^+ + n_i^- q_i^- \mu_i^-)^2\}} \right] \quad (2)$$

- Where n_i are the electrical carrier density of positively and negatively charged ions having the electrical polarities q_i along with their mobilities respectively,

Experimental Analysis

The Ganga water sample from Haridwar, Garumukhteshwar and Narora had been placed in thin film type rectangular geometry and transverse electrodes in transverse 4-probe Hall geometry having electrode separation of a few mm. The x -directional current density J_x carrying experimental probe when placed in high magnetic field H of the order of 10kGauss range develops y -directional Hall-electric field whose potential lies in milli-Volt range as depicted in the figure-1. The oscillatory nature of these magneto-potential records in an indicator of the dynamical movements of bewildering variety of atoms in ionic shape and molecules in the dipolar structure. The imposition of radiofrequency f in Mega-Hertz range up to $f=7\text{MHz}$ is found to deeply influence the dynamical behavior of all the entities within the Ganga water. This suggests that an artificial MRF-control over Ganga water may yield it's resource generation capability for which many type of electronic exploration has been made by our research team.

The temporal development of electrical potentials on different water samples of Ganga and from Makka, Saudi Arabia namely Abezamzam had been recorded as shown in following figure-2 of oscillatory nature

The experimental observations of temporal records of Ganga flood water oscillatory Electrical potentials having good refrigeration capability has been shown in figure-3. The MRF-Electric potential temporal development with magnetic field H has been depicted in figure-4.

Fig.1

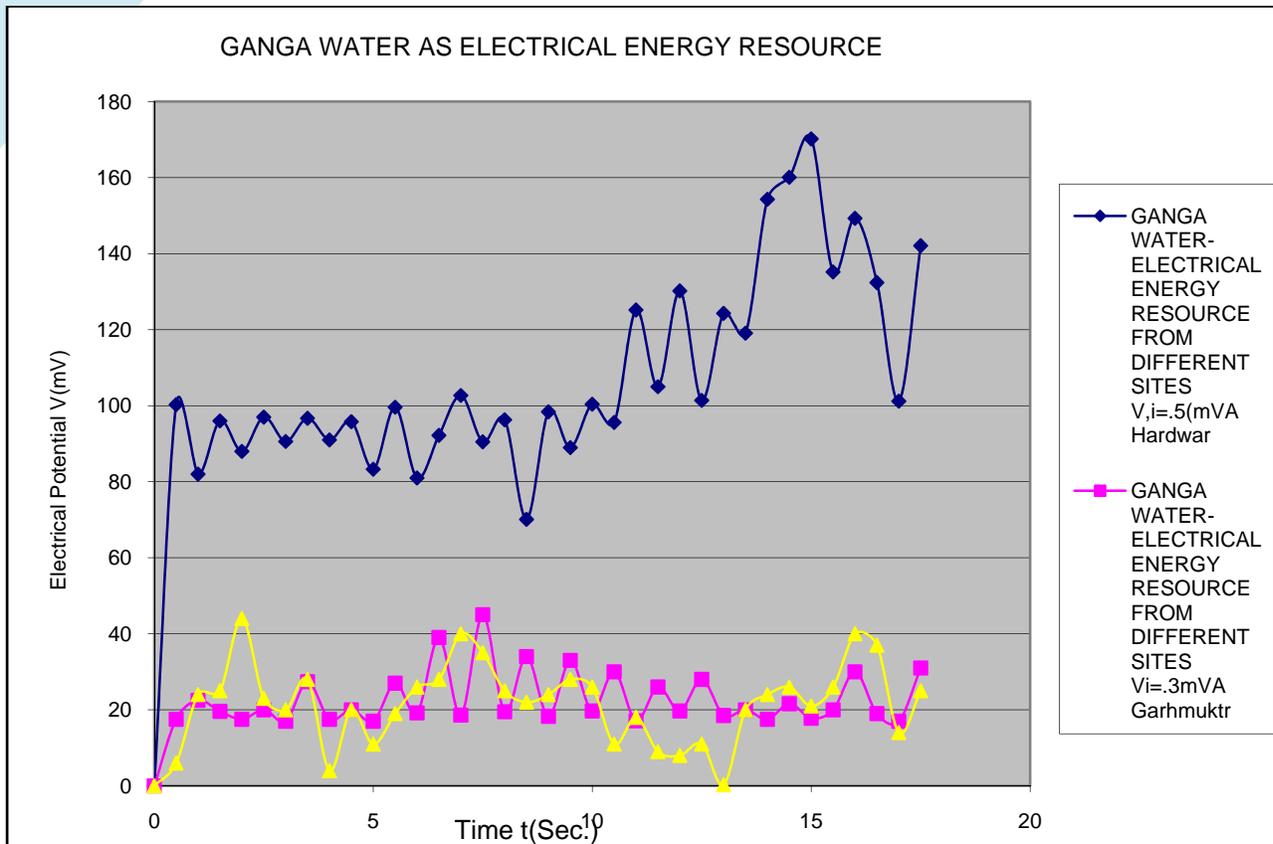


Fig.2

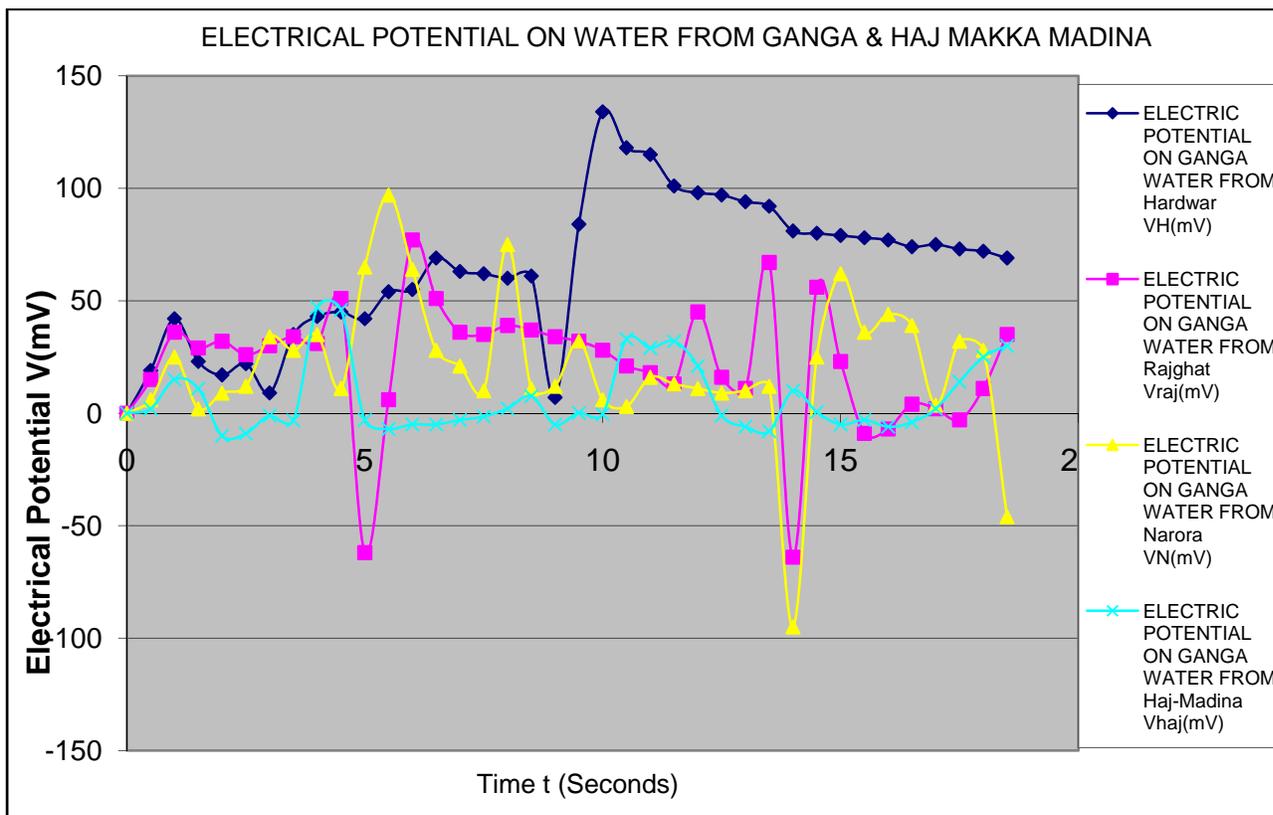


Fig. 3

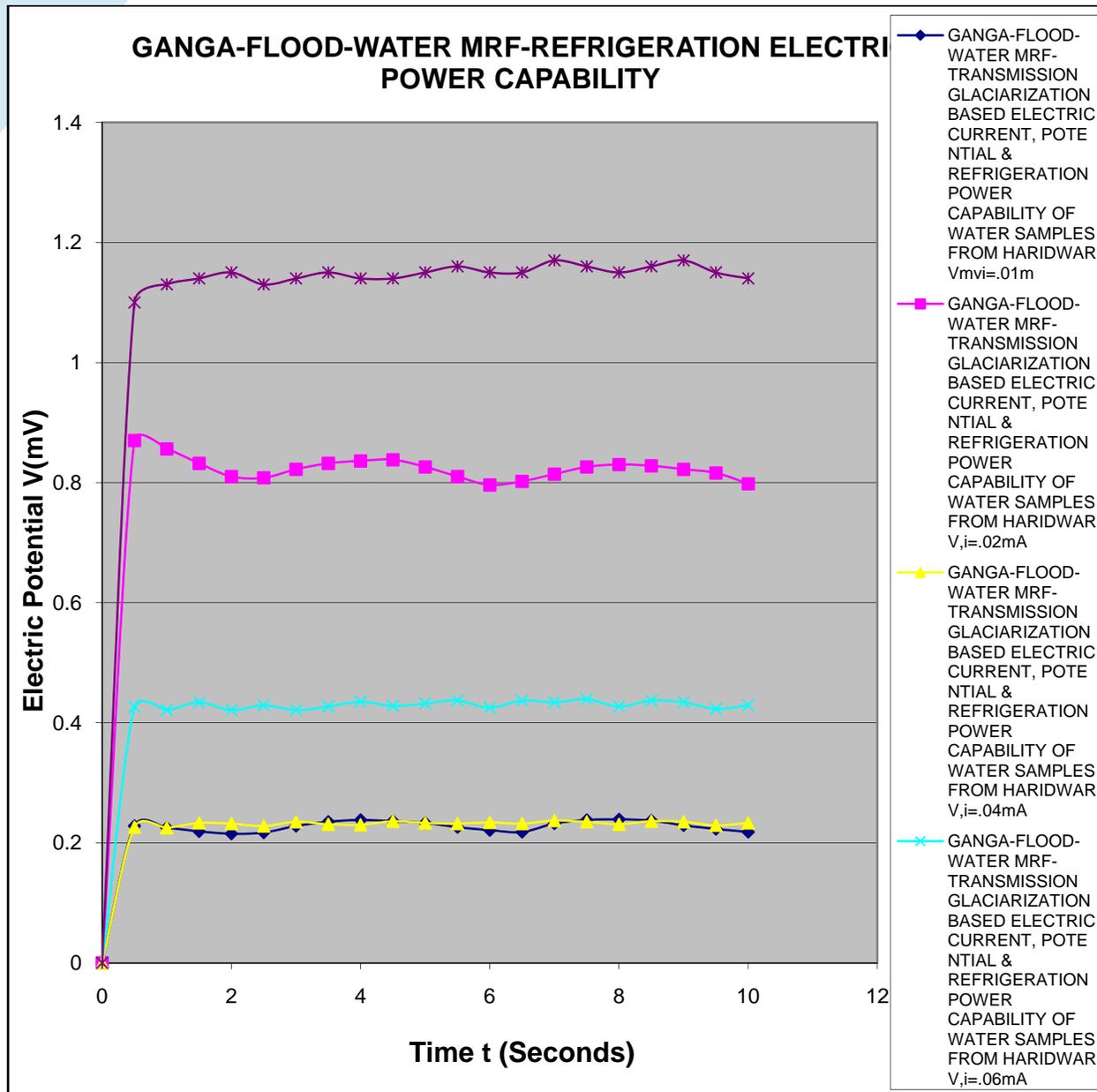


Fig. 4

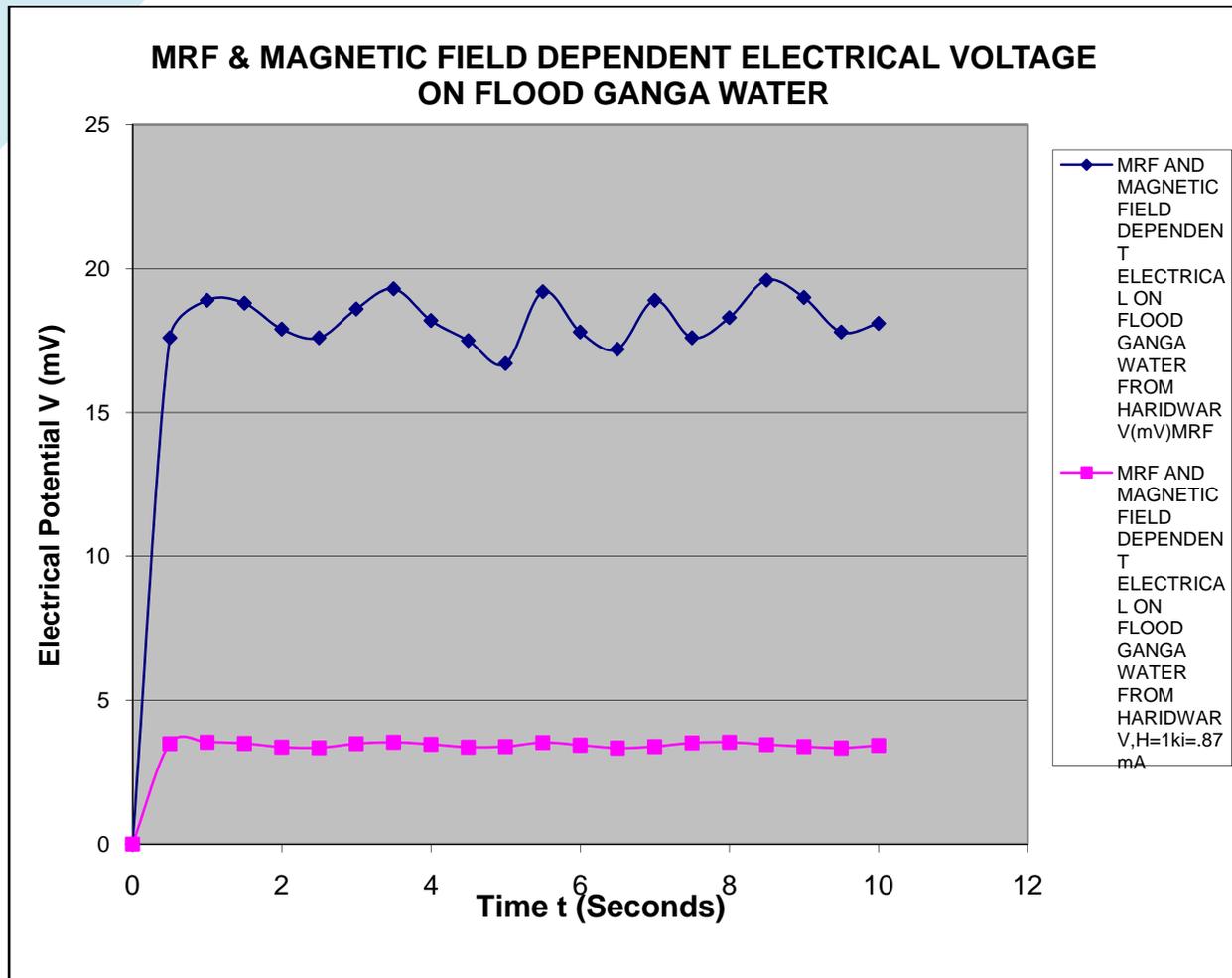
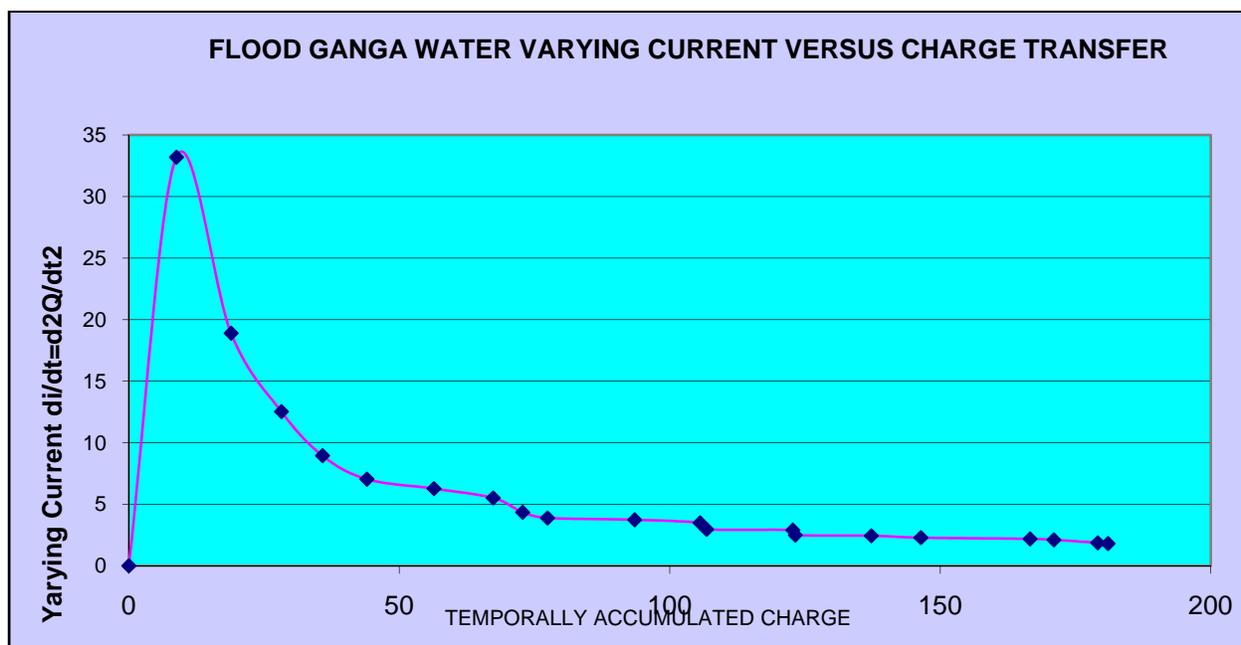


Fig.5



The Ganga flood water varying current with charge has been depicted in figure-5. The Exponential variation trend of varying current versus charge characteristic curve depicts that there exists a profound capability in Ganga water to radiate and receive energy in electromagnetic shape may it be gifts from sun or cosmos.

Results and Discussion

The Magneto-Potential & Current records of Ganga water derives the power curves with immense source of electrical energy is the main finding of present study. An electrode-system having radii of a fraction of mm receives a few nano-Watt electrical power which when computed on an appropriate electronic electrode net work will yield nearly 1000megaWatt electrical energy i.e. a potential source Pollution-Free energy in electrical shape which is a potential alternate to prevailing energy resources including Nuclear Energy. Ganga water possesses tremendous capability to absorb nuclear radiations. It filters pollution wastes thus regarding Ganga water to be destroyer of all sorts of sins of creatures. Ganga water is also acting as big preservator because it's mobility factor is very high which reduces collision probability the cause of chemical reaction which further promotes bacterial activity imposing decomposition of any fluid system. Ganga water is a big Equilibrator to elevate to elevate medicine value. Ganga water has an outstanding Fertilizer value. The food medicinal values of Ganga water is also very large. The climax of Ganga Water character is that it releases soul without pain when consumed at the last event of life because it disciplines all the constituents of human body imposing resistance to life cycle obstructed due to accomplishments of many undue worldly liabilities due to attachments with the

generations and commodities associated with all body feelings, passions, ambitions and aspirations. So the scientific physical reality associated with spiritual faith investigated in the present investigation completely matches with the title "MAHAKUMBHA 2010- CONFLUENCE OF FAITH" due to phase transition of human mentality of individualism to collective harmony not only in human beings but also in all components of universe in the verse of most famous Gayatri Mantra "OM BHUH BHUVAS SWAH" OM=Couplings of all cosmic constituents like BHUH=Earth, BHUVAH=Planetary system, SWAH=All Galaxies moving with tremendously high velocities but without collision.

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Indian pharmaceutical industry and patent amendments

Meetu Khanduja

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Abstract

The history of Patents in India dates back to 1985 and since then has undergone various amendments. However, seeking to develop a domestic pharmaceutical industry, in 1970, India abolished patents on pharmaceutical products. The WTO agreement contains an agreement on IP, namely, the Agreement on Trade Related Aspects of Intellectual Property (TRIPS). This Agreement made protection of intellectual property an enforceable obligation of the Member States. As of January 2000, all developed and developing countries who are members of the World Trade Organization (WTO) were obligated to have domestic laws and enforcement mechanisms that comply with the international standard set under TRIPS. Doing so included introducing full product patents on pharmaceutical innovations, extending all patents from 5-14 years to 20 years, and accepting limitations on compulsory licensing. The Govt. of India agreed to TRIPS for the additional benefits of WTO.

Keywords: *Patents* | Indian pharmaceuticals | *Amendments* | *WTO* | *TRIPS*

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Introduction

After Independence, the Indian pharmaceutical industry saw many ups and downs. Two expert committees were established in independent India to study patents and provide suggestions on the type of patent system that India should implement. These committees conducted an extensive survey of patents in India. The Patent Enquiry Committee (1948-1950) and the Ayyangar Committee (1957-1959). The reports of these committees concluded that foreigners held 80-90% of the patents in India and were exploiting the system to achieve monopolistic control of the market. The industry majorly relied on drug import and the domestic's drug production remained minimal. The British colonial patent system 1911 secured the Indian market for the British industry. The Multinational Corporations set their base in India and they controlled 70-80 percent of the market.

The Patent Act 1970 brought a great revolution in the Indian Pharmaceutical industry. The Act contained several provisions intended to support the domestic pharmaceutical industry by providing soft patent regime. Until then, the cost of drugs in India was very high, the availability of the drugs was low and the great deal of the pharmaceutical needs was met by imports. The R&D initiative was almost negligible and so was the drugs export because of lack of patent protection In India.

Relationship between patents and pharmaceutical industry growth:

A Patent is an exclusive right granted by the Government of a country to an inventor over his invention for a limited period of time. Patent grants monopoly right to the inventor/companies to make, use, manufacture and market their invention. This means that a company holding a patent on a drug in a particular country can prevent other companies to manufacture and sell the drug in that country for the duration of the patent term. (20 years according to WTO rule). Thus the companies having the patent right can charge high prices for the drugs as there are no competitors in the market. Lack of competition leads to high drug prices and limited industrial growth.

In the absence of patents, multiple producers compete for a share of the market, driving the price down as low as possible. In addition, having multiple sources helps increase the availability of drugs and hence growth in the pharmaceutical sector. . In pharmaceuticals, that has meant that a tiny tweak in the synthesis of a molecule yields a new patent. Several companies can produce the same drug, creating competition that drives down prices.

The Patent Act, 1970

The patent Act 1970 which came into effect in April, 1972 greatly weakened the IPR protection particularly in the pharmaceutical industry in India. The Act particularly accomplished the following:

1. It disallowed product patent for “substance intended to use or capable of being used as food, or as medicine or drug”. Under the Act , only the process patents were allowed for these substances.

2. The statutory term was shortened to 5 to 7 years on pharmaceutical process patents and automatic licensing was put in place.

Effects

1. Inventions in the field of drugs, pharmaceuticals and chemicals became unpatentable, allowing inventions patented elsewhere to be freely copied and marketed in India.
2. It encouraged the domestic production of drugs through adopting different manufacturing process (reverse engineered products) thereby restricting the drug imports.
3. India gradually became a major drug exporter as the Act encouraged the local firms to manufacture the copies of drugs by adopting their own production methods.
4. India’s share in world exports of pharmaceuticals has risen by 2.5 times over the 1970 to 1998.
5. The share of pharmaceuticals in national exports has increased from 0.55 per cent in 1970-71 to over 4 per cent by the 1999-2000.
6. All inventors were affected by the weak patent regime therefore, foreigners no longer found taking out a patent in India worthwhile. Thus, foreign ownership in Indian drug industry decreases to 39% in 1993 as compared to 80% in 1970.

Growth of the pharmaceutical industry in the absence of product patents

With the patent Act 1970, Indian pharmaceutical Industry saw a significant development. The amount of investment which stood at Rs. 2250 million in 1973, rose to Rs.6000 million by 1982. In the 1980s, the industry had grown at a rapid rate of 11 percent per annum, which further accelerated to 17

percent per annum during 1990s (Pradhan 2004). The number of drug manufacturing units grew from 2,257 (in 1970), to 16,000 (in 1990) and to over 23,000 (in 2005).

Number of Drugs and Pharmaceutical Units

Years	No. of Units
1952-53	1752
1969-70	2257
1977-78	5201
1979-80	5126
1980-81	6417
1982-83	6631
1983-84	9000
1984-85	9234
1985-86	9540
1989-90	16000
2000-01	20053

Source: DK Mittal (1993): *Drugs and Pharmaceutical Industry, New Delhi, Annual Publications Pvt. Ltd.*

Organisation of Pharmaceutical Producers of India (2001), Drug Prices Control Order 95, OPPI.

This industry, which produced only formulations in the pre-1970s era, started manufacturing more than 400 bulk drugs making up around 6% of the international bulk drug market. The value of bulk drugs production has increased from Rs. 13,200 million in 1993-94 to Rs. 2, 41,850 million in 2002-03.

Another achievement of the industry is the production of low cost drugs. Also, the composition of the Indian pharmaceutical industry import and export changed over this

period of time. , the ratio of pharmaceutical products to the total exports grew from a mere 0.6 percent in 1970-71 to 4.9 percent by 2000-04. The ratio of pharmaceutical imports to total imports, on the other hand, came down from 1.5% in 1970-71 to 0.8 percent in 2003-04.

Export and Import of Drugs and Pharmaceuticals from 1993-94 to 2001-02

Years	Exports(in Rs. Million)	Imports(in Rs. Million)
1993-94	14901	11374
1998-99	61520	30473
2000-01	72302	15020
2001-02	87299	20325

Source: Directorate General of Commercial Intelligence and Statistics (DGCIIS)

Amendments in the Patent Act 1970

The two recent amendment in the patent Act 1970, Patent (Amendment) Act 1999 and Patent (Amendment) Act 2002, generally aimed at ending the system of short-term process patent and increased the patent term to 20 years.

Patent Amendment Act 1999

The Act was passed in March 1999 and has retrospective effect from 1st January 1995. The Act was passed in order to comply with the international standards of TRIPS agreement which provided that patents shall be made available for all the inventions whether process or product.

The major amendments were:

- EMR(Exclusive Marketing Rights) - EMR constitutes a monopoly right given to the patent applicant even before the grant of a patent. Exclusive Marketing Rights is only for selling and distributing the product but not for manufacturing the same and is granted for five years from the date of the

EMR application or date of grant of patent or rejection of patent whichever is earlier. The application for the grant of an EMR can be made for an invention relating to an article or substance intended for use or capable of being used as a drug or medicine, developed after 1.1.2005.

- Section 5 (2) has been inserted by this amendment which provides for filing of applications for patent of a product in the field of drugs, medicines and agro-chemicals. It also includes alloys, optical glass, semi-conductors and inter-mechanic compounds.

Patent Amendment Act 2002

The salient features of the patent (Amendment) Act 2002 are:

- **Redefining the term invention**

The patent Act 1970, provided that in order to be patented, the invention must be useful but it did not define the requirement of "capable of industrial application". The patent Amendment Act 2002 redefines an invention as –

"invention" means a new product or process involving an inventive step and capable of industrial application".

- The key issues included in this Amendment were, re-defining patentable subject matter, extension of the term of patent protection to 20 years and amending the compulsory licensing system.

It is now possible to make an application for patent claiming for a substance itself intended for use or capable of being used as Medicine or Drug, excepting the intermediate for the preparation of drug.

Patent Amendment Act 2005

As a founder member of WTO, India has to work within the confines of the provisions and articles approved by the world body. One of these is the Agreement on Trade-related Aspects of Intellectual Property, or TRIPS, which obliges WTO countries to grant patents on technological products, including

pharmaceuticals, subject to the normal tests of novelty, inventiveness and industrial applicability. (Article 27.1) India claims to have conformed to the TRIPS agreement of WTO by amending its patent Act for the third time by an ordinance passed by the Central Government on 27 December, 2004 that eliminated 35 years of national exemption of medicines from product patent protection. The amendment introduced product patents for drugs, foods and chemicals.

The Patent (Amendment) Act 2005 came into effect from 1 January, 2005. A few important amendments of the act are:

- Provision related to black box application (means by which product patent applications can be filed from January 1, 1995)- if filled before 1Jan. 2005 .Under the transition provision of TRIPS, any manufacturer who has made significant investment for the manufacturer of product and has produced and marketed the product before 1 Jan. 2005 will be able to continue the production after 1Jan. 2005 without infringing the patent.
- Herbal preparations having medicinal value can be patented under the amended law.
- TRIPs Art. 27(3)(b) makes it obligatory to grant patents to microorganisms and biological processes
- Routine issuance of compulsory licenses after January 1, 2005 in India. Conditions for obtaining compulsory license have been clarified in order to facilitate export of patented pharmaceutical products by Indian companies to countries that do not have adequate production capacities such as least developed countries. The compulsory licensing is an instrument that the TRIPS allows by which governments can allow domestic manufacturers to manufacture patented products within 3 years of their introduction.
- The Patents (Amendments) Act, 2005 introduced s. 92A which would not permit export of compulsorily licensed medicines

from India without a compulsory license granted in the importing country.

- Remove provisions for the granting of new-use or second-use patents, currently described in Section 3(d) of the Patents Act.

The Amendments in the patent Act effected the price (i.e., increased price) for two drug categories: (i) the drug invented and patent protected after 1 January, 2005, and (ii) the generic drug until now protected by patent Act 1970 but patent protected outside India.

Post Amendment Scenario

While the patent Act 1970, focusing on the process patent system helped to establish a strong and highly competitive domestic pharmaceutical industry and made India a bulk supplier of drugs to the world, the recent amendments in the Act will end the golden period of the Indian pharmaceutical industry by introducing the product patent system. The product patent mechanism would filter the pharmaceutical companies and would favor only the ones with built-in scientific and technical resources. R&D departments are moving away from reverse-engineering in favour of developing novel drug delivery systems and discovery research.

Table 2: FDI Inflows into India

(Rs. million) Year	Pharmaceuticals	All sectors	Share of pharmaceuticals (%)
Aug 1991-Dec 1999	8221.75	576821.15	1.43
2000	2079.88	123537.34	1.68
2001	4081.79	167777.54	2.43
2002	2510.52	181955.56	1.38
2003	2793.28	116171.7	2.40
2004	15711.08	172665.2	9.10
2005	5107.25	192990.9	2.64
Total	40505.55	1531920	2.64

Source: Government of India, Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Secretariat for Industrial Assistance, *SIA Newsletter*, various issues

In order to meet the growing changes, the industry developed a new approach involving:

Contract Research

Companies specialized in the line of clinical trials offered services which include product development, formulation and manufacturing, clinical trial management, toxicology and clinical, medical and safety monitoring.

Contract Manufacturing

Many pharmaceutical multi nationals are looking to outsource manufacturing to Indian companies, which have a cost advantage in comparison to companies in the developed countries.

With regard to this, the pharmaceutical companies are undertaking compliance with reputed International regulatory agencies like USFDA, MCC for their manufacturing units.

Current Scenario

The Indian pharmaceutical Industry is growing very well for the past few years.

- High FDI (foreign direct investment): global firms are reluctant to invest in a country with no IPR protection. Pharmaceutical industry accounts for about 2.91% of total FDI into the country. The FDI in pharmaceutical sector is estimated to have touched US\$ 172 million, thereby showing a compounded annual growth rate of about 62.6%. Drugs and pharmaceuticals sector is at 8th rank in India's top 10 FDI attracting sectors.
- A recent market research done by RNCOS – has found that the share of Indian pharmaceutical industry is growing commendably at a rate of 10% per year.
- The Pharmaceutical industry is growing at a rate of 10.8 per cent and is expected to reach \$168 billion in the year 2009.
- India is the world's fourth largest producer of pharmaceuticals by volume, accounting for around 8% of global production and 13th in terms of value of global pharma business. In value terms, production accounts for around 1.5% of the world total.
- The Indian pharmaceutical industry directly employs around 500,000 people and is highly fragmented. While there are around 270 large R&D based pharmaceutical companies in India, including multinationals, government-owned and private companies.
- The estimated worth of the Indian Pharmaceutical Industry is US\$ 6 billion.
- Almost most 70% of the domestic demand for bulk drugs is catered by the Indian Pharma Industry.
- The Indian Pharmaceutical Industry is one of the biggest producers of the active pharmaceutical ingredients (API) in the international arena.
- The Pharma Industry in India produces around 20% to 24% of the global generic drugs.

Summary

So far, the Indian pharmaceutical industry has made use of reverse engineering process and cheap labor under the process patent regime to produce bulk drugs and has become one of the major exporter of drugs to the nation. The advent of pharmaceutical product patent recognition in January 2005 changed the ground rules for Indian companies. The industry is undergoing a transition phase. The post-WTO scenario is likely to be characterized by soaring drug prices, intense competition, new drug discovery and introduction into Indian markets, large expenditures on research and development, large scale downsizing, increase in social costs, etc. Indian companies have adopted different strategies in order to penetrate regulated generics markets. Some have entered these markets through partnerships with established generic companies; others have set up their own sales and marketing organisations, either organically or through acquisitions. Today, Pharmaceutical Market in India is actively partnering with Government, NGOs and other Healthcare providers to improve the health and quality of life by innovating and developing safe, cost-effective and quality medicines. It also aims to increase the access of medicines to people in rural areas and those living at or below the poverty line.

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Rhizosphere Algae of Paddy in Vidarbha region of Maharashtra State

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Abstract

The microorganisms in the rhizosphere act as microbiological buffers and protect the plant from the infection of the pathogens. The actual mechanism of the buffering may be different for different types of plants. Plants influence the growth of microorganisms in its rhizosphere. The rhizosphere microorganisms showed different qualities and quantities in different types of plants and its stages and depths. Addition of organic manures to soil will increase the microbial activity in the soil. In all 84 taxa of 30 genera were identified through collection as well as cultures studies from the experimental fields. 56 belongs to Cyanophyta, 19 belongs to Chlorophyta and 9 belongs Bacillariophyta. Rhizosphere of 4 varieties of rice (Nagpur-22, Ratna, Jaya and Sakoli-6) were studied. Blue-green algae were pre-dominant in the rhizosphere of all the 4 varieties. More species of algae were found in the rhizosphere (39 algal taxa) than in the non rhizosphere soil (26 algal taxa). The inter-specific differences in rhizosphere algae were present, as 13 algal taxa were attracted by all the 4 varieties of rice whereas others were not.

Introduction

Algae play an important role in the economy of soil. Hiltner (1904) introduced the term 'Rhizosphere'. Information has been accumulated on the subject of the abundance and activity of various microorganisms in the rhizosphere of different species of plants. Although the algae are invariably represented in the micro flora of soils, our knowledge of their occurrence in the rhizosphere is meager. The rhizosphere micro flora of root exerts certain effects known as 'Rhizosphere effect'. The microorganisms in the rhizosphere act as a microbiological buffers and protect the plant from the infection of the pathogens. The actual mechanism of the buffering may be different for different types of plants.

Rhizosphere is an ecological niche which comprises the surface of plant roots (rhizoplane) and the region of the surrounding soil in which microbial population is affected by the presence of roots. The rhizosphere generally extends a few centimeters from the rhizoplane. The microorganism of the soil exert a variety of beneficial effects on the growth of the higher plants, on the other hand plants influence the growth of microorganisms in its rhizosphere. The microorganisms like Bacteria, Fungi and Algae play an important role in soil by solubilizing phosphorus and

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making it available to plants, thus increasing the fertility of the soil (Wani, More & Patil 1979). Particular plants attract specific groups or species of microorganisms (Katznelson *et al.*, 1948). The living plants furnish algae in its rhizosphere with more suitable conditions (Gonzalves & Yalavigi, 1960).

The extent to which the plant benefits from the rhizosphere micro flora is not clear. It may protect the plant from soil born pathogens or mineralizing activity of them. Gray & Williams (1971) proposed that terrestrial algae may function in the formation and stabilization of soils. Enhanced growth of algae in the rhizosphere has been observed by several workers (Katznelson 1946, Shtina 1959 b, Hadfield 1960, Gonzalves & Yalavigi, 1960, Cullimore & Woodbine 1963). The microbial population in the rhizosphere was more than the distant soils (Agnihotrudu, 1953). Gonzalves & Yalavigi (1960) concluded that more algae were found in the rhizosphere than other areas at the same depths. The seedlings of Tea plants significantly increase the algal population in the root zone (Hadfield 1960). Cullimore & Woodbine (1963) reported stimulatory rhizosphere effect of Pea root on soil algae. The rhizosphere microorganisms showed different qualities and quantities in different types of plants and its stages and depths.

Addition of organic manures to soil will increase the microbial activity in the soil. Application of Sesamum oil cake to red sandy soil stimulate increase bacterial and fungal population, while Groundnut oil cake stimulate bacteria and inhibit fungal activity. Amendment of soil with gypsum, sulphur & groundnut oil cake increase the number of rhizosphere flora (Sunar & Chohan, 1971). Phorate granules, a systemic insecticide affects the rhizosphere micro flora of various plants (Tiwari, 1972,

Kandaswamy *et al.* 1975, Visalakshi & Nair (1979). The light intensity and mineral nutrients affects the abundance of rhizosphere flora (Newman 1978). Algalization decreases the rhizosphere mycoflora of Rice plants (Gangawane & Saler, 1979).

Material and Methods

In Vidarbha, both transplanted variety as well as drilled variety was used for cultivation. In all 23 varieties of rice were used, of which 19 of transplanted variety and 4 drilled variety. The transplanted variety yield more than the drilled variety. Total 4 varieties *i.e.* Nagpur-22, Ratna, Jaya, Sakoli-6 were grown in the fields for the study. The seed rate (40 – 50 kg/hector), distance between two rows of plants (20 cm.) and fertilizers (100:50:50: N.P.K.) were as done in normal course of cultivation. Plant population per hector was maintained as 3.50 lakhs.

Paddy field of Umrer in Nagpur district was chosen for experimental studies. Plants were sowed in July and transplanted in August. Plants showed healthy growth and were observed regularly. The rhizosphere and non rhizosphere soil samples were collected from September to October and also after the harvesting of the crop *i.e.* November.

Rhizosphere soil sample

Plants were carefully dug out from the field and superfluous soil adherent to the roots gently removed by shaking to release the root system. The entire root was then snipped off and transferred to a measured amount of sterile distilled water in a wide mouthed bottle. The contents of the bottle were then subjected to vigorous shaking and the root system further washed out in to the bottle before being removed and discarded. The resulting suspension was then filtered through a dried Whatman no. 1 filter paper

which after filtration was introduced into culture media. Multiple of cultures were made in different media.

Non- rhizosphere soil sample

Soil samples from similar depth away from the roots of the rice plants were taken for each variety of rice. These samples were inoculated into the culture media. Multiple cultures of the sample were made in different media to rule out the possibility of an algae missing from the observation.

Culture media: Two types of cultures, liquid and moist, were prepared for studying the soil algae and fresh collections. The bottles and conical flasks were used for the liquid cultures whereas petridishes were used for the moist cultures. The culturing vessels with culture media were sterilized in an autoclave at 2 lbs pressure for 20 minutes prior to inoculation.

Three different culture media were employed for culturing. They are as follows :

1. De's (1939) modified Beneck's medium
2. Allen and Arnon's (modified) medium (Allen&Arnon, 1955, b)
3. Chu. No. 10 (Modified Medium (Cerloff *et al.*, 1950)

Culture media were made in double distilled water with required constituents.

Results and Discussion

The occurrence of an alga at a particular region is confirmed by soil cultures. The spores can reach other regions of soil due to drainage or cultivation method. In dry powdered soils only spores of algae can present and not any vegetative stage of it. Such sample shows algal growth only after 15 days. The alga which make the presence

within 10 days after inoculation were considered to be present in vegetative stage.

In all 84 taxa of 30 genera could be identified through collections as well as culture studies, out of which 56 belong to Cyanophyta, 19 belong to Chlorophyta and 9 Bacillariophyta. The genera collected with the number of species in parenthesis are Microcystis (1), Chroococcus (8), Gloeotheca (3), Aphanocapsa (5), Aphanothece (2), Chlorogloea (1), Oscillatoria (11), Phormidium (8), Lyngbya (3), Anabaenopsis (1), Nostoc (4), Anabaena (3), Aulosira (1), Plectonema (1), Tolypothrix (1), Calothrix (2), Hapalosiphon (1), Chlamydomonas (2), Chlorococcum (2), Scenedesmus (3), Ulothrix (5), Geminella (2), Protococcus (1), Closterium (3), Cosmarium (1), Fragillaria (1), Synedra (1), Achnanthes (1), Navicula (2), Cymbella (2), Nitzschia (2). The Cyanophycean members were dominated over other classes of algae as it has 66.66% of the total whereas only 22.73% Chlorophyceae and 10.71% Bacillariophyceae were present in the experiment field.

The rhizosphere algae of 4 varieties of rice (Nagpur-22, Ratna, Jaya and Sakoli-6) were studied. Nagpur-22 variety of rice had 24 taxa of algae out of which 17 belonged to Cyanophyta, 5 belonged to Chlorophyta and 2 belonged to Bacillariophyta. The 24 taxa were distributed amongst 17 genera as Chroococcus (3), Aphanocapsa (1), Oscillatoria (3), Phormidium (2), Lyngbya (1), Nostoc (2), Anabaena (1), Plectonema (1), Tolypothrix (1), Calothrix (2), Chlamydomonas (1), Chlorococcum (1), Protococcus (1), Closterium (1), Cosmarium (1), Fragillaria (1), Cymbella (1).

In all 20 taxa were identified from the rhizosphere of Ratna variety out of which 14 belonged to Cyanophyta, 3 belonged to

Chlorophyta and 3 belonged to Bacillariophyta. These taxa were distributed amongst 16 genera as Chroococcus (3), Aphanocapsa (1), Aphanothece (1), Oscillatoria (1), Phormidium (2), Lyngbya (1), Nostoc (1), Anabaena (1), Plectonema (1), Tolypothrix (1), Hapalosiphon (1), Chlorococcum (1), Protococcus (1), Cosmarium (1), Fragillaria (1), Navicula (2). The Jaya variety showed 19 taxa in its rhizosphere which belonged 13 to Cyanophyta, 3 to Chlorophyta and 3 to Bacillariophyta. The species of 13 genera were included. They are Chroococcus (2), Aphanocapsa (1), Oscillatoria (2), Phormidium (3), Nostoc (2), Anabaena (1), Tolypothrix (1), Calothrix (1), Chlorococcum (1), Protococcus (1), Cosmarium (1), Fragillaria (1), Nitzschia (2). The rhizosphere of Sakoli-6 variety holded 26 algal taxa which belonged 18 to Cyanophyta, 6 to Chlorophyta and 2 to Bacillariophyta. They are Chroococcus (3), Aphanocapsa (2), Oscillatoria (1), Phormidium (3), Lyngbya (2), Nostoc (2), Anabaena (1), Aulosira (1), Tolypothrix (1), Calothrix (2), Hapalosiphon (1), Chlamydomonas (1), Chlorococcum (1), Ulothrix (1), Geminella (1), Protococcus (1), Cosmarium (1), Fragillaria (1), Cymbella (1).

The common rhizosphere algae of all the 4 varieties of rice were Chroococcus minor, C. schizoder-maticus, Aphanocapsa grevillei, Oscillatoria sancta, Phormidium luridium, P. tenue, Nostoc muscrum, Anabaena naviculoides, Tolypothrix byssoidea, Chlorococcum humicolo, Protococcus viridis, Cosmarium granatum, Fragillaria brevistriata F. elongata. The algae which were present in both rhizosphere and non-rhizosphere were Chroococcus minutes, Aphanocapsa fronticola, Lyngbya hieronymusii, Ulothrix variabilis Geminella minor.

The result shows that blue green algae were pre-dominant in rhizosphere soils of all the 4 varieties of rice studied. Since the rhizosphere provides rich food base and alkaline soils, it supports the blue green algae than other groups of algae (John 1942). More species of algae were found in the rhizosphere (39 algal taxa) than in the non-rhizosphere soil (26 algal taxa). As the plant develops, the soil around the roots naturally becomes more favorable medium for the growth of algae as it may be receiving certain exudates from the roots. Maximum number of algal species was found when the plant begins to flower. However it is likely that as the number of algal species increase in the region of the rhizosphere, some of the algal spores may be carried away from the rhizosphere by small animals or may be washed down by rain to places away from roots.

Conclusion

Culture and collection studies of soil algae of the experiment field proved the dominance of Cyanophyceae over other groups of algae present. Number of algal taxa was found to be more in the rhizosphere than in the non-rhizosphere. The inter-specific differences in rhizosphere algae were present, as 13 algal taxa were attracted by all the 4 varieties of rice whereas others were not.

S. No.	Name of Alga	Nagpur-22	Ratna	Jaya	Sakoli-6
CYANOPHYTA					
1	<u>Chroococcus limneticus</u>		p		0
2	<u>Chroococcus minutus</u>				p
3	<u>Chroococcus minor</u>	P	p	p	p
4	<u>Chroococcus schizodermaticus</u>	P	p	p	p
5	<u>Chroococcus tenax</u>	P			
6	<u>Aphanocapsa fonticola</u>				p
7	<u>Aphanocapsa grevillei</u>	P	p	p	p
8	<u>Aphanothece naegelii</u>		p		
9	<u>Oscillatoria princeps</u>	P			
10	<u>Oscillatoria proboscidea</u>	P		p	
11	<u>Oscillatoria sancta</u>	P	p	p	p
12	<u>Phormidium bohneri</u>			p	p
13	<u>Phormidium luridum</u>	P	p	p	p
14	<u>Phormidium tenue</u>	P	p	p	p
15	<u>Lyngbya hierogymusii</u>	P			p
16	<u>Lyngbya lachneri</u>		p		
17	<u>Nostoc muscorum</u>	P	p	p	p
18	<u>Nostoc spongiaeforme</u>	P		p	p
19	<u>Anabaena naviculoides</u>	P	p	p	p
20	<u>Aulosira aenigmatica</u>				p
21	<u>Plectonema tomasinianum</u>	P	p		
22	<u>Tolypothrix byssoidea</u>	P	p	p	p
23	<u>Calothrix epiphytica</u>	P		p	p
24	<u>Calothrix marchica</u>	P			p
25	<u>Hapalosiphon welwitschii</u>		p		p
CHLOROPHYTA					
26	<u>Chlamydomonas globosa</u>				p
27	<u>Chlamydomonas mucicola</u>	P			
28	<u>Chlorococcum humicola</u>	P	p	p	p
29	<u>Ulothrix variabilis</u>				p
30	<u>Geminella minor</u>				p
31	<u>Protococcus viridis</u>	P	p	p	p
32	<u>Closterium parvulum</u>	P			
33	<u>Cosmarium granatum</u>	P	p	p	p
BACILLARIOPHYTA					
34	<u>Fragillaria brevistriata f. elongate</u>	P	p	p	p
35	<u>Navicula clavata</u>		p		
36	<u>Navicula grivillei</u>		p		
37	<u>Cymbella cymbiformis</u>	P			
38	<u>Nitzschia dissipata</u>				
39	<u>Nitzschia gracillis</u>				

Table I: Rhizosphere Algae of four varieties of Rice

Table I: Rhizosphere Algae of four varieties of Rice

CYANOPHYTA

1. Chroococcus macrococcus
2. Chroococcus minutes.
3. Chroococcus spelaeus.
4. Chroococcus turgidus v.
fuscescens.
5. Aphanocapsa fonticola.
6. Aphanocapsa nivalis.
7. Aphanothece microscopica.
8. Chlorogloea microcystoides.
9. Oscillatoria curviceps v. angusta.
10. Oscillatoria jenensis.
11. Oscillatoria subbrevis.
12. Phormidium africanum.
13. Phormidium foveolarum.
14. Phormidium jenkelianum.
15. Phormidium uncinatum.
16. Lyngbya aerugineo-coerulea.
17. Lyngbya heironymusii.
18. Anabaenopsis circularis.
19. Nostoc microscopicum.
20. Anabaena laxa.

CHLOROPHYTA

21. Chlorococcum vitiosum.
22. Ulothrix variabilis.
23. Geminella minor.
24. Closterium acutum

BACILLARIOPHYTA

25. Synedra affinis
26. Cymbella austriaca

Table II: Non-rhizosphere algae of the experiment field

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Effect of Paushamycin on Paddy field soil algae of Umrer, Nagpur District, Maharashtra

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Abstract

Antibiotics are used to protect the crop plants from bacterial diseases by spraying it on the crop plants. Some of it may fall on the soil and create an impact on the soil micro flora. The soil micro flora condition the soil for better crop production. The author studied the impact of Paushamycin on the soil algae of paddy field of Umrer in Nagpur district, Maharashtra. Total 64 algal taxa could be indentified from the experiment field of which 38 belongs to Cyanophyta, 18 to Chlorophyta and 8 to Bacillariophyta. The different paddy field soil algal taxa show variable resistance to Paushamycin. The blue green algae show more resistance to the antibiotic than the green algae. Higher concentration of antibiotic used in this experiment gave 100% algicidal value in both Cyanophyta and Bacillariophyta, but Chlorophyta could not respond so, due to the two species of the genera, *Chlorococcum*. *C. humicola* and *C. vitiosum* were highly resistant to antibiotic used. It may be due to their sheath or cell wall organization.

Introduction

The antibiotics are used to control bacterial diseases on crop plants. They are sprayed on the crop field and a major part of it may fall on the soil. Introduction of any chemicals organic or inorganic will definitely create an impact on the soil micro flora. Usually it is negative impact rather than positive. The present investigation is aimed to find out the effect of such antibiotic on the growth of soil algae. The soil algae play an important role in soil conditioning by increasing the humus and other nutrients available to crop plants. It also prevents the erosion of soil. Thus any negative impact on these important soil organisms will adversely affect the crop production.

Pure cultures of algae were obtained by several phycologists using different antibiotics (Provasoli *et al.*, 1951, Shelubsky 1951, Pappus & Hoffman 1952, Barkley 1956, Zender & Hughes 1958). The inhibitory effects of antibiotics on some groups of algae were reported by the observations made by Hunter & Veigh (1961), Kumar (1964a), Taylor (1965), Tarar & Kelkar (1978). The potential value of antibiotics in relation to their action on algal forms have been investigated by Foiter *et al.*, (1953), Hunter & Veigh (1961), Lampmen & Arnow (1961), Perlman (1964) and Zehnder & Hughes (1958). They opined that algae are less

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sensitive towards antibiotics than bacteria and fungi.

The experiments were conducted in the paddy fields of Umrer in Nagpur districts, which is about 45 km. away from Nagpur city. It receives approximately 75-85 cm of rain fall and the temperature varies from 7.5 c. in January to 46 c in May. The soil is of clay type and it is light brown in colour. The field is located about 6 km away from Umrer town.

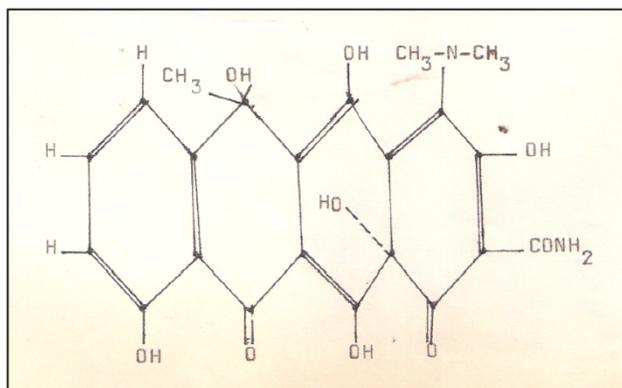
Material and Methods

Paushamycin

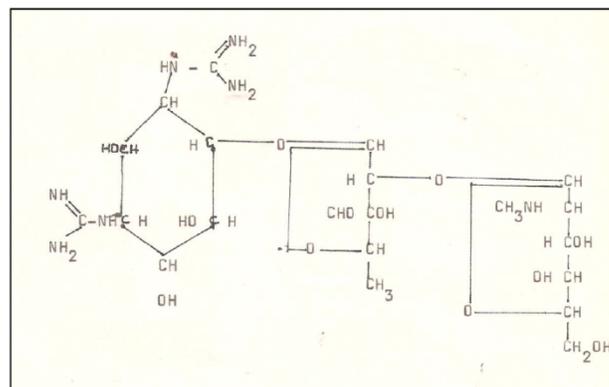
It is an antibacterial plant spray formulation recommended for effective control of no. of bacterial plant diseases. It is stable, free flowing, fine wetttable antibiotic powder. Oxytetracyclin has been added to streptomycin to synergize the activity of streptomycin and easily absorbed through the foliage and does not wash off in rain. It is non toxic to human.

Composition: Oxytetracyclin base
activity 1.5%
Streptomycin activity
15% With suitable wetting
agent.

Terramycin (Oxytetracyclin) $C_{22}H_{24}N_2O_9$



Streptomycin



To study the algicidal potential of Paushamycin on algae, different concentrations were prepared and treated with the culture of algae. Five concentrations were used as 0.2%, 0.4%, 0.6%, 0.8% and 1.0%. These concentrations of the antibiotic solution are prepared by dissolving the required quantities of antibiotic in distilled water. Paushamycin do not dissolve completely in water and hence its suspension is used as stock solution.

Algal cultures

Multiple sets of cultures were made in De's modified Beneck's media, Allen & Arnon's media and Chu 10 media for each percentage treatment.

1. De's (1939) modified Beneck's medium:

KNO ₃	-	0.2 gm
Mgso ₄ 7H ₂ O	-	0.2 gm
K ₂ HPO ₄	-	0.2 gm
CaCl ₂ 2H ₂ O	-	0.1 gm
FeCl ₃ (1%)	-	2 drops
EOTA	-	Traces
Distilled water-		1000 ml

2. Allen and Arnon's (Modified) medium (Allen&Arnon, 1955, b):

MgSO ₄ 7H ₂ O	-	0.001 M
CaCl ₂	-	0.0005 M

NaCl	-	0.004 M
K ₂ HPO ₄	-	0.002 M

Minor elements:

MnSO ₄ 4H ₂ O	-	0.5 ppm
MoO ₃	-	0.50 ppm
ZnSO ₄ 4H ₂ O	-	0.05 ppm
CuSO ₄ .5H ₂ O	-	0.02 ppm
H ₃ BO ₃	-	0.50 ppm
NH ₄ VO ₃	-	0.01 ppm
CO (NO ₃) ₂ ·6H ₂ O	-	0.01 ppm
N iSO ₄ ·6 H ₂ O	-	0.01 ppm
Cr ₂ (SO ₄) ₃ K ₂ SO ₄ ·24H ₂ O	-	0.01 ppm
Na ₂ WO ₄ 2H ₂ O	-	0.01 ppm
TiO (C ₂ O ₄) x.YH ₂ O	-	0.01 ppm
Fe EDTA	-	4 ppm

3. Chu. No. 10 (Modified) Medium**(Gerloff *et al.*, 1950) :**

Ca (NO ₃) ₂	-	0.04 gm
K ₂ HPO ₂	-	0.01 gm
MgSO ₂ . 7H ₂ O-	-	0.025 gm
Na ₂ CO ₃	-	0.020 gm
Na ₂ SiO ₂	-	0.025 gm
Ferric Citrate	-	0.003 gm
Citric acid	-	0.03 gm
A ₅ solution	-	1.0 ml
Distilled water-	-	1000 ml

A5 trace element stock solution:

H ₃ BO ₃	-	2.86 gm
MnCl ₂ 4H ₂ O	-	1.81 gm
ZnSO ₄ .7H ₂ O	-	0.222 gm
MoO ₃ (85%)	-	0.0177 gm
CuSO ₄ .5H ₂ O	-	0.07 gm
Distilled water-	-	1000 ml

The inoculated culture media were kept in racks with illumination for 12 hrs. per day.

Treatment

The desired concentrations i.e. 0.2%, 0.4%, 0.6%, 0.8% and 1.0% of Paushamycin were prepared by dilution of the stock solution with sterilized distilled water. 7.5 ml of solution of 5 different concentrations were added to separate flasks containing 5 gm of soil sample and 75 ml of nutritive media. After inoculation of the antibiotic all the culture samples were agitated to ensure a uniform distribution. A control sample is also kept with each set without treatment of Paushamycin.

Algal culture is made from soil with each type of media and another set of the same treatments were done with fresh culture obtained previously. Each flask with required media and Paushamycin is inoculated with 5ml of well stirred algal cultures. The treated and control culture flasks were kept in ideal condition of light and temperature for 45 days for the growth of algae.

Results and Discussion

The algal flora of experiment field is observed by culture as well as collection studies. The total algal taxa observed from the experiment field is 64 of which 38 belongs to Cyanophyta, 18 to Chlorophyta, and 8 to Bacillariophyta. The cyanophycean members consists of 12 genus. The genus Microcystis, Chlorogloea and Anabaenopsis were represented by one species each. Aphanothece, Lyngbya and Anabaena were represented by 2 species each. The rest genus were represented as Chroococcus with 5 species, Gloeotheca with 3 species, Aphanocapsa with 4 species, Oscillatoria with 9 species, Phormidium with 5 species and Nostoc with 3 species. The nitrogen fixing blue greens were represented by

Anabaenopsis (1 taxa), Nostoc (3 taxa) and Anabaena (2 taxa).

The 18 Chlorophycean members were represented by Chlamydomonas (2 taxa), Chlorococcum (2 taxa), Scenedesmus (3 taxa), Ulothrix (5 taxa), Geminella (2 taxa), Closterium (3 taxa) and Cosmarium (1 taxa). The 8 members of bacillariophyta were represented by Fragillaria (1 taxa), Synedra (1 taxa), Achnanthes (1 taxa), Navicula (2 taxa), Cymbella (1 taxa) and Nitzschia (2 taxa). Thus the experiment field of Umrer paddy field is dominated by Cyanophyta.

Effect of Paushamycin

The Table I shows the total number of algal taxa along with their presence in different concentration treatment of Paushamycin. It is observed that the lower concentrations i.e. 0.2% and 0.4% of Paushamycin did not have any effect on all the Cyanophycean members. *Microcystis stagnalis* was found to be resistant up to 0.6% concentration treatment. *Chroococcus minutes* and *Chroococcus turgidus* v. *fuscescens* are more sensitive as compared to the other species of *chroococcus* which made their occurrence up to 0.6% treatment. *Gloeotheca palea* is more resistant (0.6%) than *Gloeotheca samoensis* which occurred only up to 0.4% treatment. The genus *Aphanocapsa* showed a variable sensitivity to the different percent treatment of Paushamycin. *Aphanocapsa nivalis* found to be more resistant and occurred up to 0.8% treatment. *Aphanocapsa pulchra* found to be less resistant and occurred only up to 0.4% treatment. Other species of *Aphanocapsa* occurred in 0.6% whereas *Aphanocapsa microscopica* occurred up to 0.4% treatment. The lone species of *Chlorogloea microcystoides* was resistant up to 0.6% treatment. All the species of *Oscillatoria* were

resistant up to 0.8% treatment except *Oscillatoria princeps* which occurred only up to 0.6% treatment. *Phormidium africanum* was more sensitive and occurred only up to 0.4% treatment. *Phormidium ceylanicum* and *P. uncinatum* was more resistant than *P. foveolarum* and *P. jenkelianum* which occurred only up to 0.6% treatment, where as the former 2 species occurred upto 0.8% treatment. *Lyngbya lachneri* occurred up to 0.6% while *L. aerugineo-coerulea* occurred up to 0.8% treatment. *Anabaenopsis*, *Nostoc* and *Anabaena* were found resistant up to 0.6% treatment.

In Chlorophyta some forms i.e. all species of *Chlamydomonas*, *Geminella*, *Closterium* and *Cosmarium* were found to be very sensitive and was absent in all the concentration treatment. The *Chlorococcum humicola* and *C. vitiosum* were much resistant and were observed in all the concentration treatment. *Scenedesmus bijugatus* v. *bicellularis* was resistant up to 0.8% treatment whereas other species of the genus was found resistant up to 0.6% treatment. The *Ulothrix tenuissima* was more resistant (0.6%) as compared to other species of the genus which occurred only up to 0.4% concentration treatment.

In Bacillariophyta, *Fragillaria brevisstrata* F. elongate was more resistant since it occurred up to 0.8% treatment. Out of the rest both species of *Navicula* were more resistant as compared with the rest, which occurred up to 0.4% treatment whereas the former occurred up to 0.6% treatment. *Cymbella austriaca* was found to be most sensitive as it occurred only up to 0.2% treatment.

In all the number of species survived in 0.2%, 0.4%, 0.6% 0.8% and 1.0% treatment were 56, 55, 41, 17 and 2 respectively. The survival percentage and algicidal value of different

concentration of Paushamycin is given in Table II. The 0.2% Paushamycin has no algicidal value in case of Cyanophyta and Bacillariophyta, whereas the Chlorophyta has 44.45% algicidal value. The 0.4% Paushamycin has no algicidal value in Cyanophyta but in Chlorophyta and Bacillariophyta it has 44.45%, 12.5% algicidal values respectively. The 0.6% Paushamycin has 18.43%, 67.67% and 50.0% algicidal value in Cyanophyta, Chlorophyta and Bacillariophyta respectively. The 0.8% Paushamycin has 65.79%, 83.34% and 87.5% algicidal value in Cyanophyta, Chlorophyta and Bacillariophyta respectively. The Cyanophyta and Bacillariophyta responded

1% Paushamycin with 100% algicidal value whereas 88.89% algicidal value was observed in Chlorophyta.

The different paddy field soil algal taxa show variable resistance to Paushamycin. The blue green algae show more resistance to the antibiotic than the green algae. Higher concentration of antibiotic used in this experiment gave 100% algicidal value in both Cyanophyta and Bacillariophyta, but Chlorophyta could not respond so, due to the two species of the genera, *Chlorococcum*. *C. humicola* and *C. vitiosum* were highly resistant to antibiotic used. It may be due to their sheath or cell wall organization.

Sr. No.	Name of Algae	Paushmycin concentration				
		0.2%	0.4%	0.6%	0.8%	1.0%
I.	CYANOPHYCEAE					
1.	<i>Microcystis stagnalis</i>	p	p	p	-	-
2.	<i>Chroococcus macrococcus</i>	p	p	p	-	-
3.	<i>Chroococcus minutus</i>	p	p	-	-	-
4.	<i>Chroococcus schizodermaticus</i>	p	p	p	-	-
5.	<i>Chroococcus spelaeus</i>	p	p	p	p	-
6.	<i>Chroococcus turgidus</i> Var. <i>fuscescens</i>	p	p	-	-	-
7.	<i>Gloeothece membranacea</i>	p	p	-	-	-
8.	<i>Gloeothece palea</i>	p	p	p	-	-
9.	<i>Gloeothece samoensis</i>	p	p	-	-	-
10.	<i>Aphanocapsa biformis</i>	p	p	p	-	-
11.	<i>Aphanocapsa grevillei</i>	p	p	p	-	-
12.	<i>Aphanocapsa nivalis</i>	p	p	p	p	-
13.	<i>Aphanocapsa pulchra</i>	p	p	-	-	-
14.	<i>Aphanothece microscopica</i>	p	p	-	-	-
15.	<i>Aphanothece naegelii</i>	p	p	p	-	-
16.	<i>Chlorogloea microcystoides</i>	p	p	p	-	-
17.	<i>Oscillatoria animalis</i>	p	p	p	p	-
18.	<i>Oscillatoria curviceps</i> Var. <i>angusta</i>	p	p	p	p	-
19.	<i>Oscillatoria decolorata</i>	p	p	p	p	-
20.	<i>Oscillatoria grunowiana</i>	p	p	p	p	-
21.	<i>Oscillatoria jenensis</i>	p	p	p	p	-
22.	<i>Oscillatoria limosa</i> Var. <i>disperse-granulata</i>	p	p	p	p	-
23.	<i>Oscillatoria princeps</i>	p	p	p	-	-
24.	<i>Oscillatoria subbrevis</i>	p	p	p	p	-
25.	<i>Oscillatoria terebriformis</i>	p	p	p	p	-
26.	<i>Phormidium africanum</i>	p	p	-	-	-
27.	<i>Phormidium ceylanicum</i>	p	p	p	p	-
28.	<i>Phormidium foveolarum</i>	p	p	p	-	-
29.	<i>Phormidium jenkelianum</i>	p	p	p	-	-
30.	<i>Phormidium uncinatum</i>	p	p	p	p	-
31.	<i>Lyngbya aerugineo-coerulea</i>	p	p	p	-	-
32.	<i>Lyngbya lachneri</i>	p	p	p	p	-
33.	<i>Anabaenopsis circularis</i>	p	p	p	-	-
34.	<i>Nostoc microscopicum</i>	p	p	p	-	-
35.	<i>Nostoc muscorum</i>	p	p	p	-	-
36.	<i>Nostoc piscinale</i>	p	p	p	-	-

37.	<i>Anabaena circinalis</i> Var. <i>crassa</i>	p	p	p	-	-
38.	<i>Anabaena laxa</i>	p	p	p	-	-
II.	CHLOROPHYCEAE					
39.	<i>Chlamydomonas globosa</i>	-	-	-	-	-
40.	<i>Chlamydomonas mucicola</i>	-	-	-	-	-
41.	<i>Chlorococcum humicola</i>	p	p	p	p	p
42.	<i>Chlorococcum vitiosum</i>	p	p	p	p	p
43.	<i>Scenedesmus bijugatus</i> Var. <i>bicellularis</i>	p	p	p	p	-
44.	<i>Scenedesmus arcuatus</i>	p	p	p	-	-
45.	<i>Scenedesmus dimorphus</i>	p	p	p	-	-
46.	<i>Ulothrix oscillarina</i>	p	p	-	-	-
47.	<i>Ulothrix subtilissima</i>	p	p	-	-	-
48.	<i>Ulothrix tenuissima</i>	p	p	p	-	-
49.	<i>Ulothrix variabilis</i>	p	p	-	-	-
50.	<i>Ulothrix zonata</i>	p	p	-	-	-
51.	<i>Geminella minor</i>	-	-	-	-	-
52.	<i>Geminella protogenita</i>	-	-	-	-	-
53.	<i>Closterium acerosum</i>	-	-	-	-	-
54.	<i>Closterium acutum</i>	-	-	-	-	-
55.	<i>Closterium parvulum</i>	-	-	-	-	-
56.	<i>Cosmarium ornatum</i>	-	-	-	-	-
III.	BACILLARIOPHYCEAE					
57.	<i>Fragillaria brevistriata</i> f. <i>elongata</i>	p	p	p	p	-
58.	<i>Synedra affinis</i>	p	p	p	-	-
59.	<i>Achnanthes delicatula</i>	p	p	-	-	-
60.	<i>Navicula clavata</i>	p	p	p	-	-
61.	<i>Navicula grivilleri</i>	p	p	p	-	-
62.	<i>Cymbella austriaca</i>	p	-	-	-	-
63.	<i>Nitzschis dissipata</i>	p	p	-	-	-
64.	<i>Nitzschia gracilis</i>	p	p	-	-	-
	(P) = Present					
	(-) = Absent					
	Total	56	55	41	17	2

TABLE – I: Algae observed in different types of treatment of antibiotics

Antibiotics gm/100ml	Cyanophyceae			Chlorophyceae			Bacillariophyceae		
	No. of Survival forms.	Survival %	Algicidal Value %	No. of Survival forms.	Survival %	Algicidal Value %	No. of Survival forms.	Survival %	Algicidal Value %
Paushamycin									
0.2	38	100.0	00.0	10	55.55	44.45	8	100.0	0.0
0.4	38	100.0	0.0	10	55.55	44.45	7	87.5	12.5
0.6	31	81.57	18.43	6	33.33	67.67	4	50.0	50.5
0.8	13	34.21	65.79	3	16.66	83.34	1	12.5	87.5
1.0	0	0.00	100.0	2	11.11	88.89	0	0.0	100.0

TABLE – II: Total Number of viable forms, their survival percentage in various conditions of antibiotics used in the present investigation with their respective Algicidal value.

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Ethnomedicinal Ferns Species used by Tribals of Gondia District, Vidarbha Region of Maharashtra

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Abstract

The study enumerates the Pteridophytes widely used by the local people and tribes in the treatment of various diseases in Gondia district of Vidarbha region of Maharashtra State. They grow in terrestrial, epiphytic or lithophytic habitats. The present study deals with the ethnomedicinal uses of available Pteridophytic plants which are prevalent in the study area, along with botanical name, family, habitat, plant part used and mode of uses. The present study focus specifically on the ethnomedicinal importance of 13 species of Pteridophytes, used by Gond, Gowari, Halba, Gawali, Pradhan and other aboriginal tribes occurring in the region. The botanical name, family name, vernacular name, and their ethno medicinal uses are provided. A field survey of the study area was carried out to document the medicinal utility of plants occurring in the area by tribe. Traditional uses of these plant species are described in this paper.

Introduction

Pteridophytes are the seedless vascular cryptogams which occupy a position between the lower non-seed bearing and higher seed bearing plants, generally much neglected group of plants. About 250 million years ago, they constituted the dominant vegetation on earth surface. However, they are now replaced by seed bearing plants in the modern day flora. Pteridophytes grow luxuriantly in moist tropical and temperate forest and their occurrence in different eco-geographically threatened regions from sea level to the highest mountain are of much interest. About 12, 000 species of Pteridophytes occur in the world floras of which about more than 1,000 species were reported from India. These species are grouped into 191 genera of 70 families (Dixit, 1984).

The ferns had an important role in folklore medicine. These plants have been successfully used in the different systems of medicines like Ayurvedic, Unani, Homeopathic and other systems of medicines. In a recent compilation, Singh (1999) reported 160 species of useful Pteridophytes in India on the basis of phytochemical, pharmacological and ethnobotanical studies.

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A systematic survey of the antibiotic activity of Pteridophytes, however has been scarcely undertaken. The antimicrobial potential of some ferns has been studied (Kumar and Kaushik, 1999; Parihar and Bohra, 2002a & b, 2003). With this background experiments were done to assess the antibacterial activities of certain ferns. Out of 1,000 species of Pteridophytes occurring in India, 170 species have been found to be used as food, flavor, dye, medicine, bio-fertilizers, and fiber. The medicinal value of Pteridophytes against bacteria, fungi, virus, cancer, rheumatism, diabetes, inflammation, fertility, diuretic, pesticides, hepatoprotective, and sedative had been reported. Besides sugar, starch, proteins and amino acids, ferns contain a variety of alkaloids, glycosides, flavenoids, terpenoids, sterols, phenols sesquiterpens etc. as potential components used in various industries (Kulandairaj and John de Britto, 2000). The ethnomedicinal uses of fern in Gondia district was described by Ramteke D. D (2007). Gondia district has Forest Area about 47.08 % and Forest Cover is 37.92 %. The forest is typical Southern mixed dry deciduous forest, a region of the Indian subcontinent long known for its extraordinary beauty and biodiversity and is bounded lofty hills, inhabited by Gond, Gowari, Halba, Gawali, Pradhan and other aboriginal tribes depend on nearby area to treat different ailments affecting human health. Small branches of the Satpura range make their way into the interior of the district. More than one-third of the district covered by jungle. In comparison to higher plants they have found little applications in medicine. The tribal communities, ethnic groups and folklore throughout the world are utilizing their plant parts like rhizome, stem, fronds, pinnae and spore in various ways for the treatment of various ailments since ancient time. At

present a re-survey of the pteridophtic flora is required to study the distribution and ecology of the Pteridophytes in the region of Gondia District of Vidarbha.

Materials and Methods

The present data is outcome of field research carried out as part of floristic and ethnomedicinal study. Ethnomedicinal data was collected from elderly tribal people, who practice herbal medicine. In the present study an intensive field survey was made in various places of Forest ranges of Nawegaon Bandh National Park and Nagzira Wildlife Sanctuary namely, Pitezari, Chorkhamara, Nawegaon, Keshori, Siregaon, Dewalgaon, Gothangaon. Elderly people of the village were interviewed to find how they use the Ferns for their day to day life. During the course of survey ferns and fern allies were collected and the herbarium was made. All the specimens were compared and identified with the standard herbarium available in Department of Botany Hislop College, Nagpur. Specimens were collected for reference.

Study Area

Gondia District is well known for its rich biological diversity. In the present study extensive survey of the region was made in various places of Forest ranges of Nawegaon Bandh National Park and Nagzira Wildlife Sanctuary were carried out in different phases. Later on, collections of ethnomedicinal information were obtained from Vaidus, Mukhiya, and Pradhan of villagers are selected for the collection of data. Ethnomedicinal survey was carried out, by visiting such tribal area where local people mostly used medicinal plants for healing various diseases. The different villages Pitezari, Chorkhamara, Nawegaon, Keshori,

Siregaon, Dewalgaon, and Gothangaon were surveyed.

Gondia district has Forest Area about 47.08 % and Forest Cover is 37.92 % the forest is typical Southern mixed dry deciduous forest, a region of the Indian subcontinent long known for its extraordinary beauty and biodiversity and is bounded lofty hills, inhabited by Gond, Gowari, Halba, Gawali, Pradhan and other aboriginal tribes depend on nearby area to treat different ailments affecting human health. Small branches of the Satpura range make their way into the interior of the district. More than one-third of the district was covered by jungle.

Results and Discussion

This survey observed species of Pteridophytes from the area are enumerated with botanical name, family, popular name, parts used and medicinal uses are provided, which includes 13 species of Pteridophytes used in ethnic herbal practices.

***Angiopteris evecta* (Forst) Hoff.**

Family: Marattiaceae.

Local Name: Morpankhi

Parts used: whole Plant

Medicinal Properties: Astringent and antihelmintic

***Adiantum caudatum* L.**

Family: Pteridaceae.

Local Name: Mayurshikha

Parts used: Plants, Rhizomes

Medicinal Properties: Cough and fever., Antihelmintic

***Marsilea Quadrifolia* L.**

Family: Marsileaceae

Local Name: Chaupatti

Parts used: Leaves, Rhizome

Medicinal Properties: Cough and bronchitis

***Selaginella tenera* (Hook & Grev.)**

Family: Selaginellaceae

Local Name: Sanjeevni

Parts used: Plant

Medicinal Properties: Diuretic gonorrhoea and hallucination

***Dryopteris cochleata* (Buch.Ham.Ex D.Don)**

Family: Dryopteridaceae

Local Name: Kakolisag

Parts used: Rhizome

Medicinal Properties: Leprosy, antifungal, Swellings, ulcers and pains

***Equisetum debile* Roxb**

Family: Equisetaceae

Local Name: Horsetails

Parts used: Whole Plant

Medicinal Properties: Diuretic and given in gonorrhoea, Bone Fracture, Fever etc.

***Ophioglossum reticulatum* L.**

Family: Ophioglossaceae

Local Name: Banpalak

Parts Used: Rhizome

Medicinal Properties: used in headache, inflammation, wound haeling.

***Pteridium aquilinum* (L.) Kuhn,**

Family: Dennstaedtiaceae

Local Name: Bracken Fern

Parts used: Rhizome and fronds

Medicinal Properties: Antihelmintic and astringent. Chronic disorders

***Lygodium flexuosum* (L.) Sw.**

Family: Lygodiaceae.

Local Name: daria paya,

Parts Used:Leaves

Uses: improve memory.

Nephrolepis cordifolia (L.) Presl.

Family: Dryopteridaceae.

Local Name:Neché

Parts uses: Leaves, Rhizome

Uses: Herb is used against cough and skin diseases.

Pteris vittata L.

Family: Pteridaceae

Local Name:Jassumba

Parts uses: Plant

Uses: Herb juice used for diarrhea and dysentery.

Tectaria macrodonta (Fee). C. Christensen

Family: Tectariaceae

Local Name. Aski.

Parts Used: Plant

Uses: plant decoction taken orally, for stomach-ache.

Isoetes coromandeliana

Family:Isoetaceae

Local Name:

Parts used: Corm

Uses: Spleen and liver diseases

Sr. No.	Botanical Name	Family	Local Name	Parts used	Medicinal Properties
1	<i>Angiopteris evecta</i> (Forst) Hoff.	Marattiaceae.	Morpankhi	whole Plant	Astringent and antihelmintic
2	<i>Adiantum caudatum</i> L.	Pteridaceae	Mayurshikha	Plants, Rhizomes	Cough and fever., Antihelmintic
3	<i>Marsilea Quadrifolia</i> L.	Marsileaceae	Chaupatti	Leaves, Rhizome	Cough and bronchitis
4	<i>Selaginella tenera</i> (Hook & Grev.)	Selaginellaceae	Sanjeevni	Plant	Diuretic gonorrhoea and hallucination
5	<i>Dryopteris cochleata</i> (Buch.Ham.Ex D.Don	Dryopteridaceae	Kakolisag	Rhizome	Leprosy, antifungal, Swellings , ulcers and pains
6	<i>Equisetum debile</i> Roxb	Equisetaceae	Horsetails	Whole Plant	Diuretic and given in gonorrhea, Bone Fracture, Fever etc.
7	<i>Ophioglossum reticulatum</i> L.	Ophioglossaceae	Banpalak	Rhizome	used in headache, inflammation, wound haeling.
8	<i>Pteridium aquilinum</i> (L.) Kuhn,	Dennstaedtiaceae	Bracken Fern	Rhizome and fronds	Antihelmintic and astringent. Chronic disorders
9	<i>Lygodium flexuosum</i> (L.) Sw.	Lygodiaceae	Daria paya	Leaves	Improve memory.
10	<i>Nephrolepis cordifolia</i> (L.) Presl.	Dryopteridaceae	Neché	Leaves, Rhizome	Herb is used against cough and skin diseases.
11	<i>Pteris vittata</i> L.	Pteridaceae	Jassumba	Plant	Herb juice used for diarrhea and dysentery.
12	<i>Tectaria macrodonta</i> (Fee). C. Christensen	Tectariaceae	Aski	Plant	Plant decoction taken orally, for stomach-ache.
13	<i>Isoetes coromandeliana</i>	Isoetaceae		Corm	Spleen and liver diseases

Discussion

This study provides evidence that the tribal people and other villagers residing area in the vicinity of the Nawegaon Bandh national park and Nagzira wildlife sanctuary uses plant species for the treatment of various ailments

and household uses. The tribal people depend mostly on herbal medicines as there are no clinics in the villages. Pteridophytes, fern and fern allies are known for great medicinal values. The Gondia district of Vidarbha region is a natural reservoir of Medicinal plants. The important Fern species are discussed in this

paper are collected and its herbarium. The tribes have specific culture, rituals and living habits. They practice herbal medication which is easily available. The data were gathered by enquiry, personal observation in their colonies and holding frequent discussion. Interview with the tribal community was more reliable for easy asses of information.

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Ethnomedicinal Plant Resources from Navegaon National Park Based on Socioeconomic Documentation from Gondia District, Maharashtra, India

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Abstract

Documentation of traditional knowledge on ethnomedicinal use of plants has been considered as a high priority to support the discovery of drugs benefiting mankind. The forests of Gondia District are rich and diverse in medicinally important flora. The Navegaon National park situated in Gondia district of eastern Maharashtra, The area includes a variety of plant species having socioeconomic and medicinal importance. The purpose of this study was based on certain objectives to document the indigenous folk knowledge of the inhabitants of the Navegaon National park. The tribal communities residing nearby area of National park possess indigenous ethnic knowledge about the utility of the majority of plants and they have developed a special herbal health care system for themselves. A field survey of the study area was carried out to document the medicinal utility of plants occurring in the area by tribe. Traditional uses of these plant species are described in this paper. The documented ethnomedicinal plants are mostly used to cure skin diseases, diarrhea, jaundice, cough, wounds, piles, urinary troubles, Azospermia,

menstrual disorders, snake bites and on insects bites etc. The data reported was compiled through a fusion of interview and non-participant observation method. One important result of the survey conducted is that it revealed different plant species having ethnomedicinal uses.

Introduction

Recent research in plant science has focused mainly on ethnomedicinal investigations to fulfill the increasing demand of herbal products. Some plants gives better result in the treatment of certain ailments (Jain. S. K., 1999.). The use of raw plant products in the treatment of various diseases are increasing day by day (Gupta, *et al.*, 2009, Ramteke D.D. 2008). Many plants having ethnomedicinal importance are to be found within the very rich, diverse flora of the Indian subcontinent. Therefore it is essential to investigate such plants from core areas and unexplored regions and collect the indigenous knowledge regarding their utilities. The correct identification of the plants is a must for the data storing (Cooke, T. 1967, Kapoor W. D. 2001, Naik, V.N., 1998) Gondia district has Forest Area about 47.08 % and

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Forest Cover is 37.92% . The forest is typical Southern mixed dry deciduous forest, a region of the Indian subcontinent long known for its extraordinary beauty and biodiversity and is bounded by lofty hills, inhabited by Gond, Gowari, Halba, Gawali, Pradhan and other aboriginal tribes who depend on nearby area to treat different ailments affecting human health. Small branches of the Satpura range make their way into the interior of the district. More than one-third of the district lies under jungle, which yields gum, plant species of medicinal value, edible fruits, lac, honey and the blossoms of the *Bassia latifolia* which are eaten by the poorer classes, and used for the manufacture of a kind of spirit (Ramteke, D.D., 2007).

The present paper deals with the traditional uses of some important plant species employed in ethnomedicinal practice by tribal and local people nearby area of Navegaon Bandh National park. For each plant species, details on the scientific name, botanical family, local name and use are provided along with parts harvested for treatment, the manner of processing and the mode of administration. The ethnic communities having indigenous ethnic knowledge about the utility of the majority of these plants and they have developed a special herbal health care system for themselves. The authors had explored the study area and documented some important species of ethnomedicinal importance.

Material and Methods

Field Survey

Extensive surveys of the National park were carried out in different phases. Later on, collections of ethnomedicinal information were obtained from Vaidus, Mukhiya, and

Pradhan of villagers are selected for the collection of data. The data were compiled through a combination of interview with local people of the tribal regions. Ethnomedicinal survey was carried out, by visiting such tribal area where local people mostly used medicinal plants for healing various diseases. The people from Navegaon, Keshori, Siregaon, Dewalgaon, villages were interviewed and different plant species were surveyed and collected. Identification of the collected specimens to the species level were completed from the references (Sharma B.D. *et al.*, Ugemuge 1986). The collected material is deposited in the Department of Botany, Hislop College, Nagpur, in the form of herbarium sheets and photographs.

Results and Discussions

In the ethnomedicinal survey, the various plants were found to treat different types of diseased conditions such as inflammation, fever, hepatic disorder, hypertension, wounds, leprosy, tuberculosis, etc. Data were gathered and comprehended by conducting personal interview with the tribal people using those medicinal plants as a remedy for treatment of diseases and observing tribal patients who were on those herbal medications. The survey possessed healing properties against various types of diseases in both districts. The ethnomedicinal uses of the collected plants are given in Table 1.

Research and extension work are the major pathways to integrate folk knowledge about ethnobotanical and ethnomedicinal plants for modern primary health care and human welfare. The major objective should be to match safe, effective remedies to common illnesses, using local medicinal plants and

cost effective household needs. The problem is that very little is known about folk and traditional medicine proper, and it is impossible to say how effective they are without a lot more research. Most of the plants and ethnomedicinal uses of some plants are reported first time in the study area are cited in this paper.

This study provides evidence that the tribal people and other villagers residing area in the vicinity of the Navegaon Bandh national park uses plant species for the treatment of various ailments and household uses. The tribal people depend mostly on herbal medicines as there are no clinics in the villages. The plants are generally used for stomach disorders, skin diseases, aphrodisiacs, fever, tonic, ulcer,

asthma, snake-bite, respiratory diseases, leucorrhoea, dandruff, eye-diseases, diabetes, and in the treatment of cancer. As the villagers of this area are mostly illiterate, they know how to make use of their plants but have little or no knowledge on how to conserve them. Thus, there is an urgent need for training in conservation and on the cultivation of plants of economic importance. The undesirable effect of the modern medicine has already diverted the attention of the people towards herbal medicines. To increase the acceptability and awareness among the people, there is an urgent need to develop trust and faith towards the safer indigenous system by establishing its validity in treatment for various diseases.

Botanical name	Local name	Family	Part used	Ethnomedicinal Uses
<i>Alternanthera sessalis</i> L.	Bahali	Amaranthaceae	Entire Plant	Plant extract used in Piles, Liver and spleen diseases.
<i>Asperagus racemosus</i>	Satawari/ Marbat	Liliaceae	Rhizome	Digestive problems, jaundice, liver ailments, stimulant, Menstrual disorders.
<i>Argemone mexicana</i> L.	Piwala Dhotra	Papaveraceae	Seeds, Anthers	Treatment of fungal infection, Dysentery
<i>Achyranthus aspera</i> L.	Kutri	Amaranthaceae	Leaves Rootes	Snake bite, eye disorders, piles Contraceptives
<i>Andrographis paniculata</i> (Burm. f.) Wall ex Nees.	BhuiNeem	Acanthaceae	Leaves, Bark, Seed and Root	Whole Plant Decoction of plant is given to cure Malaria, Typhoid and Diarrhea.
<i>Ageratum conyzoides</i> L.	Mukhra	Asteraceae	Entire plant	Used in Cuts, Wounds, Ulcer
<i>Bombax ceiba</i> L.	Sawar	Bombacaceae	Wood, roots	Mouth problems, Stimulant
<i>Cardiospermum helicacabum</i> L.	Kapalphodi	Sapindaceae	Leaves	Treatment of dysentery.
<i>Cassia fistula</i> L.	Bahawa	Caesalpinaceae	Leaves, flowers, Bark and Root	Ringworm and some skin diseases. Bark is a laxative and astringent.
<i>Cassia tora</i> L.	Tarota	Caesalpinaceae	Entire plant	To cure psoriasis.
<i>Calotropis procera</i> (Willd) R. Br.	Rui	Asclepiadaceae	Latex	Treatment for cough and asthma, ringworms and skin disease.

Dendrocalamus strictus (Roxb.) Nees.	Bamboo	Poaceae	Leaves, Stem	coughs and colds, as vegetable
Dalbergia sissoo Roxb.	Shisham	Fabaceae	Leaf, Bark	Treatment of gonorrhoea. Menstrual disorders.
Datura metal L.	Dhotra	Solanaceae	Leaves, Fruits and Seeds	treatment of asthma and bronchitis,
Euphorbia hirta L.	Noma, Dudal (Garo)	Euphorbiaceae	Entire plant	treatment of cough, asthma, piles, and semen debility
Equisetum debile L.	Khadyanag	Equisetaceae	Entire plant	Bone fracture, arthritis, inflammation, wound healing.
Ficus religiosa Roxb.	Peepal	Moraceae	Wood, Bark, Fruits	gonorrhoea and scabies. fruits are used as a laxative.
Grewia tillifolia (Vanl.)	Dhaman	Tiliaceae	Wood, Leaves and Bark	Treatment of inflammation.
Hemidesmus indicus R. Br.	Khobarvel/ Anantmul	Asclepiadaceae	Climber	Treatment of fever, diabetes, cough and blood disorders.
Mimosa pudica L.	Lajari	Mimosaceae	Roots	Diarrhea.
Merremia emarginata Hallier.	Undir kana	Convolvulaceae	Leaves	Treatment of corns.
Ocimum americanum L.	Dev tulsi	Lamiaceae	Leaves	Eczema and other Skin infections.
Ocimum basilicum L.	Kali tulsi	Lamiaceae	Leaves and Seed	Skin infections, cold and cough.
Phyllanthus niruri L.	Bhui-awala	Euphorbiaceae	Entire plant	Jaundice and urino-genital infections.
Plumbago zeylanica L.	Chittrak	Plumbaginaceae	Entire plant	Fever, Malaria, Diarrhoea, Dyspepsia, Piles & Skin diseases.
Ricinus communis L.	Arand	Euphorbiaceae	Leaves, Seeds,	Treatment of jaundice, Seeds, Castor oil is given to counter constipation.
Semicarpus anacardium L.	Bibba	Anacardiaceae	Fruit and Seed	The fruits are eaten to relieve indigestion. Also used in the treatment of coughs, piles and boils and scabies.
Sapindus laurifolius L.	Reetha	Sapindaceae	Fruits	To promote hair growth.
Solanum xanthocarpum Schard & Wendl	Bhui ringani	Solanaceae	Leaves	respiratory diseases and dropsy
Vanda roxburghii R. B.	Banda	Orchidaceae	Entire plant	Treatment of rheumatism and arthritis.
Terminalia belarica Roxb.	Beheda	Combrataceae	Stem, ranches and Fruit	treatment of cough, fever, indigestion, dropsy, leprosy, piles
Tinospora cardifolia (Willd.) Miers,	Gulvel	Menispermaceae	Roots	treatment of diabetes
Tridax procumbens L.	Kambermodi	Asteraceae	Entire Plant	Taken orally in diarrhea, anti-inflammatory.

Table: 1. Ethnomedicinal Uses of Plants

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Water quality assessment of Vikram Vatika Sarovar, Ujjain degraded due to idol immersion

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Abstract

At the time of Ganesh festival people immerses Idols of lord Ganesh prepared by various materials, it immersed into nearby water body which is hazardous to environment it directly affect on lake water. These idols are made up of plaster of paris, clay and cloth supported by small iron rods and is painted with different metal-based paints. On immersion of these idols in the water bodies the water is contaminated with these metal paints and a change in chemical load in the water body is expected. When idols immersed these colored chemicals dissolve slowly leading to significant changes in the water quality. In this study water quality of vikram vatika sarovar has been investigated with respect to important physicochemical parameters viz pH, Free CO₂, DO, BOD, COD, alkalinity, chlorides, Hardness and metals *etc.*

Keywords: *Idol immersion* | *water quality* | *Vikram vatika* |

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Introduction

India is the country of rich cultural heritage and festivals. Peoples here religiously follow the rituals and enjoy festivity. Water bodies play the significant vital role in performing rituals. These rituals including taking holy dip in scared rivers and idol immersion. Approximately, close to 10 lakh idols are immersed each year in India's water bodies every year after Durga puja and Ganesh Utasav. The biological oxygen demand (BOD) levels in rivers fall dramatically due to idol immersion. Very low BOD levels can lead to death of marine life. The colours used on these idols are the main ingredient responsible for polluting the water. The level of lead, mercury, cadmium used in these colours is very high Due to tremendous population growth of the city and rapid urban development of the city lakes are facing various environmental problems resulting in deterioration of its water quality. In India, about 70% of the available water is polluted out of which 8-16 % water is polluted by industrial pollution and 84-92 % by sewage pollution (Chaudhary 1982). The Vikram

Vatika Sarovar of Ujjain has been surveyed before and after immersion of Ganesh idols and it was found that there is sudden increased of some chemical pollutants after idol immersion. By comparing values of chemical pollutants they found that the concentration of calcium had increased significantly in the lake water after idol immersion. Monitoring of the water is an essential step to mark the trend pattern of pollutants and their effect on living systems in today's developing life. The quality of natural water bodies impacts those using or living within those water bodies. Discharges of pollutants can degrade the quality of the water and hence adversely affect the water's beneficial uses as well as health of its aquatic ecosystem. It is therefore necessary to make

use of technical observation of the various aspects of water quality and pollution.

Study Area

The Vikram Vatika Sarovar is situated at Kothi road in Vikram university campus which is 3.00 km away from Ujjain bus stand and 4.00 km from Railway station (fig. 1.1). The source of water in the pond is rain water and quite a bit from ground water. The Vikram Vatiak Sarovar is at height of 491.00 meter from the mean sea level (Longitude 75° 61" E and Latitude 23° 65" N). The depth of pond is 3.90 meter and minimum 0.50 meter. Pond receives little domestic sewage from drains of adjacent houses, and in rainy season fertilizers, pesticides are also swept with rain water and mixes in pond.

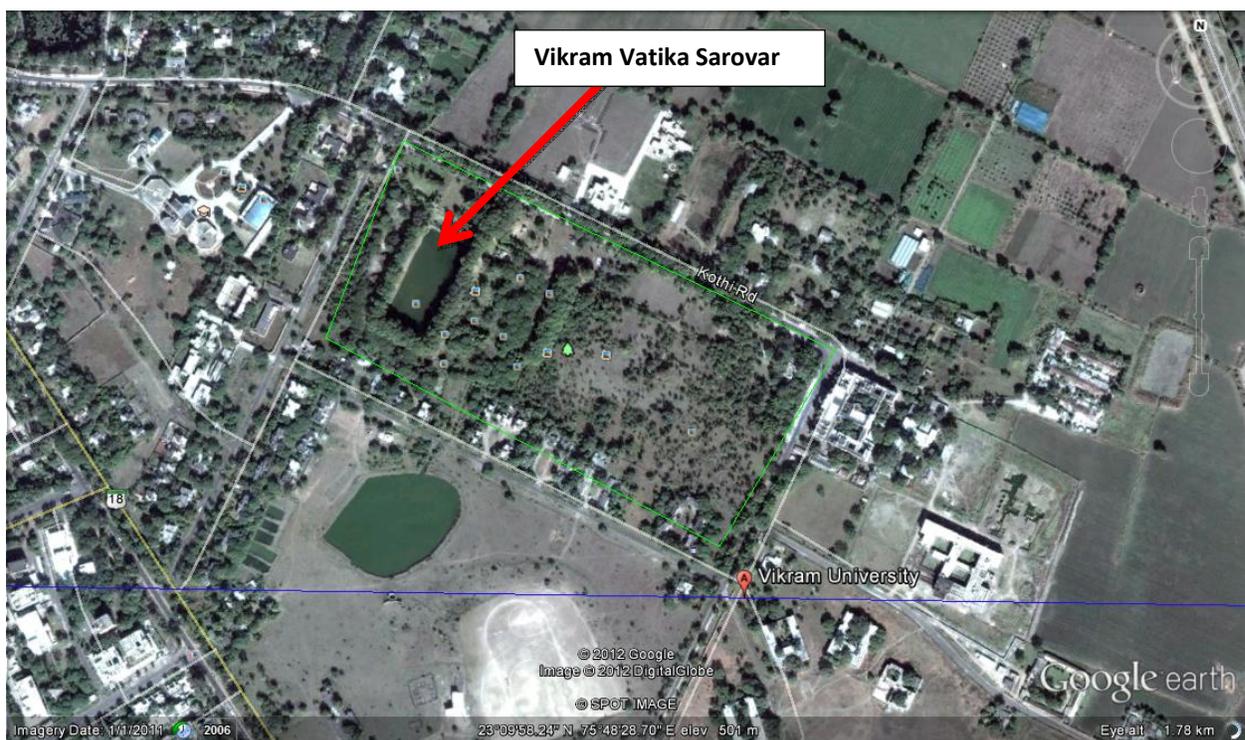


Fig.1 Vikram vatika sarovar

For the study purpose two sampling site were selected located at northern area of the pond is sampling site I, southern area of the pond is sampling site II.

Sampling Site – I : -- Sampling site – I is situated at the northern bank of the sarovar. This sampling site is near the entrance gate of vikram vatika and depth of water at this site is 2.55 meter.

Sampling Site – II : -- Sampling site – II is situated at the southern bank of the pond near the zoo of sarovar. The depth of water is 3.00 meter. This sector receives a little bit of waste water from nearby area.

Material and Method

Samples were collected and preserved from both the sampling site before and after idol immersion as per standard methods mentioned in APHA. For physicochemical analysis of water samples was collected in pre rinsed and pre cleaned plastic bottle during morning hours (7-10 AM) in triplicates. Physiochemical parameters *viz.* temperature, pH, dissolved oxygen, BOD, COD, Free CO₂, alkalinity, acidity chlorides and hardness were analysed as per standard methods of Trivedi and Goel (1984) and APHA 1998; Mati 2001. The determination of heavy metals in the water samples was done by the Atomic Absorption Spectrophotometer.

Results and Discussion

The water samples were collected from the site of idol immersion at different intervals *i.e.* pre immersion, post immersion. Pre-idol immersion samples were collected three day before the immersion activities. Post-idol

immersion samples were collected 5 days after the completion of immersion activities. The samples were subjected to physico-chemical analysis in the laboratory. The parameters namely pH, Temperature, Total Solid, Turbidity, Total Hardness, BOD, COD were analyzed. On the basis of analysis result of various physic-chemical parameters and metal are given in table 1 and 2.

pH was analyzed by digital pH meter. Value of pH was found to be increased after immersion of idol in Vikram Vatika Sarovar. It might be due to the addition of organic matter and material used in the preparation of idols. The pH varied from 6.90 to 7.90. At sampling station 1 the value of ph was recorded 7.10 before immersion and after immersion pH was noted down 7.90 while on the other hand at sampling station II value of ph was recorded 7.10 before immersion and after immersion pH was noted down 7.90. The minimum pH (6.90) was observed before pre immersion at sampling station II while acidic pH (7.90) was observed after immersion of idols at sampling station I. Similar study was made by jain et al (2006), Gupta et al (2001).Khan & Khan (1985) and Narayani (1990) also reported similar results at Seikha Jheel in Aligarh and eutrophic wetlands (lower lake, Bhopal) respectively. Temperature is the most important factor which influences chemical, physical and biological characteristics of water bodies. The present study revealed that temperature varied from 17.25° to 21.25° however maximum temperature was found at sampling site I and minimum was observed at sampling site I and II respectively. Value of temperature was

recorded 28.50° before immersion and after immersion temperature was noted down 29.00° while on the other hand at sampling station II temperature was recorded 28.50° before immersion and after immersion temperature was noted down 28.50°. At sampling station I total solid was recorded 568.23 before immersion and after immersion total solid was noted down 680.21 while on the other hand at sampling station II value of total solid was recorded 612.54 before immersion and after immersion it noted down 725.25. Turbidity measure of water clarity tells the degree to which light entering a column of water is scattered by suspended solids. Suspended solids include things such as mud, algae, detritus, and faecal material. Factors contributing to water turbidity include soil erosion, elevated nutrient inputs that stimulate algal blooms, waste discharge, and an abundance of bottom feeders that stir up sediments (Schlesinger 1991). At sampling station I turbidity was recorded 7.57 before immersion and after immersion turbidity was noted down 8.89 while on the other hand at sampling station II value of turbidity was recorded 7.85 before immersion and after immersion temperature was noted down 9.21. The dissolved oxygen play important role in survival of aquatic organisms. Decreasing value was observed in DO during the study period while the value of BOD and COD were observed high during the idol immersion period. The values of DO at sampling station I was recorded 6.80 before immersion and after immersion it was noted down 3.60 while on the other hand at sampling station II value of DO was recorded 6.50 mg/l before

immersion and after immersion it was noted down 3.30 mg/l. The higher values of BOD means present of more biodegradable organic material. (ICMR, 1975). It has been used as a measure of the amount of organic materialism an aquatic solution which supports the growth of micro-organism. At sampling station 1 BOD was recorded 2.40 mg/l before immersion and after immersion it was noted down 13.50 mg/l while on the other hand at sampling station II BOD was recorded 2.50 mg/l before immersion and after immersion it was noted down 12.80 mg/l. COD were found to vary from 16.00 mg/l to 80.00 mg/l. COD determines the amount of oxygen required for chemical oxidation of organic matter using a strong chemical oxidant such as potassium dichromate under reflux conditions. At sampling station 1 the value of COD was recorded 16.00 before immersion and after immersion COD was noted down 71.00 mg/l while on the other hand at sampling station II value of COD was recorded 18.00 mg/l before immersion and after immersion it was noted down 80.00 mg/l. The free CO₂ released by microbial activity is important for algal growth, as it is required for the photosynthesis. Low free CO₂ (1.21 mg/L) was found during pre-immersion at sampling station II while high free CO₂ (2.85 mg/L) was found after immersion period at sampling station II. free CO₂ was recorded 1.42 mg/l and 1.21 mg/l before immersion at sampling station I and II respectively and after immersion free CO₂ was noted down 2.56 mg/l and 2.85 mg/l at sampling station I and II respectively. Alkalinity is an important parameter in determining the quality of water

at sampling station 1 the value of alkalinity was recorded 36.87 mg/l before immersion and after immersion it was noted down 42.56 mg/l while on the other hand at sampling station II value of alkalinity was recorded 38.45 mg/l before immersion and after immersion it was noted down 45.87 mg/l. Acidity at sampling station 1 the value of acidity was recorded 4.65 mg/l before immersion and after immersion acidity was noted down 8.64 mg/l while on the other hand at sampling station II value of acidity was recorded 4.60 mg/l before immersion and after immersion it was noted down 9.12 mg/l. Total Hardness was analysed by titrimetric EDTA method Hardness is a very important parameter in decreasing the toxic effect of poisonous element. value of hardness was recorded 54.56 mg/l and 62.54 mg/l before immersion at sampling station I and II respectively and after immersion hardness was noted down 115.24 mg/l and 118.56 mg/l at sampling station I and II respectively.

The heavy metals are known to be persistent in the aquatic environment, and gradually accumulate and magnify through the process known as bioaccumulation and biomagnifications while they move up in the food chain. (Bajpai, A., 2003). In present study found that the concentration of Zinc had increased significantly in the lake water after the idol immersion however, it was below the limits of permissible standards. Magnesium,

lead, mercury and magnesium concentrations had also increased significantly in the lake water after the idol immersion. (Pande, 1980) studied the metallic content in water & sediments of lake Nainital, India & found that the concentration of metallic content in sediments is much higher than in the lake water. After the immersion of the idols its concentration increased in the water (Table 2).

Before immersion period the concentration of Zn in the water was observed to 0.013 mg/l and 0.018 mg/l at sampling station I and II respectively while on the other hand after immersion concentration was found 0.202 mg/l and 0.215 mg/l respectively. The concentration of lead in the water was observed below detection limit at sampling station I and 0.011 mg/l at sampling station II while on the other hand after immersion period it was 0.204 mg/l and 0.256 mg/l respectively. Concentration of mercury in the water in the water was observed 0.102 mg/l and 0.125 mg/l at sampling station I and II respectively while on the other hand after immersion period it was 0.412 mg/l and 0.556 mg/l respectively. The concentration of Manganese before immersion period in the water was observed to 0.072 mg/l and 0.082 at sampling station I and II respectively while on the other hand after immersion it was 0.168 mg/l and 0.186 mg/l respectively.

Parameters	Sampling Site I (Northern area of Sarovar)		Sampling Site II (Southern area of Sarovar)		Average
	Pre immersion 3 days before	Post immersion 5 day after	Pre immersion 3 days before	Post immersion 5 day after	
pH	7.10	7.90	6.90	7.80	7.52±0.38
Temp	28.50	29.00	28.50	28.50	28.62±0.25
Total Solid	568.23	680.21	612.54	725.25	646.55±69.80
Turbidity	7.57	8.89	7.85	9.21	8.38±0.79
DO (mg/l)	6.80	3.60	6.50	3.30	5.05±1.85
BOD (mg/l)	2.40	13.50	2.50	12.80	7.80±6.18
COD (mg/l)	16.00	71.00	18.00	80.00	46.25±33.98
Free CO ₂ (mg/l)	1.42	2.56	1.21	2.85	2.01±0.81
Alkalinity (mg/l)	36.87	42.56	38.45	45.87	40.93±4.06
Acidity (mg/l)	4.65	8.64	4.60	9.12	6.75±2.46
Chloride (mg/l)	52.19	59.64	55.14	62.54	57.37±4.60
Hardness (mg/l)	54.56	115.24	62.54	118.56	87.72±33.87

Table 1: Physico-chemical characteristics of Vikram Vatika Sarovar

Parameters	Sampling Site I (Northern area of Sarovar)		Sampling Site II (Southern area of Sarovar)		average
	Pre immersion 3 days before	Post immersion 5 day after	Pre immersion 3 days before	Post immersion 5 day after	
Lead (mg/l)	BDL	0.204	0.011	0.256	0.157±0.12
Zinc (mg/l)	0.013	0.202	0.018	0.215	0.145±0.11
Mercury (mg/l)	0.102	0.412	0.125	0.556	0.364±0.22
manganese	0.072	0.168	0.082	0.186	0.145±0.05

Table 2: Metal of Vikram vatika Sarovar

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