ECO PHYSIOLOGICAL STUDIES OF SOME FRESH WATER SAMPLES FROM VENA RIVER OF HINGANGHAT AREA OF WARDHA DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT –

The present work was a part of survey conducted for ecophysiological studies of fresh water samples of Vena River of Hinganghat tahsil of Dist. Wardha (M.S,). Algal and water samples were collected from three sites /stations of River Vena (Hinganghat, M.S.). viz., Under Bridge (Site-1), Dunkin (Site-2) and Shalangadi (Site-3) and analyzed for Water quality for variable (physicochemical) parameters. The data was analysed with reference to ISI & WHO standards. It was observed that the water was safe for domestic purposes and aquatic life as far as levels of pH, density, surface tension, viscosity, conductance, TDS, alkalinity, DO and chloride concentration. However, the water quality parameters such as total hardness and Ca++ hardness at some stations were beyond the permissible limit. Therefore, it was suggested to remove total hardness and Ca++ hardness to make it fit for consumption. Algae encountered in the water body reflect the average ecological conditions and they may be used as indicators of water quality. During the investigation total 37 algal species were encountered and were identified belonging to class Chlorophyceae, Cyanophyceae and Bacillariophyceae. *Cosmarium reniforme* (Ralf) Arch. and Roth. and *Scenedesmus bijugatus* (Turp.) Kuetz. were the dominant green algae followed by the remaining other rare species of *Scenedesmus* Meyen and *Staurastrum* Meyen ex Ralfs. All these taxa constitute new records for the study area.

***Key words*:** Vena River, Aquatic life, Physico-chemical parameters, ISI and WHO standards, Bacillariophyceae, Chlorophyceae, *Cosmarium*, Cyanophyceae, *Scenedesmus* *Staurastrum*,etc.

INTRODUCTION

Algae are frequently found in polluted and unpolluted water and due to this behavior they are generally considered as indicators to determine the quality of water because water is essential for life. The main reason of water contamination came from urbanization and industrialization. In rural areas where the water sources like dam, canal, or river are not available and hence the ground water is being continuously explored for agricultural purposes. As per current analysis, this was realized that, the ground water gets polluted drastically because of increased human activities,that facilitates the water borne diseases and causes the lot of health problems.

Therefore, basic concentration is needed to monitor the quality of water as well as to find out various sources which increased ground water pollution. The present study basically focused to examine the water quality of various potable water sources specially, ground water at Hinganghat. During experimentation, Physico-chemical parameters of water were tested to ensure good quality of water. But chemical analysis of water provides a good indication of the chemical quality of the aquatic systems, but do not integrate ecological factors such as altered riparian vegetation or altered flow regime and therefore, do not necessarily reflect the ecological state of the system [Karr, *et al.,* 2000].

Study of algal flora is a useful alternative for assessing the ecological quality of aquatic ecosystems, since biological communities integrate the environmental effects of water chemistry, in addition to the physical and geomorphological characteristics of Rivers and lakes [Stevenson *et al.,* 1999]. Phytoplankton encountered in the water body reflects the average ecological, condition and therefore, they may be used as indicator of water quality [Bhatt, *et al.,* 1999, Saha, *et al.,* 2000].These are very suitable organisms for the determination of the impact of toxic substances on the aquatic environment because any effect on the lower level of the food chain will also have consequence on the higher level [Joubert, 1980].

Algae are used for assessing the degree of pollution or as indicator of water pollution of different water bodies [Trivedy, 1986, Sudhaker, *et al.*, 1994, Dwivedi *et al.,* 2002]. With the advent of development, there is exponential increase in the demand for water. The main source to fulfil this demand of irrigation, industries and drinking water is river water. The quality of water is directly linked with human welfare. A comparative study of surface water and ground water sources from villages of different Talukas of Ariyalur area, Tamil Nadu [Rani, *et al*., 2009]. Shilpi Bansal., (2006), studied hydrochemical monitoring of pollutants in drinking water of Aligarh. The results indicate that drinking water quality of Aligarh is deteriorating and water is becoming polluted due to untreated industrial and sewage water discharge which can be controlled by adopting standard methods for water treatment.

Dr. Indradev Yadav., [2006] analyse the drinking water before and after the flood of east zone of Kosi division and concluded that when the concentration of Nitrate exceed 40 mg/lit, the skin becomes glue due to the decreasing efficiency of haemoglobin to combine with oxygen. It affects the mortality in pigs and calves due to the presence of high concentration in cattle. Mathew Koshy., [2006] studied water quality parameters of rever in Alappuzha district. The results of present work indicate that there are variations in the physicochemical parameters in the river water system. D.V. Tayade., [2006] reported the assessment of some metal in ground water and canal water of Nagapur village of Yavatmal district, Maharashtra. The results claimed to contain Calcium, Magnesium, and Iodide elements were below the maximum permissible limit, whereas fluoride was above the maximum permissible limit. Bilgrami, and Dattamunshi., [1985] examined the pH values in river Ganga and its major tributaries mainly Gandak, Barni, Kosi and attributed pH changes due to planktonic and fish activities.

The contribution to the Vidarbha and Marathwada Cyanophycean Chlorophycean, and Bacillariophycean flora have been studied by Tarar, J. L., and Seema Bodkhe, (1998); Sarode , P. T., and Kamat, N. D. (1979, 1983). However, the morpho-taxonomic studies of Vidarbha fresh water algal flora have received very little attention. That's why the present study was aimed to explore the algal flora of Vena river in relation to physico-chemical properties.

Area of study:

Hinganghat is one of the tehsils of Wardha District situated in $20^{0}18^{1}$ to 20^{0} and 49^{1}N and $78^{0}32^{1}$ to $79^{0}14$ E latitude. The town is located on the bank of river Vena, a tributary of the Wardha river which joins the big river Pranhita ahead at a distance place, which ultimately merges into the Godavari river later. In British India Hinganghat was the centre of India, but after the partition of Hindusthan into India and Pakistan, the Nagpur is considered as the center (heart place) of India. At vena river pump house there is an historical old stone, on which it was written that Hinganghat is the centre of India.

The major portion of the total annual rainfall is received from mansoon months of June to September of every year. The average rainfall of Hinganghat Tahsil is 1071.70 mm and has a dry tropical weather climate. The climate is hot and dry. Max temp in ^{0}C were noted as 47.9^{0}C and Min temp in ^{0}C were noted as 10.2^{0}C. The seasons of a year were divided climates into three season namely cold, hot and monsoon.

Wardha District has a typical seasonal mansoon, where people are engaged in agriculture. Hinganghat city lies in the south east of Wardha District. Its South East border touches Chandrapur District and South west border touches to Yeotmal District. The land scape of the city faces towards the south. There are fast running streams and Vena River bordering the north, west and south sides of the city. The city is rich in fauna and flora and water sources.

Fig. 1. *Map of Maharashtra State Showing Study area*

Fig. 2. *Map of Wardha District Showing Study area*

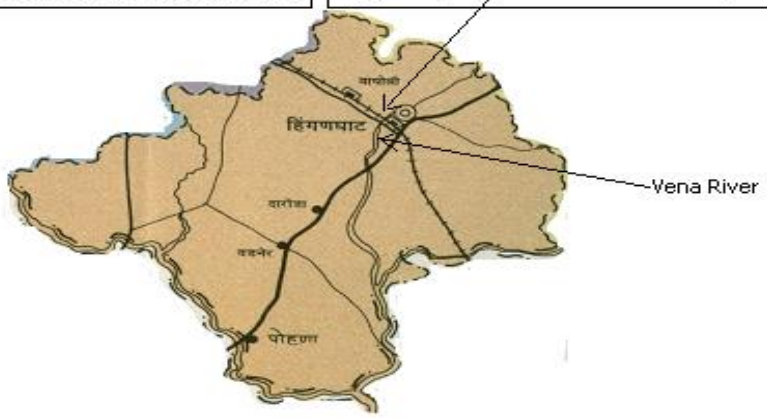

Fig. 3. *Map of Hinganghat tahsil Showing Study area*

MATERIAL AND METHODS

The water of Vena River is utilized for various purposes like domestic, farming, industrial purposes etc. The effluents from industries and sewage water from villages mostly polluted the river. Hence, in order to know the impacts of pollution due to industrial effluents and waste water, it was aimed to investigate the physico-chemical parameters of this river along with the investigation of Ecophysiological study of Vena River.

For this investigation work, water samples were collected from different depth, were mixed in equal volumes and preserved in 500ml stopper bottles and were allowed to stand for at least 24 hours. Thereafter, from the settled planktons, employing a graduated pipette, an aliquot of samples was taken and one drop (0.05 ml) of the sample was placed on a clean glass slide for qualitative and quantitative analysis. Algae were identified by employing the manual of Desikachary and Raja Rao [1980]. All the chemicals used in the study were of A.R. grades. Double distilled water was employed throughout the study. Standard methods for collection, preservation and analysis were adopted [ALPHA, 1985].

Stations: - Water samples from three stations of the Vena River were collected at Hinganghat Wardha district, namely Under Bridge (Station 1), Dunkin (Station 2) and Shalangadi (Station 3) of (M.S.) from May 2013 to April 2014. All samples were collected between 11.00 am to 12.00 pm.

OBSERVATION AND RESULT

Analytical study of Algae:

Physicochemical parameters viz. Temperature, colour, turbidity, density, viscosity, surface tension, electrical conductivity, pH, DO, hardness, alkalinity, TDS, chloride concentration, etc were analysed for the selected three stations of Vena River from May 2013 to April 2014. Analytical results were tabulated in Table 1.

Table 1: Showing analysis of water samples

Sr. No.	Parameter	Unit	S1	S2	S3
1	Colour		colourless	colourless	colourless
2	Temperature	^{o}C	31.7	30.4	23.9
3	pH		8.70	7.27	6.77
4	Turbidity		visibly not turbid	visibly not turbid	visibly not turbid
5	Density	gm/cm3	0.9965	0.9950	0.9945
6	Viscosity	mpoise	7.557	8.114	8.514
7	Surface Tension	dyne/cm	72.4158	69.4141	70.4147
8	Conductance	mM	0.465	0.467	0.551
9	Suspended Solids	ppm	281	201	198
10	Dissolved Solids	ppm	101.06	128.23	132.25
11	T.D.S.	ppm	375.253	347.951	298.523
12	Temporary Hardness	mg of CaCO3/lit	137.6	158.5	128.36
13	Permanent Hardness	mg of CaCO3/lit	166.1	144.93	170.3

14	Total Hardness	mg of CaCO3/lit	268.7	324.51	266.2
15	Ca++ Hardness	mg of CaCO3/lit	156.8	146	79.2
16	Mg++ Hardness	mg of CaCO3/lit	110	296.6	187.1
17	Alkalinity of water				
	(I) Total Alkalinity	mg /lit	83	75	36
	(II) Phenolphthalein Alkalinity	mg /lit	0	0	0
	(III) Methyl orange Alkalinity	mg /lit	85	76	37
18	D.O.	ppm	16	1.02	2.88
19	Chloride	mg /lit	124.07	89.33	137.54

Temperature: The fluctuations in temperature of different stations may be due to the influence of environmental temperature.

pH: The pH is one of the most important factors that influence the aquatic production. In the present study the pH was found to be acidic at Station 3 and normal to alkaline at Stations 2 and 3. The range of pH was between 6.77-8.70. The higher alkaline state of pH at Station 1 might be due to the enhanced chemical interaction that leads to buffering and release of alkaline ions bicarbonate and carbonate ions) or salts in the river water.

Density, Surface Tension and Viscosity: Density was found to be lowest at Station 3 and highest at Station 1. The viscosity is found lowest at Station 1 and highest at 3 while surface tension highest at Site 1 and Lowest at site 2.

Electrical Conductivity: Electrical conductivity is useful tool to evaluate the purity of water which is minimum at Stations 1 and 2 and maximum at Station 3.

TDS: TDS are those which get dissolved in water cannot be separated from water by filtration. They may be chemically organic or inorganic. According to Trivedi, and Goel., [1984] TDS are composed mainly of carbonates, bicarbonates, chlorides, sulphates, calcium, magnesium, phosphate, nitrate, sodium, potassium and iron.

In the present investigation, the highest value of TDS was recorded at Station 1. The high value may be due to the evaporative loss of water and consequent increase in the concentration of salts present in water. The ISI standard for dissolved solids is up to 500 mg/lit and the maximum permissible quantity is 1500 mg/lit [WHO,1994]. In the present investigations, the results indicate that all the samples of water from all stations were within permissible limit of ISI standard.

Total Hardness: The total hardness of water samples ranges from 266.2-324.51 mg/lit. According to ISI, the acceptance limit of total hardness (as CaCO3) is 200 mg/lit which can be extended to 600 mg/lit. Ca++ & Mg++ are important ions contributing towards total hardness. Hardness has no known adverse effects. Hardness above 200 mg/lit of water is not suitable for domestic use viz., washing, cleaning and laundry purpose. The acceptable limit of Ca++ & Mg++ for domestic use were 75 mg/lit & 200 mg/lit respectively (ISI).But according to Ministry of Rural Development, India, the ground water in case of non-availability of alternate water source , Ca++ & Mg++ up to 200 and 400 mg/lit respectively can be accepted. In studied area, Ca++ content ranged from 79.2-156.8 mg/lit. It means all three stations have

Ca++ content within the acceptable limit. Similarly Mg++ content is also within the permissible limit (110 to 296.6 mg/lit).

Alkalinity: The phenolphthalein alkalinity of all the water samples is 0. But the total alkalinity is found between 36 to 83 mg/lit. According to ISI, the acceptable limit of total alkalinity of drinking water sample is 500 mg/lit and maximum desirable limit is 1500 mg/lit. The alkalinity may be due to the contamination due to leaching process through surface water during rainy season [Singh *et al.,* 1999].

DO: In the present investigation, DO was found to be in the range of 1-16 ppm. This reveals that the DO at Station 1 is beyond the acceptable limit.

Chloride: Chloride value ranges from 89.33 to 137.54 mg/lit. The acceptable / desirable limit is 200 mg/lit [Park *et al*., 1980]. Results showed that all the samples fall within acceptable limit. It produces a salty taste at 250 mg/lit to 500 mg/lit [Trivedy, *et al*., 1984].

Ecophysiological study of algae:

From the collected water samples of Vena River, Hinganghat following species of algae were identified.

Table: 2. Table showing the total number of species in Vena River.

Algal groups	**Names of Algae**	**Stations**			**Total**
		S1	**S2**	**S3**	
Cyanophyceae	*Coelastrum polychordum* (Korschikoff) Hindak .	+	-	+	**9**
	Lyngbya birgei G.M.Smith.	+	+	+	
	Microcystis aeruginosa (Kutzing) Kutzing.	+	+	-	
	Merismopedia elegans A. Braun.	-	+	-	
	Merismopedia glauca (Ehrenberg) Kutzing.	+	+	+	
	Oscillatoria brevis Kutzing ex Gomont.	+	-	+	
	Oscillatoria princeps var. *minor* Vaucher.	+	+	+	
	Spirulina gigantea Schmidle.	-	+	+	
	Spirulina platensis (Gomont) Geitler.	+	-	-	
Chlorophyceae	*Cosmarium caelatum* Ralf.	-	+	-	**13**
	Cosmarium depressum (Nageli) P.Lundell.	-	+	+	
	Cosmarium leave var. *validius* Nordstedt.	-	+	+	
	Cosmarium microsphinctum var. *crispulum* Nordstedt.	+	+	-	
	Cosmarium reniforme (Ralf) Arch.	+	+	+	
	Cyclotella menengiana Kutzing.	+	+	-	
	Kirchneriella obesa (West) West & G.S.West.	-	+	-	
	Mougeotia scalaris Hassall.	+	+	+	
	Oedogonium accuminatum (Hirn)Tiffany.	+	+	+	
	Pediastrum boryanum (Turpin) Meneghini.	+	+	-	
	Pediastrum simplex Meyen.	+	-	-	
	Scenedesmus bijugatus (Turp.) Kuetz.	-	+	+	
	Scenedesmus dimorphus (Turpin) Kutzing.	+	+	+	
Bacillariophyceae	*Amphora copulate* (Kutzing) Schoeman	+	+	-	**15**

	&Archibald.				
	Closterium abruptum West.	-	+	+	
	Cymbella affinis Kutzing.	-	+	+	
	Cymbella aspera (Ehrenberg) Cleve.	+	-	+	
	Cymbella microcephala (Grunow) Krammer.	-	+	+	
	Cymbella tumida (Brabisson)Van Heurck.	+	-	-	
	Cylindrotheca closterium (Ehrenberg) Reimann & J.C.Lewin.	-	+	-	
	Gomphonema truncatum Ehrenberg.	+	+	+	
	Diatoma vulgaris Bory.	-	+	+	
	Frustulia vulgaris var. asiatica Skvortzow.	+	+	+	
	Gomphonema christenserii R.L. Lowe et Kociolek.	+	+	-	
	Navicula striatula (Turpin) Ehrenberg.	+	+	+	
	Navicula ambigua Ehrenberg.	+	-	+	
	Pinnularia viridis (Nitzsch) Ehrenberg.	+	+	+	
	Synedra ulna (Nitzsch) Ehrenberg.	+	+	-	

DISCUSSION

During the investigation total 37 algal species were encountered. Out of these station1 characteristically shown the (Under Bridge) abundance of Cyanophycean members of algal flora were, *Coelastrum polychordum* (Korschikoff) Hindak var. *polychordum, Oscillatoria princeps* var. *minor* Vaucher *and Spirulina platensis* (Gomont) Geitler; Chlorophycean members like *Cosmarium microsphinctum* var. *crispulum* Nordstedt, *Cosmarium reniforme* (Ralf) Arch, *Mougeotia scalaris* Hassall, *Pediastrum simplex* Meyen, *Scenedesmus bijugatus* (Turp.) Kuetz and Bacillariophycean members like *Amphora copulate* (Kutzing) Schoeman &Archibald, *Cymbella aspera* (Ehrenberg) Cleve, *Frustulia vulgaris var. asiatica* Skvortzow, *Gomphonema christenserii* R.L. Lowe et Kociolek and *Navicula striatula* (Turpin) Ehrenberg. Station 2 (Dunkin), Cyanophycean members were *Merismopedia elegans* A. Braun. *Chlorophycean members- Cosmarium caelatum* Ralf, *Cosmarium depressum* (Nageli) P.Lundell, *Cosmarium leave* var. *validius* Nordst, *Cosmarium microsphinctum* var. *crispulum* Nordstedt, *Cosmarium reniforme* (Ralf) Arch, *Mougeotia scalaris* Hassall, *Scenedesmus bijugatus* (Turp.) Kuetz. Bacillariophycean members like *Amphora copulate* (Kutzing) Schoeman &Archibald, *Cymbella affinis* Kutzing, *Cymbella microcephala* (Grunow) Krammer, *Diatoma vulgaris* Bory, *Frustulia vulgaris var. asiatica* Skvortzow, *Gomphonema christenserii* R.L. Lowe et Kociolek and *Navicula striatula* (Turpin) Ehrenberg. Station 3 (Shalangadi), Cyanophycean members of algal flora like, *Coelastrum polychordum* (Korschikoff) Hindak var. *polychordum, and Oscillatoria princeps* var. *minor* Vaucher. Chlorophycean members like *Cosmarium depressum* (Nageli) P.Lundell, *Cosmarium leave* var. *validius* Nordst, *Cosmarium reniforme* (Ralf) Arch, *Mougeotia scalaris* Hassall and *Scenedesmus bijugatus* (Turp.) Kuetz Bacillariophycean members like *Cymbella affinis* Kutzing, *Cymbella aspera* (Ehrenberg) Cleve, *Cymbella microcephala* (Grunow) Krammer, *Diatoma vulgaris* Bory, *Frustulia vulgaris var. asiatica* Skvortzow. Bacillariophycean members were dominant on other two groups of algae. At station 2 more algal species were identified than the station 1and station 3. Station 3 has lowest number of algal species.

CONCLUSIONS

From the above observations and results, it can be concluded that the differential study of physicochemical parameters such as pH, density, viscosity, S.T., conductance, TDS, alkalinity, DO, chloride concentration were within the permissible limit. However, the water quality parameters like total hardness and Ca++ hardness were beyond the permissible limit at station 1 (Under Bridge). Therefore, it was suggested that the river water should be treated to remove excess of total hardness and Ca++hardness to make it fit for consumption. Demonstration-cum-awareness camps for the purpose should be arranged in the rural areas. Total hardness and Ca++ hardness can be removed by ion exchange and boiling. The Government should make firm policies and guidelines for the utilization of ground water. The above analysis of water also revealed that all the three stations under study were fairly suitable, productive and healthy for aquatic ecosystem. The values of parameters were well within the permissible limit (except some parameters) and therefore, can support and sustain the dependent aquatic organisms. The concentration of algal taxa increases from station 3 towards station 1. It might be because of the enhanced chemical interaction that led to buffering and release of alkaline ions or salts in the river water.

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