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ORIGINAL RESEARCH ARTICLE

Seasonal Variation in Physico-Chemical Parameters of Palar River in and Around Vaniyambadi Segment, Vellore District, Tamil Nadu, India

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ABSTRACT

In the present investigation the physico-chemical characteristics in Palar River water at Vaniyambadi segment was analysed to assess the water quality. The physico-chemical parameters like Temperature, pH, Electrical conductivity (EC), Total hardness (TH), Total alkalinity (TH), Chlorides (Cl), Dissolved oxygen (DO), Biological oxygen demand (BOD), Chemical Oxygen demand (COD) Turbidity, Total solids (TS), Total dissolved solids (TDS), Total suspended solids (TSS), Phosphates (PO_4) , Nitrates (NO_3) and Sulphates (SO_4) were considered. The overall analysis, it was observed that the fluctuations in the Physico-chemical parameters of water samples. The Palar River daily has been facing the problems of municipal sewage, industrial wastes and anthropogenic activities.

Key words: Palar River, Vaniyambadi and Physico-chemical parameters.

1. INTRODUCTION

Rivers have been the most important freshwater resources and our ancient civilizations have flourished along the banks of rivers. River water finds multiple uses like agriculture, industry, transportation, aquaculture, public water supply and they have been used for cleaning and disposal purposes. Huge loads of waste from industries, domestic sewage and agricultural practices find their way into rivers resulting in large scale deterioration of the water quality. The growing problem of degradation of our river ecosystem has necessitated the monitoring of water pollution and water quality of various rivers all over the country to evaluate their production, capacity, utility potential and to plan restorative measures.

Water is an essential component of the environment and it sustains life on the earth. All animals and human beings depend on water for their growth, development and survival. It is a raw material for photo synthesis and also important for crop production. It is a known fact that the maximum agricultural production depends on water and soil quality [1]. Industrial effluents contain large number of pollutants in higher concentration. These effluents are commonly used for the irrigation in adjoining areas of drains of the industries. Some workers suggested that the use of effluents after treatment to make suitable for irrigation [2]. However the adverse effects of treated effluent on crop plants also has been reported [3].

Pandey (2006)[4] analysed physico-chemical properties and heavy metal contents of the effluent discharged from Flash Light Ltd., and reported accumulation of heavy metals in *Raphamus sativus* and *Spinacia oleraea* when irrigated with industrial effluent. Alam *et al*. (2006)[5] studied the water quality conditions of Sylhet city of Bangladesh and its restaurants and their investigation was based on questionnaire survey of restaurants and laboratory tests on water samples like dissolved oxygen, electrical conductivity, total hardness, turbidity, temperature, suspended solid and coliforms bacteria.

Smitha *et al*. (2007)[6] studied the physico-chemical characteristics of water samples of Bantwal taluk in Karnataka and reported that it is suitable for irrigation and agricultural purposes. The quality of water in four streams of Cauvery River in Mandya, District analysed by taking into account the transparency, turbidity, depth, dissolved oxygen, colour, biochemical oxygen demand, nitrite, nitrate, total hydrocarbon and the overall density of rotifers to assess the impact of effluent on the water quality [7].

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2. METRIALS AND METHODS

Water samples were taken from the Palar River at Vaniyambadi segment using acid washed polypropylene containers of one litre capacity from a depth of 10 to 25 cm. Physico-chemical parameters of water samples were analyzed by following the standard methods given in [8]. pH was estimated by using Digital pH meter Elico-Li-120. Temperature was measured by using standard mercury thermometer. EC was measured by using conductivity meter. Nitrate was measured by nitrate reduction column method. The PO_4 and SO_4 were determined by Titrimetric method. Alkalinity and hardness were estimated by EDTA Titrimetric method. Dissolved oxygen, Chloride, TDS, BOD and COD were determined by Standard procedures by Pandey and Carney [9].

3. RESULTS AND DISCUSSION

3.1. Temperature

The physico-chemical parameters of Palar river water at Vaniyambadi segment are presented in (**Table1**). The parameter of temperature values varied from 28.7°C – 30.9°C at different times as indicated by the *in situ* reading. The average temperature was 29.8°C. The temperature was basically important for its effects on the chemistry and biological activities of organisms in water. Temperature was known to influence in the determination of other factors like pH, conductivity, dissolved gases and various forms of alkalinity. Some of the factors that affect Palar river water temperature are heat exchange on the earth surface under controlled radiation in and out, ground water movement and chemical and thermonuclear processes occurring in an aquifers, as suggested by Drever (1997)[10].

3.2. pH

pH is the measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions. The pH of the water samples varied from 5.40- 6.00 at different times, as indicated by the *in situ* readings. The result reveals that the pH value was not within the desirable limit of BIS and WHO standards (1981)[11] so that the river water cannot be used for drinking purpose. River waters with a pH of 5.5 and below are particularly at risk [12]. Basically, the pH was determined by the amount of dissolved carbon dioxide which forms carbonic acid in water [13,14]. The pH of ground water can also be lowered by organic acids from decaying vegetation and the dissolution of sulfide minerals [15]. The pH was considerably lower in Palar river water which may be due to greater input of effluents from different types of industries.

Usually alkaline pH is considered to be good for promoting high primary productivity. However the present value shows more congenial conditions for primary production. Natural water has pH values between 6.5 – 8.5. These values are typical with slight seasonal variations, and a sudden change would indicate industrial pollution. Further, highly acidic or highly alkaline waters are undesirable because of corrosion hazards and possible difficulties in treatment.

3.3. Electrical conductivity

Conductivity is the measure of capacity of a substance or solution to conduct electric current. Conductivity is reciprocal of the resistance. In this study, electrical conductivity values ranged from 11.90-13.15 µmhos/cm at different times, as indicated by the *in situ* readings. EC values indicate the presence of more salts in river water as suggested by Abdullah and Musta (1999)[16]. EC values are a good measure of the relative difference in water quality between different aquifers [17]. It was related to TDS content and its value becomes higher with the increase of the degree of pollution.

3.4. Total hardness

Total hardness is defined as the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate in milligrams per litre. The hardness of water fluctuated from 152.20 – 231.19 mg L^{-1} and this value was within recommended BIS standards. A high concentration of hardness may be due to leaching from the soils or due to the high background concentration of the waters. WHO (1984)[18] permissible limit for total hardness of water is 150 mg L^{-1} and ISI (1983)[19] desirable limit was 300 mg L^{-1}. Todd (1995)[20] suggested that the values between 150 and 300 mg L^{-1} of TH means the water was hard, and TH greater than 300 mg L^{-1} means the water is very hard. High concentration of hardness may cause the problem of heart disease and kidney stones [21]. According to the report of NRC (1977)[22] fifty studies in nine countries have established a consistent statistical association between drinking water hardness and the incidence of cardiovascular problem. Todd (1995)[23] suggested that water with a hardness of 50 ppm was considered to be soft; however a hardness of 300 ppm was permissible for domestic use, whereas it should be 2 to 80 ppm for boiler feeders, and an upper limit of 150 ppm was usually recommended for agriculture.

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3.5. Total Alkalinity (TA)

Alkalinity of water is its acid – neutralizing capacity. Alkalinity is significant in many uses and because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate and hydroxide content, it is taken as an indication of the concentration of these constituents. The total alkalinity of Palar river water at Vaniyambadi segment ranged from 23.5 – 28.73 mg L^{-1}. Alkalinity values serve as an index of productive potential of the water [24]. In this study, the recorded alkalinity values indicate a lower ability of the river water to support algal growth and other aquatic life.

3.6. Chlorides

The chloride content of water samples varied from 45.50 – 78.60 mg L^{-1}. The concentration of chloride was well within the prescribed standards of WHO, BIS and USPH (1985)[25]. An excess of chloride beyond desirable limit in inland waters is considered as index of water pollution. The existence of considerable amount of chloride in river water may be due to discharge of industrial effluents into it. Sewage water and industrial effluents are rich in chloride content and discharge of these waste waters results in greater chloride level in fresh waters [26].

Chloride enters into the water by weathering of sedimentary rocks, from sewerage, industrial and agricultural run-off. In a big city, it is an indicator of sewage pollution because of the chloride content in urine and animals excretory products. Microbiological treatment of drinking water involves chlorination and the quantity is kept in excess to maintain maximum level till end consumer. However excess of residual chlorine leads to the formation of potential carcinogenic chloro-organic compounds such as chloroform [27].

3.7. DO, BOD and COD

The DO, BOD and COD values ranged between 1.75-2.90 mg L^{-1}, 41.85–60.32 mg/L and 110.61-161.48 mg L^{-1} respectively. Dissolved oxygen is one of the important parameters in water quality assessment and reflects the physical and biological processes prevailing in the waters. Its presence is essential to maintain the higher forms of biological life in the water. Oxygen can be removed from the waters by discharge of the oxygen demanding wastes. Other inorganic resultants like hydrogen sulphide, ammonia, ferrous ion, nitrites and other oxidizable substances tend to decrease dissolved oxygen in water. Low oxygen in water may kill fish and other organisms present in water. For instance, game fish requires a minimum of 5 mg/l and coarse fish about 2 mg/l. Low oxygen content is generally associated with heavy contamination by organic matter. Oxygen saturated waters have a pleasant taste whereas waters with negligible oxygen content have an insipid taste.

Water quality characteristic of aquatic environment arise from a multitude of physical, chemical and biological interactions [28]. The over production of higher tropic levels biomass and the subsequent decay of dead plants could lead to oxygen depletion, death of aquatic organisms and development of anaerobic zone where bacteria action produce foul odours and bad tastes [29].

The overall DO concentration was very low probably due to the presence of high organic content leading to oxygen depletion. The persistent DO deficit indicated that the deoxygenation rate due to biological decomposition of organic matter is higher than reoxygenation from the atmosphere [30]. The registered dissolved oxygen amount was inadequate for normal hydrobiont life activities. It should be emphasized that relatively high concentration more than 7 mg/l of dissolved oxygen is required for a normal growth of phytoplankton species.

BOD is a measurement of the oxygen required for microorganisms whilst breaking down organic matter to stable inorganic forms such as CO_2, NO_3 and H_2O. On an average basis, the demand for oxygen is proportional to the amount of organic waste to be degraded aerobically. Thus, the BOD values are useful in process design, stream pollution control management as well as the measure of treatment plant efficiency and operation. Further, types of microorganisms, pH, presence of toxins, some reduced mineral matter and nitrification are the factors directly influencing the BOD test.

Chemical oxygen demand is the oxygen required by the organic substances in water to oxidize them by a strong chemical oxidant. In the present investigation, the recorded low value of DO and higher values of BOD and COD can be ascribed to the discharge of effluents and non point-source pollution into the Palar River at Vaniyambadi segment.

3.8. Turbidity, TS, TDS and TSS

The turbidity of water samples showed variation from 7.30 – 20.89 NTU. The registered value exceeded the highest desirable limit of WHO and BIS standards, therefore, not recommended for drinking purpose. Similarly the values of total

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solids (TS), total dissolved solids and total suspended solids (TSS) varied from 800.63 – 903.15 mg L^{-1}, 453.19 – 510.10 mg L^{-1} and 346.00 – 390.20 mg L^{-1} respectively. The total solids value exceeded the desirable limit of WHO, BIS and UPSH standards, therefore, not recommended for drinking and bathing purposes. Solids may affect water quality in a number of ways. Waters with high dissolved solids generally are of inferior palatability and may induce an unfavourable physiological reaction in the transient consumer. Waters high in suspended solids may be esthetical unsatisfactory for bathing. Solids analyses are important in the control of biological and physical waste water treatment processes and for assessing compliance with regulatory agency wastewater effluent limitations.

3.9. PO_4, SO_4 and NO_3

The phosphate content varied from 4.65-9.80 mg L^{-1} and this value seems to be higher than the unpolluted fresh waters [31]. Phosphate is present in natural waters as soluble phosphates and organic phosphates. This phosphate content may come from agricultural run-off containing phosphate fertilizer residues and also discharge of effluents into the river. Further registered phosphate concentration confirms the intensive eutrophication.

Nitrate concentration in Palar River at Vaniyambadi segment ranged from 5.90 – 14.30 mg L^{-1} and this value was within the USPH, WHO and BIS standards. Nitrate has long been associated with the occurrence of blue baby disease in infants or infantile methaemoglobinaemia which is caused by bacterial reduction of nitrate into nitrite in stomach.The registered nitrate value fell within the limit of the International standards, therefore, no chance for the occurrence of blue baby disease at Vaniyambadi village. Higher concentration of nitrate in the water may be due to local run-off from the adjacent crop fields where the farmers had used nitrogen fertilizers.

The sulphate content of the water samples varied from 11.10-19.76 mg L^{-1}. This value was within the desirable limit of BIS, WHO and UPSH standards. Waste water from tanneries, paper mills and textile mills contributes to the sulphate in natural waters along with some agricultural runoff containing residue of fertilizers.

Table 1: Physico-chemical parameters of Palar river water at Vaniyambadi segment (values expressed in mg L^{-1} except T, pH and EC)

Temperature	Range values of water samples	Average concentration of water samples
Temperature	28.7°C – 30.9°C	29.8°C
pH	5.40 – 6.00	5.7
Electrical Conductivity (EC)	11.90-13.15 µmhos/cm	12.52
Total hardness (TH)	152.20 – 231.19	191.69
Total alkalinity (TA)	23.5 – 28.73	26.12
Chlorides (Cl)	45.50 – 78.60	62.05
Dissolved oxygen (DO)	1.75 – 2.90	2.32
Biological oxygen demand (BOD)	41.85 – 60.32	51.08
Chemical oxygen demand (COD)	110.61 – 161.48	136.05
Turbidity	7.30 – 20.89 NTU	14.09
Total solids (TS)	800.63 – 903.15	851.89
Total dissolved solids (TDS)	453.19 – 510.10	481.64
Total suspended solids (TSS)	346.00 – 390.20	368.10
Phosphate (PO_4)	4.65 – 9.80	7.23
Nitrate (NO_3)	5.90 – 14.30	10.10
Sulphate (SO_4)	11.10 – 19.76	15.38

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REFERENCES

1. Santhakuamr, M., K.R. Saravanan, D.Soumady, M.Balaji and K.Ramudu. 1999. Effect of Monocrotophos on the activity of acid and alkaline phosphatase in brain and gills of an air-breathing fish Anabas *testudineus*, (Bloch). Ecol. *En. Cons.*, 5 (3): 231-234.
2. Holdway, D.A. and J.B. Sprauge. 1979 Chronic toxicity of vanadium to flag fish., *Water Research*, 13: 905-910.
3. Pandey, A.K. 2006. Histopathological alterations in the gill and kidney of an esturine mullet, *Liza parsia* (Hamilton-Buchanan) caused by sub-lethal exposure

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to lead (Pb). *Indian, J. Fish*, 44 (2): 171-180.

4. Alam, A., Margiocco, C., Melodia, F and P.Mensi. 2006. Biochemical effects of long-term exposure to chromium, cadmium, and nickel on rainbow trout (*Salmo gairdneri* Rich). Influence of sex and seasons, *Chemosphere*: 11, 47-67.
5. Smitha, G.G. Herman, S.P. and R. Kieln. 2007. Electrophysiology of methyl mercury poisoning. *J, Pharmac. Exp. ther.*, 186, 572-592.
6. Abbasi, S.A. and R. Soni. 1987. Water quality criterial for the management of chromium and vanadium in irrigation water and industrial effluents with reference to impact studies on fresh water teleost Nuria denricus. In: Pollution in the urban environment, MWH Chan, RWM Horarte, PR Holems, RJS Law and SB Reeds (Eds), Elsveier, London and New York, 566-574.
7. APHA 2000. (American Public Health Association) Standard methods for examination of water and wastewater 15th edition. AWWA, APCF Washington, DC 2005, USA.
8. Pandey, G.N and Carney, G.C. 1989. Environmental Engineering. Tata Mc Graw-Hill publishing Company Limited, New Delhi.
9. Drever, N. 1997. Cough responses and uptake of mercury by brook trout (Salvelinus fontinalls) exposed to mercuric compounds at different hydrogen ion concentrations. Transactions of American Fisheries Society, 103, 244-249.
10. Sures, B., Dezfuli, B.S., and H.F. Krug 2003. The intestinal parasite *Pomphorhynchces acanthocephala* laevis interfers with the uptake and accumulation of lead in its fish host chub *Leucicus cephalus.* Inter. J. Parasitology, 33 (14): 1617-1622.
11. Sauter, S., Buxton, K.S., Macek, K.J. and Pertrocelli, R. 1976. Effects of Exposure to Heavy Metals on Selected Freshwater Fish. Toxicity of Copper, Cadmium, Chromium, and lead to Eggs and Fry of Seen Fish Species, EPA-600/3-76-105, Environmental protection Agency, Washington.
12. Horvath, D.J. 1976. Trace elements and health In: Neuberne, P.M. (Ed). Trace Substances and Health. Marcell Dekker Incorporation, New York and Basel, 319-357.
13. Anita Susan, T. and K.S. Tilak. 2003. Histopathological changes in the vital tissues of the fish *Cirrhinus mrigala* exposed to fenvalerate technical grade. *Poll. Res.*, 22 (2): 179-184.
14. Tepe, Y., I. Akyurt, C. Ciminli, E. Mutlu and M. Calskan. 2004 Protective effect of clinoptilolite on lead toxicity in *Cyprinus carpio* (Common carp) Fressenius. *Environ. Bulletin*, 13 (7): 639-642.
15. Todd, L.P. 1995. Changes in biological characteristics of *Daphnia magna* from chronic action of copper and nickel at low concentrations. *Hydrobiological journal,* 5: 59-62.
16. Abdullah and Musta. 1999. Histopathological lesions induced by copper sulphate and lead nitrate in the gills of fresh water fish *Nandus nandus. J. Ecotoxicol. Environ. Monit*., 12 (2): 105-111.
17. RMC. 1990. A manual of freshwater aquaculture Oxford and IBH Publishing Co. Pvt. Ltd., India.
18. WHO, 1984. Effect of mercuric chloride on some bio-chemical and physiological parameters of the freshwater murrel, *Channa punctatus*. *Environmental Research*, 34: 343-350.
19. ISI. 1983. Acute effects of methyl mercury toxicity in channel catfish *Ictalurus punctatus* kidney. *Bull. Environ. Contam. Toxicol*., 13 (5): 570-578.
20. Todd, L.P. 1995. Changes in biological characteristics of *Daphnia magna* from chronic action of copper and nickel at low concentrations. *Hydrobiological journal,* 5: 59-62.
21. Jain, R. 1996. Individual and combined effects of heavy metals on behaviour and respiratory responses of *Oreochromis mossambicus. Indian. J. Fish*., 37 (2): 129-143.
22. NRC, 1977. Nutrients and Toxic Substances in Water for Livestock and Poultry National academy of Science, Washington D.C
23. Todd, L.P. 1995. Changes in biological characteristics of *Daphnia magna* from chronic action of copper and nickel at low

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concentrations. *Hydrobiological journal*, 5: 59-62.

24. Mary Chandravathy, V. and S.L.N. Reddy. 1991. *In vivo* recovery in the glycogen metabolism in liver and muscle of freshwater fish *Anabas scandens* after exposure to lead nitrate, *Indian J. Environ. Toxico*., 1(1): 53-58.
25. WHO, 1984. Effect of mercuric chloride on some bio-chemical and physiological parameters of the freshwater murrel, *Channa punctatus*, *Environmental Research*, 34: 343-350.
26. Gao-Qian and Nie-Pin. 2000. Lead content in the monogenean, *Ancyrocephlus mogurndae* and in different organs of its host the mandarian fish, *Siniperca chuatsi*. *J. China. Enviro. Sci*., 20 (3): 23-236.
27. APHA 2000. (American Public Health Association) Standard methods for examination of water and wastewater 15th edition. AWWA, APCF Washington, DC 2005, USA.
28. Dee, J.G. 1989. Mercury and Lead during breast-feeding. *J. Brit. Jour. Nutri*., 92 (1): 21-40.
29. Forstner, U and G. T. W. Wittmann. 1979. Metal pollution in the Aquatic Environment Springer, Berlin, Hellderberg, New York.
30. Muramoto, S. 2005. Vertebral column damage and decrease of calcium concentration in fish experimentally exposed to cadmium. *Environmental Pollution,* 24: 87-92.
31. Kanagaraj, M.K., R. Mahte and R. Manavalaramanujam. 2008. Effect of cadmium Nitrate an plasma electrolytes of the fish, *Catla catla*. *J. Environ. Biol*., 19 (2): 107-110.

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