Journal of Environmental Biology
©Triveni Enterprises, Lucknow (India)
Free paper downloaded from: www.jeb.co.in

September 2008, 29(5) 765-768 (2008)
For personal use only
Commercial distribution of this copy is illegal

Evaluation of physical and chemical parameters of river Kaveri, Tiruchirappalli, Tamil Nadu, India

P. Raja*, A. Muhindhar Amarnath, R. Elangovan and M. Palanivel

P.G. and Research Department of Zoology, Periyar E.V.R. College, Tiruchirappalli - 620 023, India

(Received: May 10, 2007; Revised received: August 25, 2007; Re-revised received: October 04, 2007; Accepted: November 04, 2007)

Abstract: *The physical, chemical and total heterotrophic bacteriological parameters (THBP) bacterial population were measured at three sampling stations namely Upper Anicut (S1), Chinthamani road bridge (S2) and Grand Anicut (S3) for a period of three month January to March 2007 in the river Kaveri, Tiruchirappalli. The pH ranged from 6.7 to 7.8, the level of solids and total hardness was high in station S2 when compared to other stations. Station 2 registered a minimum level of DO (3.6 mg l^{-1}), and the BOD and COD varied from 3.47 to 4.27, 20.67 to 41.47 mg l^{-1} respectively. THBP colony count was found to be high in S2 (8.16 x 10^2 CFU ml^{-1}) and a lowest level in S1 (2.64. x 10^2) and S3 (1.80 x 10^2). It was observed in the present study that in reservoir (anicut) stations factors like pH, TDS, TSS, Hardness and THBP were at lower level than for the water at Chinthamani road bridge (S2), probably due to the mixing of municipal sewage at this point.*

Key words*: Pollution, Physical chemical parameters, River Kaveri, Total heterotrophic bacterial population (THBP)*
PDF of full length paper is available with author ***(*rajazoo75@yahoo.co.in)***

Introduction

Though water is a renewable resource, reckless usage and improper management of water systems may cause serious problems in availability and quality of water. Water may be contaminated by various means, chemically or biologically and may become unfit for drinking and other uses. In our country 70% of the water is seriously polluted and 75% of illness and 80% of the child mortality is attributed to water pollution. The quality of water is usually determined by its physico-chemical characteristics. It is a well established fact that domestic-sewage and industrial effluent discharged into natural water result in deterioration of water quality and cultural eutrophication (Shaw *et al*., 1991). The other important sources of water pollution include mass bathing, disposal of dead bodies, rural and urban waste matters, agricultural run-off and solid waste disposal (Tiwana, 1992).

During the last several decades, the water quality of the Indian rivers has been deteriorating due to continuous discharge of industrial wastes and domestic sewage (Dyniel and Wood, 1980; Unni, 1984; Shaw *et al.,* 1991; Sivakumar *et al*., 2000; Sachidanandamurthy and Yajurvedi, 2006; Krishna *et al.,* 2007; Duran and Suicmez, 2007; Smitha *et al.,* 2007). A similar situation appears to exist at Dalmianagar and this has caused great damage to the riverine biota, particularly fish fauna as a result of alteration in the physico-chemical parameters (Sinha, 2002). Industries are duming their effluents in to the rivers, thereby polluting them severely (Srinivasan *et al.,* 1980; Kakati and Bhattacharya, 1990). Studies in relation to physico-chemical factors of some rivers have been made by a number of workers (Chattopadhya *et al.,* 1984; Bhowmic and Singh, 1985; Gill *et al.,* 1993). Clean drinking water is an essential human requisite for sustenance of life. Clean water is also a *Sine quanon* for the development of fishery resources.

With India's rapidly growing population, accompanied by increasing hazards of domestic and industrial pollution to the inland waters of the country (Sreenivasan, 1970), scientists envisage a rapid degradation of water quality unless concrete steps are taken immediately to abate pollution. There have been added an array of agricultural pesticides and insecticides which are further seriously aggravating the problem of pollution both public health as well as aquaculture (Singh and Singh, 1995).Increased pollution load in fresh water bodies increases the nutrient level of water. The nutrient – rich water in warm climate encourages excessive growth of aquatic weeds and existence of algal blooms. Certain pollutants get involved in the enhanced growth of few species and suppress the others (Attab Alam, 1995).

Fishes are affected by pollutants both directly and indirectly in various ways. Some of the effects produced are as given below: An increase in the osmotic preasure, violent alteration in the pH of water, reduction of oxygen content of in water by substances with a high oxygen demand, specific toxic ingredients, which may injure the gills and other external structures, cause death either from anoxemia or by in take and absorption. Fishes are affected indirectly when its habitual food organisms are destroyed. The covering of the bottom of a water body by a coating of waste matter greatly reduces the food supply of the fish. Destruction of spawning grounds can be serious in respect of major carps and other fishes which require

special environment for breeding (Muchmore and Dziegielewski, 1983; Chessman and Robinson, 1987; Muduli *et al.,* 2006).

Gopalakrishnan *et al.* (1962), reported mechanical injury or blocking of gills by silts or other suspended material. Large scale fish mortality due to choking of gills and gullet with mud and filaments of Oscillatoria and diatom could also be observed which lead to the reduction in oxygen uptake. Long distance migratory fishes, during some phase of their life history may be adversely affected by highly localized pollution of the river. Pathogens are carried to human beings through fish cultured in polluted water. Sewage pollution even in small quantities may change the character of an aquatic environment over a period of years. Thus, with the gradual process of aging, deep, clear oligotrophic lakes may be sedimented, becoming mesotrophic then eutrophic and eventually turning into bogs. The water quality criteria have been studied in various streams by a number of authors, *viz*., Draper and Smith, 1996; Scanaad and Hess, 1977; Sinha, 2002.

Materials and Methods

Study area: Three sampling stations of river Kaveri stretch, namely upper anicut (S1), Chinthamani road bridge (S2) and Grand anicut (S3) were selected and water samples collected from these locations (Fig.1). Upper anicut (Station 1) is an impoundment in the river about 20 km upstream of Station 2 (Chinthamani). It represents a semi-lentic system with fine bottom. It is one of the centres of major fishing activity. Chinthamani (Station 2) is located in the heart of Tiruchirappalli city and suffers from maximum human interference. Direct discharge of sewage here is an important point of concern. Grand Anicut (Station 3) is the second impoundment across the river Kaveri located about 15 km downstream of Station 2 (Chinthamani). It represents a semi-lentic system with considerable pollution load received from the city. It is also one of the active fishing centres of the river.

Physico-chemical parameters: River water samples were collected in a polythene can (2 liter) and were refrigerated in laboratory at 4°C. The physico-chemical parameter such as pH, total solid, total dissolved solid, total suspended solid, total hardness, total alkalinity, salinity, DO, BOD, COD, nitrite, silicate and phosphate were analysed. The pH of the water sample was measured using a digital pH meter (Elicomodel No. L1 120) and estimation of remaining parameters were made by the following methods described in APHA (2005); Trivedi and Goel (1986) and the results were expressed in mgl^{-1}.

Total heterotrophic bacterial population (THBP): To determine the total heterotrophic bacterial population in the effluents, samples were collected in sterile plastic bags and immediately transported to the laboratory. Bacteria were enumerated as colony forming units (CFU) employing the standard pour plate technique following methods described in APHA (2005) and Cruickshank *et al.* (1975). Plate count agar medium (III Media laboratories, India) was used for enumeration purposes. The agar medium was autoclaved prior

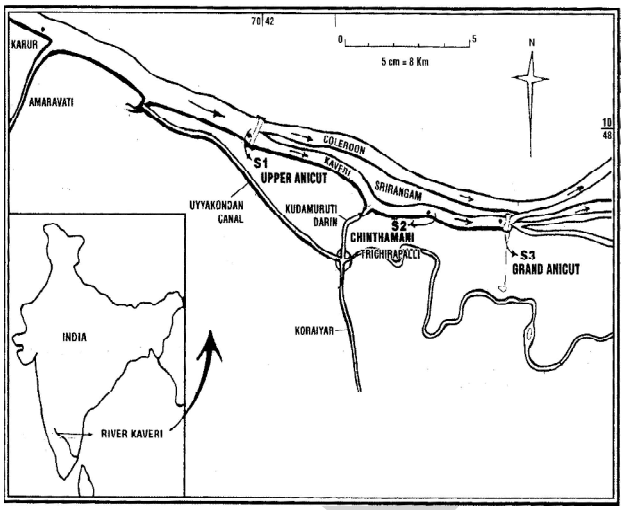

Fig. 1 : Map showing location of the sampling sites (S1, S2 and S3)

to use. Effluent samples were collected in sterile containers and were serially diluted using sterile tap water before inoculation into sterile petri dishes. Plating was done employing pour plate technique and the plates were incubated at 30° C in an incubator. After 3-5 days of incubation, colony counts were made using a colony counter. THBP and expressed as no. per 100 ml.

Results and Discussion

The mean values of physical and chemical parameters of river Kaveri, Tiruchirappalli are presented in the Table 1. In all the three stations pH ranged from 6.7 to 7.6. The variation of pH is due to the fluctuation of discharges from the domestic sewage waste. The mean values of TDS, TSS,TS, total hardness, total alkalinity, salinity, DO, BOD, COD, nitrite, silicate and phosphate varied from 333 to 470, 63 to 100, 396.67 to 570, 880 to 973, 191 to 255, 133 to 201.2 , 4.1to 5.8, 3.5 to 4.3 , 21 to 41.5 , 0.18 to 0.28, 2.6 to 3.2 and 0.33 to 0.38 mg l^{-1} respectively.

In Station 2, higher levels of solids, total hardness and COD was observed due to domestic sewage. Total solids, total dissolved solid and total suspended solid, for all the stations were considerably, high and the highest average value was found at Station 2. All the stations in the study contained either below or equal to 500 mg l^{-1} of total solids. The total alkalinity in all the stations varied from 191.7 to 255 mg l^{-1} respectively. Sarma *et al.* (2002) reported marked variations in the total alkalinity from season to season with a tendency to have maximum values during the winter season and the lowest values in conformity with its low pH. There is no standard set for total alkalinity. The possible reason for this may be the presence of carbonate and bi-carbonates (Ravichandran, *et al*., 2002). The high hardness of these samples also suggest presence high chloride content. Singh and Singh (1995) reported that the higher level of salinity was due to increase in decomposition of organic matters. Direct correlation was also found between the salinity content and pH. The decomposition of organic matters was

Table - 1: Mean values of physical and chemical parameters of river Kaveri, Tiruchirappalli

Parameters	Stations upper anicut (S1)	Chinthamani road bridge (S2)	Grand anicut (S3)
pH	6.74-7.1	7.01-7.8	6.77-7.20
TDS	333.33±94	470.00±108.8	336.67±50.9
TSS	63.33±22.5	100.00±49.8	73.33±13.7
TS	396.67±109.3	570.00±155.2	410.00±64.5
Hardness	933.33±122.1	973.33±112.5	880.00±32.2
Alkalinity	196.67±30.4	191.67±32.4	255.00±11.8
Salinity	201.17±18.3	153.83±18.3	132.93±9.8
DO	4.1±0.8	3.6±0.1	4.9±0.8
BOD	3.47±0.6	4.07±0.9	4.27±0.5
COD	20.67±7.9	41.47±5.4	34.67±3.2
Nitrite	0.28±0.1	0.21±0.1	0.18±0.1
Silicate	3.19±1.0	2.83±0.5	2.57±0.6
Phosphate	0.38±0.1	0.33±0.1	0.33±0.2

All the values are expressed in mgl^{-1} except pH no. of analyses (n) = 4

Table - 2: Total heterotrophic bacterial population colony counting in the River Kaveri, Tiruchirappalli

Sampling atations		Total colony count CFU ml^{-1}
S1	Upper anicut	2.64×10^2
S2	Chinthamani road bridge	8.16×10^2
S3	Grand anicut	1.8×10^2

normally found to be higher and the physical and chemical parameters were also found to be higher in the Station 2. The similar trend was also reported by George (1966), Sreenivasan (1970), Mandal and Hakim (1974).

The level of DO acts as an indicator of the oxygen status of the water body. It fluctuated from 3.6 to 4.9 mg l^{-1} in the river stretch under study. Large depletion of DO is indicative of the presence of considerable amount of bio degradable organic matter in the river water. The DO values showed a general increasing trend during monsoon periods (Sarma *et al.,* 2002). The minimum level of DO 3.6 mgl^{-1} was found in S2 which received the municipal sewage and domestic waste water. The similar trend was also recorded in river Sone and Dalmianagar (Bihar) by Singh and Singh (1995). DO depletion can also be attributed to the phytoplankton respiration and sediment oxygen demand. DO is also less because of inflow from bed spring is proportionately large due to less catchments flow (Wani *et al*., 2002) BOD is measure of organic pollution. The BOD values varied from 3.47 to 4.27 mg l^{-1}. These values are within the standards limit (WHO, 1984: 5 mg l^{-1}). DO value were found to be lower than the optimal level (5 mg l^{-1}). In the present study, the mean values of COD varied between 20.67 to 41.47 mg l^{-1}. The COD values were found to be much higher than BOD values, indicating

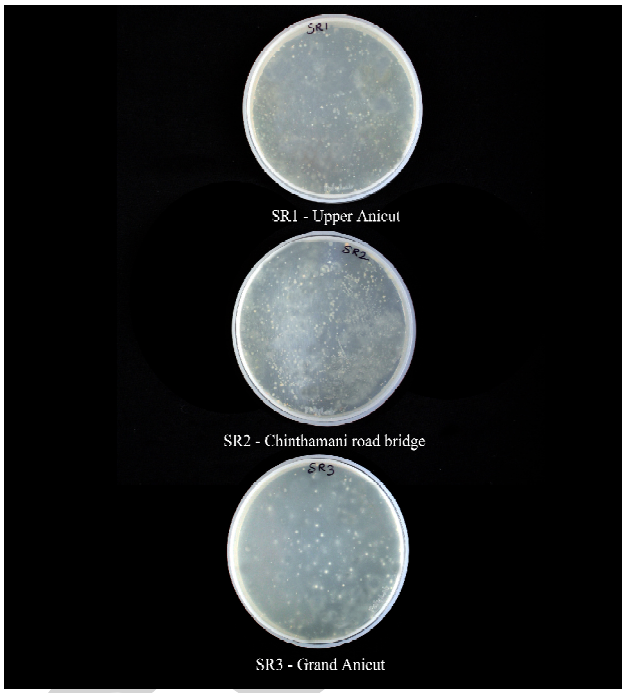

Fig. 2: Heterotrophic bacterial population in Kaveri river

considerable presence of chemically oxidizable matter, most of which were non-bio degradable.

The nitrate and phosphate is contributed from fertilizers in used agricultural fields near the river region which seeps into the ground water. This reason is comparable with several reports made in literature for contamination of ground water may be due to the seepage of agricultural chemicals, domestic sewage and animal waste. In the present study mean values of nitrite, silicate and phosphate varied between 0.18 and 0.28 mg l^{-1}, 2.57 and 3.19 mg l^{-1}, 0.33 and 0.38 mg l^{-1} respectively. The nitrite, silicate and phosphate were found to be higher in impoundment stations such as stations 1, 2 and 3. The presence of higher vegetation in the impoundment station is possible reason for higher level of nutrients. Similar findings were also found by Attab Alam (1995). They suggested that the nutrients like nitrate, salinity, phosphate and silicate were recorded more in ponds with macrophytes. The phosphorus content was higher due to the presence of microcystic bloom. The higher levels of nutrients are mainly due to the entering of agricultural drain which contains higher level nutrients.

It is necessary to provide safe drinking water and sanitation to the entire country by using cost effective tools to eliminate all water borne disease as a single problem. Health education to disseminate the knowledge and practice of hygiene is equally important to prevent the water borne disease (Dhanapaul, 2006). Table 2 and Fig. 2 provides data total heterotrophic bacterial population evaluation were carried out in river Kaveri, Tiruchirappalli. The total colony count was estimated for different sampling stations namely Upper Anicut,

Chinathamani Road Bridge and Grand Anicut. In all the stations total heterotrophic bacterial population counts were registered as S1: (2.64 x 10^2); S2: (8.16 x 10^2) and S3: (1.8 x 10^2). Generally, the total viable count (TVC) or standard plat count (SPC) is used to test the bacterial density of the water sample. The result reveals that the TVC or SPC were found to be high in S2 (8.16 x 10^2 CFU/ml^{-1}) and lowest level in S3 (1.80 x 10^2). The higher CFU count is attributed to the discharge of municipal sewage and domestic wastewater into river Kaveri at this Station (S2).

Acknowledgments

Our sincere thanks are due to Prof. K. Palanivel, Head, Dr. N. Anbusaravanan, Dr.George John, P.G. and Research Department of Zoology and Principal, Periyar E.V.R. College Tiruchirappalli for the constant encouragement in this works.

References

Attab, Alam: Physico-chemistry of four lentic freshwater bodies infested by varying dominant biota with emphasis on the impact and causes of proliferation of dominant biota. *IJEP,* **8**, 99-104 (1995).

APHA: Standard methods for the examination of waters and waste water analysis. 21th Edn., Washigton. D.C. (2005).

Bhowmic, B.N. and A.S. Singh: Effect of sewage on physico-chemical characteristics and bacterial population in river Ganga at Patna. *Ind. J. Eco.,* **12**, 141-146 (1985).

Chattopadhya, S.N. Routh Tapan, V.P., Sharma, H.C. Arora and P.K. Gupta: Pollution status of rive Ganga in Kanpur region : A short term study. *Ind. J. Environ. Hlth.,* **26**, 244-257 (1984).

Chessman, B.C. and D.P. Robinson: Some effect of the drought on water quality and macroinvertibrate fauna in the lower Latrobe river, Victoria. *Autri. J. Mar. Freshwater Res.,* **38**, 289-299 (1987).

Cruickshank, R., J.P. Duguid, B.P. Marmion and R.H.A.Swain: Medical microbiology. The practice of medical microbiology 12th Edn., Vol.2. Chrichill livingastons. Edinburg London and New York. p. 996 (1975).

Dhanapaul, S.: Water borne diseases. Proc. Nat. Con. Water and wastewater management. J.J. College of Engineering and Technology, Trichy. p. 31 (2006).

Draper, N.R. and S. Smit: Applied Regression Analysis. Wiley, New York (1996).

Duran, Mustafa and Menderes Suicmez: Utilization of both benthic macroinvertebrates and physicochemical parameters for evaluating water quality of the stream Cekerek (Tokat, Turkey). *J. Environ. Biol.,* **28**, 231-236 (2007).

Dyniel, C. and F.S. Wood: Fitting Equation of Data. 2nd Edn., New York (1980).

Gopalakrishnan, V. and E.G. Srinath: Some experimental observations on the use of activated sludge as fertilizer for fish culture. *Proc. Ind. Acad. Sci.,* **57**, 37-39 (1962).

George, M.G.: Comparative plankton ecology of five fish tanks in Delhi. *India Hydrobioligia,* **27**, 81-108 (1966).

Gill, S.K., S.K. Sahota, G.P.S. Sahota and H.S. Sahota: Pytoplankon and physico-chemical parameters. Examination river sutledge. *IJEP*, **18**, 171-175 (1993).

Jakhar, G.P., J. Dey, S.D. Mishra and S.C. Bhargave: Dinural variation in physico-chemical factors and zooplankton pollution in Balsam and lake Jodhpur. *Geobios*, **8**, 92-97 (1981).

Kakati, G.N. and K.G. Bhattacharya: Bacteriological quality of drinking water in rural India. *Ind. J. Environ. Hlth.*, **32**, 276-279 (1990).

Krishnan, R.R., K. Dharmaraj and B.D. Ranjitha Kumari: A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. *J. Environ. Biol.,* **28**, 105-108 (2007).

Mandal, B.K., A. Hakim, S.P. Roy. and J.S. Munshi J.S. Datta: Aquatic insect fauna of Bhagalpur. *Ind. J. Zoology,* **15**, 111-119 (1974).

Muchmore, C.B. and B. Dziegielewski: Impact of drough on quality of potential water supply sources in the Sangamon river basin. *Water Resourc. Bull.,* **19**, 37-46 (1983).

Muduli, S.D., G.D. Swain, N.K. Bhuyan and N.K. Dhal: Physico-chemical characteristic assessment of Brahmani river Orrisa, India. *Pollut. Res.,* **25**, 763-766 (2006).

Radha Krishnan, R., K. Dharmaraj and B.D. Ranjitha Kumari: Effect of heavy metals (Hg and Zn) on the growth and phosphate solubilising activity in halophilic phosphobacteria isolated from Manakudi mangrove. *J. Environ. Biol.,* **28**, 105-108 (2007).

Ravichandran, C., A. Moses, K. Girija and P. Paul Sharma Chakravarthy: Drinking water quality assessment in few selected pilgrim centres and tourist spots in Tamil Nadu. *IJEP,* **22**, 129-136 (2002).

Sachidanandamurthy, K.L. and H.N. Yajurvedi: A study on physicochemical parameters of an aquaculture body in Mysore city, Karnataka, India. *J. Environ. Biol.,* **27**, 615-622 (2006).

Sarma, C., Deka, D.K. and K.G. Bhattacharyya: Quality of water in a few urban drinking water sources. *IJEP,* **22**, 173-183 (2002).

Scanaad, L.J. and B.A. Hess: The impact of the soil and fertilizer phosphorous on the environment. *J. Mech. Chem.*, **20**, 619 (1977).

Shaw, B.P., A. Sahu and A.K. Panigrahi: Water quality of the Rushikulya river estuary in relation to waste water discharge from a chlor-aikali plant. *Pollut. Res.*, **10**, 139-149 (1991).

Singh, R.K. and S.P. Singh: Physico-chemical conditions of the River Sone at Dalmilanagar (Bihar). *J. Freshwater Biol.*, **7**, 93-98 (1995).

Sinha, D.K.: Statistical analysis of physical chemical parameters of the water of river Sai at Rae Bareli. *IJEP,* **22**, 184-187 (2002).

Sivakumar, R., R. Mohanraj and P.A. Azeez: Physico-chemical analysis of some community ponds of Rourkela. *Pollut. Res.*, **19**, 143-146 (2000).

Smitha, P.G., K. Byrappa and S.N. Ramaswamy: Physico-chemical characteristics of water samples of Bantwal Taluk, south-western Karnataka, India. *J. Environ. Biol.,* **28**, 591-595 (2007).

Sreenivasan, A.: Limnology of Tropical Impoundments. A comparative study of major reservoirs in Madras state. *Hydrobiological,* **30**, 443-469 (1970).

Srinivasan, A.V., K. Sampath, M. Paramasivam and R. Ananthanarayanan: Pollutio of river Cauvery from industrial and urban waste. Proc. Symp. Environ. Biol., Trivandrum. pp. 179-190 (1980).

Trivedy, R.K. and P.K. Goel: Chemical and biological methods for water pollution studies. Environmental Publications, Karad (1986).

Tiwana, A.J.: Water resource management quality and quality aspects. Proc. Int. Con. Rural works and sanitation in developing countries, IWWA, Nagpur, India. pp. 6-17 (1992).

Unnai, K.S.: Limnology of sewage polluted pond in central India. *Int. Revue. Ges. Hydr. Berlin.*, **69**, 553-566 (1984).

Wani, M.M., Renu Bhargava, A. Gairola and M.R.D. Kundangar: Status of water quality in dal lake. *IJEP,* **22**, 121-128 (2002).

WHO: Guidelines for drinking water quality recommendations. World Heath Organization, 1, 1-130 (1984).