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PHYSICO-CHEMICAL PARAMETERS OF ITHIKKARA RIVER, KERALA, INDIA

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ABSTRACT

Ithikkara river was comparatively unpolluted rivers of the Kerala State, without any major industry in its bank. The present study was carried out to evaluate the water quality scenario of the Ithikkara river. Seasonal and annual average values of surface and bottom water temperature, pH, dissolved oxygen, free carbon dioxide, salinity, nitrate, nitrite, phosphate and silicate, and averages of transparency and velocity of flow were observed from six different stations are presented in this paper. Observations revealed that physico-chemical characteristics were almost at the optimum level..

INTRODUCTION

The Ithikkara river system after its origin from Madathurikunnu, which lies at a height of 240m above msl (Lat 8053?; long 7701?), traverses 56km and finally drains into Paravur lake. It is a comparatively unpolluted river of the state without any major industry in its bank. The cottage industries like pottery and several bricks manufacturing units are located at the bank of the river. In its course, it receives a variety of domestic wastes and domestic waste water and agricultural effluents. This river water is used for drinking bathing and fisheries.

Physico-chemical aspects of the Ithikkara river have been investigated to assess the quality of water. The variations of the physico-chemical properties of the water samples directly influence the biotic communities and primary productivity of the water bodies at different stations. This paper aims at elucidating the water quality of Ithikkara river. The fishery recourse of the water bodies are supported mainly by the primary and secondary producers which in turn are influenced by various physico-chemical parameters of the environment.

MATERIALS AND METHODS

The water samples were collected from the six sampling stations (station I – 4km from source, station II –15km from source, station III– 26km from source, station IV – 46 km from source, station V– 52 km from source and station VI – 56 km from source) once in a month and analysed physico–chemical parameters for a period from December 1995 to November 1996. The samples were analysed as per standard methods of APHA (1985); Golterman *et al*. (1978); Trivedy & Goel (1984). The temperature, transparency and velocity of flow of water were recorded in the field.

RESULTS AND DISCUSSION

Based on the data of annual rainfall during the study period (1995- 96), the year can be divided into two period, each of six months duration - the dry season (December - May) and the wet season (June – November). The period, December to May representing dry season received 346 mm rain fall and, in wet season received 2246.9mm rainfall. The data of annual averages and seasonal averages of velocity of flow,

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water temperature, pH, transparency, dissolved oxygen, free carbon dioxide, salinity and nutrients of Ithikkara river are presented in the Table 1.

The surface and bottom water temperature generally showed no marked variation between the two layers. The analysis of the data of water temperature did not showed much variation between the stations and seasons. Similar observations were made by Rao *et al*. (1990) ; Nair (1986

During the present study it was observed that the light penetration was lowest during the wet season and highest during the dry season at all the six stations. Station I and II were very shallow regions and the river bottom was clearly visible. The increased flow rate of the river during the rainy days also contribute to the turbidity of the river water, which reduces transparency. The low transparency value during the wet season was connected with the leaching of silt and clay into the river system along with flood during rainy days. Observations of annual average values of transparency revealed that, it was low in station IV (0.55meter) may be due to intensive sand mining.

Seasonal averages of velocity of flow revealed that it was high in wet season and low in dry season in all stations. Observations of annual average of the velocity of flow at different stations showed that the flow rate was high in station II (0.51 m/sec) and it was low in station VI (0.11 m/sec), where the river joins the backwater system. This is due to the gradual decrease in the gradient from station I which is situated at the origin of the river to station VI where the Ithikkara river opens into the Paravur lake. Velocity of flow mainly depends on rain, surface gradient roughness of streambed and depth and width of the streambed.

The hydrogen ion concentration of the water changed with the changes in the climatological and biological factors. Annual average and seasonal average values showed that hydrogen ion concentrations were relatively moderate in all stations and did not showed much variation between stations and seasons. In station III, the hydrogen ion concentration of the bottom water was always lower than that of the surface water during the summer months (February - May). This may be due to the fact that there was decaying organic matter brings acidic conditions of water (Clark, 1954). In all stations except station III, surface and bottom water pH concentration showed no remarkable variation.

Dissolved oxygen content of the water is an important gauge of existing water quality and the ability of water body to support aquatic life. Dissolved oxygen exhibited a fluctuating pattern during the present study yet, annual averages showed that it was decreased from the head stream towards the tail stream (Nair, 1986; Varghese, 1994). In all stations, dissolved oxygen content of water was high during wet season. This may be due to the mixing up of atmospheric oxygen. The lower values of oxygen during summer months may be due to the loss of oxygen to the atmosphere at higher temperature and utilisation of oxygen for the fast decomposition of the settled organic matter.

Annual averages showed that carbon dioxide content of the water at upstream region was found be high. The surface water of upstream region is from the inflowing ground water which is filtering through the soil containing decomposing matters. This might be the reason for the high quantity of carbon dioxide in upstream region. Similar pattern of the distribution of carbon dioxide content was observed in wet season. The higher quantity of CO_2 in the water in other stations in dry season may be due to the increase the quantity of phytoplankton in these stations. According to Welch (1952) respiration of animals and plants produce and release of carbon dioxide into the water.

Observations revealed that the river system upto station IV was perfectly a freshwater system. The two lower down stream regions, that is station V and VI become more saline due to the influx of saline water from Paravur lake/backwater, which is an estuary opening into the Lakshadweep sea. Higher salinity was observed in station VI, where Ithikkara river joins to Paravur lake. Salinity was gradually increased from station IV to VI. During dry season salinity was remarkably high in station III to VI due to the influx of saline water and lower salinity in wet season may be due to the addition of rainwater. Salinity in surface and bottom water showed a fluctuating pattern.

Nitrate content of the water in all stations was high during wet season except in station I. The monsoon showers might be responsible for the increase of the nitrate content during wet season. In station I, nitrate content was high in dry season; this may be due to the decomposition of the dead organic matter. There was no remarkable variation of nitrate content between surface and bottom water. Annual variations showed that nitrate content was low at the estuarine zone.

The concentrations of nitrite in the river water of six stations were very low compared to that of other nutrients. The fluctuations in the concentrations of nitrite were almost the same in all the stations except

Table 1. Physico-chemical status of Ithikkara river during the period of 1995-96 at six stations (seasonal and annual average values are indicated)

Parameters	Sampling Stations								
	I			II			III		
	DS	WS	A	DS	WS	A	DS	WS	A
Temperature ^{0}C									
Surface water	25.4	25.6	25.5	26.1	25.8	26.0	25.4	25.7	25.5
Bottom water	---	---	---	---	---	---	24.5	25.5	25.4
Transparency (m)	---	---	---	---	---	---	0.78	0.5	0.64
Velocity of Flow(m/sec)	0.12	0.29	0.21	0.40	0.61	0.51	0.16	0.40	0.28
pH									
Surface water	5.8	6.5	6.15	6.2	6.4	6.3	5.9	6.3	6.1
Bottom water	---	---	---	---	---	---	5.8	6.2	6.0
Dissolved O_2(mg/L)									
Surface water	7.0	8.0	7.5	6.9	7.7	7.3	6.6	7.8	7.2
Bottom water	---	---	---	---	---	---	6.5	7.7	7.1
Free CO_2 (mg/L)									
Surface water	6.0	7.0	6.5	6.0	6.1	6.05	6.3	5.0	5.65
Bottom water	---	---	---	---	---	---	6.6	5.2	5.9
Salinity (0/00)									
Surface water	---	---	---	---	---	---	---	---	---
Bottom water	---	---	---	---	---	---	---	---	---
Nitrate (µg/L)									
Surface water	5.6	4.9	5.25	5.5	7.0	6.25	5.0	7.6	6.3
Bottom water	---	---	---	---	---	---	3.6	7.3	5.5
Nitrite (µg/L)									
Surface water	0.38	0.35	0.36	0.2	0.68	0.47	0.28	0.98	0.63
Bottom water	---	---	---	---	---	---	0.38	1.13	0.76
Phosphate (µg/L)									
Surface water	0.73	0.57	0.65	0.77	0.57	0.67	0.71	0.91	0.81
Bottom water	---	---	---	---	---	---	0.81	2.39	1.6
Silicate (µg/L)									
Surface water	26.02	21.6	23.81	12.3	16.02	14.07	10.53	17.58	14.06
Bottom water	---	---	---	---	---	---	10.83	15.88	13.36

Contd....

in station VI. Annual averages showed that nitrite content was high at station VI. The concentration of nitrite increased during wet season in all stations except in station I. Monsoon showers and decreased phytoplankton production, which utilised the nutrients for their growth, may be responsible for such a rise in the nitrite concentration. The slight increase of nitrite concentration during the dry season in station I might be due to the decomposition of the dead organic matter. Krishnaswarup and Singh (1979) have made similar observations. Nitrite concentration in surface water was higher than that of bottom water in station IV, V and VI, but in case of station III, nitrite concentration in bottom water was slightly higher that of surface water.

The phosphate content of water in all the stations increased during wet season except the stations I and II. Higher phosphate concentration is associated with rain and surface runoff. In station I and II phosphate content was high during dry season. This may be due to the decomposition of dead organic matter. The phosphate levels fluctuated at all the six stations. The phosphate concentration of the station VI was comparatively lower than that of other stations, this may be due to the utilization of it by phytoplankton. Phosphate content in bottom water was higher than that surface water in station III, IV and V, but in station VI, phosphate concentration in surface water was slightly higher than that of bottom water.

The concentration of silicate in the water of six stations were very high compared to that of other nutrients. The river water was relatively rich in silicate. This finding agrees more or less with the observations of Welch (1952). During wet season the concentration of silicate was high in all the stations except station I. In station I, the silicate content was

	IV			V			VI		
	DS	WS	A	DS	WS	A	DS	WS	A
Temperature ^{0}C									
Surface water	25.4	26.2	25.9	26.4	27.1	26.7	24.0	26.0	25.0
Bottom water	25.9	26.0	26.2	26.7	26.1	26.4	24.8	26.6	25.7
Transparency (m)	0.63	0.48	0.55	0.84	0.55	0.69	0.75	0.60	0.67
Velocity of Flow(m/sec)	0.13	0.31	0.22	0.14	0.17	0.15	0.07	0.15	0.11
pH									
Surface water	5.8	6.2	6.0	5.9	6.3	6.1	6.1	6.2	6.3
Bottom water	5.8	6.3	6.05	5.9	6.3	6.1	6.3	6.5	6.4
Dissolved O_2(mg/L)									
Surface water	6.4	7.6	7.0	6.2	7.4	6.8	6.6	7.4	7.0
Bottom water	6.3	7.3	6.8	6.0	7.2	6.6	6.5	7.1	6.8
Free CO_2 (mg/L)									
Surface water	5.6	5.0	5.3	6.6	5.0	5.8	6.4	5.3	5.88
Bottom water	5.4	5.0	5.2	6.0	4.4	5.2	6.4	4.6	5.5
Salinity (0/00)									
Surface water	0.34	0.07	0.21	11.0	1.2	6.12	20.05	4.84	12.44
Bottom water	0.26	0.06	0.15	10.9	1.24	6.11	21.85	6.45	14.14
Nitrate (µg/L)									
Surface water	4.2	7.8	6.0	2.3	6.2	3.8	1.85	6.1	4.0
Bottom water	5.4	7.8	6.6	2.6	5.6	4.1	1.7	6.2	4.0
Nitrite (µg/L)									
Surface water	0.32	0.62	0.44	0.26	0.47	0.73	1.37	2.32	1.34
Bottom water	0.27	0.50	0.38	0.27	0.45	0.35	0.17	2.1	1.14
Phosphate (µg/L)									
Surface water	0.61	2.18	1.4	0.67	4.5	2.6	0.50	0.69	0.6
Bottom water	1.35	2.03	1.7	0.68	6.37	4.1	0.44	0.57	0.51
Silicate (µg/L)									
Surface water	9.52	13.90	11.7	4.67	9.2	6.93	4.38	7.15	5.77
Bottom water	10.0	11.47	10.7	5.05	9.68	8.11	3.33	7.6	5.47

DS – Dry Season WS – Wet Season A – Annual average

high in dry season may be due to the increase of diatoms. A similar observation was made by Shaji (1990) in Sabarmati river. The increase of silicate content in wet season was due to the rain washing. In the case of silicate content of the water there was a gradual decrease from station I to VI (from the source of the river to its mouth), this may be associated with the decrease in the rate of flow of water from the source to the mouth of the river. Silicate concentration in surface and bottom water was in a fluctuating pattern . In short, the physico-chemical characteristics like temperature, velocity of flow, transparency, pH, dissolved oxygen, free CO_2, salinity, nitrate, nitrite, phosphate and silicate were almost at optimum level in Ithikkara river.

REFERENCES

APHA 1985. *Standard Methods for the Examination of Water and Wastewater*. 15ed., American Public Health Association, Washington. D.C.

Golterman, H.L., Clymo, R.S. and Ohstad, M.A.M. 1978. *Methods for Physical and Chemical Analysis of Freshwaters*. IBP. No, 8, Blackwell scientific publications.

Krishnaswarup and Singh, S.R. 1979. Limnological Studies of the Suraha Lake (Ballia). 1. Variation in the water quality. *J. Inland. Fish. Soc. India*. II (1) : 22-33.

Nair, N.B. 1986. River ecology in relation to man made changes in the western Ghats. Final technical report submitted to the department of environment. Government of India. New Delhi, (No. 9(6) 1/83).

Rao, S.N; Chaubey, R. and Srinivasan, K.V. 1990. Ganga water quality in Bihar. *J.Environ.Hlth.* 32(4):393-400.

Shaji, C. 1990. *Studies on algal flora and ecology of some polluted waters in Gujarat*. Ph.D.thesis.Sardar Patel University, Gujarat.

Trivedy, R.K. and Goel, P.K. 1984. *Chemical and Biological Methods for Water Pollution Studies*. Environ. Pub., Karad (India).

Varghese, J.G. 1994. *Studies on the fish assemblages in the Achenkovil river system with special reference to their niche segregation and habitat usage*. Ph.D. Thesis. M.G. University, Kerala.

Welch, P.S. 1952. *Limnology*. 2nd ed. New York – Toranto and London. Mc Graw Hill Book Co.