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Research Article

AN ANALYSIS OF PHYSICO-CHEMICAL VARIABLES OF WATER IN LOWER ANICUT, THANJAVUR DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

During the last few years, the water quality of most Indian aquatic systems have been deteriorating because of increased anthropogenic activity organisms especially phytoplankton which are the producers of aquatic systems depend directly on the physico-chemical variables of water. Hence, physico-chemical variables play an important role in the composition and diversity of aquatic organism. Hence, the present study was attempted at Lower Anicut at Anakkarai area in Thanjavur District, Tamil Nadu. Various physico-chemical variables have been analysed on a seasonal basis and the results interpreted with those of similar workers.

Keywords: Physico-chemical, Phytoplankton, Water quality, Aquatic systems.

INTRODUCTION

Though water is a renewable resource, reckless usage and improper management of water systems can cause serious problems in availability and quality of water (Raja *et al*., 2008). During the last few years, the water quality of most Indian aquatic systems including rivers have been subjected to severe anthropogenic activity leading to vast deterioration of the water quality (Krishnan *et al*., 2007; Kumara *et al*., 2010; Rajamanickam & Nagan, 2018; Sivakumar *et al*., 2000). Further, the development of phytoplankton in a river depends directly upon the physical factors of flow and turbidity. In addition, day length and temperature also seem to be important (Annalakshmi & Amsath, 2012). Many authors (Chellappa *et al*., 2008; Egge & Aksnes, 1992; Gujarathi & Kanhere, 1998) have suggested that nutrient availability also plays a significant role in algal production.

Hence, physico-chemical variables play an important role in the composition as well as diversity of an aquatic system. Hence, the present study was aimed at assessing the physico-chemical variables of Lower Anaicut of Anakkarai area in Thanjavur district, Tamil Nadu for three seasons of the year.

MATERIALS AND METHODS

The Lower Anicut is located at Anakkarai, Thanjavur District, Tamil Nadu, India (Latitude: 10.95, and the Longitude: 79.38). Water samples from Lower Anicut were collected during the three different seasons of the year (2017-18). Water samples were collected from this system in a polyproplene cans (2 liters capacity) and transported to the laboratory. pH of the water samples was measured using a digital pH meter. The various variables like Total Dissolved Solids (TDS), alkalinity, Dissolved Oxygen, BOD, COD and nutrients like NO_3-N, NO_2-N, PO_4-P, NH_3-N, Silicate, Calcium, Magnesium and Sodium were estimated by following the methods in (APHA,2005) and (Trivedy & Goel, 1984). To determine the total heterotrophic bacterial density, total coliform bacteria and total fecal coliform bacteria density, the water samples were collected in sterile plastic bags and immediately transported to the laboratory. The total bacterial count was enumerated as colony forming unit (CFU) employing the standard pour plate technique following the methods described in (APHA,2005) and (Cruickshank *et al*., 1975).

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Plate count nutrient agar medium was used for enumeration purposes. The agar was autoclaved prior to use. After 24 hours of incubation, colony counts were made using a colony counter and expressed as cfu/ml^{-1}.

RESULTS AND DISCUSSION

The various physico-chemical variables analysed in the system are presented in Table 2. As evident from the table, the surface water temperature was found to range from 26 to 33°C for the three seasons showing an annual variation of 7°C. The minimum was noticed in the rainy season (August-November) and the maximum in the summer season (May-July).Water temperature plays a major role in the biology and distribution of organisms. According to Jhingran, (1991), fishes especially carps thrive well in temperature range of 18.3 - 37.3°C. pH on the other hand was found to vary from 7.8 to 8.4 with an overall range of 0.6 units. Again, the minimum was noticed during the rainy season and the maximum during the summer season. The high pH levels noticed during the summer season can be attributed to high photosynthetic activity resulting in increased production of CO_2 shifting the equilibrium towards the alkaline side as opined by Saxena & Saksena, (2012).

Table 1. Seasonal variationof physio-chemical variables of water at Lower Anicut.

S. No.	Parameters	Unit	Rainy Season (Aug-Nov)	Pre-Summer (Dec-Mar)	Summer Season (Apr-Jul)
1.	Atmospheric Temperature	°C	29 ± 0.72	31 ± 0.54	38 ± 0.32
2.	Water Temperature	°C	26 ± 0.64	28 ± 0.54	33 ± 0.24
3.	pH	piːˈeɪtʃ	7.8 ± 0.42	8.0 ± 0.78	8.4 ± 0.52
3.	Transparency	cm	12 ± 0.56	35.0 ± 0.98	46 ± 0.92
4.	Dissolved Oxygen	mg/l	7.8 ± 1.6	6.6 ± 0.88	5.4 ± 0.46
5.	Free CO_2	mg/l	0.5 ± 1.2	0.65 ± 0.80	0.82 ± 0.92
6.	Total Alkalinity (MOA)	mg/l	14.0 ± 2.6	160 ± 0.42	210 ± 0.56
7.	Total Dissolved Solids (TDS)	mg/l	196 ± 1.6	230 ± 0.56	270 ± 0.32

Table 2. Seasonal variation of nutrient and bacterial load of water at Lower Anicut.

S. No.	Parameters	Unit	Rainy Season (Aug-Nov)	Pre- Summer (Dec-Mar)	Summer Season (Apr-Jul)
1.	Phosphate (PO_4-P)	mg/l	1.76 ± 4.0	1.20 ± 0.32	1.4 ± 0.64
2.	Silicate (SiO_2-Si)	mg/l	6.8 ± 0.64	4.7 ± 0.35	5.6 ± 0.52
3.	Nitrate-N (NO_3-N)	mg/l	2.8 ± 0.72	2.0 ± 0.38	1.8 ± 0.56
4.	Nitrite-N (NO_3-N)	mg/l	0.42 ± 0.79	0.76 ± 0.42	0.94 ± 0.52
5.	Ammonia-N (NH_3-N)	mg/l	0.48 ± 0.92	0.56 ± 0.72	0.67 ± 0.64
6.	Calcium (CO_3)	mg/l	82 ± 0.70	02 ± 0.94	99 ± 0.7
7.	Magnesium (Mg)	mg/l	34 ± 0.66	36 ± 0.98	38 ± 0.64
8.	Sulphate (SO_4)	mg/l	7.6 ± 0.37	8.2 ± 0.83	9.8 ± 0.24
9.	Chloride (Cl_2)	mg/l	140 ± 0.42	156 ± 0.80	160 ± 0.46
10.	Sodium (Na)	mg/l	180 ± 0.46	192 ± 0.72	210 ± 0.52
11.	Biological Oxgen Demand	mg/l	7.2 ± 0.34	8.4 ± 0.46	9.4 ± 0.56
12.	Chemical Oxygen Demand	mg/l	47.8 ± 0.56	49.4 ± 0.94	52 ± 0.62
13.	Total Bacterial Density	/100 ml	8.6×10^3±0.62	7.4×10^3±0.52	8.1×10^5±0.84
14.	Total Coliforms Count	/100 ml	280 ± 0.53	142.3 ± 0.64	167.7 ± 0.26
15.	Fecal Streptococci	/100 ml	185 ± 0.42	96.4 ± 0.62	103.0 ± 0.80

Dissolved oxygen in the system was found to vary from 5.4 (Summer) to 7.8 mg/l (rainy season) with an overall range of 2.4 mg/l. On the other hand, free CO_2 was found to range from 0.5 (rainy season) to 0.82 mg/l (summer season) with an overall range of 0.32 mg/l. Thus, there was an inverse relationship between them. Hutchinson, (1957) also reported higher DO in winter/rainy season and lowest amount in summer season. He attributed this to the ability of water to hold more dissolved gases in low temperature. The lower DO content noticed in summer could be due to the result of increased decomposition as suggested by

Wetzel, (1983). The higher levels of free CO_2 noticed during the summer season could be due to increased decomposition of organic matter and low precipitation of free CO_2 as carbonates (Mugilan, 2014).

The methyl orange alkalinity of the system was found to range between 14 (rainy season) and 21 mg/l (Summer season) with an overall range of 7 mg/ml. Literature reveals that water in tropical plains with low rainfall during summer have high alkalinity values (Sankar Rao, 2013; Sivakami *et al*., 2011; Young *et al*., 1972; Mugilan, 2014) Further, the high alkalinity levels noticed in summer may be due to increased rate of organic decomposition during which free CO_2 is liberated which reacts with water to form bicarbonates resulting in increased alkalinity (Trivedy & Goel, 1984).

The total dissolved solids were found to vary from 196 to 270 mg/l with the minimal levels noticed in rainy and the maximum levels in the summer season. According to (Santharam, 1979), the variation in TDS can be attributed to the age of the system in addition to the materials being washed into the system. The various nutrients analysed in the system are presented in Table 2. The level of phosphate in the system varied between 1.2 to 176 mg/l with an overall variation of 0.56 mg/l. The minimal levels were recorded in the rainy season. The same trend appeared to be true for silicate levels also. The effect of rainfall increasing the nutrient content has been recorded by a number of workers (Garg *et al*., 2009; Mugilan, 2014; Sankar Rao, 2013; Santharam, 1979).

A comparison of other nutrients like NO_2-N, SO_4, Ca, Mg, Cl and Na reveals that the minimum levels were recorded in the rainy season and the maximum levels in the summer season. While the minimum levels of these nutrients noticed during the rainy seasons could be attributed to the increased water level bringing about dilution of the nutrients, the maximum level noticed in the summer season could be attributed to their utilization in addition to decrease in water level leading to increase in the concentration of these nutrients. On the other hand, NO_3-N and NH_3-N recorded minimal levels in summer season and maximum levels in the rainy season. The maximum levels noticed in rainy season can be attributed to their autochthonous entry brought about by runoff water, in addition to entry of fertilizers from the nearby fields. Similar results have been reported by Kastooribai, (1991), Rajalakshmi, (1984), Reid, (1961) and Mugilan, (2014).

The BOD levels in the system was found to range between 7.2 to 9.4 mg/l with an overall variation of 2.2 mg/l while the COD levels ranged between 47.8 to 52 mg/l with a variation of 4.2 mg/l, while both BOD and COD recorded minimal levels in the rainy season, the maximum was recorded during the summer season. The high levels of BOD noticed during the summer season clearly suggest increased decomposition which resulted in a decrease of oxygen. In conjunction with the BOD test, the COD test is useful in indicating the toxic condition and presence of biologically resistant organic substances (Prabhahar, 2012; Sarma & Elias Gutierrez, 1999; Sivakami *et al*., 2011). The total bacterial density (TBD) was found to range between 7.4×10^{-3} (pre-summer season) to 8.6×10^{-3}cfu/ml^{-1} (rainy season). The maximum TBD noticed during the rainy season can be attributed to the inflow of surface run off entering the system bringing along with it enough nutrients required for the growth of the organisms while the minimum noticed during the pre-summer season may be due to lower water temperature and inadequate nutrients (Kumar & Saha, 2009; Shimna, 2012).

CONCLUSION

The total coliform count varied 142.3 to 280 cfu/ml^{-1}and fecal streptococci from 96.4 to 185 cfu/ml^{-1}. Both these variables recorded minimal levels in the pre-summer season and the maximal levels in the rainy season. The maximum levels noticed in the rainy season can be attributed to the influx of water entering the system enriching it with nutrients. (Shimna, 2012) and (Sankar Rao, 2013)while studying two fresh water systems in Tamil Nadu also reported maximal occurrence during the rainy season.

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