



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

P. Balasubramanian¹ and R. Sivakami^{2*}

¹PG & Research Department of Zoology, Government Arts College (Autonomous), Kumbakonam-612002, India.

²PG & Research Department of Zoology, Arignar Anna Govt. Arts College, Musiri-621211, Tamil Nadu, India.

Article History: Received 25th April 2018; Accepted 24th May 2018; Published 31st May 2018

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 polypropylene 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 NO₃-N, NO₂-N, PO₄-P, NH₃-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).

*Corresponding Author: R. Sivakami², PG and Research Department of Zoology, Arignar Anna Govt. Arts College, Musiri -621211, Tamil Nadu, India. Email: drsiva17@gmail.com

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 CO₂ shifting the equilibrium towards the alkaline side as opined by Saxena & Saksena, (2012).

Table 1. Seasonal variation of 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	pi:'etf]	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 Oxygen 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 CO₂ 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 CO₂ noticed during the summer season could be due to increased decomposition of organic matter and low precipitation of free CO₂ 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 CO₂ 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 NO₂-N, SO₄, 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, NO₃-N and NH₃-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 Kastoorigai, (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 (Prabhakar, 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.

ACKNOWLEDGMENT

The authors express sincere thanks to the PG and Research Department of Zoology, Government Arts College (Autonomous), Kumbakonam and PG and Research Department of Zoology, Arignar Anna Govt. Arts College, Musiri, Tamil Nadu, India for the facilities provided to carry out this research work.

REFERENCES

- Annalakshmi, G., & Amsath, A. (2012). Studies on the hydrobiology of river Cauvery and its tributaries arasalar from Kumbakonam region (Tamilnadu, India) with reference to phytoplankton. *International Journal of Plant, Animal and Environmental Sciences*, 2(2), 37-46.
- APHA. 2005. *Standard Methods for the Examination of Water and Wastewater*. 21st ed. American Public Health Association, Washington DC, 1-1220.
- Chellappa, N., Borba, J., & Rocha, O. (2008). Phytoplankton community and physical-chemical characteristics of water in the public reservoir of Cruzeta, RN, Brazil. *Brazilian Journal of Biology*, 68(3), 477-494.
- Cruickshank, R., Duguid, J., Marmion, B., & Swain, R. (1975). *Medical Microbiology, the Practice of Medical Microbiology*. vol 2 Churchill Livingstone. London and New York, 2,1-256.
- Egge, J., & Aksnes, D. (1992). Silicate as regulating nutrient in phytoplankton competition. *Marine Ecology Progress Series*, 281-289.

- Garg, R., Rao, R., & Saksena, D. (2009). Water quality and conservation management of Ramsagar reservoir, Datia, Madhya Pradesh. *Journal of Environmental Biology*, 5, 909-916.
- Gujarathi, A., & Kanhere, R. (1998). Seasonal dynamics of phytoplankton population in relation to abiotic factors of a fresh water pond at Barwani (MP). *Pollution Research*, 17, 133-136.
- Hutchinson, G. (1957). A treatise on limnology, Vol 1. Geography, physics and chemistry John Wiley and Sons. Inc, New York. *The Journal of Geology*, 66 (6), 10-710.
- Jhingran, V. (1991). Culture of air-breathing fishes and non-air-breathing predatory carnivorous fishes. Fish and Fisheries of India, 3rd edn. Hindustan Publishing Corporation, Delhi, India, 498-503.
- Kastooribai, R. (1991). A comparative study of two tropical lentic systems in the context of aquaculture. Ph. D. Thesis, University of Madras, India.
- Krishnan, R. R., Dharmaraj, K., & Kumari, B. R. (2007). A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. *Journal of Environmental Biology*, 28(1), 105-108.
- Kumar, S., & Saha, L. (2009). Incidence of indicator bacteria in different drinking water sources. *Assessment of water pollution (Ed. SR Mishra)*. APH Publishing Corporation, New Delhi, 1-386.
- Kumara, B. H., Srikantaswamy, S., & Raghunath, T. (2010). Seasonal water quality status in Tungbhadra river around TB dam, Karnataka, India. *Asian Journal of Environmental Science*, 5(2), 99-106.
- Mugilan, V. (2014). Biodiversity of microorganisms in two different fresh water ecosystems and their role in environmental pollution abatement. Ph. D. Thesis, Bharathidasan University, Tiruchirappalli, India.
- Prabhakar, C. (2012). Seasonal Variation in Physico-Chemical Parameters of Palar River in and Around Vaniyambadi Segment, Vellore District, Tamil Nadu, India. *International Journal of Pharmaceutical and Biological Archive*, 3(1), 99-104.
- Raja, P., Amarnath, A. M., Elangovan, R., & Palanivel, M. (2008). Evaluation of physical and chemical parameters of river Kaveri, Tiruchirappalli, Tamil Nadu, India. *Journal of Environmental Biology*, 29(5), 765-768.
- Rajalakshmi, R. (1984). A study of the social, economic and political aspects of the growth of higher education of women in the Madras presidency, 1-447.
- Rajamanickam, R., & Nagan, S. (2018). Assessment of Comprehensive Environmental Pollution Index of Kurichi Industrial Cluster, Coimbatore District, Tamil Nadu, India—a Case Study. *Journal of Ecological Engineering*, 19(1), 191-199.
- Reid, G. K. (1961). Ecology of inland waters and estuaries. Reinhold Publishing, New York, 1-396.
- Sankar Rao, M. (2013). A study on seasonal variations of microorganisms in temple ponds and its role in antimicrobial activity. Ph. D. Thesis, Bharathidasan University, Tiruchirappalli.
- Santharam, K. (1979). *Biology of Daphnia carinata King (Cladocera: Daphnidae)*. PhD Thesis, Madurai Kamaraj University, India.
- Sarma, S., & Elías-Gutiérrez, M. (1999). Rotifers (Rotifera) from four natural water bodies of Central Mexico. *Limnologia-Ecology and Management of Inland Waters*, 29(4), 475-483.
- Saxena, M., & Saksena, D. (2012). Water quality and trophic status of Raipur reservoir in Gwalior, Madhya Pradesh. *Journal of Natural Sciences Research*, 2(8), 82-96.
- Shimna, P. (2012). *Microbial diversity and abundance of ponds of subtropical India*. Ph. D. Thesis, Bharathidasan University, Tiruchirappalli, India.
- Sivakami, R., Sankarrao, M., Shimna, P., & Premkishore, G. (2011). Rotifer population in two freshwater bodies with varied water sources in Tiruchirappalli, Tamil Nadu. *Journal of Current Science*, 16(1), 207-210.
- Sivakumar, B., Berndtsson, R., Olsson, J., Jinno, K., & Kawamura, A. (2000). Dynamics of monthly rainfall-runoff process at the Gota basin: A search for chaos. *Hydrology and Earth System Sciences Discussions*, 4(3), 407-417.
- Trivedy, R., & Goel, P. (1984). Chemical and biological methods for water pollution studies. Environmental publication (Karad, India), 6, 10-12.
- Wetzel, R. (1983). Limnology An Overview. Saunders College Publishing New York, 1-860.
- Young, W. C., Hannan, H. H., & Tatum, J. W. (1972). The physicochemical limnology of a stretch of the Guadalupe River, Texas, with five main-stream impoundments. *Hydrobiologia*, 40(3), 297-319.