Full Length Research Article

MONTHLY VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS IN UPPANAR ESTUARY WATER SAMPLES, CUDDALORE DISTRICT, SOUTH EAST COAST OF TAMIL NADU, INDIA

*Kumaresan, T.

Department of Zoology, Annamalai University, Tamil Nadu, India

Water quality status of Uppanar estuary was studied using various physico-chemical characteristics of one year (January 2016 to December 2016). Results indicate variation in the water temperature between 23.62°C to 31.05°C. Transparency ranged between 35.75 to 53.02 cm. pH value ranged between 7.72 to 8.42. Salinity varied between 17.27 to 26.27 ppt. The value of dissolved oxygen varied from 4.24 to 6.23 mg/L. The Calcium level fluctuated between 123.15 to 244.45 mg/L. Values of nitrate varied from 0.40 to 0.59 mg/L, while, values of ammonia ranged between 0.04 to 0.17 mg/L. respectively. In the present observation, eight various physico-chemical parameters of Uppanar esturine water samples were studied during the study period of January 2016 to December 2016.

Key words: Physico-chemical parameters, Monthly variations, Maximum and minimum, Water quality.

INTRODUCTION

The estuarine environment is a complex blend of continuously changing habitats. Unlike fresh water bodies like lakes and rivers, estuaries can produce a wide range in the values of physical and chemical parameters that will be recorded and frequent changes occur in these values both with tidal and meteorological events. In streams, rivers and lakes, water quality parameters are more likely to fluctuate within a well-defined range largely determined by rainfall and season and these values are often homogeneous throughout the water body (Bouillon *et al*., 2001). In an estuary, in contrast these parameters can change abruptly in time and space are dependent on the study locations (sampling sites) and may or may not reflect general conditions throughout the estuary. Two key phenomena that control physical and chemical parameters are tidal oscillation and stratification (vertical and horizontal) (Meenakshi chatterjee *et al.,* 2013) tidal oscillations are the net transport for water (as well as sediments and contaminants) out of an estuary with tidal flow and river flow. Stratification is layering of the estuary generally associated with the inflow of dense salt water at depth and the outflow of more buoyant fresh water at the surface. Layering can also occur when seasonal heating causes a sharp differential or thermocline (interface where temperature change rapidly with depth) so that the warm surface layer is isolated from the cold bottom layer. Estuaries act as natural laboratories studying the dynamics of physical and chemical parameters. Rivers carry into estuaries a variety of nutrients that are necessary for the growth of aquatic plants that in support aquatic animals such as finfishes and shellfishes. The nutrients most essential to plant productivity nitrogen, phosphorus and silica are called to the estuary by fresh water inflows.

Freshwater inflows also contribute to the productivity of estuaries by bringing dissolved gases and food (detritus) to sessile animals namely mussels, clams and gastropods, which have developed fielder feeding mechanism to trap nutrients and gases for their energy metabolism (Montagna *et al*., 2002) hydrographic feature like temperature, salinity, dissolved oxygen, pH and transparency constitute the important environmental requisites which govern the distribution and abundance of flora and fauna in estuaries (Rajashree Gouda and Parugrahy, 1993; Nedumaran and Perumal, 2012). Estuaries as transition areas between land and sea form aquatic ecosystems that are characterized by a variety of inter-related biotic and abiotic structural components and intensive chemical, physical and biological processes. On a global scale, estuaries form rather narrow belts (from hundreds of meters to hundreds of kilometers) where river and sea waters mix, often called ''marginal filters'' (Lisitzin, 1999). Biological processes such as primary production and decomposition can modify the physico – chemical conditions which the biological inter – relationship such as reproduction, recruitment and predator – prey cycles can modify the community structure. The latter in turn can have further consequences for the modification of physico–chemical characteristics of estuaries (De Jonge *et al*., 2002).

Water is one of the most valuable natural resources on earth, and is essential for every living organism. Human history is tied directly or indirectly to fresh water source such as lakes, rivers and estuaries. Human beings as well as other terrestrial and adequate life forms are sensitive to changes in the quality of the fresh water supply. Changes in properties such as total dissolved solid, pH and dissolved oxygen in particular affect the mortality of aquatic life. The characteristics of both natural weathering process and anthropogenic activities can have a significant impact on water quality.

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*Corresponding author: **Kumaresan, T.**
Department of Zoology, Annamalai University, Tamil Nadu, India

Table 1. Physico-chemical parameters of Uppanar estuary water samples (January 2016 to December 2016)

Month and Year	Temp. (°C)	Turbidity (cm)	pH	Salinity (ppt)	DO (mg/L)	Calcium (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)
Jan-16	26.62 ± 0.37	39.39 ± 0.37	7.72 ±0.09	19.36 ± 0.35	5.48 ± 0.33	136.16 ± 2.42	0.45 ± 0.27	0.11 ± 0.01
Feb-16	27.6 ± 0.13	41.49 ± 0.27	8.05 ±0.13	20.51 ± 0.23	5.12 ± 0.13	148.75 ± 0.49	0.47 ± 0.17	0.12 ± 0.01
Mar-16	28.57 ± 1.31	43.97 ± 0.89	8.15 ±0.13	21.17 ± 0.75	4.83 ± 0.11	193.17 ± 2.77	0.48 ± 0.08	0.13 ± 0.008
Apr-16	29.07 ± 0.79	44.15 ± 0.75	8.31 ±0.11	22.67 ± 1.12	4.51 ± 0.13	215.95 ± 2.74	0.51 ± 0.09	0.16 ± 0.008
May-16	31.05 ± 0.48	46.27 ± 0.61	8.42 ±0.09	23.57 ± 0.54	4.35 ± 0.17	234.9 ± 1.33	0.58 ± 0.07	0.14 ± 0.01
Jun-16	28.57 ± 1.31	48.7 ± 0.65	8.32 ±0.12	22.26 ± 0.76	4.24 ± 0.23	244.45 ± 0.96	0.56 ± 0.07	0.15 ± 0.005
Jul-16	26.57 ± 1.31	53.02 ± 1.25	8.05 ±0.13	23.40 ± 1.41	4.46 ± 0.10	223.42 ± 1.08	0.59 ± 0.07	0.17 ± 0.01
Aug-16	29.95 ± 0.82	52.2 ± 0.91	8.2 ± 0.08	26.27 ± 0.59	4.61 ± 0.07	131.25 ± 0.96	0.53 ± 0.11	0.06 ± 0.008
Sep-16	27.71 ± 1.62	40.25 ± 1.26	8.22 ±0.09	23.45 ± 1.26	4.53 ± 0.08	126.87 ± 1.31	0.50 ± 0.10	0.05 ± 0.005
Oct-16	29.92 ± 0.38	44.12 ± 0.85	7.87 ±0.12	22.52 ± 1.04	5.03 ± 0.13	129.62 ± 1.11	0.48 ± 0.08	0.04 ± 0.009
Nov-16	25.62 ± 2.62	41.87 ± 1.31	8.15 ±0.19	20.32 ± 0.80	6.23 ± 0.14	135.12 ± 1.03	0.45 ± 0.09	0.07 ± 0.02
Dec-16	23.62 ± 3.35	35.75 ± 1.21	7.62 ±0.19	17.27 ± 0.76	5.19 ± 0.16	123.15 ± 0.87	0.40 ± 0.08	0.10 ± 0.009

Each value is the mean ± S.D. of four observations

Rain fall tends to dissolve and carry away minerals and contaminants found in the soil and the atmosphere (Lawrence, 2010). In the present observation attempts to provide such vital information for future references. All the physico-chemical parameters were studied from Uppanar estuary water samples, Cuddalore District south east coast of Tamil Nadu, India for a period of January 2016 to December 2016.

MATERIALS AND METHODS

Water samples were collected from Poompuhar marine water samples, south east coast of Tamil Nadu, India, which is located at latitude 11.15º 05´ North South and longitude 79 .84º 5´ East West on Southern part of India. 2 litre capacity of plastic cans for physico-chemical samples were used to collect surface water samples and kept immediately in an ice box and transported to the laboratory. The samples were analyzed every month during January 2016 to December 2016. The various physico-chemical parameters were analyzed by using standard methods (APHA, 1998).

Temperature: In the present study water temperature of the pond water recorded by using Mercury field celcious thermometer.

pH: The pH was determined by using Elico, model LI. 120 Digital pH meter.

**Turbidity:** It can be determined by using turbidity meter.

Dissolved oxygen: The Dissolved oxygen was determined by the modified Winkler's method (1888).

Salinity: The salinity content was determined by Mohr's titration method. The other parameters like, calcium estimated by EDTA Titrimetric method, The nitrate were determined by the Brucine method and ammonia was determined by the Nesslerization method (APHA, 1998).

RESULTS

In the present study, physico–chemical parameters of Uppanar estuary Cuddalore District, south east coast of Tamil Nadu, India. In this area was located at Cuddalore during the study period from January 2016 to December 2016. The water temperature fluctuated from 31.05 to 23.62ºC in Uppanar estuary.

It was found to be low (23.623ºC) in the month of December 2016 and high (31.05ºC) in May 2016 (Table 1 & Fig. 1). Turbidity of the estuarine water depends on availability of either zooplankton or phytoplankton and suspended soiled particles. The transparency of the estuary varied from 35.75 to 53.02 cm. It was found to be low (35.75cm) in the month of December 2016 and high (53.02 cm) in the month of July 2016 (Table 1 & Fig. 2).
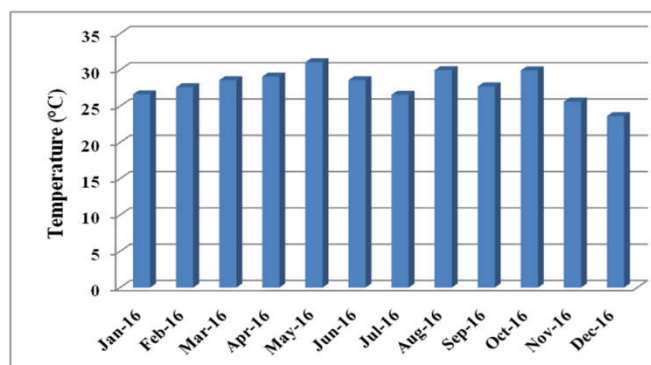
Fig. 1. Monthly variations of temperature (^{0}C) in the estuarine water samples
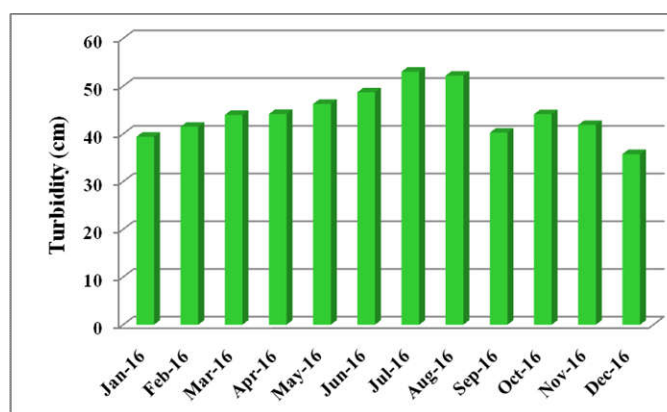
Fig. 2. Monthly variations of turbidity (cm) in the estuary water samples

pH is another important biological parameter. The pH of the estuarine water showed alkaline ranges throughout the study period. It varied from 7.72 to 8.42. It was found to be minimum (7.72) in January 2016 and maximum (8.42) in the month of May 2016 (Table 1 & Fig. 22). The salinity content ranged from 17.27 to 26.27 ppt.
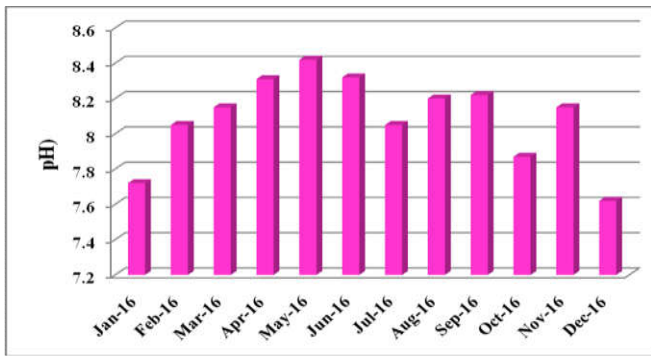
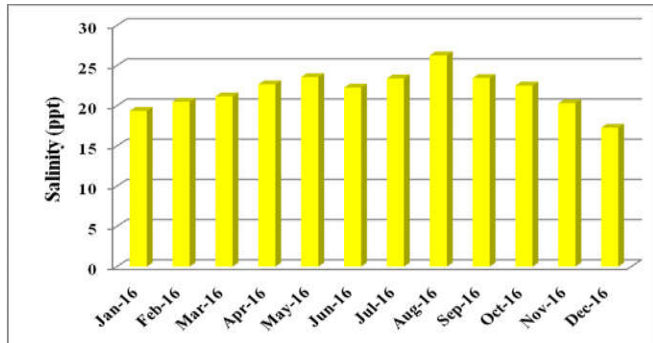**Fig. 3. Monthly variations of pH in the estuary water samples**

Fig. 4. Monthly variations of salinity (ppt) in the estuary water samples
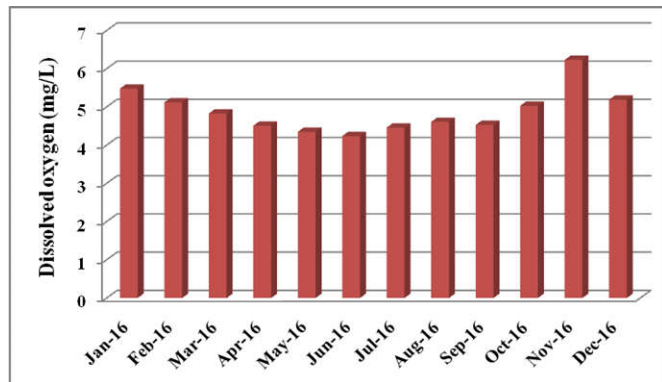

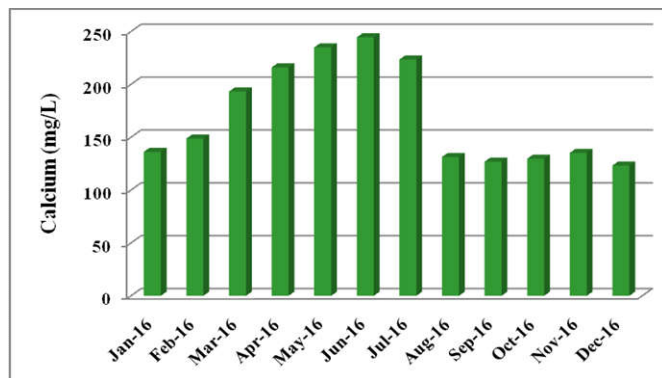**Fig. 5. Monthly variations of dissolved oxygen (mg/L) in the estuarywater samples**

Fig. 6. Monthly variations of calcium (mg/L) in the estuarine water samples

It was found to be high (26.27 ppt) in the month of August 2016 and low (17.27 ppt) was recorded in December 2016 (Table 1 & Fig. 4). The dissolved oxygen is important

biological factor. The dissolved oxygen content ranged from 4.24 to 6.23 mg/L. It was found to be low (4.24 mg/L) in June 2016 and high (6.23 mg/L) in November 2016 (Table 1 & Fig. 5). Calcium content was fluctuated from 123.15 to 244.45 mg/L. It was found to be low (123.15 mg/L) in the month of December 2016 and high (244.45 mg/L) in June 2016 (Table 1 & Fig. 6). Nitrate content in the estuary water samples fluctuated from 0.40 to 0.59 mg/L. It was found to be low (0.40 mg/L) in the month of December 2016 and high (0.59 mg/L) in July 2016 (Table 1 & Fig. 7). The ammonia content ranged from 0.04 to 0.17 mg/L. It was found to be low (0.04 mg/L) in the month of October 2016 and high (0.17 mg/L) in July 2016 (Table 1 & Fig. 8).
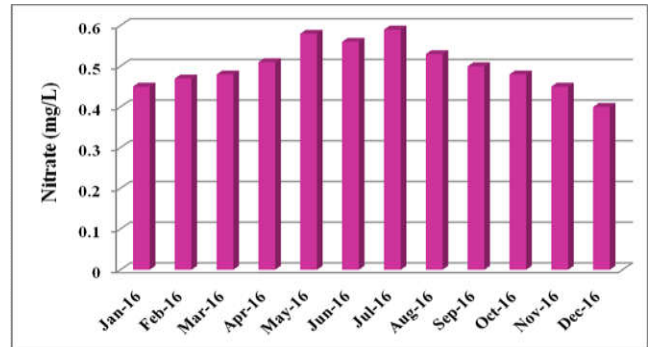

Fig.7. Monthly variations of nitrate (mg/L) in the estuarine water samples
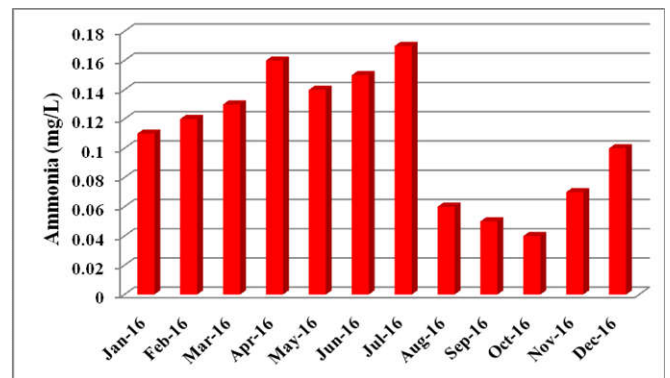

Fig. 8. Monthly variations of ammonia (mg/L) in the estuarine water samples

DISCUSSION

The surface water temperature largely depends upon the intensity of solar radiation, evaporation, freshwater influx, cooling and mixing due to currents and tidal flow. The gradual increase in water temperature is directly related to atmospheric conduction and radiation (Sundaramanickam, 2004; Ganesan, 1992). Temperature of water may not be important in pure water because of the wide range of temperatures tolerance in aquatic life, but in polluted water temperature can have profound effects on dissolved oxygen (DO) (Kesalkar *et al.,* 2012). Similarly temperature salinity was low during monsoon and high during summer season in the Agniar estuary (Sukumaran *et al*., 2013). The excessive turbidity in water causes problems with water purification processes such as flocculation and filtration, which may increase treatment cost, elevated turbid water is often associated with the possibility of microbiological contamination as high turbidity makes it

difficult to disinfect water properly (Malaviya and Rathore, 2007). Turbidity in water is caused by suspended and colloidal matter such as clay, silts, finely divided organic and inorganic matter, plankton and other microscopic organism. Thommai Arockia Gaspar and Lakshman, (2014) reported that the monsoon time the level of turbidity is very high due to the estuary received rain water along with industrial waste and manmade waste. In summer, low level of turbidity was observed it may be due to the low level of inflow of fresh water. The alkaline pH of water, having pH value of 7 to 7.9 is optimum for many aquatic organisms. pH below 5.0 and above 9.0 is lethal to fishes. Many of the chemical and biological activities in the pond and controlled by the level of pH. The maintenance of pH was promoting the growth of the aquatic organisms. The alkaline pH was also recorded throughout the year by Mali and Gajaria, (2004). The value of pH remained in the range of 7.0 - 8.5 which was considered best for all fish species (Afzal *et al.,* 2008). The present study is a similar range was obtained lowest pH value was found during winter due to heavy rainfall and dilution effect by Shiddamallayya and Pratima, (2008). Similarly pH was low during monsoon and high during summer season in the Agniar estuary (Sukumaran *et al.*, 2013).

Salinity is profoundly influences the abundance and distribution of the microorganism in the estuarine environment. Salinity is profoundly influences the abundance and distribution of the microorganism in the estuarine environment (Rault *et al.*, 2011). The salinity of water indicates the presence of ionic substances that may come from the reaction of metals and acids containing in water. A marked seasonal change in salinity was observed throughout the study period. Minimum salinity (5.6%) was recorded during monsoon and was slowly increased during post monsoon and attained maximum during summer seasons (Anand and Kumarasamy, 2013). The WHO (2004) reported that the amount of dissolve oxygen in water depends on the source, temperature, chemical and biological process taking place in the water body. However, water with high dissolved oxygen usually had greater biotic community as observed in estuarine environment. Dissolved oxygen is one of the most important parameter less amount of dissolved oxygen was recorded during the monsoon and the summer season due to increased photosynthetic activity in the water body (Shiddamallayya and Pratima, 2008). Similar observations in dissolved oxygen values have also been reported from the Vellar estuary (Ashok Prabu *et al.*, 2008). Dissolved oxygen (DO) plays an important role in aquatic environment and is essential for growth of phytoplankton and fish productivity. The inhabitant organisms are affected greatly due the diurnal and seasonal variation in the dissolved oxygen of the ambient water was reported (Kiran, 2010). As salinity increases, the amount of oxygen in water decreases (Prasannakumar *et al.*, 2010).

Calcium is considered as one of the most important parameters in the coastal environment influencing growth, reproduction and metabolic activities of living being. Distribution of nutrients is mainly based on the season, tidal conditions and freshwater flow from land source. The variation may be due to the various process line adsorptions and desorption of calcium and buffering action of sediment under varying environmental conditions (Rajasekar, 2003). Calcium play an important role in antagonizing the toxic effect of various ions

and neutralizing the excess acid produced (Das and Srivastava, 2003). The maximum calcium was observed in May and minimum value in March. Calcium reached at peak in May and then show gradual decline was reported (Muhammad Naeem *et al.,* 2011). Nitrate is an essential nutrient but at high concentration is toxic and is capable of disturbing the aquatic environment. Nitrate level less than 0.5 mg/L will not pollute the water (Ayoola and Kutan, 2009). Inorganic nitrite concentration was found to be lower than nitrate probably due to its very stable nature and it perhaps gets immediately converted to ammonia or nitrate and evaporated and its seasonal distributions was similar that of nitrate (Ravaniah *et al.*, 2010). The nitrate content was found to be low in summer and high during monsoon season in the Agniyar estuary (Sukumaran *et al.*, 2013). Ammonia maximum was observe in the monsoon and post monsoon seasons due to rainfall and the river runoff carrying large amount of detritus (Indirani *et al.*, 2010). The highest ammonia concentration was recorded during the dry season (Kaniz Fatema *et al.* 2014), a result stemming from low precipitation. However, dilution of rainwater may be important in reducing the ammonium level in the estuary. A similar pattern of results was observed by Damotharan *et al.* (2010).

Conclusion

The present observation, the various physico-chemical parameters were recorded in the Uppanar estuary water samples, Cuddalore District, south east coast of Tamil Nadu India. The data which showed that the physico-chemical properties of the marine zone were significantly varied when compared with study period. Thus, it can be concluded that the variations water quality parameters determine in the Uppanar estuary water samples, south east coast of Tamil Nadu India during the study period.

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