International Standard Serial Number (ISSN): 2249-6807

International Journal of Institutional Pharmacy and Life Sciences 3(5): September-October 2013

INTERNATIONAL JOURNAL OF INSTITUTIONAL PHARMACY AND LIFE SCIENCES

Life Sciences **Research Article……!!!**

Received: 12-02-2013; Revised; Accepted: 25-10-2013

SEASONAL VARIATIONS IN PHYSICO-CHEMICAL CHARACTERISTICS OF AGNIAR ESTUARY SOUTHEAST COAST OF INDIA

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Keywords:

Physico-chemical parameters, Nutrients, Agniar estuary

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ABSTRACT

The seasonal variations of physico-chemical parameters were studied during October 2011 to September 2012 in the Agniar estuary (Lat.10° 20' N Long.79° 23'E) Adirampattinam southeast coast of India. The rain fall ranged between 0.33 to 551.8. The atmospheric and water temperature ranged from 27.5°C to 35°C and 25°C to 31.5°C respectively. The pH ranged between 7.1 and 8.2 . The DO was ranged from 3.5 to 7.2 ml/l. Salinity fluctuated between 5.5‰ and 34‰. The nutrients such as total phosphorus, nitrate and silicate ranged from0.29 to 2.15 µg/l, 0.47 to 3.75 µg/l and 28.25 to 98.74 µg/l respectively. The DO and nutrients was found to be low in summer and high during monsoon season. Similarly temperature, pH and salinity were low during monsoon and high during summer season.

INTRODUCTION

Estuarine environmental study has accelerated during the past two decades since estuaries support a rich pelagic, benthic communities and serves as excellent nursery and feeding grounds for many commercially important fishes and shrimps (Ganapati, 1975). They also form the centres for natural seed collection of most of the commercially important fin fishes and shell fishes suitable for aquaculture (Jayabalan et al., 1980). The faunal distribution and productivity of estuary depend on various physico-chemical factors such as temperature, pH, salinity, DO and nutrients such as nitrate, phosphate and silicate. Several investigations have been carried out on the physico-chemical features of southeast Indian estuaries viz., Uppanar estuary (Nedumaran *et al*.,2011), Muthupet mangroves (Paramasivam and Kannan,2005), Pichavaram mangroves (Ashok Prabu, 2008), Vellar estuary (Rajasegar, 2003), Kaduviyar estuary (Vengadesh Perumal *et al*., 2009), Mulki estuary (Vijayakumar,2000) and Pennar estuary (Ravaniah *et al*., 2010). No paper has been published on the physico-chemical characteristics in Agniar estuary Adirampatinam. Hence the present study was conducted to study the physico-chemcial parameters of water in the Agniar estuary, southeast coast of India.

MATERIALS AND METHODS

Agniarr estuary is situated at Adirampattinam (Lat.10° 20' N Long.79° 23’E) of Bay of Bengal, southeast coast of India(Fig.1). In the present investigation, monthly samplings were made during forenoon in a plastic container from October 2011 to September 2012. The physico-chemical parameters, temperature, pH, salinity, dissolved oxygen, nutrients such as total phosphorus, nitrate, and silicate were estimated by adopting standard procedures (Strickland and Parsons, 1972).

RESULT AND DISCUSSION

Monthly variations in meteorological and physico- chemical parameters viz., rainfall, air and surface water temperature, pH, salinity, dissolved oxygen, phosphate, nitrate and silicate contents in Agniar estuarine waters were recorded for a period of one year from October 2011 to September 2012 (Table. 1 and Figs.2-9).

The physico-chemical parameters such as temperature, pH, salinity, dissolved oxygen and nutrients showed seasonal variations. The seasonal variations of the environmental features in the estuarine system is chiefly controlled by the spectacular regime of the rainfall during monsoon.

The north east monsoon in Tamilnadu brings very heavy rain during October, November and December months. The pattern of rainfall facilitates the divisions of the year into post monsoon (January – March), summer (April – June), Pre monsoon (July – September) and monsoon (October – December).

Temperature is an universal factor in the aquatic ecosystem, which influence the physico-chemical characteristics and also influence the life of organisms. The highest value of surface water temperature was recorded in summer season and lowest in monsoon periods. During the study period air temperature varied from 28.8 to 35°C. The minimum was recorded during monsoon season (December, 2011) and maximum during the summer season (May 2012) (Table.1 and Fig.2).The atmospheric temperature showed a positive correlation with water temperature (r= 0.7617) of Agniar estuary. The surface water temperature ranged from 25°C to 31.5°C. The minimum surface water temperature (25°C) was recorded during monsoon season (November, 2011) and maximum (31.5°C) was recorded during the summer season (May, 2012). (Table.1 and Fig.3). Water temperature of the Agniar estuary showed a positive correlation with salinity (r=0.7140) and pH (r=0.7918) and a negative correlation with dissolved oxygen (r=-0.7207). (Table.2).

The seasonal variations in the water temperature may be associated with the wind force, freshwater discharge influx of the inshore water and atmospheric temperature. The reduction in the water temperature mainly depend upon the intensity of rainfall during monsoon and the low air temperature existed at the time. Similar observations have been reported by Thangaraj (1984) in Vellar estuary; Senthilnathan (1990) in Vellar, Uppanar and Kaduviar river estuary; Bikash Saha *et al*. (2001) in Sundarbans brackish water ; Soundarapandian *et al*. (2009) in Uppanar estuary; Palpandi (2011) Vellar estuary. Thus the present findings favour the earlier reports on the fluctuations of water temperature on the estuaries.

The monthly mean values of hydrogen ion concentration of water varied from 7.1 to 8.2. Maximum values of pH were observed in the summer season (May, 2012) and minimum values were recorded in the monsoon seasons (December 2011). (Table.1 and Fig.4)Statistical analysis showed that the pH had positive correlation with water temperature (r=0.7918) and salinity (r=0.8858) whereas dissolved oxygen had an inverse relationship (r=-0.6831). (Table.2). Generally low pH values were recorded during the monsoon period and slightly higher values during summer period. Similar

seasonal pattern was recorded earlier by Thangaraj (1984), Palpandi (2011), Santhanam and Perumal (2003) in Vellar estuary; Murugan and Ayyakkannu (1991) and Soundarapandian *et al*. (2009). In Uppanar backwaters, minimum values of pH during monsoon in the study area may be controlled by the influence of freshwater discharge, rainfall and also due the decomposition of organic matter as stated by Ragothaman and Patil (1995) and Upandhayay (1998).

The seasonal variation of salinity in Agniar estuary are graphically represented in fig.6. A marked seasonal changes in salinity was observed throughout the study period. Minimum salinity (5.5‰) was recorded during monsoon (December 2011) and was slowly increased during post monsoon and attained maximum (34‰) during summer seasons (May 2012). (Table.1 and Fig.5) Salinity of the Agniar estuary showed positive correlation between temperature (r=0.7140) and pH (r=0.8858) while it showed negative correlation with dissolved oxygen (r = - 0.6439) (Table.2). The salinity act as a prime factor among the most important environmental parameters in the distributions of living organisms (Chandra Mohan and Sreevanivas, 1998). The salinity variation in the exchange of ions and nutrients because of the tidal flow and low during the monsoon season in the Agniar estuary. The intrusion of neritic water and low river discharge may be responsible for high salinity, the monsoonal rain and continuous flow of the freshwater of the rivers may be responsible for low salinity in the present study in conformity with the earlier reports from Vellar estuary (Chandran and Ramamoorthi, 1984; Palpandi, 2011; Singbal, 1976); Uppanar backwaters (Murugan and Ayyakannu, 1991; Soundarapandian, *et al*., 2009).

Dissolved oxygen(DO) in Agniar estuary was varied between 3.5 and7.2 ml/l. Minimum DO was recorded during the month of June, 2012 and maximum in November, 2011 (Table.1 and Fig.6). Statistical analysis showed that dissolved oxygen had a negative correlation with water temperature (r=-0.7207), salinity (r=0.6439) and pH (r=0.6831) (Table.2). Dissolved oxygen (DO) contents showed well marked seasonal variations in the Agniar estuary. It seemed to be controlled by various factors such as rainfall, temperature, phytoplankton photosynthesis and salinity. Dissolved oxygen content was high during monsoon period in the study area could be due to the influx of fresh water during the monsoon, higher solubility and low salinity. Similar observations in DO values have also been reported from the Vellar estuary (Vijayalakshmi and Venugopalan, 1973, Brinda *et al*., 2010; Nedumaran *et al*., 2001);

Pichavaram mangroves (Govindasamy and Kannan, 1991); Mandovi and Zuari estuaries (Dwivedi *et al*., 1974); Point Calimere coastal water(Damotharan *et al*., 2010); Mutthkadu backwaters (Prema and Subramanian, 2003).

The presence of total phosphorus in an estuary can be taken as an index of total fertility in the ecosystem (Redfield, 1934). The monthly variations of dissolved phosphate recorded in Agniar estuary are shown in the Fig.7. The total phosphorus was minimum (0.29 µg/l) in the month of June, 2012 and maximum (2.15 µg/l) in the month of November 2011. Total phosphorus showed positive correlation with dissolved oxygen (r=0.7649) and negative correlation with pH (r=-0.6642) and salinity (r=0.7924). (Table.2) In the present study, the total phosphorus were found to be increased during monsoon periods and decreased slowly from summer onwards. High concentration of total phosphorus during monsoon season due to heavy rainfall, decomposition of particular organic matter, industrial effluents and from the agricultural discharges from the adjacent lands. Such monsoonal maximum and summer minimum in the total phosphorus concentration was also reported from Vellar estuary (Sivakumar, 1982; Chandran and Ramamoorthi, 1984; Nedumaran *et al*. (2001); Periyar river estuary (Sarala Devi *et al*., 1991), Coleroon estuary (Prabha Devi, 1986) and Mandovi estuary (Dehadrai, 1970 and Dwivedi *et al*., 1974).

The nitrate was varied from 0.47 to 3.75 µg/l. Minimum was recorded during the month of June, 2012 whereas maximum during the month of October, 2011 (Table.1 and Fig.8). Statistical analysis showed that the Nitrate had positive correlation with DO (r=0.8518) and negative correlation with pH (r=-0.8295) and salinity (r=-0.9144) (Table.2). In the present study, nitrate concentration was high during the monsoon and low during summer season. The high nitrate content observed during monsoon periods is mainly due to the river water discharge from agricultural fields containing nitrogenous particles of various origin. Low values of nitrate observed during summer seasons might be due to the lesser amount of freshwater inflow and higher salinity. Similar maximum value in monsoon and minimum in summer season were also recorded by Qasim *et al*. (1969) from Cochin backwaters, De Souza (1977) from Mandovi and Zuariestuaries, Sivakumar (1982) in Vellar estuary, Hari Muraleedharan *et al*. (2010) in Thondi coastal waters, Sundaramanikam *et al*. (2008) in Parangipettai and Cuddalore coast. The monthly variations of silicate of the water observed in Agniar estuary during the study period (October 2011- September 2012)

are graphically represented in Fig.9. The silicate content showed a minimum value of 28.25µg/l (May 2012) and a maximum value of 98.74µg/l (November 2011). Throughout the study period, mean seasonal temperature, pH, Salinity, Do, phosphorus, nitrate, and silicate contents were not uniform in Agniar estuary. The seasonal average silicate content in the study area showed maximum values during monsoon and minimum during summer seasons. The peak values of silicate observed during monsoon may attributed to the heavy fresh water influx and land run off which carries slit and other silicon deposits from upper reaches of the river. Observations similar to present study were reported earlier by Qasim *et al.* (1969) and Ansari and Rajagopal (1974) in Cochin back waters. Nair *et al*. (1983) in Ashtamudi estuary, Praba Devi (1986) in Coleroon estuary. The silicate concentration also showed negative relationship (r=-0.9036) with salinity, which was also noted earlier in Vellar estuary (Chandran and Ramamoorthi, 1984 and Thangaraj, 1984) Kerala backwaters (Sarala Devi *et al.*, 1983).

ACKNOWLEDGEMENTS

The first author thanks to UGC (SERO-Hyderabad) for financial support.

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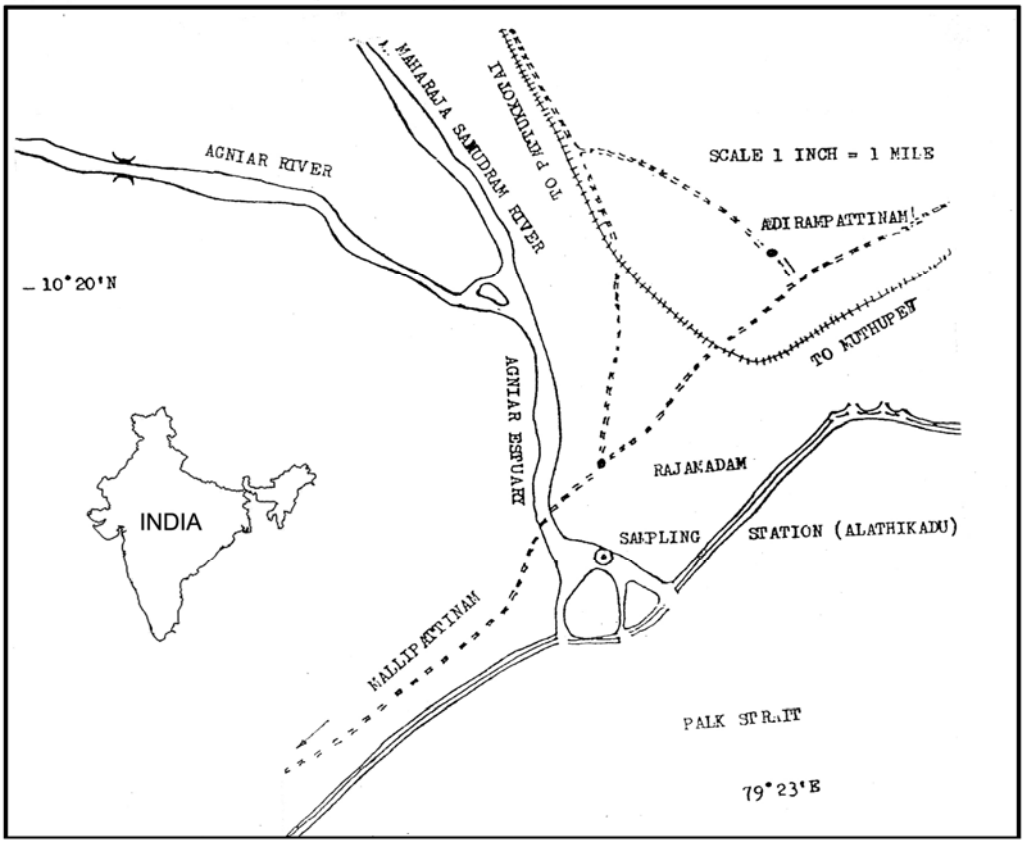

Fig. 1: Map of the study area – Agniar Estuary

Table1. Physico-chemical characteristics of Agniar estuary

Parameters	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	April 2012	May 2012	June 2012	July 2012	Aug 2012	Sep 2012
Atmosphere ^{o}C	30	30	28.8	30	32	33	34	35	33.4	31	32	31
Water ^{o}C	28	25	27	29.5	30	28.4	30.5	31.5	31	28	28	27
pH	7.2	7.2	7.1	7.3	7.8	7.5	7.7	8.2	7.8	7.8	7.4	7.3
Salinity ppt	6.0	5.5	6.5	10.5	17.5	20	31	34	25.5	30.5	19.5	14.7
Dissolved Oxygen ml/l	6.8	7.2	6.1	5.8	4.5	4.3	5.0	4.9	3.5	4.7	6.5	5.5
Total Phosphorus µg/l	1.45	2.15	1.63	1.95	1.25	0.88	0.77	0.58	0.29	0.44	1.15	1.30
Nitrate µg/l	3.75	3.45	2.45	1.52	1.92	1.28	1.25	1.15	0.47	0.95	1.35	2.23
Silicate µg/l	80.15	98.74	81.17	69.25	49.15	38.64	30.15	28.25	35.15	37.15	65.25	54.24

Table 2. Correlation coefficient (r) values between the environmental parameters.

Parameters	*At.temp.*	*W.temp.*	*pH*	*Salinity*	*DO*	*Silicate*	*Phosphorous*	*Nitrate*
At.temp.	1							
W.temp.	0.7618	1						
pH	0.8244	0.7918	1					
Salinity	0.8396	0.714	0.88582	1				
DO	-0.608	-0.721	-0.6831	-0.6439	1			
Silicate	-0.745	-0.639	-0.7843	-0.9036	0.8024	1		
phosphorous	-0.647	-0.781	-0.6643	-0.7924	0.765	0.8457	1	
Nitrate	-0.827	-0.786	-0.8295	-0.9144	0.8518	0.9042	0.8356368	1

Fig. 2: Monthly changes in water temperature during 2011 to 2012 in Agniar estuary

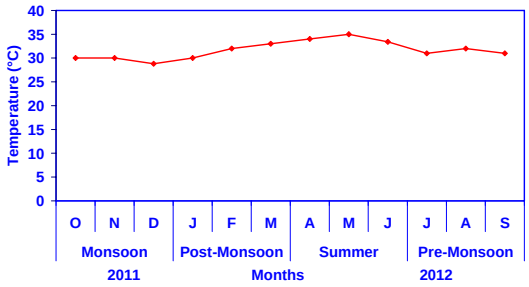

Fig. 3: Monthly changes in atmospheric temperature during 2011 to 2012 in Agniar estuary

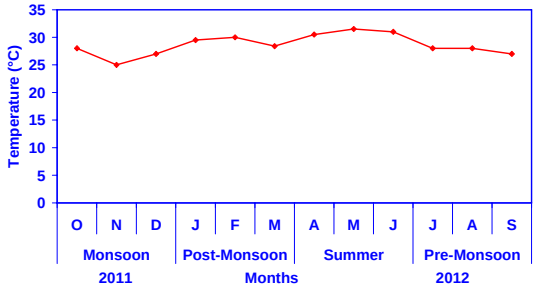

Fig. 4: Monthly changes in pH during 2011 to 2012 in Agniar estuary

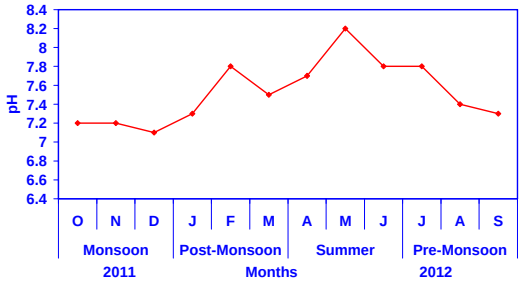

Fig. 5: Monthly changes in salinity during 2011 to 2012 in Agniar estuary

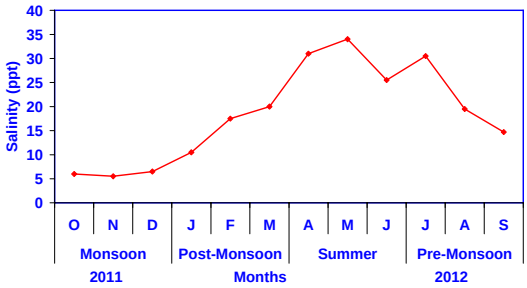

Fig. 6: Monthly changes in oxygen during 2011 to 2012 in Agniar estuary

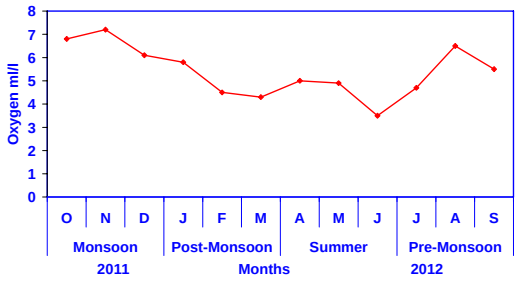

Fig. 7 Monthly changes in total phosphorus during 2011 to 2012 in Agniar estuary

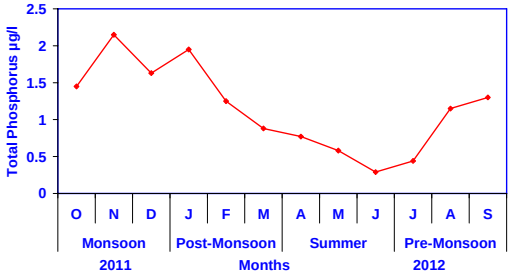

Fig. 8 Monthly changes in nitrate during 2011 to 2012 in Agniar estuary

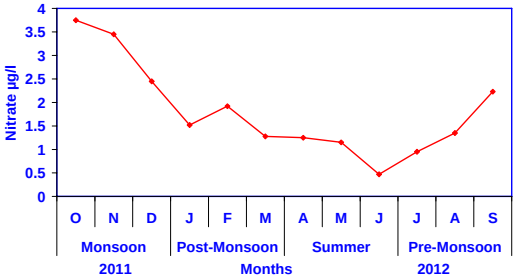

Fig. 9 Monthly changes in silicate during 2011 to 2012 in Agniar estuary