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Studies on The Physico-Chemical Parameters And Their Seasonal Variations In The Selected Sites of Valapattanam River In Kannur District, Kerala

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Abstract:*Water is an important element of the physical environment and a valuable resource with numerous and varied uses. Rivers are primary source of water for drinking, irrigation and other domestic purposes. The present study has been undertaken to know the extent of effects of pollutants on the physicochemical characters and nutrient load of river Valappattanam at Kannur, where river is grossly polluted. Three different stations viz., Valappattanam, Kuppam and Parassinikadavu have been selected. In the same site itself water is analyzed from mangrove and non-mangrove area also. All parameters were found to be the maximum in different station.The physical parameters like temperature, P^H, electrical conductivity and total dissolved solids were analyzed. The chemical parameters like alkalinity, acidity, total biological oxygen demand hardness, dissolved chloride, dissolved calcium, dissolved magnesium and dissolved oxygen were analyzed. The variations in temperature of the three station ranges from 28.1 to 31.6 ^{o} C. The pH values are ranged between 4.5 to 8.66. The total dissolved value is high at Valapattanam non mangrove river (146 ppm). Highest conductivity value 4142 µmhos was observed at Valapattanam mangrove river area. In the study areas total alkalinity ranges from 18.1-170 mg/l. Maximum values of dissolved $CO_2$is 320 mg/l observed at Valapattanam mangrove. Hardness concentration values ranged from 15-50 ppm in the study areas. Maximum value of chloride was found in Valapattanam non mangrove area. The maximum value of Calcium was found in Valapattanam non mangrove area is 242.484mg/l. The maximum value of Calcium was found in Valapattanam non mangrove area. Highest dissolved oxygen value is 5.92 mg/l reported at Kuppam non mangrove area. BOD minimum value is observed at Valapattanam mangrove area (0.24mg/l)and maximum of 4.62 mg/l at Kuppam non mangrove area.*

Keywords*: Irrigation, Mangrove, Parameters Physicochemical, Pollutants.*

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I. Introduction

The rivers always form the lifeline of nation and society by providing precious resources for development and perpetuation of life. In India, the surface water, especially rivers form an inevitable part of culture and are used as drinking and irrigational water source. Water is the most vital resource for the existence of life on earth. But this most precious resource is getting deteriorated by human activities. Civilization itself cannot survive if the natural environment collapses and man must balance the resources of the planet if he wants to survive (Camp Thomas, 1929).The property of water of dissolving many substances makes it very useful in industries and in daily use. After use in home, agriculture and industry, water gets contaminated. The used water may contain waste and harmful substances called pollutants. Pollutants are residues of substances made by us as waste products which pollute the environment in one way or other. Pollution of a river first affects its chemical quality and then systematically destroys the community disrupting the delicate food web. Diverse uses of the rivers are seriously impaired due to pollution and even the polluters like industry suffer due to increased pollution of the rivers. River pollution has several dimensions and effective monitoring and control of river pollution requires the expertise from various disciplines (Trivedy *et al.,* 1990). Pollution of river is a global problem. In India it is reported that about 70% of the available water is polluted. The chief source of pollution is identified as sewage constituting 84 to 92 percent of the waste water. Industrial waste water comprised 8 to 16 percent (Dhirendra *et al.,* 2009). Bio monitoring of water bodies also help to understand the composition of biota and its dynamics (Scholl, 2010 and Grainer*et al.,* 2011).

II. Materials And Methods

2.1 Study Area

The Kerala state is blessed with 44 rivers and Valapattanum river is the largest river in Kannur district. The length of main stream is 110 Km. Parassini kadavu river and Kuppam river are main tributaries of Valapattanum river. The study was carried out in three different sites such as Valapattanum, Parassini Kadavu

and Kuppam puzha. Valapattanum is well known for its wood based industries. Valapattanum, Kuppam and Parassini rivers are famous for fishing. In this Parassini kadavu is a famous pilgrimage area. Considerable number of human population also depends on this river for their daily livelihood. Household sewage, small factory effluents, pesticides and fertilizers discharge from farms is main reasons of river water pollution (Simpi *et al.,* 2011). Five water samples were collected with an aim to study the physical and chemical characteristics to investigate the factors responsible for causing water pollution and also analyzing the water pollutions in mangrove and mangrove less area in the three sites. But Parassini river area is free of mangrove plants.

2.2 Sample Collection

Mid-stream water samples were collected from June 2016 to February 2017analysis from three sampling stations. The collections were made once in a month at the time i.e., 7.30 to 8.30 am and from same spots throughout the period of study. The samples were collected in wide mouthed polythene bottles and stored in ice box for further analysis after determining temperature, pH and electrical conductivity. The samples were analyzed for following physico – chemical parameters*viz.,* temperature, P^H, electrical conductivity, total dissolved solids, alkalinity, acidity, total biological oxygen demand, hardness, dissolved chloride, dissolved calcium, dissolved magnesium and dissolved oxygen were analyzed by using Water Quality Analyzer (ELICO) Model No. PE 138. Most of the physico- chemical parameters were determined by standard method prescribed by APHA (2005).

III. Results And Discussions

The study provides data on the physico-chemical parameters of Valapattanum and its two tributaries Kuppam and Parassinikadavu (Fig 1a, b. and c) which are discussed below.

3.1 Physical Parameters

3.1.1 Temperature

Temperature is an important factor which influences the chemical, biochemical and biological characters of the aquatic system (Kumar *et al.,* 2005). Temperature is an important water quality parameter and is relatively easy to measure waste bodies will naturally show changes in temperature seasonally. The variations in temperature of the three station ranges from 28.1 to 31.6 ^{o} C (Table 1). 28.1 ^{o} C during monsoon and 31.6 ^{o} C during summer. Due to the pre-monsoon period highest temperature was vertical temperature could be due to open nature of site and due to the hot climate in pre-monsoon. Among the ecological factors, the water temperature is considered as an important factor in which the spewing in fishes depends.

3.1.2 P^H

The pH values are ranged between 4.5 to 8.66 (Table 1). Aquatic organisms are affected by P^H because most of their metabolic activities are P^H dependent (Wang *et al*., 2002). 4.5 are reported at Valapattanam non mangrove area during February and maximum value 8.66 at Valapattanam non mangrove area during December (Table 1). Optimal p^H range for sustainable aquatic life is 6.5-8.2 (Murdock *et al*., 2001). Slight deviation towards acidity in some samples can be attributed to the anthropogenic activities like improper irrigation process and weather process in the study area.

3.1.3Total Dissolved Solids

Total dissolved solids are an indication of the degree of dissolved substances such as metal ions in water. Water with a high total dissolved solids indicated more ionic concentration, which is of inferior palatability and can induce an unfavorable physico-chemical reaction in the consumers. Katarina*et al,* (1996) reported that increase in value of TDS indicated pollution by extraneous sources. The high amount of dissolved, suspended and total solids of samples adversely affects the quality of running water and it is unsuitable for any other purpose irrigation and drinking. Value was high as 146 ppm noticed from Valapattanam non mangrove river during June 2016 (Table 1). The permissible value recommended for TDS is 500 mg/l prescribed by IS 10500 and BIS, FAO. The present study observed pond water samples having medium TDS which indicates the water is mineralized with pollutants.

3.1.4 Conductivity

Conductivity in natural water is the normalized measure of the waters ability to conduct electric current. Electrical conductivity is a useful tool to evaluate the purity of water the most desirable limit of EC in drinking water is prescribed as 1.500 µmhos .The source of EC may be an abundance of dissolved salts due to poor irrigation management, minerals from rain water runoff or other discharges (Acharya *et al*.,2008). This is mostly influenced by dissolved salts such as sodium chloride and potassium chloride. Highest conductivity value 4142 µmhos was observed at Valapattanam mangrove river area (Table 1) during July and minimum of

0.0493 µmhos at Valapattanam mangrove during February (Table 1). The variations in the conductivity value during different seasons can be related to the quality of water.

3.2 Chemical Parameters

3.2.1 Alkalinity

Alkalinity constitutes important parameters in determining the quality of water (Giri and Singh, 2014).The permissible value of alkalinity as recommended by the Indian standards is 250mg/l as calcium carbonate. In the study areas total alkalinity ranges from 18.1-170 mg/l. Minimum value observed is 18.1 mg/l at Valapattanam non mangrove area during January. The maximum value of 170 mg/l during December at Valapattanam mangrovearea (Table 4).

3.2.2Dissolved Carbon Dioxide

Free CO_2 is an extremely necessary constituent in an aquatic environment as described by Welch (1952). Free CO_2 in water occurs due to respiration of aquatic biotic decomposition of organic matters and also due to infiltration through the soil. Carbon dioxide is an important component of the buffer system which influences the carbonate and bicarbonate concentration in water. Values of dissolved CO_2 are maximum of 320 mg/l at Valapattanam mangrove during August (Table 4). The minimum value of 2 mg/l was reported at Valapattanam normal, Valapattanam mangrove, Kuppam mangrove, Parassinikadavu during October. (Table 4, 5 and 6).

3.2.3Total Hardness

Total hardness of water is mainly due to its calcium and magnesium ions in salts. Hardness of water is a measure of its capacity to form precipitate with soap and scales with certain anions present in the water. Hardness concentration values ranged from 15-50 ppm in the study area. According to APHA the desirable limit for total hardness is 300 mg/l .In the present study the observed value of total hardness ranges from 7.5-152.5 mg/l. The minimum value 7.5 mg/l during October at Kuppam mangrove region (Table 5). The maximum value of 152.5 mg/l during December at Valapattanum non mangrove area (Table 4).Compared to the desirable limit, the values of the samples is found to lie within the limit and was satisfactory. (Mishra *et al*.,2014). Although hard water has no known effect on health but it is unsuitable for domestic uses (Wolf *et al.,* 2013). Therefore the water of Valapattanum river and its branches are unsuitable for domestic and other purpose.

3.2.4 Chloride

Chloride is one of the major inorganic anion in water and waste water (Ensik *et al.,* 2010). The higher concentration of chloride is considered to be an indicator of pollution due to high organic waste of animal origin maximum value was found in Valapattanam non mangrove area during December at 525.4 mg/l (Table 4) and minimum of 15.8 mg/l during June at Kuppam normal region (Table 5). In most of the places at different season chloride shows any result.

3.2.5Calcium

Calcium is an important nutrient for aquatic, organism and it is commonly present in all water bodies(Ansari *et al*.,2000).Calcium contributes to the hardness of water within the bicarbonate, forming temporal carbonate hardness and sulphate, chloride and nitrate forming temporal carbonate hardness (Twort and Dickson, 1994).The maximum value of Calcium was found in Valapattanam normal area during October is 242.484mg/l (Table 4) and minimum of 2.004mg/l during August and January at Kuppam mangrove and non-mangrove region (Table 5) . The decrease in amount of calcium may be due to its absorption by living organism.

3.2.6Magnesium

Magnesium occurs in nature, primarily in the mineral dolomite, magnetite and salt deposits etc. The presence of Mg proves to be diuretic and laxative which reduces the utility of H_2O for domestic uses. The maximum value of Magnesium was found in Valapattanam normal area during October is 105.986mg/l Table (4) and minimum of 4.51 mg/l during January at Parassinikadavu river area (Table 6).The maximum permeable limit of calcium hardness is 30mg/l(BIS 1991). Magnesium is often associated with all kind of water, but its concentration remains generally lower than the calcium (Venkatasubramani*et al*., 2007). Decrease in level of magnesium reduces the phytoplankton population

3.2.7Dissolved Oxygen

Dissolved oxygen is indicative of the health of an aquatic system, the vital metabolism of aerobic organisms, respiration depends purely on the amount of oxygen dissolved in the water optimum concentration of dissolved oxygen is essential for maintaining aesthetic qualities water as well as for supporting life. The chemical and biochemical process undergoing in water body are largely dependent upon the presence of oxygen. Estimation of dissolved oxygen is a key test in water pollution and waste treatment process control. The

permissible value recommended for DO is 5mg/l as per Indian standard. Dissolved oxygen recorded maximum is 5.92 mg/l during September at Kuppam normal (Table 5). The minimum value of 0.048 mg/l was reported at Valapattanam non mangrove and mangrove area during February (Table 4). Vetriselvi *et al.,* (2011) reported that the highest values might be the accumulation of clothing, washing and bathing by soaps and detergents which hampered the quality of water.

3.2.8 Biological Oxygen Demand

BOD is used as a measure of the amount of organic matter in an aquatic system which ultimately supports the growth of microorganisms (Onda *et al.,* 2012). BOD is an excellent indicator of the strength of domestic and industrial contaminants in aquatic environment. BOD value ranges from 0.24mg/l was reported at Valapattanam mangrove area during February (Table 4) and maximum of 4.62 mg/l during November at Kuppam non mangrove area (Table 5).

IV. Conclusion

The result of the studies shows that all three rivers selected for our studies are highly polluted. One of the major environmental problems faced by the rivers of Kerala is due to the disposal of untreated municipal sewage. Various anthropogenic activities are showing its impacts on the water quality of Valapattanam, Kuppam and Parassini River. Intensive efforts such as regular monitoring systematic assessment in the inlets and outlets of depth survey fields can save the vitality of biotic components and to regulate the anthropogenic pressures at both aquatic habitats. This would be an effective tool in order to prevent the ecological balance for non – stop survival and endurance of productive nutrients and aquatic biota. The water is polluted at all the stations during the course of study and its unfit for consumption, domestic and irrigation purposes. Otherwise water needs to be treated before using it for any domestic purposes. The revealed results need to conserve manage and restore the water.

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Table 1. Seasonal changes of physical parameters of Valapattanam river.

Parameters			Temperature (^oC)	pH	Total dissolved substances(ppm)	Electric conductance (µmhos)
Month	Jun	N	28.1	7.1	146	246
		M	28.1	7.3	123.1	273
	Jul	N	28.3	7.4	11.4	3413
		M	28.1	7.5	12.9	4142
	Aug	N	28.9	6.2	$3.6x10^{-6}$	3280
		M	28.8	6.5	$2.6x10^{-6}$	2650
	Sep	N	29.4	6.3	$3.5x10^{-6}$	219.6
		M	29.3	6.1	$2.8x10^{-6}$	584
	Oct	N	29.8	5.1	11.44	268.7
		M	30	5.7	18.32	622.5
	Nov	N	30.1	7.4	12.14	446.7
		M	31.2	7.1	17.3	461.8
	Dec	N	31.1	8.66	$17.2x10^{-6}$	143.6
		M	31	8.5	$18.77x10^{-6}$	14
	Jan	N	31.6	5.2	$23.47x10^{-6}$	112.6
		M	31.1	5.1	$23.53x10^{-6}$	27.16
	Feb	N	29.6	4.5	$22.12x10^{-6}$	0.0506
		M	29.6	4.9	$22.15x10^{-6}$	0.0493

N:Water collected from non mangrove area; M: Water collected from mangrove area.

Table 2. Seasonal changes of physical parameters of Kuppam river

Parameters			Temperature (^oC)	pH	Total dissolved substances(ppm)	Electric conductance (µmhos)
Month	Jun	N	28.9	6.1	96.4	188.2
		M	28.6	6.23	94.2	162.3
	Jul	N	29.2	7.1	86.2	172
		M	29.3	7.4	82	195
	Aug	N	29.2	6.3	132.4	139.4
		M	29	7.8	131.1	129.2
	Sep	N	29.2	7.2	82.1	219.1
		M	29.4	7.4	83.4	219.6
	Oct	N	29.9	6.2	132.1	266.8
		M	30.6	5.2	130	268.7
	Nov	N	29.8	5.3	44.4	140.1
		M	30	5.6	46.3	144.6
	Dec	N	30.8	8.26	10.55	19.22
		M	30.9	8.39	10.55	20.10
	Jan	N	30.4	5.07	14.67	27.16
		M	31.1	4.9	11.86	21.04
	Feb	N	29.6	4.7	$15.8x10^{-6}$	165.1
		M	29.5	4.9	86.24	29.13

N:Water collected from non mangrove area; M: Water collected from mangrove area.

Table 3. Seasonal changes of physical parameters of Parassinikadavu river.

Parameters			Temperature (^oC)	pH	Total dissolved substances(ppm)	Electric conductance (µmhos)
Month	Jun	N	28.2	6.8	75.2	142.5
	Jul	N	29.4	6.9	71.2	146.2
	Aug	N	28.4	6.6	59.5	273.6
	Sep	N	29.2	7.2	54.5	584
	Oct	N	30.4	5.3	41.9	624.5
	Nov	N	30.5	7.2	48.2	45.1
	Dec	N	30.7	8.47	12.36	22.89
	Jan	N	31.3	4.6	63.33	112.6
	Feb	N	29.6	4.8	19.38	44.14

N:Water collected from non mangrove area.

Table 4. Seasonal changes of chemical parameters of Valapattanam river.

Parameters			Alkalinity (mg/L)	Dissolved carbon dioxide (mg/L)	Hardness (mg/L)	Dissolved oxygen (mg/L)	Biological oxygen demand (mg/L)	Calcium (mg/L)	Magnesium(mg/L)	Chloride (mg/L)
Month	Jun	N	72	35.3	32.5	3.4	4.32	14.6	82.840	-
		M	75	34.1	31.05	3.5	4.4	14.4	80.124	-
	Jul	N	82	35.9	27.5	4.9	4.48	16.2	10.96	-
		M	83	36.7	30	4.6	4.39	16.04	12.82	-
	Aug	N	90	120	145	4	2.72	18.03	57.251	-
		M	80	320	132.5	4.32	-	18.03	53.602	-
	Sep	N	70	120	17.5	3.52	2.56	54.108	24.364	-
		M	65	32	17.5	4.32	2.56	48.096	13.4	-
	Oct	N	90	2	17.5	5.44	3.2	242.484	105.986	-
		M	80	2	32.5	4.8	2.88	196.392	82.840	-
	Nov	N	141	3.5	-	-	0.89	56.12	-	-
		M	145	3.91	-	-	4.4	55.43	-	-
	Dec	N	165	150	152.5	3.68	2.88	56.112	40.02	525.4
		M	170	84	132.5	4	3.68	50.1	34.11	362.1
	Jan	N	18.1	26	-	1.44	0.64	46.092	-	269.8
		M	19.7	22	-	1.12	2.88	38.076	-	159.7
	Feb	N	110	28	31.05	0.048	0.48	46.092	80.124	361.2
		M	105	37	31.05	0.048	0.24	44.088	80.124	-

N: Water collected from non mangrove area; M: Water collected from mangrove area.

Table 5. Seasonal changes of chemical parameters of Kuppam river.

Parameters			Alkalinity (mg/L)	Dissolved carbon dioxide (mg/L)	Hardness (mg/L)	Dissolved oxygen mg/L)	Biological oxygen demand (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Chloride (mg/L)
Month	Jun	N	74	48	12.5	4.3	3.14	2.14	4.87	15.8
		M	76	42.1	22.5	4.2	3.08	2.3	9.7	16.8
	Jul	N	81	44.8	25	3.62	4.01	3.12	8.527	22.4
		M	84	47.1	31.05	3.41	4.45	3.6	80.12	23.5
	Aug	N	90	82	15	4	-	2.0	6.09	156.2
		M	70	70	17.51	3.52	4.16	2.0	7.31	104.51
	Sep	N	25	28	15	5.92	-	4.0	4.87	28.4
		M	40	70	15	5.6	4.16	4.01	4.87	17.75
	Oct	N	80	38	35	6.4	4	10.02	12.02	169.3
		M	45	2	7.5	6.4	3.68	52.4	-	134.9
	Nov	N	47	143	25	-	4.62	51.14	8.527	148.1
		M	52	140	25	-	4.01	-	-	143.1
	Dec	N	60	122	122.5	3.36	2.4	50.1	29.237	443.75
		M	75	70	120	3.84	2.4	34.06	37.765	628
	Jan	N	66	48	-	4.8	2.08	2.01	-	255.6
		M	68.1	51	-	4.64	2.08	2.01	-	166.85
	Feb	N	75	56	36	1.6	0.8	38.07	43.638	269.4
		M	75	65	-	0.9	0.8	32.06	-	186.63

N: Water collected from non mangrove areaM: Water collected from mangrove area.

Table 6. Seasonal changes of chemical parameters of Parassinikadavu river.

Parameters			Alkalinity (mg/L)	Dissolved carbon dioxide (mg/L)	Hardness (mg/L)	Dissolved oxygen (mg/L)	Biological oxygen demand (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Chloride (mg/L)
Month	Jun	N	42	34.5	27.5	3.18	4.18	-	11.1	19.4
	Jul	N	45	49.8	30	4.25	4.08	-	13.4	18.42
	Aug	N	40	90	30	5.28	3.04	4.008	12.82	215.2
	Sep	N	55	90	25	4.8	3.36	6.012	8.527	28.4
	Oct	N	65	2	37.5	4.5	2.56	16.032	8.527	305.3
	Nov	N	42	63.1	-	5.2	0.42	-	7.31	245
	Dec	N	25	104	67.5	5.12	4.1	64.128	6.091	305.3
	Jan	N	28.1	30	-	0.8	4	8.016	4.51	273
	Feb	N	35	26	36.4	0.048	0.32	34.068	6.568	255

N: Water collected from non mangrove area.

Fig 1. Study area-(a) Valapattanam river (b) Kuppam river (c) Parassinikadavu river

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