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PHYSICO-CHEMICAL ANALYSIS OF A POLLUTED FRESH WATER POND OF POLLACHI, TAMIL NADU

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Physico-chemical analysis of a polluted fresh water pond has been carried out. The studies reveal a higher quanta of certain parameters like pH; TDS; EC; Hardness; Chloride; Total Nitrogen; Phosphate; Sulphate; BOD and COD. The results clearly indicate the eutrophic and polluted nature of the pond water.

Keywords : Eutrophication; Physico-chemical analysis; Polluted pond.

Introduction

All fresh water bodies are subjected to mild to heavy pollution due to discharge of domestic sewage, agricultural wastes, industrial effluents etc. causing changes in physical, chemical and biological spheres. Various physico-chemical parameters have been employed by a number of workers to assess water pollution levels of aquatic habitats[1,2,3]. The different pollutants running into the water are deleterious and infectious[4]. The pond selected for the present study is located at the foot hills of Anamalai Hill range of Coimbatore district in Tamilnadu. The lentic and lotic fresh water ecosystem of this area are relatively oligotrophic but some spots are already indicating the impact of environmental pollution. The pond called Krishnan Anaikatti Kulam (KAK Pond) is situated at 10° 36' N latitude and 77° 03' E longitude at an elevation of 270.09 m above msl near Pollachi. This rain fed pond is partly to heavily loaded by the inflow of municipal and domestic sewage besides being also subjected to human and other interferences. The pond water is used for irrigation to some extent of the near by agricultural lands. There have been a few studies on the hydrobiology of oligotrophic water bodies[5,6] but with respect to eutrophic water bodies the present study was carried out to assess the physico-chemical status of this polluted pond.

Materials and Methods

The water samples for physico-chemical analysis were collected in 5 litre plastic canes at fortnightly intervals for a period of two years (June 1995 to May 1997). Standard methods of water analysis were followed for the estimation of physico-chemical parameters[7,8]. Transparency, Temperature, pH, Total Dissolved Solids (TDS) and Electrical conductivity (EC) were measured on the spot. Separate samples were collected and fixed preliminarily for dissolved oxygen (DO) estimation. The other physico-chemical parameters were estimated in the laboratory immediately after the collection of samples. For computing and presenting the observational results of physico-chemical features, the months June to October were represented as Rainy months (Monsoon season), November to February as Cold months (Winter season) and March to May as Hotter months (Summer season) for both the years of study as per the prevailing climatic conditions on this locality. The data of the bimonthly values for the mentioned months constituting the seasons are represented as averages.

Results and Discussion

The results pertaining to the physico-chemical parameters of the KAK pond are given in the Table 1.

On an average the transparency values decrease from monsoon to summer in both the years of study (I yr. 31.9 cm > 22.8 cm and II yr 34.9 cm > 33.3 cm).

The monsoon and winter temperatures of the water in both the years of study are close to 30° C and exceed 35° C in the summer months.

The KAK pond is an alkaline pond

and on the average the pH is between 8.0 and9.0 with minor fluctuations. Higher range of pH is evident during summer months and it is evident here that the pond water tends to become more alkaline towards hotter months (Table 1). pH has been reported as one of the physico-chemical parameters that accounts for the seasonal variation in inorganic nutrient component of water bodies[9]. The alkaline nature of pond might be due to the influx of salts from the surrounding area.

TDS values tend to decrease in the first year as compared to second year. In both the years of study maximum TDS values are observed during summer months (I yr. 1830, II yr. 1200 mg/ml).

The EC values have considerably decreased in the second year than the first year. The eutrophic nature of KAK pond is revealed by high TDS and EC values during summer months. This summer peak of TDS and EC values may be attributed to the evaporation of water due to high temperature and occasional summer rains which may be responsible for salt influx[3].

The OH^- alkalinity of the pond water is evident only in the summer of II year and hence it is a rare phenomenon. CO_3^- and HCO_3^- alkalinities are present, the latter being more pronounced than the former. The CO_3^- alkalinity increases in the I year, reaching a maximum in the summer where as in the II year it is generally on the decline. The HCO_3^- alkalinity is at the maximum during monsoon months with the subsequent decline in the winter and summer months. An inverse relationship between CO_3^- and HCO_3^- level is evident from the present study on most of the occasions and the same was reported already[10]. It becomes clear that pH tends to increase with carbonate alkalinity (Table 1) as reported earlier[9].

The free CO_2 content of the water on an average basis is on the decline from monsoon to summer months in both the years of study. Monsoon maxima of free CO_2 has already been reported[11] and the KAK pond is not an exception to these reports of monsoon peak of free CO_2 and this might be due to high precipitation and low photosynthesis by meagre population of phytoplankton. More the strenght of free CO_2 more the quanta of bicarbonate alkalinity and they are directly proportional for all the seasons of both the years of study. But this relationship with carbonate alkalinity is just reverse to that of bicarbonate alkalinity.

The dissolved oxygen (DO) content is on its maximum during summer season of both the years. The high DO content during summer might be due to high rate to photosynthesis by phytoplanktonic organisms of the pond.

The total hardness on an average is high during monsoon season of both the years and least during summer season. In general the hardness values are on the decline from monsoon to summer and they show a positive relationship with bicarbonate alkalinity. But hardness and carbonate alkalinity show a negative relationship. It is also evident from the present study that hardness and transparency values are positively related while hardness and DO are negatively related.

The chloride content on a average increases from monsoon to summer in both the years evidently highest in the hotter months which might be due to rapid evaporation of water during this season and increased rate of metabolism and excretion by aquatic organisms[12, 13]. The chloride content during summer season was also reported by Prasad *et al.*[14].

The nitrate content tends to be highest in the summer months and is lower in monsoon and winter months. The nitrites on the average reach a maximum of one mg/l in winter months with minor fluctuations in monsoon and summer months. The total nitrogen increases from monsoon to summer months. The maximum total nitrogen is close to 130 mg/l in the hotter months and this summer peak might be due to high oxidation of organic matter.

Table 1. Physico-chemical features of KAK pond (Seasonwise).

Parameters	Period	Rainy Months June to October		Cold Months Nov. to Feb.		Summer Months March to May	
		Range	Average	Range	Average	Range	Average
Transparency (cm)	I year	28-35	31.9	22-32	28.9	16-30	22.8
	II year	26-44	34.9	32-42	36.5	29-38	33.3
Temperature (^{0}C)	I year	28-33	30.4	27-33	30.3	32-38	35.6
	II year	27-34	30.3	27-31	29.3	36-38	36.8
pH	I year	7.3-9.5	8.2	7.2-9.4	8.6	8.3-9.1	8.7
	II year	8.1-9.8	8.8	7.8-90	8.3	8.0-9.5	8.6
TDS (mg/l)	I year	1710-1840	1764	1100-1680	1603	1740-1950	1830
	II year	520-1280	950	410-640	498	880-1700	1200
Electrical Conductivity (m.mhos)	I year	500-1760	1650	940-1420	1160	1500-1900	1683
	II year	610-1310	1028	480-800	833	920-1450	1120
OH Alkalinity (mg/l)	I year	0	0	0	0	0	0
	II year	0	0	0	0	20-95	53
CO_3 Alkalinity (mg/l)	I year	64-184	118	64-190	146	100-220	162
	II year	30-200	99.0	20-120	59.0	10-140	88.0
HCO_3 Alkalinity (mg/l)	I year	56-436	287	6-456	171	0-186	50
	II year	50-320	186	10-290	138	0	0
Dissolved CO_2 (mg/l)	I year	0-38	26-3	0-36	16-9	0	0
	II year	0-38	16.0	10-26	18.6	0-8	4.7
Dissolved O_2 (mg/l)	I year	2-13	4.8	3.8-10.6	6.67	2.8-9.2	6.2
	II year	3-10.2	6.0	4.2-10.8	7.68	7-10	8.4
Hardness (mg/l)	I year	220-520	425	300-530	413	194-480	296
	II year	180-560	382	220-480	330	220-360	282
Chloride (mg/l)	I year	28-60	33.4	30-53.3	43.7	31-67	51.2
	II year	16-76	40.0	26-60	43.0	32-72	46.3
Nitrate (mg/l)	I year	4-29.5	13	2-23	14.9	25-32	28.8
	II year	3-26	16.9	6-14	8.3	4-25	15.8
Nitrite (mg/l)	I year	0.25-1.20	0.72	0.75-1.50	1.0	0.25-1.50	0.80
	II year	0.10-1.0	0.58	0.40-1.20	0.78	0.20-0.60	0.40
Tital Nitrogen (mg/l)	I year	30.5-112	42	26-123	81.9	115-142	129.1
	II year	30-119	62	64-85	72.3	92-125	111.3
Silicate (mg/l)	I year	1-6	4.3	3-4.2	3.5	3-7	4.6
	II year	2-6	3.8	6-8	7	2-6	4.2
Fluoride (mg/l)	I year	2.2-8	3.9	3.0-4.0	3.3	2-3.5	2.75
	II iear	2-5	3.6	3.0-4.0	3.5	3.0-4.0	3.3
Phosphate (mg/l)	I year	6.6-12	9.5	6.5-13.5	10.2	14.5-20	15.5
	II year	8-34	22.1	4-8.5	6.5	8-26.0	15.5
Sulphate (mg/l)	I year	8.5-56	32.1	18-21	19.6	19-32	26.5
	II year	22-56	35.2	28-52	41.2	50-60	54.0
BOD (mg/l)	I year	940-1646	1346	960-1520	1240	540-1800	1686
	II year	620-1840	1176	1240-1920	1520	950-1650	1216
COD (mg/l)	I year	1200-2240	1775	1280-2040	1670	1720-2400	2113
	II year	1280-1730	1540	1240-1920	1360	1360-1810	1590

I Year = June 1995 to May 1996; II Year = June 1996 to May 1997.

Silicate content of the pond reaches a maximum of 7 mg/l in the winter of II year, otherwise it is less than 5 mg/l with minor fluctuations.

The water shows a declining trend of fluoride content from monsoon to summer of both the years of study. The fluoride content is less than 4 mg/l. The fluoride enrichment of water might be due to the run off water from surrounding areas carrying domestic sewage.

The phosphate values range form a little more than 5 to 20 mg/l during the period of study. It fluctuates in the rainy months, decrease in the cooler months and again increase in the hotter months.

Sulphate content of the pond decreases from monsoon to winter and increases in summer during the first year of study where as it is steadily on the increases from monsoon to summer during the second year.

The BOD values are high in the summer months of I year and cooler months of II year. The COD values are at the peak in the summer months of both the years. The high levels of BOD and COD are readily accounted by the arrival of domestic and municipal sewage at the site of the pond. The high quanta of BOD and COD along with high magnitude of TDS and EC; Hardness; Total nitrogen; Sulphate; Chloride indicate high level of pollution and eutrophication and these conditions are in agreement with the earlier studies[1,12].

The Pond under consideration like any other aquatic ecosystem exhibited fluctuating set of physico-chemical characteristics. Eutrophication and pollution are artificial events that are superimosed in this aquatic ecosystem and they are well evaluated by physico-chemical parameters employed in this study. The following clear picture emerges out of the two year long investigations on the physico-chemical status of the pond water : the KAK pond is highly polluted in terms of high levels of TDS; EC; Hardness; Total nitrogen; Chloride; Sulphate; Phosphate; BOD andCOD especially during summer season and the quality of KAK pond is tending towards that of a sewage drain and hence the pond water becomes increasingly unsuitable for irrigation of agricultural lands. The high values of inorganic nutrients clearly indicate that the KAK pond is a highly polluted pond and such a conclision warrants further confirmation by phytoplanktonic analysis, pollution indices etc.

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