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Physico-chemical Analysis of Two Fresh Water Ponds of Hajipur, Vaishali District of Bihar

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Abstract:
The present study was conducted to assess the physico–chemical analysis of the two fresh water ponds located in Hajipur, Vaishali, Bihar and effects of sewage pollution from the drains of surrounding areas. The study was carried on from January 2018 to December 2018. The range of variation for some physico – chemical parameters like dissolved O2, free CO2, Carbonate, Bicarbonate, Alkalinity, Calcium, Chloride Phosphate, Nitrate and BOD was studied for both the ponds. These parameters show a marked difference between two fresh water ponds depending upon the quality and nature of sewage pollution.

Keywords: Water bodies, Sewage pollution, Hydrological Status, Dissolved Oxygen.

INTRODUCTION

Ponds are considered to be one of the most productive and biologically rich inland surface water ecosystems. It represents a complete self-maintaining and self-regulating ecosystem. The dominating characteristics of aquatic environment result from the physical properties of water.

A water molecule is composed of oxygen atom which is slightly negatively charged bounded with two hydrogen atoms, which are slightly positive charged. This dipolar structure enables water molecules to attract and dissolve more substances than any other liquid on the earth.

On the other hand the solubility of oxygen is an essential resource of both plants and animals and decreases rapidly with an increasing temperature and oxygen diffuses only slowly in water.

Notable contributions are those of APHA 1998, Atkins et al. 1994, Avyapsan. S. et al. 1980, Chatterjee chinmoy and Raziuddin, M. 2000, Sutta Munshi and Rai. D. N – 1981, Mandal, B.K. & Hakim, A 1977, Michael, R.G. 1969, Naik, U.G. and Neelekanthan 1984.

The district of Vaishali is an important agricultural district of north Bihar situated in the north of river Ganga.

In view of above an attempt was made to assess the impact of various types of pollutants on physico-chemical characteristics of two ecologically different freshwater ponds.

MATERIALS AND METHODS

Monthly sampling of water was carried out in two ponds from January to December of 2018 in order to evaluate the physico-chemical parameters. Air and water temperature were recorded by mercury thermometer and pH with the help of pH meter. The transparency was measured by Secchi's disc.

Other parameters, such as dissolved oxygen (DO), free CO_2 alkalinity, chloride, phosphate, nitrate, BOD etc. were determined by standard methods (APHA 1995).

Pond-I situated at Pokhara Muhalla. This pond is moderately a large water body, almost square shaped with an area of 4 acres. The water depth of this pond was from 6 to 16 feet. The pond has sand and clay mixed bottom and was having coastal saprophytes. The bank was also provided with some trees. Bathing activities by the local people were usually noticed.

Pond-II is situated at Mamubhanja pokhar. It was comparatively smaller perennial water body, spreading in about 2.5 acres with an average depth of 6 feet. The adjoining areas of this pond are residential and thickly populated. It is subjected to pollution due to discharge of domestic sewage and by the defecation of local people. The sewage carrying amount of waters passing through the residential areas is discharged into the pond by large drain throughout the period of investigation. The northen bank of the pond is sloppy, covered with variable size of dense green vegetation. It is also infested with microphytes, especially Eicchorniacrassipes.

RESULTS AND DISCUSSIONS

Seasonal fluctuations of certain abiotic factors of pond waters have been shown in Table 1 & 2. During the present investigation, the minimum temperature was recorded in January (16.5^0C in pond-I and 16.2^0C in pond-II) whereas its maximum temperature was observed in June (32.5^0C in pond-I and 34.0^0C in pond-II) of the study period. Transparency was influenced mainly by suspended organic matter (Green 1974). A higher value of transparency was recorded in pond-I (31.3-47.5cm) than the pond-II (29.2-37.7cm). It may be due to minimum input from the surrounding. The low transparency in pond-II might be due to various human activities and domestic effluents from the adjoining areas. In the present study, higher transparency was recorded in winter months in both the ponds. This could be attributed to less decomposition of organic matter due to low temperature and less input of solids by the surface run off due to cessation of monsoon rain. This confirms the findings of George (1976). But Kaushik et al. (1991) observed higher transparency during summer in Matsya Sarovar at Gwalior. Low transparency was recorded during later summer and monsoon which may be due to influx of rain water in addition to huge suspended colloidal matters. Kumar et al. (1996) observed that domestic sewage is also responsible for low transparency.

pH is the index of water quality. Free CO_2 and total alkalinity show indirect impact upon the status of pH. During the present investigation, pH value ranged between 7.5 and 8.4 and 7.5 and 8.4 in pond-I and pond-II respectively. The pH value showed that the both ponds were alkaline in nature.

Low pH was observed during summer months which might be due to the surplus amount of free CO_2 on account of accelerated rate of decomposition during periods of high temperature. pH value in pond-II is comparatively higher than removed free CO_2 from the water during day time and high value of carbonates and bicarbonate in the water.

The dissolved oxygen ranged between 3.75 and 8.40 mg/l pond-I and between 3.20 to 7.35 mg/l in pond-II. The level of DO in a water body is perhaps of the greatest importance for the survival of the aquatic organisms. During the present investigation, both seasonal as well as spatial changes in oxygen content have been recorded. The general trend of changes in DO concentration during different seasons is directly or indirectly governed by fluctuation of temperature and BOD. Higher value of DO content was recorded in winter (pond-I), the period during which the water temperature was lowest. This might be due to that the solubility of DO increases with decreases in water temperature. Kumar (1996b) has reported low solubility of oxygen at higher temperature, which is also in close accordance with the present study. Loss of oxygen to the atmosphere and its utilization by faster decomposition of organic matter at higher temperature seems to be the cause for such an observation. Low value of DO in the same pond during monsoon in attributed to the reduction in photosynthetic activity and decomposition of organic matter. DO content was noticed comparatively low in pond-II throughout the study period which might be due to the high rate of oxygen

consumption by oxidisable matter coming in along with domestic sewage. This is further supported by Singh (1995) and Kumar (1996 b).

Free CO_2 was not recorded throughout the period of investigation in pond-I, it was present from June to October and the range was from 3.25 to 5.90 mg/l. Its presence during monsoon months may be due to the rain water and respiratory activities of aquatic biota. Pond –II was infested with microphytes, therefore, the presence of free carbon dioxide in water has fluctuated irregularly from 3.20 to 48.50 mg/l. The higher value in pond-II might be due to decomposition of algae and domestic sewage coming along with nearby drains. The carbonate was not always detected during the study period. The range of carbonate varied from 6.75 to 10.58 mg/l and from 12.65 to 21.85 mg/l in pond-I and II respectively. The bicarbonate value was recorded between 108 and 150 mg/l in pond-I whereas its range was between 298 and 440 mg/l in pond-II. The presence of higher total alkalinity in pond-II might be due to rich nutrient with higher productivity (Kumar et al. 1996).

The value of calcium ranged between 21.75 and 32.85 mg/l and 64.20 and 100.10 mg/l in pond-I and II respectively. The concentration of calcium was recorded higher in pond-II which may be attributed to the heavy discharge of organic matter through domestic sewage whereas pond-I received comparatively very little domestic sewage. The gradual rise in the calcium content from January to May in pond-II might be due to the rapid oxidation of organic matter in the substrate.

Contamination of water from domestic sewage can be monitored by the chloride assays for the concerned water bodies. This is because human and animal excretion contains an average of 5g chloride / liter (Singh 1997). During the present study, minimum content of chloride was recorded in May (17.50 mg/l) and January (72.56 mg/l) while maximum was recorded in the month of November (24.90 mg/l) and May (112.25 mg/l) in pond-I and II respectively. The maximum value of chloride content in pond-II can be directly correlated with high degree of sewage discharge and human interferences. This is further strengthened by its lower concentration in pond-I.

Thresh et al (1994) advocated that the presence of high chloride is the index of pollution of animal origin. Kliein (1957) was also of the opinion that the chlorides appear in aquatic environment mainly due to the sewage contamination. The higher concentration of chloride during summer (May) in pond-II may be associated with reduced water level and frequently run – off loaded with contaminated water from the surrounding settlement and high rates of evaporation. Sunder (1983) and Kumar (1995) have also observed the same pattern.

The phosphate content is considered to be nutrient of major importance in production process (Vollenwider 1968). But Jones and Lee (1982) have conveyed that an emphasis on phosphorus control will have to be given while evaluating eutrophication control options because of its ability to stimulate algal growth as well as the growth of other aquatic plants. The increased application of fertilizers, use of detergents and domestic sewage play a great role in contributing the heavy loading of phosphorus in water (Golterman 1975).

During the present investigation, the phosphate contents were found comparatively higher (0.198-0.855 mg/l) in pond-II, because this water body receives the influx of sewage effluents and decomposed organic matter. The value of phosphate was also observed fluctuating from season to season. Its value was maximum during summer months. The increased solar radiation light have encouraged of the biological degradation of organic matter and subsequent release of more phosphate.

The nitrate content is an excellent parameter to judge the organic pollution and it represents the highest oxidized form of nitrogen. The range of nitrate value was recorded between 0.250 and 1.088 mg/l in pond-I and between 0.265 and 1.670 mg/l in pond-II. During the present study the higher value of nitrate was recorded during rainy season which might be due to influx of the nitrogen rich flood water that brings large amount of contaminated sewage water. However, the nitrate values were sufficiently found higher in summer season in pond-II which might be due to the increased rate

of decomposition of organic matter on account of high temperature and concentration of sewage discharge.

During the present investigation, the range of BOD was from 1.90 to 3.40 mg/l in pond-I and from 5.20 to 9.55 mg/l in pond-II. Higher value of BOD was observed during monsoon in pond-I because of input of organic wastes and enhanced bacterial activity, and heavy value of BOD during summer could be attributed to high bacterial activity and heavy input of organic matter. Its lower value during winter might be due to retarded bacterial c=activity affected by decreased light intensity and temperature. Similar observations are also made by Paramasivam and Sreenivasan (1981) Sinha et al. (1990) and Kumar (1997).

The overall picture emerging during the present investigation shows that the sewage pollution has become a great problem in Bihar. Thus, the present study may appear a simple one, but the results are indicative of a big issue, especially in that area which is not rich economically but turbulent politically. Such small ecological problems may add fuel to the fire that can ultimately upset the whole nation. Thus, the crying need of time is the proper environmental management and mass awakening among the people right from the grass root level to the top echo planner. Only then our long cherished dream of establishing the "Ecological Socialism" on the neglected land of Hajipur could come true.

Table 1: Monthly variation in physico–chemical characteristics of two ecologically different ponds at Hajipur Town from January to December 2018

Months	Pond	Wat. Temp.( )	Transparency (cm)	pH	DO	Free CO_2	Carbonate
January	I	16.5	43.8	8.1	7.20	-	8.5
	II	16.2	31.2	8.3	4.25	25.45	-
February	I	22.1	41.9	8.1	6.85	-	10.8
	II	20.3	30.5	8.1	4.54	22.48	-
March	I	26.9	42.1	8.3	6.03	-	11.65
	II	26.5	31.4	8.3	7.32	48.50	-
April	I	29.4	38.2	7.2	5.20	-	6.80
	II	28.5	31.5	8.0	4.08	-	18.5
May	I	32.2	38.0	7.7	5.12	-	7.5
	II	30.5	29.6	8.0	4.50	-	15.5
June	I	33.5	38.2	7.7	4.55	4.50	12.60
	II	33.8	30.2	7.9	3.25	-	-
July	I	32.4	31.5	7.4	3.72	5.90	-
	II	31.2	29.4	7.2	3.20	7.50	-
August	I	31.3	33.5	7.8	4.25	4.00	-
	II	31.5	32.3	8.1	3.20	18.50	-
September	I	30.1	36.5	8.0	5.35	5.30	-
	II	30.2	34.2	8.1	4.25	3.20	-
October	I	29.4	44.8	8.2	6.85	3.25	-
	II	28.6	34.4	8.2	5.35	-	16.2
November	I	23.4	45.6	8.4	7.40	-	9.5
	II	23.2	36.4	8.3	4.70	-	14.5
December	I	18.4	46.6	8.1	8.42	-	10.3
	II	18.2	38.8	7.9	4.95	-	21.80

All parameter values are in mg/l except Temp. &pH.

Table 2: Monthly variation in physico–chemical characteristics of two ecologically different ponds at Hajipur Town from January to December 2018

Months	Pond	Bicarbonate	Calcium	Chloride	Phosphate	Nitrate	BOD
January	I	145	31.65	19.95	0.030	0.238	2.15
	II	335	90.30	72.55	0.205	0.545	5.25
February	I	155	39.80	21.25	0.032	0.325	2.25
	II	355	91.30	69.20	0.410	0.305	6.40
March	I	138	32.55	22.75	0.065	0.633	2.95
	II	415	95.30	88.95	0.602	0.865	8.35
April	I	148	31.15	21.10	0.050	0.572	2.95
	II	425	96.60	100.15	0.855	1.645	8.60
May	I	145	26.35	17.55	0.130	0.460	2.90
	II	468	100.15	112.25	0.345	1.675	9.50
June	I	130	32.50	20.20	0.135	0.460	2.90
	II	440	93.90	87.15	0.720	1.675	8.20
July	I	108	23.25	20.75	0.045	0.805	3.40
	II	375	77.35	78.15	0.502	0.833	6.75
August	I	125	23.35	22.55	0.015	1.085	3.50
	II	318	70.75	76.45	0.512	0.910	7.80
September	I	114	22.45	23.60	0.012	0.855	3.70
	II	298	64.20	73.35	0.495	0.670	5.30
October	I	115	21.75	23.65	0.025	0.455	3.10
	II	338	73.45	71.35	0.435	0.615	6.25
November	I	118	24.65	24.95	0.028	0.282	2.20
	II	366	77.20	76.30	0.320	0.440	6.35
December	I	125	28.10	21.45	0.033	0.220	1.90
	II	842	90.65	74.15	0.210	0.565	5.25

All parameter values are in mg/l

REFERENCES

1. APHA 1985. Standard methods for the estimination of water and waste water. Inc Newyark, 20th edition 29-248, 287, 4134, 53-947 PP
2. Basu B 1986. Environment protection- a many faceted problem. Yojun.30: 4-6
3. Bosc S.K. and LarKra M.P.1994.studies on the micro-zoobenthos of two freshwater ponds of Ranchi J. freshwat. Bio.6: 135-142.
4. Kant S and Vohra S 1990. Lakes their management and conservation.In Management of Aquatic Ecosystem. Ed. V.P. Agarwal, B.N Desai and S.A.H. Abidi. Society of Bioscience, Muzzafarnagar.155-168.
5. Kumar A 1996 a. The limnological profile of a tropical fish farming pond at Dumka (SantalPargana), Bihar.3..Ecobiol.8:117-122.
6. Kumar A 1996 b. Impact of Industrial pollution on the pollution status of the endangered Gangeticdolhhin (Platanistagengetic) in river Ganga, Bihar, India. Pol.Arch. Hydrobiol. 43:469-476.
7. Singh M 1995 Impact of human activities on the physic-chemical conditions of two fish ponds at Patna, Bihar. J. Freshwat. Biol.7:13-17.
8. Singh A.K. 2004.Arsenic Contamination in ground of North Eastern India.
9. Singh M.P. Singh R and Mehrotra P.N. 1994Limnobiotic investigation of a trophical freshwater reservoir. J. Freshwt. Biol.6:215-219.
10. Mukherjee A., Sengupta M.K., Hossain M.A. 2006. "Arsenic contamination in groundwater, Journal of health population and nutrition 24(2): 142-163.

11. Chatterjee Chimoy and Reziuddin , M 2000 Assessment of physic-chemical and Mirobial status of a pollute river water in relation to its impact on public health 'symp". Environmental degradation and its bioremedies. Abs 30-32.
12. Pandey J. Pandey, Usha, Tyagi H.R. Nutrition status and cyanobacterial diversity of a tropical fresh water lake. J. Environ. Biol 2000: 21(2) 133-138.
13. Sikoki F.D, Veen J.V, Aspect of water quality and the potential for fish production of Shiror Reservoir, Nigeria, living system sustainable development 2004.
14. Soni R.N, Bhatt S.A. Periodical Ecological study of an urban bond near Vododara, Gujarat, India. Proceeding of Toal (2007). The 12th World Lake Conference 1591-1596.