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STUDIES ON THE PHYSICO-CHEMICAL ASPECTS OF AZIZ BHATTI LAKES

Saiyida Nazneen and Ghazala Jamal

Department of Zoology, University of Karachi, Karachi-32

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This paper deals with the study of physico-chemical conditions of the Aziz Bhatti lakes. These are two artificial lakes which were constructed in 1970. During the course of this study the peaks of water temperature were always found coinciding with the atmospheric temperature. No marked variations were observed in the pH and colour of water. Generally the high values of nutrients were observed throughout the year and it may be due to the decomposition of aquatic weeds because both of these lakes have large quantities of aquatic weeds and they are almost in senescent stage.

Key words: Nutrients, Aquatic weeds.

INTRODUCTION

The Aziz Bhatti lakes are situated in the Aziz Bhatti Park which is located in the east of district Karachi, nearly 3 km away from Karachi University on the left side of the university road. These lakes lie between $24^{o}.55$ N latitude and 67^{o} .06 E longitude. These are artificial lakes covering an area of about 8 acres (personal communication by the KDA Office). These were actually two depressions, one was big and the other was small. They were formed during the construction of the Dalmia cement factory. To these depressions water is supplied from a water purification plant through C.O.D. The work on these lakes was started in 1966 and was completed in 1970. In the beginning both depressions were about 90 feet deep but due to continuous silting and deposition of decaying plant matter the depth of these lakes has now decreased upto 40 feet in the centre and 2-3 feet at the sides.

These lakes are surrounded by small gardens and lawns (Fig. 1). In addition to enjoyment and pleasure, these lakes can also be used as a natural habitat for the cultivation of fresh-water biota in order to propagate limnological studies in Pakistan. The present study deals only with the physico-chemical factors of these lakes but in future we intend to study the biota of lakes also.

MATERIALS AND METHODS

The data of atmospheric temperature was obtained from the Meteorological Department at Karachi while the water temperature was measured directly in the field and the colour of water was noted by the naked eye.

Water samples were collected by using Nansen's sampling bottles, usually between 9.00 a.m. to 3.00 p.m. The water was then stored in a deep freeze in plastic bottles of half litre capacity and chemical analysis were made within 24 hr. The pH was recorded at the spots by the help of Merck pH paper. The water samples were filtered before chemical analysis and their optical densities were noted on a spectrophotometer (model UV-120-02).

The dissolved oxygen was estimated by the Winkler method. Free carbon dioxide was titrated against N/44 sodium hydroxide solution with phenolphthalein as the indicator [1]. The inorganic phosphate was measured with ammonium molybdate and ascorbic acid [2]. The quantity of ammonia was determined by the modified method of Ellis *et al.* [3] of the Nessler method. Nitrate

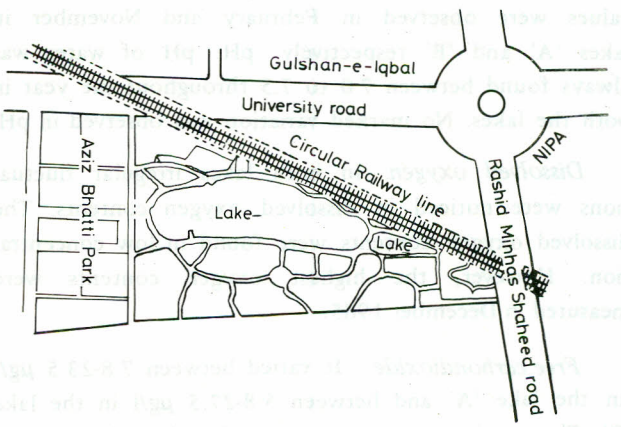

Fig. 1. Map of the Aziz Bhatti Park, showing lakes inside the park

nitrogen was estimated using phenoldisulphonic acid [4]. The total iron was measured with potassium thiocyanate solution following the method of Ellis *et al.* [3]. The salt contents of water were estimated by the procedure of Welch [1]. The organic matter was determined by weighing the total filterables and residual solids obtained on evaporation by the sample at hot plate. The biological oxygen demand (BOD) and chemical oxygen demand (COD) were also determined by the method of Golterman *et al.* [5].

RESULTS

The following physico-chemical features of the waters of Aziz Bhatti lakes were studied from July 1985 to June 1986. The seasonal variations of each parameter has been shown in Tables 1 and 2 and the brief discription is given below.

Atmospheric temperature. Generally an increasing pattern of atmospheric temperature was noticed from February to June followed by a sudden decrease in July while the minimum temperature was observed in December.

Water temperature. The pattern of water temperature is similar to atmospheric temperature. The highest temperature was recorded during the months of May and June and lowest in December and January.

Colour of water. The colour of water was pale greenish from July to September 1985 at the spot 'A' while the colour of water was more greenish at spot 'B' during these months. In both lakes the colour was became lighter from the month of October 1985 to June 1986.

Salinity. The salinity of water irregularly fluctuated between 0.5-2%. The highest salinity values were observed in both lakes in the month of August while the lowest values were observed in February and November in lakes 'A' and 'B' respectively. pH: pH of water was always found between 7.0 to 7.5 throughout the year in both the lakes. No marked variation was observed in pH.

Dissolved oxygen. In both lakes irregular fluctuations were noticed in dissolved oxygen contents. The dissolved oxygen contents were found in low concentration. However, the highest oxygen contents were measured in December 1985.

Free carbondioxide. It varied between 7.8-23.5 μg/l in the lake 'A' and between 5.8-27.5 μg/l in the lake 'B'. The maximum concentration of carbon dioxide was recorded in December in both lakes.

Dissolved phosphate. The dissolved phosphate varied between 50-1000 μg/l. The maximum phosphate values in both lakes were observed in March and April, while the minimum values were noticed in the summer months.

Ammonia. The ammonia was present almost the double amount of the nitrate in both the lakes. However, the general pattern of ammonia distribution is similar to the nitrate.

Nitrate. Like dissolved phosphate great fluctuations i.e. 100-1350 μg/1 were observed in the nitrate contents of the water of the two lakes. Nitrate contents of the water recorded an increased after the month of December in Aziz Bhatti lakes.

Total iron. In comparison with other nutrients its concentration was noticed in lesser quantities i.e. 33-145 μg/1 round the year. The level of total iron was highest in the months of December and January while the lowest concentrations were recorded in October in both the lakes.

Total filterables and volatile solids. Both these contents were measured only once. The total filterables were found 600 μg/l in the lake 'A' and 450 μg/l in the lake 'B' while residual solids were found to be 363 μg/l and 272 μg/l in both lakes respectively.

Biological oxygen demand (BOD) and chemical oxygen demand (COD). BOD and COD were also analysed only once during this study. The BOD was recorded 5014 μg/l in the lake 'A' and 6071 μg/l in the lake 'B', while COD was 1614 μg/l and 2028 μg/l in both the lakes respectively.

DISCUSSION

Aziz Bhatti lakes can be called ornamental lakes as they were chiefly formed for the purpose of recreation [6]. Both the man-made reservoirs and the natural waters differ so greatly that even two ponds in a similar locality cannot be considered identical to each other [7], because each aquatic environment is a complex system in which chemical and biological reactions take place. Biological reactions like chemical ones work at faster rates as the temperature increases. The hydrological factors are of two types: (i) controlling factors including light and temperature and (ii) limiting factors including nutrients which regulates the whole aquatic life [8]. Thus studies on the physico-chemical parameters are very important.

Aquatic organisms are poikilothermic i.e. their body temperature is identical to the surrounding water or in other words they are at its mercy. Temperature also affects

the buoyancy of organisms and this causes variation in the distribution pattern of species [9]. In the present study the temperature changes of the water are very similar to the atmospheric temperature (Tables 1 and 2). A similar direct relationship between water temperature and the atmospheric temperature was also noticed by Ganapati [10], Jayangoudar [11] and Nazneen [12].

In addition to climatic and physical factors chemical factors also play a vital role in the aquatic food chain, particularly on producer organism [13-15]. Peaks of phytoplankton always correlates high pH values [8]. However no marked variations in pH were found in the present study (Tables 1 and 2). According to Welch [16] pH remains practically constant over considerable periods of time. Besides the pH salts contents of water also affect the distribution of biota. The salt contents of Aziz Bhatti lakes were greater than those of the Haleji and Kinjhar lakes [12, 17]. In the Aziz Bhatti

Table 1. Seasonal variation of physico-chemical parameters of water in Lake 'A'

Months	Atmospheric temp. (^{o}C)	Water temp. (^{o}C)	Colour	Salinity (%)	pH	Dissolved oxygen (μg/1)	Free CO_2 (μg/1)	Dissolved phosphate (μg1)	Ammonia (μg/1)	Nitrate (μg/1)	Total iron (μg/1)
July	28	28	Pale green	1.0	7.0	242	19.6	50	1300	470	56
August	30	30	"	2.0	7.0	285	15.7	56	1680	350	53
September	29	29	"	1.4	7.2	257	17.6	100	1880	470	40
October	29	29	L. pale green	1.0	7.1	214	15.7	300	1800	350	33
November	25	25	"	1.1	7.3	485	19.6	200	2100	300	40
December	15	17	"	1.5	7.5	971	23.5	380	2200	470	118
January	16	18	"	1.0	7.0	714	7.8	400	1680	1360	124
Feburary	17	18	"	0.4	7.1	571	9.8	600	1380	1060	100
March	18	25	"	0.5	7.0	314	7.8	1000	1000	910	130
April	25	29	"	1.2	7.5	314	15.7	1100	800	1020	140
May	29	30	"	1.0	7.0	257	7.8	700	1100	910	145
June	30	30	"	1.5	7.2	271	11.7	700	1200	910	140

Table 2. Seasonal variation of physico-chemical parameters of water in Lake 'B'

Months	Atmospheric temp. (^{o}C)	Water temp. (^{o}C)	Colour	Salinity (%)	pH	Dissolved oxygen (μg/1)	Free CO_2 (μg/l)	Dissolved phosphate (μg1)	Ammonia (μg/1)	Nitrate (μg/1)	Total iron (μg/1)
July	28	28	Dark greenish	1.3	7.0	271	13.7	56	1380	230	46
August	30	30	"	2.2	7.0	485	11.7	56	1680	100	53
September	29	29	"	1.6	7.2	314	19.6	59	1580	180	33
October	29	29	L. "	1.4	7.1	342	27.5	300	1200	290	33
November	25	25	"	0.7	7.3	728	23.5	200	1880	270	40
December	15	17	"	1.0	7.5	800	19.6	300	2200	230	118
Janauary	16	18	"	1.8	7.0	185	9.8	500	1800	1000	124
February	17	18	"	1.3	7.1	314	5.8	400	1580	910	145
March	18	25	"	1.5	7.0	285	5.8	900	1200	1350	124
April	25	29	"	2.0	7.5	271	11.7	1000	700	940	130
May	29	30	"	1.8	7.0	214	9.8	400	900	1000	140
June	30	30	"	1.8	7.2	242	9.8	400	1000	980	140

lakes irregular fluctuations were observed in oxygen and free carbon dioxide values (Tables 1 and 2). The highest values of both gases were measured in December 1985 and low concentrations were observed in summer months. The low concentrations of carbon dioxide may have coincided with the summer peaks of phytoplankton in tropical environment [18, 19]. In comparison with carbon dioxide oxygen was found in low quantities. According to Shelfred [20] oxygen content is reduced in waters having extensive growth of plants while the minimum contents of oxygen in summer months may be attributed to high summer temperatures as pointed out by Ruttner [9] (the respiration of aquatic organisms depend not only on the dissolved oxygen contents but also on the surrounding medium and oxygen consumption is almost the doubled by the rise of 10^{o} and lake showing a decline in oxygen in summer months).

Besides the oxygen and carbon dioxide comparatively rich quantities of dissolved phosphate, ammonia, nitrate nitrogen and total iron were recorded throughout the year (Tables 1 and 2). A significant amount of these nutrients were also measured in the Kinjhar lake [12] and freshwater bodies of the Punjab as reported by Ali *et al* [21]. However, the maximum values of ammonia and nitrate nitrogen from the lake autumn to winter season can also be attributed to the poor growth of primary producers during these months in tropical waters as reported by Nazneen [22]. The high quantities of nutrients almost round the year in both spots may be due to the excessive growth of aquatic weeds because both the lakes are heavily filled with aquatic plants (Fig. 2). The nitrogen fixing ability and, the decomposition of these aquatic weeds play a major role in the liberation of nutrients in the water bodies [6]. Besides this, the evapotranspiration rate of water also increases with aquatic plants. The huge quantities of these weeds also causing great damage to the lakes. Presently these lakes are in senescent stage (Fig. 2) and the removal of aquatic weeds from these lakes is very necessary for their existence.

Fig. 2. Showing the senescent stage of Aziz Bhatti lake 'A'

REFERENCES

1. P.S. Welch, *"Liminological Methods"* (McGraw Hill Book Co., Xi, New York, 1948), pp. 538.
2. D.N. Foggxend, N.T. Wilkinson, Analyst, **83**, 406 (1958).
3. M.M. Ellis, A. Wastfall and M.D. Ellis, Fish and Wild life Service, U.S. Deptt. Interior Res. Rep. 9 122 pp.
4. F.D. Snell and C.T. Snell, *"Colorimetric Method of Analysis" (D., Van Nostrand Company, Inc. London), Ed. 3rd.*
5. H.L. Golterman, R.S. Clymo and M.A.M. Ohustad. *Methods for Physical and Chemical Analysis of Fresh Waters,* (Blackwell Sci. Publ., 1978), Ed. 2nd, pp. 148-154.
6. P. Stery, Pond Watching, Hamtlyn Paperback, 6-112 (1983).
7. G.E. Hutchunson, *"A treatise on Limnology"* (John Wiley & Sons. Inc. New York (1967), 1, pp. 1015.
8. A.M. McCombie, J. Fish Res. Bd. Con., **10**, 253 (1953).
9. F. Ruttner, *"Fundamentals of Limnology"*, 3rd ed. (Univ. Press, Toronto, 1963), pp. 295.
10. S.V. Ganapati, J. Bombay, Nat. Hist. Soc., **42**, 65 (1940).
11. I. Jayangoudar, Hydrobiol., **23**, 515 (1964).
12. S. Nazneen, Int. Rev. Ges. Hydrobiol., **65**, 269 (1980).
13. M.G. George, Proce. Indian Acade. Sci., **569**, 345 (1962).
14. Dennis and Kubly, Arch. Hydrobiol., Suppl., **62**, 491 (1982).
15. Y. Norman, Can. J. Fish Aquat. Sci., **4**, 621 (1982).
16. P.S. Welch, *"Limnology"*, (McGraw Hill Book Co., New York, 1952), Ed. 2nd., pp. 381.
17. I.U. Baqai, P.A. Siddiqui and M. Iqbal, Agr. Pakistan, **25**, 321 (1974).
18. S.M. Das and V.K. Srivastava, Proc. Indian Nat. Acad. Sci., **29**, 174 (1959).
19. S. Nazneen and G.A. Bari, Pakistan J. Agric. Res., **5**, 183 (1984).
20. V.E. Shelfred, Puget. Sound Marine Sta. Publ., **1**, 157 (1916).
21. S.R. Ali and Z.U. Khalil, Bull. Hydrobiol. Res. Gordon College, Ser., **1**, 338 (1977).
22. S. Nazneen, Pakistan J. Bot., **6**, 69 (1974).