Ecological Studies of Lake Udaisagar with Reference to its Physico-chemical Environment

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ABSTRACT

In the present work an attempt has been made to study various physico-chemical characteristics of Udaisagar lake. The study indicates that the lake is highly polluted, eutrophicated and hard alkaline water body. The major source of pollution is river Ahar which brings sewage of Udaipur city and industrial wastes of Madri Industrial Estate to the lake.

INTRODUCTION

Udaipur is known as city of lakes as a large number of lakes are located in and around Udaipur. These lakes are not only the beauty spots and tourist attraction but are also the source of drinking and irrigation water. The lakes have been damaged to the extent that all measures to arrest further damage may fail in the near future. A huge amount of undesirable elements are constantly being added, which are hastening the process of eutrophication. The problem of eutrophication in the lakes around Udaipur has reached alarming proportions.

Udaisagar lake is one of the important sources of water supply for irrigation and the main source of water supply to zinc smelter, a factory of Hindustan Zinc Limited. The lake is getting polluted by the drainage of Ahar River which carries the sewage and industrial wastes of Udaipur distillery and Madri Industrial Estate. At times, heavy blooms of algae, especially of *Microcystis aeruginosa* have been observed in this lake. Deterioration of water quality and interruption in industrial water supply are matters of great concern to the authorities.

Udaisagar lake is now highly eutrophic as indicated by bloom formation by *Microcystis aeruginosa* during the summer and rainy months. *Microcystis aeruginosa* is one of the best known indicator of sewage pollution of lakes.

Purely physico-chemical investigations in lentic and lotic waters in India have been made by several workers such as Purohit & Singh (1981), Patil et al. (1984), Patra & Nayak (1983), and Patil et al. (1984).

In view of the above, present investigation was undertaken to study certain physico-chemical characteristics of water in relation to nutrient status as well as water pollution in Udaisagar lake.

MATERIALS AND METHODS

The samples were collected during the morning hours (8 to 11 a.m.) in the 2nd week of every month.

Standard methods (APHA 1980) and Mackereth (1963) were followed.

RESULTS AND DISCUSSION

The data on physico-chemical characteristics of Udaisagar for the year 1985 and 1986 are presented in Tables 1 and 2 respectively.

Temperature is one of the most important factors in an aquatic environment (Ruttner 1963) and no other single factor has so many profound influence and so many direct and indirect effects (Welch 1952). Hence, it has been investigated by almost all the limnologists. Temperature affects many chemical processes and thus the entire ecosystem. Observations on seasonal fluctuation in water and air temperatures suggest that there exists an intimate relationship between air and water temperatures, since both of them exhibit a similar pattern in regard to their fluctuation.

Secchi disc transparency was much limited during summer and rainy months, depending on the thickness of the bloom and intensity of light thereby checking the growth of bottom vegetation and other competitors in the plankton.

Somewhat similar values that is, lower transparency during summer and rainy months and higher transparency during colder months have been reported by Pandey & Pandey (1983). This indicates very clearly the high level of turbidity of lake water, especially during summer and early monsoon period.

Welch (1952) is of the opinion that pH plays an important role in aquatic systems, especially when some other factors are in an unfavourable range. This single parameter can explain many of the limnological properties. The lake water was sufficiently alkaline in both the years, viz. 1985 and 1986. A slight decline in pH in rainy season is probably due to effect of dilution by rain water.

Hutchinson (1957) asserted that a skillful limnologist can probably learn more about the nature of a lake from a series of oxygen determination than from any other kind of chemical data. Of all the chemical substances in natural waters, oxygen is the most significant, both as a regulator of metabolic processes of the community and as an indicator of lake conditions. Dissolved oxygen concentration in surface lake waters was recorded to be maximum during winter in comparison to the rainy season, and minimum during summer in both the years. The higher concentration of DO in winter was probably due to the fact that conditions during winter are more favourable for higher photosynthesis. The lower value of DO during summer explains its quick utilization in the oxidation processes of the lake. The values recorded for different lentic and lotic inland freshwater bodies of India follow more or less the similar pattern as observed in the present work.

According to Vallentyne (1957) and Hutchinson (1957), dissolved organic matter in water may be considered as a dilute soil extract, consisting largely of humic, non-humic and many other organic compounds of known biological importance. The soluble organic matter accumulated in water in large proportion during summer and early monsoon, but decreased after heavy rainfall and reached minimum during winter. This is in accordance with the observations of Singh (1960) and Zafar (1964) who attributed the higher concentrations during summer to the accelerated rate of bacterial decomposition and during monsoon to the surface runoff. Most probably, the same was true for Udaisagar.

Acidity of the water is its capacity to neutralize a strong base to a fixed pH. It is caused by the presence of salts of strong mineral acids and weak bases.

Free carbon dioxide is more soluble in water than oxygen and nitrogen. It forms the compound carbonic acid (H_2CO_3) with water, and this acid ionizes to a small degree. A study of the carbon dioxide content of lake water is, therefore, of great importance in understanding the hydrogen ion concentration of water.

In natural unpolluted freshwater bodies the acidity is mostly due to presence of free carbon dioxide in the form of carbonic acid. Thus, acidity and free carbon dioxide are intimately correlated. The presence of free carbon dioxide indicates the presence of plenty of oxidizable organic matter while the absence of free CO_2 in the present study suggests that the dissolved inorganic carbon dioxide, necessary for photosynthesis, was obtained from bicarbonates. The absence of free carbon dioxide indicates probably very high rate of photosynthesis.

Maximum concentration of phosphate in surface lake waters was observed during the rainy season. This is probably due to the incoming rainwater, which contains all types of sewage and other rubbish matter including agricultural wastes which empty into the Udaisagar lake. The importance of the inflow of phosphate content through the catchment area during the rainy season has been emphasized by Vyas & Kumar (1968) and Verma & Shukla (1970), who have also reported high concentration of phosphates during the rainy season. Wastes from human body and domestic cattle, farmland, run off and leaching from soil are the important sources of nitrogen.

According to Sylvester (1961), the domestic sewage is mainly responsible for greater concentration of nitrates in freshwater bodies. Hem (1959) pointed out that the use of soil fertilizers in the agricultural farms around lakes may add large amounts of nitrates to the water. The maximum concentration of nitrate in the lake during the rainy season confirms that its sources is through the incoming waters during the rains. A similar explanation for the maximum concentration of nitrate during the rainy season has been proposed by Vyas & Kurnar (1968) and Adoni (1975).

CONCLUSION

It may be concluded from the present study that Udaisagar lake is highly eutrophicated, highly polluted and hard water body as indicated by water bloom formation, a large accumulation of soluble organic matter, and the higher values of nitrates and phosphates during the rainy season.

ACKNOWLEDGEMENT

Table 1: Physico-chemical characteristics of Udaisagar lake during the year 1985.

S.No.	Water characteristics	Summer (March-June)	Rainy (July-October)	Winter (November-February)
1.	Temperature (°C)			
	(a) Air	29.50	28.17	20.22
	(b) Water	27.00	26.00	18.72
2.	Transparency (m)	0.36	0.36	0.80
3.	pH	8.63	8.09	8.52
4.	Dissolved oxygen (mg/L)	3.99	7.80	10.63
5.	Dissolved organic matter (mg/L)	13.93	16.97	8.00
6.	Total acidity (mg/L)	5.12	4.00	Nil
7.	Phosphate (mg/L)	0.39	0.71	0.42
8.	Nitrate (ppm)	0.37	0.66	0.55
9.	Free carbon dioxide (mg/L)	4.50	3.52	Nil

Table 2: Physico-chemical characteristics of Udaisagar lake during the year 1986.

S.No.	Water characteristics	Summer (March-June)	Rainy (July-October)	Winter (November-February)
1.	Temperature (°C)			
	(a) Air	30.00	28.67	20.47
	(b) Water	27.50	27.00	19.02
2.	Transparency (m)	0.45	0.44	0.86
3.	Hydrogen ion conc.	8.61	8.06	8.51
4.	Dissolved oxygen (mg/L)	4.14	5.57	5.67
5.	Dissolved organic matter (mg/L)	6.93	6.63	6.50
6.	Total acidity (mg/L)	2.06	3.43	0.31
7.	Phosphate (mg/L)	0.41	0.83	0.45
8.	Nitrate (ppm)	0.40	0.69	0.54
9.	Free carbon dioxide (mg/L)	1.81	3.00	0.27

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