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Research Article

Seasonal Study of some Chemical Parameters in Daryabganj Lake, District Etah

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Abstract: In India, great regional differences are found in the topography, geology, climate etc. As a result of these differences, the limnological resources (lake, pond & reservoirs) are very unevenly distributed. The inland fisheries include, besides capture fishes of the lake, rivers and large bodies of waters, the culture fishery whose contribution to the dietary of man is of the highest importance. From the catch statistics of these waters, it becomes quite clear that fish production is low in comparison to those of other countries like China, Japan, Indonesia etc. The efforts for increasing fish production in inland waters are underway; however, any effort towards developing the fish resources requires intimate knowledge.

Keywords: Limnological resources, Fish production, pH, Carbon Dioxide, Dissolved Oxygen.

1. Introduction

The fish production, especially in Daryabganj Lake depends mostly on physicochemical properties of the fishery water. It is well known that water is the basic element in fish culture, therefore, its specific properties as culture medium are of great significance in the productivity of fishes. However, the vital life processes are at optimum when the physical and chemical conditions are normal. The important physical and chemical factors, taken for the study of Daryabganj lake. Water plays a significant role in controlling the distribution, survival, and growth of the fishes. The planktonic community is a group of tiny plants and animals, drifting or feebly swimming in the water mass (Welch, 1952). The phytoplankton is the basic source of food in a water body and the beginning of trophic cycle which supports consumers, including fish. According to Hutchinson (1967), phytoplankton is an assemblage of organisms constituting the greater part of photosynthetic production level of the water body. Zooplankton has an influence on ionic composition and nutrient availability. Plankton is used as food not only by planktivorous organism but even the herbivorous, carnivorous and piscivorous, fish also make use of this food component at one or other stage of their life cycle. Plankton is also an indicator of trophic status of a water body. In an aquatic environment, macrophytes exhibit a dominating influence on the abiotic and biotic factors. The hydrological factors represent the chief milieu of conditions governing the occurrence and growth of various macrophytic species.

Incidentally, no work has so far been done on the hydrobiological properties and fisheries of Daryabganj lake of Etah district. This is an exercise in identifying fish fauna and hydrobiological conditions of Daryabganj Lake. The proposed work has, therefore, been undertaken, keeping in view the complete survey with the aim of development and extension of fisheries. Present limnological investigations of Daryabganj lake are undertaken to record seasonal fluctuations in abiotic parameters (Temperature, light penetration, turbidity), for a period of one year (July 2000 to June 2001).

2. Methodology

2.1 Sampling and Analysis Methods

Monthly water samples were collected in specially designed water sampler from three experimental stations of Daryabganj Lake. At the time of water sampling, temperature, depth, and transparency were also noticed. The sampler was lowered into the water through the cord (graduated in Centimeters) and when the desired depth was reached, the lid of the bottle was opened by pulling up the lid cord. When the bottles filled, the lid cord was released and the sampler took out and the complete filling of the bottle was ascertained by observing the displaced air bubbles, which ceased to come upon the surface of the water. The sampling bottle used in the sampler was of one litre capacity. From each depth of all the experimental stations, three samples of water was collected, one for plankton counts second for physicochemical attributes of water and the third for estimating the dissolved oxygen.

pH is indicative of Hydrogen-ion concentration plays an important role in the biotic life of a water body. It is often used as an index for water condition. pH is

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measured on a scale of 1 to 14. If the pH is in between 6 to 7 indicates that the water is neutral. A pH of 7 to 14 means the water is basic or alkaline. Majority of natural waters are alkaline. Acidic water with pH below 6 is unsuitable for fish life. Alkalinity of water is mainly due to calcium salts in the form of bicarbonates and carbonates. For the analysis of oxygen dissolved in water, sample was taken out from the sampling bottle with the help of rubber siphon into separate airtight glass stopper bottles of 250ml capacity. Almost care and precautions were taken to avoid bubbling so that atmospheric oxygen will not diffuse inside the bottle containing the sample water. Oxygen was estimated by Winkler's method and its percentage saturation according to Hutchinson (1975). Standard methods are used for the determination of free CO_2. Dissolved oxygen was fixed by adding 1ml each of manganese sulphate ($MnSO_4$) and alkaline potassium iodide (KI). The bottle was thoroughly shaken and the precipitate so formed was allowed to settle down. To dissolve the precipitate 2ml concentrated sulphuric acid is added to the bottle and it was again well shaken to mix the contents. 100ml of this solution was titrated with N/80 sodium thiosulphate using starch as an indicator. Results were also compared by Alsterberg's alkaline sodium azide method (APHA, 1975). Carbon dioxide was estimated by sodium carbonate method. 100ml of sample water was titrated against N/20 sodium carbonate using 0.1% phenolphthalein as an indicator. Results were also compared by titrimetric method adopted for the estimation of free carbon dioxide (APHA, 1975).

2.2 Geographical Study of Daryabganj Lake

Daryabganj lake is located in Aliganj Tehsil of Etah district, about 47 km from the district headquarter on Aliganj road and 17 km away from Ganjdundwara. The coverage area is about 89.795 hectares. The lake has semilunar shape and surrounded by Kuda, Konar and Nagaria villages. The water depth varies from 5' to 16' feet. The experimental site will be near Kuda village (site A), Konar Nagla village (site B) & Nagaria village (site C).

3. Results and Discussion

3.1 pH

The alternation of pH of water is accompanied by changes in other physicochemical aspects of the medium. Ray (1955) suggested that high pH promotes the growth of phytoplankton. Similar observations have been reported by Mishra *et al*., (1992); Bhatt & Pathak (1992); Sharma *et al*., (1994) and Basheer *et al*., (1996).

In freshwater ecosystem, the usual hydrogen-ion concentration encounters towards the middle of the pH scale and seem to leave little differential effect on the majority of habitats. The distribution of many aquatic organisms unrelated to pH over a range except for some organism. Ellis (1940) pointed out that fish and other aquatic organisms prefer pH between 6.7 to 8.4 and a pH below 5.0 and above 8.8 may be detrimental or even lethal to aquatic life. Barrett (1953) has reported that the hard waters are more productive than soft water. Hora & Pillay (1962) observed that slightly alkaline water (pH slightly above neutrality) is suitable for fish production. The pH range 5 to 6.6 and 9.1 to 11.0 results in low productivity.

Daryabganj lake pH has shown annual variations of 7.7 to 8.6 at station 'A', 7.6 to 8.6 at station 'B' and 7.5 to 8.6 at station 'C'. The annual range of pH is higher than the earlier reports of Vasisht and Sharma (1975) Urban pond (7.0-7.3) Ambala, Kant and Raina (1985) from two ponds (6.0-8.1 and 6.5-8.3) of Jammu, Patil *et al*., (1985) freshwater fish tank, Jabalpur (7.0-8.0), Singhal *et al*., (1985) Jyoti Sagar fish farm (5.7-8.8), Sharma & Pathak (1992) freshwater pond (6.9-7.8), Mishra *et al*., (1992) from J.C. Moll pond (7.1-7.9). Presently the pH range is slightly higher than the findings of Singhal *et al*., (1986) for the pond of Central Inland Fisheries Research Institute (7.4-8.2), Sahai and Srivastava (1976) chileva lake (7.5-9.0), Nayak and Khare (1993) shallow water lake (6.9-8.4), Bhowmik *et al*., (1993) in sewage feed fish pond (7.2-7.9), Ahmad and Sarkar (1999) from two ponds (6.0-6.4 and 6.0-6.3). Thus, it may be inferred that pH range of Daryabganj lake is suitable for fish growth.

Table 1. Monthly Variations in pH (unit) of Daryabganj Lake.

Months and Years	Stations		
	A	B	C
July 2000	7.7	7.6	7.5
August 2000	7.9	7.8	7.9
September 2000	8.0	8.1	8.0
October 2000	8.3	8.2	8.1
November 2000	8.2	8.0	8.2
December 2000	8.4	8.3	8.0
January 2001	7.9	8.0	7.9
February 2001	7.8	7.9	8.0
March 2001	8.2	8.0	8.2
April 2001	8.4	8.3	8.4
May 2001	8.5	8.4	8.5
June 2001	8.6	8.6	8.6

Table 2. Seasonal Variations in pH (unit) of Daryabganj Lake.

Seasons	Stations		
	A	B	C
Rainy Season	7.8	7.8	7.8
Winter Season	8.3	8.1	8.1
Spring Season	7.9	7.9	8.0
Summer Season	8.5	8.4	8.5

In the present investigation, the maximum pH was recorded in summer months and minimum in rains with a slight increase in spring months. Similar trends have been reported by Kant *et al*., (1996), while slightly different observations have been reported by Sharma *et al*., (1994), who found that the pH value was highest during winter due to dense growth of phytoplankton and high values of dissolved oxygen. pH was comparatively low where human activities were low. The change in carbon dioxide and hardness also tends to change the pH of water. The

pH rises as the algae increase the photosynthetic activity during day time. The pH decreased at night when algae are not carrying the photosynthesis but reducing carbon dioxide in respiration. Such differences in pH value between day and night were also observed. Among the biotic factors, higher photosynthetic activity due to increased production of submerged macrophytes particularly in the pond may explain an increase in the pH observed from September to June. Rise in pH in response to higher photosynthetic activity has been reported. Similarly, an increase in suspended matter and low D.O. may explain low records of pH during the rainy season.

3.2 Free Carbon Dioxide

The free carbon dioxide of water is derived from the atmosphere, rains, respiration of living organisms and decomposition of organic matter; it is assumed that carbon dioxide and oxygen are interrelated in maintaining their balance in any living sphere. Regarding both, it is generally believed that the overloading of organic matter lower-down their concentration endangering the biogenic life. The low dissolved oxygen concentration increases carbon dioxide and accelerates the distress of fish (Rai & David, 1962) and the dilution is required for maintaining the oxygen balance. During aerobic decomposition of organic residues, carbon is mineralized to carbon dioxide, while during an aerobic composition both CO_2 and methane are formed. The CO_2 dissolved in the water is partially hydrated to form carbonic acid (H_2CO_3), which is the dissociated to H^+ and HCO_3 can dissociate further to H^+ and CO_3 occurs, during daytime as more CO_2 is used up by the plants than it is released at night. According to Khan *et al*., (1996), availability of carbon dioxide in negligible quantity is an indicator of the suitability of water for fish production. The rise in pH values of pond water is due to utilization of CO. The CO concentration of water varies inversely with the concentration of dissolved oxygen. A similar relationship was also recorded by Philip (1927).

In sewage fed fish pond, minimum and maximum values of free carbon dioxide fluctuated between 18.0mg/1 (January) and 33.8mg/1 (May) were observed by Bhowmik *et al*., (1993). Sharma *et al*., (1994) noticed maximum free carbon dioxide 46.2mg/1 at site-1 due to the heavy pollution and minimum 4.4mg/1 in Bharalu River. Ahmad and Sarkar (1997) recorded 1.70mg/1 (May) to 6.60mg/1 (November) in Khandong pond. Agarwal *et al*., (1997) also reported free carbon dioxide minimum of 0.8mg/l (June) and maximum 4.4mg/l (November) in Brick-kiln land area. Singh (1997) was also found level of free carbon dioxide generally high (4.5-9.5mg/1) at site-4, and low (4.1-6.5mg/1) at site-1. The concentration of CO_2 in Daryabganj Lake showed annual variation of 14.10mg/1 (A-Station), 14.00mg/l (B-station), 14.1mg/l (C-Station) in January to 25.23mg/l (C-station) in July & June. The present observation of carbon dioxide enrichment from April to June as a consequence of decomposition of dead organic matter and submerged macrophytes due to gradual rise in temperature is well documented Sharma *et al*., (1994); Kumar (1995); Basheer *et al*., (1996); Ahmad and Sarkar (1997). Rise in free carbon dioxide during rains has also earlier been worked out by Dutta (1978).

Table 3. Monthly Variations in Free CO_2 (mg/l) of Daryabganj Lake.

Months and Years	Stations		
	A	B	C
July 2000	25.23	24.08	24.00
August 2000	24.16	23.10	23.95
September 2000	22.14	22.10	23.00
October 2000	20.36	20.50	21.00
November 2000	19.88	19.22	19.45
December 2000	15.38	14.52	14.88
January 2001	14.10	14.00	14.12
February 2001	17.43	17.12	17.22
March 2001	20.95	20.50	14.45
April 2001	22.88	21.23	21.66
May 2001	23.18	22.45	22.68
June 2001	24.26	24.83	25.23

Table 4. Seasonal Variations in Free CO_2 (mg/l) of Daryabganj Lake.

Seasons	Stations		
	A	B	C
Rainy Season	23.84	22.36	22.98
Winter Season	18.54	18.08	18.44
Spring Season	17.49	17.20	16.93
Summer Season	22.44	23.57	23.52

3.3 Dissolved Oxygen (D.O.)

Dissolved oxygen is one of the most important chemical factors in an aquatic environment as fish and their food organisms (Planktons) depend on it. Oxygen gets dissolved in water; almost continuously at surface, where the air is in contact with water. The photosynthetic activity of water plants also releases oxygen, which gets dissolved in water. However, when the weeds and phytoplankton are in abundance, they hamper the dissolved oxygen in water, as it was noticed in Daryabganj Lake during summer and rainy season. The importance of dissolved oxygen in aquatic ecosystem in bringing out various biochemical changes and its effect on metabolic activities of organisms was discussed by many ecologists. Kumar (1995) and Agarwal *et al*., (1997) have discussed seasonal averages and fluctuations in dissolved oxygen. They reported D.O. values maximum in winter and minimum in monsoon. In winter maximum can be attributed to the high solubility of oxygen at low temperature. Rao and Durve (1992) reported maximum dissolved oxygen 11.8mg/1 and minimum 5.56mg/1 in Lake Rangasagar, Udaipur. Bhowmik *et al*., (1993) found level of dissolved oxygen generally high in January (4.38mg/1) in a sewage fish pond. In shallow water lakes of Panna, the minimum and maximum values of D.O. of water fluctuated between 6.80 to 14.40mg/1 and 7.2mg/1 to 16.0mg/1 (Nayak and Khare, 1993). Sharma *et al*., (1994) have been found that the D.O. varied from 1.0mg/1 to 7.6mg/1 in Bharula river and very low concentration of D.O. was found at polluted sites. In Daryabganj lake the annual variations of D.O.

reveals the fluctuation from 3.64mg/1 (July) to 8.45mg/1 (December) at station A, 3.88mg/1 (July) to 8.45mg/1 (December) at station B and 3:24mg/I (August) to 8.12mg/1 (December) at station C, all the experimental sites D.O. values were at peak in the month of December, showing a seasonal rise in winter. Comparatively the concentration remained low during monsoon & summer month. In winter rise in D.O. are observed, has also earlier been worked out by Hutchinson (1957); Vasisht and Sharma (1975); Das and Pathani (1978); Singhal *et al*., (1980).

Table 5. Monthly Variations in D.O. (mg/l) of Daryabganj Lake.

Months and Years	Stations		
	A	B	C
July 2000	3.64	3.88	3.95
August 2000	3.92	4.16	3.24
September 2000	5.02	5.42	5.12
October 2000	5.95	6.98	6.02
November 2000	7.10	7.52	7.33
December 2000	7.90	8.45	8.12
January 2001	6.85	7.26	6.92
February 2001	6.06	6.92	6.25
March 2001	7.60	8.08	7.92
April 2001	5.03	5.32	4.92
May 2001	4.98	5.16	5.00
June 2001	4.93	4.47	4.90

Table 6. Seasonal Variations in D.O. (mg/l) of Daryabganj Lake.

Seasons	Stations		
	A	B	C
Rainy Season	4.19	4.48	4.10
Winter Season	6.98	7.65	7.15
Spring Season	6.83	7.42	7.03
Summer Season	4.98	4.98	4.94

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