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Effect of Nutrient Concentration on Biochemical Characteristics of *Trapa natans* a Macrophytic species of Mansbal Lake,Kashmir,India

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Abstract: *The effect of nutrient concentration on Biochemical Characteristics of Trapa natans a macrophytic species of Mansbal Lake was carried out for a period of one year. The observations indicate that the Kondabal Area (Site IV) of the Manasbal Lake is more polluted due to influx of sewage and agricultural runoff as compared to the other sites. The increased nutrient load at this site is also indicated by the bio-chemical analysis of Trapa natans where its components viz, Chlorophyll a (2.4 - 3.5 µg/mL), Chlorophyll b (0.3-1.2 µg/mL), Total Chlorophyll (2.6-4.1 µg/mL), carotenoids (0.3-0.6 µg/mL), proteins (0.3-0.6 mg/mL),amino acids(3.5-.7 mg/mL), Starch(10.0-11 mg/mL) and free sugars(11.6-13.0 mg/mL) showed a gradual increase in their concentration from Site I to Site II to Site IV. No plant was found at Site III due to excessive depth where growth of Trapa natans is not possible.*

Key Words:Mansbal Lake,Trapa natans,Sewage,Agricultural Runoff.

I. Introduction

Lakes are inland bodies of water which are formed in rock basins of various shapes and sizes. These play an important role in the economy of a region or country and are of tremendous academic, societal and economic importance. They act as natural water reservoirs and store a large quantity of water, which can be used for drinking, industrial, irrigation, aesthetic and other purposes including generation of hydro-electricity. Kashmir is blessed with a number of lakes with different hydrological settings such as Manasbal lake (fed mainly by groundwater), Dal lake (fed mainly by fresh water streams) and Wular lake (fed mainly by the river Jhelum) (Raza *et al* 1978 and kapoor and Das 1997). The origin of the lakes in Kashmir Valley is either tectonic (as the area is tectonically active) or fluviatile, as all the lakes lie on the flood plain of river Jhelum. Manasbal Lake is the deepest (~12 m deep) of all the freshwater lakes fed by groundwater in Kashmir Valley (Lawrence 1895; Raina 1971). It is situated between 34˚15´N latitude and 74˚40´E longitude at an altitude of 1583 m amsl. It covers an area of about 280 ha of which 25 ha is marshy. The volume of water has been estimated as 12.8×106 m3 (Yousuf, 1992). The lake is also fed seasonally by an irrigational stream Larkul, on the eastern side, which is operational only during summer season. It drains into the river Jhelum through a 1.6 km Nunnyar Nalla near Sumbal village. The lake serves as an important natural water reservoir for the local population and its water is used for drinking The catchment of the Manasbal Lake consists mainly of Triassic limestone, Quaternary karewas and recent alluvium (Krishnan 1968; Wadia 1975).

II. Description Of The Plant

Trapa natans (Water Chestnut) is an annual aquatic plant, which grows best in shallow; slow moving nutrient rich waters up to a depth of 5 meters. It has a submerged flexuous stem that anchors into the mud and bears a rosette of floating leaves at the tip of the submersed stem. Although it grows best in shallow, nutrient-rich lakes and rivers, it can also grow on wet, musky substrates. Both vegetative reproduction and seed production take place. Flowers are produced singly on stalks arising from the leaf axils. Each flower is bisexual, bearing a two-chambered ovary, four stamens and four white petals. Once the ovules of the insect-pollinated flowers are fertilized, the flower stalks curve downward with the result that the fruits develop under water. The ovary and surrounding sepals mature into a nut-like, barbed spiny fruit. One acre of water chestnut can produce

enough seeds to cover 100 acres the following year. Each seed can give rise to 10–15 rosettes, and each rosette may produce as many as 20 seeds. Seeds have been known to remain viable for up to 12 years. The fruits may be dispersed when individual plants are uprooted and float downstream. Fruits fall to the bottom of the water body in the autumn and the seeds overwinter just as in terrestrial annual species. Seeds germinate in the spring; with the young root (radical) perforating at the top of the fruit.

Table 1: **Physiographic features of lake mansbal**

S.No	Parameter	Dimension
1.	Surface area (km2)	2.81
2.	Volume (km3)	0.0128
3.	Max.Depth (m)	13
4.	Min.Depth (m)	4.5
5.	Water level	Regulated
6.	Length of shoreline (km)	1.2
7.	Catchment area (km2)	3.0
8.	Normal range of annual Water level fluctuation (m)	1.5-2.0
9.	Number of main islands	None
10.	Number of out flowing rivers and channels	One

III. Materials And Methods

The present study entitled "Effect of nutrient concentration on Biochemical Characteristics of *Trapa natans* a macrophytic species of Mansbal Lake**"** was carried out for a period of one year at four different sites of Manasbal Lake of Kashmir, viz. Site I (garden site), Site II (Outlet), Site III (Central Area) and Site IV (Kondabal Area) to evaluate the parameters of ecological concern.

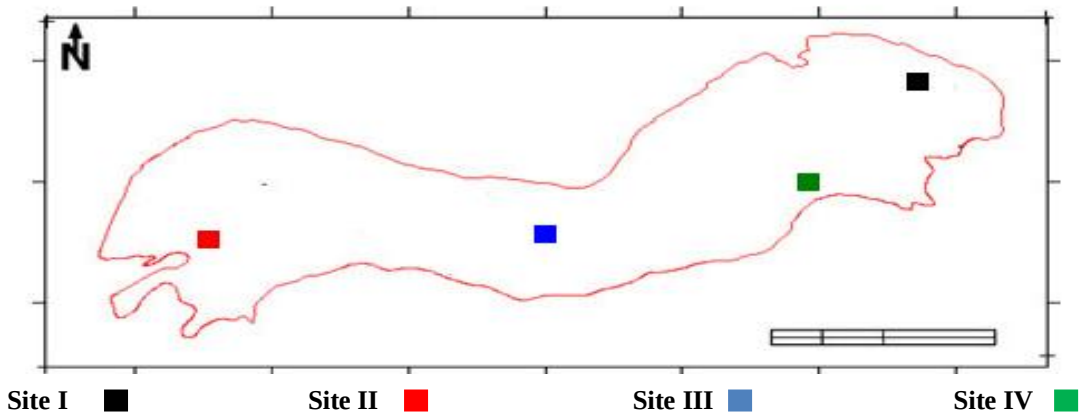

Figure 1: **Map showing Study Sites.**

Sampling And Analysis:

Physico-Chemical Analysis was carried out to determine the water quality. The water samples were collected in Plastic bottles (Capacity 1.5 ltr.) and analyzed for various parameters by following standard procedures as given in APHA 2010. Similarly for Biochemical analysis plant material was collected in the Polythene bags, after decanting water and carried to the laboratory for biochemical analysis. Following standard procedures were followed during the coarse of study.

Estimation of Pigments

The pigments like chlorophyll, carotenoids, and phaeophytin were extracted in 80% acetone. Chlorophyll contents were estimated by Strain et al.1971, Carotenoids by Duxbury and Yentech (1956) and phaeophytin content by Vernon (1960) methods.

Estimation of Proteins

Proteins were estimated by the method given by Lowry et al.,(1951).

Estimation of Free Sugar

The estimation of free sugar was done by Phenol-sulphuric acid method as given by Montgomery (1982).

Estimation of Amino Acids

Estimation of amino acid was carried out by the method of Lee and Takahashi (1966).

Estimation of Starch

Estimation of Starch was done by the method of Agarwal et al (1998).

IV. Results and Discussions

The results obtained during the present study are summarized in the Tables I & II and Figures 3 – 26.

Table-2: Physico-Chemical Parameters of mansbal lake.

S. No.	Parameter	Unit	Site I	Site II	Site III	Site IV
1.	Temperature	°C	20.0 ± 1.00	22.08 ± 0.9	20.58 ± 0.70	24.25 ± 1.66
2.	pH	-	8.18 ± 0.10	8.13 ± 0.09	7.88 ± 0.03	7.89 ± 0.18
3.	Sp. Conductivity	µS/cm	307.83 ± 12.77	287.83 ± 5.11	290.83 ± 6.30	312.83 ± 6.96
4.	TDS	mg/L	222 ± 13.68	187.08 ± 3.44	217.16 ± 7.45	226 ± 9.45
5.	Alkalinity	mg/L	98.16 ± 2.72	100.66 ± 3.39	102.83 ± 3.72	108 ± 3.91
6.	Carbonate (CO_3^-)	mg/L	63.94 ± 4.35	29.78 ± 7.96	20 ± 7.03	46 ± 8.04
7.	Bicarbonate (HCO_3^{-2})	mg/L	112.60 ± 9.91	155.41 ± 8.23	164.16 ± 21.29	81.83 ± 25.95
8.	Calcium	mg/L	38.66 ± 0.91	27.83 ± 1.75	30.66 ± 1.76	33.33 ± 2.81
9.	Magnesium	mg/L	9.50 ± 0.95	9.16 ± 0.65	8.83 ± 0.30	9.50 ± 0.71
10.	Hardness (Ca^+ & Mg^+)	mg/L	48.16 ± 0.36	37.0 ± 0.39	39.50 ± 0.82	43 ± 0.33
11.	Chloride	mg/L	5.33 ± 0.42	5.50 ± 0.42	4.33 ± 0.42	7.33 ± 0.76
12.	Sodium (Na^+)	mg/L	10.69 ± 0.68	8.0 ± 0.32	7.94 ± 0.27	9.15 ± 0.82
13.	Potassium (K^+)	mg/L	2.05 ± 0.43	2.37 ± 0.34	2.40 ± 0.35	2.33 ± 0.42
14.	Nitrate Nitrogen (NO_3-N)	µg/L	88.83 ± 2.13	83.33 ± 1.52	104.66 ± 2.48	107.83 ± 4.02
15.	Ortho- Phosphate	µg/L	58.50 ± 3.75	58.16 ± 2.96	58.66 ± 3.56	75.66 ± 8.46

± represents standard deviation.

Table-3: Oxygen related parameters of Mansbal lake:

S. No.	Parameter	Unit	Site I	Site II	Site III	Site IV
1.	Dissolved Oxygen	mg/L	5.83 ± 0.28	5.90 ± 0.06	6.70 ± 0.15	4.46 ± 0.23
2.	BOD	mg/L	95 ± 5.29	103 ± 5.57	25 ± 2.71	107 ± 5.31
3.	COD	mg/L	142 ±4.7	150 ±5.8	59.0 ±3.7	144 ±5.5

± represents standard deviation

Table-4. Bio-Chemical Parameters of *Trapa natans.*

S. No.	Parameter	Unit	Site I	Site II	Site III	Site IV
1.	Chlorophyll" a"	µg/mL	2.4 ± 0.20	2.7 ± 0.24	**	3.5 ± 0.44
2.	Chlorophyll b	µg/mL	0.3 ± 0.17	0.4 ± 0.19	**	1.2 ± 0.25
3.	Total Chlorophyll	µg/mL	2.6 ± 0.30	3.5 ± 0.39	**	4.1 ± 0.47
4.	Carotenoids	µg/mL	0.3 ± 0.17	0.5 ± 0.18	**	0.6 ± 0.20
5.	Proteins	mg/mL	0.3 ± 0.15	0.5 ± 0.16	**	0.6 ± 0.17
6.	Amino Acids	mg/mL	3.5 ± 0.23	3.6 ± 0.22	**	3.7 ± 0.24
7.	Starch	mg/mL	10.0 ± 0.30	10.6 ± 0.30	**	11.0 ± 0.29
8.	Free Sugars	mg/mL	11.6 ± 0.33	12.3 ± 0.32	**	13.0 ± 0.34

± represents standard deviation

**: *Trapa natans* not found because of excessive depth i.e. ~13m.

V. Discussion

The results of the physico-chemical analysis of water samples and biochemical estimation of *Trapa natans* are presented in Table 2, 3 and 4.

Temperature, pH and Alkalinity

The Temperature of the Lake water varied from 20º C at Site I to 24.25º C at Site IV. The increase in temperature at Site IV may be attributed to addition of sewage and increased human activity

The pH values varied from 7.88 at Site III to 8.18 at Site I. Measurement of pH is one of the most important and frequently used tests in the water chemistry. It is a strong indicator of carbonate and bicarbonates. .The Lake water is also characterized by medium alkalinity.The Alkalinity values varied from 98.16 mg/L at Site I to 108 mg/L at Site IV. The increase in the pH and Alkalinity at Site IV is due to high photosynthetic rate and presence of high nutrient load. This is in agreement with Hujare, 2008.

Electrical conductivity (EC) and Total dissolved salts (TDS),

Electrical conductivity (EC) estimates the amount of total dissolved salts (TDS), or the total amount of dissolved ions in the water. EC is controlled by number of sources of pollutants, which may be signaled by increased EC. Sources of ions are from point source like households, industries etc and non-point sources like boats,tourists etc. The present study revealed that electrical conductivity values varied from 287.83 µS/cm at Site II to 312.83µS/cm at Site IV. Increase in the conductivity values is on account of increase in the concentration of dissolved substances in the Lake water at respective sites. (Kulshrestha *et al.'s* 1989).The same is confirmed by presence of TDS that varied from 187.08 mg/L at Site II to 226 mg/L at Site IV. The increased concentration of TDS at Site IV can be attributed to continuous addition of sewage and runoff from a small stream.

Ionic Pollutants

The Calcium and Magnesium ions in the lake water contribute to total hardness of the lake. The calcium values varied form 27.83 mg/L at Site II to 38.66 mg/L at Site I and Magnesium values varied form 8.83 mg/L at Site III) to 9.50 mg/L at Site I & IV. As per the results the Lake possesses temporary hardness (Hounslow, 1995).The present study reveals that the Total Hardness varied from 36.99 mg/L at Site II to 48.16 mg/L at Site I. The Lake water could be classified as soft since its Calcium and Magnesium did not exceed 120 mg/L.

With reference to the concentration of Sodium (Na) it varied form 7.94 mg/L at Site III to 10.69 mg/L at Site I while that of Chloride varied form 4.33 mg/L at Site III to 7.33 mg/L at Site IV. The values of Potassium (K) varied from 2.05 mg/L at Site I to 2.40 mg/L at Site III. This can be attributed to increased exchange and uptake of these ions by plankton species. (Salbo and Steinnes 1995).

Nitrate-Nitrogen

Nitrate represents the end product of oxidation of nitrogenous matter and its concentration depends on the nitrification and de-nitrification activities of micro-organisms. The Nitrate-Nitrogen in the Lake water varied from 88.33 µg/L at Site II to 107.83 µg/L at Site IV. A significant increase in the Nitrogen concentration at Site IV may be attributed to agricultural runoff and sewage entering from the surrounding farm land and human settlement of the Kondbal

Ortho-phosphate

Phosphate is a very common form of phosphorous present in lake waters. The usual forms of phosphorous found in aqueous solutions include Orthophosphates, and Polyphosphates. Usually polyphosphates undergo hydrolysis and revert to the orthophosphate forms. Phosphate determination is useful in measuring the water quality since it is an important plant nutrient and may play a role of limiting factor among all other essential plant nutrients

The present study reveals that the phosphate concentrations varied from 58.16 µg/L at Site II to 75.66 µg/L at Site IV. The increase in the concentration of Phosphate especially at Site IV may be attributed to addition of detergents from the growing population, addition from dead and decayed phytoplankton cells and zooplankton excreta (Gainey and Loard, 1952). The other potential internal phosphorus sources to the lake include anaerobic sediments (Lijklema, 1994). Benthic invertebrates also mediate in the transfer of phosphorus from the sediments (Gardner et al., 1981) while active phosphorus transport by macrophytes in the littoral zone has also been assessed by. Another reason for enhancement of nutrients in the lake water is low renewal rate (Zutshi and Wanganeo, 1989).

Oxygen Related Parameters

Dissolved oxygen concentration in lake waters is important indicator regarding its trophic status. Dissolved oxygen concentration decreases from Oligotrophic to mesotrophic to eutrophic, while as its relation is inverse to biological oxygen demand (BOD) and chemical oxygen demand (COD). The present investigation reveals that the dissolved Oxygen (DO) concentration varied from 4.46 mg/L at Site IV to 6.70 mg/L at Site III. This decrease in the concentration of DO at site IV may be attributed to increased BOD (107mg/l) and COD (144mg/l) . Increase in BOD and COD concentration is by virtue of increased influx of nutrient load to this site(Kondabal Area) which is in agreement with Zutshi and Vas (1978).

Bio-Chemical Characteristics of *Trapa natans*:

The data presented in Table-3 indicates that all the bio-chemical parameters viz. Chlorophyll a (2.4 - 3.5 µg/mL), Chlorophyll b (0.3-1.2 µg/mL), Total Chlorophyll (2.6-4.1 µg/mL), carotenoids (0.3-0.6 µg/mL), proteins (0.3-0.6 mg/mL),amino acids(3.5-.7 mg/mL), Starch(10.0-11 mg/mL) and free sugars(11.6-13.0 mg/mL) showed a gradual increase in their concentration from Site I, Site II and Site IV. The significant increase in the above mentioned parameters can be attributed to increased phosphorus and nitrate-nitrogen concentration at Site IV which is in agreement with Taheruzamman and D. P. Kushari (2002). No plant was found at Site III due to excessive depth where growth of *Trapa natans* is impossible.

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