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Physico-Chemical Parameters and Cyanobacterial Population Analysis of Motia Lake, Bhopal

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Abstract: ***The physico-chemical characteristics and cyanobacterial population of Motia lake (BHOPAL) were monitored to determine the water quality of the lake. Samples were collected on monthly intervals from the lake. Physico-chemical parameters: temperature, pH, dissolved oxygen, alkalinity, water transparency and nutrients were measured simultaneously. Present investigation shows that the status of the Motia lake is eutrophic in nature.***
Keywords: Nutients, Eutrophic, Physico-chemical parameters, Dissolved Oxygen.

I. INTRODUCTION

Water is essential for life on earth without it, life is impossible. Water due to its great solvent power, is constantly threatened to get polluted easily. The requirement of water in all forms of lives, from micro-organisms to man, is a serious problem today because all water resources have been reached to a point of crisis due to unplanned urbanization and industrialization. Water quality refers to chemical, physical, biological and radiological characteristics of water (Diercing, 2009). It is a measure of the condition of water relative to the requirements of one or more biotic species and to any human need or purpose (Johnson et. al.,1997) and is determined by various physico-chemical, biological variables and changes generally due to many factors like source of water, type of pollution, seasonal fluctuations and adjacent human intervention that directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (Tiwari, 1992).Water degradation can be associated with changes in physical and chemical variables and biological indicators at the individual, population and community levels (Abbasi and Abbasi, 2012).Nutrient enrichment of waterbodies due to increased urbanisation of catchments, sewage disposal, leeching of fertilizers and other forms of cultural eutrophication supports the growth of cyanobacteria. Water quality studies of any aquatic ecosystem are fundamental to understand the water resource and one of the important features of the water body is the way in which they interact with the surrounding land, particularly due to the agricultural activity of man, construction of dams, deforestation and domestic as well as the industrial inputs. Since the quality of water affect aquatic lives in several ways, water must be of good quality for the health of all organisms.

II. MATERIALS AND METHODS

A. Study Area

Bhopal the 'City of Lake'situated at $23^0$16 N latitude and $77^0$26 E longitude, has possession of many lakes. Out of these water bodies Motia lake is also very important which is located adjacent to the Taj-ul-Masjid on the north west of the Bhopal city. At the present the pond is subjected to great environmental stress from various sources, enrichment of nutrients washer men's activities etc. Resulting in the extra ordinary deterioration of water quality and as such it can be categorized as highly eutrophic oxidative pond. The morphometric features of the lake is shown:

Latitude	23^o,26'E
Longitude	77^o 39N
Depth	Maximum depth: 8 m
Water spread in Hectares	1.89
Origin	Man Made

B. Sampling and Site Selection

The samples were collected between 10 AM to 4 PM from December 2008 to December 2010 fromThalewali Sadak region of Motia lake, Bhopal.

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C. Laboratory Methods

Water samples for physico-chemical parameters were analyzed for urgent parameters i.e Temperature, pH, conductivity, Dissolve oxygen, Free carbon dioxide and Total alkalinity in the field only and then kept in the icebox to the transported to the laboratory. In laboratory the samples were stored in a refrigerator at 4 ^{0}C. For analysis of physico-chemical parameters the book follows as Adoni (1985), APHA (1998) and Trivedy and Goel (1984).

Qualitative and Quantitative enumeration of phytoplankton-

1) *Qualitative Analysis:* Qualitative analysis of phytoplankton was done by hauling plankton net horizontally several times in lake to get a random sample, then sample were taken in to plankton bottles and 1 ml lugol was added to them.
2) *Quantitative Analysis:* Quantitative enumeration of phytoplankton was carried out by passing 40 litre of lake water through a plankton net from surface and 12 litre of lake water through a plankton net from bottom (hypolimnion).

The filtered sample was collected in plankton bottles of 50 ml after adding 1 ml Lugol's iodine solution. For the Quantitative estimation of phytoplankton, drop count method is preferred using a standard calibrated dropper.

III. RESULTS AND DISCUSSION

As shown in Table-1 and 2, seasonal variations are evident in all the Physico-chemical parameters examined.

1) *Temperature:* The minimum and maximum water temperature in the epilimnion layer were found to be 16°C in January (2010) and 30.00°C in May (2009). Similarly the minimum and maximum water temperature in the hypolimnion layer were found to be 15.1°C in January (2010) and 27°C in May (2009).
2) *Transparency:* The maximum value of Secchi disc transparency was noted as 56.5 cm. during winter (February, 2009) whereas minimum was noted as 29.4 cm. during summer season (May, 2009). The values of transparency indicate eutrophic condition of the water body.
3) *Hydrogen Ion Concentration (pH)*: The minimum and maximum ranges of pH in the epilimnion layer were observed to be 7.64 in the month of December (2008) and 9.11 during May (2010). Similarly, minimum and maximum range of pH in the hypolimnion layer was observed to be 6.98 during September (2009) and 8.13 in May (2010).
4) *Dissolved Oxygen:* The minimum and maximum D.O. level in the epilimnion layer were found to be 7.2 mg/l in January (2010) and 21.7 mg/l in August (2010). The minimum and maximum D.O. level in the hypolimnion layer were found to be 2 mg/l in December (2008) and January (2009) and 4.9 mg/l in August (2010).
5) *BOD:* The minimum and maximum BOD levels in the epilimnion layer were found to be 1.8 mg/l in January (2010) and 6.1 mg/l in August (2009). The minimum and maximum BOD levels in the hypolimnion layer were found to be 13.7 mg/l in January (2009) and 15.7 mg/l in July (2009, 2010).
6) *COD:* The minimum and maximum COD levels in the epilimnion layer were found to be 20.2 mg/l in January (2009) and 24.8 mg/l in July (2009), June and July (2010). The minimum and maximum COD levels in the hypolimnion layer were found to be 39.2 mg/l in January(2009, 2010) and 45.8 mg/l in July (2010).
7) *Alkalinity:* The minimum and maximum Alkalinity levels in the epilimnion layer were found to be 38 mg/l in July (2009) and 68 mg/l in May (2010). The minimum and maximum Alkalinity levels in the hypolimnion layer were found to be 60 mg/l in August (2009) and 108 mg/l in May (2010).
8) *Hardness:* The minimum and maximum Hardness levels in the epilimnion layer were found to be 98 mg/l in July (2009) and 148 mg/l in January (2010). The minimum and maximum Hardness levels in the hypolimnion layer were found to be 124 mg/l in July (2009) and 186 mg/l in January (2010).
9) *Total Nitrogen:* The minimum and maximum Hardness levels in the epilimnion layer were found to be 1.8 mg/l in January (2009, 2010) and 12 mg/l in May. The minimum and maximum Total Nitrogen levels in the hypolimnion layer were found to be 6.62 mg/l in January (2009) and 8.68 mg/l in May (2010).
10) *Total Phosphorus:* The minimum and maximum Hardness levels in the epilimnion layer were found to be 0.12 mg/l in January (2009) and 1.14 mg/l in July (2010). The minimum and maximum Total Nitrogen levels in the hypolimnion layer were found to be 0.34 mg/l in January (2009) and 1.44 mg/l in May (2010).

A. Qualitative Analysis Of Cyanobacteria

In Motia lake during the study period 12 genera of Cyanophyceae were identified. They are :

Anabaena, Aphenocapsa, Chroococcus, Gleotrichia, Lyngbia, Merismopedia, Microsystis, Nostoc, Osillatoria, Phormidium, Rivularia, Spirulina.

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B. Quantitative Analysis of Cyanobacteria

In the epilimnion layer the maximum density of Cyanophyceae was recorded as 60250 units/lit during summer season (June'2010) at S2 station, while minimum was recorded during winter. In the hypolimnion layer the maximum density was recorded as 64070 units/lit during summer (June'2010) at S2 station, while minimum was recorded during winter. The most dominant species of this group was *Microcystis*.

Cyanophyceae group was mainly represented by the presence of *Microcystis* species. The presence of *Microcystis* indicates that water is organically polluted and eutrophic (Saxena, 1990; Trivedi *et al.*, 1990 and Khare, 1993). High amount of nutrients responsible for eutrophication of lake.

The study of nutrients in an aquatic body is of vital importance because it is due to the presence of nutrients on which the productivity of waterbody depends (Khan, 2000). Tiwari (2007) monitored the water quality of Upper lake, Lower lake, Shahpura lake and Motia lake and found the value of transparency which are as follows – 58 to 78, 45 to 62, 60 to 76 and 25 to 40. Saxena (1990) observed transparency range of 25.0 to 70.0 cm in Lower lake. Similar conditions were observed in the present study.

Khan (2000) studied water quality of Lower lake, Bhopal and found pH between 7.4 to 9.8. Tamot and Sharma (2006) observed water quality in Upper lake and found pH between 7.1 to 9.2. Khan (2000) studied water quality of Lower lake, Bhopal and found dissolved oxygen ranging between 0.6 to 19.8 mg/1. Similar conditions were observed in the present study.

Tamot and Sharma (2006) observed water quality in Upper lake and found the value of dissolved oxygen varied between 4.5 mg/l to 9.8 mg/l. Tiwari (2007) monitored the water quality of Upper lake, Lower lake, Shahpura lake and Motia lake and found the value of dissolved oxygen which are as follows – 7.20 mg/l to 11.40 mg/l, 8.20 mg/l to 11.40 mg/l, 7.50 mg/l to 11.50 mg/l and 4.80 mg/l to 13.50 mg/l. Similar conditions were observed in the present study.

During the period under study, higher values of dissolved oxygen were noted in summer and monsoon months. During summer months high rate of photosynthetic activities by autotrophs may be the important reasons for higher concentration of dissolved oxygen. Similar findings were reported by Adoni & Vaishya (1990), Singh & Patil (1991) and Upadhyay (1998).

In the present investigation, higher values of BOD found during rainy and summer season might be due to heavy input of various nutrients along with eroded material, prevalence of favourable environmental condition for microbial activities and the period of algal bloom suggesting high organic load due to allochthonous and autochthonous source. Shukla (1996), Kumar (1997) and Saxena (1998) confirm the above observations.

Higher values of COD were noted during summer and monsoon season may be due to the higher temperature, organic deposition, decomposition and more sedimentation of algae.

Higher values of COD in the bottom were probably due to sinking of influenced dissolved chemically oxidizable organic substances trapped into the sediment which are not biodegradable. Similar observations were also recorded by Kataria (1994), Shukla (1996) and Kumar (1997).

Higher values of alkalinity were observed during summer season, may be due to higher concentration of nutrients in water, utilization of carbon dioxide and conversion of bicarbonates to carbonates by algae and other green plants etc. Naik *et al.* (1996) observed summer peak may be due to photosynthesis process of phytoplankton and macrophytes with the result of photosynthetic consumption of CO_2 and/or bicarbonate resulting in rise of the pH and carbonates gets precipitated.

During the present investigation, higher values of total hardness were recorded during winter season which may be attributed to the huge amount of surface run-off coming into the lake in rainy season. Storm water brings along with the large quantities of hardness causing elements.

Adoni and Vaishya (1990) and Kataria (1994) support the above observations.

Lower values of nitrogen were recorded during winter; this may be due to its rapid utilization by higher rooted vegetation. This study is in confirmation with the other previous studies carried out by Tamot (1996) and Durrani (1997) which also reported higher concentration of total nitrogen in such aquatic body.

The obtained results during the study show that the total phosphorous values were always high at the bottom as compared to the surface water. Similar observation were also reported by Saxena (1990), Tamot (1996) and Saxena (1998), whereby due to decomposition there is a high release of phosphorous at the bottom, which is similar to the trend observed in the present study.

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IV. CONCLUSION

On the basis of the present finding, status of the Motia lake is eutrophic in nature. Motia lake represent disturbed ecological status and deteriorated water quality. To improve the quality of water there should be continuous monitoring of pollution level is required.

Table 1 : Showing monthly variation in physico-chemical parameters of water sample of Thaliwali Sadak area (Motia lake, Bhopal) during December 2008 to November 2009

MONTHS		Water Temp (^{0}C)	Trans P	pH	D.O.	BOD	COD	Alkalinity	Hardness	Total Nitrogen	Total Phosphorus
Dec.08	E	18.1	49.2	7.64	8.1	3.4	22	58	120	2	0.18
	H	17.9		7	2	14.2	40	82	148	6.8	0.4
Jan.09	E	17.2	54.3	7.69	8.5	2.8	20.2	46	126	1.8	0.12
	H	17.1		7.11	2	13.7	39.2	78	152	6.62	0.34
Feb.09	E	17.9	56.5	8.47	9	3	21.6	48	118	2.2	0.32
	H	17.5		7.2	2.3	13.8	40.6	82	148	7.22	0.56
Mar.09	E	19.7	49.6	8.56	9.8	4.5	23.2	52	118	2.82	0.74
	H	19.5		7.31	2.6	14.7	41	92	144	7.42	0.98
Apr.09	E	24.3	37.5	8.73	10.6	4.8	23.8	56	112	3.64	0.9
	H	22.1		7.58	2.8	14.9	41.4	94	140	8	1.1
May.09	E	30	29.4	8.89	15.9	5	24.2	62	114	4	1.1
	H	27		7.61	3	15	42.8	100	140	8.62	1.32
June.09	E	26.9	32.3	8.83	19	5.4	24.6	54	110	3.2	0.9
	H	25		7.53	4	15.2	44.2	70	140	8.2	1.2
July.09	E	23.7	34.9	8.67	20.4	6	24.8	38	98	3.4	0.98
	H	21.1		7.36	4.2	15.7	45.2	64	124	8.28	1.16
Aug.09	E	20.7	35.3	7.95	20.8	6.1	23.8	42	108	3.48	1.12
	H	20.1		7.4	4.6	15.3	44.6	60	136	8.4	1.3
Sep.09	E	22.7	39.3	7.69	18.5	6	23.6	44	118	3	0.8
	H	21		6.98	4.2	15.2	43.8	74	144	8.26	1
Oct.09	E	21.8	41.1	7.88	17.1	5.8	23.2	48	126	2.2	0.48
	H	20.1		7	3.8	14.9	41	80	154	7.8	0.7
Nov.09	E	20.8	51.9	8	12.5	3	23	50	132	2	0.3
	H	19.1		7.15	3.5	14.7	40.6	78	164	7.34	0.5

(All values in mg/l) E - Epilimnion H - Hypolimnion

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Table 2 : Showing monthly variation in physico-chemical parameters of water sample of Thaliwali Sadak area (Motia lake, Bhopal) during December 2009 to November 2010

MONTHS		Water Temp (^{0}C)	Trans P	pH	D.O.	BOD	COD	Alkalinity	Hardness	Total Nitrogen	Total Phosphorus
Dec.09	E	18.9	53.8	8.2	9	2.3	22.8	52	142	1.88	0.2
	H	18		7.4	3.3	14.5	39.6	82	174	7	0.38
Jan.10	E	16	56	8.29	7.2	1.8	22.6	54	148	1.8	0.16
	H	15.1		7.47	2.8	14.2	39.2	84	186	6.68	0.4
Feb.10	E	16.4	53.9	8.48	8.4	1.9	23	56	136	2.22	0.32
	H	15.5		7.69	3.5	14.6	40.2	80	170	7.26	0.58
Mar.10	E	20.1	38.5	8.6	9.9	3	23.6	62	130	3	0.8
	H	19.2		7.83	3.7	14.8	41.8	94	160	7.44	1
Apr.10	E	23.7	35.3	8.83	12.3	3.2	23.8	64	124	3.8	0.9
	H	22.3		8.01	3.9	15	43	100	156	8.2	1.1
May.10	E	29.9	31.9	9.11	14.9	4	24.4	68	120	4.2	1.2
	H	29		8.13	4.2	15.2	44.2	108	150	8.68	1.44
June.10	E	26.7	33.2	8.79	18.4	5.2	24.8	56	118	3.2	1
	H	25.8		7.97	4.4	15.5	45.2	80	144	8.26	1.26
July.10	E	23	35.1	8.4	20.8	6	24.8	42	116	3.42	1.14
	H	22.9		7.75	4.6	15.7	45.8	74	146	8.28	1.38
Aug.10	E	20.7	39.4	8.11	21.7	6	24.4	46	116	3.6	1.11
	H	19.2		7.43	4.9	15.6	45.2	70	144	8.48	1.32
Sep.10	E	21.7	40.5	7.75	19.5	5.8	24	48	132	3.2	0.84
	H	20.5		7.01	4.4	15.5	44.8	72	160	8.28	1
Oct.10	E	18.8	42.6	7.89	16.9	5	23.8	52	138	2.42	0.5
	H	17.5		7.07	4.1	15	42.6	66	172	7.88	0.76
Nov.10	E	18.5	47.5	7.94	11.5	3.5	23.4	66	146	2.2	0.4
	H	17.1		7.14	3.7	14.9	41	86	182	7.2	0.62

(All values in mg/l) E - Epilimnion H - Hypolimnion

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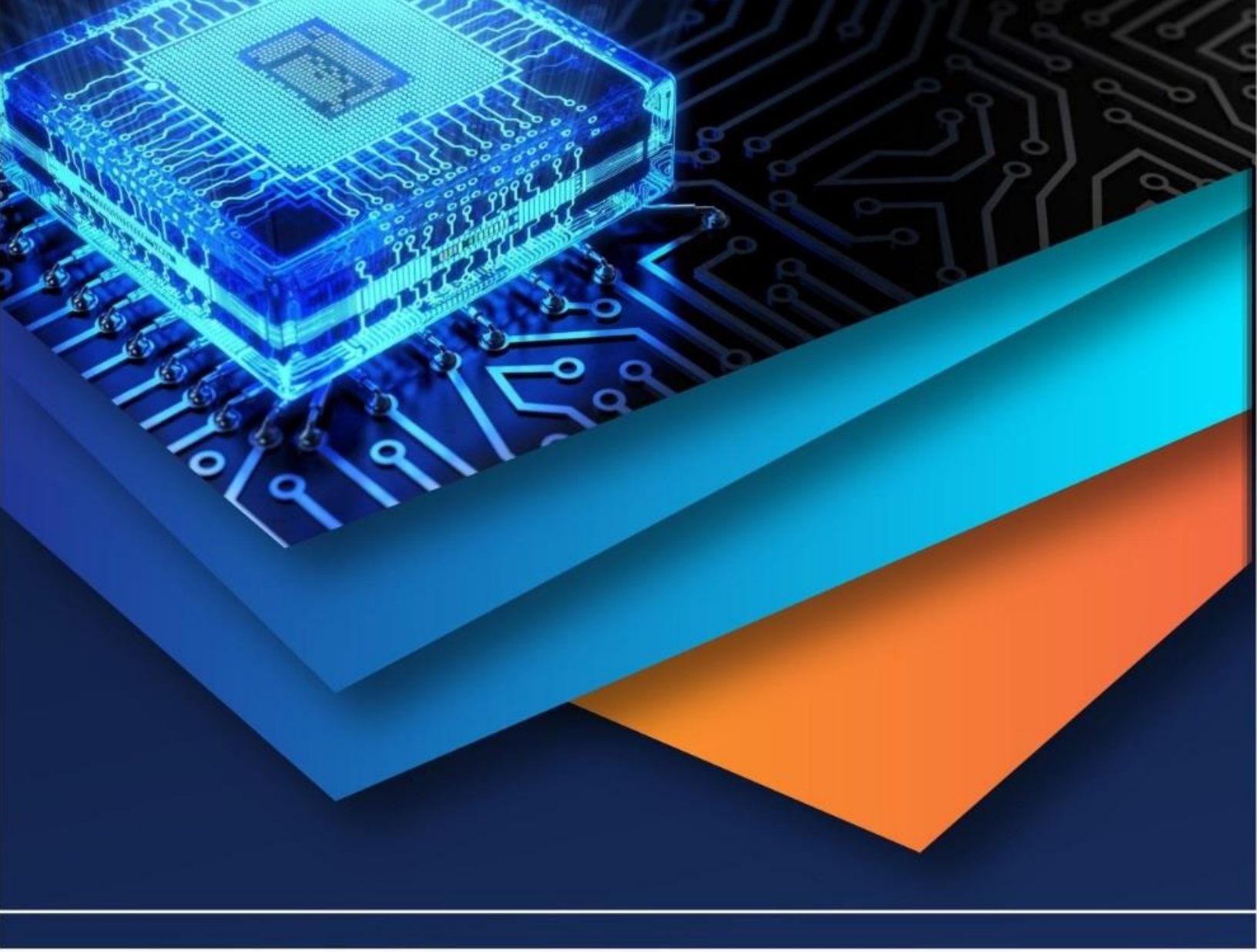

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