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Study of Water Quality by Physiochemical and Bacteriological Method of Various Lakes of Bangalore, Karnataka

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ABSTRACT

In the present study, physiochemical and bacteriological characteristics of five different lakes were determined in month of September 2013 from different locations in Bangalore, Karnataka. The concentration of TDS, iron, B.O.D., and MPN were slightly high in some samples. The results revealed that the most of the water samples were within the limits according to water quality standards.

Keywords : physio-chemical parameters, electrical conductivity, most probable number

INTRODUCTION

Water is a prime natural resource and a basic human need. Lake ecology and its biodiversity depend on its natural shoreline and connectivity of lakes. Wetlands, fresh water and its resources are economically important for the healthy survival of living beings on earth and so has become a cause of concern during this era of global warming. Lakes all over the world are drying as they have turned into dumping grounds for sewage, industry effluents and other hazardous wastes. Encroachment of the lakes, pollution of air, agricultural and sewage disposal into the lakes and rapid urbanization has apparently caused undesirable change in the climate and lake structure. The physio-chemical and bacteriological methods are used to detect the effects of pollution on the water quality.

Most lakes in the Bangalore region were constructed in the Sixteenth century by damming the natural valley systems. The effect of urbanization has taken some heavy toll on the beautiful lakes in Bangalore. The lakes in the city have been largely encroached for urban infrastructure and as result in the heart of the city only 17 good lakes exist as against 51 healthy lakes in 1985.

Most of the lakes and tanks were man-made for purposes of drinking water, irrigation and fishing needs. The lakes have also served to replenish ground water resources in the vicinity, which are tapped through wells for drinking water.

MATERIALS AND METHODS

The study is conducted at Bangalore, Karnataka which lies in the South Indian state. It is positioned at 12.97^0 N and 77.56^0 E and covers an area of 741 km^2. The water samples were collected from five different lakes, named as Ulsoor Lake, Hebbal Lake, Lalbagh Lake, K.R. Puram Lake and Varthur Lake of Bangalore and analyzed for a periods of one month, September 2013.

The water samples were collected in a sterilized plastic container of one liter and were analyzed for various physiochemical and microbiological parameters. The procedure for analysis was followed as per standard methods of analysis of water (APHA, 1998). The parameters analyzed were pH, Turbidity, Conductivity, Total Dissolved Solids (TDS), Total Hardness, Calcium, Magnesium, Chloride, Total Alkalinity, Iron, Nitrates, Sulphate, Fluorides, Arsenic, Residual free Chlorine, Copper, Manganese, Phenolic Compounds, Mercury, Cadmium, Cyanide, Lead, Chromium, Boron, Biological Oxygen Demand (B.O.D.) and Chemical Oxygen Demand (C.O.D.). Most Probable Number (MPN) of coliform bacteria was also determined in collected five water samples.

RESULTS AND DISCUSSION

pH

pH maintenance is one of the most important attributes of any aquatic system since all the biochemical activities depend upon pH of the surrounding water [1]. It was observed that the pH of water was slightly alkaline (8.28 and 7.27 in sample 3 and sample 4 respectively) and was within the maximum limit as per APHA [2]. The high value of pH may results due to waste discharge, microbial decomposition of organic matter in the water body.

Turbidity

The turbidity of all water samples were beyond the permissible limit. The observed values were 10 NTU to 127.50 NTU. It may be due to human activities, decrease in water level and presence of suspended particulate matter.

Conductivity

Electrical conductivity (EC) is a measurement of capability of water to transmit electric current in water bodies. The highest and lowest values obtained were 687 µmho/cm in sample 5 and 366 µmho/cm in sample 1 respectively. The higher EC values indicate the presence of higher concentration of dissolved salts in the water.

Total Dissolved Solids

The TDS of water samples 2 and sample 4 were 512 mg/l and 538 mg/l respectively which was slightly beyond the desirable limits. High level of

TDS in water can make water taste like minerals and make it unpleasant to drink [1].

Total hardness

Hardness is an important parameter in decreasing the toxic effect of poisonous element. The hardness was found to be in the range of 84 to 170 mg/l which was within desirable limit.

Calcium and Magnesium

The range of calcium and magnesium were 15.23 to 57.71 mg/l and 4.86 to 14.58 mg/l respectively which are well within the prescribed limit.

Chloride
The values of chloride observed were in the range of 63.81 mg/l to 134.71 mg/l which was very low. It may increase the corrosive activity of water when it combines with calcium and magnesium [3].

Total Alkalinity
It is the quantative capacity of water which indicates the presence of strong and weak bases such as carbonates, bicarbonates and hydroxides in the water body [5]. The alkalinity of all water samples were in the rage of 120 to 170 mg/l which was within the permissible limit.

Iron
The content of iron were high in sample 1, sample 2 and sample 5 as 0.60 mg/l, 0.52 mg/l and 0.70 mg/l respectively. The excess amount of iron creates problem in staining of cloths and utensils.

Nitrates and Sulphate
The observed value of nitrate and sulphate were within the norm as 4.94 to 15.40 mg/l and 20.57 to 48.55 mg/l respectively. Sulphate ion is one of the most important anion present in natural water produces cathartic effect on human being when it is present above permissible limit [6].

Fluorides and Boron
The concentration of fluoride and boron was in the prescribed limit as 0.42 to 0.84 mg/l and 0.13 to 0.28 mg/l respectively.

Manganese
It was only observed in sample 2 as 0.25 mg/l, which was near to the permissible limit [2]. The excess content of manganese can cause discolored water (brownish-red), staining of plumbing fixtures (faucets, sinks) or clothing.

Biological Oxygen Demand and Chemical Oxygen Demand
BOD is the amount of oxygen required by the living organism in the utilization of organic matter [5]. The value of B.O.D. was high in all samples. The value in sample 4 was lowest as 4 mg/l and highest in sample 1 as 194 mg/l. The concentrations of C.O.D. were also high in all samples as B.O.D.

Most Probable Number
The values of MPN were very high in all samples, which ranges from 172 to 542 MPN/100 ml. The high value in the present study may be attributed to the presence of bacterial load from the nearby surrounding areas.

The related tables and graphs of observed results are represented below.

Sl. No.	Parameters	Desirable Limits*	Permissible limits in absence of alternate source	Method of Testing Parameters	Result Sample No. 1	Result Sample No.2	Result Sample No. 3	Result Sample No.4	Result Sample No. 5
1	pH Value	6.5-8.5	No relaxation	pH meter	6.74	5.73	8.28	7.27	6.61
2	Turbidity as NTU, Max	1.00	5.00	Nephalometric	127.50	73.40	25.20	10.00	29.80
3	Conductivity in µmho/cm	_	-	Conductivity meter	366.00	670.00	468.00	680.00	687.00
4	Total Dissolved Solids, mg/l, Max	500.00	2000.00	Conductivity meter	210.00	512.00	350.00	538.00	458.00
5	Total Hardness (as $CaCO_3$),mg/l, Max	200.00	600.00	EDTA method	88.00	120.00	84.00	170.00	164.00
6	Calcium (as Ca), mg/l, Max	75.00	200.00	EDTA method	24.00	24.00	15.23	54.50	57.71
7	Magnesium (as Mg), mg/l, Max	30.00	100.00	EDTA method	6.80	14.58	11.18	8.26	4.86
8	Chloride (as Cl), mg/l, Max	250.00	1000.00	Titration	63.81	134.71	63.81	99.26	106.35
9	Total Alkalinity (as $CaCo_3$) mg/l, Max	200.00	600.00	Titration	140.00	150.00	120.00	170.00	170.00
10	Iron (as Fe), mg/l, Max	0.30	No relaxation	Phenantholine	0.60	0.52	0.20	0.18	0.70
11	Nitrates (as NO_3), mg/l, Max	45.00	No relaxation	UV - method	12.97	8.04	15.03	4.94	15.40
12	Sulphate (as SO_4), mg/l, Max	200.00	400.00	Turbiditimetric	48.55	26.33	28.80	42.80	20.57
13	Fluorides (as F), mg/l, Max	1.00	1.50	SPANDS	0.42	0.59	0.84	0.56	0.50
14	Arsenic (as As), mg/l, Max	0.01	0.05	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
15	Residual Free Chlorine, mg/l	0.20	1.00	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
16	Copper (as Cu), mg/l	0.05	1.50	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
17	Manganese(as Mn), mg/l	0.10	0.30	I.S. 3025 - APHA	BDL	0.25	BDL	BDL	BDL
18	Phenolic Compounds (as C_6H_5OH), mg/l	0.001	0.002	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
19	Mercury (as Hg), mg/l	0.001	No relaxation	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
20	Cadmium (as Cd), mg/l	0.003	No relaxation	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
21	Cyanide (as Cn), mg/l	0.05	No relaxation	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
22	Lead (as Pb), mg/l	0.01	No relaxation	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
23	Chromium (as $Cr^{+6)}$, mg/l	0.05	No relaxation	I.S. 3025 - APHA	BDL	BDL	BDL	BDL	BDL
24	Boron (as B), mg/l	0.50	1.00	I.S. 3025 - APHA	0.13	0.22	0.27	0.28	0.18
25	B.O.D. (as O_2), mg/l	_	3**	I.S. 3025 - APHA	194.00	76.00	13.00	4.00	38.00
26	C.O.D. (as O_2), mg/l	_	-	I.S. 3025 - APHA	604.00	237.00	43.00	12.00	118.00
27	Coliform Organism MPN/100 ml	_	***	M Test Tube Technique	542.00	348.00	278.00	172.00	542.00

Table 1: Physio-Chemical and Bacteriological parameters of different lake water samples
***Drinking Water Specification Second Revision – IS: 10500:2012, Edition 2.2(2003-09) (Reaffirmed1993)**

****CPCB Specification of Raw Water**

***** (a) Throughout any year, 95% of the sample should not contain coliform organism in 100 ml**
(b) No sample should contain more than 10 coliform organisms per 100 ml
(c) Coliform organism should not be detected in 100 ml of any two consecutive sample

1. BDL -Below Detection Limit

2. All the testing parameters methods are taken by APHA 20th Edition

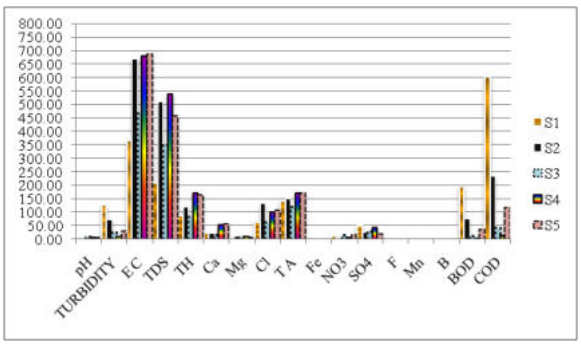

Figure 1: Graphical representation of physio-chemical parameters in different sampling stations

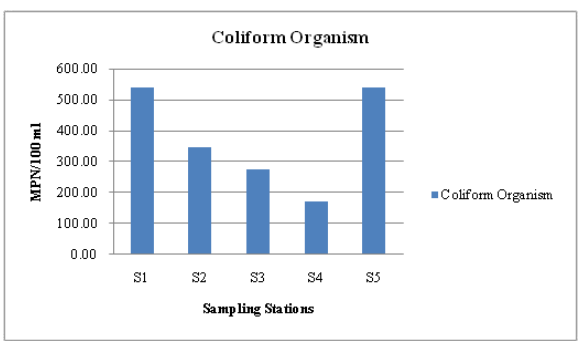

Figure 2: Graphical representation of Coliform Organism in different Sampling stations

CONCLUSION

The observation suggests that the water quality of various lakes is less polluted. However, the presence of manganese in one of the sample needs to be lowered down. The exposure to high concentrations of manganese over the course of years has been associated with toxicity to the nervous system, producing a syndrome that resembles Parkinsonism. This type of effect may be more likely to occur in the elderly. Bathing and showering in the manganese-containing water does not increase the exposure since manganese does not cross the skin and doesn't get into the air. The concentration of iron, TDS, B.O.D. and MPN is slightly high in some samples which need to be lowered down within the prescribed limit.

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