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Studies on Microbial Water Quality of Gauripada Lake of Kalyan City, Dist-Thane, Maharashtra

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ABSTRACT

Microbiological studies are of great importance both point of view of monitoring and maintaining a proper aquatic environment. Both ground and surface water may get microbiologically contaminated by a variety of means including agricultural runoff, sanitation discharge, accumulation of minerals, leakage of sewage pipelines etc. Consumption of such contaminated water is mostly responsible for the onset of water borne diseases. Present study is an attempt to analyse water quality of Gauripada Lake which is one of the important water bodies located in the Kalyan city, Dist-Thane, Maharashtra. Water samples were collected between 7.00 am to 8.00 am and examined for the presence of Total coliform and Faecal coliform. Results of this study showed that, the water quality of the lake is deteriorated with bacterial population and it is not suitable for direct domestic use which may enhance the risk of health hazards.

Keywords: MPN, Coliform, Health Hazards.

INTRODUCTION:

Surface waters from natural lakes and reservoirs are major source of freshwater for domestic, industrial and agricultural purposes in numerous regions of the world. Environmental pollution, mainly of water sources has become grave concern of public interest. Not only the developed countries have been affected but also the developing countries suffer from impact of pollution (Da Silvaand Sacomani, 2001; Koné, 2002; Yarar *et al.*, 2009).Water bodies are constantly used as receptacles for untreated waste water or poorly treated effluents accrued from industrial activities. This may render the water bodies unsuitable for both primary and/or secondaryusage (Egboka *et al.*, 1989; Kazi *et al.*, 2009; Strobl and Robillard, 2008). Microorganisms play a major role in water quality. The most dangerous form of water pollution occurs when the faeces enter the water supply. The use of bacteria as water quality indicators can be viewed in two ways; first, the presence of such bacteria can be taken as an indication of faecal contamination of water and thus as a signal to determine why such contamination is present, how serious it is and what steps can be taken to eliminate it. Second their presence can be taken as an indication of the potential danger of health risks that faecal contamination may cause.

The use of coliform group and more specifically E.coli as an indicator of microbiological water quality dates from many years (Bergstein-Ben Dan et al., 1997). This bacteria is used as indicator of potential presence of microorganisms in natural and treated waters and it is the standard means of assessing the microbiological quality of waterbody (Hemilton et al., 2005).

The studies on bacteriological aspects of water bodies have been performed by Sharma and Mall .,1988; Ramasubrama et. al., 1992; Shuanjiang et. al., 1993; Hodgkiss., 1994; Khatavkar and Trivedy., 1994; Thomas et. al., 2001; An, I. J. BD. H. Kampbell and G. P. Breidenbach., 2002; Parihar et. al., 2003; Davis et. al.,2005; Bajhel et. al., 2005; M. M. et.al., 2006; Mohan et.al., 2007; Siddhi Sharma et. al., 2008; Kazi et. al., 2009; Aw Sadat et.al., 2011, Binoj and Panekkal, 2012.s

The present work has been carried out on well known water reserviour from Kalyan city (District-Thane) namely - Gauripada Lake.

Description of the study area:

Gauripada lake is located between latitude $19^0$15'7' North and $73^0$8'56' East. It covers an area about 22,915m^2 and 1.5 to 3.5m deep. This is small water reserviour percolation tank impounded during 1990. It is situated near Birla College-Kalyan. Three sides of the Lake are surrounded by residential areas and one side is exposed to agriculture land, where paddy cultivation is practiced. The major source of water to this Lake is rain water, which inflows through its catchments area. The water level ranges from 2 to 7 meters. It is perennial water body. Soil texture is sandy in nature. Composite fish culture is practiced in this lake.

MATERIALS AND METHODS:

Monitoring sites and sampling :

In the present study water samples from station I and station II of the selected water body were collected between 7.00 a.m. to 8.00 a.m. in sterilized glass bottles and polythene bottles and transferred to the laboratory for microbiological examination and analysis of physico-chemical parameters within 1-2hrs. The bacteriological examination was conducted within 24hrs after collection for most probable number (MPN) index for coliforms in water sample using standard multiple tube fermentation technique (MTFT) (APHA, AWWA, WPCI 2004). Physico-chemical parameters were analyzed by using standard methods prescribed by APHA, AWWA, WPCF(2004) and Trivedy and Goel (1986).

The study was carried out for the period of one year 2018-2019.

Microbiological studies comprises of following analysis

- Presumptive coliform test was performed by using MacConkey's broth
- Confirmatory test was performed by using Brillant Green Lactose Bile Broth (BGLB).

Total coliform and Faecal coliform count:

Presumptive Test:

Coliform count was obtained using the five tube assay of the most probable number (MPN) technique. Presumptive coliform test was performed using Mac Conkey's broth. All the three sets of five tubes had 10ml MacConkey's broth containing inverted Durham's tubes before sterilization. The first set of five tubes received 0.1 ml of water sample using sterile pipette. Similarly 0.01 ml and 0.001 ml of water sample was inoculated aseptically in the remaining second and third set of five tubes. All the three sets of tubes were incubated at 37^o C for 24 - 48 hrs. After 48 hrs the tubes were examined carefully for acid-gas production. Acid production was determined by colour.change of the both from reddish to yellow and gas production was checked by entrapment of gas in the Durham's tube and recorded as positive (+). The tubes showing positive test were subjected to confirmatory test, as gas production is not the only criterion for a positive test.

Confirmatory Test:

Confirmatory test was performed using fermentation tube with 10ml BGLB (Brilliant Green Lactose Bile Broth) medium and inverted Durham's tube for Total coliform and 10 ml EC (E. Coli) medium and inverted Durham's tube for faecal coliform in sterile condition.

A loopful of medium was transfered from a positive tube from the presumptive test in both the tubes containing BGLB and EC medium. The tubes were incubated at 37^0C for 24 - 48 hrs for total coliform and 44.5^{o}C for 24 - 48 hrs for faecal coliform and observed for gas production.

RESULT AND DISCUSSION:

As per the results of present study the microbial parameters were found to fall in a far higher range than laid for fresh water by CPCB,Table II (Trivedi et al., 1987). Table I shows the range and mean values of coliform and faecal coliform counts of the water samples collected seasonally. Total coliform count ranged from 0.7 x 10^4 to 3.5 x 10^4 MPN/100 ml at station I and 1.3 x 10^4 to ≥ 24 x 10^4 MPN/100 ml at station II. Similarly faecal coliform count ranged from 0.04 x 10^4 to 1.4 x 10^4 MPN/100 ml at station I and 0.12 x 10^4 to ≥ 24 x 10^4 MPN/100 ml at station II.

Table I: Seasonal variation of Microbiological characteristics during the year 2018-2019.

Season	Month	Gauripada Lake (2018-2019)							
		Total Coliform (MPN/100ml)				Faecal Coliform (MPN/100ml)			
		Station I	Mean	Station II	Mean	Station I	Mean	Station II	Mean
Monsoon	July – 09	2.2 x 10^4	2.85 x 10^4	≥ 24 x 10^4	2.25 x 10^4	0.79 x 10^4	1.09 x 10^4	≥ 24 x 10^4	12.7 x 10^4
	Sept– 09	3.5 x 10^4		2.8 x 10^4		1.4 x 10^4		1.4 x 10^4	
Post Monsoon	Nov – 09	0.7 x 10^4	0.9 x 10^4	1.3 x 10^4	1.5 x 10^4	0.49 x 10^4	0.26 x 10^4	0.12 x 10^4	0.61 x 10^4
	Jan – 09	1.1 x 10^4		1.7 x 10^4		0.04 x 10^4		1.1 x 10^4	
Pre Monsoon	Mar – 10	1.1 x 10^4	1.4 x 10^4	2.2 x 10^4	1.95 x 10^4	0.21 x 10^4	0.5 x 10^4	1.3 x 10^4	1.3 x 10^4
	May – 10	1.7 x 10^4		1.7 x 10^4		0.79 x 10^4		1.3 x 10^4	

Table II : Use based classification of surface waters in India by CPCB.

Designated Best Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1.Total Coliforms Organism MPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20 □C, 2mg/l or less

Outdoor bathing (Organised)	B	1.Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20 □C, 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 and 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20 □C, 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 and 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 4. Biochemical Oxygen Demand 5 days 20 □C, 2mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical Conductivity at 25 □C micro mhos/cm, maximum 2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l
	Below-E	Not meeting any of the A, B, C, D & E criteria

Table III : Monthly Variation of Physico-chemical parameters during the year 2018-2019.

Sr. No	**Parameters**		**Gauripada Lake (2018-2019)**											
			June	July	Aug	Sept	Oct.	Nov	Dec	Jan	Feb	March	April	May
1	pH	S-I	7.32	7.3	7.81	7.88	7.04	7.44	6.4	7.27	7.68	7.8	7.1	6.72
		S-II	7.48	7.32	7.7	8.37	7.07	7.21	6.72	7.25	7.53	7.79	7.22	6.9
2	$Temp^0$ C	S-I	29	23	18	23	26	24	17	18	25	28	31	33
		S-II	29	23	18	23	26	24	17	18	26	28	31.5	32

3	Turbidity (NTU)	S-I	6	7	22	8	10	8	16	15	13	2	9	14
		S-II	6	6	21	6	7	6	19	18	18	2	8	10
4	DO (mg/L)	S-I	2.6	2.43	3.41	4.06	3.57	3.73	5.04	4.24	2.11	1.95	1.62	4.87
		S-II	2.11	2.6	3.25	4.22	3.9	4.22	5.2	2.76	2.43	2.12	1.95	4.87
5	COD (mg/L)	S-I	52	45	52	16	92	48	44	88	92	116	164	78
		S-II	44	42	48	16	56	28	52	96	120	104	92	72
6	BOD (mg/L)	S-I	35	38	56.76	22.5	34	9.6	3	12	6	3	4	24
		S-II	26	26	29	22	8	6.4	1.5	28	8	2	16	22
7	Total Alkalinity (mg/L)	S-I	268	270	154	144	138	140	150	110	184	188	160	112
		S-II	278	285	150	148	140	136	150	90	194	186	158	130
8	TDS (mg/L)	S-I	420	365	370	300	360	778	860	918	949	473	1250	947
		S-II	385	430	340	310	410	779	810	916	947	916	1213	1015
9	TSS (mg/L)	S-I	308	197	110	630	270	34	17	165	75	36	74	105
		S-II	354	148	298	30	99	101	24	118	64	192	41	185
10	TS (mg/L)	S-I	728	562	480	930	630	812	877	1083	1024	509	1324	1052
		S-II	739	578	638	340	500	880	834	1034	1011	1108	1254	1200

11	Silicate (mg/L)	S-I	0.01	2.1	3.45	4.55	3.36	3.85	5.96	3.45	2.58	1.84	6.76	3.42
		S-II	0.012	2.12	3.85	3.04	4.95	3.37	4.15	3.75	2.3	1.76	5.04	3.63
12	Nitrate (mg/L)	S-I	1.84	0.584	0.89	0.78	2.92	2.23	6.12	2.25	1.16	1.45	1.27	1.72
		S-II	1.96	1.12	0.40	2.18	3.32	1.18	5.31	1.67	1.63	1.21	1.18	0.66
13	Phosphate (mg/L)	S-I	7.35	0.175	0.183	0.18	0.175	0.24	6.1	0.023	1.1	4.3	0.32	2.4
		S-II	6.81	0.35	0.3	0.23	0.19	0.28	4.9	0.001	0.82	6.1	0.335	3.6
14	Sulphate (mg/L)	S-I	42.72	48.5	54.32	52.44	52.5	48.312	48.312	378.38	78.15	86.45	182.49	92.01
		S-II	52.5	49.15	65.45	54.25	52.5	49.187	49.187	368.96	84.23	82.32	100.44	88.08

Pathak et.al. (1994) found that 41-67 % of the water samples taken from open north eastern states of India (Meghalaya and Assam) contained coliform and /or faecal coliform. They further concluded that monitoring of water sources is essential in order to ensure supply of safe drinking water and health security of the people.

I.Zmyslowska and I. Golas (2003) reported similar range of total coliform and faecal coliform in Lake Oswin water, near town of Wegorzowo, close to Russian border. They reported the number of total coliform ranged from 1 MPN/100 ml to 75,000 MPN/100 ml depending on a research station. The lowest means of their number were recorded at station 5(15 MPN/100 ml) and the highest mean at station 6(33, 000 MPN/100 ml).

Idakwo, PY and Abu, GO (2004) carried out bacterial investigation in Lake Alau in the Arid Northern Nigeria to evaluate direct microscopic count using bright field illumination with four different microbial cell viability procedures viz. pour plate, spread plate, most probable number(MPN), membrane filtration(MF). According to them the total coliform represented 32% of the 22 isolates and of this 10% represented the faecal coliform bacteria. The faecal coliform level of 6.0×10^2 to 8.8×10^2/100 ml placed Lake Alau Dam water samples in EEC grade A2 and thus, the water is recommended for further treatments before it can be distributed to municipalities for domestic use.

Microbiological studies conducted by Riddhi Sharma et. al.,(2008) reported total coliform colonies ranged between 27.5 x 103 to 84.17 x 103 MPN/100 ml and faecal coliform ranged between 109 to 2400/100 ml during their compararive studies on four Lakes namely Pichhola Lake, Fatehsagar Lake, Swaroopsagar Lake and Udaisagar Lake from Udaipur(Rajasthan, India). They further concluded that the higher values of microbial parameters give clear indication of very poor water quality.

Aw Sadat et. al., (2011) carried out a study on Yamoussoukro Lakes (Cote D' ivoire) to evaluate the bacteriological quality of water and varying levels of bacteriological contamination was recorded in all the stations. They reported bacterial indicator numbers (log means CFU/ml) varied from 5.25 to 5.69 for total coliforms and 3.49 to 4.07 for E.coli. They further concluded that the water quality has deteriorated in Yamoussoukro Lake system.

The mean values recorded seasonally during the present investigation show maximum MPN index (2.85 x 10^4 MPN/100 ml and 2.25 x 10^4) for total coliform in monsoon season at sampling station I and II. The lowest total coliform value (0.9 x 10^4 MPN/100 ml and 1.5 x 10^4 MPN/100 ml) was recorded during post monsoon season at both the sampling stations. Similar trend was observed for the faecal coliform with higher mean values (1.09 x 10^4 MPN/100 ml and 12.7 x 10^4 MPN/100 ml) at station I and II in monsoon season and minimum mean values (0.26 x 10^4 MPN/100 ml and 0.61 x 10^4 MPN/100 ml) at both the sampling stations in the post monsoon season respectively. Higher bacterial population during monsoon months was obviously due to transport of organic matter from various sources through surface run off from the catchment areas. Similar trend have been reported by Riddhi Sharma et.al., (2008) during their study on Udaipur Lakes. However lower bacterial load during the post monsoon months may be due to lower temperature which suppresses the growth of coliform bacteria. Singh (1985), Sharma and Mall (1998) and Patralek (1992) opined that temperature also governs the bacterial population

CONCLUSION:

- On the basis of microbiological quality it can be concluded that the water quality of the reservoir is deteriorated.
- Distinct seasonal variation in bacterial load is recorded.
- The presence of coliforms at both the stations is a result of direct contamination caused by human activities.
- As the Lake water is contaminated with bacterial population it is not suitable for direct domestic use which increases risk of health hazard.
- This study focused only on the use of total and faecal coliforms as indicators of microbiological water quality. This historical concept is today in debate. Numerous limitations associated with application including ability to multiply after releasing into water column (Solo-Gabriele et al., 2000), non-faecal source (Carrillo et al.,1985; Stewart et al., 2006), inability to identify the source of contamination (diffuse and point pollution) (Kim et al., 2005) have been reported.

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