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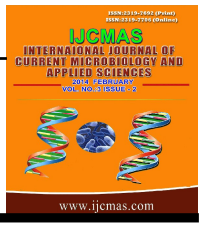

Original Research Article

Assessment of physico-chemical and microbiological parameters of Kotur Lake, Dharwad, Karnataka, India

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A B S T R A C T

This study was undertaken to evaluate the effect of water pollution by assessing physico-chemical and microbiological quality of Kotur Lake from October 2011 to March 2012. Kotur Lake showed that some of the parameters were within the limits of WHO and some were exceeded the limits. In the month of October the physico-chemical parameter values were observed very less and were high in March month. The microbiological parameters were exceeded the limits of WHO. The high Total Plate Count values were observed in March followed by January and February. The lower Total Plate Count and Most Probable Number values were observed in October, November and December. The high Total Fungal Count values were attributed in November, December and January and low Total Fungal Count values were observed in February and March.

Keywords

Kotur Lake; Physico-chemical; Microbiology parameters.

Introduction

In recent years the pollution of water has become the most significant environmental problems in the world. Water is one of the essential natural resources for existence and development of life on earth. With the contamination of water, the aquatic life is also disturbed thus disrupting the whole aquatic system. Enormous anthropogenic activities make all these water resources unfit for consumption. Eutrophication of water bodies is rapidly increasing due to growing increase quantity of sewage discharge and anthropogenic stress. Usually the microbiological quality of water is assessed by checking non-

pathogenic bacteria of fecal origin. *E.coli* and *Enterococcus* sps members are traditionally used as hygienic indicator bacteria (Annie Rompre et al., 2002). Microbiological actions and pollution are a few of the external factors which affect physico-chemical factors such as pH, total dissolved solids and conductivity of the water. These factors have major influence on biochemical reactions that occur in the water. Internal factors on the other hand include actions which between and within bacterial and plankton population in the water bodies (Zamxaka et al., 2004). The microbiological and physico-chemical quality that adversely affected the quality of water is likely to arise from a variety of sources including land application of agricultural chemicals and organic wastes, infiltration of irrigation water septic tanks, land infiltration of effluents from sewage treatment plants, pits, lagoons and ponds used for storage (Aydin, 2007). Today, the water resources have been the most exploited natural system since man paced the earth. Pollution of the water bodies is increasing due to rapid population growth, industrial proliferation, urbanization, increasing living standards wide ranges of human activities. In India too, studies on the problem of water pollution started quite early but water quality studies were given attention only during the last few decades when the situation become alarming (Oinam and Belagali, 2006).

Eutrophication has developed a widely known problem of water quality deterioration. Discharge of agricultural urban and industrial wastes have increased quantum of various chemicals that enter the receiving water, which considerably alter their physicochemical characteristics. Phosphorus and nitrogen inputs from the inland waste and fertilizers hasten the process of eutrophication (Kudari et al., 2006). Variations in the aquatic atmosphere accompanying anthropogenic pollution are a cause of rising concern and require monitoring surface waters. Monitoring the quality of surface water by hydro biological factors is among environmental significances since it permits direct guesstimate of the state of water ecosystem exposed to harmful anthropogenic factors (Vandysh, 2004).

Water contamination with pathogens and pollutants create many health problems for the consuming the water. As such water quality in relation to human health is an important fact of limnology, even though ecological interrelationship, species diversity and physico-chemical properties of Lakes have received considerable attention (Krishna et al., 2009). The coliform bacteria particularly *E.coli* present in the water is indication of fecal pollution. These persistently present in human intestine in enormous numbers. These entities live longer in water than intestinal pathogens and hence easily identified compared to existent pathogens. Moreover the presence of coliforms shows the menace of fecal pollution and consequential hazard of contracting diseases through pathogenic organisms (Usha et al., 2008). The environmental conditions of any Lake system depend upon the wetland and its exposure to various environmental factors. Their fragile ecosystem must maintain the state of environmental equilibrium with existing surroundings particularly from special perspective of human encroachment and pollution (Aboud et al., 2008). The accumulation of sewage and other waste in Lake, it is not able to recycle them and hence their self-regulatory capability is lost. The decomposition of these wastes by aerobic microbes decreases due to higher level of pollution.

The main objective of this study was to evaluate the impact of pollution by assessing the physico-chemical and microbiological quality of Kotur Lake.

Materials and Methods

Study area

The Kotur Lake is located 14 km from Dharwad City, Karnataka State, India. The Kotur Lake is fed with the water flowing through the Western Ghats, Malaprabha River and Krishna River, BenniHalla, TupariHalla basin.

Sampling methods

The water samples of Kotur Lake were collected from October 2011 to February 2012. The well cleaned plastic containers were taken for sample collection to test physico chemical parameters and sterilized borosil bottles covered with brown wrappers used for collecting samples to test microbiological parameters. The samples were collected between 7.00 am to 9.00am and were brought to the laboratory carefully for further analysis using standard procedures (APHA. AWWA, WPCF, 1998; Aneja, 2001; Trivedi and Goel, 1986).

Physico-chemical parameters

The Physico-chemical factors such as water ,temperature, p^H, electrical conductivity, turbidity, DO, BOD, COD, free CO_2, carbonates, bicarbonates, total hardness, calcium, magnesium, sodium, nitrates, sulphates, Phosphates, chlorides, fluorides, ammonia and TDS were analyzed according to APHA (1998) standard methods.

Microbiological parameters

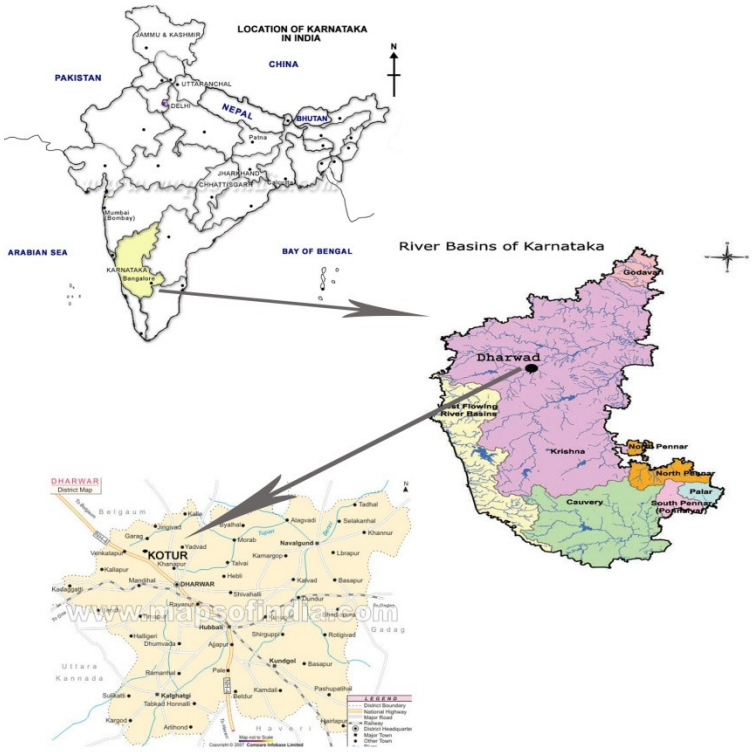
The microbiological parameters such as Total Plate Count, Total Fungal Count, and MPN tests were analyzed.The DO was fixed on the Lake sites in 300ml sterilized glass bottles. The temperature and pH were also recorded at the study sites. The determination of the total plate count was done by standard plate count technique by using plate count agar media. The samples were subjected for serial dilution with sterile saline and plated on PCA plates,incubated at 37°C for 48 hours and colony counting was performed. The fungi were isolated by using PDA.

The samples incubated at room temperature. The 3 tubes were used for counting coliform numbers in LakeWater. The 3 tubes MPN method was used for total coliform count of LakeWater samples. The MPN methods include 3 tests presumptive, confirmatory, and completed test. In this method the serial dilution of sample were inoculated into MacConky broth. The number of positive (fermentation of lactose, production of gas) tubes calculated, from which the other 2 tests of the methods were performed and then uses the combination of positive results to estimate the organisms present in colony and fecal coliform analysis, which all the 3 test have done for *E.coli*.

Results and Discussion

The results of physicochemical analysis of Kotur Lake were illustrated in table 1. The physicochemical parameters and analysis of Kotur Lake showed that some of the parameters were within the limits. Whereas, some parameters were surpass the limits. The minimum temperature (22˚C) in October and maximum (27˚C) in March were observed. A maximum pH

Figure.1 Kotur Lake site



9.0 in January and minimum 8.5 in March was observed. The electrical conductivity was maximum EC-715 NTU in February. The turbidity was observed, maximum 45 NTU in March and minimum 11.2 in November exceeded the permissible limits. According to WHO standards,the TDS value found high 206 mg/l in March and 150 mg/l in October but values were within the permissible limits. The BOD values were observed high 30mg/liter in March were exceeded the permissible limits. COD values were observed high 82mg/l exceeded the limits. The CO_2 values were also high. 7.6mg/l but exceeded the permissible limits. The carbonates, bicarbonates & chloride (73.48 mg/l) values were observed and were within the permissible limits. The TH values were lower in range from 154-209mg/liter in all the months. Likewise, magnesium and sodium values were ranging from 25.40 to 32.56 mg/l and 0.050 to 0.079 mg/l but were within the mg/L permissible limits and were well below the permissible limits respectively. The Calcium values were ranging from 35.60 to 58.66 mg/l and were within permissible limits. The NO_3, PO_4& SO_4 values were found with narrow variations ranging from 0.50 to 0.80 mg/l, 4.10 to 8.09 mg/l, and 13.0 to 19.05 mg/l respectively but SO_4 values were found exceeded the permissible limits.

The microbiological analysis showed the monthly variations in the results. The TPC, TFC and MPN tests were carried out from October 2011 to March 2012. The TPC was carried out by spread plate technique using plate count agar (PCA). The TFC was carried out by spread plate

technique using potato dextrose agar (PDA) supplemented with antibiotic chloramphenicol antibiotics to inhibit the growth of bacteria. The total coliform count was done by standard MPN (Most Probable Number) test consist of presumptive, confirmative and completed tests. The media MacConky broth, lactose fermentation broth and EMB (Eosin Methylene Blue agar) were used for Total Coliforms analysis by MPN test method.

The results of monthly variation of (October 2011 to March 2012) microbiological parameters like TPC, TFC and Total Coliforms (MPN) of Kotur were predicted in the table 2-6. The higher TPC values were observed in March followed by February and January due to higher bacterial activity at higher temperature & also dissolved Oxygen was least due to heavy consumptions of DO which was more vigorous in warm weather. Lower TPC values were attributed in December, November& October due to low temperature in the winter lower multiplication and poor growth of microbes. The TPC analysis of Kotur Lake at S_1 & S_2 confirms the presence of *Bacilli* (+ ve), *Streptococcus*sps (+ve), *Bacilli* (-ve) & *Streptococcus*sps, *Monococci* & *Diplococci.*

The TFC analysis of Kotur Lake was carried out by spread plate method. The TFC values were attributed in November, December and January due to non-living organic matters in Lake. The human anthropogenic activities, eutrophication and environmental factors makes temperature light, variations in the physicochemical parameters effect the fungal population. The low TFC values were observed in the October, February and March due to less fungal activity at high temperature in February and March also due to less *anthropogenic* activities. The TFC analysis of Kotur Lake confirm the presence of *Rhizopus* sps, *Mucus* sps, *Pencillium* sps, *Aspergillus* sps, *Fusarium* sps, *Altemeria* sps, *Cephalosporium* sps and *Cladosporium* sps. These fungal sps. may lead to pollution due to the production of toxins, which are toxic to human being, the high population of fungi usually indicate the water pollution.

The coliform count was done by standard MPN method. It is customary to report results of the coliform test by multiple tube fermentation procedure as MPN index. The high MPN values were observed in January, February & March due to high bacterial activity at higher temperature. The factors like eutrophication, anthropogenic activities, animal waste, and discharge of sewage, domestic waste and physicochemical parameters also indirectly affect coliform population. the minimum values were attributed in the October, November & December due to low temperature and less eutrophication, anthropogenic activities etc. the high values of MPN indicate the fecal pollution. Hence the Lake is unfit for potability & can be used for agricultural. The presence of *E. coli* is also confirmed with different MPN test, morphological & biochemical characterization.

The findings of present study will help to educate the people towards the implementation of proper remedial measures to maintain its quality. There is need of continuous monitoring of Kotur Lake and awareness has to be created among the village people. The suggestion also has been put for enforcement of environmental laws and regulations. The effort has also been made to protect Kotur

Table.1 Physico-chemical Parameters of water samples of Kotur Lake from October-2011 to March-2012

Parameters	WHO Stds.	Oct-2011	Nov-2011	Dec-2011	Jan-2012	Feb-2012	Mar-2012
Temperature		22	23	22	25	26	27
pH	6.5-8.5	8.5	8.6	8.8	9.0	8.6	8.5
Electrical Conductivity	2.500	750	748	735	722	715	850
Turbidity	10	12.5	11.2	18.00	24.00	27.3	45.00
D.O	5.0	4.256	3.951	3.432	3.051	2.824	2.635
B.O.D	28.30	23	25	19	27	29	30
C.O.D	10	50	62	75	48	61	82
Free CO_2	0.5-2.0	6.50	6.8	7.05	7.10	7.25	7.6
Carbonates		28	30	32	37	38	42
Bicarbonates		27	31	35	39	43	47
Total hardness	500	154	165	171	183	194	209
Calcium	75-200	35.60	39.27	45.35	49.34	53.27	58.66
Magnesium	50-150	25.40	26.32	27.17	28.13	30.11	32.56
Sodium	200	0.050	0.057	0.062	0.068	0.073	0.079
Nitrates	20-50	0.50	0.59	0.61	0.67	0.72	0.80
Sulphates	42-45	13.0	14.07	15.52	16.54	17.76	19.05
Phosphates	5.0	4.10	4.82	5.27	6.11	7.37	8.09
Chloride	200-600	52.44	54.30	57.28	60.25	64.35	73.48
TDS	500	150	163	179	187	195	206

mg/L. except p^H, temperature (ºC) and conductance (µmho/cm).

Table.2 Total Plate Count of (TPC) of Kotur Lake from October 2011 to March 2012

Samples	Sampling Site	Oct-2011	Nov-2011	Dec-2011	Jan-2012	Feb-2012	Mar-2012
Kotur Lake	S_1	150	214	265	321	359	393
	S_2	186	225	270	337	375	412

Table.3 The types of bacteria isolated from water samples of Kotur Lake

Sample	Sampling site	Organism	CFU/100ml
Kotur Lake	S_1	G+ve*Bacilli* G+ve*Streptomyce*s G-ve*Bacilli* G+ve*Streptococci*	$284x10^4$
	S_2	G+ve*Streptococci* G+ve*Monococci* G-ve*Bacilli* G+ve*Streptomyces* G+ve*Diplococci*	$300x10^4$

*CFU-Colony Forming Unit

Table.4 Total Fungal count (TFC) of Kotur lake from October-201 1 to March-2012

Sample	Sampling Site	Oct-2011	Nov-2011	Dec-2011	Jan-2012	Feb-2012	Mar-2012
Kotur Lake	S_1	130	145	152	160	127	116
	S_2	135	154	165	174	146	128

Table.5 The types of fungal sps. isolated from water samples of Kotur Lake

Sample	Sampling site	Organism	CFU/100ml
Kotur Lake	S_1	*Rizopus*sps. *Mucor*sps. *Penicillium*sps. *Aspergillus*sps.	$140x10^1$
	S_2	*Fusarium*sps. *Altemena*sps. *Pencillum*sps. *Aspergillus*sps. *Mucor*sps. *Rhizopus*sps. *Cephalosporium*sps. *Cladosporium*sps.	$150x10^1$

Table.6 MPN count from water samples of Kotur Lake from Oct-2011 to March-2012

Month	Sampling Site	NO. of tubes Showing Positive Results			MPN index Per 100ml
		3 of 10 ml	3 of 1 ml	3 of 0.1 ml	
October	S_1	3	2	1	150
November		3	2	2	210
December		3	3	0	240
January		3	3	1	460
February		3	3	2	1100
March		3	3	3	2400
October	S_2	3	2	0	93
November		3	1	2	120
December		3	2	1	150
January		3	2	2	210
February		3	3	0	240
March		3	3	1	460

***** MPN – Most Probable Number

Lake by bringing the National Lake Conservation Plan into action. The effort has also been made by suggesting the village people to grow the medicinal plants which can purify water with accumulation of toxic chemicals in their plant part. Growing bio-flocculants like woody shrubs Lavancha, Lemmon grass, Tulasi and Carrots around the Lake has also been suggested to the village people so they can reduce the BOD and COD level.

The attempts have also been made to create awareness and educate the village people of Kotur and about the ill effects of water pollution on health and also ones myth about the piles disease among the village people.

In conclusion, the physico-chemical and microbiological parameters of the Kotur Lake were exceeded the limits and hence water is not fit for potability. The Lake is polluted due to anthropogenic activities and discharge of sewage.

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