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Study of Physio-Chemical properties and microbial analysis of lakes in and around Coimbatore, Tamil Nadu, India

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Abstract

This study was aimed to screen the water quality of five lakes (Ranganathapuram Lake, Chinthamani Lake, Vedapatti Lake, Pannimadai Lake, Vallan Lake) in and around Coimbatore city, Tamil Nadu, India. The study was conducted based on their water source, phytoplankton community and origin of pollution such as utilisation by human and animals. In this study the odour, colour, pH, alkalinity, BOD and COD of water samples from five lakes along with the inorganic and organic contents viz chloride, iron, calcium, sulphite, arsenic and alkalinity was analysed. Further, pathogens such as Klebisella sp., Streptococcus sp., Shigella sp., Salmonella sp., Vibrio sp., Citrobacter sp., Enterobacter sp., and Pseudomonas sp. which are water borne pathogens were isolated. The results of this study reveal the status of wetlands quality it may helpful to protect the water resources and create awareness about the water pollution among the people living around the lakes.

Key words: Water quality, Coimbatore, wetlands, Lakes, waterborne pathogens, microorganisms.

Introduction

Lakes are described as "the pearls on the plateau," play a crucial role in water supply, fishing, waste disposal, lake reclamation, agriculture, and industry[1]. However, the catchment area of these lakes has been subject to deforestation, agricultural intensification, soil erosion, urbanization, and industrialization. As a result, water pollution and water shortages have now become a severe problem which has received more and more attention from the public and the Government[2]. For example, several water-quality monitoring programs have been initiated to track Lake water quality includes microbial, biological, chemical, and physical aspects. Chemical contamination of water sources may be due to certain industries and agricultural practices, or from natural sources[3]. When toxic chemicals are present in drinking water, there is the potential that they may cause either acute or chronic health effects[4].

The turbidity, colour, taste, odour, COD and BOD of water can be monitored. High turbidity can inhibit the effects of disinfection against microorganisms and enable bacterial growth. Drinking water should be colourless, since drinking-water coloration may be due to the presence of coloured organic matter. Organic substances cause water odour, though odours may result from many factors, including biological activity and industrial pollution also microbial pathogens cause health hazards[5]. Coimbatore, a rapidly developing city in the western part of Tamil Nadu, has several wetlands and lakes in and around its limits. These wetlands have been facing rapid degradation due to liquid or solid waste disposal, filling and reclamation, real-estate ventures and industrial development has open drainage and sewerage systems which joining these lakes without any prior treatment. Hence, the present study was undertaken in Coimbatore on five urban lakes wetlands (figure 1) to analyze water quality of these water bodies with reference to the pollution from various sources.

Material and Methods

Five lakes selected for the study were situated in and around Coimbatore city. The samples were collected in plastic bottle prior to the collection; the bottles were rinsed thoroughly with the sample water. Then the samples were brought to the laboratory. During transportation the sample bottles are kept in ice and were subjected for various microbiological analyses.

Natural Noyyal river reservoir which has some Water hyacinth and Elephant grass found around the shores of Ranganathapuram Lake. Sewage water from the whole area of Raja Street to Vaiysial Street (Includes metal waste from jewellery designing shop) are directly discharged into the Chinthamani lake. The lake is also a fish catchment area. A number of Migratory birds are encountered in the lake in winter Vedapatti lake Which lies to the outskirts of the city is more or less far from industrial activity, Pannimadai lake which do not have any existing connections with river Noyyal, are mostly rain-fed. The dense *Eichhornia crassipes* and other hydrophytes covers the Vallan Kulam. On its banks municipal wastes and wastes from the hospitals are also disposed of. The dissolved oxygen was determined using Winkler's titrimetric method. The

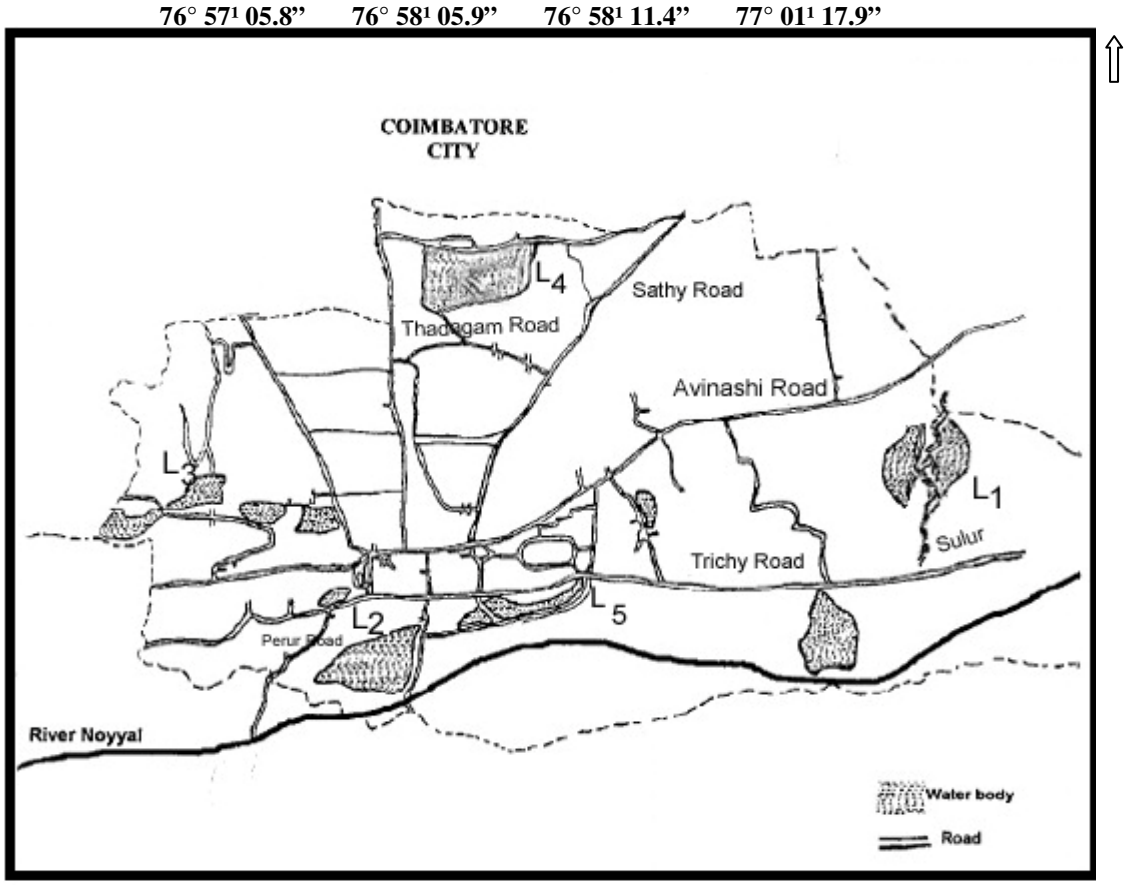
samples were incubated for 5 days at 20°C to measure BOD. COD of the sample is determined by oxidizing the organic matter in the sample with potassium dichromate in the presence of strong acid.

Alkalinity of the sample was determined by titrating with standard solution of mineral acid using pH indicators viz. Phenolphthalein and methyl orange. Chloride, Sulphite and heavy metal Iron was estimated using the standard methods[6,7]. Organic calcium was estimated using the standard method by Heron and Mackereth[8]. Drinking water and biological samples were analyzed using electrothermal atomic absorption spectrometry for arsenic concentration[9].

Results and Discussion

All the five lakes showed the characteristics colour appearance from Dark green to blackish green colour due to surrounding area pollution and urbanisation. The sample water pH varied from 7.09 to 8.84 which is possibly due to the human activities as well as natural processes such as groundwater leaching of carbonated minerals and temperature range of 30°C to 32°C[10]. The highest level of pH was recorded in Bye pass lake is 8.84 which exceeded the permissible limits (6.5 – 8.5)[4]. The rise in the pH indicates the increased level of pollution in the wet lands. The pH levels in the water in Vallan Kulam were notably higher than the previous reports[5]. The biodegradable organic matter BOD dissolved in water varied from 1.86 to 5.18 mg/l and it was highest in the waters of Vallan kulam. The BOD value above the range of 5 mg/l demonstrates the poor water quality. The COD diverse from 88 to 163 mg/l and was highest in Vallan kulam. This could be associated with higher levels of inorganic waste being discharged in to the wetlands. The present values of BOD and COD were higher than those reported[11] intimating the gradual fall in water quality here well within the acceptable limits prescribed by WHO[4]. The BOD values in the present study were higher than the values previously reported[12].

The nutrients i.e. Iron and Calcium were in the ranges of 0.3 to 0.5 mg/l and 140 to 160 mg/l respectively. The high Iron values were logged from Vedapatti lake and Pannimadai lake due to the decomposition of much zoo plankton. The sulphide concentration ranges from 25 to 35 mg/l. The highest value of sulphide was recorded from Ranganathapuram lake which seems to be food allergen when water is consumable[13].



L_1- RANGANATHAPURAM LAKE, L_2- CHINTHAMANI KULAM, L_3- VEDAPATTI LAKE, L_4- PANNIMADAI LAKE, L_5- VALLAN KULAM

Figure-1
Map showing urban land wet land

The alkalinity ranged from 150 to 190 mg/l. The maximum value for alkanitiy was seen in Pannimadai Lake. The values for Chloride varied from 88 to 327 mg/l. The value for Chloride in Chinthamani lake surpassed the permissible limits of 250 mg/l[4] probably due to the effluent from jewellery making industries joining the wet land. The greater alkalinity value in Pannimadai Lake is likely as a result of domestic waste.

The arsenic level ranged from 35.2-158 mg/l, which is 3-15 folds higher than World Health Organization[14]. The higher concentration was seen in vedapatti and Pannimadai Lake. The reason seems to be the absence of water hyacinth in the lakes which increases the arsenic level were the water hyacinth fully grown Chinthamani and Vallan kulam showed deviation in the arsenic level due to the absorption of arsenic by water hyacinth[15]. The physico chemical properties of lake were shown in the table 1.

Microbial analysis of lake showed the common water borne pathogens is identified using the colour change prevailed in the bottle. The appeared of dark purple colour with the turbidity showed the presence of *Klebsiella sp.*, *Enterobacter sp.,* and *Vibrio sp.,* The bluish green colour appeared with turbidity showed the presence of *E.coli*, *Shigella sp.*, *Streptococous sp.,* and *Pseudomonas sp.* The black colour appeared with turbidity indicates the presence of *Citrobacte*r *sp.,* and *Salmonella sp.* The presence and absence of microorganism population shown in the table 2.

Table-1
Physico chemical properties of lakes

Lake name	Temperature 0^C	pH	BOD mgl^{-1}	COD mgl^{-1}	Iron mg/l	Chloride mg/l	Alkalinity mg/l	Sulphite mg/l	Calcium mg/l	Arsenic mg/l
Ranganathapuram lake	30.7	7.23	2.36	95	0.3	88	180	35	140	153
Chinthamani lake	30.7	8.39	3.82	160	0.3	327	160	20	145	57.9
Vedapatti lake	32	7.09	2.15	88	0.5	60	170	25	160	145
Pannimadai lake	31.7	7.15	1.86	93	0.5	98	190	30	130	158
Vallan kulam	31.7	8.84	5.18	163	0.3	54	150	25	150	35.2

Table-2
Microbial analysis of lake

Pathogens	Ranganathapuram lake		Chinthamani lake		Vedapatti lake		Pannimadai lake		Vallan kulam	
Klebsiella sp	+	-	+	-	-	-	-	+	-	+
Enterobacter sp	+	+	-	+	-	+	+	-	-	-
E. coli	+	+	+	+	+	+	+	+	+	+
Shigella sp	-	+	-	-	+	+	-	+	+	-
Streptococcus sp	-	+	+	-	+	-	+	+	-	+
Citrobacter sp	-	+	+	+	-	+	-	+	+	-
Vibrio sp	-	+	-	+	+	-	+	-	+	-
Pseudomonas sp	-	+	-	+	-	+	-	+	-	+

Conclusion

The initial lake survey carried out in and around Coimbatore revealed the major environmental pollution of the wet lands of the Coimbatore. The main reasons behind the pollution are many small scale industries, mixing up of city sewage waste into the lakes.th House hold wastes and the hotel wastes are also the main cause for the lake contamination. Beyond these conditions the growth of water hyacinth which covers the entire lake and makes the lake water unsuitable for human consumption. This condition prevails at Chinthamani Kulam and Vallan Kulam where whole lake area is covered with water hyacinth.

In the microbial analysis the identification of *salmonella sp.*, *Klebsiella sp.*, *Enterobacter sp*., E.coli*, Shigella sp*., *Streptococcus sp., Citrobacter sp.*, *Vibrio sp., Pseudomonas* species shows the pathetic condition prevailing in all the lake areas which is the major disease causing factor to the humans who resides in the nearby lake area.

In accordance to the survey done the analysis of organic compounds and microbial content showed the pathetic condition of the wetlands in Coimbatore. In the current scenario lack of seasonal rainfall and the water shortage during summer season makes us to save water where the lake is the best water reservoir. The major causes for water pollution are due to the sewage, industrial waste disposal in to the lake and the growth of unwanted weeds. By implementing proper sludge treatment and the use of water hyacinth for commercial purpose like ethanol production, crafting bag conserves the wet lands from pollution and make water potable for human and animal.

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