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RESEARCH ARTICLE

ANALYSIS OF WATER QUALITY IN RELATION TO MICROBIAL POPULATION OF VEERANAM LAKE, CUDDALORE DISTRICT, TAMILNADU

***[1]Krishnamoorthi, A., [1]Selvakumar, S. and [2]Shanthi, G.**

[1]Department of Zoology, Annamalai University, Annamalainagar – 608 002, India
[2]Department of Microbiology, Rajah Muthiah Medical College & Hospital, Annamalai University, Annamalainagar – 608 002

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ABSTRACT

An attempt was made to study the microbial population of Veeranam lake water, Tamil Nadu. Water samples were collected monthly at five locations and analysed for the microbial population by MPN technique during the year from July 2011 – June 2012. The samples showed the presence of bacteria, fungi and actinomycetes. The monthly average values were taken for statistical analysis. The percentage distribution of microorganisms varied from 75.04 to 77.36% bacteria, 0.79 to 2.05% fungi and 21.23 to 24.17% actinomycetes. The concentration of bacteria and actinomycetes were lower during the premonsoon and gradually increased in monsoon, post monsoon and summer and the fungi concentration were maximum during postmonsoon and gradually reduced in monsoon, premonsoon and summer. It indicates that the water for drinking is pre-treated before consumption.

INTRODUCTION

Everything originated in the water and everything is sustained by water. All life on earth depends on water. Water is not only essential to life but is the predominant inorganic constituent of living matter, forming in general nearly three quarters of the weight of the living cells. Water can be used as a multiple resource by all the living beings on the earth. With beginning of life on the earth, there was no pollution but rapid urbanization and industrialization have culminated in to water, air and land pollution (Hariharan, 2007). The availability of safe drinking water is important for proper growth of human environment. Water may be unsuitable for drinking due to many factors. Chemical analysis alone cannot predict the actual water quality; it depends on the terrain through which it flows, its physical, chemical and microbial constituents. Water is never pure in the true chemical sense. It is always found to contain unwanted impurities in it. The impurities may be of different kinds like dissolved and suspended materials. Microorganisms are always present in water. Disease causing microorganism (pathogenic) like bacteria, viruses, fungi and protozoa etc, causes waterborne diseases, can cause swimmers to get sick, fish and shell fish can become contaminated and people who eat them can become ill. Some serious diseases like polio and cholera are water borne caused by contaminated water (Abdul, 2002). According to WHO, about 80 % of all the diseases in human beings are caused by contaminate water (Meenambal, 2005; Chaturvedi *et al.,* 2008). It is established that water is harmless for drinking, if there are not more than 3 cells of Escherichia coli in 1 litre. The tube well water is almost soil filtered and should be free from bacterial pathogens but still these sources are found to be contaminated with coliforms (Tamberkar *et al.,* 2007). Against this background, an attempt was made to assess the water quality based on the microbial population of Veeranam lake water in Cuddalore district, Tamil Nadu. Several studies have been conducted to identify the microbial population in lakes; rivers and other drinking water sources. The microbiological studies were different commercial drinking water samples in Chennai by Noorjahan (2008). Consumption of packed and bottled water is a normal process nowadays by all people in houses places etc. (The New Indian Express). Kavitha and Sivapriya (2005) who have identified the presence of *Pseudomonas* sp., *Klebsiella* sp., *Bacillus* sp., *Streptococcus* sp and *Clostridium* sp. in different samples of commercial mineral water. The presence of Bacillus and Pseudomonas was also identified by Michel *et al.* (1995), Vachee *et al.* (1997), Tamagnini and Gonzalez (1997) and Grant (1998). Actinomycetes isolated from sediment in the lake Ontario basin (Zaitlin *et al.* In press) and actinomycetes isolated from lake Kasumigaura, Japan (Sugiura and Nakano 2000). Krishna river water in Satara district by Mane *et al.* (2008) and Porur Double lake (ErettaiEri) in Chennai by Kowsalya *et al.* (2010).

Corresponding author: Krishnamoorthi, A. Department of Zoology, Annamalai University, Annamalainagar – 608 002, India

MATERIALS AND METHODS

Veeranam lake is located 14 km SSW of Chidambaram in Cuddalore District in the State of Northern Tamil Nadu in South India [coordinates 11° 20' 10''N and 79° 32' 40''E]. The lake type is reservoir, intermittent, the total catchment area of the reservoir is 25 km^2 [9.7 squaremiles] and have the capacity of store 47.5 feet of water. The lake located 235 km from Chennai, from where water is planned to be supplied to Chennai for drinking purpose, Ayacut area of 48,000 acres irrigation and capture fisheries for people living around the lake. Water samples were collected from five sampling sites in sterilized bottles once in a month and analysed for the period of one year from July 2011 to June 2012. The water

samples were seriously diluted in physiological saline by aseptically. The dilutions were used for most probable number (MPN) technique to estimate the population by the procedure of APHA (1998).

Enumeration of Actinomycetes

One ml of aliquots of 10^{-4}, 10^{-5} and 10^{-6} dilutions were inoculated by standard plate method on nutrient medium glycerol asparagines agar (GAA). Nystain, an antifungal antibiotic 50 ug/ml was incorporated in the medium to inhibit fungal growth (William and Davies, 1965). The plates were incubated at room temperature for 5-6 days. The actinomycetes were expressed in CFU/ml.

Enumeration of Bacteria

One ml of aliquots of 10^{-5}, 10^{-6} and 10^{-7} dilutions were inoculated on nutrient agar by standard plate count method by following standard methods (APHA, 1998). Plates were inoculated at room temperature for 2 days. The colonies developed on the plates were counted and expressed in CFU//ml.

Enumeration of Fungi

One ml of aliquots 10^{-2}, 10^{-3} and 10^{-4} dilutions were inoculated on Malt Extract Agar medium (MEA) or Sabourauds agar by standard plate count method. The plates were inoculated at room temperature for 4 to 5 days, colonies developed were counted and expressed in CFU/ml.

RESULTS AND DISCUSSION

The seasonal average microbial population observed in the water samples from Veeranam lake are presented in Table 1, and the seasonal percentage of microbial population are given in the Fig. 1.

The sequence of microbes occurs maximum bacteria followed by actinomycetes and fungi. The bacterial count in the lake water ranged between 16.80 ± 3.16 CFU/ml to 25.46 ± 0.74 CFU/ml in different seasons of the year. The bacterial population concentration was lower during monsoon and gradually increases in premonsoon, postmonsoon and summer season. The percentage of bacterial population presented in the Fig. 1 revealed that the maximum 77.36% in premonsoon season and minimum 75.04% occurs in summer season. The bacterial count gradually increase from monsoon to summer is due to addition of land washing organic matter and animal manure by runoff rain water, the optimum temperature and growth supporting nutrient rich in postmonsoon, low water level and high organic matter and low bacterivores plankton favour for higher bacterial concentration during summer season. Another study revealed that higher bacterial concentrations were strongly associated with rainfall and sewage sources were linked to total coliform and faecal coliform (Crowther *et al.,* 2001; Vincent *et al.,* 2006; Thorat and Sultana, 2000). Typical water borne diseases caused by bacteria include typhoid, cholera, paratyphoid, gastroenteritis and bacterial dysentery. Actinomycetes are gram-positive filamentous bacteria that are abundant in soils (Goodfellow and Williams 1983), but are often found in freshwater (Cross, 1981; Wnorowski, 1992). Some actinomycete species may be resident in freshwater environment (Roach and Silvey, 1958; Willoughby, 1974), but large number of this taxa also enter freshwater from plant with soil runoff (Persson, 1980; Niemi *et al.,* 1982). In surface waters, actinomycetes often are found associated with sediment (Johnston and Cross, 1976; Cross, 1981). In the present study, the actinomycetes count ranged between 4.63 ± 1.37 CFU/ml to 8.20 ± 0.81 CFU/ml. The actinomycetes concentration was lower during monsoon and gradually increased in premonsoon, postmonsoon and summer seasons (Fig. 1).

Table 1. Seasonal average of microbial population in Veeranam Lake from 2011-12

	Premonsoon	Monsoon	Postmonsoon	Summer
Bacteria	17.05 ± 1.62	16.79 ± 3.16	20.27 ± 3.52	25.46 ± 0.74
Fungi	0.28 ± 0.03	0.41 ± 0.06	0.55 ± 0.03	0.27 ± 0.09
Actinomycetes	4.71 ± 1.62	4.63 ± 1.31	5.98 ± 0.64	8.20 ± 0.81

Values are expressed as mean ± SD (n = 5)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Bacteria	Between Groups	146.369	3	48.790	7.598	0.010
	Within Groups	51.373	8	6.422		
	Total	197.742	11			
Fungi	Between Groups	0.156	3	0.052	13.416	0.002
	Within Groups	0.031	8	0.004		
	Total	0.187	11			
Actinomycetes	Between Groups	24.944	3	8.315	6.105	0.018
	Within Groups	10.896	8	1.362		
	Total	35.840	11			

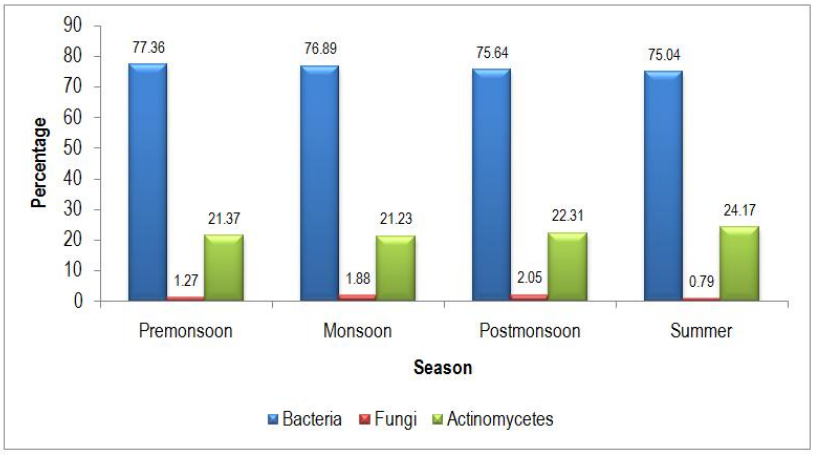

Fig. 1. Percentage of microbial population in Veeranam Lake from 2011-12

It is well established that organic load and ultimately suspended solids promote the growth of actinomycetes. Higher concentration of actinomycetes in summer season is due to low level of water, rich in organic matter and high turbidity. The primary sources of actinomycetes in the lake are soil associated with animal manure and agricultural runoff. Beryl Zaitlin *et al.* (2003) suggested that the actinomycetes were coming from similar areas as the *E. coli*, i.e., terrestrial sources associated with animal manure. Actinomycetes are often capable of producing highly potent volatile adourous compounds, particularly geosmin (trans-1,10-dimethyl-trans-9-decalol) and MIB (2-methylisoborneol). These compounds are responsible for a significant number of taste and odour outbreaks in drinking water supplied (Sugiura and Nakano, 2000). Not only the bacterial species are responsible for the water borne diseases, even the fungal species cause disease like aspergillosis, coccidiomycosis, blastomycosis, histoplasmosis and pneumocystis etc, through the food poisoning if the contaminated water is utilized for food preparation or drinking. Accidental or deliberate consumption of wild fungi or fungal contaminated food can lead to poisoning or toxicities of the consumer because some fungi naturally contain toxin metabolites called mycotoxins. Deeper systemic fungal infection of lung and central nervous and lymphatic systems cause much more serious diseases (Nicklin *et al.,* 2001). In the present study, fungal population count range between 0.27 ± 0.09 CFU/ml to 0.55 ± 0.03 CFU/ml. The population concentration maximum during postmonsoon and gradually reduced in monsoon, premonsoon and summer season. The lower concentration during summer is due to high temperature. In reservoirs, water levels can fluctuate widely, obviously the lowering of the water level and desiccation of periphyton communities suppresses growth and increases mortality of hypomycetes. Noorjahan (2008), identify 7 species of fungi in commercial drinking water bottles and sachets. Kowsalya *et al.* (2010), identify *Aspergillus* sp, *Acremonium* sp*, Chaetomium globosum, Mucor* sp and *Penicillium* sp in ErettaiEri, Chennai. Presence of fungi in water sources used for drinking and recreational purposes would cause allergic reaction, infection and toxic responses (Gomi *et al.,* 2002).

In the present study, the percentage population distribution of the microorganisms varied from 75.04% to 77.36% of bacteria, 21.23% to 24.17% of actinomycetes and 0.79% to 2.05% of fungi. It is a well-accepted fact that actinomycetes population lies intermediate to bacteria and fungi. Shejul (1998), Kulkarni (1999), Jadhav (2001) and Chougule (2006) also observed similar results. In 2004, it was estimated that 88% of the world's diarrheal disease (including cholera) is due to unsafe water and sanitation (WHO 2004). Worldwide 1.8 million people die every year from diarrheal disease, including over 6000 children under the age of 5 every day (WHO/ UNICEF, 2005). The results revealed that the differences between the seasons may be due to the influence of environmental factors. The analysis of variance shows a significant difference ($p < 0.05$) between the different season and bacteria, fungi and actinomycetes.

Conclusion

The healthy condition of an aquatic ecosystem depends upon the physico-chemical biological characteristics, which usually fluctuate with season and degree of pollution. The results of the study shows that the presence of microbial population indicate the water may be contaminated by human activities, agricultural runoff and improper water management and carelessness towards environment. The lake is an important stop-over sanctuary for some species of migratory birds. Hence, it is suggested that the water for drinking is pre-treated before consumption. Regular monitoring of water bodies with the required number of environmental parameters including that of microbiological characteristics can help to prevent outbreak of diseases and occurrence of health hazards associated with aquatic pollution.

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