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Microbial pollution- total coliform and fecal coliform of Kengeri lake, Bangalore region Karnataka, India.

N. Latha and M. Ramachandra Mohan

Lake Management and Water Quality Research Unit, Department of Zoology, Bangalore University, Bangalore-560 056.

Abstract- A survey of the occurrence of fecal indicator bacteria (total coliform TC, fecal coliform FC) in Kengeri lake was carried out during the period of 3 years (Jan 2005 to Dec 2007) using membrane filter (MF) technique. The study was implemented to assess the hygiene of water quality in order to give an indication about the actual magnitude of fecal pollution post the discharge of domestic sewage discharge. The total coliform was high in April, may and low in September while fecal coliform was high in June, July and September and low in April. On the basis of the result water was considered to be unsatisfactory for domestic and agricultural purposes throughout the study period. In general total coliform count in the Kengeri lake, greatly increased in summer months and decreased in winter and monsoon months while fecal coliform revealed high values in monsoon which declined in summer months.

Index Terms- TC (total coliform), FC (fecal coliform), Urban sewage discharge.

I. Introduction

Aquatic ecosystem contains characteristic communities of microorganisms and non indigenous species that are introduced into such environments, which commonly decline in abundance and ultimately disappear. The factors regulating the composition of aquatic microbial community would be useful in predicting the persistence and behaviour of human, animal and plant pathogens in natural water (Yigal Henis *et al.,* 1989). Water contaminated with fecal matter have the capability to pose serious health risks for shell fish consumers and swimmers and major economics losses for shell fish harvesting and business (Trevette *et al.,* 2005). Bacterial, viral and protozoan pathogens can be introduced into waters in various ways, including leaking septic tanks, sewer malfunction contaminated storm drains, runoff from animal feedlots, human fecal discharge and other sources (Aslan- Yilmaz *et al.,* 2004). Enumeration of fecal coliforms, *E coli* and /or Enterococcus Sp. has generally been used to assess microbial water quality. These micro organisms share a common feature, they all can inhabit the intestines of warm-blooded animals, including wildlife, livestock and humans and therefore can be excreted in the feces of these animals. Although these have been some association between high levels of indicator bacteria and disease outbreak (Chou *et al.,* 2004)**,** there is little or no prediction of species sources of contamination or correlation with human pathogens when using these indicators (Gonzalves and Joshi, 1964).

The aim of microbiological examination of water is to detect whether pollution has occurred or not. Though it would be ideal to look for the pathogens themselves it is not practicable since they are usually few and far outnumbered by nonpathogenic organisms. Therefore biological indicator of pollution, coliform bacteria, either total coliform or fecal coliform are generally used as indicators of pollution of water. Also Enterococci and fecal Streptococci such as *Streptococcus faecalis* are regularly present in faeces and are recognized as indicators of fecal contaminations. The natural bacterial floras of water are those species which are constantly present in water. The presence of nonpathogenic organisms is not a major concern, but intestinal contaminates of fecal origin are important. These pathogens are responsible for intestinal infections, such as bacillary dysentery, typhoid fever, cholera and paratyphoid fever. Water contamination with pathogens and pollutants create many health problems for the water consumers. The study is undertaken to know the microbial pollution of Kengeri lake.

II. Material and Methods

Samples of water for bacterial analysis were collected at monthly frequency during January 2005 to December 2007. The samples are collected in sterilized borosilicate glass stoppered bottles, the stopper and neck of the bottle should be covered to protect against dust and handling contacts and wrapping paper, pressed over stopper and neck sealed by secure hood. The samples are stored at a temperature between 6-10^{0}C in refrigerator.

III. Experimental Design

Membrane filter technique was used for counting coliform numbers (quantity) in water bodies. This technique involves filtering a known volume of water through a special sterile filter. These filters are made of nitrocellulose acetate and poly carbonate with a 150µm thick and have 0.45µm diameters pores. When the water samples are filtered bacteria in the sample are trapped on the surface of the filter. The filter is then carefully removed placed in a sterile petri plates containing the solidified media and incubated for 20-24 hours at 37^{0}C and 44.5^{0}C for Total coliform and Fecal coliform respectively.

The enumeration of fecal coliform and total coliform population was made by membrane filter technique with the following high media;

IV. M-FC MEDIA

The medium containing: Tryptone 10.0g; Proteose peptone No.3 5.0g; Yeast extract 3.0g; Sodium Chloride 5.0g; Lactose 12.5g, Bile Salt No.3 1.5g; Aniline blue 0.1g; Agar 15.0g and water 1000ml.

V. M- ENDO MEDIA

The medium containing: Tryptose 10.0; Thiopeptone, 5.0; casitone, 5.0; yeast extract,1.5; lactose, 12.5; sodium chloride, 5.0; dipotassium dihydrogen, 4.37; potassium dihydrogen phosphate, 1.375; sodium lauryl sulfate, 0.05; sodium dosolycholate, 0.10; sodium sulfite, 2.10; basic fuchsin, 1.05; Agar 15.0g and water 1000ml.

VI. RESULT AND DISCUSSION

The total coliform count during 2005-2007 is represented in the fig. 1.In the year 2005, the highest total coliforms were observed (232/100ml) in May and lowest were observed (98/100ml) in September. In the year 2006, the highest total coliforms were observed (510/100ml) in April and lowest were observed (210/100ml) in September. In 2007, highest total coliforms were observed (1500/100ml) in May and lowest total coliforms were observed (640/100ml) in September.

The fecal coliform count during 2005-2007 is represented in the fig. 2. In the year 2005, the highest fecal coliforms were observed (98/100ml) in June and lowest were observed (48/100ml) in April. In the year 2006, the highest fecal coliforms were observed (112/100ml) in September and lowest were observed (70/100ml) in April. In 2007, highest fecal coliforms were observed (510/100ml) in July and lowest fecal coliforms were observed (210/100 ml) in April.

The water contamination, the outcome of rapid development of industry, has resulted in contamination of all kinds of natural water system. This contamination is not only confined to highly industrialized countries, where the population explosion has given rise to complications such as increasing amounts of waste, waste water and other types of contaminants which have endangered living organisms dependent on this vital resource. Water acquires bacteria from air, soil, sewage, organic wastes, dead plants and animals. Almost any organism may thus be found in water at any time. However, most of the bacteria find condition unfavourable and soon die and survivors contribute natural flora of that water body. Coliform bacteria also consists of an artificial grouping of organisms believed to be associated with fecal pollution but in reality may also include environmental organisms from soil, vegetation and decaying organic matter (Geldreich and Bordnee, 1962).

Total coliforms are a group of closely related bacteria that are not harmful to humans. TC is common inhabitants of ambient water and may be injured by environmental stress, lack of nutrients and water treatment in a manner similar to most bacterial pathogens. TC are used to determine the adequacy as otherwise the data obtained on TC in the studied lake indicate the degree of pollution, and its relationship to sewage input quanta in the different lakes. In general, it is found that the densities of TC greatly increased in the summer months and decreased in winter and monsoon months, a trend that is dependent on the inflow of water into the lakes.

Higher values of bacteria in Kengeri lake was due to bathing and washing at the locations making them more polluted further cattle dropping from the catchment area have contributed for its count this is in similar with the findings of (Bagde and Varma, 1982). Bacterial number was reported lowest in the winter and highest in summer in many water bodies as reported by (Saxena *et al.,* 1966 and Seenayya, 1973). Low winter counts were attributed to lower multiplication and poor growth following low temperature. The highest coliform counts were witnessed in summer when dissolved oxygen was the least. This may be due to heavy consumption of dissolved oxygen, which was more vigorous in warm weather (Hannan, 1979).

Fecal coliform bacteria are routinely used to monitor aquatic systems for sewage contamination, and considerable attention has been directed at evaluating the survival of FC in aquatic systems. The general trend of the densities of FC greatly increased in the monsoon months and decreased in the summer months (as in the case of TC highest bacterial population during monsoon months is obviously due to transport of organic matter from various sources through surface run off from the catchment area). Other factors that have increased bacterial population density in Kengeri lake are a) the human activities causing pollution and b) the runoff water from catchments areas flowing into the lakes with abundant nutrients and direct sewage inlet into lake. The temperature also influences the trend in variation of density of bacterial population. This is in accordance to other researchers (Patralekha, 1992).

Fecal coliform bacteria are bacteria that originate from intestinal tracts of homothermic animals. Their presence indicates fecal contamination of water. Total and fecal coliform bacteria are sensitive and commonly used indicators of bacterial pathogen contamination of natural waters. Their presence implies the potential presence of micro organisms that are pathogenic to humans. Fecal coliform bacteria have a strong correlation with fecal contamination of water from warm-blood animals. If 1 fecal coliform per 100 ml of water is detected, the water is considered unsafe to ingest (USEPA, 1998). Since the counts are higher than USEPA standards the Kengeri lake water is unsafe for human and domestic usage. Further agricultural operations need to be aware of the potential for the spread of disease-causing micro organisms to farm workers while handling such water. Disease associated with enteric bacteria range from bacteria that cause mild to life threatening gastroenteritis, hepatitis, skin infection, wound infections, conjunctivitis, respiratory infections, and generalized infections (Moe, 1997).

Moreover, human activities in the catchments area usually cause some intensification of the transport of nutrients, thus aggravating the processes of degradation. In addition storm water and other sources without a human component can contribute heavy loads of indicator bacteria to surface water (Haack *et al.,* 2003). From the observations made in the present study, it is also evident that interferences in the catchment area by direct or indirect activities of human and cattle influences the water quality of the studied lake.

VII. Conclusion

From the data obtained in this study on health risk indicators and pathogen densities of Kengeri lake it is concluded that due to increasing load of bacterial counts the lake grouped under the polluted and this water is neither fit for domestic nor agricultural purposes.

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Authors

First Author – Latha,N, M S c,Ph D,Bangalore University, lathanarayan201@gmail.com
Second Author – Prof.M.Ramachandra Mohan .Dept of Zoology,Bangalore University,mohanramachandr@gmail.com

Correspondence Author – Latha,N, M S c,Ph D,Bangalore University, lathanarayan201@gmail.com

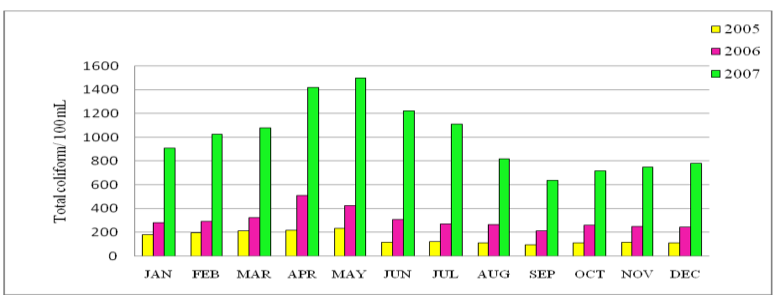

Fig.1: Monthly variation of Total Coliform in Kengeri Lake during Jan 2005 to Dec 2007

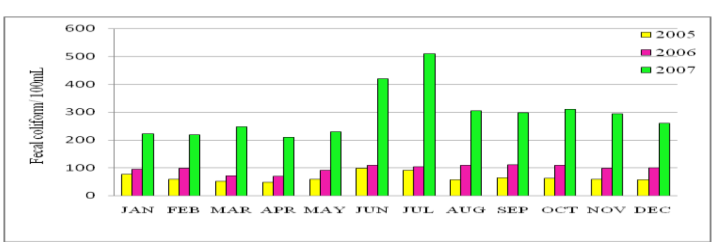

Fig.2: Monthly variation of Fecal Coliform in Kengeri Lake during Jan 2005 to Dec 2007