Asian Journal of Chemistry Vol. 22, No. 6 (2010), 4286-4290

Bacterial, Fungal and Algal Population of Pennar River: A Fresh Water Wetland in Kottayam District, Kerala

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A short term, baseline study was undertaken to determine the occurrence of microbial pollution in the Pennar river. Four stations were selected for study on the basis of land use pattern. Bacteriological, fungal and algal examinations were made and the results obtained showed that 8 species of bacteria isolated were opportunistic pathogens and total coliform count ranged from 460-2400/100 mL, thus making the water unsafe to drink unless treated properly. Fecal pollution from non human and human source is one of the major factors that contribute to the degradation of water quality and that restrict its use. Four fungal species were identified which are also opportunistic pathogens. In the present study about 36 different genera comprising 61 species of algae were idetified. High pollution tolerant species like *Scenedesmus*. *Coelastrum*, *Oscillatoria*, *Nitzchia paella*, *Ankistrodesmus*, *Anabaena*, *Synedra* and *Navicula* were present in different sites of Pennar river especially in the site I which is highly populated. High socioanthropological activities, clogging of water body due to weeds and agricultural practices in the basins were identified as a contributory factors to the situation.

Key Words: Bacteria, Fungus, Algae, River.

INTRODUCTION

Access to safe drinking water remains an urgent human need in many places in Kerala. The availability of treated water being perhaps the single most important factor limiting the attainment of improved quality of life for almost two-thirds of the world' s population. For many people, water supply, sanitation and safe disposal of wastes remain the most important of all environmental problems. Two environmental issues are involved: (a) the costs to human health and productivity resulting from polluted water and inadequate sanitation and (b) the stresses placed on water resources by rapidly growing human demands for water[1]. The importance of water as a vehicle for the spread of diseases has long been recognized[2]. Most diseases which prevail when water supply and sanitation are deficient are infectious diseases caused by bacteria, amoebae, viruses or various worms and algae.

Liquid and solid wastes generated from both animal and domestic sources can significantly impair drinking, irrigation and recreational water sources in rural areas. The assessment and management of non-point sources of microbial pollution, in

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particular, is an issue of great interest. Although most big rivers in Kerala are used extensively for drinking water and other domestic purposes as well as for small scale fishing and mining, there is very little information on the microbial quality of the waters.

Pennar river, one of the tributaries Meenachil river has different water channels which spread over Kumaranalloor, Aymanam, Arpookara, Athirampuzha, Neendoor, Vechoor, the western villages of Kottayam district and finally joins with backwaters of Vembanad lake.

EXPERIMENTAL

Pennar is the study area from where four different site areas were selected on the basis of land use. Following are the site area: Boat jetty area (populated area-site I), pumping station (agricultural area-site II), Pennar Kaipuzha river junction. (coconut palm area-site III) and oil palm area (site IV). Surface water and sub surface water samples were collected for the water quality analysis. The prime investigation is to identify the factors related to poor water quality of Pennar and also to identify the microbial contamination in the Pennar.

Bacterial and fungal analyses were made by using standard procedures. For algal analysis samples collected from four different sites were kept for sedimentation by adding 4 % formalin. After two days, algae settled at the bottom of the bottle are observed under high power of the microscope.

RESULTS AND DISCUSSION

Bacterial and fungal analysis: It is difficult to check for all pathogens in water and it is also a time consuming process. Indicator organisms are used instead. The most widely used indicator is the coliform group of bacteria. This group includes *Escherichia coli* which is most common intestinal inhabitant and is widely used as water quality indicator to find out the presence of human faecal matter and other pathogens possibly associated it.

A total of eight pathogenic bacteria (*E. coli*, *Proteus*, *Klebsiella pneumoniae*, *Pseudomonas*, *Staphylococcus* sp., *Enterobacter* sp., *Klebsilla* sp. and *Citrobactor*) are isolated from the four collection centers. All of them are opportunistic pathogens (Table-1). The analysis of the results showed that the concentration of total coliform count ranged from 460-2400 count/100 mL. Which is higher at boat jetty area. Fecal pollution from non human (pets, live stock or wild life) and human source is one of the major factors that contribute to the degradation of water quality and that restrict its use[3-5]. The high organic matter in the river provides suitable substrate for the growth of the bacteria. Contamination from human source post a threat in most of the study areas. All stations sampled have indication of human faecal contamination. *Pseudomonas* is reported as pathogen in fishes and shellfishes in aquatic ecosystem[6]. So the occurrence of this pathogen in the sites may lead to diseases in humans and other animals.

TABLE-1
BACTERIAL ANALYSIS OF SUFACE (S) AND SUBSURFACE (SS) WATER

Bacteria	Site I		Site II		Site III		Site IV	
	S	SS	S	SS	S	SS	S	SS
Escherichia coli	OP	OP	OP	OP	OP		OP	OP
Klebsiella pneumoniae	OP	OP		OP		OP		OP
Citrobacter sp*.	OP			OP	OP	OP	OP	
Staphylococcus sp*	OP							
Enterobacter sp*			OP				OP	
Klebsilla sp*				OP				
Proteus sp*					OP			
Pseudomonas sp								OP
MPN	2400	1100	240	460	460	460	240	460

Legend: PP: potentially pathogenic; OP: opportunistic pathogen; *species level characterization pending.

A good indicator of the quality of water for drinking or swimming and bathing is the number of coliform bacteria present in 100 mL sample of water. The world health organization recommends coliform bacterial count of zero colonies/100 mL for drinking water and the EPA recommends maximum levels for swimming water of 200 colonies/100 mL because the average human excretes about 2 billion such organisms a day. Higher levels of coliform bacteria are found in the populated boat jetty area.

Four fungal species were identified in the site IV (oil palm area). In the site I only the surface water contains fungal species. *Aspergillus flavus* reported in the surface water of site I, subsurface water of site II and IV are potentially pathogenic. The fungal species *Aspergillus niger* (site I surface and IV subsurface), *Penicillium* sp. (site IV subsurface), *Absidia corymbifera* (site III subsurface), *Mucor circinelloides* (site IV subsurface) reported are opportunistic pathogens (Table-2).

TABLE-2
FUNGAL ANALYSIS OF SUFACE (S) AND SUBSURFACE (SS) WATER

Fungi	Site I		Site II		Site III		Site IV	
	S	SS	S	SS	S	SS	S	SS
Aspergillus niger	OP							OP
Aspergillus flavus	PP			PP				PP
Penicillium sp*								OP
Absidia corymbifera						OP		
Mucor circinelloides								OP
Aspergillus niger	OP							OP
Aspergillus flavus	PP			PP				PP
Penicillium sp*								OP
Absidia corymbifera						OP		

Legend: PP: potentially pathogenic; OP: opportunistic pathogen; NP: non-pathogenic *species level characterization pending.

Algal analysis: Algae are known to indicate the level of pollution and are widely used throughout Europe and North America. Various species *Microcystis*, *Oscillatoria*, *Aphanizomenon*, *Spirulina*, *Arthrospira*, *Lyngbya*, *Phormidium*, *Chlorella*, *Gomphonema*, *Scenedesmus*, *Spirogyra*, *Schizomeris*, *Chlamydomonas*, *Pandorina*, *Nizschia*, *Euglena*, *Phacus*, *etc*., indicate organic pollution, while *Cyclotella ocellata*, *Melosira islandica* and many desmids indicate the purity of water[7-9].

In all natural water system certain plankton genera are present in common. In the present study about 61 species of algae coming under 36 different genera were identified (Table-3). Most of the species were coming under the families *Bacillariophyceae* and *Chlorophyceae*. Species richness is noted in the site I where there is more human intervention. The important thing to mention here is that high pollution tolerant species like *Scenedesmus*. *Coelastrum*, *Oscillatoria*, *Nitzchia paella*, *Ankistrodesmus*, *Anabaena*, *Synedra* and *Navicula* were present in different sites of

TABLE-3
LIST OF ALGAE IDENTIFIED (SURFACE AND SUBSURFACE WATER)

Name of algae	Site I		Site II		Site III		Site IV		Name of algae	Site I		Site II		Site III		Site IV	
	S	SS	S	SS	S	SS	S	SS		S	SS	S	SS	S	SS	S	SS
Chlorophyceae									**Euglenophyceae**								
(a) *Chloroccales*									*Euglena gracilis*	+	+		+	+		+	+
Pediastrum duplex			+						*Euglena acus*				+	+			+
Scenedesmus lunatus	+					+	+		*Euglena Oxyuris*						+		
Scenedesmus cuminatus			+			+			*Euglena virdis*						+		
Kirchneriella	+								*Phacus 1*		+						
Crucigenia	+								*Phacus 2*		+						
Coelastrum microporum	+								*Phacus 3*			+		+			+
Ankistrodesmus	+					+	+		*Phacus 4*				+	+			+
(b) *Conjugales*									*Phacus 5*					+			+
Cosmarium 1	+	+	+	+	+				*Trachelomonas armata*	+	+	+	+	+			
Cosmarium quadrum	+								*Trachelomonas cylindrica*		+	+	+	+	+		+
Cosmarium 3								+	*Trachelomonas oblonga*		+		+	+	+		+
Cosmarium 4								+	*Trachelomonas*								+
Cosmarium 5				+					*Lepocinclis*						+		
Closterium 1	+	+			+			+	**Bacillariophyceae**								
Closterium 2				+	+				*Cyclotella*			+					
Eusatrum	+						+		*Melosira*	+	+		+	+	+	+	+
Sraurastrum	+	+							*Synedra ulna*	+				+		+	
Gonatozygon	+								*Nitzschia 1*	+		+			+		
Mougeotia						+			*Nitzschia 2*	+			+	+		+	+
Stigeoclonium							+	+	*Nitzschia 3*				+	+		+	+
Micrasterias									*Nitzschia 4*					+			+
Cyanophyceae									*Nitzschia 5*								+
Oscillatoria	+			+			+	+	*Navicula*		+						
Myxosarcina							+		*Eunotia 1*		+		+				
Phormidium							+		*Eunotia 2*		+		+	+		+	
Anabaena							+	+	*Eunotia 3*				+	+		+	+
Stigonema							+		*Eunotia 4*							+	+
									Eunotia 5								+
									Stauroneis								
									Achnanthes								
									Pinnularia 1	+				+	+	+	
									Pinnularia 2	+				+			+
									Suriella		+						
									Fragilaria					+			
									Diatoma					+	+	+	+
									Stauroneis					+		+	

Pennar especially in site I which is highly populated. The presence of genera like *Chlorella*, *Scenedesmus*. *Coelastrum*, *Oscillatoria*, *Nitzchia paella* which comes under the most pollution tolerant genera. *Chlorella*, *Scenedesmus*, *Nitzchia*, *Microcystis*, *Oscillattoria* indicates organic pollution[3,4]. Among them two pollution indicating genera *Scenedesmus* and *Ankistrodesmus* were also identified in Pennar.

Results of the microbial levels obtained from Pennar indicate that it cannot serve as potable water source without proper treatment. The present study has provided some useful information on the state of microbial pollution in Pennar. People in rural areas have a different perception about water. Their general outlook maybe different from their urban counterparts who are usually more concerned with quality as well as quantity. In many rural communities people pay little attention to the quality of water; to them any water is safe to drink. The manner in which people choose between alternative water sources and the criteria they use to do so are largely determined by distance and price factors.

The risk of epidemic is a possibility in the basins studied if the population is to depend on the untreated water as source of their drinking water. This is due to high socio-anthropological activities such as farming, bathing, fishing and boat service currently operating in the catchments area. To ensure that the poorer communities are put at minimum risk treated waters should be very close to the users. There should be provision of toilet facilities in the towns/villages. Farming should be some distance away from the river source. Intensify water education in order to avoid contamination of the water sources.

ACKNOWLEDGEMENTS

The authors are grateful to University Grants Commission for providing financial assistance and Principal, K.E. College for Providing Laboratory Facility to carry out the investigation.

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(*Received*: 24 June 2009; *Accepted*: 6 February 2010) AJC-8403