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Assessment of faecal indicator bacteria in the coastal waters of Visakhapatnam, India

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ABSTRACT

The present study investigates the presence of faecal indicator bacteria in the three stations of Visakhapatnam coast. Results showed that the total coliforms varied from13 cfu/ml to 92 cfu/ml, faecal coliforms ranged from 6 to 24 cfu/ml and E.coli is *found more in station 1 and minimum in station 3. Faecal streptococci varied from 1 to 8 cfu/ml. Higher microbial densities were recorded in fishing harbour and shipyard and hence these areas were indicative of sewage pollution. Therefore monitoring the indicator organisms in the effluents is more likely to be predictive of the presence of certain pathogens in order to protect public health.*

Keywords: Faecal indicator bacteria, sewage, *Escherichia coli*, Visakhapatnam coast**.**

INTRODUCTION

Coasts are considered as important economic areas in the world. Due to increased urbanization and industrialization the water quality of the coastal water has declined considerably [1]. Inputs of large quantities of sewage effluents into the coastal waters are the major cause for faecal contamination [2], [3], [4]. Such waters are unsuitable for recreation [5], fishing [6], aquaculture [7], [8] and can cause health hazards in humans [9]. Hence assessment of coastal waters by measuring faecal indicator bacteria (FIB) [10] viz., total coliforms, faecal coliforms, *E.coli* [11] and faecal streptococci is crucial for protection of human and ecosystem health, for risk assessment and remediation of water bodies with impaired quality [12].

Along Bay of Bengal, the Visakhapatnam coast is considered as one of the productive zones. In recent years due to increase in domestic sewage and various anthropogenic activities of the human beings, the sanitary conditions of the water have been a serious concern [13], [14]. The focus of the present study is to investigate the pollution due to faecal matter in the coastal waters of Visakhapatnam during the period March 2011 to February 2012 using faecal indicator bacteria and there by assessing human risk from the pathogens.

MATERIALS AND METHODS

Study area and Sample collection

The study area is Visakhapatnam coast situated between the latitudes 17^0 14' 30" and 17^0 45' N and the longitudes 83^0 16' 25" and 83^0 21' 30" E on the east coast of India. For the present study three sampling stations were chosen viz., fishing harbour (station1), shipyard (station2) and Bhimili (station3). The surface water samples for physicochemical parameters and microbiological analysis were collected using sterilized glass bottles and transported in ice box to the laboratory. Temperature using centigrade thermometer, Hydrogen ion concentration

(pH) using digital pH meter and salinity using salinometer were measured in the field. Dissolved oxygen was analyzed using Wrinkler's method [15]. All the readings were taken in triplicates.

Bacterial study

The total viable count (TVC) in different samples was estimated by inoculating nutrient agar plates with suitable dilution of the water sample. The results were expressed as colony forming units (cfu/ml) enumerated after 48 hrs of incubation. Hi-media were used for isolation of different faecal indicator bacteria. Total coliforms and *E.coli* were identified using Mac Conkey agar and the plates were incubated for 24 hours at a temperature of 37^0C. Faecal coliforms were identified using m-FC agar, incubated for 24-48 hours at 44.5 ± 0.2^0C and faecal streptococci were identified in M-Enterococcus agar [16].

RESULTS AND DISCUSSION

Monthly variations in physicochemical and bacterial parameters were recorded for a period of one year from March 2011 to February 2012. The surface water temperature in the study area varied from 26^0C to 34^0C with maximum temperature recorded at station 3 and minimum at station 2 (Figure 1). Temperature is the main abiotic factor which influences physicochemical and biological characteristics of the water bodies. It also affects the growth and survival of microorganisms. Among the three stations, salinity varied from $23^0/_{00}$ to $33^0/_{00}$ recording maximum in May and minimum during December (Figure 2). pH followed trend similar to that of salinity. pH gets changed with time due to changes in temperature, salinity and biological activity. It ranged from 7.4 to 8.2 (Figure 3). Dissolved oxygen varied from 3.9 ml/l to 8.1ml/ l (Figure 4). Physico chemical characteristics showed similar trend as reported by earlier workers [17], [18], [19], [12].

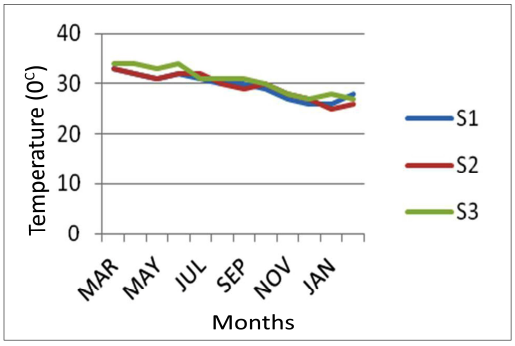

Fig 1.Monthly variation of temperature in three stations

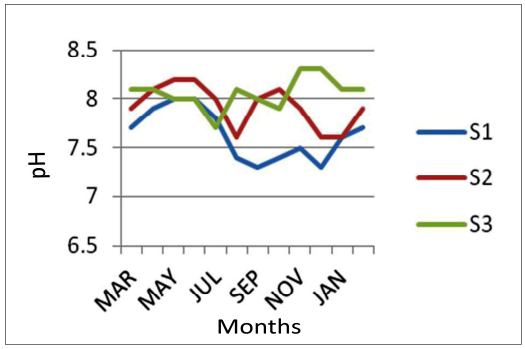

Fig 2.Monthly variation of pH in three stations

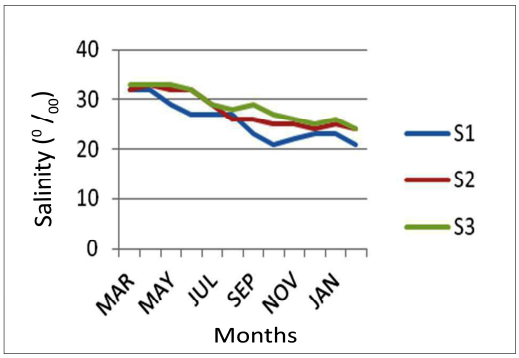

Fig 3.Monthly variation of salinity in three stations

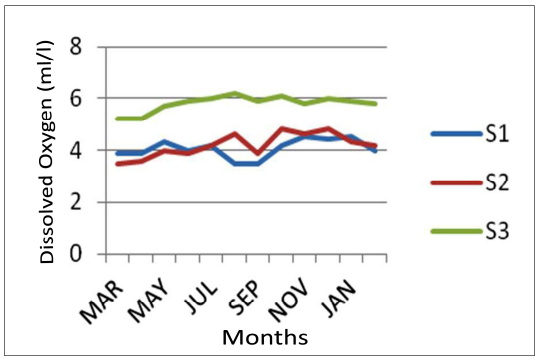

Fig 4.Monthly variation of dissolved oxygen in three stations

Faecal indicator bacteria have been used in many countries as a monitoring tool for microbiological impairment of water and for prediction of presence of bacterial, viral and protozoan pathogens [20]. Monthly variation of the FIB is shown in the Table 1. During the study period total viable count (TVC) varied from 120 cfu/ml to 812 cfu/ml. TVC is maximum in station1 and minimum in station 3. Total coliforms (TC) ranged from 13 cfu/ml to 92 cfu/ml. TC

was more in station1 than other stations due to increase in human activities. Seasonal variations in TC were reported in all the three stations and the maximum was recorded in the month of September during monsoon due to land runoff. Similar results were obtained from the other coasts [1], [16]. TC was higher than FC and FS as TC included both faecal and non faecal sources. Faecal coliforms (FC) ranged from 6 to 24 cfu/ml. Maximum FC was reported in the station 1 and minimum in station 3. *E.coli* is found more in station 1 and minimum in station 3. *E.coli* is normally found in humans is the most reliable indicator of faecal contamination in water which indicate the possible presence of pathogens [19], [2], [11]. Faecal streptococci ranged from 1 to 8 cfu/ml. Maximum is recorded in station 1 and minimum in station 3. Faecal streptococci are considered to be a good indicator of faecal pollution as they are more resistant than coliforms to the environmental stress [21], [22].

Table1: Monthly variation in the faecal indicator bacteria and faecal streptococci in three sampling stations

MONTH	STATION-1					STATION-2					STATION-3				
	TVC	TC	FC	*E.coli*	FS	TVC	TC	FC	*E.coli*	FS	TVC	TC	FC	*E.coli*	FS
MAR	185	43	15	4	4	149	38	13	10	3	120	20	10	2	2
APR	190	48	15	7	3	138	40	11	9	2	120	19	8	2	3
MAY	218	40	16	10	4	149	30	13	7	4	139	15	8	3	2
JUN	229	38	14	10	6	250	32	14	3	4	145	13	7	2	2
JUL	335	35	13	10	3	360	58	11	5	2	173	25	8	1	1
AUG	446	29	17	13	8	480	65	13	4	3	253	28	8	3	2
SEP	730	36	12	9	7	685	85	8	6	5	253	48	10	3	2
OCT	812	52	17	6	8	490	93	15	5	5	169	28	11	3	3
NOV	739	39	18	6	7	390	85	13	2	5	170	39	11	0	1
DEC	749	42	18	4	5	625	83	14	4	3	189	35	9	2	2
JAN	450	39	24	5	6	685	85	18	3	4	140	39	6	2	3
FEB	550	40	20	7	5	650	85	15	4	3	180	40	6	0	2

All the parameters are expressed in colony forming unit /ml.

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CONCLUSION

This study investigates faecal contamination of coastal waters of Visakhapatnam by monitoring faecal indicator bacteria. Results showed more microbial load at fishing harbour and shipyard indicating that these areas are more polluted with sewage and other anthropogenic activities of human beings. Hence continuous monitoring and remedial action is to be taken to avoid risk of pathogens affecting human health.

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