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

V. Hima Sailaja, Ayyagari Archana and K. Ramesh Babu

Department of Marine Living Resources, College of Science and Technology, Andhra University, Visakhapatnam

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 from 13 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° 14’ 30” and 17° 45’ N and the longitudes 83° 16’ 25” and 83° 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°C. Faecal coliforms were identified using m-FC agar, incubated for 24-48 hours at 44.5 ± 0.2°C 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°C to 34°C 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‰ to 33‰, 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 8.1 ml/l (Figure 4). Physico chemical characteristics showed similar trend as reported by earlier workers [17], [18], [19], [12].

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 station 1 and minimum in station 3. Total coliforms (TC) ranged from 13 cfu/ml to 92 cfu/ml. TC
was more in station 1 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 normally found in humans is the most reliable indicator of faecal contamination in water which indicate the possible presence of pathogens [19], [2]. 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].

<table>
<thead>
<tr>
<th>MONTH</th>
<th>MONTH</th>
<th>MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVC</td>
<td>TC</td>
<td>FC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAR</td>
<td>185</td>
<td>43</td>
</tr>
<tr>
<td>APR</td>
<td>190</td>
<td>48</td>
</tr>
<tr>
<td>MAY</td>
<td>218</td>
<td>40</td>
</tr>
<tr>
<td>JUN</td>
<td>229</td>
<td>38</td>
</tr>
<tr>
<td>JUL</td>
<td>335</td>
<td>35</td>
</tr>
<tr>
<td>AUG</td>
<td>446</td>
<td>29</td>
</tr>
<tr>
<td>SEP</td>
<td>730</td>
<td>36</td>
</tr>
<tr>
<td>OCT</td>
<td>812</td>
<td>52</td>
</tr>
<tr>
<td>NOV</td>
<td>739</td>
<td>39</td>
</tr>
<tr>
<td>DEC</td>
<td>749</td>
<td>42</td>
</tr>
<tr>
<td>JAN</td>
<td>450</td>
<td>39</td>
</tr>
<tr>
<td>FEB</td>
<td>550</td>
<td>40</td>
</tr>
</tbody>
</table>

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

**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 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.

**Acknowledgements**

The authors are thankful to the Head of the department, Marine living Resources, Andhra University for providing facilities to carry out this work.

**REFERENCES**


*Pelagia Research Library*