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Short Communication

Density of heterotrophic bacteria in Meghadri mangrove ecosystem, Visakhapatnam, east coast of India

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Abstract

The density of heterotrophic bacteria was investigated from the sediments of Meghadri mangrove ecosystem of Visakhapatnam from April 2006 to March 2007. The sediments harboured the bacterial genera *Bacillus, Pseudomonas, Brevibacterium, Staphylococcus* and *Micrococcus*. The mean density of total heterotrophic bacteria was 7.93 x 10^3cfu.g^{-1}. Among the proteolytic, glycolytic and lipolytic bacterial densities, the lipolytic bacteria (5.31 x 10^3 cfu.g^{-1}) were found higher than the other bacteria. The mean values of temperature, salinity, pH, dissolved oxygen and sedimentary organic matter during the study period were 29.0°C, 33.1 ppt, 7.5, 2.27 mg/ml and 2.13% respectively. The density of bacteria in the mangrove sediments is discussed in relation to the physico-chemical parameters.

Mangrove ecosystems support a wide variety of organisms, of which, microbial populations specifically bacteria and fungi play an important role in remineralisation and production of biologically active substances like antibiotics, vitamins, enzymes, amino acids, alcohols etc. Harold and Millwood (1974), Droop and Jannasch (1977) and Chandra Mohan (1997) investigated the heterotrophic bacteria from the estuarine and coastal habitats. The Meghadri River in Visakhapatnam (east coast of India) harbours small patches of mangrove vegetation (17° 42′ N lat; 83° 16′E long.) principally composed of *Avicennia marina* and *Excoecaria agallocha*. There are several studies on the distribution and density of bacteria in the Indian mangrove habitats (Choudhary, 1987; Ramamurthy *et al.,* 1990; Rajeswari *et al.,* 1995; Ratnakala and Chandrika, 1997; Untawale and Wafar, 1997; Priya *et al.,* 2004; Surajitdas *et al.,* 2007). However, information on the density of heterotrophic bacteria from Andhra Pradesh mangrove habitats is limited. We made an attempt to study the distribution of heterotrophic bacteria with emphasis on proteolytic, glycolytic and lipolytic bacterial populations from Meghadri mangroves of Visakhapatnam port.

Materials and methods

Sediment samples were collected at fortnightly intervals during April 2006 - March 2007 from six selected sites of Meghadri mangroves. Sediment core samples from the study area were aseptically collected in sterile polythene bags. Each sediment sample (10g) was diluted with 100 ml of aged sterile seawater (25% distilled water and 75% seawater). The inoculations were prepared aseptically using ten fold dilutions. The total heterotrophic bacteria, glycolytic bacteria, proteolytic bacteria and lipolytic bacteria were cultured on Zobell marine agar (Zobell, 1946), carbohydrate medium (Rhodes medium; Aaronson, 1970), Frazier gelatin agar (Weyland *et al.,* 1970) and lipolytic medium (Sierra, 1957) respectively, at 33ºC for 24 to 36 hours under sterile conditions. The glycolytic, proteolytic, and lipolytic bacterial populations were identified by processing the cultures with gram iodine, saturated ammonium sulphate and saturated copper sulphate solutions respectively. The colonies were counted using a bacteriological colony counter and the densities were expressed as 10^3 cfu.g^{-1}. Bacteria grown on the cultures were identified up to genus level using the culture, morphological and biochemical

Table 1. Physico-chemical parameters and density of bacterial populations in Meghadri mangrove sediments during April 2006 - March 2007

Months	T(°C)	S(ppt)	D.O (mg/ml)	pH	S.O.M (%)	T.H.B	G.B	P.B	L.B
Apr I	32.0	34.2	2.24	7.4	1.80	10.0	3.4	3.2	6.6
Apr II	29.5	35.2	2.48	7.8	1.94	7.8	3.5	6.0	7.5
May I	26.4	34.0	2.80	7.5	2.10	13.3	6.5	8.3	7.0
May II	28.5	35.0	2.50	7.5	2.25	8.2	6.6	6.4	6.9
Jun I	30.4	35.4	1.89	7.5	1.69	7.8	4.8	5.0	6.0
Jun II	29.1	35.0	2.80	7.5	1.94	9.2	4.8	4.7	5.3
Jul I	26.5	32.6	1.80	7.5	2.26	8.8	4.2	4.5	5.2
Jul II	28.8	35.4	2.50	7.1	2.05	7.4	5.2	5.0	6.6
Aug I	30.2	36.3	1.87	7.8	2.00	8.2	5.2	6.3	5.2
Aug II	27.5	35.6	1.38	7.5	1.95	5.8	2.1	3.2	3.7
Sep I	29.5	34.5	1.68	7.5	1.99	8.2	3.2	4.1	5.3
Sep II	28.7	27.5	1.49	7.7	1.79	7.6	4.8	5.2	5.0
Oct I	28.4	34.5	2.80	7.5	2.50	7.8	3.2	3.5	4.5
Oct II	-	-	-	-	-	-	-	-	-
Nov I	24.3	35.6	1.81	7.4	1.80	8.0	4.8	5.4	6.0
Nov II	29.9	33.2	2.80	7.5	2.50	9.0	5.7	6.9	6.6
Dec I	28.5	34.5	3.00	7.6	2.40	7.8	4.7	4.1	5.5
Dec II	29.5	29.5	2.10	7.5	1.80	4.2	3.2	3.1	3.9
Jan I	30.6	28.4	2.50	7.5	2.40	6.4	5.0	4.2	4.6
Jan II	30.0	30.0	2.20	7.8	2.20	5.4	3.4	3.6	4.0
Feb I	30.4	32.0	2.60	7.5	2.60	10.4	5.4	4.4	4.8
Feb II	30.6	30.2	2.40	8.0	2.30	6.0	5.0	4.8	4.2
Mar I	30.0	30.0	2.00	7.8	2.20	6.4	4.0	3.8	3.4
Mar II	28.8	32.2	2.60	8.0	2.60	8.8	3.6	2.8	4.4
Mean	29.0	33.0	2.27	7.5	2.13	7.93	4.4	4.71	5.31

(T = Temperature, S = salinity, D.O = dissolved oxygen, S.O.M = sedimentary organic matter, T.H.B = total heterotrophic bacteria, G.B = glycolytic bacteria, P .B = proteolytic bacteria, L.B = lipolytic bacteria; bacterial counts are 10^3 cfu.g^{-1}; - denotes no sample)

Table 2. Pearson correlations between physicochemical parameters and bacterial densities (n= 23) in Meghadri mangrove sediments

Bacteria	Temperature	Salinity	Dissolved oxygen	pH	Soil organic matter
T.H.B	-0.19914*	0.379618*	0.366966*	-0.21131*	0.145035*
G.B	-0.09894	0.049686	0.408683	-0.15507*	0.193876*
P.B	-0.26421*	0.284564*	0.205968*	-0.10708	-0.07744*
L.B	-0.13898*	0.547981*	0.308024*	-0.40169*	-0.2149*z

(* indicates significance at $p < 0.05$). (T.H.B = total heterotrophic bacteria, G.B = glycolytic bacteria, P.B = proteolytic bacteria, L.B = lipolytic bacteria)

characters (Skinner, 1975). Sediment temperature was recorded using a 0.1ºC sensitivity thermometer. Salinity and dissolved oxygen of sediment water samples were measured by Knudsen method and Winkler's method (Strickland and Parsons, 1965). The sediment organic matter was determined by chromic acid digestion method *(*Jackson, 1967*)* and sediment pH by a digital pH meter (Elico). The density data were processed using SPSS software Version 10.

Results and Discussion

During the present study, the mangrove sediments harboured five genera of bacteria namely, *Bacillus, Brevibacterium, Staphylococcus, Pseudomonas* and *Micrococcus.* The first four genera were regularly recorded in the sediments. *Micrococcus* was recorded only in April I, September II and February II samples. Choudhary (1987) reported eight genera of bacteria from Sunderban mangrove sediments. Four genera, *i.e., Bacillus, Brevibacterium, Pseudomonas* and *Micrococcus* are present in both the Sunderbans and Meghadri mangroves. The genus *Brevibacterium* is reported from the east coast mangroves only namely, Sunderbans and Meghadri mangroves. Rajeswari *et al.* (1995) reported twelve genera of bacteria from Andaman mangrove sediments. Priya *et al.* (2004) recorded twelve genera of bacteria from Zuari mangrove sediments. The qualitative data indicate that the genera *Bacillus, Pseudomonas, Staphylococcus* and *Micrococcus* are the common heterotrophic bacteria in the mangrove habitats. The mean values of temperature, salinity, pH, dissolved oxygen and sediment organic matter of the Meghadri mangroves were 29.0º C, 33.1 ppt, 7.5, 2.27 mg/l and 2.13% respectively. The mean densities of glycolytic, proteolytic, lipolytic and total heterotrophic bacteria recorded were 4.40, 4.71, 5.31 and 7.93 x 10^3 cfu.g^{-1} respectively (Table 1). The density of lipolytic bacteria was relatively higher in the sediments which may be attributed to the availability of lipid sources in the ecosystem due to the hydrocarbons released from the adjacently located HPCL oil refinery. The seasonal density of bacteria exhibited almost similar trend with peak abundance during May (summer) and late November (winter). The seasonal density fluctuations were more prominent in the total heterotrophic bacteria, glycolytic bacteria and proteolytic bacteria, but negligible in lipolytic bacteria. Surajitdas *et al.* (2007) reported 1.01 x 10^3 to 37.98 x 10^3 cfu.g^{-1} heterotrophic bacteria in 10^3 the slope sediments of western Bay of Bengal. The density of mangrove sediment bacteria of Mandovi estuary ranged from 2.65x10^3 cfu.g^{-1} in premonsoon to 3.56 x 10^3 cfu.g^{-1} in monsoon (Priya *et al.,* 2004). Table 2 provides Pearson correlations between physico-chemical parameters and bacterial densities in the Meghadri mangrove sediments. The positive correlations of salinity and dissolved oxygen with total heterotrophic bacteria, proteolytic bacteria and lipolytic bacteria were significant ($p < 0.05$). The negative correlations of temperature with total heterotrophic bacteria, proteolytic bacteria and lipolytic bacteria and of pH with total heterotrophic bacteria, glycolytic bacteria and lipolytic bacteria were observed as significant ($p < 0.05$). The soil organic matter showed positive correlations with total heterotrophic bacteria and glycolytic bacteria but negative correlation with proteolytic bacteria and lipolytic bacteria. The correlation analysis indicates the importance of soil organic matter in the density of the four groups of bacteria. In conclusion, it may be stated that the heterotrophic bacteria of Meghadri mangrove sediments registered seasonal differences, and the community consisted of relatively higher density of lipolytic bacteria when compared to the other components.

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