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HETEROTROPHIC BACTERIA IN THE SURFACE LAYERS OF OCEANIC WATERS OF THE WADGE BANK REGION

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ABSTRACT

This paper embodies the results of bacteriological investigations carried out in the Wadge Bank region of the Indian Ocean during August, 1985. The aerobic heterotrophic bacterial population of the surface waters (0-100 m) ranged from 1×10^5 / ml to 9.8×10^5 during the peak monsoon season. Bacteria belonged to genera of *Pseudomonas, Aeromonas, Vibrio, Alcaligens* and *Micrococcus*. The isolates were found to be active decomposers of macromolecules. No significant correlation was observed between the bacterial population and the light intensity at various depths.

INTRODUCTION

The heterotrophic micro-organisms play a very important role in the process of mineralization in the sea and also in other environments by virtue of their zymogenous activity (Wood, 1967). Considerable amount of information on the heterotrophic bacteria from the coastal regions and estuaries is available (Kannan and Vasanta, 1986; Vasanta and Kannan, 1987; Alavandi, 1989) whereas the data on the heterotrophic bacteria of offshore waters around the Indian peninsula, even in the Exclusive Economic Zone (EEZ) is limited. This paper is a preliminary report on the qualitative and quantitative aspects of aerobic heterotrophic bacteria in the surface layers of the oceanic waters in the Wadge Bank region of the Indian Ocean where three seas viz., Arabian Sea, Indian Ocean and the Bay of Bengal confluence.

MATERIALS AND METHODS

During the sixth cruise of FORV *Sagar Sampada* in August, 1985, water samples from three stations viz., 138, 139 and 140 from depth 0, 50 m and 100 m were collected with the help of rosette sampler fitted with tefflon coated bottles. Then a portion of water samples was transferred to sterile glass bottles for microbiological analysis. The water samples were inoculated in duplicate immediately onboard the vessel on Zobell's marine agar 2216 (Himedia) by serial dilution and spread plate method. After incubation for 5 days at 28°C the colonies were counted and recorded as total viable count (TVC). Morphologically distinct colonies were isolated and identified upto generic level according to Buchanan and Gibbons, 1974. The isolates were tested for their extracellular enzyme activity viz., of Protease, Amylase and Lipase by conventional methods in order to understand their potential to breakdown the macromolecules. The proteolytic activity of the isolates was tested by inoculating the bacteria on Zobell's marine agar incorporated with 4 per cent nutrient gelatin. After an incubation for 48 hours, the plates were flooded with $HgCl_2$ solution. Positive activity was indicated by a clear zone around the colonies. Amylolytic activity was tested by inoculating the bacteria on Zobell's marine agar incorporated with 2 per cent soluble starch. The plates were flooded with lugol's iodine solution after incubation, and the activity was indicated by a clear zone around the colonies. Similarly bacteria were inoculated onto Zobell's marine agar supplemented with 1% Tween 80, and the formation of a turbid zone around the colonies indicated positive lipolytic activity. The light intensity available at various depths of the ocean was obtained from the Quantameter fitted onboard the vessel and expressed as percentage quanta.

RESULTS AND DISCUSSION

The culturable aerobic heterotrophic bacterial population in the surface layers of the oceanic waters in the Wadge Bank area of the Indian Ocean ranged from 1×10^5 per ml to 9.8×10^5 per ml with an average of 4.7×10^5 per ml (Table 1). The present findings conform with Kriss *et al.* (1960) who reported high heterotrophic bacterial counts from the

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TABLE 1. *Quantitative distribution of heterotrophic bacteria Vs. light intensity*

Stn. No., Depth at Stn., Position, Time of sampling	Depth of Sampling	TVC x 10^5 per ml	Illumination in Quanta %
138	Surface	3.5	98.29
2767 m	50 m	5.3	97.04
4° 59.3' N,77° 29.5'E			
0700 hrs	100 m	3.6	95.96
139	Surface	5.1	-
2483 m	50 m	5.3	-
5° 30' N, 76° 16'E	100 m	9.8	-
2000 hrs			
140	Surface	1.0	97.88
2754 m	50 m	6.4	95.43
6° 00.1'N, 75° E			
0730 hrs	100 m	3.3	94.01

equatorial regions of the oceans of the world including the Indian Ocean. This has been attributed to high organic content of allocthonous origin. It is interesting to note that despite the oligotrophic nature of the oceanic waters, the bacterial population did not show much decline compared to the coastal areas, where the bacterial load is of the order of 10^6 per ml (Alavandi, 1989). High counts of bacteria could be due to the availability of high organic content originating either from phytoplankton (Gundersen, 1976), or dead and decaying fauna, in the form of detritus, or from allocthonous materials. This is substantiated by the highly active nature of the isolates of bacteria in decomposition of macromolecules viz., protein, starch and lipid (Table 3). High zymogenous activity indicates the potential of these bacteria in breaking down organic matter in the oligotrophic marine environment.

TABLE 2. *Zymogenous nature of the genera of bacteria isolated from Wadge Bank oceanic waters*

Genera	No. of isolates tested	Lipase	Amylase	Protease
Vibrio	3	++-	++-	+++
Pseudomonas	2	+-	++	+-
Aeromonas	4	+++-	+++-	++++
Alcaligens	1	-	-	-
Micrococcus	1	-	-	+

Only the genus *Alcaligens* was found to be lacking the extracellular enzymes to degrade the macromolecules among the bacteria found in the Wadge Bank area of the Indian Ocean.

Although the primary productivity and the population of photoautotrophs which are involved in the conversion of inorganic matter into their cellular constituents in the presence of photic energy, a correlation analysis was carried out between the quanta of light available in the subsurface waters and the population of heterotrophic bacteria. A Negative correlation (r= - 0.31) was observed although not significant. Bacterial abundance and light intensity in the aquatic environment are known to be negatively correlated (Zobell, 1946). The insignificant correlation observed in this study may be attributed to (i) low intensity of light because of cloudy monsoon and (ii) time of sampling (See Table 1).

The population of different genera of bacteria at various depths is given in Table 2. Genus *Aeromonas* appears to occur in large numbers compared to other genera in this region of the Indian Ocean, although *Pseudomonas* is reported to be predominant genus occurring in the marine environment among the culturable bacteria (Zobell, 1946). *Vibrio, Pesudomonas* and *Aeromonas* occurred in all the three locations, whereas *Alcaligens* and *Micrococcus* occurred less frequently.

TABLE 3. *Qualitative distribution of heterotrophic bacteria in the Wadge Bank region*

Depth	Organism	138	139	140
Surface	*Vibrio*	0.020	-	-
	Aeromonas	74.300	88.20	90.000
	Pseudomonas	5.700	9.80	6.000
50 m	*Vibrio*	47.500	5.70	11.100
	Aeromonas	42.500	94.30	85.200
	Pseudomonas	0.004	-	0.002
	Alcaligens	9.400	-	-
100 m	*Vibrio*	27.800	1.02	0.020
	Aeromonas	61.100	96.90	75.800
	Pseudomonas	8.300	-	-
	Micrococcus	-	-	3.030

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