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Diversity of Anaerobes around Indian Antarctic station 'Maitri' (Antarctica)

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ABSTRACT:

Soil and sediment samples collected around Indian Station "Maitri" (Antarctica) were analyzed for presence of anaerobic microbial population. The anaerobic counts for soil and sedimentsvaried from 1 x 10^2 to $8.5x10^4$ and $2x10^2$ to $3.7x10^5$ CFU gm-1 soil and sediment samples respectively. Almost all the soil samples showed the presence of anaerobic psychrotrophs whereas. 77.5% of them supported the growth of anaerobic psychrophiles. In sediment samples an anaerobic psychrophiles were found more abundant than psychrotrophs. Further studies on characterization of anaerobes and production of cold adopted anzymes are suggested.

INTRODUCTION:

The pristine environment of Antarctica was previously thought to be devoid of microorganisms due to the extreme cold and harsh climatic conditions prevailing there. Contrary to that, the biology of Continental Antarctica is enriched, rather microbialy dominated by a variety of microorganism (Wynn-Williams, 1990). The abundance of microorganism clearly indicates the successful adaptation of various species to the extreme environmental conditions. Bacteria are important agents of decomposition and nutrient regeneration (Moran and Hudson, 1989) and thus play a significant role in controlling the nutrients for autotrophic processes and food web dynamics. The high level of biological activity and reduced surface water temperature make the Antarctic subcontinent a particularly intriguing geographical area to study. Microbiological studies in Antarctica are mainly confined to aerobic microorganisms. Therefore, the objective of the present study was to detect the abundance of anaerobes from different ecological niche of Antarctica.

MATERIALS AND METHODS :

Sampling:

Environmental samples were collected from the vicinity of Indian station 'Maitri' of the Schirmarcher Oasis (Queen Maud Land/ Dakshin Gangotri Hill ranges) situated between the coordinates 70° 12' to 70° 46' 30" S latitude and 11° 22' 44" to 11° 54' 00" E longitude. During the sampling period (January - February, 1999) the average soil and water temperature of lake was in the range of -3° - 3° C and -6° - 6° C, respectively.

Sediment samples were collected from Zub (Priyadarshani) lake located near the Indian station from ten random sites with the help of sediment corer and stored in sterile glass bottles. For collection of soil samples, about 9-12 inches of surface soil was cleared with sterile spatula and the underlying soil was collected and transferred to sterile polythene bags, which were then sealed.

Microbiological analysis:

The quantitative enumeration of viable populations of anaerobes was carried out following standard microbiological methods using anaerobic medium (Hi-Media Ind. Pvt. Ltd.). Samples were plated after appropriate dilutions to determine anaerobic microbial population both at room (28 ± 2° C) as well as at freezing temperatures (4° C). Plates were incubated anaerobically in anaerobic jars (E Merck),

RESULTS AND DISCUSSIONS:

Microbiological studies revealed the presence of anaerobic bacteria both in sediment and soil samples collected from Antarctica. Total viable anaerobic counts from different soil and sediment samples are summarized in Table 1 and 2 respectively. The anaerobic counts for soil and sediments varied from $1.0 x 10^2$ to $8.5 x 10^4$ and $2.0 x 10^2$ to $3.7 x 10^5$ C.F.U gm-1 soil/sediment samples respectively. The heterogenous bacterial population consists of mostly rods and clumps of cocci.

Among soil samples, 7 (22.5%) of them did not support the growth of anaerobic psychrophiles whereas anaerobic psychrotrophs were detected in all samples except two (6.4%) Samples (Table 1). In 18 (58.1%) soil samples, anaerobic psychrophiles showed dominance over anaerobic psychrotrophs, while in 13 (41.9%) samples, psychrotrophs were more abundant than anaerobic psychrophiles.

In sediment Samples, anaerobic psychrophiles were more abundant as compared to psychrotrophs (Table 2). The anaerobic psychrotrophic counts were <100 x 102 cells/ gm except in two sediment samples.

The results give a clear indication that along with aerobes (Shivaji, 1987), Antarctic soil and sediments are enriched with a variety of anaerobic microbial population. Anaerobic psychrophiles were dominant microflora in the Antarctic lake ecosystem whereas in soil samples both psychrophiles and psychrotrophs were the dominant microflora. This observation is in accordance to the earlier reports of aerobic bacteria (Ellis-Evance, 1985). The quantitative abundance of heterotrophic microbes is a direct indication of the rich availability of organic nutrients. It is known that the abundance of bacteria in the soils and sediments of Antarctica is dependent on the local climate conditions, the richness of the soil, and the nutrient supply (French and Smith, 1986). The preliminary investigation suggests extracellular enzymatic activities among anaerobes obtained from Antarctica. Thus from this study it is substantiated that their enzymatic and heterotrophic-processes are of basic importance in the biogeochemical cycling of organic matter. Additionally, owing to their fast growth and production of enzymes at low temperature (Morita, 1975; Feller et al., 1994), cold adapted microorganisms and their derived enzymes can be potentially used in several industrial processes such as cold washing, food industry, environmental bioremediation and molecular biology applications. Therefore, further studies on characterization of anaerobes and production of cold-adapted enzymes requires extensive investigations.

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TABLE-1

Anaerobic bacterial population in soil samples around 'Maitri'

CFU x 10^2 g-1

S.No.	Psychrophiles	Psychrotrophs
01.	ND	3
02.	10	14
03.	850	11
04.	4	390
05.	173	53
06.	2	4
07.	TNT	9
08.	4	10
09.	ND	92
10.	ND	55
11.	2	1
12.	6	1
13.	6	ND
14.	TNT	ND
15.	8	4
16.	8	4
17.	6	5
18.	640	19
19.	180	2
20.	ND	1
21.	3	26
22.	ND	7
23.	ND	40
24.	38	6
25.	320	5
26.	20	6
27.	9	3
28.	TNT	37
29.	ND	29
30.	38	22
31.	520	720.

Sample No. 1-14: From around Zub (Priyadarshani) lake.
Sample No. 15-19: From around Russian station.
Sample No. 20-22: Dry soils
Sample No. 23-28: From under moss mat
Sample No. 29: Contaminated with diesel
Sample No. 30: Treated kitchen waste
Sample No. 31: Contaminated with diesel supporting algal growth.

TABLE-2

Anaerobic bacterial population in sediment samples of Zub (Priyadarshani) lake.

CFU x $10^2 g^{-1}$

Sl. No.	Psychrophiles	Psychrotrophs
01.	200	22
02.	230	13
03.	270	03
04.	88	14
05.	16	06
06.	220	04
07.	110	43
08.	430	120
09.	930	14
10.	220	71