J. Phytol. Res. 6 (1 & 2):55-58, 1993

INTERRELATIONSHIPS BETWEEN HETEROTROPHIC BACTERIA AND PHYSICOCHEMICAL CHARACTERISTICS OF A FRESHWATER POLLUTED LAKE AT AJMER

M. PARVATEESAM AND MANESHA MATHUR
Microbiology Lab., Department of Botany, Government College, Ajmer - 305001, India.

The various physicochemical parameters of lake water had a direct effect on the heterotrophic bacterial populations. High bacterial populations were obtained during post summer, monsoon and winter season. High concentrations of phosphates, nitrates, organic matter, total dissolved solids and nitrogen favoured high bacterial counts.

Keywords : Heterotrophic bacteria; Physicochemical characteristics; Polluted lake.

Introduction

The basis of lake life are the aquatic microbes, chiefly the bacteria and fungi which perform the vital function of degrading the organic matter into inorganic salts necessary for the producers, thus performing the vital process of nutrient recycling. The growth of these aquatic micro-organisms is affected by a great variety of physical and chemical factors operating in that water body.

The study of heterotrophic bacteria of lakes dates back to the recent past and many contributions have been made from time to time[1,2].

There have been reports on the physicochemical characteristics of various water bodies in India, but studies involving bacteria are rare[3,4]. Keeping this in view the present study was undertaken to critically examine and evaluate the interrelationships between the aerobic heterotrophic bacteria and physicochemical characteristics of Anasagar Lake at Ajmer.

Materials and Methods

Anasagar lake, a fresh water lake, is situated in the heart of Ajmer city and is subjected to many anthropological activities resulting in its pollution. In the present study four sites were randomly selected with different site characteristics. Water samples for physicochemical analysis were collected in a one litre sterile polythene bottle and for bacteriological enumeration samples were collected in a small (60 ml) sterilized glass bottle. Analyses were performed using the methods recommended in the Mannual of Microbiological methods by the Society of American Bacteriologists[5-8].

Results and Discussion

The population of various bacterial types isolated and the physicochemical parameters of lake water are tabulated (Tables 1 & 2). Marked seasonal variations have been observed both in bacterial types, population and physicochemical characteristics. Maxi-

mum bacterial populations were recorded in post summer, monsoon and winter season, respectively.

During winters when the temperature was low, high amounts of dissolved oxygen and comparatively low amounts

Table 1. Seasonal variation in the heterotrophic bacterial populations.

		Seasons		
	Bacteria	Winter	Summer	Monsoon
1.	*Pseudomonas aeruginosa*	+++	++	+++
2.	*Pseudomonas putida*	+++	+++	+++
3.	*Pseudomonas* sp. 1	++	+	+++
4.	*Pseudomonas* sp. 2	++	+++	+++
5.	*Pseudomonas* sp. 3	+++	+	++
6.	*Pseudomonas* sp. 4	-	+++	+++
7.	*Pseudomonas* sp. 5	+	++	+++
8.	*Pseudomonas* sp. 6	+++	-	+++
9.	*Xanthomonas* sp. 1	-	-	+++
10.	*Xanthomonas* sp. 2	-	++	+++
11.	*Zoogloea* sp. 1	+++	+	-
12.	*Zoogloea* sp. 2	-	+	+++
13.	*Zoogloea* sp. 3	-	+++	+
14.	*Vibrio* sp.1	+	+	+++
15.	*Vibrio* sp. 2	+++	-	++
16.	*Vibrio* sp. 3	+++	-	++
17.	*Vibrio* sp 4	+++	++	+++
18.	*Bacillus mycoides*	-	+++	++
19.	*Bacillus* sp.1	+++	+++	++
20.	*Bacillus* sp. 2	-	++	+++
21.	*Flavobacterium aquatile*	+++	-	++
22.	*Flavobacterium* sp. 1	+	+	+++
23.	*Flavobacterium* sp.2	+++	+++	++
24.	*Alcaligens* sp. 1	++	-	+++
25.	*Alcaligens* sp. 2	+++	++	-
26.	*Alcaligens* sp. 3	-	++	+++
27.	*Cellulomonas* sp.	+	++	+++
28.	*Azomonas* Sp.	+++	-	+
29.	*Micrococcus conglomeratus*	++	-	+++

+++ = abunduant; ++ = moderate; + = little; - = absent.

Table 2. Seasonal variation in physicochemical characteristics of Anasagar lake water

(Average values)

PARAMETERS	SEASONS		
	Winter	Summer	Monsoon
Temperature °C	22.0	30.7	28.7
	(20.0 - 25.0)	(22.0 - 38.0)	(25.0 - 34.0)
pH	7.1	8.0	7.2
	(6.8 - 7.4)	(7.0 - 9.0)	(6.5 - 8.0)
Dissolved Oxygen	7.18	5.0	5.3
(mg/l)	(4.55 - 11.6)	(1.5 - 8.6)	(2.3 - 9.2)
Free Carbon dioxide	4.1	5.3	3.8
(mg/l)	(2.2 - 6.6)	(2.2 -13.2)	(0.0 - 10.2)
Ammonical nitrogen	0.21	0.35	0.85
(mg/l)	(0.0 - 0.35)	(0.14 - 0.42)	(0.56 - 1.12)
Nitrate nitrogen	0.30	0.50	1.60
(mg/l)	(0.10 - 0.86)	(0.12 - 1.10)	(0.96 - 3.10)
Total dissolved solids	2350	4383	8545
(mg/l)	(2000 - 2800)	(2400 - 6200)	(2000 - 28000)
Phosphates	105.80	379.16	257.67
(mg/l)	(87.70 - 116.24)	(116.24 - 877.60)	(109.70-434.80)
Dissolved organic matter	23.49	23.63	30.76
(mg/l)	(12.40 - 38.60)	(19.47- 27.58)	(18.20 - 48.60)

of carbon dioxide, ammonical nitrogen, phosphates, total dissolved solids, nitrates and organic matter were present. Of the total 29 bacterial types isolated, about 19 types were present in large numbers. Some types including *Pseudomonas* sp. 5 and *Cellulomonas* sp. were few in number, and *Pseudomonas* sp. 4, *Xanthomonas* sp., *Zoogloea* sp. 2 and sp. 3, *Bacillus mycoides; Bacillus* sp. 2 and *Alcaligens* sp.3 were not recorded at all.

In summers the high temperature was followed by maximum increase in the concentrations of phosphates and carbon dioxide however, there was a decrease in the values of dissolved oxygen. Of the total, only 18 bacterial types showed abundant to moderate growth. *Pseudomonas* sp. 1 and sp. 3; *Zoogloea* sp. 2 showed very little growth and some forms like *Pseudomonas* sp. 6; *Xanthomonas* sp. 1; *Vibrio* sp. 2 and sp.3; *Flavobacterium acuatile; Alcaligens sp. 1; Azomonas* sp. and *Micrococcus conglomeratus* were totally absent.

During monsoon the temperature was moderate with high values of am-

monical nitrogen, nitrate nitrogen, organic matter and total dissolved solids. Maximum (26) bacterial types were present in this season. Few species like *Zoogloea* sp. 2 and *Azomonas* sp. were present in very low number. Some forms like *Xanthomonas* sp. 2 and *Alcaligens sp. 2 were totally absent.*

The populations of heterotrophic bacteria in natural environments primarily depend on the availability of nutrients which is chiefly in the form of organic matter either dissolved or suspended. The utilisation of the organic matter by the bacteria during summers results in decrease in the concentration of this nutrient. During monsoon the runoff brings in from the surrounding areas a fresh stock of bacteria and other nutrients like phosphates, nitrates and organic matter which contribute to the high nutrient levels and also high bacterial population number.

Earlier, Jones[1] and Tiwari and Mishra[3] have reported on bacterial increase during monsoon. The concentration of nitrogen and organic matter also increases due to the death and decay of aquatic organisms[2]. In winters there is always a maximum activity of phytoplanktons resulting in decrease in the concentration of phosphates and ammonical and nitrate nitrogen which is consumed by these phytoplanktons. In turn, when the death and decay of these aquatic organisms takes place, the concentration of bacteria also increases to decompose the organic matter.

The study reveals that all physiochemical parameters show a cumulative influence rather than individual in regulating the bacterial populations.

Acknowledgement

The authors gratefully acknowledge the financial assistance received from U.G.C., New Delhi.

References

1. Jones J G 1971, *J. Ecol.* ***59*** 593
2. Rheinheimer G 1985, *Aquatic microbiology* John Wiley and Sons Ltd. p. 252
3. Tiwari B R and Mishra R B 1985, *Acta Botanica Indica* ***13*** 51
4. Varadaraj P and Ayappan S 1989, *Indian J. Environ. Hlth.* ***31*** (2) 162
5. Society of American Bacteriologists 1951, *Manual of methods of pure culture study of bacteria* Mc. Graw Hill, New York.
6. Holt J G (ed) 1977, *The shorter Bergey's Manual of determinative bacteriology* Williams and Wilkins Publishing Co. Baltimore, p. 333
7. Golterman H L, Clymo R S and Ohnstad M A M 1978, *Methods for physical and chemical analysis of freshwater* J.B.P. Handbook No. 8, 2 nd ed. Blackwells Scientific Publications, Oxford p. 213.
8. A.P.H.A., A.W.W.A. and W.P.C.F. 1989, *Standard methods for the examination of water and waste water* 17th ed. New York.