MICROBIAL STUDIES ON THE ESTUARINE BACTERIA IN EAST COAST OF INDIA.

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ABSTRACT

Heterotrophic bacteria density distribution in the surface waters of Champavathi estuary, Vizianagaram on east coast of India was studied from July 2006 to July 2009 at monthly intervals. Water quality parameters like Temperature, pH, Salinity and Dissolved oxygen were also measured. Total bacteria registered a maximum density of 918.22 x10t cfu/ml. The lipolytic bacteria, density (370.08 x10t cfu/ml) was relatively higher than the proteolytic (348.38 x 10t cfu/ml) or the glycolytic (265.63 x 10t cfu/ml) bacterial densities. The densities of total Heterotrophic bacteria exhibited all positive correlations with the four physical parameters investigated, while the lipolytic bacteria densities showed all negative correlations. The paper discusses the impact of physical parameters on the density distribution of bacteria in the surface waters of Champavathi estuary.

Key note: Total heterotrophic bacteria, Proteolytic bacteria, Lipolytic bacteria, Glycolytic bacteria.

INTRODUCTION

The importance of heterotrophs in fisheries environmental research has received only very little attention in the marine environment. The present study is on the numerical abundance of heterotrophic bacteria in the estuarine environment of vizianagaram in order to assess their ecological importance in aquatic environments. According to the studies of paramasivam and kannan from south east coast of India in coastal waters, factors related to water quality such as temperature, salinity, pH, dissolved oxygen, total organic carbon and nutrients are particularly important for determining the biota and ecosystem functions An attempt was made to correlate the variations in density with some physical factors such as temperature, Salinity, Dissolved oxygen and pH

MATERIALS AND METHODS

The Champavathi river is located in vizianagaram district of Andhra Pradesh bounded by\Lat 18.01p N and Long 83.56p E (Fig 1). Altogether five stations were studied four of them are situated in the brackish waters where as one of them is almost in fresh water condition. Water samples were collected from 0m depth in a clean sterile glass bottles for microbial analysis. The samples were diluted ten fold and were inoculated on Zobell's marine agar (2216 Himedia) by serial dilution and spread plate method. The general bacteriological media (M012, Himedia) were enriched with 0.2% dextrose for glycolytic bacteria, 0.4% gelatin for proteolytic bacteria and 0.2% of tween80 for lipolytic bacteria. After incubation for 24hrs at 28°C the colonies were counted using colony counter and were expressed in ....x10^4cfu/ml. The physical parameters of water like temperature, was measured using a hand held (0.1° sensitivity) thermometer, salinity was measured by Knudsen's method. Wrinkler's method was used to estimate Dissolved oxygen (Strickland and Parsons 1972). P^H was measured with digital p^H meter. The density data was statistically analyzed for mean values and standard deviations. Pearson correlations for physical parameters and density were calculated. The obtained correlations (Table 3) were tested for their significance using't' test (Ostle 1954)

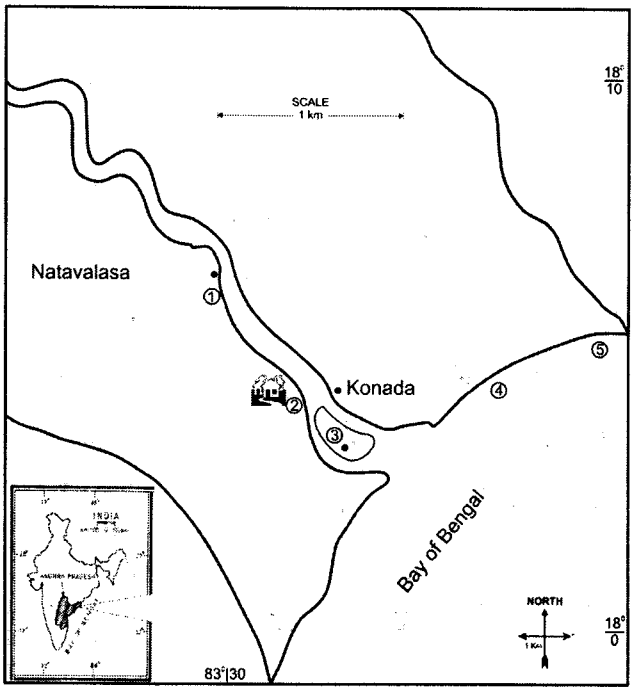

Table-1 Mean values and Standard Deviations of **Temperature** (0° C), **Salinity** (ppt), **Dissolved Oxygen** (mg/l), and ***pH*** of **Champavathi estuary** during study period 2006-2009.

Period	Temperature		Salinity		Dissolved Oxygen		pH	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2006-July	26.7	0.1356	30.4	0.4898	3.70	0.4647	7.2	0.1709
Aug	27.3	0.1264	31.4	0.4898	4.06	0.0943	6.6	0.1743
Sept	29.2	0.1166	29.1	0.16	8.26	0.0552	8.2	0.0248
Oct	31.0	0.1166	29.4	0.0748	6.78	0.5306	7.4	0.0632
Nov	28.1	0.04	24.3	0.1019	4.52	0.4069	7.7	0.2190
Dec	26.4	0.3033	29.0	0.04	3.25	0.1838	7.7	0.1414
2007-Jan	25.2	0.1854	27.2	0.1720	5.64	0.1496	6.2	0.1624
Feb	26.6	0.0489	26.3	0.4586	2.48	0.2039	6.3	0.0748
March	33.6	0.7467	32.0	0.08	4.58	0.2039	8.1	0.5383
April	35.5	1.7792	32.1	0.5979	8.27	0.0826	6.2	0.1624
May	34.6	2.0135	32.5	0.2785	9.34	0.2154	7.2	0.1414
June	26.2	0.6997	31.0	0.0748	3.80	0.7797	6.4	0.1496
July	28.2	0.28	30.3	0.3006	1.96	0.2039	7.3	0.2416
Aug	27.3	0.3633	34.1	0.0748	2.32	0.8541	6.3	0.1166
Sept	28.2	0.2870	28.9	0.4758	6.10	1.0237	8.1	0.1264
Oct	27.1	0.5549	29.3	0.1854	6.32	1.2749	7.0	0.0564
Nov	NS	NS	NS	NS	NS	NS	NS	NS
Dec	26.3	0.3577	28.8	0.4445	4.80	1.1454	7.3	0.3158
2008-Jan	25.2	0.8270	26.9	0.4516	4.41	0.1685	6.4	0.0748
Feb	22.9	0.9165	25.9	0.4841	1.39	0.3605	6.4	0.4898
March	26.7	0.4	32.1	0.1019	4.56	0.1624	7.3	0.0632
April	34.6	0.7578	32.1	0.5946	8.24	0.1624	6.1	0.1854
May	33.1	0.1019	31.8	0.4874	8.47	0.0531	7.2	0.1720
June	26.3	0.3687	31.0	0	3.63	0.2887	6.4	0.1720
July	26.3	0.16	30.5	0.4472	2.59	0.0922	7.4	0.3006
Aug	26.2	0.3762	32.1	0.1549	2.68	0.1166	6.2	0.1166
Sept	28.1	0.0894	28.1	0.0632	7.21	0.1561	7.4	0.1414
Oct	28.2	0.2870	29.0	0.0487	4.57	0.0744	7.0	0.0402
Nov	27.2	0.3773	24.1	0.1166	6.34	0.1624	7.1	0.0101
Dec	26.0	0.0748	29.0	0.0489	3.92	0.4765	7.4	0.3370
2009-Jan	24.1	0.0632	26.9	0.4560	4.40	0.1414	6.4	0.04
Feb	22.0	0.04	26.1	0.1166	2.70	o.1414	6.3	0.1854
March	33.0	0.04	31.8	0.4363	4.42	0.1720	7.1	0.0748
April	34.2	0.3655	32.2	0.2449	7.36	0.1854	6.1	0.08
May	35.0	0.08	32.2	1.1661	8.08	0.0748	7.2	0.0748
June	26.0	0.0748	30.6	0.4898	3.24	0.1854	6.3	0.1166
July	26.5	0.2756	30.4	0.32	2.36	0.1496	7.1	0.1354

NS= No Sample

Table-2 Mean values (5x104cfu/ml) and standard deviations of Total Heterotrophic Bacteria (TB), Glycolytic Bacteria (GB), Proteolytic Bacteria (PB), and Lipolytic Bacteria (LB) of Champavathi estuary during study period 2006-2009.

Total	Heterotrophic bacteria (TB)		Glycolytic Bacteria (GB)		Proteolytic Bacteria (PB)		Lipolytic Bacteria (LB)	
Period	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2006-July	134	37.73592	161	13.05986	169	16.24808	175	52.16129
Aug	152	24	104	38.26225	157	26.03382	89	47.6084
Sep	870	652.3803	4	3.929377	4	5.425864	21	29.39388
Oct	117	29.98266	46	2.993326	0	0	12	11.24278
Nov	33	7.889233	51	21.54066	106	60.19967	30	7.418895
Dec	114	10.28597	62	17.20465	63	17.20465	44	24.49816
2007-Jan	99	10.48046	14	7.386474	4	0.632456	90	5.571355
Feb	194	48.82622	0	0	128	81.3388	188	57.75812
Mar	216	124.996	22	4.586938	4	3.929377	196	46.73329
Apr	400	158.1139	18	2.315167	370	235.7965	0	0
May	143	46.31371	16	2.059126	61	40.05197	62	41.54227
Jun	143	113.2332	43	27.26169	59	52.81666	129	22.1239
Jul	93	21.81742	30	15.66652	60	34.1526	110	79.55275
Aug	129	22	117	10.77033	71	57.11182	71	41.34924
Sep	1062	600.4798	187	8.099383	120	140.5993	50	63.24555
Oct	168	94.74175	109	6.437391	16	17.84825	0	0
Nov	NS	NS	NS	NS	NS	NS	NS	NS
Dec	21	29.7281	74	20.59126	31	25.08864	27	22.21711
2008-Jan	94	9.264988	66	29.87708	71	32.31099	71	28.40845
Feb	88	50.75431	3	2.497999	38	21.35416	67	52.16282
Mar	77	16.30951	6	2.059126	29	38.64919	17	17.4631
Apr	310	111.3553	16	2.059126	32	26.19924	40	50.28558
May	132	34.87119	14	2.481935	4	3.929377	8	1.720465
Jun	131	87.93043	34	18.54724	70	36.24141	120	28.98275
Jul	75	24.8998	27	14.69694	59	28	130	59.26753
Aug	121	23.74868	104	10.19804	76	59.19459	71	43.63485
Sep	700	258.8436	174	10.19804	104	98.25477	0	0
Oct	118	42.14262	100	6.324555	24	17.93767	0	0
Nov	38	12.8841	68	17.20465	18	22.27106	46	3.136877
Dec	11	5.830952	72	17.20465	76	13.56466	73	17.6454
2009-Jan	97	3.773592	60	29.66479	48	14.69694	90	38.47909
Feb	134	37.20215	3	2.059126	38	20.39608	168	43.08132
Mar	67	15.36229	6	2.059126	52	2.332381	184	44.98889
Apr	77	4.37924	12	2.57682	200	126.4911	0	0
May	116	18.54724	14	2.481935	31	34.57976	0	0
Jun	33	23.38889	34	18.54724	70	14.14214	107	6
Jul	106	10.19804	40	3.187475	46	4.630335	182	29.25748

Table-3 ***Pearson Correlations*** between ***Physico-Chemical*** parameters and ***Bacterial densities*** during study period (N=35).

Bacteria	Temperature	Salinity	Dissolved oxygen	pH
Total Bacteria(TB)	0.166	0.005	0.394	0.378
Glycolytic Bacteria(GB)	-0.231	-0.053	-0.065	0.187
Proteolytic Bacteria(PB)	0.229	0.161	0.079	-0.279
Lipolytic Bacteria(LB)	-0.302	-0.014	-0.618	-0.091

RESULTS AND DISCUSSION

In the present study the bacterial counts showed seasonal fluctuations in numbers at different seasons giving a maximum in monsoom and premonsoon months (September 2007 and March 2007). The bacterial counts of the present study were of similar magnitude as given by Zobell (1948) from the southern California coast, Velankar(1955) from the Palk Bay and the Gulf of Mannar, Civic (1955) in the Adriatic sea and Kriss(1961) in the Black sea. Also no definite seasonal trend was noted as also reported by Velankar (1955) and Lioyd (1930) Wood(1959) found irregular seasonal distribution in the waters of Lake Macquire but in the water of Sydney, Brown(1964) recorded higher bacterial counts during summer and spring than at other seasons. The distribution of physical parameters like temperature, salinity, dissolved oxygen and p^H table1. Table 2 provides mean distribution of the four categories of bacteria. Correlations between physico-chemical parameters and bacterial densities were presented in Table 3. The maximum densities of Total bacteria (1062 X10t September 2007), Glycolytic bacteria (187; September 2007), Proteolytic bacteria (370; April 2007), and Lipolytic bacteria (196; March 2007) were recorded either in monsoon months (for TB & GB) or summer months (for PB&LB). The peak abundances of bacteria recorded in September 2007 may be attributed to the relatively high values of the dissolved oxygen and pH recorded. The correlation analyses also reveal positive correlations with the densities of total heterotrophic bacteria. The glycolytic bacteria exhibited negative correlations with temperature, salinity and dissolved oxygen. The negative correlations are with respect to temperature and dissolved oxygen indicating their negative impact on density distribution of glycolytic bacteria. Further the glycolytic bacterial density is also influenced by pH, as there exists a positive correlation between them. The glycolytic bacteria (187x10t) contributed significantly to the density of general heterotrophic bacteria during September 2007. The proteolytic bacterial density exhibited positive correlation with temperature, salinity and dissolved oxygen and a negative correlation with pH. The proteolytic bacteria contributed very significantly (370x10t cfu/ml) to total Heterotrophic bacteria during April 2007, which may be due to high salinity (32.1‰) and high D.O (8.27 mg/l). The density distribution of lipolytic bacteria revealed negative correlations with all the four physical parameters. The highest count of the general heterotrophic bacteria may also be contributed by other groups of bacteria (i.e. non glycolytic, non proteolytic and non lipolytic bacterial forms)

CONCLUSION

The present study recorded the occurrence of high densities of heterotrophic bacteria ion the Champavathi estuary. The dominance of lipolytic bacteria in the water samples indicated abundant availability of lipids (oil and others) compared to protein in the estuary waters. The low abundance of proteolytic bacteria in the water samples might be because of low contribution of fish wastes(protein), which may be utilized as food by other marine animals.

The marine bacteria rapidly adapt themselves to different environmental conditions because of their ability to form adaptive (induced) enzymes produced by the influence of new substrates of the surrounding environment consequently the production of adaptive enzymes may cause a change in the character of metabolism and biological functions of the new variants which needs a further study.

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LITERATURE CITED

Brown AD. 1964. Seasonal variations in heterotrophic bacterial populations in waters of Sydney. *Aust J. Mar. Freshw. Res* **15** (1): 73-76.

Civic V. 1955. Distribution of bacteria in the waters of the Mid Adriatic. *Sea. Ref. M. V Hyar Crusies* [Split Yugoslavia, **4**(1)].

Lloyed Blodwen. 1930. Bacteria of the Clyde Sea area. A quantitative investigation.*Mar. Biol. Ass.* U.K; **16**:879-907.

Martin Knudsen. 1953. Hydrographical tables reprinted by Tutein og Koch, Copenhagen published by G.E.C Gad cophenhagen

Ostle B. 1954. Correlation Methods. In: Statistics in Research. pp. 174–201. Iowa State College Press, Ames, IO.

Paramasivam S and L Kannan. 2005. Physico-chemical characteristics of muthupettai mangrove environment southeast coast of India. *Int. J. Ecol. Environ. Sci.*, **31**: 273-278.

Strickland JDH and Parsons TR. 1968. Determination of dissolved oxygen. in A Practical Handbook of Seawater Analysis. Fisheries Research Board of *Canada, Bulletin,* **167:** 71–75.

Velankar NK. 1955. Bacteria in the inshore environment ot Mandapam. *Indian J. Fish*: **90:**5.

Winkler LW. 1888. Die Bestimmung des in Wasser gelösten Sauerstoffen. *Berichte der Deutschen Chemischen Gesellschaft,* **21**: 2843–2855

Wood EJF. 1959. Some aspects of marine microbiology. *Indian J. Mar. Biol*, **1**:26-32.

Zobell CE. 1948. Sulfate reducing bacteria in marine sediments *J Mar. Res* (Sears Found Marine Res), **7**: 602-617.