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MONTHLY VARIATION OF WATER QUALITY AND SELECTED MICROBIAL INDICATORS IN SELECTED FRESH WATER PONDS CONNECTED THROUGH CANAL FROM PEACHIPARA RESERVOIR OF KANYAKUMARI DISTRICT, SOUTH INDIA

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ABSTRACT

The paper discusses the monthly variation of Physicochemical and bacteriological characteristics of surface water samples collected from selected ponds, connected through Chittar Pattanam canal in Kanyakumari district. The water samples were also analyzed for the presence of fecal bacteria namely: total coliforms, faecal coliforms, faecal streptococci, *Salmonella, Shigella, Proteus* and *Klebsiella* and *Pseudomonas* bacteria present in sample water. Occurrence of total coliforms, faecal coliforms, faecal streptococci, *Salmonella, Shigella, Pseudomonas, Proteus* and *Klebsiella* indicated poor water quality due to domestic sewage and surface run off. Situation warns of the possible epidemics from recreational use of the waters and risk to the aquatic fauna. The physico-chemical parameters like temperature, pH, electrical conductivity, alkalinity, phosphate, hardness, dissolved oxygen and biological oxygen demand etc were studied for a period of 1 year (2011) on monthly basis. The present investigation proved that Peachipara reservoir is under the category of less anthropogenic influence, other stations are eutrophic.

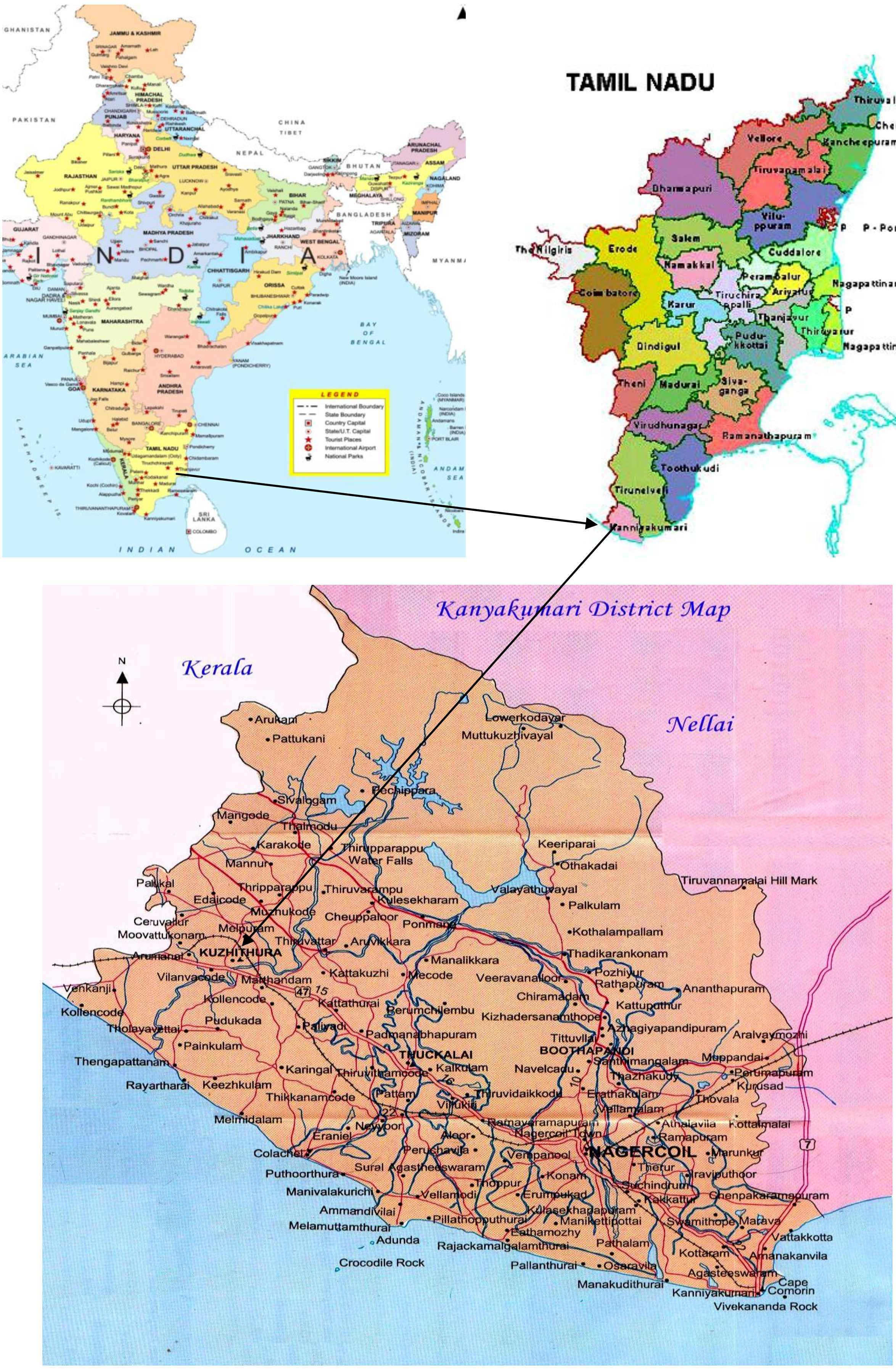
Key words: Microbial Indicators, Kanyakumari, Fecal Bacteria and Physico-chemical Parameters.

INTRODUCTION

Peachparai reservoir is one among the 58 small reservoir in Tamilnadu, which is situated in the southernmost tip of peninsular India. The virgin droplets from the westernghats collected in this reservoir, spread throughout the kanyakumari district through canal fill most of the ponds and finally excess water flow in to the Arabian Sea near Thangapattanam. Water from the reservoir met the ever growing needs of this district. About 4450 MCFT of water stored in the reservoir. Seasonal famine affects the water storage.

Rapid industrialization and urbanization in the surrounding area generate large quantity of sewage and garbage makes land, water and air to pollute. Ponds are the multipurpose surface water storage tank, easily affected by the additional loading of wastes. The biotic components of the aquatic ecosystem are planktons, protozoan, Bacteria, Viruses and Macrophytes. Majority of the native bacterial flora play vital role in purification of water and decompose the organic matter, recycled the minerals. Pollute water contains large quantity of pathogenic and nonpathogenic bacteria. The origins of potential pathogens are faces of human and warm blooded animals. Detection

Figure-1. Showing various sampling stations



and enumeration of all potential pathogens in an aquatic ecosystem are time consuming and money consuming process and it is impossible. No single method is used to detect the all pathogens. So people used indicator organisms to detect the possibility of the presence of pathogen. Coliform bacteria are a commonly used bacterial indicator of sanitary quality of water.

Present preliminary study trying to monitor the reservoir and canal water connected study stations physic-chemical and bacteriological parameters at monthly basis. The result of the present study explains the extent of pollution and status of water, which is useful to preserve the voluble resource for our next generation.
Materials and Methods:

In order to study the water and microbial quality, five stations were chosen for sample collection along the stretch of the Chittar Patanam canal, as described in Fig.1. (1) Peachipara reservoir (98.450702, 77.309187) Station A, (2) Thirunanthikarai (8.392160, 77.298423) Station B, (3) Udayanikulam (8.291548, 77.234525), Station C, (4) Perumkulam (8.241487, 77.185923) Station D, Arasakulam (8.285428, 77.217452) Station E, situated near the Thangapattanam estuary of Kanyakumari district, India has been selected for the present study. The distance between A and B is approximately 7kms, B and C is 16.9 kms, C and D is 3.5kms , D and E is 11.5 kms.

MATERIALS AND METHODS

Water sampling:
Sampling was carried out always on the Ist week of the month during the study period Jun 2011 to Dec 2011. The water sample for microbiological analyses was collected in a sterile glass bottle. The sample bottles were capped and labeled with details of the source of water, time and date of collection. Samples were immediately transported to the laboratory and processed within 2–4 hrs after being collected. The enteric bacteria were identified using Hymedia viz, Mac Conkey's Agar for coliforms, MFc Agar for faecal coliforms, M-Enterococcus Agar for faecal Streptococcus, Xylose Lysine Deoxycholate Agar for *Salmonella* like

Table 1. Showing the physicochemical characters of study stations water.

Parameters (Average values)	Station I	Station II	Station III	Station IV	Station V
Air Temperature (^{0}C)	26 -30	26.5-31	27-30	27-32	27-32
Water Temperature (^{0}C)	26-29.75	25.5-30	26-30	27	25.5
pH	7.1-8	7-8.	6.5-7.8	6.7-8.2	6.8-7.3
Conductivity (µS/cm)	41.6-76.5	91.02-210.3	191.2-700.5	241.9-454.7	324.8-456.3
TDS (mg/l)	27.45-50.49	60.07-138.79	131.47-264.33	156.65-300.1	214.36-301
Calcium (mg/l)	1.68-4.8	2.8-7.26	4.6-12.02	7.9-17.05	7.9-14.4
Magnesium (mg/l)	0.8-2.1	1.01-2.47	1.3-6.7	2.1-9.37	2.4-7.6
Hardness (mg/l)	11.7-15.1	14.1-23	28-56	20-68	21.5-49
Free CO_2 (mg/l)	0.4-4	1.4-5.2	1.8-6	1.2-6	0.8-4.8
Alkalinity (mg/l)	10-22	12-28	16-52	24-64	12-24
DO (mg/l)	5-7	3.9-5.7	3.5-4.8	3.2-4.3	4-5.12
BOD (mg/l)	0.01-0.15	0.6-2.2	1.5-2.9	1.5-2.3	0.48-1.9
Chloride (mg/l)	1.27-1.42	1.7-2.13	2.18-2.84	2.84-3.26	2.1-2.41
Sodium (ppm)	2.07-2.82	4.2-9.9	14.2-31.4	14.5-24.7	20.4-25.8
Potassium (ppm)	0.72-1.01	1.09-2.4	1.75-2.84	2.14-2.64	1.94-2.91
Sulphate (mg/l)	0.2-0.5	0.48-1.02	0.4-1	0.23-0.98	0.6-1.4
Phosphate (mg/l)	0.003-0.02	0.3-0.94	0.24-1	0.21-1.04	0.07-0.98
Nitrate (mg/l)	1-2.6	4.1-7.2	2.1-7.1	3.6-8.4	4-9.3

organisms, *Shigella* like organisms,, *Proteus* and *Klebsiella* and *Pseudomonas* Agar for *Pseudomonas* Sp. The water samples were processed for bacteriological water quality by presence–absence (P–A) test (Clark 1968). Faecal coliforms and streptococci were enumerated by membrane filtration method and the other organisms by pour plate method (APHA, 1985).Physicochemical parameters were assessed by the standard procedure of Trivedy and Goal (1985).

RESULTS AND DISCUSSION

The data on Physichochemical parameters are presented in Tables1and the bacterial indicator population of the study area water are presented in Tables 2 respectively.

Air temperature ranged from 26^{o}C (Nov) to 30^{o}C (May & Aug) at Station A, 25.5^{o}C (Jan) to 31^{o}C (Apr, May & Aug) at Station B, 26^{o}C (Dec) to30^{o}C (April & May) at Station C, 27^{o}C (Dec) to 32^{o}C (May) at Station D, and 27^{o}C (Dec) to 32^{o}C (Apr) at the Station E. The mean values 27.9 ± 1.25, 28.7 ± 1.65, 28.58 ± 0.92, 29.56 ± 1.58 and 29.16 ± 1.52 respectively. Maximum air temperature at summer months and minimum in winter months.

Water temperature ranged from 26^{o}C (Jan, Feb & Nov) to 29.75^{o}C (May) at Station A, 25.5^{o}C (Nov) to 30^{o}C (May) at Station B, 26^{o}C (Dec) to 30^{o}C (May) at Station C, 26.5^{o}C (Dec) to 30^{o}C (Sep, April &May) at Station D, and from 27^{o}C (June & Dec) to 29.5^{o}C (May) at the Station E. The mean monthly values were 27.04 ± 1.31, 28. ± 1.41, 27.5 ± 1, 28.3 ± 1.29 and 27.9 ± 0.83 respectively. Maximum water temperature at summer months and minimum in winter months.

PH ranged from 7.1 (Jan) to 8 (May) at Station A, 7 (July) to 8 (Oct) at Station B, 6.5 (Sep) to 7.8 (May) at Station C, 6.7(Apr) to 8.2 (Sep) at Station D, and from 6.8 (Jan) to 7.3 (May) at the Station E. The mean monthly values were 7.4 ± 0.24, 7.6 ± 0.63, 7.05 ± 0.35, 7.39 ± 0.4 and 7.01 ± 0.12 respectively. Venkateswarlu (1983), has classified reservoirs into five categories, viz., acido-biontic (pH less than 5.5), acidophilus (pH between 5.5 and 6.5), indifferent pH (between 6.5 and 7.5), alkaliphilous (pH between 7.5 and 9.0), and alkalibiontic (pH more then 9.0). If above mentioned classification is applied Station C was identified as alkaliphilous, other stations were indifferent pH. Maximum pH at summer months and minimum in winter months, it may be due to surface evaporation and reduced water level.

Table 2. Showing the Pollution indicators of study stations water.

Parameters (Average values)	Station I	Station II	Station III	Station IV	Station V
Total coliforms Cfu/ml	11×10^2- 27×10^2	21×10^2 - 70×10^2	$48\times10^{2-}$ 98×10^2	21×10^2 - 94×10^2	43×10^2 - 72×10^2
fecal coliforms Cfu/ 100ml	nil -3×10^2	10×10^2 - 48×10^2	21×10^2 - 45×10^2	10×10^2 - 69×10^2	13×10^2 - 36×10^2
fecal streptococci Cfu/ 100ml	nil - 3	100 - 480	210- 450	100 - 300	130 - 280
Salmonella like organism Cfu/ml	nil - 3	4- 41	nil - 8	nil - 60	nil - 4
Shigella like organism Cfu/ml	nil - 6	1 - 6	nil - 10	nil - 15	3 - 12
Proteus and *Klebsiella* Cfu/ml	nil - 9	nil - 12	3 - 29	3 - 12	10 -29
Pseudomonas Sps Cfu/ml	nil - 17	2 - 32	4- 48	10- 56	12 - 32

Electrical conductivity ranged from 41.6 (Jun) to 76.5 µS/cm (May) at Station A, 91.02 (Sep) to 210.3 µS/cm (May) at Station B, 191.2 (March) to 400.5 µS/cm (May) at Station C, 241.9 (Oct) to 454.7 µS/cm (May) at Station D, and 324.8 (Nov) to 456.3 µS/cm (May) at the Station E. The mean monthly values were 56 ± 10.12, 113.64 ± 35.78, 349.75 ± 64.54, 388.55 ± 61.73 and 367.9 ± 37.52 respectively. Olsen (1950) classified the name for water bodies having conductivity values between 200 to 500 µS/cm as mesotrophic, below 200 µS/cm as oligotrophic and greater than 500.00 µS/cm as eutrophic. If above mentioned classification is applied Peachiparai reservoir water was falling under oligotrophic other stations were mesotrophic. Present finding prove the finding of A. Srinivasan (1970) as peachiparai reservoir is oligotrophic. High surface evaporation and reduced water level leads to maximum Ec at summer months and minimum in rainy months due to dilution effect.

Calcium hardness ranged from 1.68 mg/l (Aug) to 4.8 mg/l (May) at Station A, 2.8 mg/l (Aug) to 7.26 mg/l (May) at Station B, 4.6 mg/l (Jan) to 12.02 mg/l (May) at Station C, 7.9 mg/l (Sep) to 17.05 mg/l (May) at Station D, and from 7.6 mg/l (July) to 14.4 mg/l (May) at the Station E. The mean monthly values were 2.95 ± 0.81, 3.8± 1.34, 7.5 ± 2.66, 11.68 ± 2.76 and 10.9 ± 1.99 respectively. Ohle (1938) classified water bodies having Ca>10 mg/l as poor, 10 to 25 mg/l as medium and <25 as rich. If above mentioned classification is applied water samples from reservoir and Station B and III were fall under poor other stations were medium. Present finding prove the finding of A.Srinivasan (1970) nutrient poor catchment area of Peachiparai.

Magnesium hardness ranged from 0.8mg/l (Aug) to 2.1 mg/l (May) at Station A, 1.01 mg/l (Aug) to 2.4 mg/l (May) at Station B, 1.3 mg/l (Dec) to 6.7 mg/l (May) at Station C, 2.1 mg/l (Sep) to 9.37 mg/l (May) at Station D, and from 2.4 mg/l (July) to 7.6 mg/l (May) at the Station E. The mean monthly values were 1.48 ± 0.39, 1.6 ± 0.45, 2.5 ± 1.65, 4.8 ± 2.54 and 4.14 ± 1.48 respectively. All the water samples under study had magnesium concentration within the permissible limit of 100 mg/l.

Total hardness ranged from 11.7 mg/l (July) to 15.1 mg/l (May) at Station A, 14.1 mg/l (Feb) to 23 mg/l (May) at Station B, 28 mg/l (Oct) to 56 mg/l (May) at Station C, 20 mg/l (Sep) to 68 mg/l (May) at Station D, and from 21.5 mg/l (July) to 49 mg/l (May) at the Station E. The mean monthly values were 13.16 ± 1.05, 17.46± 2.81, 37.59± 9.85, 37.5 ± 14.64 and 33.81 ± 7.97 respectively. Sawyer (1960) classified water bodies on the basis of hardness into three categories viz. soft (hardness less than 75.0 mgl-1), moderately hard (from 75.0-150.0 mgl-1) and hard (from 151.0-300.0 mgl-1). If above mentioned classification is applied all the station can be placed under the category of soft water. Similar result was observed by Srinivasan (1970). But the obtained values were below the permissible limit of 600 mg/l (BIS 1998). High surface evaporation and reduced water level leads to maximum Total hardness at summer months and minimum in winter months.

Total dissolved substance ranged from 27.45 mg/l (June) to 50.49 mg/l (May) at Station A, 60.07 mg/l (July) to 138.79 mg/l (May) at Station B, 131.47 mg/l (Mar) to 264.33 mg/l (May) at Station C, 156.65 mg/l (Oct) to 300.1 mg/l (May) at Station D, and from 214.36 mg/l (Jan) to 301.15mg/l (May) at the Station E. The mean monthly values were 36.96 ± 6.68, 75 ± 23.61, 215.33 ± 41.74, 248.81 ± 40.74 and 247.03 ± 24.76 respectively. High surface evaporation and reduced water level leads to maximum TDS at summer months and minimum in rainy months due to dilution effect.

Free carbon dioxide ranged from 0.4 mg/l (Jan) to 4 mg/l (May) at Station A, 1.4 mg/l (Dec) to 5.2 mg/l (May) at Station B, 2 mg/l (July) to 6 mg/l (May) at Station C, 1.8 mg/l (Dec) to 6 mg/l (May) at Station D, and from 0.8 mg/l (Dec) to 4.8 mg/l (April) at the Station E. The mean monthly values were 1.5± 1.34, 2.7 ± 2.7, 3.86 ± 1.33, 3.41± 1.4 and 3.3± 1.22 respectively.

Alkalinity ranged from 10 mg/l (Feb) to 22 mg/l (May) at Station A, 12 mg/l (June) to 28 mg/l (April) at Station B, 16 mg/l (Sep) to 52 mg/l (May) at Station C, 24 mg/l (Dec) to 64 mg/l (May) at Station D, and from 12 mg/l (Nov & Dec) to 24 mg/l (May) at the Station E. The mean monthly values were 15 ± 3.27, 18.91 ± 4.16, 31.6 ± 12.6, 38.91 ± 12.69 and 16 ± 3.86 respectively. Spence (1964) has classified water bodies into three major categories based on the values of alkalinity. They are (i) nutrient poor (from 1.0-15.00 mg/l), (ii) moderately rich nutrient (from 16.0-60.0 mg/l), and (iii) nutrient rich (>60.0 mg/l).

In the present study, it was found, that mean monthly values were 15 mg/l in Peachiparai reservoir which has been found to be poor nutrient and less productive nature prove the study of A.sreenivasan,1970, Where as other study stations were moderately rich nutrient and productive nature.

DO ranged from 6 mg/l (May) to 8 mg/l (Dec) at Station A, 4.9 mg/l (May) to 6.7 mg/l (Jan) at Station B, 4.5 mg/l (May) to 5.8 mg/l (Dec) at Station C, 4.2 mg/l (May) to 5.3 mg/l (Jan) at Station D, and from 5 mg/l (April) to 5.12 mg/l (Dec) at the Station E.

Table 3 showing the correlation matrix of various physicochemical characters.

Correlations	WT	PH	EC	DO	BOD	CO2	TA	Ca2+	Mg2+	TH	TDS	NO3-	Cl-	Na+	K+	PO43-	SO42-
WT	1																
PH	0.00842	1															
EC	0.30342	-0.3830	1														
DO	-0.5058	0.11166	-0.6643	1													
BOD	0.489	-0.1093	0.73708	-0.7791	1												
CO2	0.41379	-0.1010	0.49262	-0.5787	0.56942	1											
TA	0.34418	0.00625	0.50993	-0.5317	0.71156	0.46709	1										
Ca2+	0.37958	-0.3523	0.90756	-0.6105	0.72915	0.489	0.51311	1									
Mg2+	0.46561	-0.2225	0.72023	-0.4768	0.62662	0.43879	0.66457	0.86498	1								
TH	0.3737	-0.381	0.83641	-0.6045	0.70707	0.54256	0.72507	0.80897	0.85188	1							
TDS	0.30233	-0.3833	0.99996	-0.6643	0.73724	0.49402	0.51229	0.9073	0.71946	0.83779	1						
NO3-	0.24329	-0.1720	0.57835	-0.6429	0.61719	0.20624	0.27449	0.52267	0.36041	0.42384	0.57795	1					
Cl-	0.28956	-0.1827	0.82917	-0.7923	0.87789	0.51107	0.73271	0.74442	0.58551	0.72765	0.83059	0.60975	1				
Na+	0.16807	0.0211	0.39294	-0.2807	0.39149	0.24918	0.15049	0.3369	0.14133	0.19507	0.39282	0.28878	0.38718	1			
K+	0.32837	-0.3135	0.86081	-0.7598	0.73872	0.40506	0.46336	0.75068	0.5108	0.69731	0.86233	0.62885	0.80384	0.37534	1		
PO43-	0.16086	0.03595	0.38759	-0.6142	0.52373	0.27321	0.40409	0.25298	0.1222	0.3191	0.38928	0.40269	0.64444	0.24248	0.54534	1	
SO42-	0.22595	-0.3771	0.43665	-0.3189	0.20135	0.40125	-0.0044	0.38103	0.27253	0.31654	0.43763	0.49945	0.20801	-0.0464	0.50005	0.06531	1

The mean monthly values were 7.2 ± 0.68, 5.7 ± 0.57, 5.09 ± 0.4, 4.96 ± 0.31 and 5.69 ± 0.41 respectively. Maximum Do observed during winter months and minimum in summer months due to raised temperature.

BOD ranged from 0.01 mg/l (Jan & Dec) to 0.15 mg/l (May) at Station A, 0.06 mg/l (Jan) to 1.2 mg/l (May) at Station B, 0.95 mg/l (Dec) to 1.9 mg/l (May) at Station C, 1.4 mg/l (Jan) to 2.3 mg/l (May) at Station D, and from 0.48 mg/l (July) to 1.51 mg/l (May) at the Station E. The mean monthly values were 0.05± 0.04, 0.8 ± 0.37, 1.13 ± 0.33, 1.85 ± 0.2 and 0.96 ± 0.31 respectively. Based on BOD values on water bodies are classified in to very clean 1 mg/l, clean 2 mg/l, fairly clean 3 mg/l, doubtful 5 mg/l, poor 7.5 mg/l and bad 10 mg/l. Based on the above classification Station A and II were very clean and other stations are clean. But the values were well below the standard limit of 3 mg/l. Maximum BOD at summer months and minimum in rainy and winter months due to high Do.

Nitrate ranged from 1 mg/l (Apr) to 2.6 mg/L(May) at Station A, 4.2 mg/l (Jan &Nov) to 7.2 mg/l (Sep) at Station B, 0.9 mg/l (Jan) to 7.1 mg/l (Oct) at Station C, 3.6 mg/l (Mar) to 8.4 mg/l (June) at Station D, and from 4 mg/l (Nov) to 9.3 mg/l (May) at the Station E. The mean monthly values were 1.76± 0.54, 6± 1.05, 5.05 ± 1.85, 6.9 ± 1.25 and 5.75 ± 1.69 respectively. The present results were below the permissible limit of 45 mg/l. Maximum Nitrate at summer months and minimum in rainy and winter months.

Chloride ranged from 1.27 mg/l (Nov) to 1.42 mg/l (May) at Station A, 1.7 mg/l (Aug) to 2.13 mg/l (May) at Station B, 2.18 mg/l (Nov) to 2.84 mg/l (May) at Station C, 2.84 mg/l (Sep) to 3.26 mg/l (May) at Station D, and from 2.1 mg/l (Oct) to 2.41 mg/l (May) at the Station E. The mean monthly values were 1.36 ± 0.4, 1.98 ± 0.14, 2.65 ± 0.18, 2.93 ± 0.13 and 2.26 ± 0.98 respectively. Unni (1983) have designated less domestic pollution with chlorides from 17.9-57.6 mg/l, moderate domestic pollution with chlorides from 50.9-129.9 mg/l and high domestic pollution with chlorides ranging from 92.4-206.4 mg/l. If Unni's (1983) criterion was applied all the study stations were free from domestic pollution. High surface evaporation and reduced water level leads to maximum Chloride at summer months and minimum in rainy and winter months due to dilution effect.

Sodium ranged from 2.07 ppm (Oct) to 2.82 ppm (Feb) at Station A, 4.2 ppm (Sep) to 9.9 ppm (June) at Station B, 14.2ppm (Mar) to 31.4 ppm (Nov) at Station C, 14.5 ppm (Oct) to 24.7 ppm (Sep) at Station D, and from 20.4ppm (Mar) to 25.8ppm (Aug) at the Station E. The mean monthly values were 2.48 ± 0.28, 7.3 ± 1.65, 23.1 ± 4.94, 22.35 ± 3.2 and 23.36 ± 2.05 respectively.

Potassium ranged from 0.72 ppm (oct) to 1.01 ppm(May) at Station A, 1.09 ppm (Aug) to 2.4 ppm (May) at Station B, 1.75ppm (Mar) to 2.84 ppm (Oct) at Station C, 2.14ppm (Dec) to 2.64 ppm (July) at Station D, and from 1.94 ppm (Sep) to 2.91ppm (June) at the Station E. The mean monthly values were 0.88± 0.09, 1.65± 0.42, 2.39± 0.36, 2.47± 0.15 and 2.39± 0.32 respectively. All study station Potassium values was below the permissible limit of 10 mg/l (BIS 1998).

Sulphate ranged from 0.22 mg/l (Dec) to 0.5 mg/L(May) at Station A, 0.48 mg/l (Jan) to 1.02 mg/l (July) at Station B, 0.47 mg/L(Dec) to 1 mg/l (July) at Station C, 0.23 mg/l (Feb) to 0.98 mg/l (June) at Station D, and from 0.6 mg/L(Nov) to 1.4 mg/L(July) at the Station E. The mean monthly values were 0.37 ± 0.92, 0.66 ± 0.18, 0.6 ± 0.18, 0.48 ± 0.22and 1.02 ± 0.21respectively.

Phosphate ranged from 0.003 mg/l (June) to 0.024 mg/l (July) at Station A, 0.3 mg/l (Nov) to 0.94 mg/l (March) at Station B, 0.24 mg/l (Jan) to 1 mg/l (July & Sep) at Station C, 0.21 mg/l (Nov) to 1.04 mg/l (May) at Station D, and from 0.7 mg/l (Jan) to 0.81 mg/l (Apr) at the Station E. The mean monthly values were 0.009 ± 0.05, 0.7 ± 0.18, 0.86 ± 0.23, 0.9 ± 0.28 and 0.32 ± 0.21respectively. Lee et al. (1981), on the basis of phosphorus contents have classified the water

bodies into five categories viz., oligotrophic less than 0.007 mg/1, oligo-mesotrophic between 0.008 and 0.011 mg/1, mesotrophic between 0.012 and 0.027 mg/1, meso-eutrophic between 0.028 and 0.039 mg/1, eutrophic more than 0.040 mg/1. If criterion of Lee *et al.,* (1981) applied all the study station fall under the categories of eutrophic water body except reservoir which is in oligo-mesotrophic. Except peachiparai reservoir water, other study stations showed high phosphate concentration compared to the permissible limit of 0.3 mg/l.

During the study period, the bacterial population showed great variation and are mainly depends on hydrological condition, anthropogenic activities prevalent on that station at the time of sampling as well as on the point of discharges. Colibacteria are relatively harmless microorganisms, which are present in the intestines of humans and animals in large numbers. The high coliform count obtained in the samples may be an indication that the water sources are faecally contaminated (EPA, 2003) These sources cause gastrointestinal infections following ingestion or infections of the upper respiratory tract, ears, eyes, nasal cavity and skin.(WHO)

In the present study total coliform (TC) positive ranged from 11×10^2 (May, station 1) to 98×10^2 (June, station 3), faecal coliform (FC) positive ranged from 0 (various months and sites) to 48 (July-2011,station 2), faecal streptococcus (FS) positive ranged from negative (various months and sites) to 480 (Nov-2011,station 2), salmonella like organism (SLO) positive ranged from 0 (various months and sites) to 60 (Nov-2011,station 4), shigilla like organism (SGLO) positive ranged from 0 (various months and sites) to 15 (Nov-2011,station 4), Proteus and Klebsiella (Pro & Kleb) positive ranged from 0 (various months and sites) to 29 (June ,2011,station 3), Psedomonas (Psedo) positive ranged from 0 (various months and sites) to 56 (June, 2011, station 4). The visible bacterial count at all the study stations mainly depends on hydrological condition, anthropogenic activities prevalent on that station at the time of sampling as well as on the point of discharges.

The Total Coliforms positive varied between 11×10^2 Cfu/ml (May) and 27×10^2 (Aug) cfu/ml in Station A; 21×10^2 Cfu/ml (April) and 70×10^2 Cfu/ml (Oct) in Station B; 48×10^2 Cfu/ml (Mar) and 98×10^2 Cfu/ml (June) in Station C; 21×10^2 Cfu/ml (April) and 94×10^2 Cfu/ml (Oct) in Station D and 43×10^2 Cfu/ml and 72×10^2 Cfu/ml in Station E. The mean reported Cfu/ml was 16.6 ± 5.41, 36.8 ± 16.3, 61 ± 14, 55 ± 21.9 and 55.5 ± 8.85. Minimum Cfu/ml recorded was 11×10^2 Cfu/ml at Station A in the month of Oct, 2011 and the maximum TC of 98×10^2 Cfu/ml Cfu/ml was recorded at Station C in the month of June, 2011.

The fecal Coliforms positive varied between nil (Jan, June, July, Aug, Oct and Dec) and 3×10^2 Cfu/ 100 ml (July) at Station A, 10×10^2 Cfu/ 100 ml (Nov) and 48×10^2 Cfu/ 100 ml (July) at Station B, 21×10^2 Cfu/ 100 ml (Dec) and 45×10^2 Cfu/ 100 ml (June) at Station C, 10×10^2 Cfu/ 100 ml (Mar) and 32 Cfu/ 100 ml (Oct) at Station D, and from 13×10^2 Cfu/ 100 ml (Jan) and 28×10^2 Cfu/ 100 ml (Mar) at the Station E. The mean values are 1.6 ± 1.08, 21.08 ± 7.78, 30 ± 7.78, 24.5 ± 6.08 and 19.66 ± 4.39. Minimum Cfu/ml recorded was nil at Station A in the month of Oct, 2011 and the maximum FC of 98 Cfu/ 100 ml was recorded at Station C in the month of June, 2011.

Faecal streptococci are a bacterial group that has been used as an index of faecal pollution in recreational Water (WHO). In the present study the range of positive faecal streptococci varied between nil to 3 cfu/ 100 ml in Peachiparai; 100 to 480 cfu/ 100 ml in Thirunanthikarai; 210to 450 cfu /100 ml in Udayanikukam pond; 100 to 300 cfu/100 ml in Perumkulam and 130 to 280 cfu /100 ml in Arasakulam.

Salmonella like organisms do not seem to multiply significantly in the natural environment (out of digestive tracts), but they can survive several weeks in water and several years in soil if conditions of temperature, humidity, and pH are favorable. Salmonella like organisms ranged between nil Cfu/ml (Jan, Feb, Mar, May, Aug, Sep, Oct,Nov and Dec) and 3 Cfu/ml (July) at Station A, from nil Cfu/ml (June, July,Aug, Sep,

Oct,Nov and Dec) and 3 Cfu/ml (Feb) at Station B, from nil Cfu/ml (May,July, Aug, Oct and Nov) and 8 Cfu/ml (Sep) at Station C, from nil Cfu/ml (Jan,May,Sep and Oct) and 60 Cfu/ml (Nov) at Station D, and from nil Cfu/ml (Apr,July,Sep and Dec) and 28 Cfu/ml(Mar) at the Station E .Minimum value recorded was nil at all stations in Jan, Feb, Mar, May, July, Aug, Sep, Oct, Nov and Dec and the maximum SLO of 60 Cfu/ml was recorded at Station D in November.

Shigilla like organism positive varied between nil Cfu/ml (Oct) and 6 Cfu/ml (May and July) at Station A, 1 Cfu/ml(Jan, Apr, and Nov) and 6 Cfu/ml(Sep) at Station B, from nil Cfu/ml(Oct) and 10 Cfu/ml(July) at Station C, from nil Cfu/ml(May and Sep) and 15 Cfu/ml(Oct) at Station AV, and from 3 Cfu/ml(Nov) and 12 Cfu/ml(June) at the Station E. The mean values are 3.08 ± 2.02, 2.83 ± 1.58, 5 ± 3.51, 5.6 ± 4.96 and 7.58 ± 2.93. Minimum value recorded was nil at all stations in May, Sep & Nov and the maximum SHLO 15 was Cfu/ml of recorded at Station D in October.

Proteous and Klebsiella like organisms varied between a minimum of nil Cfu/ml (Nov and Dec) and 9 Cfu/ml (Mar) at Station A, nil Cfu/m l (Oct) and 12 Cfu/ml (July) at Station B, 3 Cfu/ml (Feb) and 29 Cfu/ml (July) at Station C, 3 Cfu/ml (May) and 12 Cfu/ml (Oct) at Station D, and from 10 Cfu/ml(June) and 29 Cfu/ml(Sep) at the Station E. The mean values are 3.08 ± 3.02, 4.1 ± 3.56, 11.3 ± 8.66, 6.41 ± 2.81 and 15 ± 5.06 respectively. Minimum value recorded was nil at Station A &II in Oct, Nov & December and the maximum Proteous and Klebsiella like organisms of 29 Cfu/ml was recorded at Station C & V in July & September.

Psedomonas like organisms varied between a minimum of nil Cfu/ml (May) and 17 Cfu/ml(Aug) at Station A, 2 Cfu/ml(June) and 32 Cfu/ml(Nov) at Station B, 4 Cfu/ml(May) and 48 Cfu/ml(Dec) at Station C, 10 Cfu/ml(July) and 56 Cfu/ml(June) at Station D, and from 12 Cfu/ml(Sep) and 32 Cfu/ml(Jan) at the Station E. The mean values are 5.91 ± 4.81, 18 ± 8.95, 19.5 ±13.9, 24.9 ±14.06 and 16.75 ± 5.37 respectively. Minimum value recorded was nil at Station A in May and the maximum of 56 Cfu/ml was recorded at Station D in June. These microorganisms can introduce disease in humans and animals that swim in polluted water. Visible bacterial counts were high in rainy months whereas it was low during hot months.

CONCLUSION

Results obtained suggest that peachipara reservoir till in oligotrophic condition with very less anthropogenic influence but other stations are eutrophic, with pollution indicator load. Most of the water samples analyzed in the present investigation is contaminated. Presence of coliforms indicate the alarming situation to the public. Hence there is a necessity to extend such studies to the water sources of individual's houses and to investigate in detail microbial, physico chemical quality of drinking water supplies of panchayats in kanyakumari district.

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