WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES

SJIF Impact Factor 6.647

Volume 6, Issue 8, 1043-1050 Research Article ISSN 2278 – 4357

ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS AND MICROBIAL POPULATION OF THE HOGENAKKAL RIVER, INDIA

[1]*Dr. R. Mary Suja and [2]Dr. B. Christudhas Williams

[1]Director William Research Centre, Nagercoil – 1.

[2]Assistant Professor Department of Botany and Research Centre, Scott Christian College (Autonomous) Nagercoil - 629 003.

Article Received on 31 May 2017,

Revised on 21 June 2017,
Accepted on 12 July 2017

DOI: 10.20959/wjpps20178-9680

***Corresponding Author**

Dr. R. Mary Suja

Director William Research Centre, Nagercoil – 1.

ABSTRACT

Seasonal monitoring of the physico-chemical parameters and microbial population of the Hogenakkal river water was done to assess the water quality. The obtained values of different physico-chemical parameters and correlation co-efficient of microbial population revealed both positive and negative correlation at 0.01 and 0.05 level of significant. Evaluation of multiple regressions and multiple linear regression analysis were predicted from the available data and the quality of water was determined on the basis of environmental conditions, physico-chemical parameters and anthropogenic activities. The present investigation reveals that the water quality of the Hogenakkal River was not highly deteriorated with respect to the physico-chemical parameters. However, fungal population was found exceptionally high ($24x10^3 CFUml^{-1}$) during pre-monsoon when compared to the bacterial population ($20x10^3 CFUml^{-1}$) in monsoon season.

KEYWORDS: Physico-chemical parameters, Hogenakkal River, Correlation, Multiple Regression.

INTRODUCTION

Water the precious gift of nature to mankind and millions of other species living on the earth. The quality of drinking water is of vital concern for human health and life problems associated with the water quality are often a severe problem in India and these sources have been rendered unsafe for human consumption as well as for other activities such as irrigation and industrial needs. The United Nations General Assembly, in December 2003, proclaimed the years 2005 to 2015 as the International Decade for Action 'Water for Life'. A decade of action! The primary goal of the 'Water for Life' decade is to promote efforts to fulfill international commitments made on water and other water issues (UN, 2005). Rivers are major source of the world's drinking water accounts for just over 0.1% of the earth's total water. In India there are 14 major, 44 medium and 55 minor rivers which shares 83% of total dangerous drainage system. It has many localized areas, where water pollution creates a situation which is dangerous to health and wealth with the rapid establishment of industries and increase in human population (Solanki *et al*., 2012). Microbes are the integral parts of aquatic ecosystem used to define water quality. *E.coli* (FC/FS) ratio is an indicator to differentiate faecal pollution of human and animal (Gleick and Kenner, 1969).

MATERIALS AND METHODS

Study Area

Hogenakkal is a beautiful spot in the Megattu Hills of the Dharmapuri district, an attractive picnic spot. The river Kaveri flows from a height of 22 metres and the water plunges into a deep narrow valley. The flow of water from the falls looks like a "Smoking rock", that is why it is called Hogenakkal. Human interaction take place at Hogenakkal and tourist start their cruise from this site from morning to evening. The water in this station was always furbid due to continuous boat plying as well as hierarchy of streams joins the river at this site with thick vegetation.

Field visit and Sample collection

Water samples were collected as per the standard method of sampling techniques, APHA, (2005). Triplicates of the river water samples were aseptically collected in a sterilized water can (3 litres) around 2km, during four seasons, namely Pre-monsoon (June-August), Monsoon (September-November), Post-monsoon (December-February) and summer (March-May).

Microbial Analysis

To determine the total microbial population, the running river water samples were collected in sterile plastic can and immediately transported to the laboratory. Bacteria were enumerated as Colony Forming Unit (CFU) employing the standard pour plate technique as described in APHA, (2005). Plate count agar medium was used for enumeration purposes and the agar medium was used for enumeration purposes autoclaved prior to use. The collected samples were serially diluted using sterile distilled water and inoculated into sterile petridishes.

Plating was done by employing pour plate techniques and the plates were incubated at 30^{o}C in an incubator. After 24 hours of incubation, colony counts were made by using a colony counter.

Statistical Analysis

Statistical analyses of the data obtained for the different variables were carried out using SPSS software package. Standard deviation, correlation co-efficient analysis, multiple regression and multiple linear regression model were done for the variables including bacterial and fungal population associated with the water quality. Temperature, rainfall, pH, turbidity, conductivity, TDS, total alkalinity, total hardness, calcium, chloride, magnesium, sulphate and phosphate were taken into account their standard values and observed values were compared to reveal the water quality.

RESULT AND DISCUSSION

Temperature controls the behavioral characteristics of an organism and plays a major role in controlling the chemical and biological characteristics of an aquatic ecosystem. The present investigation indicated that the monitoring temperature in river water samples varied from 29±0.7ºC in post-monsoon to 34±1.58ºC in summer. Jayaraman *et al*., (2003) observed a difference in surface water temperature of 25^{o}C to 30.6^{o}C in Karamana River near Thiruvananthapuram. High seasonal rainfall and heavy discharge of water during monsoon season resulted in high flushing rate seldom favours colonization of macrophytic communities. The rainfall revealed a noticeable seasonal fluctuation ranged from the minimum of 0.62±0.30mm in summer to the maximum of 340±0.07mm in monsoon. This was in good agreement supported by the findings, at lower Anicut in the river Kaveri with maximum rainfall during monsoon season (Thirumurugan, 2000).

Hydrogen ion concentration of natural water is an important environmental factor inhabiting the ecosystem. pH varied from 6.9±0.07 in pre-monsoon to 8.43±0.007 in post-monsoon. According to Bulushu, (1987) natural water with pH value from 6 to 8 was considered as neutral water and majority of potable water falls in this category. Turbidity of water is due to colloidal and extremely fine dispersions of suspended matters varied from 0.78±0.7 NTU in monsoon to 2±0.707 NTU in summer. The present findings are similar to the observation of Amanullah, (1994) recorded maximum turbidity during summer and minimum in monsoon has been largely attributed due to suspended particles. Conductivity of the natural water indicated the capacity of water carries electric current ranged from 505±4.12µmhos/cm in pre-monsoon to 520±1.58µmhos/cm in post-monsoon. From the above observation, it was evident that the river water samples falls above the permissible limit for domestic purposes (APHA, 2005).

Total dissolved solids are a measure of solid material dissolved in the river water includes salts, organic materials, a wide range of nutrients and toxic materials varied from 231±0.70741mg/l in post-monsoon to 730±1.58 mg/l in summer, ranges above the permissible limit of CPHEEO (Central Public Health Environmental Engineering Organization) 500mgL^{-1} for total dissolved solids. Total alkalinity of the natural water was closely related to the nature of sub-surface formation ranged from 205±3.16mg/l in monsoon to 440±1.58mg/l in summer. The present study inferred that the low alkalinity levels observed during monsoon season might be due to incoming of inorganic and organic solids from surrounding mountains and hills includes cattle and birds excreta along with runoff water. Hardness is a measure of calcium and magnesium content in water to assess the quality of water varied from 110±1.41mg/l in monsoon to 240±1.58mg/l in summer. From the present observations it was evident that the moderate hardness value during hot months attributed raising the temperature thereby increasing the solubility of calcium and magnesium salts (Garg, 2003).

Calcium is the most abundant elements in natural water imparting hardness ranged from the minimum of 20±0.70 mg/l in summer to the maximum of 56±1.41mg/l in monsoon. Chloride content of the surface water occurs naturally moreover due to anthropogenic activities such as dissolution of salt deposits, use of inorganic fertilizers, landfills and animal feeds varied from 50±2.23mg/l in monsoon to 115±4.12mg/l in pre-monsoon. Evidences supporting the above observations of high solubility of chloride through the run-off from catchments areas and high rates of evaporation coupled with low level of river water (Rao, 1971). Magnesium occurs in all kinds of natural water with calcium ranged from 24±0.70mg/l in monsoon to 30±0.707mg/l in summer. The general acceptable limit of magnesium content in water is usually 50mg/l where as its maximum permissible limit is 100 mg/l (ICMR, 1975) and the obtained data revealed that the river water is good for drinking purpose (Table: 1).

Table – 1 Physico-chemical parameters of Hogenakkal river water samples

Parameters	Pre-monsoon	Monsoon	Post-monsoon	Summer
Temperature	31.2± 2.28	30±1.58	29±0.7	34±1.58
Rainfall	3.4±0.14	340±0.07	1.3±0.07	0.62±0.30
pH	6.9±0.07	7.4± 0.07	8.43±0.007	8.1±0.07
Turbidity	1.41±0.48	0.78±0.7	1.02±.277	2±0.707
Conductivity	505±4.12	510±1.41	520±1.58	515±1.41
TDS	319±1.41	320±3.16	231±0.707	730±1.58
Total alkalinity	200±1.4	205±3.16	225±0.707	440±1.58
Total hardness	200±4.81	110±1.41	200±1.58	240±1.58
Calcium	28±4.1	56±1.41	36±1.58	20±0.70
Chloride	115±4.12	50±2.23	80±1.58	90±1.58
Magnesium	27±0.7	24±0.70	26±1.58	30±0.707

The influx of inadequately treated municipal wastes along with the river water cause distinct and predictable changes in the microbial community. The present investigation revealed that the bacterial population of the river water samples varied from the minimum of $10 x 10^{-3}$ CFU/ml^{-1} in summer to the maximum of $20 x 10^{-3}$ CFU/ml^{-1} in monsoon. On the other hand, fungal population varied from the minimum of $5 x 10^{-3}$ CFU/ml^{-1} in post-monsoon to the maximum of $24 x 10^{-3}$ CFU/ml^{-1} in pre-monsoon (Table- 2).

Table - 2 Microbial Population of the Hogenakkal river water samples

Microbial Population	Colony Count CFU/ml^{-1}			
	Pre-monsoon	**Monsoon**	**Post-monsoon**	**Summer**
Bacteria	11	20	15	10
Fungi	24	19	5	20

Correlation co-efficient analysis was carried out to evaluate the inter-relationship between different variables showed both positive and negative correlation between microbial populations. The present investigation revealed that the correlation co-efficient for bacterial population in the river water samples are positively correlated (1.000)** at 0.01 level of significant associated with total hardness and magnesium content in monsoon, conductivity and calcium content in post-monsoon and fungal population with calcium and magnesium content in post-monsoon, temperature and calcium content in summer. In contrast correlation co-efficient for bacterial population exhibited negative correlation (-1.000)** of pH, turbidity and conductivity in monsoon, total hardness (-0.991**) in pre-monsoon showed 0.01 level of significant, on the other hand (-0.885)* rainfall and (-0.935*) conductivity in monsoon showed 0.01 level of significant. However chloride content of the bacterial population in monsoon season (-0.949)* and fungal population with chloride content in monsoon season (-0.949)* showed 0.05 level of significant (Table: 3).

Table- 3 Correlation co-efficient of the bacterial and fungal population

Parameters	Pre – monsoon	Monsoon	Post-monsoon	Summer	Pre - monsoon	Monsoon	Post-monsoon	Summer
Temperature	-0.682	-0.447	0.447	0.500	-0.296	-0.286	0.447	1.000**
Rainfall	0.710	0.447	0.447	0.233	-0.368	-0.885*	0.447	-0.261
pH	0.714	-1.000**	0.447	0.224	-0.368	-0.539	0.447	0.447
Turbidity	-0.447	-1.000**	-0.114	0.500	-0.437	0.185	-0.121	0.447
Conductivity	0.936*	-1.000**	1.000**	0.447	0.599	-0.935*	0.300	0.447
TDS	0.677	-0.447	-0.447	-0.224	0.160	0.906*	-0.447	0.800
Total alkalinity	0.719	-0.477	0.447	0.447	-0.368	-0.478	0.447	0.800
Total hardness	-0.991**	1.000**	0.800	0.447	-0.658	-0.103	0.300	0.800
Calcium	0.850	0.277	1.000**	0.500	0.839	-0.103	1.000**	1.000**
Chloride	0.278	-0.949*	0.800	0.447	-0.816	0.455	0.300	0.832
Magnesium	0.682	1.000**	0.447	0.500	-0.368	0.863*	1.000**	0.447

Multiple regression analysis for bacteria was used to predict their degree of relation associated with the water to explore whether the variables are dependent or independent. The present investigation revealed that the bacterial population associated with the river and bore well water samples showed relatively high degree of relation with the entire variables. Multiple regression analysis for bacterial population associated with the river water samples is exclusively dependent against the variables (R^2 value 1) in monsoon and post-monsoon season and highly dependent (0.994) in pre-monsoon and summer. In contrast fungal population is exclusively dependent against the variables (R^2 value 1) in pre-monsoon, monsoon, post-monsoon and summer season (Table: 4).

Table – 4 Multiple regression for Microbial population

Microbial Population	R Square value			
	Pre- monsoon	Monsoon	Post –monsoon	Summer
Bacteria	0.994	1	1	0.994
Fungi	0.999	0.999	0.999	0.999

Multiple linear regression for bacterial population

Pre-monsoon

Y=2.763 X_1+0.311; X_2+2.283; X_3+1.401; X_4+4.605; X_5+0.020; X_6+0.031; X_7 +0.049; X_8+0.051; X_9+0.358; X_{10}+0.095; X_{11}+0.479; X_{12}+0.224; X_{13}+153.5.

Monsoon

Y=5.636 X_1+0.756; X_2+0.0607; X_3+2.876; X_4+11.0727; X_5+0.0405; X_6+0.0628; X_7+0.095; X_8+0.186; X_9+0.352; X_{10}+0.329; X_{11}+0.866; X_{12}+0.886; X_{13}+704.5.

Post-monsoon

Y=3.909 X_1+0.497; X_2+11.169; X_3+1.701; X_4+22.727; X_5+0.028; X_6+0.062; X_7 +0.064; X_8+0.072; X_9+0.406; X_{10}+ 0.178; X_{11}+0.566; X_{12}+1.162; X_{13}+781.8.

Summer

Y=2.690; X_1+0.296; X_2+15.112; X_3+1.190; X_4+5.286; X_5+0.019; X_6+0.014; X_7 +0.052; X8+0.041; X9+0.477; X10+0.103; X11+0.157; X12+0.423; X13+336.25.

Multiple linear regression for fungal population

Pre-monsoon

Y=6.381X_1+0.719; X_2+5.274; X_3+3.235; X_4+10.64; X_5+0.046; X_6 +0.071; X_7 +0.114; X_8+0.117; X_9+0.828; X_{10}+0.218; X_{11}+0.107; X_{12}+0.518; X_{13}+354.5.

Monsoon

Y=5 X_1+0.756; X_2+0.060; X_3+2.876; X_4+11.073; X_5+0.0405; X_6+0.063; X_7 +0.095; X_8+0.187; X_9+0.352; X_{10}+0.329; X_{11}+0.866; X_{12}+0.866; X_{13}+704.5.

Post-monsoon

Y=1.181 X_1+0.150; X_2+3.374; X_3+0.514; X_4+6.866; X_5+0.008; X_6+0.0187; X_7 +0.032; X_8+0.022; X_9+0.123$_{10}$+0.054; X_{11}+0.171; X_{12}+0.351; X_{13}+236.

Summer

Y=5.272 X_1+0.295; X_2+15.112; X_3+1.190; X_4+5.285; X_5+0.019; X_6+0.014; X_7 +0.052; X_8+0.041; X_9+0.477; X_{10}+0.103; X_{11}+0.157; X_{12}+0.432; X_{13}+336.25.

CONCLUSION

The analysis of physico-chemical parameters and microbial population predicted that the knowledge of microbial population of the river water relieves to improve the water quality. The present study showed that the sampling station is moderately polluted on the other hand regular monitoring of the riverine and mitigation measures like setting of common treatment plant will control pollution and prevent the depletion of water quality of the river water.

REFERENCES

1. Amanullah, B. 1994. Studies on benthic animals of Kaveri river stretch from Karur to Grand Anicut (Tiruchirapalli, India). Ph.D Thesis, Bharathidasan University, Tamil Nadu, India.
2. APHA,2005, Standard methods of examination of water and waste water APHA, AWWA and WPCF, 19th Ed. American Public Health Association Inc.Spring field, Newyork.
3. Bulushu, K.R. 1987. Chemical constituents in water related treatment and management. NEERI. Nagapur: 25.
4. Garg,S.S, 2003. Water quality of well and borewells of 10 selected locations of Chitrakoot region. *Indian Jr. Env. Prot*., 23(9): 966-974.
5. Gleick, E.E and Kenner, B.A. 1969, concept of faecal streptococci in stream pollution. *Journal of water pollution control federation*, 41: 352-355.
6. ICMR, 1975. Manual of Quality of Drinking Water supplies Indian Council for Medical Research, *Indian Hydrobiology*, 13(1): 75-79.
7. Jayaraman, P.R., Ganga Devi, T. and Vasudevan Nayar, T. 2003. Water quality studies on Karamana River. Thiruvananthapuram district South Kerala India. *Poll. Res.* 22(1): 85-100.
8. Rao, V.S. 1971. Hydrobiol 38: 213*. Ecology and Pollution of Indian Rivers. Ashish Publishing House, New Delhi.
9. Solanki, H. A., Chitnis R. D. and Bhavsar H. A. 2012. Physico-chemical and Bacterial analysis of Sabarmati river in Ahmedabad. *Life Sciences Leaflets* 2: 70-82 ISSN 0976-1098.
10. Thirumurugan, R. 2000. Studies on some aspects of dietary nutrition and feed formulations for freshwater prawn. Macrobrachium malcolmsunii. Ph.D thesis, Bharathidasan University, Tamil Nadu, India.
11. U.N. 2005. UN Decade for Sustainable development (2005-2014).