QUALITY ANALYSIS AND STUDY OF A REGION OF KALPATHY RIVER USING BACTERIA INOCULUM

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Abstract

The study was conducted to find out the changes in physio-chemical and bacteriological characteristics of Kalpathy River at Palakkad district Kerala, India. The river water samples were collected in and around the region to be studied. After fixing the boundaries using QGIS software and sample were analyzed for various physio-chemical and bacteriological parameters using bacteria inoculum. Bacteria are introduced to water sample based physical parameters of water in the river and analyzing the changes made by bacteria to the parameters of water. The study indicated that the mean value of studied parameters, biological oxygen demand (BOD), chemical oxygen demand (COD) of the river water sample were within the permissible limit. The parameters include total suspended solids, BOD, COD, of the river water sample were tested after bacterial inoculation for a period of time and finding out the changes occurred in the river by the bacteria before and after the bacterial inoculation.

Index Term- ***River water, Physicochemical characteristics, Drinking water***

I. INTRODUCTION

Rivers are the most important natural resource for human development but it is being polluted by indiscriminate disposal of sewage, industrial waste and plethora of human activities, which affects its physicochemical and microbiological quality. The potential cause of degradation of river water quality due to various point and nonpoint sources. Increasing problem of deterioration of river water quality, it is necessary to monitoring of water quality to evaluate the production capacity.

There are 44 rivers in Kerala, all but three originating in the Western Ghats. 41 of them flow westward and 3 eastward. The rivers of Kerala are small, in terms of length, breadth and water discharge. The rivers flow faster, owing to the hilly terrain and as the short distance between the Western Ghats and the sea. All the rivers are entirely monsoon-fed and many of them shrink into rivulets or dry up completely during summer. Bharathappuzha ("River of Bhārata"), also known as the River Nila, is a river in India in the state of Kerala. With a length of 209 km, it is the second longest river in Kerala, after Periyar. The word "Nila" indicates the culture more than just a river. Nila has groomed the culture and life of south Malabar part of Kerala. It is also referred to as "Peraar" in ancient scripts and documents. The headwaters of the main tributary of Bharathapuzha originates in the Anaimalai Hills in the Western Ghats, and flows westward through Palakkad Gap, (also known as Palghat gap) across Palakkad, Thrissur and Malappuramd istricts of Kerala, with many tributaries joining it, including the Tirur River. For the first 40 km or so, the Bharathappuzha follows an almost northerly course till Pollachi near Coimbatore. At Parli, the Kannadipuzha and Kalpathippuza merge and flow as Bharathappuzha, following a westerly course until it empties into the Lakshadweep Sea at Ponnani. At Mayannur, Gayathripuzha merges with the river. The Thootha River merges with the Nila at Pallippuram. As the Thootha River is rich in water, after its merger, the Nila becomes thicker in flow.

A Geographic Information System (GIS Software) is designed to store, retrieve, manage, display, and analyze all types of geographic and spatial data. GIS software lets you produce maps and other graphic displays of geographic information for analysis and presentation. GIS software lets you produce maps and other graphic displays of geographic information for analysis and presentation. With these capabilities a GIS is a valuable tool to visualize spatial data or to build decision support systems for use in your organization. A GIS stores data on geographical features and their characteristics. The features are typically classified as points, lines, or areas, or as raster images. On a map city data could be stored as points, road data could be stored

as lines, and boundaries could be stored as areas, while aerial photos or scanned maps could be stored as raster images.Geographic Information Systems store information using spatial indices that make it possible to identify the features located in any arbitrary region of a map. For example, a GIS can quickly identify and map all of the locations within a specified radius of a point, or all of the streets that run through a territory.

There are many bacterias used for water treatmentprocess.Photosynthetic bacteria c an use short-chain organic acids as electron donors for the production of hydrogen at the expense of light energy. These bacteria have several advantages over their fermentative counterparts, such as high theoretical conversion yield and the utilization of wide spectral light energy to decompose organic acids into hydrogen and CO_2. This positive free-energyreaction is impossible to be accomplished by anaerobic digestion.Inaddition, photosyntheticbacteria lack oxygen-evolving activity, which otherwiseposes oxygen inactivation proble ms in different biological systems. The combination of photosynthetic and anaerobicbacteria can provide an integratedsystem for the maximization of hydrogen yield. order of gram-positive, low-GC, acid-tolerant, generally nonsporulating, nonrespiring, either rod-shaped (bacilli) or spherical(cocci) bacteria thatsharecommon metabolic and physiological characteristics. These bacteria, usually found in decomposing plants and milk products, produce lactic acid as the major metabolic end product of carbohydrate fermentation. This trait has, throughout history, linked LAB with food fermentations, as acidification inhibits the growth of spoilage agents. Proteinaceous bacteriocins are produced by several LAB strains and provide an additional hurdle for spoilage and pathogenic microorganisms.
Furthermore, lactic acid and other metabolic products contribute to the organolepticand textural profile of a food item. The industrial importance of the LAB is further evidenced by their generally recognized as safe (GRAS) status, due to their ubiquitous appearance in food and their contribution to the healthy microbiota of animal and human mucosal surfaces. The genera that comprise the LAB are at its core Lactobacillus, Leuconostoc, Pediococcu s, Lactococcus,and Streptococcus,these belong to the order Lactobacillales

II.MATERIALS AND METHODS

1.SOFTWARE

QGIS (previously known as **Quantum GIS**) is a free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data.

2 FUNCTION

2.1 Layers

QGIS can display multiple layers containing different sources or depictions of sources.

2.2 Preparing maps

In order to prepare map with QGIS, Print composer is used. It can be used for adding map, labels, legends, etc.

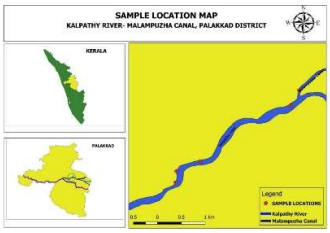

Fig no.1 Sample Location Map

3 SAMPLING

It is an absolute necessity that one attempts to collect samples that are representative of the matrix under investigation. When collecting samples, one must follow predetermined sampling protocols (procedures and methods) which have been chosen (bearing in mind the sampling (collection) site, the number of samples to be collected, and the timing of the sampling) to meet the purpose of the survey, and which are appropriate to the media being investigated.
Water quality

4 SAMPLING TIMING

Time the sampling trip such that it is possible to collect a representative water sample from the designated sampling point. Take into account factors such as the weather, tides, currents, geography etc.

5 SAMPLING POINT

For rivers, the primary sampling point is in the surface water layer (0-5 cm from the surface) at the centre of the main flow. However, the top 1-2 cm of this surface

layer should be avoided so as not to collect floating dust, oil, etc. In addition, further samples can be collected through the full depth of the water column if required to meet the purpose of the study.

6 SAMPLING TOOLS

The type of water sampling tool required will depend on the sampling site and the type of sample to be taken. Sampling can be achieved using buckets, open water grab samplers (a ladle or bottle on the end of a long pole), or vertical and horizontal messenger activated samplers (such Niskin bottles or Kemmerer water samplers).

7 SAMPLE CONTAINERS

The size and type of sample to be taken will determine the type of sample container required.

- For volatile organic compounds, use clear or brown bottles or vials with screw caps or stoppers lined with tetrafluoroethene resin films, or similar products, which can be closed to provide a gas-tight seal.
- For semi-volatile or non-volatile organic compounds, use clear or brown glass jars with a stoppers or Teflon lined screw caps.
- For inorganic compounds such as heavy metals, use polyethylene or glass containers.

8 CLEANLINESS

Sampling tools and containers should be contamination free. The method and extent of cleaning will be determined by one's target analyte and predetermined instrumental detection limits. However, wherever possible use tools and containers which have been cleaned thoroughly. In particular,

- For volatile organic compounds, containers should be heated at 105 °C for 3 hours and then allowed to cool in a desiccator to avoid contamination immediately before use.
- For semi- and non-volatile organic compounds, use containers which have been washed with pesticide residue analysis grade solvent, and dried immediately before use.
- For heavy metal, use containers which have been washed with 10 % v/v nitric acid, or 16 % v/v hydrochloric acid, and then rinsed several times with pure (deionised) water.

9 SAMPLING OPERATION

The number and volume (size) of the samples to be collected will depend on the number and concentration of the target analytes, the difficulty and expense of analysis, and whether extra storage is required. Collect the water sample using the most appropriate sampling tool given the nature of the sampling site, the target analyte, and the instrument on which quantitative measurement will be performed. Sample containers should be washed 3-4 times with water from the exact site of sampling prior to taking the sample. The samples should be carefully and gently poured into its container without making bubbles. For underground water, collect spring water directly into sampling bottles when the groundwater is gushing out.

10 FIELD RECORDS

On a form which has been prepared in advance, record all pertinent details e.g. the sampling date, sample name (code), sampling site's name (code), an accurate position for the sampling site (map of G.I.S. position), general environmental conditions such as the nature of the surrounding landscape, the state of the tide or river flow, weather conditions such as cloud cover and air temperature, and general water conditions such as colour, water temperature, pH, and dissolved oxygen content, etc.

11 LABELLING OF SAMPLES

Label each sample unambiguously, i.e. write on the sample bottle in water-resistant ink details of the name or code of the sample, the sampling date, the sampling site name etc. Alternatively, one may attach a label to the sample bottle detailing the same information. II Sampling - 26 - Remember also to record these details in the field record mentioned earlier. This provides a backup record of the sampling sequence and allows cross-checking of the analytical results with field data, and reduces future problems with identification (confusion) of stored samples. Finally, record on each sample and in the field record details of transport methods, storage methods, etc.

Fig 2- Sample Labelling

12 TRANSPORT AND STORAGE OF SAMPLES

Procedures for handling the sample during transport will depend on the nature of the sample matrix and the target analytes. However, ideally all samples should be cooled in ice soon after collection, and then transported to the laboratory packed in ice. If samples must be stored for any significant period of time, refrigerate or freeze samples as soon as possible after collection or arrival at the laboratory.

13 EFFECTIVE MICROORGANISM

E.M. is an abbreviation for Effective Microorganisms.Microorganisms are tiny units of life that are too small to be seen with the naked eye and they exist everywhere in nature.There are friendly guys of the microbial worlds known as beneficial microorganisms. Not so friendly group called pathogens that are harmful and capable of producing disease.EM is an consortium of selected microbes.

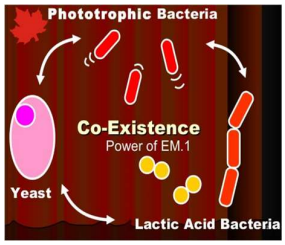

Fig 3-Bacteria Maple present in EM

Membrane filters have a known uniform porosity of predetermined size (generally 0.45µm) sufficiently small to trap microorganisms. Using the membrane filter technique, sample is passed through the membrane using a filter funnel and vacuum system. Any organisms in the sample are concentrated on the surface of the membrane. The membrane, with its trapped bacteria, is then placed in a special plate containing a pad saturated with the appropriate medium. The passage of nutrients through the filter during incubation facilitates the growth of organisms in the form of colonies, on the upper surface of the membrane. Discrete colonies thus formed can be easily transferred to confirmation media.

Step-by-step Procedures

1. Collect the sample and make any necessary dilutions.
2. Select the appropriate nutrient or culture medium. Dispense the broth into a sterile Petri dish, evenly saturating the absorbent pad.
3. Flame the forceps, and remove the membrane from the sterile package.
4. Place the membrane filter into the funnel assembly.
5. Flame the pouring lip of the sample container and pour the sample into the funnel.
6. Turn on the vacuum and allow the sample to draw completely through the filter.
7. Rinse funnel with sterile buffered water. Turn on vacuum and allow the liquid to draw completely through the filter.
8. Flame the forceps and remove the membrane filter from the funnel.
9. Place the membrane filter into the prepared Petri dish.
10. Incubate at the proper temperature and for the appropriate time period.
11. Count and confirm the colonies and report the results.


Fig 4-PVDF Apparatus

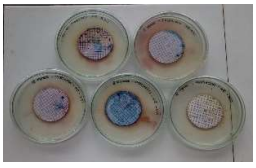
Fig 5-bacteria cultured before inoculation

III. RESULTS AND DISCUSSIONS

In the first phase of the project the fixing the boundaries of River water for bacterial inoculum using QGIS software and Bhuvan. Latitude and longitude of the project areas (Kalpathy River) was taken using GPS during field visit. Mapping will be further based on this data. The river is divided into three portion as upstream side, middle area and downstream side. The river water samples was collected in and around the region to be studied and given for primary characteristic testing.Then Various physio-chemical and bacteriological parameters are tested. After testing the Physio-chemical and bacteriological parameters the bacteria inoculation was prepared in the laboratory and 10ml 0f this bacterial solution after activation for 15 days are introduced to that river water sample. The changes in the water sample are be observed for a regular time period of 7days.After 7days water quality parameters are tested again and changes in observation are noted. The result noted.

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Table No 4.1- pH of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	8.22	6.54
SAMPLE-2	9.20	6.50
SAMPLE-3	8.30	6.58
SAMPLE-4	9.47	6.52
SAMPLE-5	9.27	6.61

Table No 4.2- Temperature of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	34.4	32.2
SAMPLE-2	34.6	32.1
SAMPLE-3	35.0	32.4
SAMPLE-4	35.2	32.4
SAMPLE-5	35.2	32.5

Table No 4.3- EC(µs) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	209.5	288
SAMPLE-2	212.6	289.9
SAMPLE-3	214.3	276.5
SAMPLE-4	208.4	288.6
SAMPLE-5	237.2	303.6

Table No 4.4- TDS(ppm) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	126.4	161.6
SAMPLE-2	123.5	158.4
SAMPLE-3	128.1	157.9
SAMPLE-4	126.1	164.1
SAMPLE-5	143.2	173.1

Table No 4.5- Turbidity(NTU) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	14.6	12.8
SAMPLE-2	15.6	12.0
SAMPLE-3	15.4	9.9
SAMPLE-4	16.8	9.0
SAMPLE-5	18.0	7.5

Table No 4.6- Chloride(mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	50	60
SAMPLE-2	40	60
SAMPLE-3	50	50
SAMPLE-4	40	50
SAMPLE-5	40	50

Chloride(as Cl),mg/l = no of drops X 10

Table No 4.7- Residual Chlorine(mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	0.2	0
SAMPLE-2	0.0	0
SAMPLE-3	0.5	0
SAMPLE-4	0.0	0
SAMPLE-5	0.2	0

Table No 4.8- Fluoride (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	0	0
SAMPLE-2	0	0
SAMPLE-3	0	0
SAMPLE-4	0	0
SAMPLE-5	0	0

Table No 4.9- Phosphate (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	0	0
SAMPLE-2	0	0
SAMPLE-3	0	0
SAMPLE-4	0	0
SAMPLE-5	0	0

Table No 4.10- Iron (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	3	1
SAMPLE-2	1	1
SAMPLE-3	1	1
SAMPLE-4	3	1
SAMPLE-5	1	1

Table No 4.11- Ammonia (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	0.0	1
SAMPLE-2	0.5	1
SAMPLE-3	0.5	1
SAMPLE-4	0.5	0.5
SAMPLE-5	0.0	0.5

Table No 4.12- Nitrite (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	0.0	0
SAMPLE-2	1.0	0
SAMPLE-3	0.5	0
SAMPLE-4	0.0	0
SAMPLE-5	0.5	0

Table No 4.13- DO(mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	4.4	32.8
SAMPLE-2	3.2	34.4
SAMPLE-3	4.5	35.2
SAMPLE-4	6.5	31.2
SAMPLE-5	3.9	35.2

1000ml of 1N thiosulphate =8g of O_2

DO (mg/l) = $(V_2 \text{ X } N \text{ X } 8\text{X}1000)/V_1$

V_1 = Volume of Sample in ml,

V_2 = Titrate Value in ml,

N = Normality of Thiosulphate

Table No 4.14 BOD(mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	53.01	46
SAMPLE-2	24.10	24
SAMPLE-3	72.29	66
SAMPLE-4	96.39	72
SAMPLE-5	24.96	24

t-day BOD= [DOt-DO0]/(P)
where P= Dilution factor = 300mL/(sample volume in mL)

Table No 4.15 COD (mg/l) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	1588	1490
SAMPLE-2	1437	1339
SAMPLE-3	1342	1222
SAMPLE-4	1297	1177
SAMPLE-5	1168	1069

Table No 4.16 Total Coliform (Nos) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	628	12
SAMPLE-2	359	56
SAMPLE-3	199	61
SAMPLE-4	79	19
SAMPLE-5	1086	55

Table No 4.17 E-Coli(Nos) (Nos) of water before and after applying bacterial inoculum

SAMPLE	BEFORE APPLYING BACTERIAL INOCULUM	AFTER APPLYING BACTERIAL INOCULUM
SAMPLE-1	78	Nil
SAMPLE-2	15	4
SAMPLE-3	57	Nil
SAMPLE-4	4	1
SAMPLE-5	790	1

pH, Temperature, EC, Total Dissolved Solids, Turbidity,Chloride,Residual Chlorine,Fluoride,Phosphate,Iron,Ammonia,Nitrite,DO,BOD,COD, E-Coli and Total coliform count of each samples were find out. As per specification of BIS10500:1992 pH limit is between 6.5–8.5, desirable limit of total dissolved solids is 500 mg/l and its permissible limit is 2000 mg/l. desirable limit of hardness is 300 mg/l as $CaCO_3$ and permissible limit is 600 mg/l as $CaCO_3$, desirable limit of chloride is 250 mg/l and permissible limit is 1000 mg/l, d Coliform count should not contain more than 10 coliform per 100ml.

From the table 4.19 it is clear that the samples pH is almost with in the limit. pH is also with in the limit. Total dissolved solids are within the limit. Conductivity is within the limit Chloride content is within the limit.. Coliform count is more than 10 coliform per 100 ml that means the water sample contenting E-coli which is harmful microorganism to human body was removed after the bacterial inoculation process.

IV. CONCLUSION

Rivers are the backbone of human civilization. They provide us with fresh water which is helpful for various purposes such as drinking, cleaning, washing, etc. Without rivers, life will come to a halt. Rivers just keep on flowing without any stop. We humans exist because of rivers. The rise of the inflow of waste is clearly due to the

rapid growth of residential and commercial activities in the study area. Due to the discharge of sewage, domestic wastes and human activities the changes in Various physio-chemical and bacteriological parameters .If Sewage mixes with the river system, the river water could be used for irrigation but this is unsuitable for drinking purposes due to the presence of faecal coliforms, E. coli, other bacterial population and higher concentration of phosphate, BOD and COD. The bacteriological counts in the river water make the water unfit for human consumption. Regular monitoring of river and taking suitable remedial measures like collection of domestic sewage and setting up the common treatment plant; before discharge of sewage into river system, it should be treated. This will control pollution and prevent the depletion of the quality of river waters.The water sample were collected for the experimental work from different locations of river. The MAPPLE EM solution was kept for activation for about 15 days. Study shows that the the Mapple EM solution is best bacterial inoculam for removing of harmuful micro organism like E-Coli. Also it decrease the BOD and COD level.This river contation mostly contain E-coli as harmful microorganism. This MAPPLE EM solution can be used for killing the Bacteria and water can be used without primary treatment for basic activity

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