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FULL LENGTH ARTICLE

A Comprehensive Study on Physicochemical and Microbiological Quality of Mallaprabha River – A Case Study at Saugandipur and Ramapur Site, Savadatti, Belagavi, Karnataka

Ambarish S. Sindagi[1], Manjula S. Patil[1] and Krishna N. Kulkarni[2]
[1]Centre for Interdisciplinary Studies and Research, Dharwad. Karnataka, India
[2]Nichrome Testing Laboratory and Research, Pvt. Ltd Narayanpur, Dharwad, Karnataka, India
Email: ambarishimb.s@gmail.com

ABSTRACT
In recent years the pollution of water reservoirs has become the leading environmental problem in the world. Eutrophication of water bodies is rapidly increasing due to growing increase quantity of sewage discharge and anthropogenic activities. The main objective of the study is to assess physicochemical and microbiological quality of water samples from Saugandhipur and Ramapur site at Savadatti, Karnataka. The results of the physicochemical analysis showed that some of the parameters were above the permissible limits and some were within the limits. The results of the microbiological analysis showed that the water is fecal contaminated and water is not fit for the drinking purpose. The MPN values were exceeded the permissible limits of WHO standards. The water at these sites is fecaly polluted due to anthropogenic activities and discharge of sewage at the study site; hence water is not fit for potability.
Key words: *Eutrophication, physicochemical, anthropogenic, enforcement, potability.*

INTRODUCTION

Water playing an vital role in the day today life of human. The natural factors like road runoff, dust, weathering of minerals, use of chemical fertilizers, cattle washing, discharge of domestic waste and human anthropogenic activity leads to eutrophication of water bodies. Discharge of industrial waste water, urban and agriculture wastes alter the physic-chemical characteristics of water bodies. The chemical parameters like phosphorus and nitrogen inputs from the domestic and agricultural wastes accelerate the eutrophication process as well [1]. Now a day's self-purification and metabolising capacity of water bodies has been diminished. The exposure of chemicals from the agriculture soils washed to lakes which stimulates the growth of phytoplanktons and zooplanktons. Changes in the aquatic environments accompanying anthropogenic pollution are cause of growing concern and require monitoring of surface waters [2]. The microbiological quality of water is assessed by monitoring non-pathogenic bacteria of fecal origin. The *E. coli* and *Entrococcus* spp member are traditionally used as hygiene indication [3]. Today water resources have been the most exploited natural system since man strode the earth. Pollution of the water bodies is increasing steadily due to rapid population growth, industrial proliferation, urbanization, increasing living standards and wide sphere of human activities [4]. Changes in the aquatic environment accompanying anthropogenic pollution are a cause of growing concern and require monitoring of surface waters. The monitoring of quality of surface water by hydro biological parameters is among environmental priorities because it permits direct estimation of the state of water ecosystems exposed to deleterious anthropogenic factors [5]. The presence of non-pathogenic organisms is not a major concern but intestinal contaminates of fecal origin are important. These pathogens are responsible for intestinal infections such as bacillary dysentery, typhoid fever, cholera and paratyphoid fever .Water contam ination with pathogens and pollutants create many health problems for the people consuming the water. As such water quality in relation to human health is an important fact of limnology. Even though ecological diversity and physico-chemical properties of water from ponds and lakes has received considerable, attention [6]. The present study was undertaken with the aims to provide a baseline data, comprising study of their main physico-chemical and microbiological characteristics to study the concernt studies of water quality of Malaprabha River of Sawgandhipur and Ramapur site at Savadatti.

Sampling and Analysis

The water samples from Saugandhipur and Ramapur Site at Savadatti, Karnataka were collected in well cleaned plastic containers for physicochemical tests as per APHA. The well sterilized borosil glass bottles covered with brown wrappers for microbiological tests between 7.00 am - 9.00 am and were brought to the laboratory carefully for further analysis using standard procedures prescribed by APHA [8] and NEERI Lab Manual, Trivedi & Goel [9], Aneja [7]. All chemicals and Media are purchased from Hi Media.

Table 1. Physicochemical analysis of Saunghadhipur Site (Tap water)

Sl.No	Parameters	WHO Standards	Result
1	Color Hazen units	-	BDL
2	Conductivity µs/cm	2500	160
3	Total Dissolved Solids (TDS) mg/L	2000	100
4	pH	6.5-8.5	7.5
5	Total Alkalinity mg/L as $CaCO_3$	200	55
6	Total Hardness (TH) mg/L as $CaCO_3$	500	41
7	Nitrate mg/Las NO_3	25-50	BDL
8	DO in mg/L	5.0	3.0
9	BOD in mg/L	28-30	15
10	COD in mg/L	10	4.5
11	Free CO_2 in mg/L	0.5-2.0	1.5
12	Phosphates in mg/L	5.0	2.4
13	Chloride mg/L as Cl	200-600	2.0
14	Sulphate mg/L as SO_4	42-45	0.1
15	Calcium mg/L as Ca	75-200	10
16	Magnesium mg/L as Mg	50-150	4
17	Fluoride mg/L s F	1.00	0.3
18	Iron mg/L as Fe	0.3	0.1
19	Turbidity NTU	10	BDL

Note: BDL-Below Detectable Limit

Sl.No	Parameters	WHO Standards	Result
1	Color Hazen units	-	BDL
2	Conductivity µs/cm	2500	500
3	Total Dissolved Solids (TDS) mg/L	2000	240
4	pH	6.5-8.5	7.5
5	Total Alkalinity mg/L as $CaCO_3$	200	150
6	DO in mg/L	5.0	2.5
7	BOD in mg/L	28-30	40
8	COD in mg/L	10	80
9	Total Hardness (TH) mg/L as $CaCO_3$	500	320
10	Free CO_2 in mg/L	0.5-2.0	7.5
11	Phosphates in mg/L	5.0	8.0
12	Nitrate mg/L as NO_3	20-50	0.80
13	Chloride mg/L as Cl	200-600	2.0
14	Sulphate mg/L as SO_4	42-45	0.1
15	Calcium mg/L as Ca	75-200	10
16	Magnesium mg/L as Mg	50-150	4
17	Fluoride mg/L s F	1.00	0.3
18	Iron mg/L as Fe	0.3	0.1
19	Turbidity NTU	10	45.0

Table 2. Physicochemical analysis of Ramapur Site (Sewage water discharge point)

Table 3: Total Plate Count of (TPC) of Saugandhipur and Ramapur sites.

Sl.No	Sampling Site	Organism	CFU/100ml
1	Saugandhipur Site, Savadatti.	G+ve*Bacilli* G+ve*Staphylococci* G-ve*Bacilli* G+ve*Streptococci*	254 x 10^4
2	Ramapur site, Savadatti	G+ve*Streptococci* G+ve*Monococci* G-ve*Bacilli* G+ve*Staphylococci* G+ve*Diplococci*	486x 10^3

Note: BDL-Below Detectable Limit

Table 4: Total Fungal Count of (TFC) of Saugandhipur and Ramapur sites.

Sl.No	Sampling Site	Organism	CFU/100ml
1	Saugandhipur Site, Savadatti	*Rizopus* sps. *Mucor* sps. *Penicillium* sps. *Aspergillus* sps.	90x10^3
2	Ramapur site, Savadatti	*Fusarium* sps. *Altemena* sps. *Pencillum* sps. *Aspergillus* sps. *Mucor* sps. *Rhizopus* sps. *Cephalosporium* sps. *Cladosporium* sps	175x10^2

Table5: Observation chart for Bacterial isolates at Saugandhipur and Ramapur Sites.

Colony Characters / Isolates	Isolate I	Isolate II	Isolate III	Isolate IV
General Observations				
Sample	Water	Water	Water	Water
Culture Media	PCA	PCA	PCA	PCA
Incubation Time	24-48 hours	24-48 hours	24-48 hours	24-48 hours
Incubation Temp.	37^0C	37^0C	37^0C	37^0C
Dilution factor	10^4	10^4	10^4	10^4
Macroscopic Observations				
Number of colonies	45	68	72	50
Size in mm	2	3	6	4
Colour	White	Yellow	Grey	Cream
Surface	Round	Round	Round	Round
Margin	Smooth	Smooth	Smooth	Smooth
Elevation	Flat	Flat	Flat	Flat
Microscopic Observations				
Magnification	100X	100X	100X	100X
Shape	Bacilli	Cocci	Cocci	Bacilli
Arrangement	Streptobacili	Staphylococci	Streptococci	Diplobacilli
Gram staining	G+ve	G+ve	G+ve	G-ve
Other	-	-	-	-

Note: PCA- Plate Count Agar

Microscopic view of the fungal isolates

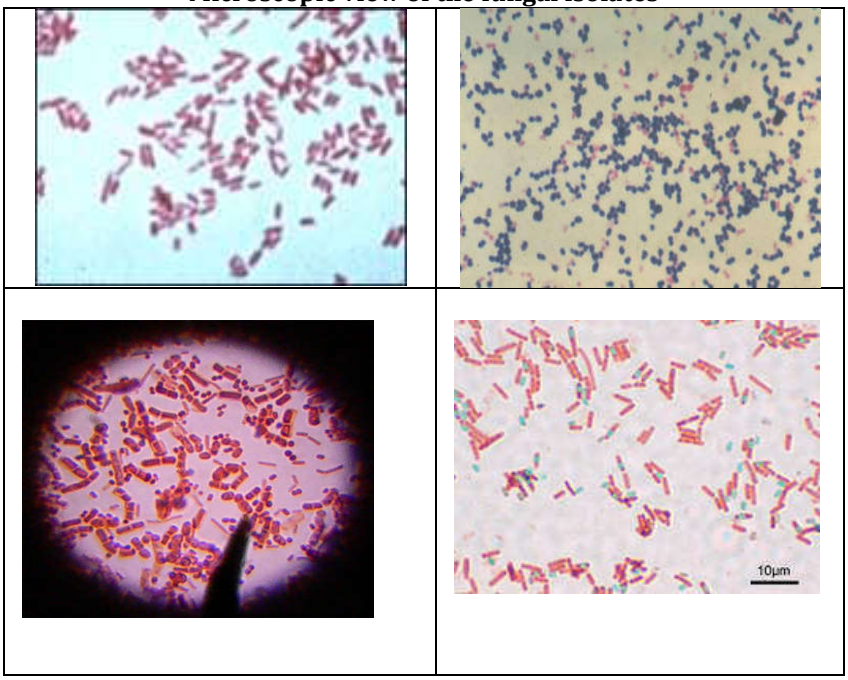
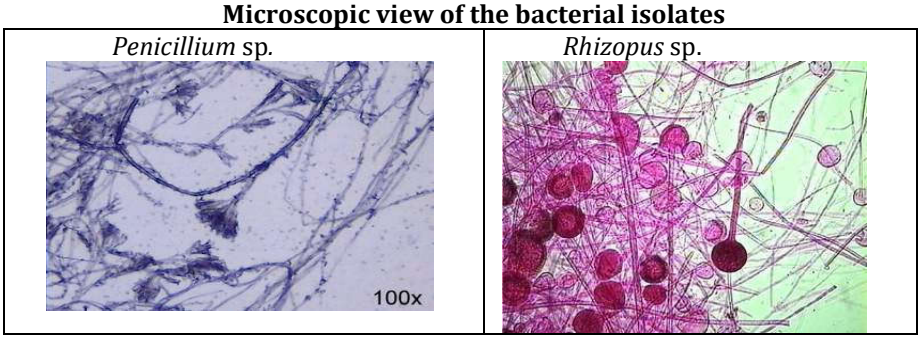


Table 6: Observation chart for Fungal isolates at Saugandhipur and Ramapur Sites.

Colony Characters / Isolates		Isolate I	Isolate II	Isolate III	Isolate IV
General Observations					
Sample		Water	Water	Water	Water
Culture Media		YEGCA	YEGCA	YEGCA	YEGCA
Incubation Time		3-5 days	3-5 days	3-5 days	3-5 days
Incubation Temp.		25^0C	25^0C	25^0C	25^0C
Dilution factor		10^2	10^2	10^2	10^2
Macroscopic Observations					
Number of colonies		19	14	12	09
Size in mm		12	18	21	15
Colour of colonies	**Front**	Bluish Green	Black	Bluish green	Greenish black
	Back	White	Dark black	Orrange	Black
Surface		Leathery	Cottony	Leathery	Cottony
Margin		Irregular	Cottony	Round	Irregular
Microscopic Observations					
Magnification		40X	40X	40X	40X
Septation		Septate	Aseptate	Aseptate	Septate
Conidia		Brush shape	Spherical	Ascending	Chains of Macraoconidia
Genera		Penicillium	Rhizopus	Aspergillus	Alterneria
Other		-	-	-	-

Note: YEGCA - Yeast Extract Glucose Chloramphenicol Agar

Microscopic view of the bacterial isolates



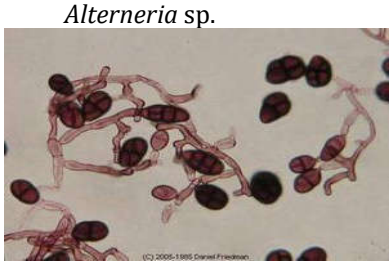
Alterneria sp.	*Aspergillus* sp.
	

Table 7: MPN count at SS & RS site.

Sampling Site	No. of tubes Showing PositiveResults			MPN index/100ml
	3 of 10 ml	3 of 1 ml	3 of 0.1 ml	
S_1	3	2	1	150
S_2	3	2	0	93

Note: **MPN** – Most Probable Number, **SS**- Saugandhipur Site, **RS**- Rampur Site

Table 8: IMViC test for *E. coli*

Biochemical test	Result
Indole	+ve
M.R	+ve
V.P	-ve
Citrate	-ve

Note:-M.R- Methyl Red, **V.R** – Voges Prasuker

Photos of Total Plate Count

Fig 1

Fig 2

Photos of Fungal Count (TFC)

Fig 3

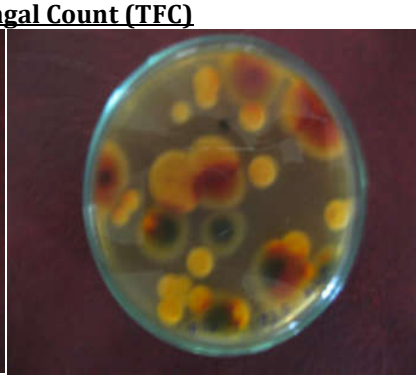


Fig 4

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Photos of MPN test

Fig 5: Positive MPN tubes showing Acid gas production

Fig 6: Metallic sheen colonies on EMB agar plates

RESULTS AND DISCUSSION

The results of physico-chemical and microbiological analysis of the Malaprabha River at Saugandhipur and Ramapur sites were summarized in the table 1-8.

Electrical Conductivity: The EC values were found within the permissible limits. The variability of EC could be explained by the nature and concentration of ionized substances present in water. Higher EC values were found in Rampur sites() and lower values of Saugandhipur sites().

Total Dissolved Salts: The TDS values of Rampur sites and Saugandhipur sites were within the permissible limits. The higher values of TDS found at Rampur sites (200mg/h) and lower values found at Saugandhipur sites. The high concentration og TDS due to distress in cattle and livestock aafter drinking.

pH: The pH values obtained at Saugandhipur sites and Rampur sites 7.5 and 8.2 respectively. The high pH values found at Rampur sites. The pH values are within the permissible limits. It is one of the most important parameter in the acid base neutralization and water softening.

Total Alkalinity: The total alkalinity of the water samples were within the permissible limits. The high total alkalinity values (150 mg/L) were found in Rampur sites due to the discharge and anthropogenic activities at Rampur sites. The lower total alkalinity values (55 mg/L) were found at Saugandhipur sites.

Total Hardness: The water quality depends on its total hardness. The total hardness values of water samples at both the sites were within the permissible limits. The higher total hardness values (320 mg/L) were found at Rampur sites due to washing clothes and discharge of sewage at the sites. The lower values of total hardness (41 mg/L) were found in Saugandhipur sites.

Nitrates: The nitrates values of both sites were found below the WHO permissible limits. The nitrates values at Saugandhipur sites was found below (0.8mg/L) detectable limit. The low nitrate value was found at Ramapur site.

DO, BOD and COD: The quality of water is assessed on the basis of vital parameters such as DO,BOD and COD. DO is an index of physical and biological processes occurring in water and it is the fuel for aquatic organisms. The DO values of Rampur sites were exceeded the permissible limits.(6.5mg/L) and lower values (3.0mg/L) were found at Saugandhipur sites. The higher DO values attributed due to the anthropogenic activities at the Rampur sites. The BOD values at both the sites were within the permissible limits. The lower BOD values (15mg/L) were found at Saugandhipur sites. The higher BOD value (40mg/L) was found at Rampur sites due to high discharge of domestic wastes and the partial growth of algae and inflow of industrial, fertilizers and agricultural wastes. The COD values at Rampur sites were exceeded the permissible limits(80mg/L) due to high discharge of agricultural waste, industrial pollutants and anthropogenic activities. The lower COD values (45mg/L) was found at Saugandhipur sites.

Free CO2: The free CO2 value was found within the permissible limits (1.5mg/L) at Saugandhipur site. The high free CO2 value (7.5mg/L) was found at Rampur site. The variations in the CO2 values were due to anthropogenic activities.

Phosphate: The low phosphate value (2.4mg/L) was found at Saugandhipur site. The high phosphate value (8.0mg/L) was found at Rampur site. Phosphate in water indicates the degree of pollution of the water body.

Chloride: The low chloride value (250mg/L) was found at Saugandhipur site. The high chloride value (300mg/L) was found at Rampur site. The high concentration of chloride attributed to the use of detergents and chemicals.

Sulphate: The low sulphate value (20.5mg/L) was found at Saugandhipur site. The high sulphate value (40.2mg/L) was found at Rampur site. The sulphates in lake water is probably due to leaching, from mineral ores and agricultural runoff.

Calcium, Magnesium, Flouride and Iron: The low values of Ca(35mg/L), Mg(40mg/L), F(BDL) and Fe(0.05mg/L) were found at Saugandhipur site simultaneously. The high values of Ca(50mg/L), Mg(65mg/L), F(0.3mg/L) and Fe(0.5mg/L) were found at Rampur site. The variation in the above are values due to sewage water discharge of industrial wastes disposal and anthropogenic activities.

Nitrates and Turbidity: The low value of nitrate (1.5mg/L) was found at Saugandhipur site. The high value (50mg/L) was found at Rampur site. The value of turbidity was below the detectable limits at Saugandhipur site. The value of turbidity was found high (45mg/L) at Rampur site. The nitrates were attributed to the decay of organic matter, leaching of fertilizers, industrial effluents and waste dump.The results of physicochemical analysis of both sites showed that some of the parameters at Ramapur site exceeded the permissible limits. Hence the water at Ramapur site is not fit for the drinking purpose. The results of the microbiological anaylsis were illustrated in table 3-8. The results of microbiological analysis of both sites reviewls that the water at Ramapur site exceeded the permissible limits and fecaly contaminated. Total plate count ($486x10^3$) and total fungal count ($175x10^2$) values were exceeded permissible limits. Hence the water at Ramapur site fecaly contaminated and not fit for the drinking purpose as MPN values exceeded the permissible limits. The discharge of sewage water from sewers is main source of fecal contamination. The microbiological analysis of Saugandhipur site water showed the all the parameters are within the limits and hence water is fit for drinking purpose. Total plate count ($254x10^4$) and total fungal count ($90x10^3$) values within the permissible limits. The photos of TPC, TFC and MPN tests were shown in Fig 1 to 6.

The awareness is created at Saugandhipur and Ramapur village regarding the status of water pollution and poor water treatment. The questionnaire also been carried at Saugandhipur and Ramapur village the ill effects of water pollution on health. Through this we come to know the peoples are suffering from water borne diseases like cholera, typhoid and dysentery. From the study effort has been made to assess the water quality and creating awareness regarding the water pollution at these sites in savadatti. The awareness programme also been conducted to educate the people about the water quality and monitoring the water pollution at the sites.

CONCLUSION

From the study it can be concluded that the physico-chemical and microbiological parameters of the Ramapur site water were exceeded the limits and hence water is not fit for drinking purpose. The lake is fecaly polluted due to anthropogenic activities and discharge of sewage to water. The effort has been made to assess the water quality and creating awareness regarding the water pollution at these sites in Savadatti. The awareness programme also been conducted to educate the people about the water quality and monitoring the water pollution at the sites.

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