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Analysis of Water Quality of River Ganga from Digha Ghat to Gai Ghat in Patna District, Bihar, India

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ABSTRACT- This study is an attempt to analyze the water quality of river Ganga in Patna district. Water samples were collected from 16 different Ghats during March-May 2017. Due to heavy discharge of municipal waste and anthropogenic activities in the river the biological, chemical and physical characteristics of water have changed to a considerable extent. The objectives of this study were to find out the changes in physicochemical nature as well as the biological health of river Ganga. Samples were analyzed on various physicochemical parameter i.e. Total Hardness, pH, B.O.D., and D.O. by using the standard methods and procedures. The result shown that the average pH -7.95, average, D.O.-2.91 mg/L, average B.O.D. -2.41 mg/L, average total hardness -114.72 mg/L. Microbial analysis was also conducted in terms of Most Probable Number (MPN) of total coliforms in the water sample and it shown the highest value for all samples. The presence and absence of the gas bubble in each tube were used to calculate an index known as the Most Probable Number.

Key-words- Ganga, Patna, Physicochemical, Microbial, Coliforms, MPN, D.O., B.O.D., Hardness, pH

INTRODUCTION

Water is an essential natural resource in the world on which existence of life depends. From the history, it is well known fact that all the great civilization around the world evolved around the rivers [1]. Due to growing population, unorganized urbanization and fast industrialization along the rivers, the quality and quantity of water resources declining. Water quality is defined in terms of its physicochemical and biological parameters [2]. The major pollution source in the river Ganga at Patna are untreated domestic sewage waste water, industrial effluents and dead bodies [3]. Today over 29 cities, 70 towns and thousands of villages extend along the Ganga banks. All of their sewage over 1.3 billion liters per day goes directly to the river [4]. The present investigation was carried out along 16 different Ghats of River Ganga in Patna district .Under this investigation physicochemical quality of Ganga water i.e. pH, D.O, B.O.D, and Total hardness were determined by using standard protocols.

The bacteriological examination of water has a special significance for pollution studies as it is a direct measurement of the effects of pollution on human health. Total coliforms are indicator organism of fecal contamination in water [5]. Microbial analysis was performed in terms of the most probable number [6]. The presences of fecal coliform were seen in all samples of Ganga water obtained from 16 different Ghats from Digha to Gai Ghat in Patna district.

MATERIALS AND METHODS

This study was conducted between March–May, 2017 in Patna district, India. In the present investigation water sample were collected from 16 different Ghats of river Ganga in Patna district, Bihar state, India.

Analysis of physicochemical biological properties of water samples
Determination of Physicochemical properties
Determination of pH: pH indicated the acid base balance of water and mainly depends upon carbonic acid and interaction between carbonates and bicarbonates. The pH value was determined by using a digital pH meter (Systronics Model 361).

Determination of D.O. and B.O.D: The samples for the determination of dissolved oxygen were collected in

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B.O.D. bottle (Borosil 300 ml) and they were fixed at the site and brought immediately to the laboratory and were analyzed by Wrinkler's method [5]. D.O., and B.O.D. were analyzed as per the norms of APHA [5].

Determination of Total Hardness: To determine the total hardness of water samples, 50 ml of the water samples was pipette out in conical flask. One ml of ammonia, ammonium chloride buffer solution and 2–3 drops of Eriochrome black T indicator were added in the sample, the color of the solution turns wine red. This solution was titrated against previously standardized EDTA solution taken in the burette until the color changes from wine red to sky blue which indicates the end point. The final reading of the burette was noted and the titration was repeated to get total concordant value. Finally, using the analytical calculation, total hardness of water samples was determined in terms of mg/L of $CaCO_3$ [6].

Determination of Bacteriological analysis
The bacteriological analysis was carried out for the indicator organism i.e. Total and Fecal coliform [7,8]. Total 10.3 gm of MacConkey broth were dissolved in 100 ml of distilled water and is autoclaved at 121^0C For 15 minutes and then cooled at room temperature. Ten ml of this solution were filled in the test tubes and a Durham's tube was added in inverted position in each test tube plugged with non absorbent cotton plug. Again 5.15 gm of MacConkey broth was dissolved in 100 gm of distilled water and is autoclaved at 121^0C for 15 min and then cooled at room temperature. 10 ml of this solution were filled in test tubes and a Durham's tube was added in an inverted position in each test tube plugged with non absorbent cotton plug. Fifteen tubes filled with MacConkey broth (Hi media Pvt. Ltd Mumbai, India) arranged in three sets of test tubes. First set containing 10 ml of double strength MacConkey broth was inoculated with 10 ml of water sample. Second row containing 10 ml of single strength MacConkey broth was inoculated with 1 ml of water sample. The third row containing 10 ml of single strength MacConkey broth was inoculated with 0.1 ml of water sample respectively in an incubator at 37^0C for 48 hours. After incubation, the acid and gas production in forms of bubble was counted and the MPN of coliform in 100 ml water sample was estimated [9].

RESULTS AND DISCUSSION
The present study deals with the physicochemical and microbial analysis of Ganga Water collected from 16 Ghats of Patna region, Bihar, India. The collected water samples were analyzed for their physicochemical properties like: pH, D.O., B.O.D. and Total hardness. The values are enlisted in Table 1.

Table 1: Physicochemical analysis of different Ganga Ghats of Patna

ID	Sampling sites	D.O	B.O.D	Hardness	pH
1A	Kurji Ghat	3.2	1.2	128	7.82
2A	LCT Ghat	2.4	0.4	123	8.02
3A	Dheere Ghat	2.4	0.4	132	8.15
4A	Kali Ghat	1.6	0.4	128	8.04
1R	Pipapul (Down)	3.6	0.4	112	8.03
2R	Pipapul (Up)	4.4	0.4	107	8.13
3R	Nariyal Ghat	2.4	0.4	104	7.15
4R	Nasriganj Ghat	4.0	0.4	111	8.06
1A	Digha Ghat	3.2	0.4	118	7.86
2A	Janardhan Ghat	3.2	0.4	114	8.25
3A	Makhdumpur Ghat	3.0	0.3	7.62	7.62
R1	Raja Ghat	2.8	1.2	116	7.84
R2	Hanuman Ghat	2.4	0.4	106	7.88
R3	Pathri Ghat	2.8	0.4	112	8.11
R4	Gagha Ghat	2.8	0.8	108	8.08
R5	Gandhi Ghat	2.8	0.8	106	8.25

D.O; B.O.D; Hardness measured in (mg/L)

The highest pH was recorded 8.25 for Janardhan Ghat as well as Gandhi Ghat whereas lowest pH was recorded 7.15 for Nariyal Ghat. The pH values of all 16 Ghats are shown in Fig. 1.
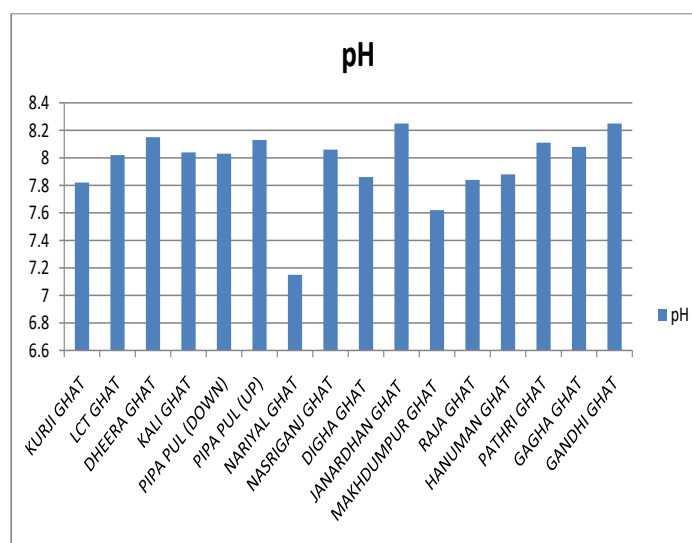
Fig. 1: Graph showing pH of the water samples of all 16 ghats

Dissolved Oxygen value of Nasriganj Ghat is shown at maximum of 4.0 mg/L and Kali Ghat shown minimum of 1.6 mg/L of D.O among 16 samples of various Ghats. The D.O. value of all 16 Ghats is shown in Fig. 2.
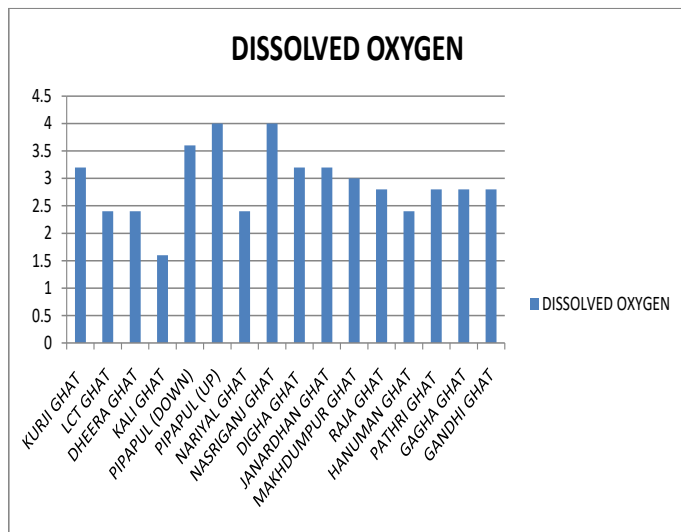

Fig. 2: Graph showing values of Dissolved Oxygen for the water sample of different Ghats

B.O.D. was recorded highest for Raja Ghat and Kurji Ghat, i.e. 1.2 mg/L and lowest for Makhdumpur Ghat, i.e. 0.3 mg/L. The details of B.O.D. values for water samples at various Ghats are shown in Fig. 3.
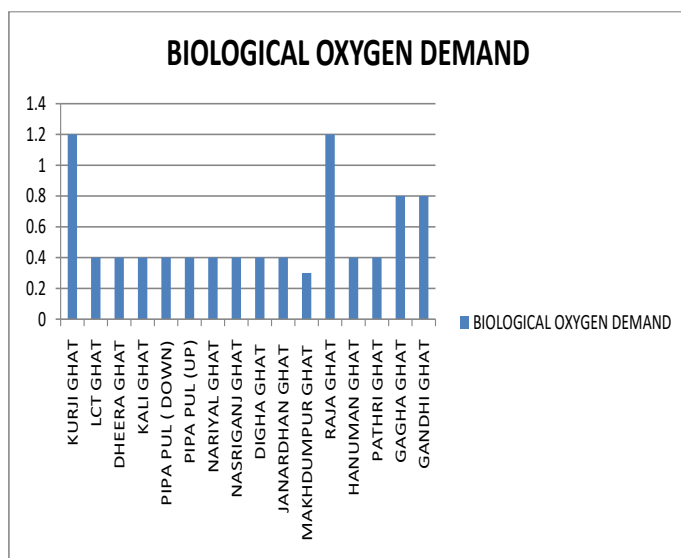

Fig. 3: Graph showing B.O.D. values for the water samples of different Ghats

Total hardness was calculated and the result has shown maximum of 128 mg/L for both Kurji Ghat and Kali Ghat, whereas Nariyal Ghat were shown the minimum Total Hardness of 104 mg/L among the 16 Ghats. The results of Total hardness of all samples are given in Fig. 4.
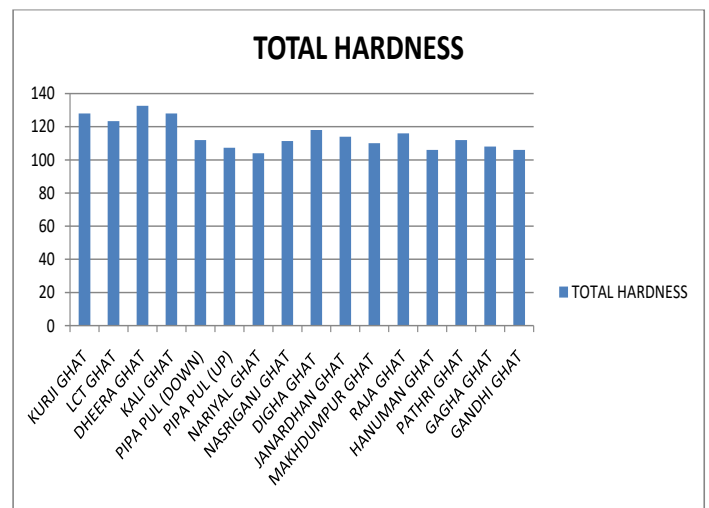

Fig. 4: Graph showing value of total hardness of samples at different Ghats

The water samples were analyzed for their microbial environment. Coliforms were detected in all water samples. The water quality was determined by the standard MPN method. The details of all 16 samples are enlisted in Table 2. The graphical representations of MPN value are shown in Fig. 5.

Table 2: Results of microbial analysis (MPN) of water sample from different Ghats of Ganga

S. No	ID	Sampling sites	Indole	MPN	MPN Index
1	1A	Kurji Ghat	Positive	5-5-5	>1600
2	2A	LCT Ghat	Positive	5-5-5	>1600
3	3A	Dheera Ghat	Positive	5-5-5	>1600
4	4A	Kali Ghat	Positive	5-5-5	>1600
5	1R	Pipapul (Down)	Positive	5-5-5	>1600
6	2R	Pipapul (Up)	Positive	5-5-5	>1600
7	3R	Nariyal Ghat	Positive	5-5-5	>1600
8	4R	Nasriganj Ghat	Positive	5-5-5	>1600
9	1A	Digha Ghat	Positive	5-5-5	>1600
10	2A	Janardhan Ghat	Positive	5-5-5	>1600
11	3A	Makhdumpur Ghat	Positive	5-5-5	>1600
12	R1	Raja Ghat	Positive	5-5-5	>1600
13	R2	Hanuman Ghat	Positive	5-5-5	>1600
14	R3	Pathri Ghat	Positive	5-5-5	>1600
15	R4	Gagha Ghat	Positive	5-5-5	>1600
16	R5	Gandhi Ghat	Positive	5-5-5	>1600
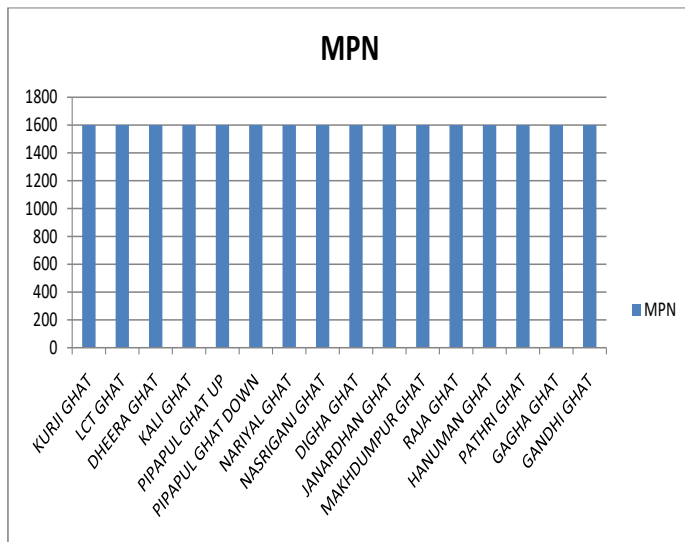
Fig. 5: Graph shown MPN value of all samples of Ganga water taken from various Ghats

The observation of Physicochemical and Microbial analysis, which is enlisted in the Table 1-2 respectively shown that the pH value of all the Ghats of Ganga is coming under the permissible limit (6.5–8.5). The pH of water mainly depends upon carbonic acid and the interaction between carbonate and bicarbonates. The pH values of water at sewage discharge points were usually lower than that of the river water [12,13].

Total Hardness of the water sample from 16 Ghats shown normal and come under the permissible limit (300 mg/L). There is no any major industrial setup present along these 16 ghats. Industrial effluents contain cations (calcium, magnesium and sodium) which increase total hardness [10]. Absence of industry along above the ghats keeps hardness levels lower.

The B.O.D value High values of this parameter indicate potential depletion of dissolved oxygen in the water body [10]. B.O.D values lower than the standard value (BIS) for all the samples of 16 ghats. A similar result was reported by Arya et al. [14].

Oxygen deficiency in the water bodies due to discharge of municipal waste, rich in organic compounds [10]. The D.O values for all 16 water samples were recorded lower than the permissible limit (6 mg/L). So the bacteria utilize the dissolved oxygen in the process of decomposition and DO have reached the lowest level. Decreasing of DO value from upstream to downstream indication of organic pollution load in river or it may be also due to increasing of temperature [15,16].

The value of pH, Total Hardness, B.O.D, D.O, and MPN were Compared to Standard of B.I.S [11]. A similar study was carried out by Gupta et al. [10] on river Yamuna and they reported high value of total hardness, B.O.D and Lower D.O level than the standard limits.

The MPN values of all the water samples of 16 Ghats of Ganga were recorded above the permissible limit (50 cfu /100 ml). Such higher value of MPN is also supported from the studies of other researchers [17,18].

CONCLUSIONS

From this study, the results clearly indicate that the water quality of the river Ganga is contaminated. The water quality declined mainly due to mass bathing, discharge of untreated sewage water, domestic wastewater of the Patna urban area. Establishment of the large number of apartments, industries, and hospitals on the bank of river Ganga has led to increasing the pollution. There is an urgent need of taking some appropriate measurement to stop further deterioration of Ganga river water quality. Awareness is needed among the people of the concerned areas decrease the level of pollution in Ganga water, a collective approach by the Government, common people, media, students, and all the section of the society is essential.

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