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RESEARCH ARTICLE

PHYSICOCHEMICAL AND MICROBIOLOGICAL STUDY OF RIVER WATER OF GANGA AND YAMUNA IN ALLAHABAD

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ABSTRACT

Ganga and Yamuna are two main rivers of north India and the area around them is the fertile Indo-Gangetic plain. Yamuna merges into Ganga at Triveni Sangam in Allahabad. During festival season people take a holy dip in the Ganga river and Sangam and also use it for drinking. Sangam is the site for the Kumbh Mela every twelve years, Ardh Kumbh Mela every six years and Magh Mela every year. Various sources of pollution make the water of these rivers unfit for human consumption. This study was carried out in Allahabad to assess the quality of water of these rivers before and after the Magh Mela. Different physicochemical parameter like pH, turbidity, DO, BOD, COD, and TDS were assessed. These were found to be above the permissible limits. Various pathogenic microorganisms were isolated from these rivers water. Thus the water of these rivers Ganga and Yamuna was found to be unfit for human consumption without treatment.

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INTRODUCTION

Rivers are the lifeline of any country. In India Ganga is a major river and Indo-Gangetic plain houses nearly 57 million people who directly use its water for domestic and irrigation purposes. Yamuna is the largest tributary of river Ganga in northern India. It merges into Ganga at Triveni Sangam in Allahabad. Sangam is a holy place where people take a dip during auspicious time. It is the site of Kumbh Mela every twelve years, Ardh Kumbh every six years and Magh Mela every year. Various human activities have polluted the water of these rivers. During mass bathing people offer various religious materials into the water. Many a times such offerings are brought in polythene bags and in the absence of a proper disposal system, these polythene bags and other non-biodegradable materials are dumped at the site of river banks which remain either floating on the water surface or cover the river bed substratum, creating a suffocating environment for the aquatic life. High level of pollutants in river water systems causes an increase in Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS) and Total Suspended Solids (TSS). These Physico-chemical characteristics in many ways have significant influence and impact on aquatic life.

Any alteration in these parameters may disturb the quality of water. Dissolved oxygen is of great importance to all the living organisms and is considered to be the sole parameter which to a large extent can reveal the nature of whole water body. Biological oxygen demand (BOD) also indicates the amount of organic compounds in water as measured by the volume of oxygen required by bacteria to metabolise it under aerobic condition. Chemical oxygen demand (COD) is a measure of reduced chemicals in water. It is commonly used to indirectly measure the amount of organic compounds in water. Water pollution also increases various microorganisms in water. This may cause an array of water borne diseases like Cholera, Hepatitis, Typhoid and Amoebic dysentery. Therefore, effective maintenance of water quality is required through appropriate measures.

MATERIALS AND METHODS

Water samples were collected twice before and after the MaghMela, from different river sites of Allahabad: Shastri Bridge (Ganga), Saraswati Ghat (Yamuna) and Sangam and transferred immediately to the laboratory for further processing.

Physicochemical analysis

The different physicochemical analysis were of pH, Turbidity, Total dissolved solids, DO, BOD and COD. They were measured by standard methods.

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Microbiological analysis

Bacteria were isolated by spread plating serially diluted sample on Nutrient agar plate. The isolated colonies were identified by Morphological, Cultural and Biochemical characteristics as given in Bergey's Manual of Systematic Bacteriology.

Cultural characteristics

Bacteria were identified on the basis of different colony characteristics like colour, consistency, margin, opacity, pigmentation and shape of colony on the culture plates.

Morphological characteristics

The isolates were picked from the plates for smear preparation and Gram's staining was performed.

Biochemical characteristics

The following biochemical tests were performed: carbohydrate fermentation test, oxidase test, H₂S production test, MRVP test, citrate utilization, catalase test, indole hydrolysis test, urease test, nitrate reduction test and starch hydrolysis test.

RESULTS AND DISCUSSION

Details of physicochemical analysis water analysis are present in Table 1 to 6 and Graph 1 to 4

Table 1. Physicochemical Parameters of Yamuna river water before Magh Mela at Allahabad

S.NO	Paramaters	Standard Parameter	Result
1	pH	6-8.5	8
2	Turbidity (NTU)	5.0	7.0
3	TDS (μ /litre)	1500	1600
5	DO (mg/litre)	>6	3.2
6	BOD (mg/litre)	4-6	13.8
7	COD (mg/litre)	<50	56

Table 2. Physicochemical Parameters of Ganga river water before Magh Mela at Allahabad

S.NO	Paramater	Standard Parameter	Result
1	pH	6-8.5	7.5
2	Turbidity(NTU)	5.0	8.0
3	TDS (μ /litre)	1500	1668
4	DO (mg/litre)	>6	3.1
5	BOD (mg/litre)	4-6	11.4
6	COD (mg/litre)	<50	72

Table 3. Physicochemical Parameters of Sangam water before Magh Mela at Allahabad

S.NO	Paramaters	Standard Parameter	Result
1	pH	6-8.5	8
2	Turbidity(NTU)	5.0	8.0
3	TDS (μ /litre)	1500	1650
4	DO (mg/litre)	>6	4.5
5	BOD (mg/litre)	4-6	14
6	COD (mg/litre)	<50	40

Table 4. Physicochemical Parameters of Ganga river water after Magh Mela at Allahabad.

S.NO	Paramaters	Standard Parameter	Result
1	pH	6-8.5	8
2	Turbidity (NTU)	5.0	7.5
3	TDS (μ /litre)	1500	1800
4	DO (mg/litre)	>6	2
5	BOD (mg/litre)	4-6	17
6	COD (mg/litre)	<50	60

Table 5. Physicochemical Parameters of Sangam water after Magh Mela at Allahabad

S.NO	Paramaters	Standard Parameter	Result
1	pH	6-8.5	8.5
2	Turbidity (NTU)	5.0	9
3	TDS (μ /litre)	1500	1900
4	DO (mg/litre)	>6	3
5	BOD (mg/litre)	4-6	15
6	COD (mg/litre)	<50	75

Table 6. Physicochemical Parameters of Yamuna water after Magh Mela at Allahabad

S.NO	Paramaters	Standard Parameter	Result
1	pH	6-8.5	9
2	Turbidity (NTU)	5.0	8
3	TDS (μ /litre)	1500	2000
4	DO (mg/litre)	>6	3
5	BOD (mg/litre)	4-6	15
6	COD (mg/litre)	<50	70

pH: Before Magh Mela pH was between 7-8, but after Magh Mela it was between 8-9.

Dissolved Oxygen:- Dissolve oxygen content of Yamuna river, Ganga and Sangam was found to be 3.2, 3.1 and 4.5 mg/l respectively, which was found very less as per the standard requirements i.e. 6 mg/l.

Biological oxygen demand (BOD):- B.O.D. content at above three sites was observed to be 13.8, 14 and 11.4 mg/l respectively, i.e. very high in comparison to the standard requirements of 4-6 mg/l.

Chemical oxygen demand:- C.O.D. was also found higher at three sites i.e. 56, 72 and 40 at Yamuna, Ganga and Sangam respectively as far as the standard requirements were concerned i.e. <50 mg/l. This variation in DO, BOD, and COD of the Yamuna river, Ganga and Sangam water was observed due to the high content of organic matter.

Microbial Analysis

Bacteria and Fungi

For microbiological analysis, total plate count technique and biochemical test were used to enumerate and identify the bacteria. For this, 1 ml serially diluted water sample of

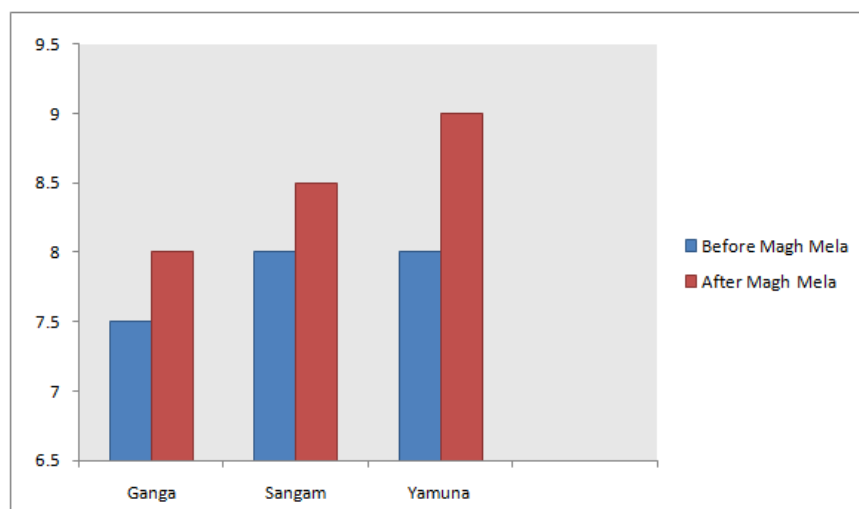


Figure.4.2.1 The above graph shows that all the water samples before the Magh Mela had pH within the permissible limit and only Yamuna water sample's pH was above the permissible limit after the Magh Mela.

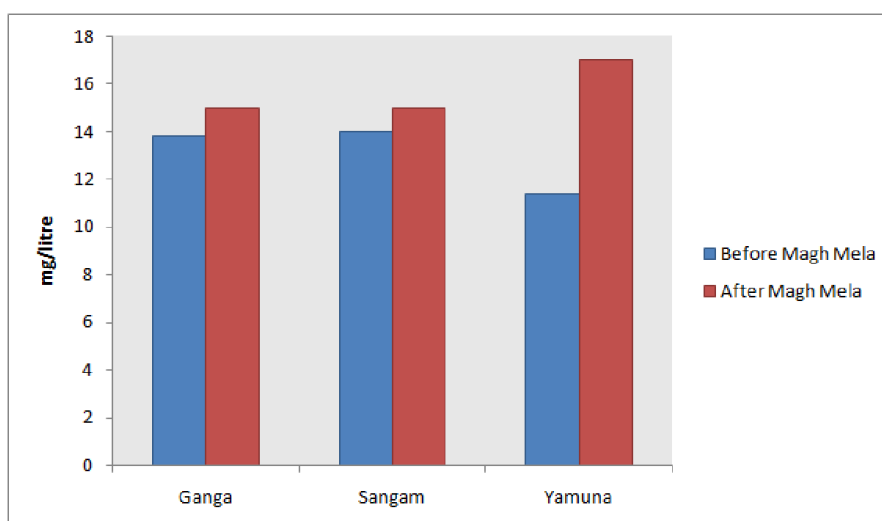
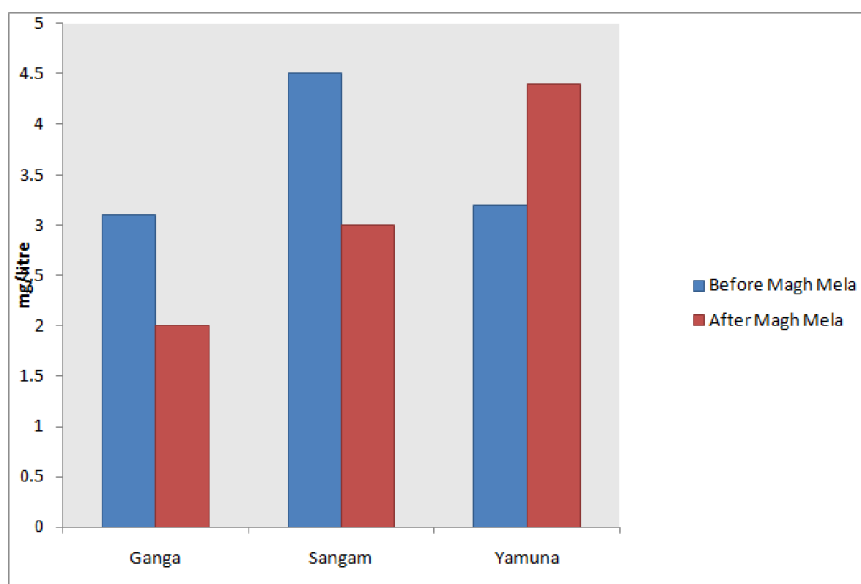


Figure.4.2.3 BOD of all the water samples was above the permissible limits before and after Magh Mela.

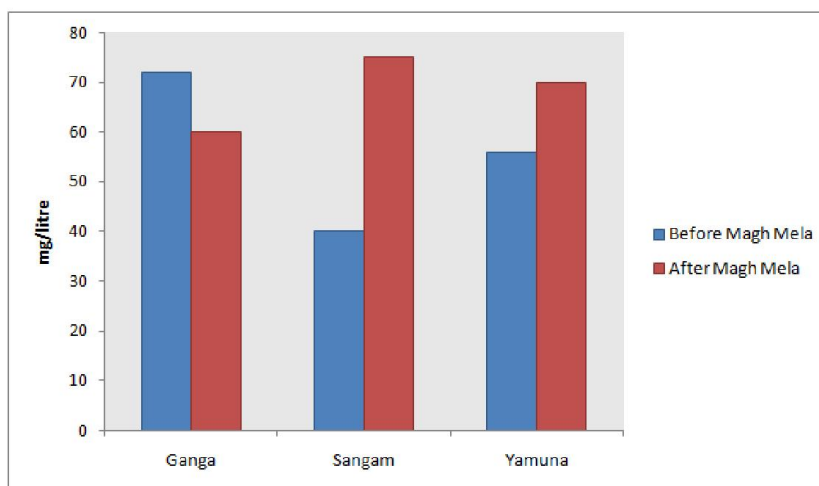


Figure.4.2.4 COD Except the water sample of the Sangam before the Magh Mela, the COD of all the water samples was above the permissible limits .

Yamuna, Ganga and Sangam was spread on Agar plate medium. After incubation at 37 °C for 24 hrs.the C.F.U. was calculated i.e. 4×10^4 colonies/ml. Isolated different microorganisms in Yamuna (*Nisseria mucosa*, *Nesseriaflavecens*, *Proteus mirabilis*, *Lactobacillus fermentum*), Ganga (*Nesseria mucosa*, *Proteousmirabillus*, *Lactobacillus fermentum*) and Sangam (*Bacillus cereus*, *Proteusmirabilis*, *Lactobacillus acidophilus*, *E.coli*) river water.

Conclusion

This study carried out in the month of January-May (2014) for which three rivers sites were chosen i.e. Ganga, Yamuna and Sangam in Allahabad. Water samples were collected from three monitoring stations viz. Shastri Bridge (Ganga), Swarwati Ghat (Yamuna) and Sangam in Allahabad. The samples were analyzed for physical, chemical and microbiological parameters.

The sample temperatures ranged from 7.8 - 28°C, pH from 7.02 - 8.16, turbidity from 1-15 NTU, DO from 6.3 – 10 mg/l, BOD from 1.4 - 4.5 mg/l., COD 11.4 to 35.2 mg/l and TDS 460 to 553 µg/l. Various microorganisms were isolated and identified during microbial analysis of these rivers water. Yamuna (*Nisseria mucosa*, *Nesseriaflavecens*, *Proteus mirabilis*, *Lactobacillus fermentum*,) Ganga (*Nesseria mucosa*, *Proteousmirabillus*, *Lactobacillus fermentum*,) Sangam (*Bacillus cereus*, *Proteus mirabilis*, *Lactobacillus acidophilus*, *Escherichia coli*) From the above physicochemical and microbiological parameters, it is clear that the Yamuna, Ganga and Sangam water is unfit for drinking, washing and irrigation also.

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