



Microbiological Screening of river Ganga before and after Shivratri

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Received: 20.07.2011

Accepted: 15.09.2011

Abstract

Rivers in India have been regarded from time immemorial as sacred water bodies. The holy Ganges flowing in the most populated northern India is also declared unfit for even bathing. The present investigation has been carried out to monitor the water quality of river Ganga. Water samples were taken from five different sites and were checked out for microbiological study by evaluating SPC. Later on enumeration, isolation and identification of bacteria was done. Sensitivity tests were also carried out. The results obtained after performing the experiments indicates that the water in the tested stretch is unfit for both bathing and drinking purposes.

Keywords: *Ganga, microbiological, monitor, river, sacred, SPC*

Introduction

Water is a prime natural resource and is a basic need of life. The water is available abundantly in nature. The water covering about 75% of earth's crust. Water is found in everything in different forms. It is an essential component of all cellular organism.

The main problem now a days before the world is of safe drinking water which is affected due to various pollutants in different proportion, alteration in physical, chemical and biological characteristics of fresh water due to human activities which ultimately cause harmful effects on human beings and aquatic biota. The underlying assumption in traditional water resource planning process still continues. Fresh water is a gift of god which could continue to be available in perpetuity and in abundance. This is not valid as both quantity and quality of water pose serious problems (Kaul *et al.*, 1999).

The river Ganga occupies unique position in the cultural ethos of India. Even today, people carry treasured Ganga water all over India and abroad because it is "holy water" and known for its "curative" properties (Sharma, 1997). The holy Ganges flowing in the most populated northern

India is also now declared unfit even for bathing (Pandey *et al.*, 2005).

During recent years due to the urbanization and industrial growth, the quality of Ganga water has deteriorated considerably. Due to increasing pollution, chemical contents of the water have gone over eight to nine units beyond the permissible limit of seven units. Besides this the water is becoming saline and flow of Ganga is slowing down gradually. According to scientists of the Pollution control research institute (PCRI) in their study warned that unless steps are taken in time, Ganga will become unfit for use (Agarwal, 1992). At Haridwar thousand of pilgrims washing away their sins in the Ganga everyday, considerable deterioration has been witnessed in the quality of water during peak bathing hours. Ganga is not only polluted by bathing but also by garbage. At Haridwar Central Pollution Control Board puts the figure at 17.5 million litre of waste dumping per day in Ganga (Banerjee, 1987) several pathogenic microorganisms enters into the water body which cause harmful effects and chronic diseases in man and animals. The bacteria, viruses and protozoa may begin to grow on sewage under anaerobic conditions. This may cause the spread water borne disease like viral hepatitis, polio, cholera, dysentery, typhoid, amoebiasis, giardiasis etc. such activities are increased many folds on the occasion

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of festivals. Due to mass bathing Ganga water becomes highly polluted and many water borne diseases spread rapidly.

Ganga water has significance due to its self purification capacity. So Ganga water considered as “Holy” water due to its purification property. Ganga water has self purification property as the bacteria degrade or decompose everything in Ganga ecosystem. Velz (1947) explained the process of recovery and self purification capacity of river.

Material and Methods

The study was conducted on Ganga water at five different sites in Haridwar before and after Shivratri festival. The five different sites selected for collection of water were:-

Site I -Har Ki Pauri, which is the main place of ‘Ganga Snan’ during the festival.

Site II -Prem Nagar Ghat, which is 4.5 km from Site I

Site III -Daksh Mandir, which is 7 km from Site I

Site IV -Singh Dwar Ghat, which is 5 km from Site I

Site V -Jatwara Pul Ganga Canal, which is 8 km from Site I

Sampling Procedure

The sterilized sampling bottle were held at its base by hand and dipped in to the water with its neck downwards upto 6 inches below the water surface and then its mouth was opened inside the water and removing its stopper against its flow. The bottle was filled completely and about 10% of the volume of bottle was left unfilled, the mouth of bottle was closed inside the water.

Analysis of water

Water was analysed for Microbiological study (SPC). Bacteria were isolated and identified and then sensitivity tests were carried out against multidisc antibiotics.

Isolation and identification

Isolation of bacteria was carried out by serial dilution method. The bacteria were identified with the help of Gram staining and biochemical tests as described in Bergey’s manual of Systematic Bacteriology (Holt *et al.*, 1994).

Antibacterial sensitivity test

The susceptibility test was carried out by Disc diffusion method (Bauer *et al.*, 1966)

Results and Discussion

The numbers of bacterial colonies obtained in Ganga water before and after festival are tabulated in table 1 and 2. The number of bacterial colonies obtained in Har Ki Pauri were 145 ± 0.67 CFU before shivratri and 172 ± 0.54 CFU after Shivratri. In Prem Nagar Ghat the number of colonies were 132 ± 0.14 CFU before Shivratri and 154 ± 0.10 CFU after Shivratri. In Daksh Mandir the number of colonies were 148 ± 1.65 CFU before Shivratri and 161 ± 0.73 CFU after Shivratri. In Singh Dwar Ghat the number of colonies were 141 ± 0.54 CFU before Shivratri and 157 ± 1.32 CFU after Shivratri. In Jatwara Pul Ganga Canal the number of bacterial colonies were 137 ± 0.47 CFU before Shivratri and 146 ± 0.02 CFU after Shivratri (Table-1).

Bacteria were identified on the basis of Gram’s staining, their morphology, cultural characteristics and biochemical characterisation. There were large number of bacterial colonies obtained like *Bacillus* sp, *E.coli*, *Micrococcus* sp., *S. aureus*, *Serratia* sp. etc. some of the bacteria were pathogenic while others were found as non-pathogenic.

The most abundant bacterial colonies after shivratri festival was *Micrococcus* sp. It was observed by the data that non-pathogenic bacteria was generally present in the Ganga water but after festival usually pathogenic bacteria such as *S. aureus* and *Bacillus* sp. were increased in the water due to arrival of large number of pilgrims who took bath in the holy river Ganga and washing away their sins in the Ganga (Table-2).

During the study activity of different antibiotics and chemotherapeutic drugs on *Bacillus* sp., *E.coli*, *Micrococcus* sp., *S. aureus*, *Serratia* sp. following results are obtained –

The zone of clearance of *Bacillus* sp. to various antibiotics and chemotherapeutic agents are as follows –

Ofloxacin > Ciprofloxacin > Tetracycline > Roxithromycin > Pefloxacin > Gentamycin > Cephalixin > Cefotaxime. The isolate was completely resistant to Co-trimoxazole, Amphotericin, Cloxacillin and Lincomycin.

The zone of inhibition of *E. coli* to various Antibiotics and chemotherapeutic agents are as follows –

Ciprofloxacin > Amphotericin > Tetracycline = Chloramphenicol > Gatifloxacin > Cefotaxime > Amikacin = Ofloxacin. The isolate was completely



resistant to Piperacillin, Co – trimaxazole, There is no zone of clearance in *Micrococcus* sp. therefore it shows resistance against all the antibiotics and chemotherapeutic agents. The zone of inhibition of *S. aureus* to various antibiotics is as follows: -

Gentamycin > Pefloxacin > Ofloxacin > Ciprofloxacin > Roxythromycin > Cefotaxime = Lincomycin > Tetracycline > Cloxacillin > Cephalixin.

ceftizoxime and Gentamycin.

The isolate was completely resistant to Ampicillin and Co-trimaxazole.

The zone of inhibition of *Serratia* sp. to various antibiotics is as follows:

Amphotericin > Ciprofloxacin = Gatifloxacin > Tetracycline > Cefotaxime = Ofloxacin > Chloramphenicol > Co-trimaxazole = Amikacin. The isolate was completely resistant to Piperacillin, Ceftizoxime, Gentamycin. (Fig 1-4, Plate-1)

Table-1: Bacterial Population in Ganga Water Before & After Shiv Ratri Festival

S. NO	SITE	COLONY FORMING UNIT (CFU) \pm	
		Before Festival	After Festival
1.	HAR-KI-PAURI	145 \pm 0.67	172 \pm 0.54
2.	PREM NAGAR GHAT	132 \pm 0.14	154 \pm 0.10
3.	DAKSH MANDIR	148 \pm 0.65	161 \pm 0.73
4.	SINGH DWAR GHAT	141 \pm 0.54	157 \pm 1.32
5.	JATWARA PUL GANGA CANAL	137 \pm 0.47	146 \pm 0.02

\pm = Standard error

Table-2: Bacterial Population(CFU) of Individual Bacteria Before & After Shiv Ratri Festival

S.NO.	Isolated Bacteria	Har Ki Pauri		Premnagar Ghat		Daksh Mandir		Singh Dwar Ghat		Jatwara Pul Ganga Canal	
		BS	AS	BS	AS	BS	AS	BS	AS	BS	AS
1.	<i>Bacillus</i> sp.	28	35	28	24	33	27	-	24	-	28
2.	<i>E.coli</i>	37	41	35	40	37	38	42	40	33	38
3.	<i>Micrococcus</i> sp.	56	68	55	63	56	61	58	64	57	62
4.	<i>S.aureus</i>	11	14	-	15	12	24	20	17	31	-
5.	<i>Serratia</i> sp.	8	12	11	12	-	7	14	12	14	10
6.	Unidentified	5	2	3	-	10	4	7	-	2	8

BS = Before Shiv Ratri
AS= After Shiv Ratri



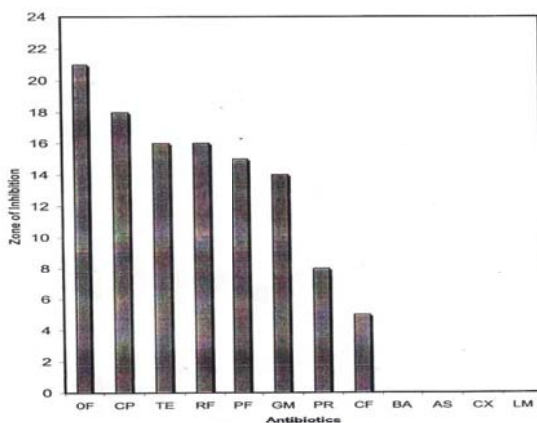


Fig. 1. Showing sensitivity pattern of *Bacillus* spp. against different antibiotics.

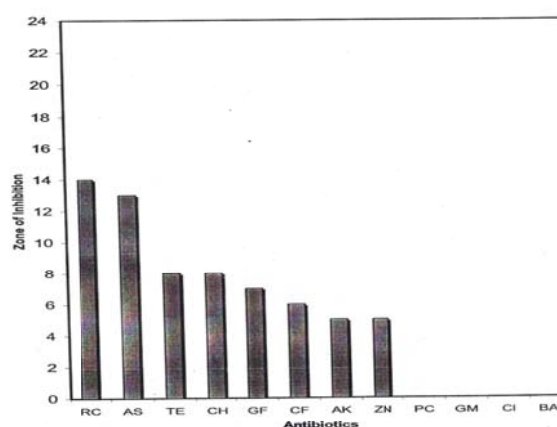


Fig. 2. Showing sensitivity pattern of *E. Coli* against different antibiotics.

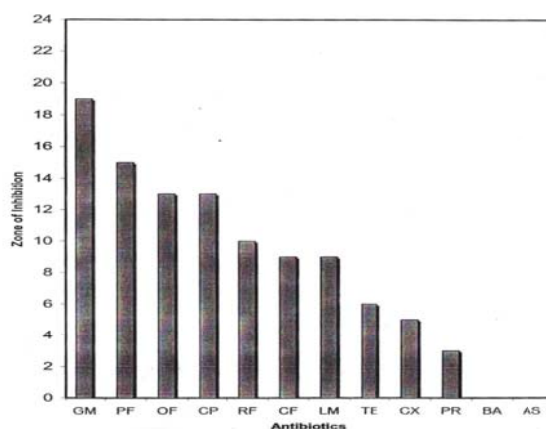


Fig. 3. Showing sensitivity pattern of *S. aureus* against different antibiotics.

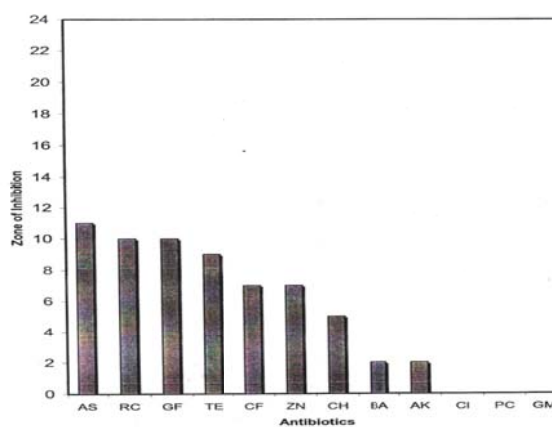


Fig. 4. Showing sensitivity pattern of *Serretia* Spp. against different antibiotics.

Standard plate count (SPC) technique enumerate the total population of bacteria present in water. The total bacterial population may include many pathogenic and non-pathogenic bacteria in addition to the coliform group. Total bacterial count of 100 colonies / ml. of water is acceptable but the test sample showed the striking higher population after festival between 146-172 colonies/ml. It indicates towards the height of microbial population in the holy river due to large number of pilgrims who took bath in Ganga during festivals and due to domestic and industrial disposal.

A total of 43 different bacterial species were obtained in Ganga water, which were distributed in 24 genera. Of these 31 species were isolated from Alaknanda, 25 from Bhagirathi and 28 from Lower Ganga in Uttarakhand (Sood *et al.*, 2010).

Many pathogenic bacteria are found in Ganga water which cause serious disease in all living beings e.g. *Bacillus* sp. *E.coli*, *S.aureus* and some non-

pathogenic bacteria like *Micrococcus* sp. and *Serretia* sp. are also found.

Bacillus sp. is a Gram +ve bacteria. It can cause food borne gastroenteritis. Some species may be responsible for opportunistic infection. It is found at all the sites but its population is increasing after shivratri mainly at Har Ki Pauri and Daksh Mandir during peak bathing hours.

E. coli is Gram -ve bacteria. It causes urinary tract infection, diarrhoea, pyrogenic infection and septicemia etc.

Micrococcus sp. is found at all the five sites of Ganga water before and after Shivratri almost in equal amount, is a Gram Positive non-pathogenic bacteria.

S. aureus is also a Gram positive bacteria and is responsible for skin allergy and throat infection. Highest population of *S. aureus* is found after Shivratri at Daksh Mandir.

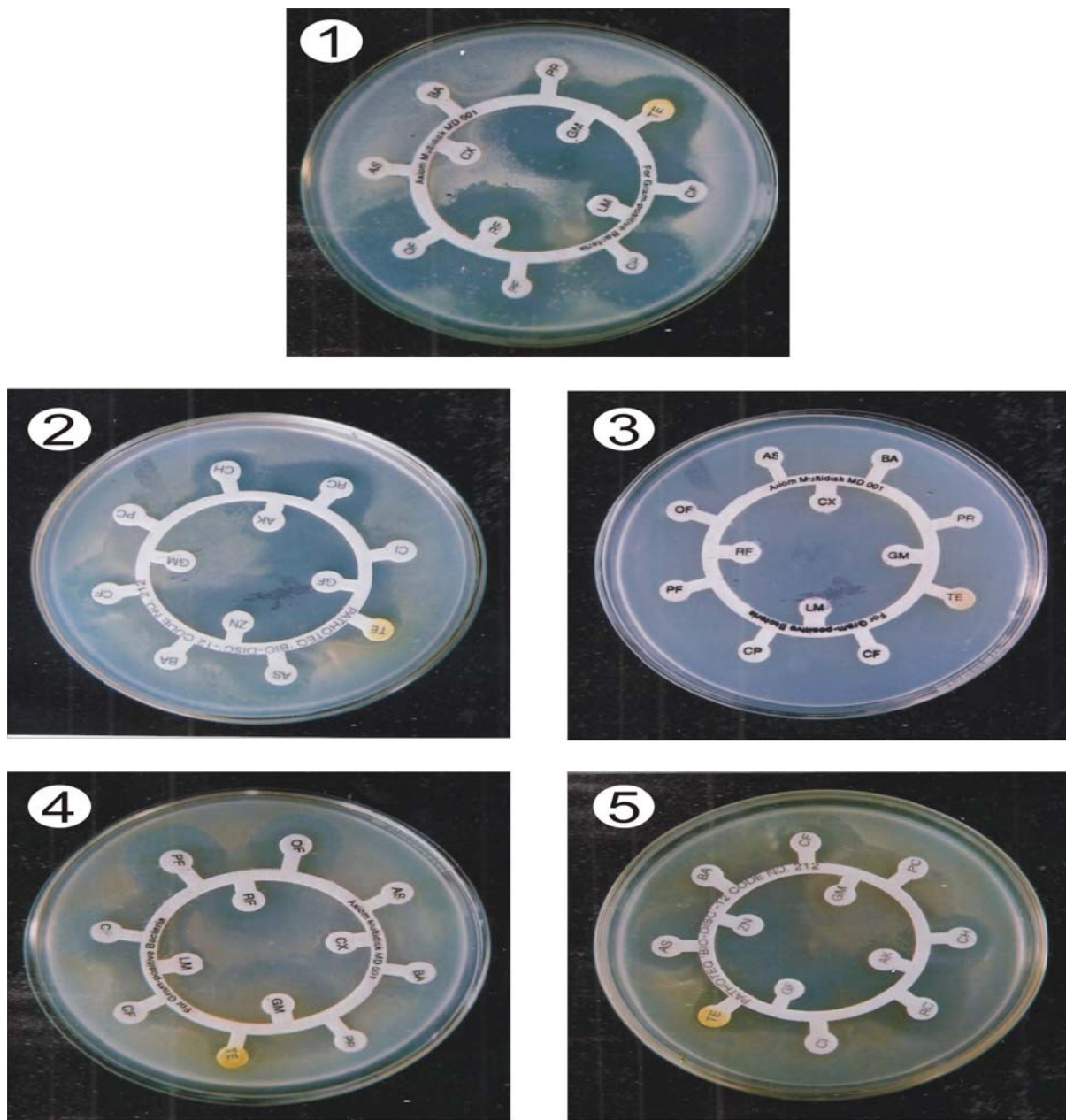


Plate 1 – Zone of inhibition exhibited by different antibiotics :
1. *Bacillus* sp., 2. *E.coli*, 3. *Micrococcus* sp.,
4. *S.aureus*, 5. *Serratia* sp.

Serratia sp. is found in Ganga water at very lowest amount. It is a Gram -ve and non-pathogenic bacteria.

The study of different antibiotics and chemotherapeutic drugs were tested against isolated bacteria. *Bacillus sp.* showed maximum zone of inhibition was about 21mm against the antibiotic

Ofloxacin.

E. coli showed maximum zone of inhibition was about 14mm against Ciprofloxacin.

In Case of *S. aureus* the some of inhibition was maximum about 19mm against Gentamycin.

Amphicillin gave best results in case of *Serretia sp.*, the zone of inhibition was maximum about 11.



Conclusion

From the present study it can be concluded that large number of bacteria are present in Ganga water and showed resistance against some antibiotics and chemotherapeutic agents. The main source of pollution includes urban liquid waste discharge, Industrial liquid waste discharge and large scale bathing of local pilgrims, cattle, throwing of dead bodies in the river, mass bathing during festival and many others.

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