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PHYSICO-CHEMICAL AND BACTERIOLOGICAL EXAMINATION OF RIVER THE GANGA AROUND SHEORAPHULI, HOOGHLY, W.B., INDIA

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ABSTRACT

Physicochemical properties and bacterial load in the river Ganga at Sheoraphuli, Hooghly, West Bengal, India were studied. The water temperature fluctuated depending on aerial temperature viz. 15°C (December) to 32°C (May). Mean pH of the water was 7.2, alkalinity was 42-185 mg/L and changed throughout the year. The BOD and dissolved oxygen were maximum (3.4 mg/L and 9.8, respectively) in the winter and minimum (7.3 mg/L and 3.8, respectively) in the summer. Total suspended material varied from 104 mg/L in winter (Check?) to 725 mg/L in summer. Total hardness increased gradually from 49.5-74.5 mg/L from October to June. The chloride (15-19 mg/L) and iron (0.37-0.50 mg/L) contents of the river Ganga fluctuated in different seasons. MPN index of the coliform bacteria was more than 920 bacteria/100 mL. Coliform count (cfu /mL) ranged from 5.8 x105 to 4.7 x105/ mL during the study period i.e. the mean number was 6.9 x 105/ mL. Nevertheless, higher coliform load revealed that the water of the Ganga river at Sheoraphuli region is not potable.

INTRODUCTION

Water pollution caused by organic, inorganic and biological constituents is the main reason for about 80% of the water-borne human diseases like diarrhoea, cholera, typhoid etc. and more than 50% of domestic water supplied from ground water and the surface is not considered to be potable in India (Kumaresan and Bagavathiraj 1996; Dahiya and Kaur 1999; Jeyabalan *et al*. 2002). Industrial or municipal wastes and agrochemicals are creating a major problem to the aquatic bodies. The water-suspended solids, dyes, heavy metals, bio-degradable chemicals, detergents, alkali, salts etc. result in harmful changes of water resources, causing eutrophication and undesirable changes for biological activities (Fresenives *et al*. 1983; Katayal, 1991, Kumaresan 1996). The Ganga is the great river in India being important source for domestic, agricultural, aquacultural and industrial purposes. Effluents from industries and different cities are continuously being discharged in the river-water and to make the contamination and pollution. Therefore, the study was undertaken to evaluate the water quality i.e. physico-chemical properties and bacteriological load of the Ganga in and around Sheoraphuli, Hooghly, West Bengal, India.

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MATERIALS AND METHODS

Water samples were collected (one ft below the surface) in clean 2 litre polyethylene bottles from the Ganga at Sheoraphuli, Hooghly, West Bengal, India at monthly intervals between May 2008 to April 2009 in the morning between about 7–10h and stored at 4±0.1°C in a refrigerator for water quality analysis (APHA 1998). At the same time, water samples were collected in autoclaved (15 lbs/sq. in, 15 min) 500 mL bottles and preserved at 4±0.1°C in a refrigerator for bacteriological analysis (APHA 1998). The water samples were analyzed for physical, chemical and water quality parameters and the coliform bacteria and other microbiological studies were done using standard methods (Trivedy and Goel, 1984; Manivasakam 1987, APHA 1998).

Presumptive test

For the presumptive test of coliform bacteria, aliquots (10, 1, 0.1 mL) of water were added to 10 ml lactose fermentation broth (20 g/L lactose and bile salt to suppress the non-coliform bacteria) containing an inverted gas vial (APHA 1998). Each inoculum level was designated as a group. For each group 5 replicated tubes were taken. The three groups were designated as series. Three such separate series were set up i.e. each group had a total of 15 tubes. Development of gas in any of the tubes was presumptive evidence of the presence of coliform bacteria in the sample (APHA 1998). The MPN was estimated by determining the number of tubes in each group that formed gas according to APHA (1998).

Confirmed test

The confirmed test was done on eosin methylene blue (EMB) agar medium (Composition (g/l): Peptone10, Lactose 5, dipotassium phosphate 2, eosin Y 0.4, Methylene blue 0.065, agar–15, distilled water 1000 mL). A loopful of the sample of positive presumptive test was streaked and incubated for 48h at 35±0.1°C. The coliform colonies formed a dark centers and a green metallic sheen characteristic for *Escherichia coli*, the main indicator of fecal pollution.

Completed test

An isolated colony was picked up from the confirmatory test plate and inoculated into a tube of lactose broth containing Durham's tube, as well as, streaked on a commercial (Himedia, India) nutrient agar (NA) (20g/L) slant and incubated at 35±0.1°C for Gram staining. Acid and gas production in the lactose broth and presence of Gram (–)ve short rod shaped bacteria (observed under a phasecontrast microscope) confirmed of presence of the *E. coli*.

RESULTS AND DISCUSSION

Water temperature of the river varied every month according to aerial temperature (Table 1). Minimum temperature was 15°C in December and maximum temperature was 32°C in May (Table 1). Water pH varied between 6.6-7.6 during May-January and between 6.7-7.4 during February to April (Table1) and mean pH of water was 7.2 (Table1). According to the international standard (WHO 1993), the pH for drinking water and maximum permissible level for domestic use accepted by ICMR is 6.5 which indicated that the pH of the water is safe for use. Alkalinity of the water varied from 42-185 mg/L (Table1). Alkalinity of the water would be dependent on the carbonate and bicarbonate levels (Abubacker et al. 1996). The total suspended solid was 104 mg/L in May and 725 mg/L in the rainy season (Table 1) which might be due to sedimentation in the former and input of soil by land washing in the later period. The lower suspended solids in the summer would be due to lesser turbulence of water resulting in settlement of the soil particles. The dissolved oxygen level varied from 3.8-9.8 which was maximum in the winter and minimum in the summer and supported the results of the dissolved oxygen level in this region f the Ganga. Higher dissolved oxygen content in winter was probably due to low water temperature and increased phytoplankton and microbial load favoured by the prevailing pH, oxygen and temperature. The BOD indicates pollution level and quality of water which changed from 3.4-7.3 mg/L in July and May, respectively (Table 1).

Table 1. Monthly changes of the physico-chemical and coliform microbial population in the Ganga river at Seoraphuli region.

Parameter	Measurements
Temperature	Max.-32°C; Min.15°C
pH	6.6-7.6
Alkalinity	42 mg/L - 185 mg /L
Total suspended solids	104 mg/L - 725 mg/L
Dissolved oxygen	3.8 - 9.8
Chloride	15mg/mL-19 mg/L
Total hardness	49.5 - 74.5 mg/L
Iron	0.37mg/L - 0.50 mg/L

According to WHO (1993), 6 mg/L BOD indicates minimum pollution and according to Central Pollution Control Board, India, BOD should be more than 8 mg/L for drinking and bathing. Thus the BOD results suggest that the Ganga water would be acceptable for domestic purposes. The chloride content was lower in October (15 mg/L) and more in June (19 mg/L) (Table1). It showed upward trend from the winter to summer. The chloride imparts salty taste at above 250 mg/L level (Dahiya and Kaur 1999). The results revealed that the chloride level was within the permissible limit (200mg/L) (Dahiya and Kaur, 1999). Total hardness i.e. Ca and Mg content of water varied from 49.5–74.5 mg/L (Table1) which increased gradually from October–June but was within the permissible limits (APHA 1998). Iron load of the Ganga water ranged from 0.37mg/L in July to 0.50 mg/L in December (mean 0.41mg/L) (Table1) which was within the permissible limit (0.3–1 mg/L) of the international standard for drinking water (WHO 1993). Nevertheless, ICMR recommended a higher level i.e. 0.1–1 mg/L iron content for domestic use which was satisfied by the Ganga water of this region also. The coliform bacteria are biological indicators of water pollution (Atlas and Bertha, 1997; Patralekh, 1991, Bonde, 1977 and Garode *et al*. 1998). Most probable number (MPN) of the coliform bacteria in the Ganga water at the Sheoraphuli region of West Bengal was more than 920 bacteria/100 mL. Bacteriological examination indicated the presence of coliforms ranging from 5.8 x105 to 4.7 x105/ mL during the study period i.e. the mean number was 6.9x105/mL. Nevertheless, higher coliform load revealed that the water of the Ganga river at Sheoraphuli region is not potable.

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