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ASSESSMENT OF GANGA RIVER WATER AT DIFFERENT LOCATIONS AND ITS SUITABILITY FOR DRINKING PURPOSES

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Abstract: An attempt has been made in this study to evaluate the surface water quality of Ganga river at different locations. They were analyzed for a total of 14 physio-chemical parameters. In addition to these elements, 05 heavy metals, namely, Cd, Pb, Zn, Cu and Cr. The results showed that all samples were observed colourless, odourles and neutal to pH. Another physico-chemical parameters showed below the permissible limit as prescribed by WHO and BIS standards. The concentration of heavy metals observed in majority of samples within permissible as per described by WHO and BIS guideline. The water is acceptable due to below the concentration of heavy metals. It is suggested that regular monitoring is required to determine the pollution load with improve the water quality, which is being used for drinking purpose.

Keywords: Ganga, River, Water, Metals

INTRODUCTION

Ganga, the mighty Indian river originates from the snowed peaks of Himalayas, is the lifeline of millions of Indians. From its source to its entry in to the Bay of Bengal, it travels a distance of around 2525 Kms. The river with its well knit tributaries drains the Ganga Basin which encompasses an area of more than a million square kilometers. (1060,000 sq km) spread over four countries- India, Nepal, Bangladesh and China (Chapekar and Mahatre, 1983). Domestic sewage is the major cause of contamination in the Ganga river. According to the CPCB, 2,723 million litre a day (MLD) of sewage is generated by 50 cities located along the Ganga river, which adds up to over 85 percent of the river's pollution load *(Source: CPCB 2013, Pollution Assessment: River Ganga, Central Pollution Control Board, MoEF, July)*. Rapid industrialization, profuse use of fertilizers, heavy sewage effluents in agricultural land, domestic waste, medicinal waste and other anthropogenic activities on the ground also led to the deterioration of surface water quality (Jain *et al.* 2010, Gupta *et al*, 2012 and Sharma and Uniyal, 2013). These activities increase in the level of metal concentration in soil and water is significantly exceeding from those originating from the natural resources. River Ganges is considered to be the most pious river of India and its water used as drinking as well as aesthetic purposes. River Water quality monitoring is necessary especially where the water serves as drinking water sources, are threatened by pollution resulting from various human activities along the river course . The majority of the Ganga pollution is organic waste, sewage, trash, food, and human and animal remains (Chopra, 1990). Drinking water quality has emerged as major issue requiring immediate attention. Hence, regular monitoring of water quality is necessary to determine the pollution level of surface waters. Among the heavy metals, Cadmium and Lead are most dangerous to health (Bryan and Langston, 1992). Cadmium is one of the most toxic metal compounds released into the environment (Kungolos *et al.*, 2001). Cadmium can cause cancer; Lead can cause brain and bone damage (WRI, 1987). An estimated 1.3 billion people living in per capita low income countries do not have access to safe drinking water (UNDP-HDR 2006).

In this paper we have reported an assessment of the water quality of Ganga river at different locations based on phyico-chemical and heavy metals namely cadmium, copper, lead and zinc and their suitability for drinking purposes.

MATERIAL AND METHOD

Three sources of Ganga river water namely Shukratal, Distict- Muzaffarnagar, (site no.1), Garh, District- Hapur, (site no.2), and Annopshahr, District- Bulandshahr (site no.3), were selected as water sampling sites (Table 1 & 2). The collected samples were kept in air tight plastic ice-cold container and were transported with 5 hrs of the collection for further processing. In lab all samples were stored at low temperature. The physical parameters such as colour, odour, pH, turbidity, electrical conductivity (EC) and temperature were measured in the sites using water and soil analysis kit (Electronics India, Model 16 E) and rest of the characteristics of water samples were measured in the laboratory. Dissolved oxygen, BOD, COD, calcium (Ca2+), magnesium (Mg_2^+) Chloride (Cl^-), sulphate (SO_4^-), sodium (Na^+) and potassium (K^+) were estimated using standard procedures [10]. To ensure accuracy analysis was done in triplicates and mean value was taken into consideration. The samples were also analyzed for level of toxic ion like Cadmium, Lead, Zinc, Copper and Chromium by described method of (APHA, 2005).

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RESULT AND DISCUSSION

The detailed discussion of analyzed physico-chemical characteristics of collected water samples from different location is presented under the Table 1 & 2. These results are also compared with WHO (2006) and Bureau of Indian Standard (BIS 10500, 2012) recommended for drinking purpose. All three samples collected from different locations were observed colorless and odorless. The pH values ranged from 7.5-7.8 and it was maximum observed from the water collected from Garh (Hapur). The pH values in all drinking water sources were found within the recommended limit of WHO and BIS as 6.5 to 8.5. Turbidity varied from 32-42NTU and all samples it was more than the permissible limit as prescribed by WHO and BIS standards. EC has a wide applicability with respect to drinking point of view high conductivity denotes proportionately high value of calcium, magnesium, sodium and potassium. In the present study, all samples showed more EC as prescribed the limit. Dissolved oxygen varied from 1.86-2.46 Mg/l and it was maximum analyzed from the water collected from Shukratal. All samples showed, the dissolved oxygen concentration more than permissible limit as per recommended by WHO. Chloride in the water samples ranged between 14.56-17.88 Mg/l and the maximum concentration was noted from the water sample collected from Annopshahr site. Chloride occurs in all natural waters in widely varying concentration. Chloride normally increases as the mineral contents increases (Duvey, 2003). Water containing more than 250 mg/l of Cl- ion has salty taste. In our study, chloride concentration remains well within the prescribed limit as prescribed by WHO. The concentration of sulfate varied from 11.52-12.40 mg/l and all samples were within the specified limit. Sulfate causes gastrointestinal irritation if exceeded 250 mg/l level (Raghunath, 1987). The excess of sulfate (more than 250 mg/l) may also reason bitter taste and may have laxative effect to human beings and livestock at further higher level (WHO, 1984).Very high levels of sulfates have been associated with some brain disorders in livestock. The range of sodium found in between 1.46-2.00 Mg/l and all samples it was below the permissible limit as described by WHO. The values of potassium were confined between 1.68-2.14 Mg/l in water samples collected from different locations. WHO have prescribed the limit for potassium ions in drinking water is 12.0 Mg/l. All samples the concentration of potassium was observed under permissible limit It is useful for total ionic balance as well as important nutrient for human body. The high level of these parameters might be due to that the river has been under constant threat of pollution by sewage and industrial waters, disposal of dead bodies, deforestation, excessive use of fertilizers and pesticides, bathing, pilgrims and water development programmes(Khare et al, 2011). Similar findings were reported by Tyagi and Singh (2012) in Ganga water.

The heavy metal concentration of the surface water samples is given in Table 2. These results are also compared with WHO (2006) and Bureau of Indian Standard (BIS 10500, 2012) recommended for drinking purpose. The cadmium concentration varied in the range from BDL-0.002 Mg/l. WHO have prescribed the limit for cadmium in drinking water is 0.003 Mg/l. All samples the concentration of cadmium was observed within permissible limit as prescribed by WHO and BIS. Lead values ranged 0.006-0.008 and it was maximum observed from the water sample collected from Shukratal site. It is pertinent to note that in this study area, lead in almost all samples showed within the permissible limits. The concentrations of zinc (Zn) and coppers (Cu) ranged between 2.8-7.50 Mg/l and BDL to 0.04 Mg/l respectively in all sampling site. Zn concentration was quit more than the permissible limit as per recommended by WHO and BIS. Chromium (Cr) concentrations in all samples were also more the standard limits, varying from BDL-0.04 Mg/l and all samples showed its limit within the permissible limit. The study also revealed that there was a dramatic increase in the concentration of heavy metals at almost all sampling sites. The heavy metals in Ganga river water might be due to organic waste, sewage, trash, food, excessive use of fertilizers and pesticides, bathing, pilgrims, human and animal remains. Similar report has been reported by Chopra, 1990 and Goswami and Singh, 2014).

Table 1. Physio-chemical analysis of Ganga river water at different locations

S.N.	Parameters analyzed	Units	Shukratal	Garh	Anoopshahr
1.	Colour	-	Colourless	Colourless	Colourless
2.	Odour	-	Odourless	Odourless	Odourless
3.	pH	-	7.5	7.8	7.7
4.	Turbidity	NTU	32	35	42
5.	Conductivity	µScm–1	185	194	192
6.	Dissolved oxigen	Mg/l	2.46	2.20	1.86
7.	BOD	Mg/l	1.86	2.12	2.54
8.	COD	Mg/l	210	380	420
9.	Calcium	Mg/l	10.50	13.96	15.82
10.	Magnesium	Mg/l	1.20	1.45	1.54

11.	**Chloride**	**Mg/l**	**14.56**	**17.24**	**17.88**
12.	**Sulphate**	**Mg/l**	**11.52**	**11.98**	**12.40**
13.	**Sodium**	**Mg/l**	**1.46**	**1.85**	**2.00**
14.	**Potasium**	**Mg/l**	**1.68**	**1.86**	**2.14**

Table 2. Heavy metals analysis of Ganga river water at different locations

S.N.	Parameters analyzed	Units	Shukratal	Garh	Anoopshahr
1.	**Cadmium (Cd)**	**Mg/l**	**0.002**	**BDL**	**0.002**
2.	**Lead (Pb)**	**Mg/l**	**0.008**	**0.006**	**0.007**
3.	**Zinc (Zn)**	**Mg/l**	**2.8**	**4.24**	**7.50**
4.	**Copper (Cu)**	**Mg/l**	**BDL**	**0.04**	**BDL**
5.	**Chromium (Cr)**	**Mg/l**	**0.01**	**BDL**	**0.04**

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