

A comparative study of quality of river waters in the city of Allahabad, U.P., India

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River water was assayed in the city of Allahabad. Amongst the parameters used were BOD, DO, pH, conductivity and heavy metals, viz., Cu, Cd, Cr, Fe, Zn, Pb, Ni, Mn. Site specific water samples were collected from the ghats of Ganga, Yamuna, Sangam and subjected to analysis. Physico-chemical characteristics of the water samples indicated a lower level of pollution in the water of Yamuna river whereas the confluence (Sangam) was found to be most polluted.

Key words : Physico-chemical, Heavy metals, Water samples, Pollution.

INTRODUCTION

Rivers are the most important water resource, but unfortunately the water quality of rivers is getting worse with the demand of water for domestic, municipal, agricultural and industrial purposes. Pollution of river first affects its physico-chemical quality and then systematically destroys the community, disrupting the delicate food web.

The waste water quality is conventionally assessed in terms of pH, DO, BOD and bacterial count (APHA *et al.*, 1992). The chemical criteria of water quality as suspended and dissolved solids, pH, electrical conductivity, DO and several cations were determined periodically at a number of representative sites (Reevan, 1999). The increasingly high percentage of heavy metals in waste sewage and the continuous use of these waste waters for irrigation results in the increment of the top soil with heavy metals (Larson *et al.*, 1975). Copper (most common among the heavy metals) is toxic to aquatic lives in trace amounts, if present in the water system (Moore and Ramamoorthy, 1984). Chromium is discharged into water through the effluents from tanneries, electroplating, textiles, mining etc., concentrate in the tissues of aquatic biota and is known for its deleterious effects (Abassi *et al.*, 1995). The total blood cholesterol, serum, acid and alkaline phosphatase levels increased significantly at all the concentrations of Cadmium with time (Srivastava *et al.*, 1993). The present study, which is a first attempt, was carried out to find out the impact of physico-chemical characteristics on the water quality of Ganga, Yamuna and Sangam.

MATERIALS AND METHODS

Samples of water were collected from the sites of Ganga, Yamuna and Sangam in sterilized polypropylene capped bottles. The collected samples were kept in ice-cold condition, brought to the laboratory and analyzed for various physico-chemical parameters by the standard methods. BOD, DO, pH and conductivity of water was done as per standard methods (APHA *et al.*, 1992; Trivedy and Goel, 1984). The metal concentration in water was determined by atomic absorption spectro-photometer using conventional flame.

RESULTS AND DISCUSSION

The values of BOD and DO are presented in Table. 1 which showed that the BOD was found to be maximum and the DO was minimum in the water samples obtained from Sangam. In case of Yamuna river, BOD value was lowest while DO value was highest. This indicates that the density of aquatic organisms is more at the Sangam site and less at the site of Yamuna river.

Table 2 shows the values of conductivity and pH.

Source	BOD	DO
Ganga	5.6 ± 0.2	7.8 ± 0.2
Yamuna	3.5 ± 0.2	8.5 ± 0.2
Sangam	6.5 ± 0.2	5.3 ± 0.2

All values shown are Mean ± S.D. of 3 replications, Values are obtained after deduction from blank sample. BOD (Biological Oxygen Demand) and DO (Dissolved Oxygen) are expressed as mg lit⁻¹.

Table 2 : Conductivity and pH of river waters

Source	Conductivity	pH
Ganga	$4.6 \pm 0.2 \times 10^{-3}$	8.8 ± 0.2
Yamuna	$2.2 \pm 0.1 \times 10^{-3}$	8.7 ± 0.2
Sangam	$8.7 \pm 0.2 \times 10^{-3}$	8.9 ± 0.2

All values shown are Mean \pm S.D. of 3 replications. Conductivity is expressed as mhos cm^{-1}

pH = Hydrogen ion concentration.

deteriorated due to poor sanitation facilities for the pilgrims, agricultural runoff, sewage effluents and domestic wastes. The study provides a quick, simple and analytical method of quality evaluation of water in these rivers and calls for proper sanitation facilities for the pilgrims, proper treatment, disposal and management of waste for improving the water quality of these rivers.

Table 3 : Concentration of heavy metals in river waters

Source	Heavy metals							
	Copper	Cadmium	Chromium	Iron	Zinc	Lead	Nickel	Manganese
Ganga	0.9 ± 0.08	5.4 ± 0.2	2.5 ± 0.2	4.5 ± 0.2	3.6 ± 0.2	1.6 ± 0.1	3.5 ± 0.3	2.5 ± 0.2
Yamuna	0.6 ± 0.08	4.5 ± 0.3	1.6 ± 0.2	3.0 ± 0.1	2.8 ± 0.2	0.9 ± 0.08	2.5 ± 0.2	1.6 ± 0.1
Sangam	3.5 ± 0.1	7.5 ± 0.1	9.5 ± 0.2	8.4 ± 0.2	9.2 ± 0.2	7.5 ± 0.3	8.4 ± 0.2	7.5 ± 0.3

Each value shown is Mean \pm S.D. of 3 replications. Concentration of heavy metals is expressed as parts per million (ppm)

The conductivity was observed to be highest in Sangam water samples and lowest in water samples obtained from Yamuna, which indicates the presence of large amount of electrolytes in Sangam water as compared to water samples from the other two sites. The pH measurements did not show any clear cut fluctuations in the water samples obtained from the three different sites indicating that water quality is not substantially affected.

The concentration of eight heavy metals is given in Table 3 which supplements the data of Table 1 and Table 2 *i.e.* the contamination of heavy metals was observed to be maximum in water samples from Sangam and minimum in the water samples obtained from Yamuna. Obviously, the contamination is intermediate in the water samples of Ganga river.

The physico-chemical parameters revealed that water samples taken from Yamuna river appeared to be least contaminated and polluted vis-a-vis the water samples obtained from the other two sites *i.e.* Ganga and Sangam. The present study via physico-chemical analysis also clearly showed maximum contamination/pollution at the place of convergence *i.e.* Sangam. However, the water quality of Ganga river showed sub-standard comparatively.

The present analytical data on water samples clearly showed that the quality of water of these rivers

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