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Research Article

Physico-Chemical Analysis of Drinking Water of Balasore Area, Odisha, India

M. K. Dash[*a], N. Behera[b], P. Rath[c], R. B. Panda[d] and S. P. Rout[e]

[a]Dept. of Chemistry, Seemanta Engineering College, Jharpokharia, Mayurbhanj-757086, Odisha, India
[b]Dept. of Chemistry, Betnoti College, Betnoti Mayurbhanj-757025, Odisha, India
[c]Dept. of Chemistry, School of applied Science, KIIT University, Bhubaneswar, Odisha, India
[d]Dept. of Environmental Science, Fakir Mohan University, Vyasa Vihar, Balasore-756020, Odisha, India
[e]Former Professor of Chemistry, Utkal University, Vani Vihar, Bhubaneswar-751004, Odisha, India

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Abstract

Knowing the significance of drinking water for a healthy society, an analysis for drinking water quality was made by collecting water samples from 120 different locations in and around Balasore town in three different seasons namely summer, post-monsoon and winter. The samples were subjected to a comprehensive physico chemical analysis from the suitability point of view of water for human consumption. Critical water quality parameters such as pH, Turbidity, Total dissolve solids, Total Hardness, Nitrate, Fluoride, Sulfate, Alkalinity and Iron etc were considered for determining the quality of drinking water of the study area. The analysis revealed that the drinking water quality in the study area is reasonably good and does not show any alarming levels of pollutants. However it needs some degree of treatment before consumption as the concentration of the parameters such as Iron, Fluoride, Turbidity, Alkalinity and Total Hardness exceed the permissible limits for drinking water.

Keywords: *Balasore Area, pH, Turbidity, Alkalinity, Total Hardness*

1. Introduction

The sources of water for the domestic and industrial purposes in the study area are the surface and ground water. In general surface water sources are not acceptable for drinking as these are often encumbered by various organic, inorganic and biological constituents (A. Kumar *et al.*,1996; A. Kaur *et al* 1999). Groundwater which refers to any subsurface water that occurs beneath the water table in the soil and other geologic forms constitute upto 95% of the total fresh water for drinking purpose in the study area. Almost every city of the developing nations is facing water quality problem as well as drinking water shortage especially during summer season (M. Singh and A.K. Singh, 2012). Availability of groundwater is plenty in the study area except in summer season, though a few bore well show salinity due to seawater intrusion. Groundwater in the area is mainly due to the accumulation of water below the ground surface, caused by rainfall and its subsequent percolation through pores and crevices. Percolated water accumulates till it reaches impervious strata consisting of confined clay or confined rocks. (S.Naik *et al.,* 2001). Extraction of groundwater is done by means of dug wells, dug cum driven well, bore wells and open wells.

Groundwater is also used for industrial water supply and irrigation all over the world. In the last few decades, there has been an incredible increase in the demand for freshwater due to rapid growth of population and the accelerated pace of industrialization (C.R. Ramakrishnaiah *et al*., 2009). Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Rapid urbanization, especially in developing countries like India, has affected the availability and quality of groundwater due to its overexploitation and improper waste disposal, especially in urban areas (P. Anderson *et al*., 1991). According to WHO, about 80% of all the diseases in human beings are caused by water. It is therefore becomes imperative to regularly monitor the quality of water and to device ways and means to protect it. (P.Samantray *et al.,* 2009), (P.C. Mishra *et al*., 2001).

The objective of the present work is to discuss the suitability of drinking water for human consumption based on computed water quality parameters.

2.Material and Methods

2.1 Study Area

Balasore is one of the coastal districts of Odisha, lies on the northern most part of the state having 21 degree 03' to 21 degree 59' North Latitude & 86 degree 20' to 87 degree 29' East Longitude. Geographical area of the district is 3634 sqkm. Balasore Area constitutes a small part of the district. The climate of Balasore district is mostly hot and

*Corresponding Author E-mail: mkd.sec@gmail.com

humid. The major industries located in this area are Birla Tyres Ltd, Balasore Alloys Ltd, Emami Papers Ltd and Oriplast Ltd which are in and around the township. The sampling locations in and around Balasore town were chosen within a radius of 10 kms with Azimabad as the center.

2.2. Methodology

The sampling locations in and around Balasore town were chosen within a radius of 10 kms with Azimabad as the center and are shown in Fig.1. Water samples were collected in three seasons namely summer, post-monsoon and winter in polyethylene bottle. The sampling and preservation procedure were performed as per standard method (APHA, 1995) and the physico chemical parameters were analysed as per CPCB guidelines and approved methods.

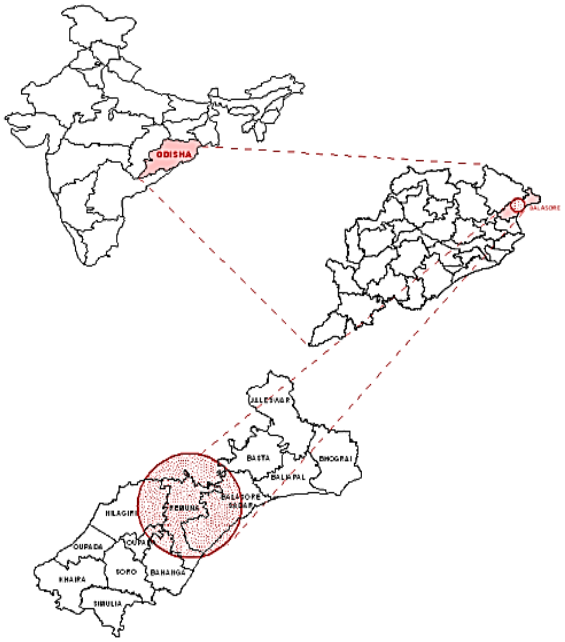

Fig-1. Location map of the study area and sampling stations

3. Results and Discussion

Post Monsoon Season

- pH of water samples collected from ground water varied between 7.04 to 7.70 The pH values of all the ground samples were within the prescribed drinking water standards.
- The concentration of TDS varied between 818 mg/l at Haripur to lowest 117 mg/l at Sahadevkhunta.
- Fluoride values ranged between 0.3 mg/l to 1.7 mg/l.
- Total hardness of water samples varied between 54 mg/l to 715 mg/l.
- Sulfate values varied in between 9.8 mg/l to 50.7 mg/l.
- Iron content values varied in between 0.4mg/l to 1.0 mg/l.
- Out of all the samples, the sample collected from police line square was having maximum Nitrate concentration of 12.52 mg/l.

Winter Season

- pH of water samples varying between 6.98 to 7.59 and within the prescribed drinking water standards,
- The concentration of TDS varied between 823 mg/l at Haripur to lowest 119 mg/l at Remuna.
- Maximum fluoride of 0.3 mg/l is observed at Bhimpura and minimum is observed 1.9 mg/l at Balia.
- Total hardness of water samples varied between 62 mg/l at Chhanpur to 748 mg/l at Ganeswarpur.
- Iron content values varied in between 0.5 mg/l at Bhimpura to 1.0 mg/l at Bampada.

Summer Season

- The pH of all the ground samples was within the prescribed drinking water standards.
- The concentration of TDS varied between 847 mg/l at Haripur to lowest 121 mg/l at Januganj.
- Total hardness of water samples varied between 78 mg/l at Chhanpur to 769 mg/l at Badagaon.
- Sulfate concentration was observed to be very high in the samples collected from Badagaon and Bampada respectively. Nitrate concentration was observed to be very high in the samples collected from Balia and Bampada respectively.

pH of water samples collected from ground water varied between 6.98 to 7.70 indicating slight alkaline in nature. The pH values of all the ground water samples in all the three seasons under study were within the prescribed drinking water standards.

The turbidity values of almost all the ground water samples of all the three seasons under study were within the prescribed drinking water standards except collected from Haripur.

The permissible total dissolved salts for drinking water is 500 mg/L. In the absence of potable water source the permissible limit is upto 2000 mg/L. It is found from the analysis that all the well water samples TDS is within the maximum limit of 2000 mg/L in all the three seasons under study. The highest concentration of total dissolved solids was found to be 847 mg/L at Haripur in summer season due to dense residential area and due to intensive irrigation in that area. High values of TDS in groundwater are generally not harmful to human beings but high concentration of these may affect persons, who are suffering from kidney and heart diseases. Water containing high solids may cause laxative or constipation effects.

Out of all the samples, the sample collected from police line square was having maximum Nitrate concentration of 12.52 mg/l. Due to hazardous nature of Nitrate the permissible limit of Nitrate for drinking water has been

reduced from 100 mg/l to 45 mg/l by the Bureau of Indian Standards (BIS) in recent years . Excessive concentration of Nitrate in drinking water is considered harmful for infants causing methaemoglobinemia (Julio and Alvaro, 2006)

During the study period (2011-2012), based on the comparisons of chemical constituents with IS:10500,1991 and WHO (1994) standards, it is found that, out of the total samples, eight percentage of samples have total hardness value above maximum permissible limit of 500 mg/L. Total hardness varies from 78 to 769 mg/L. The hardness values for the study area are found to be high for almost all locations for post-monsoon and determined to fall above the desirable limit of WHO specification.

The iron content values of almost all the ground water samples in all the three seasons under study were above the prescribed drinking water standards.

The details of Percentage of drinking water samples with respect to desirable and permissible limits as per IS: 10500:1991 and WHO is given in the table1.

Table 1: Percentage of drinking water samples with respect to desirable and permissible limits as per IS: 10500 and WHO

Parameters (mg/l)	IS:10500:1991		WHO	Summer				Post monsoon				Winter			
	DL	PL	MAC	WD	BD	BP	ND	WD	BD	BP	ND	WD	BD	BP	ND
pH	6.5-8.5	6.5-8.5	6.5-8.5	100	Nil	Nil	-	100	Nil	Nil	-	100	Nil	Nil	-
TH	300	600	500	55	40	5	-	56	41	3	-	56	41	3	-
Turb. (NTU)	5	10	10	58	33	9	-	59	34	7	-	62	32	6	-
TDS	500	2000	1000	55	45	Nil	-	56	44	Nil	-	50	50	Nil	-
Fe	0.3	0.3	0.3	20	75	5	-	20	70	8	2	20	75	5	-
NO_3	45	100	100	35	Nil	Nil	65	24	Nil	Nil	76	23	Nil	Nil	77
Fluoride	1	1.5	1.5	55	32	4	9	59	26	3	12	62	21	2	15
SO_4	200	400	400	88	Nil	Nil	12	90	Nil	Nil	10	88	Nil	Nil	12
Chloride	250	1000	250	100	Nil	Nil	-	100	Nil	Nil	-	100	Nil	Nil	-
Alkalinity	200	600	600	Nil	100	Nil	-	Nil	100	Nil	-	Nil	100	Nil	-

DL= Desirable limit, PL= Permissible limit, MAC = Maximum allowable concentration, WD = Within desirable, BD = Beyond desirable, BP = Beyond permissible, ND = Not detectable.

Conclusion

The analysis of the samples revealed that out of the total water samples collected from 120 different locations in three different seasons, the concentration of Iron, Fluoride, Turbidity, Alkalinity and Total Hardness of a major percentage of the samples exceed the upper limit for drinking water. About 20% of water samples are poor in quality during the study period in the study area. In this study area the groundwater quality may improve due to inflow of freshwater of good quality during rainy season. Overall it has been observed from the analysis that the drinking water quality in the study area is reasonably good and does not show any alarming levels of pollutants, However it need some degree of treatment before consumption as the concentration of the parameters such as Iron, Fluoride, Turbidity, Alkalinity and Total Hardness are high so that the human beings can be protected from adverse health effects.

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