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Evaluation of Drinking Water Quality in Bihpuria Area of Lakhimpur District, Assam, India

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ABSTRACT

Water used for human consumption should be free from organisms and substances, which are hazardous to human health. A water sample is normally rejected for drinking purpose if it is highly turbid, highly coloured or which has objectionable taste, but the absence of these adverse sensory effects does not guarantee the safety of water for drinking. Although appearance, taste and odour are useful indicators of the quality of drinking water, suitability in terms of public health is determined by microbiological, physical, chemical and radiological characteristics. This study involves the determination of the water quality parameters in drinking water samples of the Bihpuria area of Lakhimpur District of Assam, India. Twelve water samples were analyzed during October-November, 2011 for pH, total hardness (TH), fluoride, nitrate, calcium, chloride, iron, sulphate, magnesium and arsenic contents by adopting standard methods (APHA-AWWA-WPCF, 1995). The result obtained during the study was compared with standards [2] and it was found that in most of the cases the parameters were within the desirable limit. This means that the Bihpuria area receives very low amount of pollution from the surrounding and the water of this area is free from contamination.

Keywords: P^H, Hardness, Fluoride, Nitrate, Arsenic etc.

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INTRODUCTION

The Environment for any living organism has never been constant or static. Development has brought many undesirable modifications to environment with increased number of industries and population. Aquatic environment of water bodies also disturbed due to somewhat mismanagement and unawareness of people. The development of new environment problems as a result of this has given rise to new ideas in the field of monitoring and assessment of aquatic ecosystem [3]. Monitoring and assessment provide the basic information on the condition of a water bodies.

Water used for human consumption should be free from organisms and substances, which are hazardous to human health. A water sample is normally rejected for drinking purpose if it is highly turbid, highly coloured or which has objectionable taste, but the absence of these adverse sensory effects does not guarantee the safety of water for drinking. Chemical contamination does not cause immediate acute health problems unless they are present in massive quantities. However, after prolonged periods of exposure to chemical contaminants even in trace amounts may also do considerable harm by being cumulative poisons and carcinogens. The health burden is most significant for two chemicals: arsenic and fluoride. Arsenic contamination of drinking water sources is being found in increasing numbers of water supplies world – wide and in Asia in particular. Excessive intake of fluoride results in skeletal and dental fluorosis. Severe symptoms lead to death when fluoride doses reach 250-450 ppm [4]. Nitrate (NO_3^-) contamination of the groundwater, due to the intensive use of fertilizers has become a serious ecological problem in many rural areas of India and in many developing nations worldwide [4]. Excessive sulphate content has a cathartic effect on humans resulting in purgation of the alimentary canal. It may also lead to corrosion of metals in the distribution system, particularly when the water has low alkalinity. Iron in excess of 0.3 mg/l is known to cause staining of clothes and utensils. The higher concentration of iron is also not suitable for processing of food, ice dyeing, bleaching and many other activities. Water with higher concentration of iron, if used in preparation of tea and coffee, interacts with tannins to give a black inky appearance with a metallic taste. Chloride concentration of 250 mg/l in drinking water is recommended as the guide line value [1]. Concentration in excess of this can damage pipes and structures and can inhibit plant growth [5]. The need to monitor drinking water quality has been universally recognized and is a necessary safe guard against a large number of health hazards. Water pollution studies in India have received tremendous momentum in recent times. Most studies are, however, related to rivers. Sarma and Bhattacharya [6] studied the quality of drinking water in Darrang district of Assam with respect to fluoride and nitrate content in some locations. Drinking water quality in various locality of Dhemaji district of Assam with respect to fluoride, nitrate, arsenic and iron content was studied by Buragohain. [7, 8, 9] studied the drinking water quality w.r.t Arsenic, Fluoride, Nitrate, Sodium, Potassium and Iron content in Dhakuakhana Sub-division of Lakhimpur district of Assam. Chutia [10] also studied the seasonal variation of drinking water quality in Dhakuakhana Sub-division of Lakhimpur district of Assam with respect to fluoride and nitrate content in some locations. There is no earlier data available for various water quality parameters in Bihpuria area of Lakhimpur district, Assam. The present research is undertaken with a specific view to strengthen the national and local water quality database.

STUDY AREA:

The Lakhimpur District is situated in the eastern parts of India on the North-East corner of Assam. Located between the latitudes of 27 ^{0} 00 $^{/}$ (N) and 27 ^{0} 18 $^{/}$ (N) and the longitude of 94 ^{0} 13 $^{/}$ (E) and 94 ^{0} 32$^{/}$ (E). The district is constituted of two sub divisions – North Lakhimpur and Dhakuakhana. The study area Bihpuria is a Police Station area situated in the North Lakhimpur sub-division of the district. Located at the foot of the Himalayas, the study area has a relatively cool but humid climate. The average temperature varies between 10^{o}C and 17.5^{o}C in winter and 25^{o}C and 30^{o}C in summer. August is the Warmest and January is the coolest month of the year. The average annual rainfall varies between 20cm to 40cm in winter and 240 cm to 800 cm in summer. July and August being the rainiest months. December and January tend to be the driest months. Relative humidity is always high dropping never below 60%.

MATERIALS AND METHODOLOGY

The need for careful sampling techniques varies according to the constituent being tested. Separate water samples were selected by random selection and compiled together in plastic bottles to set a representative sample. Samples were protected from direct sun light during transportation. Standard methods (APHA-AWWA-WPCF, 1995) [1] were followed during the analysis of water samples. The pH was analyzed immediately on the spot after the collection, whereas the analyses of remaining parameters were done in the laboratory. The results were evaluated in accordance with the WHO Standards.

DISCUSSION

The experimental data on general characteristics (Shown in table 2 & 3) of water samples from the 12 drinking water sources of Bihpuria area of Lakhimpur district were analyzed in order to assess the portability of water in the area. Sampling Points are shown in table 1. The P^{H} is an important water quality parameter measuring the acid-base equilibrium of the dissolved components. In natural waters, the P^{H} is controlled by the carbon dioxide-bicarbonate – carbonate equilibrium and generally the values lie in the range 6.5 to 8.5. In Bihpuria area the water collected from ring wells, taps and rivers were slightly alkaline in nature which could be due to solutes, which may show a buffering action i.e. H+ ions are compensated with OH - ions [11]. The Tube-well water samples were found slightly acidic with a narrow variation. In most of the cases, the values were within the WHO guide line values for safe drinking water.

Table1: Sample no. with corresponding sampling points.

Sample No.	Sampling Point	Sample No.	Sampling Point
A_1	Ward No.4	A_7	Ward No.1
A_2	Ward No.3	A_8	Ward No.6
A_3	Ward No.3	A_9	Ward No.10
A_4	Ward No.4,	A_{10}	Ward No.2
A_5	Ward No.2	A_{11}	Dikrang River
A_6	Ward No.5	A_{12}	Ward No.10

Table 2: Experimental values of p^H ′ TH, F^- ′ NO_3^- and Ca^{2+} of the drinking water samples of the study area

Sample No.	Source of Sample	p^H	TH ($CaCO_3$)	F^- mg/lit	NO_3^- mg/lit	Ca^{2+} mg/lit
A_1	Tap water	6.4	84	0.830	2.5	16.8
A_2	Ring well	6.3	56	0.240	0.5	11.2
A_3	Tube well	6.2	60	0.362	1.8	15.2
A_4	Tube well	6.3	34	0.050	1.5	8.8
A_5	Ring well	6.8	30	0.078	2.0	7.2
A_6	Tube well	6.5	90	0.123	0.9	21.6
A_7	Tube well	6.1	176	0.079	0.8	27.2
A_8	Tube well	6.3	160	0.069	0.8	32
A_9	Ring well	7.2	76	0.079	1.2	14.4
A_{10}	Tube well	6.8	66	0.266	2.0	19.2
A_{11}	River water	7.1	28	0.131	0.9	10.4
A_{12}	Tap water	7.5	52	0.142	0.5	12

Table 3: Experimental values of, Cl^- , Fe^{2+}, SO_4^{2-} Mg^{2+} and As of the drinking water samples of the study area

Sample No.	Source of Sample	Cl^- mg/lit	Fe^{2+} mg/lit	SO_4^{2-} mg/lit	Mg^{2+} mg/lit	As mg/lit
A_1	Tap water	70	49.88	23.46	10.2	Trace
A_2	Ring well	26	0.46	7.62	6.8	Trace
A_3	Tube well	8	27.15	13.14	5.3	Trace
A_4	Tube well	22	25.75	33.78	2.9	Trace
A_5	Ring well	10	1.26	5.65	2.9	Trace
A_6	Tube well	28	28.85	12.72	8.7	Trace
A_7	Tube well	96	6.96	17.37	26.0	Trace
A_8	Tube well	34	0.23	45.88	19.4	Trace
A_9	Ring well	22	0.78	15.01	9.7	Trace
A_{10}	Tube well	14	31.19	6.95	4.4	Trace
A_{11}	River water	6	0.46	2.59	0.5	Trace
A_{12}	Tap water	20	Trace	27.88	5.3	Trace

Hardness is the property of water which prevents lather formation with soap and increases the boiling point of water .The hardness of water may be due to the presence of a number of dissolved polyvalent ions like Ca^{2+} , Mg^{2+} , Sr^{2+} , Fe^{2+} , Ba^{2+} and Mn^{2+} , the first two are considered as the principal hardness causing ions in natural waters [3]. In the study area the high values of TH were recorded at sampling points A_7 and A_8 which exceed the highest desirable limit of potable water (100ml/l) [12]. Ground water being rich in carbonic acid and DO , has a high solubilizing potential towards soil or rock containing minerals calcite, dolomite and gypsum and consequently groundwater is much more hard than surface water.

Fluoride is beneficial to certain extent when present in concentration of 0.8 to 1.0 mg/l for calcification of dental enamel especially for the children below eight years of age [11]. But it causes dental fluorosis if present in excess of 1.5 mg/l and skeletal fluorosis beyond 3 mg/l, if such water is consumed for about 8 to 10 years [13]. WHO guide line for drinking water quality and water technology mission of the government of India have specified the permissible limit for fluoride in drinking water as 1.0 mg/l. It can be extended to 1.5 mg/l if there is no alternative source in the villages. The highest desirable and maximum permissible limits for fluoride content given by ISI [2] for fluoride in drinking water is 0.6 to 1.2 mg/l. In the present investigation, the fluoride concentrations were found to be within the permissible limit of WHO, but in some location where the fluoride concentration in water is less than 0.7 mg/l may cause dental carries.

Nitrates can be found in soil, water and plants. Organic nitrogen compounds (eg. Proteins, amino acids etc.) are oxidized to nitrates by bacteria present in soil and water when sufficient oxygen is present. Oxides of nitrogen formed in the atmosphere are also brought to water bodies as nitrates by the rains. Other sources of nitrates in water are fertilizer use, decayed vegetables and animal matter, domestic effluent, sewage sludge, industrial discharge, refuge dump leachates etc [14]. Normally the nitrate level is below 5 mg/l in most waters with the level being higher in ground water than in surface water where aquatic plants decrease the level. The level tends to go up after heavy rain fall following severe drought. The content of nitrate was found to be highest i.e. 2.7 mg/l in River waters. This may be due to flow of agricultural waste water and may be due to ground water recharge. Higher concentration of nitrates enhances the growth of algae and other aquatic plants leading to eutrophic conditions. All the water sources have nitrate content within permissible limit.

Calcium is present in water naturally, they may result from the leaching of soil and other natural sources, but the addition of sewage waste might also be responsible for the increase in amount of calcium [3]. Calcium is usually one of the most important contributors to hardness. Human body requires approximately 0.7 to 2.0 grams of calcium per day as a food element, excessive amounts can lead to the formation of kidney or gallbladder stones. In the present investigation, the calcium concentrations were found to be within the permissible limit of WHO (75 mg/L). [12]

Chloride is a common constituent of all natural waters and is generally not classified as a harmful constituent. Natural source of water contains < 10 mg/l of Chloride and a content of < 250 mg/l is recommended as the guide line value [1]. Concentration in excess of this can damage pipes and structures and can inhibit plant growth [5]. In the present investigation, the chloride concentrations in most of the water samples were found within the guide line value.

The iron contents of the tube wells were found to be higher in comparison to the other sources. It may be due to soil origin and age old iron pipes used. The data exceeds the WHO guideline value of 0.3 mg/L [12] in all the cases. The iron contents of tube well waters need immediate attention.

Sulphates enter natural water through wastes. Atmospheric SO_2 formed by combustion of fossil fuels and emitted from metallurgical processes can also be transferred to water systems through precipitation. Sulphate contents in fresh water ranges from 20 to 50 mg/l [1], although the guide line value is 400mg/l [12]. Excessive sulphate content has a cathartic effect on humans resulting in purgation of the alimentary canal. It may also lead to corrosion of metals in the distribution system, particularly when the water has low alkalinity. In the present investigation, the sulphate concentrations in the water samples range from 2.59mg/l to 45.88mg/l.

Magnesium is often associated with calcium in all kinds of waters, but its concentration remains generally lower than the calcium [3]. Magnesium is essential for chlorophyll growth and it also acts as a limiting factor for the growth of phytoplankton [3]. In the present investigation, the magnesium concentrations were found to be within the permissible limit for safe drinking water [2].

Arsenic, a deadly poisonous metal generated from fossil fuel burning, is well known for its toxicity to humans. Ingestion of as little as 100 mg usually results in severe poisoning and 130 mg has proved to be fatal. Arsenic in water may be carcinogenic causing cancers of the skin and liver. Slow poisoning causes nausea, fainting, salivation, vomiting and burning pain in stomach. In the present investigation, the arsenic concentrations were found to be below the detectable range.

CONCLUSION

The result obtained during the study was compared with standards [2] and it was found that in most of the cases the parameters were within the desirable limit. This means that the Bihpuria area receives very low amount of pollution from the surrounding and the water of this area is free from contamination.

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