

QUANTIFICATION OF FLUORIDE IN DRINKING WATER OF RURAL AND URBAN AREAS OF BALRAMPUR DISTRICT, U. P., INDIA

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ABSTRACT

A study of fluoride status in drinking water was evaluated in the Rural and Urban areas of Balrampur district. The study was conducted with an aim to assess and evaluate the reason for increasing level of fluoride in underground water around Balrampur district. Though, in most of the areas level was within the acceptable range but a significant change in level was observed as fluoride was modetectable in these areas. Excessive entry of fluorides in human body results in fluorosis. Fluoride is found to affect calcium and phosphate contents in bones which become making brittle. The preliminary survey reports several cases of arthritis in this area.

Key words: Ground water, fluorosis, Urban and Rural water quality.

INTRODUCTION

The increasing industrialization, urbanization, and developmental activities to cope up with the population explosion have brought inevitable water crisis. Water, the universal solvent, serves as an unavoidable medium for the livelihood of the humanbeings, plants and animals. The available fresh water is hardly 0.3 to 0.5% of total water on the earth.

Underground water plays an important role in the overall water balance of the environment. As a reservoir, it has an enormous capacity to store water in rainy periods which can be utilized in dry periods. Ground water is primary source of fresh water in several towns and rural areas.

It is widely used as a source of water for drinking purpose. Affected ground water quality, which is not useful for drinking purpose. Ground water pollution causes irreparable damage to soil,

plants and animals including humanbeings. Polluted ground water is the cause for the spread of chronic diseases and other diseases in epidemic form.

In both Urban and rural India, ground water is the major source of drinking water and it is the major source of fluoride pollution. It constantly dissolves from the environment and goes into the ground water (Jain *et al.*, 2005). Fluoride, though occurs in minimum quantities in natural water yet evokes considerable interest due to its impact on human health.

Fluoride in every limited quantities is desirable for healthy growth of teeth and bones in human beings and prevents dental caries. But in excess quantities, not only causes disturbance of enamel structure but it also causes genetic damage, and neurological damage (Saxena *et al.*, 2005).

MATERIAL AND METHODS

About 50 water samples were collected

early in the morning from sources such as taps, ponds, wells, handpumps, rivers and borewells of different Urban and Rural areas of Balrampur district. Fluoride concentration was estimated by electronic method using expandable ion analyzer EA-940. For this two electrodes *i.e.* reference electrode and fluoride sensing electrode were used. The electrodes were prepared and the instrument was calibrated by 1 ppm, 10 ppm and 100 ppm of known standard fluoride solutions. 10 ml of unknown sample was taken in a beaker and 1 ml of TISAB III solution was added. Fluoride concentration was directly read in the samples, by dipping the electrodes. 221 mg NaF was dissolved in 1 liter of distilled water to make stock solution. 100 ml of this stock solution was taken and 1 liter of distilled water was added to make standard fluoride solution (1 ml = 1 µg F).

RESULTS

Fluoride concentration in urban water samples (Table 1) varied between 0.568 mg/L to 1.213 mg/L. The fluoride concentration in municipal supply varied from 0.658 to 0.958 mg/L in summer season, 0.434 to 0.512 mg/L in monsoon seasons and 0.592 to 0.956 mg/L in winter seasons. The fluoride concentration in hand pump varied between 0.725 mg/L to 0.951 mg/L, but in summer it varied from 0.812-1.122 mg/L, in monsoon it varied from 0.631 to 0.802 mg/L and in winter it varied from 0.732 to 0.982 mg/L. The average fluoride concentration in open well, ponds, river and Swan nallah varied from 0.678-0.727 mg/L, 0.568-0.591 mg/L, 0.870 to 1.017 mg/L and 0.713 to 1.213 mg/L, respectively. All the samples were found below the maximum permissible limit of 1.5 mg/L. They were also below the desirable limit of 1.0 mg/L except samples of Suaon Nallah upstream and Rapti River down stream.

Fluoride concentration in rural water samples is presented in table 2 and 3. The data revealed that average fluoride concentration varied in hand pump was 0.882-1.281 mg/L but in summer, monsoon and winter it fluctuates from 0.922-1.312 mg/L, 0.838-1.261 mg/L and 0.882-1.281 mg/L, respectively. The average fluoride concentration in open well varied from 0.868 1.105

mg/L with fluctuation 0.913 - 1.092 mg/L in summer, 0.821 - 1.113 mg/L in monsoon and 0.872 - 1.181 mg/L in winter seasons. The average fluoride concentration in Borewell water sample varied from 0.968-1.065 mg/L with fluctuation 0.973-1.091 mg/L in summer, 0.882-1.172 mg/L in monsoon and 0.932-1.042 mg/L in winter seasons. The average fluoride concentration in ponds varied from 0.896 - 0.908 mg/L with fluctuation 0.960 - 0.983 mg/L in summer, 0.812-0.852 mg/L in monsoon and 0.893- 0.912 mg/L in winter seasons. All the samples were found below the maximum permissible limit of 1.5 mg/L. They were also below the desirable limit of 1.0 mg/L except handpump and borewell water samples of rural areas (Table 3). Presence of high level of fluoride in water from hand pumps and borewell of rural area could be due to high concentration of fluoride in subsoil and shallow borings.

DISCUSSIONS

The permissible limit of fluoride content in drinking water recommended by ISI and WHO is 1.0 mg/L. The maximum permissible limit of fluoride in drinking water according to the Bureau of Indian standard (BIS, 1983) is 0.6 mg/L to 1.2 mg/L. However, Teotia and Teotia (1984) on the basis of their studies have suggested the maximum permissible limit of fluoride below 0.5 mg/L. The drinking water has been classified according to its fluoride content as safe (up to 1.0 mg/L) marginally contaminated (1.1 mg/L to 2.5 mg/L) and highly contaminated (2.6 mg/L and above) (Sushella, 1999). Buragohain *et al.*, (2007) reported that fluoride concentration in water less than 0.7 mg/L may cause dental caries. Thus all the sites of Balrampur district are within the permissible limit except the hands pumps and borewell of rural area could be due to high concentration of fluoride in subsoil and shallow boring (Kumari and Rao, 1993; Garg *et al.*, 1998 and Pandey *et al.*, 2001) and due to fluoride bearing minerals in the rocks where these hand pumps and borewells are situated. (Sharma *et al.*, 2002).

In the present study, the result reveals that although an overall picture of the area within the municipal limits does not have fluoride content

Table 1:
Concentration of fluoride in the water sample of Balrampur city.

S. No.	Sampling Source	Sampling Sites	No. of Samples	Fluoride (mg/L)				Standard error of mean
				Summer	Monsoon	Winter	Average	
1.	Municipal supply	Chowk	12	0.958	0.434	0.956	0.782	±0.09
2.	Municipal supply	Civil line	12	0.718	0.482	0.698	0.632	± 0.16
3.	Municipal supply	Purabtola	12	0.658	0.512	0.592	0.587	± 0.14
4.	Municipal supply	Khalwa	12	0.712	0.501	0.621	0.611	± 0.31
5.	Hand pump	Sugar Factory colony	9	1.120	0.802	0.932	0.951	± 0.41
6.	Hand pump	Bhagwatiganj	9	1.122	0.742	0.813	0.892	± 0.35
7.	Hand pump	Terhi Bazar	9	0.990	0.732	0.982	0.901	± 0.05
8.	Hand pump	Baluha	9	0.812	0.631	0.732	0.725	± 0.14
9.	Open well	Purabtola	6	0.750	0.652	0.781	0.727	± 0.11
10.	Open well	Teachers Colony	6	0.703	0.521	0.812	0.678	± 0.32
11.	Ponds	Pajwa	12	0.658	0.432	0.614	0.568	± 0.11
12.	Ponds	NaiBasti	12	0.712	0.532	0.531	0.591	± 0.31
13.	Suaon Nallah	Upstream	9	1.350*	1.148	1.142	1.213	± 0.14
14.	Suaon Nallah	Downstream	9	1.512	0.928	1.211	0.713	± 0.13
15.	Rapti River	Upstream	9	0.821	0.832	0.958	0.870	± 0.18
16.	Rapti River	Downstream	9	1.121	0.914	0.989	1.017	± 0.21

* Slightly higher concentration of fluoride according to BIS

Table 2:
Concentration of fluoride in the water sample of rural area of Balrampur district.

S. No.	Sampling Source	Sampling Sites	No. of Samples	Fluoride (mg/L)				Standard error of mean
				Summer	Monsoon	Winter	Average	
1.	Hand pump.	Mathura Bazar	12	0.922	0.838	0.882	0.880	± 0.25
2.	Hand pump.	Lalia	12	1.312	1.261	1.281	1.284*	± 0.11
3.	Hand pump.	Ratanpur	12	1.130	0.981	1.042	1.051	± 0.12
4.	Hand pump.	Arjunpur	12	1.090	0.951	1.021	1.020	± 0.18
5.	Borewell	Navbasta	9	0.973	0.941	1.042	0.985	± 0.20
6.	Borewell	Sisai	9	1.091	1.172	0.932	1.065	± 0.27
7.	Borewell	Laxminagar	12	1.061	0.973	1.012	1.015	± 0.10
8.	Borewell	Vishunpur	9	1.022	0.882	1.00	0.968	± 0.45
9.	Open well	Ranijot	10	0.913	0.821	0.872	0.868	± 0.07
10.	Open well	Ajabnagar	10	0.962	0.821	0.903	0.895	± 0.18
11.	Open well	Mahari	12	1.021	1.113	1.181	1.105	± 0.23
12.	Open well	Premnagar	12	1.092	1.012	1.041	1.048	± 0.30
13.	Ponds	Pakari	10	0.982	0.813	0.893	0.896	± 0.17
14.	Ponds	Mahua Bazar	10	0.962	0.852	0.912	0.908	± 0.25
15.	Ponds	Tilkahna	12	0.960	0.850	0.912	0.907	± 0.21
16.	Ponds	Sehriwa	12	0.983	0.812	0.894	0.896	± 0.31

* Slightly higher concentration of fluoride according to BIS.

Table 3:
Concentration of fluoride in mg/L in water samples in Balrampur district.

Sampling source	Average concentration of Fluoride			
	Urban area	Rural area	Urban area	Rural area
Hand pump	0.725-0.951	0.882-1.281	0.867	1.058
Openwell	0.781-0.812	0.868-1.105	0.796	0.979
Municipal supply	0.587-0.782		0.653	-
Borewell	-	0.968-1.065	-	1.008
Ponds	0.568-0.591	0.896-0.908	0.579	0.901
Rivers	0.870-1.017	-	0.943	-
Suaon Nallah	0.713-1.213	-	0.963	

higher than permissible limits, but there is certain village where the fluoride concentration is slightly higher than the desirable limits. Probably, our study area lies in this safezone. It should also be borne in mind that although only two out of thirty two sites in this study showed a very marginally higher value of fluoride as compared to that setup by BIS (1.2 mg/L), but the long term use of such waters may be detrimental for human health. Fluoride in the range of 0.5 – 1.2 mg/L is generally considered to be beneficial to human beings, but consumption of fluoride for a long time through drinking water containing higher fluoride concentration than 1.2 mg/L will lead to fluorosis, which is a chronic disease characterized by mottling of teeth and softening of bones, ossification of tendons and ligaments.

Thus, the quality of drinking water in rural area of Balrampur district is not safe for drinking purposes from ground water source. The fluoride content in the surface water such as pond and river was less as compared to ground water such as hand pump and borewell. Hence, it is desirable that the drinking water should be monitored for the presence of fluoride to be well within the permissible limits, the population should also be made aware of the harmful effects of fluoride.

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