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High concentration of fluoride in groundwater of Rajauli, Nawada (Bihar) leading to fluorosis

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Abstract- Water crisis is a major problem in the present scenario. Due to excessive use of chemical fertilizers, pesticides, dumping of wastes from industries, release of industrial effluents on open land, dumping of domestic wastes, the groundwater has got polluted in many areas throughout the world. Fluoride rich minerals present in the earth crust results into groundwater fluoride contamination naturally. The intake of fluoride rich water results into a medical condition called fluorosis- a severe bone disease. Hardia Sector D (Jajpur), Singar Khas, Hanuman Nagar and Bhaunr villages of Rajauli block of Nawada district, Bihar are among the fluorosis endemic areas. Most of the groundwater sources in these villages have fluoride concentration above the maximum permissible limit of 1.5 mg/L. People suffering from skeletal fluorosis, non-skeletal fluorosis and dental fluorosis were found in the villages.

Key words: Fluoride, Groundwater, Fluorosis, Aquasol Kit

INTRODUCTION

Almost three-fourth of the earth's surface is covered with water. The total quantity of water present in the earth is about 1.4 billion cubic km.¹ In spite of such a huge quantity of water, the amount of water useful for human consumption is very low. 97.3 % of the global water is present in oceans and seas which is saline and is not fit for human consumption. The remaining 2.7 % of the total global water is fresh water. 75.2% of the available fresh water on earth is present in glaciers and polar ice caps. 22.6 % of the fresh water is present as groundwater. The rest of the water is present in lakes, rivers, ponds, atmosphere, moisture soil and vegetation. Less than 1%

of the global water is available for consumption.²

Water crisis is a major problem in the present scenario. The reason is clear as much of the water is saline and not fit for human consumption.³ Also the crisis is because the geographical distribution of water is also not the same. Some places on the earth have huge water reserves whereas other places suffer from water scarcity.⁴ Water pollution has also led to the depletion of water quality.

Some important reasons that have led to depletion in water quality and scarcity are as follows⁵⁻⁷:

- Population explosion
- Increase in demand for water for irrigation
- Industrialization, urbanization and generation of hydroelectricity
- Pollution of surface and groundwater
- Misuse of water

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Usually groundwater is considered to be the most suitable for domestic purposes. It is considered to be pollution free. However due to excessive use of chemical fertilizers, pesticides, dumping of wastes from industries, release of industrial effluents on open land, dumping of domestic wastes, the groundwater has got polluted in many areas.⁸ The contaminants from these wastes percolate into the soil very slowly and finally reach the groundwater resulting into groundwater pollution. The intake of this polluted water possesses serious problems not only to human beings but also to plants and animals. Fluoride, Arsenic, Nitrate and other radicals and ions present in groundwater result into large number of diseases.⁹ Fluoride rich minerals present in the earth crust results into groundwater fluoride contamination naturally. The intake of fluoride rich water results into a medical condition called fluorosis.¹⁰

Rajauli, a block in Nawada district Bihar has many villages which are fluorosis endemic. Hardia Sector D (Jajpur), Singar Khas and Hanuman Nagar of Hardia panchayat and Bhaunr village of Sirodabur panchayat of Rajauli block are among the fluorosis endemic areas. Most of the groundwater sources in these villages have fluoride concentration above the maximum permissible limit of 1.5 mg/L.¹¹ The WHO describes the maximum permissible limit of fluoride in drinking water as 1.5 mg/L. People suffering from skeletal fluorosis, non-skeletal fluorosis and dental fluorosis were found in the villages.

MATERIALS & METHODS

The groundwater samples were collected in 1 L plastic bottles. At the site itself fluoride concentration in the samples were tested by the ‘Aquasol Kit.’ For determination of fluoride contamination in water samples, the instrument used was- ORION STAR A214 Ion Selective Electrode. Mostly AR grade MERCK chemicals were used for analysis. All the solutions were prepared in double distilled water. Water samples were analysed by methods recommended by APHA at the Centre for Fluorosis Research, Department of Chemistry, A.N. College, Patna.¹² A total of 44 samples from the four villages were collected and analysed during three different seasons- Pre-monsoon, Monsoon and Post-monsoon of the year 2018. To identify the fluorosis affected people, health status survey was done. The health survey included the daily food intake, detection of fluorosis and the BMI (Body Mass Index) values of the people surveyed.

Table 1- Fluoride ion conc. (in mg/L) in groundwater samples of villages of Rajauli

Sample no.	Pre-monsoon	Monsoon	Post-monsoon
1	3.57	3.25	3.51
2	1.69	1.56	1.64
3	2.93	2.36	2.61
4	2.78	2.35	2.31
5	2.89	2.80	2.54
6	2.35	1.95	2.38
7	2.10	1.67	1.88
8	1.45	0.71	1.13
9	3.54	3.88	3.58
10	2.06	3.09	1.85
11	3.43	3.28	3.07
12	2.78	2.87	1.75
13	2.89	2.28	2.21
14	3.58	3.49	3.59
15	2.41	2.54	1.98
16	2.25	2.21	1.95
17	3.63	3.52	3.35
18	3.40	3.48	3.35
19	3.45	3.09	3.13
20	3.23	3.15	2.68
21	2.90	4.02	2.90
22	1.45	1.29	1.60
23	1.54	1.66	1.41
24	4.48	4.12	5.05
25	2.61	2.47	2.88
26	3.83	2.62	3.88
27	5.67	4.73	5.92
28	4.59	3.55	4.49
29	2.04	2.52	2.69
30	3.30	1.75	3.60
31	2.08	2.20	2.16
32	3.97	3.57	3.56
33	3.72	2.64	3.12
34	2.73	2.82	2.89
35	2.93	2.61	2.71
36	3.15	2.91	2.97
37	2.28	1.91	1.95
38	7.51	7.21	7.21
39	2.36	2.23	2.27
40	4.78	2.54	4.11
41	2.25	2.24	2.47
42	1.44	2.32	2.30
43	6.28	5.32	6.26
44	4.04	3.59	3.68

Sample no. 1-20 Hardia Sector D,
 Sample no. 21-23 Singar Khas and Hanuman Nagar,
 Sample no. 24-44 Bhaunr

Maximum groundwater sources in the villages were found to be contaminated with fluoride. In Hardia Sector D, the maximum conc. of fluoride was found to be 3.88 mg/L (Sample no. 9) during the monsoon period. Only one sample of this village was found to be fluoride safe.

The maximum fluoride conc. in Singar Khas and Hanuman Nagar was 4.02 mg/L during the monsoon period whereas in Bhaunr it was 7.51 mg/L (Sample no. 38) during the pre-monsoon period.

During the health survey many people of the study villages reported dental problems, muscular pains, joint

pains, bone deformities and many more ailments related to fluorosis. Some cases of knock knee and bow legs were also observed. The BMI values of many of the villagers was found to be lower than 18.5. The intake of food by the villagers of Hardia Sector D, Singar Khas and Hanuman Nagar was little nutritious. The severity of fluorosis was higher in three of the four villages. However, in Bhaunr, most people intake nutritious food in their diet and hence the severity of fluorosis was not as high as in the other three villages.



Fig. 1- Cases of Fluorosis in Rajauli

CONCLUSION

The intake of fluoride contaminated water by the inhabitants of Hardia Sector D (Jajpur), Singar Khas Hanuman Nagar and Bhaunr villages of Rajauli has led to fluorosis in these villages. People suffering from all three types of fluorosis have been found in these villages. The severity of fluorosis was higher where the intake of nutritious food was poor.

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