FLUORIDE ASSESSMENT AND CHARACTERIZATION OF DRINKING WATERS IN JHABUA DISTRICT OF MADHYA PRADESH

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ABSTRACT

Humans need water. Life need water. Drinking, irrigation, hydroelectricity, industry, transit, sanitation, leisure, and more require water. Nonetheless, most water is utilized for drinking and farming. Hence, clean water is vital to life. Ground water is rainwater that seeps through soil pores, joints, and rock fractures. Groundwater supplies drinking, household, and 60% of the nation's farmland irrigation (FAI 2011).

Life need water. It covers approximately three fourths of the planet and is odorless and tasteless. 2.5% of Earth's water is fresh, while 98.8% is ice and groundwater. Groundwater provides most drinking and agricultural water on Earth. Ground water with excessive dissolved ions is unsafe for home usage. Groundwater contains anions such carbonate, bicarbonate, chloride, sulphate, and cations like sodium, potassium, calcium, and magnesium. Water also includes minor levels of lithium, fluoride, nitrate, selenium, and arsenic. Excess of each ion depletes or poisons soil, plants, animals, and humans, posing health risks. These particular ions affect water quality and agricultural irrigation. Water provides micronutrients to humans and animals. Long-term supplementation of drinking water ions like fluoride and selenium improves health. Fluoride is important for animal and human development since. In some states, low water-supplemented fluoride is good for health. Unfortunately, much fluoride degrades drinking water and causes fluorosis and other health issues in children. Fluoride isn't needed by plants.

Keywords: *Fluorosis, Defluorination, Fluoride, Groundwater.*

INTRODUCTION

Due to long-term fluoride usage, 25 countries have fluoride problems, including India. Fluorosis affects more than 60 million Indians, including children. Groundwater fluoride levels are high in impacted locations. The Rajiv Gandhi National Drinking Water Project, New Delhi, found endemic fluorosis in 16 of 32 Indian states till 1992. India may have more impacted districts and states presently. Pie charts show each state's impacted districts. Fluorosis affects 30% of Punjab, Haryana, Madhya Pradesh, Maharashtra, and Bihar districts and 50% of Uttar Pradesh, Rajasthan, Gujarat, Andhra Pradesh, and Tamil Nadu districts. Delhi and Kerala have less impacted districts. Dental fluorosis is prevalent in 14 Indian states and 1,50,000 villages, especially in Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh (Pillai and Stanley2002). Madhya Pradesh (M.P.) and Chhattisgarh has 170 fluoride-toxic villages in six districts.

Jhabua district has about 50% damaged communities. Madhya Pradesh's south-western Jhabua district. Bheel, Bhilala, Patelia, and Manka make up 86.8% of Jhabua's population (Census, 2001). The Jhabua hills, part of the Vindya hill ranges in southern Madhya Pradesh, drain rail water into rivers through small tube wells or bore wells, and ponds provide drinking water. Poor, uneducated, and rural, these tribes earn little. Due to excessive fluoride levels in the drinking water, numerous

tribes' children have fluorosis and other health issues. Rock phosphate mining and processing for phosphatic fertilizer manufacture contaminates drinking water. Rock phosphate is abundant in Jhabua. Fluoraspar, cryolite, and fluorapatite contain it. Superphosphate fertilizer is made from rock phosphate ores. Native rock phosphate slowly dissolves or is processed into phosphatic fertilizers in mining areas, releasing fluoride into surface and ground waterways. This may have contaminated Jhabua district groundwater with fluoride, according to surveys. Shivpuri, Jhabua, Mandla, Mandsaur, Hoshangabad, Bhind, Morena, and Guna have examined ground water fluoride toxicity in Madhya Pradesh. Chakma et al. (1997) found 9.22 to 10.83 ppm fluoride in deep bore wells in Mandla district, Madhya Pradesh. Public health engineering department, Mandla district, documented deep bore well depths from 37 to 43 meters. In few isolated areas of Hoshangabad, Bhind, Morena, and Guna, groundwater fluoride exceeded 1.0 mg/L (permissible limit) and even reached 4.5 mg L-1 in several villages of Bhind district (Minhas and Samra, 2003). pH and ESP dominated fluoride adsorption. Systematic data is needed to assess groundwater quality. The Rajeev Gandhi National Drinking Water Mission (1992) found increased fluoride levels in ground water in Jhabua, but no recent study has characterized fluoride status in drinking water. PHE Department (latter No. 4750), Jhabua reported fluoride-affected drinking water in 518 communities. In various talukas, Petlawad had 79 villages, Thandla 88, Meghnagar 84, Jhabua 90, Rama 98, and Ranapur 76. Defluoridation, the removal of excess fluoride, and fluoridation, the addition of modest quantities of fluoride to drinking water, are becoming major issues in rural places like these tribes in Jhabua district. Fluorosis is widespread due to excess fluoride in drinking water. The current research proposes to "survey and characterisation of drinking water sources of Jhabua districts of Madhya Pradesh in India" due to the importance of fluoride supplementation in Jhabua's tribes and the absence of comprehensive, up-to-date fluoride status data.

MATERIALS AND METHODS

Location and extent

Jhabua is in south-west Madhya Pradesh. It's a major tribal district in Madhya Pradesh's Jhabua Hill Zone. The district borders Madhya Pradesh's Dhar, Ratlam, Alirajpur, and southwestern Rajasthan. The district is between latitude 21020' and 23040' N and longitude 74030' and 750 16' E of India. Average altitude is 450–700 m above sea level. The district covers 5,517 Sq. Km. District Jhabua lies in Madhya Pradesh's XI Jhabua Hill climate zone. The Bhil Adivasi, or indigenous people, make up 86.8% of the population in south-western Madhya Pradesh. Jhabua has 1,024,091. The climate is dry to subhumid with 600-800 mm of yearly precipitation. Rainfall fluctuates annually. Summer averaged 10 oC and 51 oC. Summers are hot and winters pleasant. South west monsoon is responsible for most yearly rainfall from June to September.

Collection of Drinking Water Samples

208 water samples from hand pumps, tube wells, and wells in Jhabua district villages were collected and evaluated for water quality and particular ions like fluoride and nitrate. Table 3.1 describes water sample site characterisation, and appendix-I lists village locations and other significant data. Jhabua is mostly Archaean granites. Gnesise, Granite, Lameta, Bagh Formations contain fluoride.

Fluoride dissolves from these rocks. Granite-covered areas have high groundwater fluoride concentrations.

RESULTS

Depth of drinking water Sources

The present study asked adjacent homeowners about tube well and hand pump depths.

Jhabua district ground water samples were categorised by well and tube well depth (Table 1). Jhabua, Ranapur, Rama, Meghnagar, Petlawad, and Thandla blocks have more than 65% of hand pumps with wells/tubewells less than 45 m deep.

Jhabua area has 65% hand pumps within 45 meters. 11.5, 21.6, 15.4, 15.211.2, and 32.2 percent of Jhabua, Ranapur, Rama, Meghnagar, Thandla, and Petlawad hand pumps are deeper than 45 m.

Table 1: Distribution of ground water samples according to hand pump depth in Jhabua.

S.N.	Hand pump / bore well depth (m)	Percentage of water samples in various Blocks of Jhabua					
		Ranapur	Rama	Jhabua	Megh-nagar	Thandla	Petlawad
1	< 45	88.5	78.4	84.6	74.8	78.8	67.8
2	>45	11.5	21.6	15.4	15.2	11.2	32.2

Block Wise Drinking Water Quality for Six Blocks in Jhabua District

Table 2 shows the average drinking water quality metrics during post-monsoon (October 2011) seasons, including range and mean alkalinity (pH), salinity (EC), and fluoride (F-) concentrations for various water samples from different blocks.

Water reaction (pH)

Table 3 shows the average pH of 208 October 2011 drinking water samples. Water pH varied from 7.05 to 7.33 with a mean of 7.13. Most water samples reacted normally.

Electrical Conductivity (EC)

Table 4.3 showed that post-monsoon drinking water EC values varied from 0.83 to 1.67 dSm-1 with a mean of 1.26. Block Meghnagar had the lowest salt content (0.83 dSm-1) in water tests, whereas Ranapur had the highest (1.67).

Table 2: Fluoride concentration and other water quality parameters of drinking water in different blocks of Jhabua district during October 2011.

S.N.	Name of block	No. of water samples	pH	EC, dsm-1	Fluoride conc. mg/L	Nitrate conc. mg/L
1	Ranapur	40	7.31	1.64	1.310	2.173
2	Rama	43	7.08	1.13	2.467	1.333
3	Jhabua	27	7.11	1.52	0.811	1.944
4	Meghnagar	28	7.05	0.83	0.911	1.466
5	Thandla	37	7.18	1.12	2.187	1.374
6	Petlawad	33	7.01	1.22	1.194	1.507

All	Mean	208	7.11	1.24	1.562	1.626

Fluoride concentration in drinking waters

Table 2 shows that hand pump water F concentrations varied from 0.810 to 2.477 mg F/L with a mean of 1.573 mg/L in October 2011. Rama and Thandla had the highest F concentrations in drinking water sources, whereas Jhabua and Meghnagar had the lowest at 0.810 and 0.910 mg/L.

Block Wise Drinking Water Quality for Six Blocks in Jhabua District

Table 3 shows the range and mean of alkalinity (pH), salinity (EC), and fluoride (F-) content for water samples from various blocks in presummer (March 2012) seasons.

Table 3 Fluoride concentration and other water quality parameters of drinking water in different blocks of Jhabua district during March 2012

S.N.	Name of block	No. of water samples	pH	EC, dsm-1	Fluoride conc. mg/L	Nitrate conc. mg/L
1	Ranapur	40	7.75	1.25	1.758	16.07
2	Rama	43	8.15	0.94	2.485	11.03
3	Jhabua	26	8.33	1.02	0.890	7.222
4	Meghnagar	29	7.87	0.61	1.421	4.821
5	Thandla	38	8.02	0.95	1.292	4.798
6	Petlawad	29	8.04	1.02	0.765	6.174
All	Mean	205	8.01	0.98	1.531	8.828

Water reaction (pH)

Pre-summer pH of 205 drinking water samples varied from 7.75 to 8.33 with a mean of 8.03. The pH (alkalinity) of water samples was lower during monsoon season than before summer.

Electrical Conductivity (EC)

Table 3 shows that presummer drinking water salinity averaged 0.99 dSm-1.

Presummer water samples had lower salinity than post-monsoon ones. Jhabua drinking water fluoride levels vary seasonally.

Figs. 2 and 3 demonstrate that F concentrations in drinking water samples from several Jhabua areas varied widely between October 2011 and March 2012. The mean of 205 water samples was 1.570 mg F/L for post-monsoon (October 2011) and 1.530 mg F/L for presummer seasons (March 2012).

Results demonstrated that drinking water samples in both seasons had F concentrations around the 1.5 mg F/L World Health Organization (2002) acceptable limit for drinking water worldwide. The average F concentrations of drinking water sources varied from 0.810 to 2.477 mg F/L, with Rama having the highest concentration, followed by Thandla, Ranapur, Petlawad, Meghnagar, and Jhabua.

CONCLUSIONS

Systematic information on fluoride content of ground water in Jhabua is scarce, so the research topic chosen is of topical interest with the following objectives: survey of fluoride status in drinking water being consumed in Jhabua district, study the impact of fluoride contaminant water on

general health, find limits of fluoride content in drinking water sources and interaction with other ions present in drinking water to assess water sa Hence, groundwater resources in Jhabua district, Madhya Pradesh, were assessed in Oct-Nov 2011 and Feb-March 2012. These water samples had pH 6.65–7.58, electrical conductivity 0.47–4.22 dS/m, and sulphate 0.5–11.6 mg/L. Carbonate was 0.1–0.6 and bicarbonate 2.2–5.8 me/L. These fluids contain 1.8 to 14.8 me/L Na and cations like Ca and Mg. Villages, blocks, and this area had 0.43 to 4.51 mg/L fluoride in drinking water. October 2011 and March 2012 averaged 1.53 and 1.57 mg F/L over 1.50 mg/L. These dangerous waters may cause fluorosis in Jhabua. Block-wise critical assessment found that most hand pumps in Jhabua and Meghnagar blocks had sufficient pH, salinity, fluoride, and other parameters in October 2012, but Rama, Thandla, and Ranapur blocks had excessive fluoride concentrations and slightly harmful drinking water. In March 2012, Megh nagar and Thandala blocks hand pumps had great pH, salinity, fluoride, and other features, while Rama and Thandla blocks had high fluoride and hazardous drinking water. Jhabua and Petlawad water quality was average.

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