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A STUDY ON THE DISTRIBUTION OF FLUORIDE IN DHAR DISTRICT IN GROUND WATER AND IT'S IMPACT ON HUMAN HELTH

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ABSTRACT

Fluoride contamination of groundwater is a growing problem in many parts of the world. Fluoride is an essential element, which is good for the teeth enamel and helps to prevent dental caries. In excessive doses, however, it will lead to a chronic fluoride poisoning, fluorosis. In India, a population of more than 66 million, especially in rural parts are dependants on groundwater for drinking water supply and have a potential risk of developing fluorosis. Therefore it is very important to understand the mechanisms of mobilization of fluoride in groundwater in order to mitigate the problem as effectively as possible. In the state of mp, there are reported occurrences of fluoride in groundwater; however, as compared to other states in India, the problems are relatively localized. Previous studies around dharampuri Town have shown levels of fluoride in ground waters exceed both 1.0 mg/L, the limit for drinking water set by the Bureau of Indian Standards (BIS), and 1.5mg/L, the limit set by WHO, where as in DHAR , fluoride concentrations were as high as 1.8 mg/L. The present study reports the results on the investigations on the hydro geochemical characteristics of the ground waters of DHAR districts with an aim to understand the mechanisms of mobilization of fluoride. This information could then be used to create more effective mitigation systems.

INTRODUCTION

The beneficial attributes of fluorides to human health have been known for many years. The fluoride ion is a very important dietary substance. When ingested at specific doses, the fluoride ion is beneficial to both bone and dental development in human beings. At correct intake levels it plays a very important role in the formation of teeth. Too low fluoride intake levels during childhood may give rise to the occurrence of preventable dental caries in later years. Dental caries is a disease caused by specific bacteria harbored in dental plaque, fermenting carbohydrates to produce acids that can demineralise tooth enamel. If this demineralization is allowed to continue, the enamel is penetrated permitting bacterial invasion and eventual loss of the tooth by decay in the absence of restorative dental care. Too high fluoride intake normally gives rise to teeth mottling (dental fluorosis) and related problems. Chronic endemic fluorosis is a condition which is caused by an excess of fluorides in drinking water and which affects the calcification of the teeth, resulting in what is commonly known as dental fluorosis. It is evident in the literature that there are various sources of fluoride. These include the ingestion of certain foods such as green tea, green vegetables like spinach, etc., the use of fluoride supplements such as various toothpastes, fluoride pills, mouthwash and drinking water. The occunence of fluoride levels in drinking water and the effect on human health is the basis of this dissertation. The majority of dental fluorosis sufferers in India live in rural areas. These people use untreated surface and groundwater as sources for drinking water. Groundwater is obtained from springs, wells and boreholes. The value of groundwater represents a strategic component of the water resources in India. It occurs widely. Geographically, almost two thirds of Indian's population depends on it for their domestic water needs. Different studies have shown that the occurrence of dental fluorosis in the majority of cases in India is related to the fluoride content of groundwater used for drinking purposes.

AIMS AND OBJECTIVES OF THIS STUDY

The study has three main aims:

- To determine the distribution (current and long term) of fluoride ion concentrations in groundwater sources in Dhar (mp).
- To investigate whether a relationship exists between high fluoride levels In groundwater and the percentage morbidity of dental fluorosis in those areas.
- To describe the distribution of fluoride in Dhar (MP) groundwater.
- To describe the current status of fluoride occurrence in groundwater.
- To delineate those areas with fluoride concentrations in groundwater lower or higher than the recommended limits for drinking water.
- To identify factors that may contribute to the occurrence of high fluorides in groundwater.
- To identify areas affected by dental fluorosis.
- To compare results obtained from the assessment of the water quality data and the percentage morbidity of dental fluorosis.
- To make relevant recommendations based on the results of this study.

1. RESEARCH PROCEDURE

1.1 Fluoride affected area in India:

Fluoride is often called a two-edge sword – in small dosages, it has remarkable influence on the dental system by inhibiting dental carries, while in higher dosages causes dental and skeletal fluorosis. When present in concentration of 0.8-1.0 mg/L, fluoride is beneficial for calcification of dental enamel especially for the children below 8 years of age. At higher concentrations (1.5-2.0 mg F/L), Fluoride effects adversely and leads to dental fluorosis. At still higher concentration, (3-6 mg F/L) skeletal fluorosis occurs. The disease affects the bone and ligaments. Intakes of 20-40 mg F/day over long period have resulted in crippling skeletal fluorosis.High concentrations of fluoride in ground water are common in some of the semi-arid areas of Rajasthan, southern Punjab, Gujarat, Karnataka, Tamil Nadu, Madhya Pradesh, and southern Haryana. Several areas of Andhra Pradesh have high concentrations of fluoride in ground water (exceeding 5 mg/l). There are a number of cases of dental and skeletal fluorosis in these areas. In several parts of Karnataka, Tamil Nadu, U.P., and other areas, fluoride concentrations of groundwater are more than the permissible level of 1.5 mg/l. An extensive survey of the community water supplies has shown that around 25 million people in rural areas consume water with fluoride content more than this limit. Various authorities have given permissible limits for fluoride content in drinking water. A concentration of fluoride in drinking water in different parts of the country varies from 0.5 to 50 mg/L. Permissible limit of fluoride in drinking water prescribed

by various organizations.

Table1 permissible limit of fluoride by various organizations.

Name of the organization	Desirable limit (mg/L)
Bureau of Indian Standards (BIS)	0.6-1.2
Indian Council of Medical Research (ICMR)	1.0
The Committee on Public Health Engineering Manual and Code of Practice, Government of India	1.0
World Health Organization (International Standards for Drinking Water)	1.5

1.2 Fluoride affected area in MP:

Large populations, especially children, in 27 of the 50 Madhya Pradesh districts are threatened by the fluorosis menace as people in these districts are being forced to drink water with excessive fluoride, much beyond the permissible limit. According to the latest information available from the state public health engineering department, the fluoride content in water is much beyond the prescribed norms of 1.5 mg per litre or 1.5 part per million (ppm) in 11,460 drinking water sources (mainly handpumps) in 6,746 habitats spread across 27 districts. The problem is particularly glaring in districts like Dhar and Jhabua in western Madhya Pradesh. The department has also claimed that alternative arrangements were being made for providing drinking water in areas affected by excess fluoride in water. The main problem districts with distribution of flouride in ground water above permissible limit are Bhind, Chhatarpur, Chhindwara, Datia, Dewas, Dhar, Guna, Gwalior, Shivpuri, Harda, Jabalpur, Jhabua, Khargone, Mandsaur, Rajgarh, Satna, Seoni, Shajapur, Sheopur, and Sidhi. Inquiries have revealed there are villages in Rama block of Jhabua district and Tirla block of Dhar districts where children, over the last several years, have suffered severe bone deformities — mainly crippling of their lower limbs — as they have been drinking water with excessive fluoride over a long period.

2. RESULT AND DISCUSSIONS

2.1 DISTRIBUTION OF THE FLUORIDE ION CONCENTRATION IN GROUNDWATER

Table 2: % of Fluoride affected source

SN.	Type of water source	Total no of tested source	No. of water source(fluoride conc.<1.5mg/l)	No. of water source(fluoride conc.>1.5mg/l)	% of fluoride affected source
1	Hand pump	83	27	56	67%
2	Well	17	17	-	0%
3	Tube well	03	-	03	100%
4	Pond	06	06	-	0%

2.2 Major ions in water

The analysis of major cautions included calcium, magnesium, sodium, potassium and ammonium. The major anions that were analyzed were carbonate alkalinity, chloride, nitrate, sulphate and phosphate. The specific instruments and methods that were used are described below.

2.2.1 Calcium and magnesium

Calcium and magnesium were analyzed in two different ways. For the samples that were analyzed at CWRDM exclusively complexiometric titration was used. These samples were first diluted depending on their EC value.

2.2.2 Sodium and potassium

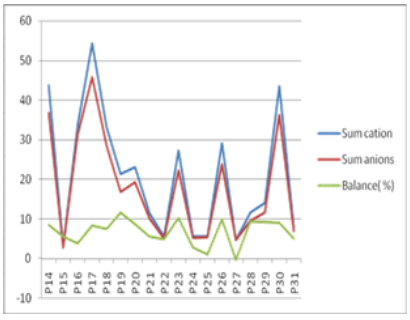
Sodium and potassium was analysed with a Systronics Flame Photometer Burner unit 121 with a Systronics Digital FPM 125 display. The instrument was calibrated before measurements with distilled water (0 on the display), and two standard solutions. For sodium measurements the standard solutions were 40 mg/L (100 on the display) and 20 mg/L (50 on the display), thus the correction factor is 0.4 to convert the display value to the sodium concentration. For the potassium measurements the standard solutions were 10 mg/L (100 on the display) and 5 mg/L (50 on the display), and the correction factor is 0.1. Any readings above 100 are out of range and the samples must be diluted before being measured again.

2.3 Statistical summary of groundwater

A statistical summary of groundwater chemistry from the investigated areas of Tirla and Dharmpuri are presented in Table …and ….

Table 3Statistical summary of groundwater chemistry in Tirla

Parameter	Mean	Median	Min	Max	10%ile	90%ile	σ
pH	7.31	7.4	6.4	8.2	6.59	7.61	0.48
Temp(° C)	27.85	27.4	25.9	31.4	26.4	29.7	1.37
Eh (mV)	268.84	273	166	317	201	300	34.8
EC (µS/cm)	1634.19	890	320	8770	550.00	3930	1439.78
Na+ (mg/l)	192.39	122.15	21.66	806.06	38.01	385.02	181.3
K+ (mg/l)	22.32	2.76	0.54	277.93	1.11	32.25	65.77
mg2+ (mg/l)	74.15	45.3	10.91	306.24	19.62	155.71	75.95
Ca2+ (mg/l)	119.4	82.24	17.49	320.44	21.74	263.77	99.12
F(mg/l)	0.78	0.7	0.1	1.80	0.2	1.31	0.44
Cl- (mg/l))	365.09	207.25	24.23	1288.6	68.12	923.5	371.41
SO4, (mg/L)	54.24	36.7	2.96	164.5	19.91	110.74	0.86
N03. (mg/l)	23.24	6	-0.2	189.1	0.03	80.68	4.77
HCO3 (mg/l)	345.23	372.32	61.99	664.35	135.88	544.32	182.45
Po4.P (mg/l)	0.37	0.11	0.04	4.6	0.07	0.2	1.06
Al (ug/l)	38.6	15.62	10.3	194.05	10.62	114.66	52.72
Mn(ug/l)	63.9	22.03	0.33	641.81	8.89	82.08	149
Fe (ug/l)	34.2	13.57	4.46	117.66	6.26	106.19	0.37
Cu (ug/l)	1.63	1.17	0.72	6.9	0.86	2.45	1.45
Zn (ug/l)	34.01	17.42	6.01	136.62	8.96	67.52	33.84



CONCLUSIONS

Fluoride concentration of this region has been found as high as 11.6 mg/l. Out of 83 hand pumps monitored, 23 hand pumps and 2 tube wells out of total of 3 tube wells monitored have more than 5 mg/L of fluoride concentration, which shows a very dangerous state. As a result of this alarming level of fluoride over 436 children are effected by mild, 105 by moderate and 10 by severe dental Fluorosis out of a total of 1300 children surveyed. Following the severity trend of dental Fluorosis of this region it is found that no cases of skeletal Fluorosis in general have been observed. This clearly indicates that the numbers of dental Fluorosis cases have

been increased due to two main reasons: High rise in dependence on hand pumps since recent years and due to Dietary practices. Annexure I show that all the fluoride concentration in selected area in dhar. Keeping these points in mind, there is a need for a detailed scientific study on Fluorosis since there are other regions, which too share the same fluoride concentration viz. Sonebhadra (UP), Naupada (Orissa), Warangal (A.P), Mandla (MP) and Unnao (UP) and have many people suffering from skeletal Fluorosis. Presently maximum population of Dhar region depend entirely on hand pump sources for drinking hence the situation here can turn to be grave in future. It is quite clear from the results of fluoride monitoring that hand pumps and tube wells sources have high fluoride concentration whereas well and nearby surface water sources (ponds) have comparatively acceptable levels of fluoride, which is thus indicative of the presence of fluoride bearing rocks in strata 25 - 30 feet below ground level. This might be a source of fluoride in water. The water policy formulation of this region should be revised, and these points should clearly be included in the policy. Thereafter planning to supply nearby available surface water should be done and in addition to this use of wells of low depth should be promoted. Last but not the least, complete ban should be imposed on the use of hand pumps and tube wells of the region

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