PHYSICO-CHEMICAL STUDY OF WATER QUALITY OF NEWAI & SURROUNDING AREA WITH SPECIAL REFERENCE TO FLUORIDE - A SILENT KILLER

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ABSTRACT

There is a significant fluoride issue in Niwai Tehsil of Tonk district, where the local population is affected by dental and skeletal fluorosis. To investigate this, a physico-chemical study was conducted across 80 villages. Groundwater samples were collected in clean polyethylene bottles and analyzed for various parameters including pH, Total Alkalinity, Fluoride (F-), Nitrate (NO3-), Total Dissolved Solids (TDS), Chloride (Cl-), Total Hardness (TH), Electrical Conductivity (EC), Calcium Hardness (Ca-H), and Magnesium Hardness (Mg-H) using standard techniques. The findings revealed alarming fluoride concentrations, with levels reaching up to 14.62 ppm. The fluoride concentration varied from a minimum of 1.5 mg/L in Jagatpura village to a maximum of 11.82 mg/L in Ajitpura village.

***Keywords**: Fluorosis, ppm, Fluoride, Ion-Selective Electrode*

Introduction

Water is a priceless gift of nature which is the most vital substance for living organisms. Water contains many minerals like calcium, magnesium and fluoride etc. Fluoride exists naturally in water sources and is derived from fluorine, the thirteenth most common element in the Earth's crust. It is well known that fluoride helps prevent and even reverse the early stages of tooth decay. Too much fluoride before 8 years of age, a time when teeth are developing, can cause enamel fluorosis[1], discoloration or mottling of the permanent teeth. Recently, the National Research Council found naturally occurring fluoride levels that exceeded the optimal levels used in community fluoridation programs (0.7 to 1.2 ppm), putting kids under 8 years old at risk for severe enamel fluorosis. India lowered its permissible upper limit from 1.2 ppm to 1.0 ppm in 1998. Fluoride can help prevent cavities[2], but as the amount taken in increases it can also harm teeth (dental fluorosis) and bones (skeletal fluorosis). Fluoride is among the substances for which there are both lower (0.06 mg/L) and upper (1.2mg/L) limits of concentration in drinking water[3]. A low concentration of fluoride below 0.5ppm causes dental caries and higher concentration beyond 1.5 ppm causes dental and skeletal fluorosis. High concentration of fluoride in ground water is a considerable health problem in several regions of the world, considerable part of India has fairly good distribution of fluoride contaminated ground water[4]

The fluoride level studies of ground water have been carried out in various countries. Awadia *et al*[5]. and Ncube *et al*[6]. Conducted study to identify areas of high fluoride concentration in ground of South Africa and reported dental fluorosis. Webber[7] studied pollution in drinking water with fluoride. Alvarado *et al*[8]. have studied Fluoride and dental fluorosis in student of Tula de Allende Hidalgo of Merxico. Farfan *et al*[9]. discussed fluoride consumption and its impact on oral health.

Various workers of our country have carried out widespred studies in the related field. Susheela[10] have been studied on fluorosis management programmed in India. In this study some point involves such as present status of fluorosis in India, types of fluorosis, remedies and recommendations. Bhujangalah and Nayak[11] studied Ground water quality of Shimoga city of Karnataka. Omkar *et al.*[12] studied water quality aspects of some wells, springs and rivers in parts of the Udhampur districts (J&K). Pandit and Foram[13] studied physico-chemical and bacteriological studies of ground water in Bhavnagar city, Gujrat. Jadeja *et al*[14]. studied the Physico-chemical and bacteriological characterstics of ground water Dharmpur Industrial Area Porbandar city, results show that the ground water of Dharmpur Industrial area, is suitable for drinking purpose, subject to proper disinfection to ensure health of population. Dutta *et* al.[15] studied monitoring of fluoride concentration in ground water of small tea gardens in Sohitpur

district of Assam. Sharma *et al.*[16] studied fluoride contamination in ground water in Agra district (U.P.), using by fluoride ion-selective electrode method.

Different workers in Rajasthan have carried out extensive studies on fluoride also. Sharma *et al.*[17]ground water quality has been studied of an industrial town Bhilwara. Jain[18] studied on chemical analysis of drinking water of villages of Sanganer Tehsil, Jaipur district, Rajasthan, the results revealed that the quality of drinking water of Sanganer is very poor, water is highly deteriorated as it is polluted with high amount of fluoride, nitrate and alkalinity. Seth *et al.*[19] studied Geochemical of fluoride in ground water of Rajasthan. Sharma *et al.*[20] studied quality status of ground water of Sanganer Tehsil in Jaipur district. Verma[21] studied the problem of ground water pollution of Sanchore Tehsil of Jalore district. Batheija *et al.*[22] were analyzed nitrate and fluoride contaminations in ground water of Churu Block, Rajasthan. Tailor and Chandel[23] were studied quality of ground water of Malpura Tehsil of Tonk district, Rajasthan. Yadav and Khan[24] reported fluoride and flurosis status in ground water of Todaraisingh of Tonk district, Rajasthan. Most people of Todarisingh area are suffer from dental and skeletal flurosis such as mottling of teeth.

Area of Study

Newai (longitude:75.8871 E; latitude:26.29635 N) Tehsil is located at the north part of Tonk district in Rajasthan. Newai is connected by NH-12 and is situated 70 km from Jaipur. The water from lakes, ponds, tube wells, wells, hand pump etc. is used for drinking, irrigation, breeding of fishes and other purposes in this area. It has been seen that nitrate, fluoride, total hardness etc. in ground water is unevenly distributed in the state. Major part of Tonk district is inherited by high quantities of nitrate, fluoride, calcium, magnesium etc.

Groundwater samples were collected from 10 villages (Ajitpura, Suraj Ka Kheda, Brijlalpura, Pathraj, Jagatpura, Choriya, Nohata, Pahadi, Bhakawa and Jodhpuria) of Niwai region in Tonk district. These samples were analyzed for fluoride by ion-selective electrode method [5]. The main attention is focused on quality of groundwater in various areas of the Newai & surrounding villages. A comparative study is thus proposed to be under taken and statistical data is processed. It will also be proposed to evolve some methods for improving the quality of potable water.

The study would provide reliable water quality data, which can be used for the Assessment of precise health risks and for framing up of effective management and necessary water treatment required for water resources. Our investigations in this field provide data to reveal the safe drinking water and to reveal whether the ground water is safe for drinking and irrigation purposes or not.

The proposed study will involve the analysis of physico-chemical parameters of water & main source of fluoride in the ground water level, its limits and how to make ground water suitable for drinking purposes.

Tonk District

Research design & Methodology

The water samples were collected from different areas of Newai tehsil in clean screw-capped polyethylene bottles from different sources viz. hand pumps, open wells, tube wells and PHED water supply. To analyze the above samples for different parameters the standard methods were used.

Fluoride Ion-Selective Electrode Method

Apparatus: Ion-Selective Meter, Fluoride Electrode, Magnetic Stirrer.
Reagent: Fluoride Standards of various ranges (0.2-20ppm) Fluoride Buffer. (TISAB-Total ionic strength adjustment buffer)
Procedure: Calibrate the instrument. Take 10ml sample in a beaker at 10ml buffer solution. Put stirring bar into the beaker immerse electrode and start the magnetic stirrer and wait until reading is constant withdrawal electrode rinse with distilled water.

Significances

The goal of water fluoridation is to prevent tooth decay by adjusting the concentration of fluoride in public water supplies. Tooth decay (dental caries) is one of the most prevalent chronic diseases worldwide. Although it is rarely life-threatening, tooth decay can cause pain and impair eating, speaking, facial appearance, and acceptance into society and it greatly affects the quality of life of children, particularly those of low socioeconomic status. In most industrialized countries, tooth decay affects 60–90% of schoolchildren and the vast majority of adults; although the problem appears to be less in Africa's developing countries, it is expected to increase in several countries there because of changing diet and inadequate fluoride exposure. In the India, minorities and the poor both have higher rates of decayed and missing teeth, and their children have less dental care. Once a cavity occurs, the tooth's fate is that of repeated restorations, with estimates for the median life of an amalgam tooth filling ranging from 9 to 14 years. Oral disease is the fourth most expensive disease to treat. The motivation for fluoridation of salt or water is similar to that of iodized salt for the prevention of mental retardation and goiter.

Results and Discussion

In Rajasthan, first case of skeletal fluorosis was reported in Jobner near Jaipur by Kasliwal and Saloman. Later Mathur *et al*., reported the prevalence of fluorosis in Ajmer district. Fluoride concentration in groundwater samples (Hand-pumps, Tube-wells and Wells) of villages assessed, was found to vary from minimum 1.5 mg/L to maximum 11.82 mg/L (Table 1), while the permissible limit of fluoride is 1.5 mg/L . This is an indication of the fact that a large number of people residing in these villages of Rajasthan are exposed to high fluoride toxicity.
From the study of fluoride content in vegetables, cereals and fodder (Table 2) it was found that leafy vegetables are rich sources of fluoride when they are irrigated with groundwater having high fluoride.
The fluoride content of ground water ranged from 0.26 to 9.60 ppm (Fig. 1). The permissible limit for F- concentration is 1-1.5 ppm according to WHO26 (1996). The data revealed that 80% villages are affected with high concentration of F- Lower in 14%villages, however 6% villages contained optimum limit of F- concentration (Table.2 and Fig. 2).

Table 1: Fluoride concentration in groundwater samples

S.No.	Name of village	Fluoride concentration (mg/L)
1.	Ajitpura	5.80 - 11.82
2.	Suraj Ka Kheda	9.76 -10.76
3.	Brijlalpura	3.86 - 6.20
4.	Pathraj	3.54 - 8.00
5.	Jagatpura	1.50 -6.00
6.	Choriya	2.51 - 4.21
7.	Nohata	2.50 - 4.20
8.	Pahadi	1.50 - 3.96
9.	Bahakawa	4.21 - 4.92
10.	Jodhpura	4.00 - 4.80

Table 2 : Showing WHO permissible limit and percentage of water Quality of villages Newai Tehsil

Parameters	Permissible Limit	Villages %		
		Below	Optimum	Higher
pH	6.9 - 9.2	-	100%	-
F-	1 - 1.5 ppm	14%	6%	80%
EC	300 µmhos/cm	-	-	100%
TDS	500-1500 mg/L	5.38%	70%	24.62%
TH	100-500 mg/L	0.76%	95.38%	3.84%
Cl-	200-600 mg/L	48.47%	46.15%	5.38%
Alkalinity	200 mg/L	3.85%	-	96.15%
Na+	50 - 60 mg/L	26.15%	13.07%	60.76%
K+	20 mg/L	100%	-	-
NO3-	40 - 50 mg/L	57.70%	10%	32.30%

Conclusions

The populace of study area was also found affected with skeletal fluorosis, bone fluorosis and dental fluorosis. The presence of excessive quantity of fluoride in drinking water is accompanied by a characteristic sequence of changes in teeth, bone and periarticular tissues. Therefore drinking water of Newai Tehsil is not potable, proper treatment of groundwater is suggested prior to its use for drinking purposes. Removal of fluoride from drinking water is suggested through various defluoridation techniques are available including quick reverse osmosis, electrodialysis and hit and trial method. The Nalgonda technique is an economical way for defluoridation. Activated alumina technology may be used which is based on ion exchange resin. Public awareness and health education are the most important measure to be widely adopted. This can be done by using audio-visual aids, seminars, conferences, symposiums and training N.G.Os. must be encouraged in such programmed for public welfare.

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