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FLUORIDE AND OTHER INORGANIC PARAMETERS IN DRINKING WATER OF TUBE WELL, RING WELL AND PHE OF HOJAI SUB-DIVISION OF NAGAON DISTRICT, ASSAM, INDIA

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ABSTRACT

The ground water quality of drinking water of tube well, ring well and PHE of Hojai sub-division of Nagaon, district, Assam, has been studied with special reference to the presence of fluoride. The concentration of fluoride ion is determined by SPADNS colorimetric analysis. Most of Fluoride levels were within permissible limits, whereas a ten water samples has higher concentration of fluoride than permissible limit (1 mg/L, WHO) Fluoride content have positive correlation with Na' and K' and negative correlation with Mg^{2+}, Ca^{2+} and total hardness (TH). Fluoride showed fairly good positive correlation with depth of sources. The main source of fluoride comes into contact with ground water from its source of origin, the rock minerals. The concentration of fluoride in groundwater basically depends on easily weathered fluoride bearing minerals, the accessibility of circulating water to fluoride bearing minerals, extent of fresh water exchange in an aquifer, evaporation and evapotranpiration, formation of ionic compound such as $CaSO_4$, $CaHCO_3$ etc. and complexing of F with Al, Be, Ferric ions.

Key words: Groundwater, Fluoride, Hojai sub-division.

INTRODUCTION

Water, the most abundant and wonderful natural resource is extremely essential for survival of all living organisms. There are many factors affecting the drinking water quality and cause of fresh as well as ground water pollution. No life can service without water. Our health depends upon the quality of water, we drink. Aquatic animals live in water and take oxygen and some nutrients from water. But pollution of water has created a serious problem in our environment. But the term water pollution, we mean the contamination of water with undesirable substance, which adversely affect the plant and animal world. The natural

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sources of water pollution are land erosion, decomposed bodies of plants and animals, fallen leaves and other organic materials. The man made sources of water pollution are industrial wastes, pesticides, fertilizers, domestic waste etc.

Increasing industrial activities, rapid progress in science and technology, human activities, use of various chemicals in agriculture etc are the factors threatening the very quality of the life sustaining aquatic system. Moreover, the geology of soil also determine the presence of chemical substance and their concentrations in water quality of water particularly that used for drinking is very much influence by these substance.

The main purpose of present study is to do chemical characterization of groundwater bodies in the area with special attention to fluoride contamination.

Fluoride ion concentration in India's ground water very widely ranging from 0.01 mg/L to 48 mg/L. The amount of Fluoride occurring naturally in groundwater is governed principally by climate, composition of host rock, and hydrogeology. Generally, the presence of Fluoride ion may be due to low-level basaltic volcanic activity.

Study area lies between $25^{o}40'$and $26^{o}9'$ North latitudes and $92^{o}45'$and $93^{o}15'$ East longitude.

EXPERIMENTAL

Materials and methods

In addition to fluoride concentration other parameter such as pH, TH, Ca^{2+}, Mg^{2+}, SO_4^{2-}, Na^{+}, K^{+}, Cl^{-}, NO_3^{-}, PO_4^{3-} are determined (Feb.-11 to Apiril-12) by standard methods. Fluoride concentration was determined spectrophotometrically by the SPADNS colorimetric methods. Fluoride reacts with the coloured complex of zirconyl acid and spands reagent [Sodium-2 (p-sulphophenylazo)-1,8-dihydroxy-3,6-naphthalein disulphonate] forming colorless $(ZrF_6)^{2-}$ and releasing the dye. This reaction, which can be followed conveniently by colorimetric measurement of the dye, is the basis of fluoride estimation. At first fluorides are separated from water samples by distillation in presence of cons H_2SO_4 and soft glass beads to obtain fluorosilicic acid. A little Ag_2SO_4 is added to distilling flask to prevent volatilization of hydrogen chloride when samples have appreciable chloride content. The fluoride is then estimated by SPADNS method. The absorbance measurements were done at 570 nn with the help of UV spectrophotometer (Hitachi, 3210). F^{-} concentration was read directly by operating the instrument in photometry mode calibrating against a standard and a blank.

The physical parameter namely pH was determined by using a digital pH meter (ELICO). UV spectrophotometer method was followed for quantitative determination of phosphate and nitrate, Quantity of sulphate was determined using a colorimeter. The amount of sodium and potassium were determined using a flame photometer (digital). EDTA titrimetric method was used for calcium and magnesium (total hardness) estimation and argentometric method for chloride determination.

Water samples were collected in pre-cleaned plastic containers of 5 L capacity and closed tightly. The samples were pretreated and proved property. A total of 30 ground water samples were collected for determination of concentration of fluoride concentration and other parameter such as pH, TH, Ca^{2+}, Mg^{2+}, SO_4^{2-}, Na^+, K^+, Cl^-, NO_3^-, PO_4^{3-} by standard methods.

For comparative evolution, correlation co-sufficient was determined between various parameters (Table 1 and 2).

Table 1: Analytic result of ground water samples of Hojai Sub-division of Nagaon Distric (Values are expressed in mg/L except pH) TH = Total hardness, T = Tubewell, RW = Ring well

S. No.	pH	TH	Ca^{2+}	Mg^{2+}	SO_4^{2-}	F^-	Na^+	K^+	Cl^-	NO_3^-	PO_4^{3-}
TW1	7.21	46	32	20	46	0.48	11	09	32	2.2	0.521
TW 2	7.12	48	40	28	55	0.24	8	16	28	1.8	0.548
TW 3	7.32	60	16	27	19	0.52	6	4	47	1.2	0.584
TW 4	7.04	50	18	20	34	0.64	13	6	49	0.6	0.422
TW 5	7.38	474	80	60	140	1.20	30	22	45	0.3	0.642
TW 6	7.52	88	120	80	128	0.48	12	36	48	1.4	0.408
TW 7	7.42	48	60	70	22	0.72	14	20	40	2	0.422
TW 8	7.22	68	72	48	30	0.08	13	18	46	0.28	0.448
TW 9	7.02	60	80	29	18	0.06	2	2	32	0.16	0.548
TW 10	7.44	28	42	21	38	3.0	14	12	37	2.3	0.922
TW 11	7.08	36	46	32	30	9.0	12	18	29	1.8	0.668
TW 12	7.11	26	56	38	27	0.02	38	8	40	2.2	0.322

Cont…

S. No.	pH	TH	Ca^{2+}	Mg^{2+}	SO_4^{2-}	F^-	Na^+	K^+	Cl^-	NO^-_3	PO_4^{3-}
TW 13	7.12	40	72	62	45	0.16	13	16	35	1.2	0.462
TW 14	7.00	26	35	30	40	5.0	52	20	40	0.88	0.488
TW 15	7.06	46	31	21	36	4.0	24	20	52	1.9	0.622
TW 16	7.08	42	28	26	19	0.40	8	4	47	0.68	0.582
TW 17	7.2	40	34	30	217	1.00	40	12	46	1.2	0.721
TW 18	7.03	56	39	60	300	10.0	9	28	45	1.7	0.720
TW 19	6.92	36	90	72	27	0.08	80	6	60	1.6	0.411
TW 20	7.08	48	112	96	37	7.0	19	14	106	1.1	0.488
TW 21	7.06	24	22	24	29	15.0	42	22	45	0.93	0.28
TW 22	7.21	46	32	20	46	20.0	11	09	32	2.2	0.521
TW 23	7.21	46	32	20	46	13.0	11	09	32	2.2	0.521
S1	7.21	46	32	20	46	0.48	11	09	32	2.2	0.521
S2	7.00	30	28	12	30	1.30	9	12	39	1.2	0.608
S3	7.00	30	28	12	30	15	9	12	39	1.2	0.608
S4	6.95	67	48	61	18	0.09	23	2	20	0.82	0.672
RW1	7.06	24	22	24	29	15.0	42	22	45	0.93	0.828
RW2	7.22	32	41	29	80	0.96	17	11	38	0.92	0.261
RW3	7.06	29	46	17	66	0.08	11	3	22	0.08	0.422

Table 2: Correlation coefficients of Hojai Sub-Division ground water Samples

Parameters	pH	TH	Ca^{2+}	Mg^{2+}	SO_4^{2-}	F^-	Na^+	K^+	Cl^-	NO_3^-	PO_4^-
pH	1										
TH	-0.033	1									
Ca^{2+}	0.268	0.167	1								
Mg^{2+}	0.203	0.077	0.822	1							
SO_4^{2-}	0.079	0.106	0.077	0.202	1						
F^-	0.028	-0.354	-0.448	-0.377	0.345	1					

Cont…

Parameters	pH	TH	Ca^{2+}	Mg^{2+}	SO_4^{2-}	F^-	Na^+	K^+	Cl^-	NO_3^-	PO_4^-
Na^+	-0.341	0.032	0.120	0.188	0.015	0.305	1				
K^+	0.400	0.206	0.275	0.341	0.406	0.445	0.021	1			
Cl^-	-0.013	0.078	0.387	0.472	0.034	0.096	0.237	0.181	1		
NO_3^-	0.248	-0.190	-0.132	-0.005	0.007	0.091	0.096	0.254	0.034	1	
PO_4^{3-}	-0.087	0.205	-0.102	-0.011	0.356	0.548	-0.332	-0.053	-0.114	0.091	1

In the present study there is no industrial, like smelted plant power station, fertilizer corporation, etc. area with capabilities of producing fluorides contains in the ground water. So the main source of fluoride and there concentration in water is geological source.

RESULTS AND DISCUSSION

Table 3: The name of sampling stations and their sources

S. No.	Sampling station	Source of water	Sample No.
1.	Kalibari	Tube well	TW1
2.	Santiban	Tube well	TW2
3.	Amtola	Tube well	TW3
4.	Nandpur	Tube well	S1
5.	Sankardev Nagar	Tube well	TW4
6.	Panigoan, Kachali	Tube well	TW5
7.	Amola Patty	PHE Supply Water	S2
8.	T. P. Road Haibargaon	Tube well	TW6
9.	R. M. Road Itachali	PHE Supply Water	S3
10.	A. D. P. Road .Bengalipatty	Tube well	TW7
11.	Dimuruguri	Tube well	TW8
12.	Teli Basti	Tube well	TW9
13.	Radha Nagar	Tube well	RW 1
14.	Jugijan	Tube well	TW10

Cont…

S. No.	Sampling station	Source of water	Sample No.
15.	Kaki	Tube well	TW11
16.	Lanka town	Tube well	TW12
17.	Howraght	Tube well	TW13
18.	Bhalukmari	Tube well	TW14
19.	Dhalpukhuri	Tube well	RW2
20.	Padumpukhuri	Tube well	TW15
21.	Shikarigati	Tube well	TW16
22.	Oamgaon	Tube well	TW17
23.	Doboka Town	Tube well	TW18
24.	Haongaon	Tube well	TW19
25.	Barpukhuri	Tube well	RW3
26.	Komorakata	Tube well	TW20
27.	Haldihati	Tube well	TW21
28.	Parokhowa	Tube well	TW22
29.	Nij Parokhowa	PHE Supply Water	S4
30.	Akashiganga	Tube well	TW23

The value of PO_4^{3-} was found to be highest for TW10 and 2nd highest for RW1 sample whereas all sources of water studied in the work were found to contain phosphate at higher concentration levels then the limit of WHO (0.1 mg/L) and thus not to be absolutely fit for use as drinking water sources. Phosphate, if consumed in excess, may produce phosgene gas in the gastrointestinal tract on reaction with gastric juice which can lead even to death of consumers.

All sulphate measurement study except samples No. TW 18 record in the present were found to lie within the guideline levels of WHO (250 mg/L). Sulphate may be present in natural water in several thousand milligrams per liters. Excessive sulphate contains of drinking water may cause catheric effect It may also cause corrosion of metals at high concentrations, specally at lower alkaline water. At high concentration levels sulphite may induce diarrhea. Moreover, laxative effect may occuer at lower concentrations if Mg is present in water at equivalent concentrations.

The range of F^- concentrations of present ground water samples very from 0.2 to 20 mg/L. the positive correlation of pH with F suggested that pH is important when F^- is determined in ground water. From previous observations by other elevated F^- in the ground water generally associated with low value of Ca^{2+}. The positive correlation of F^- with Na^+ and negative correlation with SO_4^{2-} suggests that higher value of F^- was associated with high Na^+ and low SO_4^{2-}. Fluoride showed fairly good positive correlation with depth of sources when plotted separately for different locations.

Of Hojai Sub-division, Out of thirty sample, twenty samples have F^- concentrations were not exceptionally high. Although there is no industrial activities at Hojai Sub-Division with capabilities of producing F^- contains in ground water, the main source of this F^- contamination in groundwater at fluoride effected area may be due to the presence of intertrappean sedimentary become soluble in entrapped water by favorable physic-chemical conditions. The F^- contains in groundwater basically depend on the contact with the F^- bearing minerals. The three major source of F^- in india are fluorspars, rock phosphates and phosphorites. The F^- contains in groundwater varies from place to place due to differences in geographical chemical and physical characteristics of water bearing aquifers, the porosity of rocks, the pH and temperature water. When F^- containing minerals in the rocks and soils come into contact with the ground water, they release F^- into water by the process of hydrolysis. Fluorides are ubiquitous in nature and present in rock, soil, water, plants, foods and even air. F^- value of groundwater samples in the following of regions are found in the range 3 mg/L to 20 mg/L.

Table 4

S. No.	Sampling station	Source of water	Sample No.
1.	Jugijan	Tube well	TW10
2.	Kaki	Tube well	TW11
3.	Bhalukmari	Tube well	TW14
4.	Padumpukhuri	Tube well	TW15
5.	Doboka Town	Tube well	TW18
6.	Komorakata	Tube well	TW20
7.	Haldihati	Tube well	TW21
8.	Parokhowa	Tube well	TW22
9.	Nij Parokhowa	PHE supply water	S3
10.	Akashiganga	Tube well	TW23

Dental carries is decay of tooth. Dental carries is a bacterially based disease. When it progresses, acid produced by bacterial action on dietary fermentable carbohydrates diffuses into the tooth and dissolves the carbonated hydroxyapatite mineral-a process called demineralization. Pathological factors including acidogenic bacteria (*mutants streptococci* and *lactobacilli*), Salivary dysfunction, and dietary carbohydrates are related to caries progression, protective factors, which include salivary calcium, phosphate and proteins, salivary flow, fluoride in saliva, and antibacterial components or agents-can balance, prevent or reverse dental caries. Caries progression or reversal is determined by the balance between protective and pathological factors, The results of the initial survey in present study area indicates that about 80% of population was affected by the dental carries Dental fluorosis occurs because of the excessive intake of fluoride either through fluoride in the water supply, naturally occurring or added to it; or through other sources. The damage in tooth development occurs between usually from birth to approximately 6-8 years of age, from the overexposure to fluoride. Teeth are generally composed of hydroxyapatite and carbonated hydroxyapatite; when fluoride is present, fluorapatite is created. Excessive fluoride can cause yellowing of teeth, white spots, and pitting or mottling of enamel. Fluorosis can not occur once the tooth has erupted into the oral cavity. At this point, fluorapatite is beneficial because it is more resistant to dissolution by acids (demineralization).

Almost all the people are suffering from dental fluorosis and skeleton fluorosis in present fluoride effected study area. So precaution should be taken by the people of area Jugijan, Kaki. Bhalukmari, Padumpukhuri, Doboka Town, Komorakata, Haldihati, Parokhowa, Nij Parokhowa Akashiganga region where fluoride level was found beyond permissible limit.

Skeletal fluorosis is a bone disease exclusively caused by excessive consumption of fluoride. Mild cases cause no symptoms or problems. In advanced cases, skeletal fluorosis causes pain and damage to bones and joints. Advanced cases usually involve about ten times the normal amount of fluoride. In India, the most common cause of fluorosis is fluoride-laden water derived from borewell dug deep into the earth while fluorosis is most severe and widespread in the two largest countries –India and China –UNICEF estimates that "Fluorosis is endemic in at least 25 countries across the globe. The total number of people affected is not known, but a conservatives estimate would number in the tens of millions "Common causes of fluorosis include inhalation of fluoride dusts/fumes by workers in industry, use of coal as an indoor fuel source (a common practice in China), and consumption of fluoride from drinking water. In China, the World Health Organization recently estimated that 2.7 million people have the crippling form of skeleton fluorosis, while in India 17 of its 32 states have identified as endemic areas, with an estimated 66 millions people at risk and 6 million people seriously affected. According to scientific surveys skeletal fluorosis in India and China occurs when the fluoride concentration in water exceeds 1 ppm and has been found to occur in communities with only 0.7 ppm. The Chinese government now considers any water supply containing over 1 ppm fluoride a risk for skeletal fluorosis. In United States an average of 1 ppm fluoride is purposely added to water supplies for water fluoridation while the maximum contaminant level (as established by the US Environmental Protection Agency) is 4 ppm.

Limeback's concern is seconded by an increasing number of scientist studying the fluorosis problem in India and China. The emerging consensus in that part of the world is that fluoride – in addition to damaging the bones – may also demage the brain, the kidneys, the reproductive system and other organs as well.

It has been recognized for over five decades that fluoride may have both beneficial and potentially harmful effects on dental health. While the prevalence of dental carries is inversely related to range of concentration of fluoride in drinking water consumed the prevalence of dental fluorosis has been shown to be positively related to fluoride in take from many source. Public health programmes seeking to maximize the beneficial effects of fluoride on dental health through the introduction of fluoridated drinking-water have, at the same time, strived to minimize its adverse fluorotic effects on teeth. Based upon the studies conducted by Dean and colleagues five decades ago, the "optimum" level of fluoride in drinking water associated with the maximum levels of dentals caries protection and minimum level of dental fluorosis, was considered to be approximately 1 mg/L. The effect of fluoride on dental health were examined by WHO experts committee.

F^- causes dental fluorosis if present in excess of 1.5 mg/L in drinking water and skeletal fluorosis beyond 3 mg/L, if such water is consumed for about 8-10 years.

In the present study area, although F^- contents in ground water samples above the guide line value. 80% of total population was suffered from dental and skeletal fluorosis since last twenty years in the fluoride affected area. The percentage of affected people by dental and skeletal fluorosis in the present study area is very high precaution should be taken by the people where fluoride level was found beyond permissible limit.

The different method so far tried for the removal of excess fluoride from ground water can be broadly classified into four categories, namely adsorption method, ion exchange method, precipitation method and miscellaneous methods. Out of the above the precipitation method. For this there should be 40 L plastic bucket and there should be a tap above 8 inches from the bottom of the bucket. 100 mg alum and 5 – 7 mg lime is mixed with per litre of water. Stirring is done for 10 – 15 min. and left for 1 hr. Precipitation of fluoride takes place and people get ware free from fluoride by this process.

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