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Fluoride hydrochemistry of Dikrong river basin, Arunachal Pradesh, India

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ABSTRACT

In order to understand the fluoridation condition of drinking water of Dikrong River Basin in Papumpare District, Arunachal Pradesh. The total of 30 groundwater samples collected from tube well, ring well, stem water, dug well and rivers from Dikrong River basin, papumpare district, Arunachal Pradesh, India were analysed for fluoride contamination, besides water quality Parameters such as pH, calcium, magnesium, manganese, iron and major anions such as chloride, nitrate etc.out of these thirty samples eighteen samples were taken from tube wells, ten samples from ring wells and two from rivers. The concentration of fluoride in the water samples ranged between 0.00 and0.48 mg/L and revealed that all water samples contain fluoride permissible limit.

Key words: Fluorosis, fluoride, Dikrong River, papumpare district.

INTRODUCTION

Fluoride occurs naturally in New Hampshire's bedrock.Fluoride in drinking water has appeared as serious problem. Fluorosis is considered as serious type of disease due to long term intake of excessive fluoride. Two main kinds of fluorosis, namely Dental fluorosis and skeletal fluorosis have been identified. Dental fluorosis Patients chronically develop yellowing of teeth and pitting or mottling of enamel. Skeletal fluorosis is a bone disease exclusively caused by consumption of about ten times of the normal amount of fluoride. Mild cases of skeletal fluorosis cause slight problems. However, in serious cases, skeletal fluorosis results in unbearable pain as well as severe damage to bones and joints. There are several commonly accepted causes for fluorosis such as long term intake of high fluoride groundwater, and exposure to high fluoride gas from coal burning. Water being a very good solvent dissolves all kind of impurities (solids, liquids, and gases) decomposition of plants and animals, particles suspended in water such as clay, silt, sand, and other solid particles, which absorb or reflect light turbidity. Excess of these impurities causes pollution of water or make it unsafe for drinking purposes including heavy metals like Fe, Mn, and Mg as well as fluoride, nitrates, and chloride. Their excess in water causes many diseases in plants and animals. This study has been carried out to find out the water pollutants and to test the suitability of water for drinking and irrigation purposes in itanagar and naharlagun surrounding areas in Arunachal Pradesh. The study area is the papumpare district which lies between 26^{0}28’north and29^{0}30north latitude and91^{0}30’east and96^{0}30’east longitudes.

MATERIALS AND METHODSs

Drinking water samples were collected from different parts of the district in October and November 2012. Samples were collected from 30 different samples of drinking water representing villages, town and forest. Drinking water each sources such as tube well, ring well, stream water, dug well and rivers were collected in clean and dry 1L acid wash polypropylene containers from papumpare district in Arunachal Pradesh and analyzed to understand the hemical variations of water quality parameters using standard methods. Each of the water samples were analyzed for pH, major cations and anions. Calcium content was estimated by ethelenediamminetetraacetic acid titrimetric method and magnesium was calculated by the difference in the hardness and calcium. The nitrate was analyzed by the UVvisible spectrophotometer. Chloride was calculated by argentometric titration method.. Fluoride content was determined by using

SPADNS methods using UV- visible spectrophotometer (Shimadzu UV-mini 1240) calibrating against blank and standard sodium fluoride Solutions. The chemicals used in all the purposes were of analytical grade (procured from Merck, India).

RESULTS AND DISCUSSION

Table-1 Ranges of chemical parameters and their comparison with WHO and BIS for drinking water

Chemical parameter	Concentration of ions Minimum	Maximum	Average	WHO standard (1997) (desirable - permissible)		BIS standard (1997) desirable - permissible)	
pH	6	7.9	6.95	9.2	-	6.5	9.2
Ca2+ (mg/L)	4	27.2	17.6	75	200	75	200
Mg2+(mg/L)	1.5	12.2	6.85	30	150	30	100
Mn2+ (mg/L)	0	0	0	0.4	-	0.4	-
Fe3+ (mg/L)	0.001	0.5	0.250	0.1	1	0.1	1
Cl-(mg/L)	60	285	172.5	250	600	250	1000
F^-(mg/L)	0	0.48	0.48	0.9	1.5	1	1.5
NO^3-(mg/L)	0.08	1.56	0.82	50	100	45	100

The analytical results of 30 various water samples of the study area are presented in Table-1. The pH of the analyzed sample varies from 6.0 to 7.9 with a mean value of 6.95. PH of various samples are almost neural in nature. Calcium concentration in the samples ranged from 4 to 27.2 mg/l and magnesium concentration in the samples ranged from 1.5 to 12.2 mg/l. Calcium is naturally present in water. It may dissolve from rocks such as limestone, marble, calcite, dolomite, gypsum, fluorite, and apatite. The significant increase in the calcium and magnesium concentration might be due to the fact of high evaporating rate or due to the increased rate of decomposition. Calcium is a dietary mineral present in the human body of an amount of about 1.2 kg. Calcium phosphate is a supporting substance, and it causes bone and tooth growth, together with vitamin D. it is partially responsible for muscle contractions and blood clotting. Calcium regulates membrane activity, it assists nerve impulse transfer and hormone release, stabilizes the pH of the body, and is an essential part of conception. In order to stimulate these body functions, a daily intake of about 1000 mg of calcium is recommended for adults. During the period of the study, iron (mean, 0.250 mg/L) and manganese (mean, 0.0 mg/L). While the permissible limit of iron and manganese prescribed by WHO for drinking water are 1 mg/l and 0.4mg/L.the values of chloride ranged from 60 to 285mg/l, while the permissible limit of chloride prescribed by WHO for drinking water is 600 mg/l. The minimum concentration of chloride may be due to dilution in large amount while high content in the samples may be due to the input of highly soluble chloride salts and high evaporation rate. Nitrate in the samples varied from 0.08 to 1.56 mg/l.The permissible value of NO3- is 100 mg/l; above this concentration water becomes harmful and causes a disease namely methamoglobinemia in infants a condition known as "blue baby." The infant is being asphyxiated because oxygen cannot be transported by the blood. Prompt medical attention normally results in quick recovery of the infant. Fluoride concentration varied in all the water samples from 0.0 to 0.48 mg/l and was found negligible at study area while the permissible limit of fluoride prescribed by WHO for drinking water is 1.45 mg/l. The fluoride levels around 0.5-1.0 mg/l reduce the risk of dental caries, while significantly higher levels may cause skeletal fluorosis, depending on water intake and the fluoride content of the diet. All water samples have fluoride content lesser than the recommended levels of 1.5 mg/L. The distributions of fluoride in the study area are plotted in Fig-1.

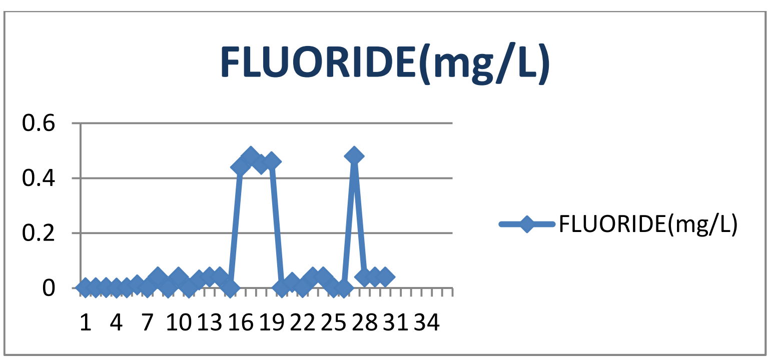
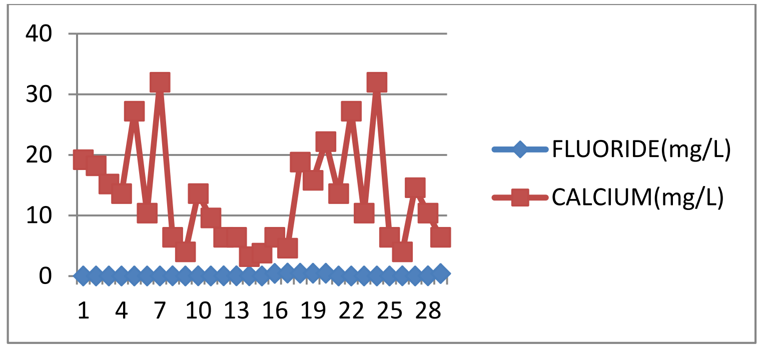
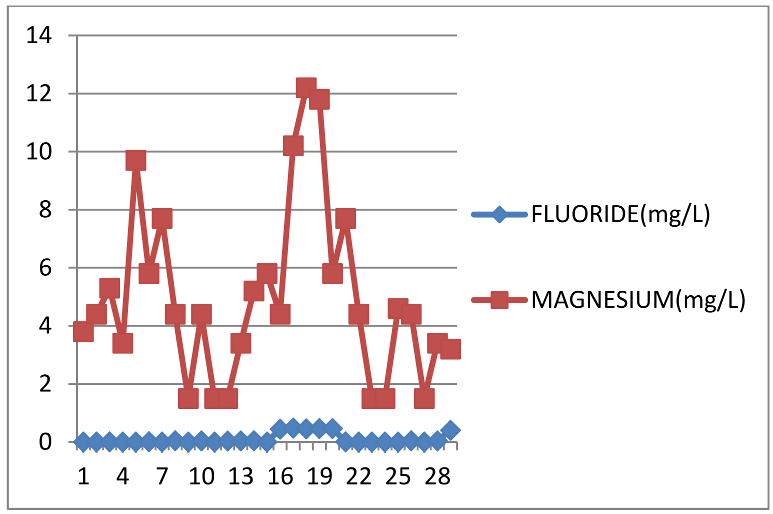


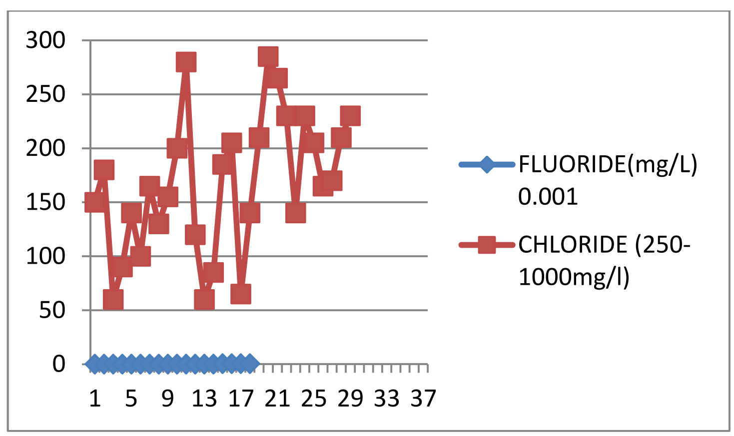
Fig-1 Fluoride distribution in various samples



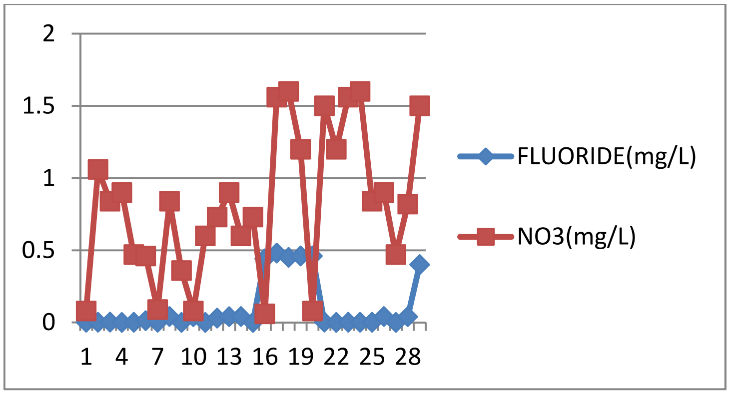
(a)



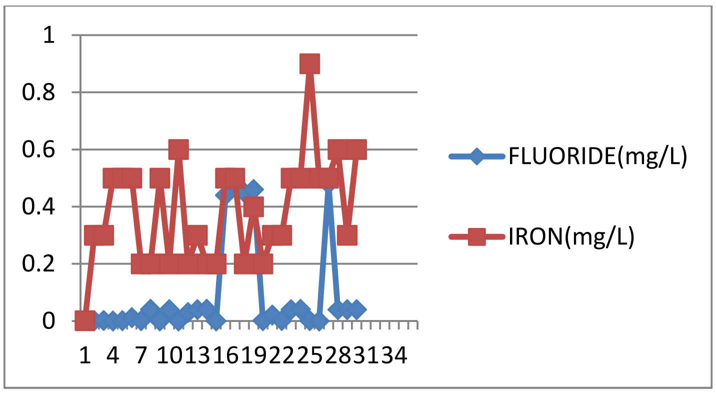
(b)



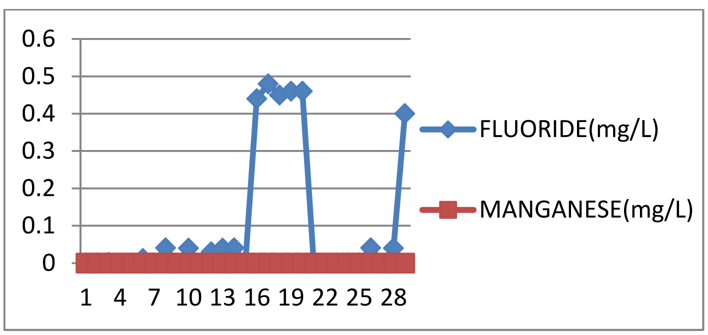
(c)



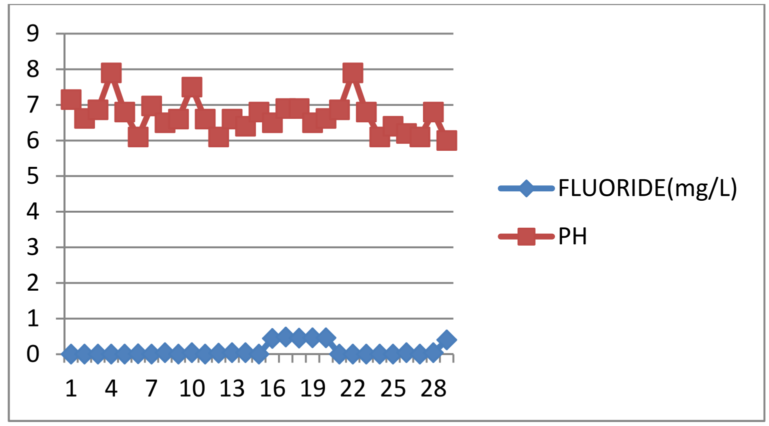
(d)



(e)



(f)



(g)

Fig-2 correlation of different parameters with fluoride concentration.

(a) F^- vs. Ca^{2+}, (b) F^- vs. Mg^{2+}, (c) F^- vs. Cl^- ,(d) F^- vs. NO_3^-, (e) F^- vs. Fe^{3+}, (f) F^- vs. Mn^{2+}, (g) F^- vs. PH ,

CONCLUSION

Ground and surface both water samples are the reliable source of drinking water for the people residing in the study area. The negligible fluoride concentration in the various water samples of the study area implies that there is no need to implement precaution measures about defluoridation.It is safe and sound from fluoride. Dilution of fluoride rich water with fluoride free water should be encouraged.

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