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Determination of Fluoride in Drinking Water in the Vicinity Area of Raipur District

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Research Paper

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ABSTRACT

Ground water forms a major sources of drinking water in urban as well as rural areas. More than 90% of the rural population uses ground water for domestic purposes .The aim of this study is the determination of fluoride concentration in ground waters of Raipur rural areas .Twenty samples were collected from four blocks of Raipur districts covering bore well, tap water. Open well and municipal water. Samples were collected in pre monsoon and post monsoon from year 2022 to2024. Determination of fluoride ion concentration was done by using Ion selective electrode. In the study area the maximum fluoride ion concentration in ground water was noted 1.6 to 3.6mg/l in different villages due to seasonal variations and salt water concentration. Result were indicated that in all the samples concentration of fluoride was higher than the permissible limit.

Introduction

Fluoride is one of the contaminants in ground water from natural geological sources, which is most hazardous , if found in excess. Fluoride in small dosages has remarkable influence on the dental system by inhibiting dental carries, while in higher dosages causes dental and skeletal fluorosis . In general, fluoride content in water between 1.5-2.0 mg/l may lead to dental mottling, which is characterized initially by opaque white patches on the teeth and in advanced stages leads to dental fluorosis followed by pitting of teeth surfaces. High manifestations of dental fluorosis are mostly found in children up to the age of 12 years and skeletal fluorosis (3,3) may occure when fluoride concentrations in drinking

water exceed 4-8 mg/l. Crippling skeletal fluorosis can occur when the water supply contains more than 10mg/l of fluoride (3,5&6).The severity of fluorosis depends on the concentration of fluoride in the drinking water, daily intake, continuity and duration of exposure, and climatic condition.

In India , approximately 62 millions people including 6 million children suffer from fluorosis because of consumption of high fluoride content. Industrial processes such as cement, electronics and steel making furnaces also contribute to high concentration of fluoride in the environment (2,6).The WHO guideline for fluoride is 1.5mg/l (4,4).which is the same as EEC guideline(4,5).U.S.,EPA also it had determined maximum concentration 4mg/l to prevent bone fluorosis (4,6).The aim of this study is to determine the concentration of fluoride in the vicinity areas of Raipur district and compare it with the permissible limit(5).

Material and methods

Groundwater samples were collected from 20 dug wells , bore wells, hand pump(where there is no dug well)and municipal water supply in the vicinity areas of Raipur rural areas during pre monsoon and post monsoon of year 2022-24. Samples for analysis were collected in sterilized bottles using the standard procedure for grab or catch sample in accordance with standard methods of APHA(1995)while collection temperature of these areas was noted by 110^0C thermometer. The fluoride content of the water samples was estimated by the Zirconium-SPADNS spectrophotometric method(11,10)and cross-checked by analysis with a fluoride ion selective electrode. Electrical conductivity and pH were measured using EC and pH meters. Double distilled water was used for the preparation of solutions. All the chemicals and reagents used were of analytical grade.

Results and discussion

The results obtained on the analysis of various parameters are presented in Table -1

Temperature

Temperature is an important parameter because it effects the biochemical reactions in aquatic organism. At high temperature the solubility of gases is decreased and amplifies the tastes and odours. The average temperature of the study areas ranged from 25^oC to 30^0C.

pH

The pH values of different waters samples in study areas varies from 7.0 to 7.5,indicating the slightly alkaline conditions which is due to the solubility of fluoride bearing minerals.

Electrical conductivity (EC)

Conductivity of water is an important parameter for determining the water quality for drinking and agriculture purposes. The electrical conductivity of water samples are obtained in the range of 0.32 to 0.81 m mhos/cm.

Fluoride

Fluoride occures naturally in underground waters of many places. These enter into the groundwater from hard rocks containing fluoride mineral like fluorspar(CaF_2),apatite($CaF_23Ca_3(PO4)_2$), Cryolite(Na_3AlF_6),Fluorosilicate. Fluoride problem is not limited to human being alone, but it effects plants , domestic and other animals. The permissible limit of fluoride in drinking water is 1.5mg/l. Out of 20 samples about 15 samples the fluoride content is exceeded 1.5mg/l above the permissible limits prescribed by the WHO and ISI standards but 5 samples (s_1,s_2)fluoride content is slightly above the permissible limit (Table-2). It is due to the natural processes such as weathering and leaching of fluoride-bearing minerals in rock formation.

Conclusion

Due to simplicity and reliability, the method can be recommended for the determination of fluoride in drinking water at low concentration.

Table - 1 Parameters of underground water

Sample no.	Name of villages	Ph	EC, mho/cm.	Temperature, O^oC	Fluoride, mg/l
S-1	Accholi	7.2	0.81	27	1.8
S-2	Borid	7.0	0.79	27	2.9
S-3	Charoda	7.0	0.77	26	3.0
S -4	Chikhli	7.5	0.76	27	1.52
S-5	Bendri	7.1	0.38	27	1.6
S -7	Kanhera	7.2	0.32	28	3.12

S-8	Tenduwa	7.2	0.35	28	3.22
S -9	Biladi	7.5	0.43	27	3.56
S -10	Hatband	7.0	0.45	27	3.54
S -11	Parsada	7.3	0.68	27	3.36
S -12	Ninwa	7.2	0.75	27	3.6
S -13	Amaseoni	7.0	0.75	28	3.23
S-14	Borea Kalan	7.1	0.74	28	3.3
S -15	Borjhara	7.0	0.75	28	3.0
S-16	Chandnidih	7.1	0.75	30	3.12
S -17	Deori	7.2	0.72	30	3.14
S -18	Dunda	7.0	0.73	29	3.56
S -19	Akoli	7.0	o.79	30	3.34
S-20	Datranga	7.2	0.77	29	3.24

Arang block – S_1 to S_4 ,Abhanpur block – S_5 to S_8 ,Tilda block - S_9 to $S_{12,}$, Dharsiwa S_{13} to S_{20}

Table -2 Blocks of Raipur district & Sources of drinking water

S.No.	Block	Collection of water samples	Sources of drinking water
1	Arang	From four villages	Borewell &Tap water
2	Abhanpur	From four villages	Bore well &well water
3	Tilda	From four villages	Bore well,Tap & Well water
4	Dharsiwa	From eight villages	Bore well,Tap & Well water

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