Appraisal of Underground Water Quality with Special Emphasis on Fluoride Contamination and its Suitability of Drinking Use in Sandur Taluk Part of Bellary District, Karnataka, India

D. M. Thotappaiah[1] T. Suresh[2] Manjappa S[3]
[1,2,3]Department of Chemistry
[1,2]Vijayanagara Sri Krishnadevaraya University, Bellary-583104, Karnataka, India
[3]University BDT College of Engineering, Davangere-577005, Karnataka, India

Abstract— Groundwater is the main source for drinking the rural area of the sandur taluk. Fluoride is dietary in human beings in rural as well as metropolitan zones throughout the world. The present study was conducted to determine the fluoride and other water quality parameters in the ground water of Sandur taluk of Bellary district of Karnataka, India. A total of twenty five groundwater samples were randomly collected at different depths from bore well water and hand pumps. The fluoride content in underground water is determined by ion selective electrode method. From the study it was observed that Sandur taluk of three villages are showing above the permissible limit of WHO. The results showed that fluoride concentration in the ground water of Sandur taluk ranges from 0.89-1.89 mg/l. Three villages are above the permissible limit and fourteen villages are showing medium range (1.2 – 1.4 mg/l) of fluoride content during the study period. The study reveals that most of the people are using and depending upon groundwater for domestic and irrigation purpose. Therefore, the intake of fluoride concentration is high as people using groundwater without any prior treatment. The results suggest that the groundwater should be used by the residents only after defluoridation. The study revealed that due to mining activity and assessment of groundwater samples from various parameters indicates that groundwater in three villages of the study area is contaminated with fluoride hence, unsuitable for drinking purpose (Laksmipura, Tumati and Nidagurthi). The data structures may be show that mining activity and geological structure contributing the higher concentration of fluoride content in aquifer of Sandur taluka, Bellary District.

Key words: Fluoride, Ground Water, Drinking Water, Defluoridation, Sandur

I. INTRODUCTION

The water is abiotic, which is also called as environmental factors and liquid gold, which is given by God. It is most important for all living organisms on the sphere. Most of the species and especially human beings depends on water for their survival including uncontaminated and clean water for drinking purposes. The water is used by human beings for different purposes like food, production, nutrition are dependent on water availability in adequate quantities and good quality (Gupta, et al., (2006). From the previous study it is revealed that and estimated that approximately one third of the total population of the world are depending on groundwater for drinking purposes and today more than half the world's population depends on groundwater for survival (Raju,et al., (2009). The major concern is most of the municipalities are supplying water to public without biochemical treatment for drinking purposes, hence the level of pollution has become a causes for human health (Rao, 2009).

Fluoride is one of the minor constituent in underground water. Fluoride content is considered as essential parameters in apprising the ascertaining the suitability for drinking water (IS: 10500 and WHO, 1997). Fluoride content in underground water is mainly due to geological structure and natural flow is still not well understood (Saxena & Ahmed, 2001). Fluoride, an electronegative element, it is not present in element state since it is highly reactive. It converts the element structure and forms covalent forms. Handa, (1975) expressed in their work in semi-arid climate, crystalline igneous rocks and alkaline soils are mostly affected the fluoride content in water. Originally the fluoride content enters into the water through weathering of alkali, igneous and sedimentary rocks. The most common present in Fluorspar, Cryolite and fluorite and also found in granite, gneisses and permaite (Nagarajan, et al., 2010). Along with the natural sources the fluoride also enters into the water through anthropogenic activities. The industry like coal burning unit, manufacturing industries like aluminum, steel, phosphate, fertilizer industry, impurities from these industries leached into the underground (Deshmukh, et al., 1995 and Rango, et al., 2008).

However and according to previous study and our best knowledge there are no studies conducted on the analysis with reference to fluoride in Sandur taluka, Bellary district, Karnataka state, India. The main objectives of the present study is analyses the fluoride content in selected ground water of Sandur taluka and its surroundings of the Bellary district.

II. STUDY AREA

The present study is carried out at Sandur area of Bellary district, Karnataka which is geographically bounded by 15° 10' and 15°50' north latitude and 76° 55' and 76° 61' east longitude covering an area of above 565 meters (Figure 1). Sandur and its surrounding village's places of natural beauty with lush green mountains, valleys, deep gorges and most of the villages are depending upon the ground water for their daily needs. The Sandur town located to the south of Hosapete. It located on the southern edge of the original Vijayanagara metropolitan area. Sanduru Taluka has deposits of manganese ore and hematite (iron ore), and is home to several mines and steel plants in and around the taluka. Study area receives 750mm of elevation but has seen more than 1000mm of rainfall. As per 2011 census the population of the study area is 37,431.

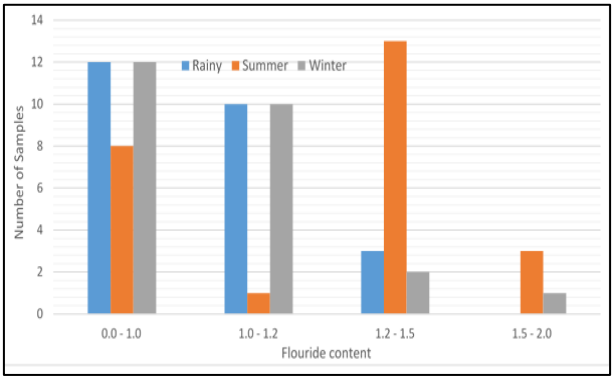

Fig. 1: Frequency Distribution of Fluoride in the bore well and hand pumps in the Sandur Taluk, Bellary District

III. METHODOLOGY

Twenty five groundwater samples were collected from 25 different locations of the study area which includes Sandur Taluk during October-November 2016. Sample location map of the study area is shown in Figure 1. The samples were collected from bore wells and hand pumps which were extensively used for drinking and other domestic purposes. The samples were collected in pre-cleaned and sterilized polyethylene bottles of two litre capacity. The depth of the bore wells varied between 250 and 1800 feet. The groundwater samples were analyzed using APHA (1995) procedure, and suggested precautions were taken to avoid contamination.

IV. RESULTS AND DISCUSSION

Fluoride rich minerals are fluorite, apatite, mica, amphiboles and clay. In the study area the major source of F is gneissic and charnockite rocks, which has high concentration. Fluoride concentrations in the study area varied between 0.730 to 1.50 mg/l during rainy season, 0.89 mg/L to 1.82 mg/L during summer season and during winter season 0.73 mg/L to 1.50 mg/L during the study period. Out of 25 villages samples analysed, only three ground water samples were observed above the permissible values of fluoride. All other samples analyzed showed lower concentrations of fluoride compared to the prescribed permissible values. Maximum fluoride concentration (1.82 mg/l) was observed in the sample collected at Laxmipura outside the village during summer season, while the minimum value (0.73 mg/l) was observed in Jaisingpura village during rainy and winter seasons. Fluoride concentrations in groundwater of the study area are shown in Table 2. W.H.O has suggested maximum permissible limit of fluoride 1.0 mg/l in drinking water. About 52% of the samples of the study area are exceeding the permissible limits of fluoride during rainy season, about 72% during summer season and during winter season same trends were shown as in rainy season.

Sl No	Village	location	Latitude and Longitude	BW/HP	Rainy	Summer	Winter
1	Laxmipura	Outside village	15.10 Lati, 76.48 Longi	B.W	1.50	1.82	1.50
2	Nandihalli	near school	15.11 Lati, 76.48 Longi	B.W	1.02	1.24	1.02
3	Tumati	Down the village	15.10 Lati, 76.48 Longi	H.P	1.33	1.62	1.33
4	Bujanganagara	Near bus stop	15.11 Lati,76.48 Longi	B.W	0.99	1.2	0.99
5	Narasingapura	bus stop circle	15.10 Lati, 76.48 Longi	H.P	0.81	0.98	0.81
6	Ranajithpura	near school	15.12 Lati, 76.48 Longi	H.P	1.02	1.24	1.02
7	Susheelanagara	Hospet road side	15.10 Lati, 76.47 Longi	H.P	1.01	1.23	1.01
8	Siddapura	near devi temple	15.12 Lati, 76.48 Longi	H.P	0.81	0.98	0.81
9	Jaisingpura	outside	15.12 Lati, 76.48 Longi	B.W	0.73	0.89	0.73
10	Venkatagiri	near Anjaiani temple	15.12 Lati, 76.48 Longi	B.W	0.76	0.92	0.76
11	Dowlatpura	near masjid	15.10 Lati, 76.50 Longi	B.W	0.99	1.21	0.99
12	D.Thimmalapura	Outside village	15.04 Lati, 76.49 Longi	H.P	0.84	1.02	0.84
13	Taranagara	near halla	15.12 Lati, 76.50 Longi	H.P	0.99	1.21	0.99
14	Muraripura	Near doni	15.11 Lati,76.50 Longi	H.P	0.76	0.92	0.76
15	V-Nagalpura	Behind the govt. school	15.11 Lati, 76.50 Longi	B.W	0.81	0.98	0.81
16	Taluru	Govt. school	15.11 Lati, 76.51 Longi	B.W	0.99	1.21	0.99
17	Chikkantapura	road side Agriculture land	15.12 Lati, 76.53 Longi	B.W	1.01	1.23	1.01
18	S-Basapura	near bus stand	15.11 Lati, 76.52 Longi	H.P	1.02	1.24	1.02
19	Kurekuppa	Road side	15.11 Lati, 76.52 Longi	B.W	0.73	0.89	0.73
20	Dharmapura	Ashryaya colony	15.11 Lati, 76.52 Longi	B.W	1.02	1.24	1.02
21	Yashavantanagara	Kudligi road side	15.04 Lati, 76.49 Longi	B.W	1.09	1.32	1.09
22	Nidagurthi	beside the pond	15.03 Lati, 76.48 Longi	B.W	1.25	1.52	1.25
23	Mallapura	near govt. school	15.03 Lati, 76.48 Longi	B.W	1.02	1.24	1.02
24	Katinakamba	near bus stand	15.02 Lati, 76.47 Longi	B.W	1.09	1.32	1.09
25	Bandri	inside vasavi temple	15.02 Lati, 76.47 Longi	H.P	1.19	1.45	1.19

Table 1: Location of the sampled bore well and hand pumps in the Sandur Taluk, Bellary District

Parameter	Fluoride			
	Rainy	Summer	Winter	Average
Max	1.500	1.820	1.500	1.607
Min	0.730	0.890	0.730	0.783
Mean	0.991	1.205	0.991	1.062
SD	±0.190	±0.232	±0.190	±0.204

Table 2: Statistical variation of obtained data various parameters during rainy, summer and winter seasons

	Rainy	Summer	Winter
Mean	0.9912	1.2048	0.9912
Standard Error	0.0381	0.0464	0.0381
Median	1.01	1.23	1.01
Mode	1.02	1.24	1.02
Standard Deviation	0.1903	0.2319	0.1903
Sample Variance	0.0362	0.0538	0.0362
Kurtosis	0.8779	0.8129	0.8779

Skewness	0.7634	0.7438	0.7634
Range	0.77	0.93	0.77
Minimum	0.73	0.89	0.73
Maximum	1.5	1.82	1.5
Sum	24.78	30.12	24.78
Count	25	25	25

Table 3: Descriptive Statistics of ground water in and around the Sandur Taluk

Important factors that determine concentration of fluoride in groundwater is availability and solubility of (F -) minerals, pH, temperature, anion exchange capacity of aquifer materials, type of geological materials and residence time, porosity, structures, depth, groundwater age, concentration carbonate and bicarbonates in water (Apambire, et al., 1997).

Fluoride concentration in natural waters depends on several factors such as temperature, pH, presence or absence of ion complexes or precipitation of ions and colloids, solubility of fluorine-bearing minerals, anion exchange capacity of aquifer materials (OH) for F), the size and type of geological formations through which the water flows and the time water is in contact with a particular formation. Principally, controls are governed by climate, host rock composition and hydrogeology. Areas of semiarid climate, crystalline rocks and alkaline soils are mainly affected (Sunitha, et al., 2012). High fluoride concentrations groundwater suggest that favorable conditions exists for the dissolution of fluoride In the study area fluoride contamination is mainly a natural process i.e. leaching of fluorine bearing minerals, since no man-made pollution has been noticed.

V. CONCLUSIONS

Ground water samples collected from 25 villages in Sandur taluka, Bellary district. The minimum and maximum content of fluoride in selected ground water samples were analyzed. Most of the ground water samples in study area were found within the drinking water quality standard (IS: 10500 and WHO, 1996). In three villages the fluoride content shown above the permissible limit. The study revealed that rock-water interaction is the major source of fluoride in ground water and very much influenced by local lithology. Especially in the study area anthropogenic activities also play significant role in the occurrence of fluoride in three villages (Laksmipura, Tumati and Nidagurthi) which are shown fluoride content above the permissible limit. Alternatively, the existing groundwater may be effectively utilized in the study area by taking up a pilot projects like de-fluoridation on priority basis. This study will be helpful in solving problem related to drinking water in the study area and further carry out research in this direction.

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