

Seasonal Distribution of Fluoride level in Ground Water Hospate Taluk, Bellary District Karnataka, India and its Suitability Assessment for Drinking Purposes

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ABSTRACT

The major objective of the present study was to find out the vulnerable bore well water in terms of fluoride contamination. A total of 50 groundwater samples were collected from major drinking water sources in Hospet Taluk Bellary District and studied with reference to the distribution and hydro- geochemistry of fluoride. Fluoride concentration in ground water samples of Hospet taluk, Bellary district is determined by Ion Selective Electrode method, a total of twenty five samples were collected and analysed in the study area. Fluoride ion exhibits single properties compared to other physico-chemical parameters as its concentration in optimum dose in drinking water is advantageous to health and if the concentration exceeds the limit, affects the health. The lowest and highest fluoride levels observed are 0.52 in summer (pre monsoon season) to 2.19 mg/L during winter season with an average of 1.10 mg/L, 1.07 mg/L and 1.12 mg/L during monsoon, summer and winter respectively. Both the minimum and maximum observed levels have slight deviation with minimum (0.5 mg/L) and maximum permissible (1.5 mg/L) limits. The overall concentration levels of fluoride in the study area and during the study period are about 12 locations (30%), 11 locations (27.5%) and 13 (32.5%) locations falls in category III during summer, monsoon and winter season respectively. Hence there is urgent need of public awareness programmers to prevent the population from fluorosis in fluoride contaminated location in the study area.

Keywords: Underground water, Fluoride, category – III, Hospet, Ion Selective Electrode, fluorosis

I. INTRODUCTION

Currently in world, ground water is main source for domestic, industrial water supply and irrigation, availability of good quality of water will help in development of any country. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Fresh water occurs as surface water and ground water in this groundwater contributes only 0.6% of the total water

resources on the earth. It is major and preferred source of drinking water in rural and urban areas particularly in India (Gupta, et al., 2006).

In India along with the other physical and chemical pollution another two acute public-health problems induced by utilization of groundwater as a source of drinking water having excess of fluoride. It is important element and essential for normal mineralization of bones and formation of dental enamel. The fluoride content exceed the permissible limit in the human body, it becomes toxic and would affect on the metabolic turbulence in animals especially in human beings including dental and skeletal flourosis (Hussain, et al., 2002).

Fluorine is the 17th abundant element on earth's crust representing 0.06%–0.09% of the earth's crust. Fluoride is important for bones and tooth formation. The main source of fluoride for the human body is usually drinking water. The concentration of fluoride in groundwater is principally governed by the climate, the composition of the host rock, and the hydrogeology. Bureau of Indian Standard / Specification for Drinking Water (BIS: 105001991) classified the permissible limit of fluoride in drinking water as 1.50 ppm which is 1.5 mg/l.

Kundu, et al., 2001, deleberated in their study, fluoride level crossed the desirable limits in groundwater is a major problem in many parts of the world. Especially, fluoride is a common geo-genic pollutant of drinking water, and in the developing countries and industrial sector, effects of fluoride on human health have been recognized. Areas with semiarid climate, crystalline rocks and alkaline soils are mainly affected.

On the other hand, Gupta et al., (2005) reported in their work apart from natural sources, a considerable amount of fluoride may be contributed due to anthropogenic activities. Hence in the present work aims at a pollutant characterization of the groundwater bodies in the selected locations, with special reference to fluoride contamination, and to highlight the probable causes of contamination, different fluoride related health and environmental concerns have reached an alarming proportion in many regions of the Hospet taluk Bellary district.

II. MATERIALS AND METHODS

Geology of Hospet Geologically rocks of granodiorite and granite associated with iron and manganese ore bands. The rock formations are joined and are traversed by doleritic dykes, Weathering in hard rock's is limited to 5 meters from ground level where as in schist and phyllite extends upto 20 meters.

A. Experimental Work

Present study comprises of interpretation and analysis of ground water samples collected from twenty five different locations at all over Hospet taluk. In our study, first we mark the sampling locations in five different zones of the city, then stations were established and groundwater samples were collected. The samples were analyzed for fluoride concentration and results were carefully studied and analyzed. The present study provides a detailed description of the fluoride level in groundwater. Fifty representative ground water samples were collected during the year 2017-2018.

B. Collection and Analytical procedure for Samples:

Ground water samples were collected in plastic bottles, which were previously thoroughly washed with tap water and rinsed with double distilled water. Groundwater level in the wells is documented and pH of groundwater samples is measured in the field using a handy pH meter. In the present study bore well water samples are collected after pumping the water for 10 min. Samples collected are transported to the laboratory and filtered using 0.45- μ m Millipore filter paper. The fluoride concentration of groundwater samples is determined using Specific Ion Electrode method (APHA, 1998).

Fluoride analyzed using fluoride Ion selective electrode with Magnetic stirrer as per the standard method. Prepared the Fluoride Standards of various ranges (0.2 - 10 ppm) used the Fluoride Buffer (TISAB- Total Ionic Strength Adjustment Buffer). Calibration curve of the instruments are prepared from standard solutions by serial dilution. Instrument is calibrated using standard fluoride solutions before conducting the experiment.

III. RESULTS AND DISCUSSIONS

The measured fluoride levels in selected ground water were represented in Table 1. All the selected locations were categorized according the following fluoride level and results are given in (Table 2). The abstract of fluoride content (Table 3) indicating the maximum fluoride level during winter season and minimum in summer season. Summary of the statistical values of the fluoride content is represented in Table 4.

Category I: Fluoride concentration below 1.0 mg/L

Category II: Fluoride concentration between 1.0 - 1.5 mg/L

Category III: Fluoride concentration between 1.6 - 3.0 mg/L

The variation of fluoride level in ground water samples of Hospet taluk Bellary District is depicted in Figure 2. Figure 3 shows the no. of villages and their fluoride level range as per divided category and Figure- 4 depicts the percentage of selected locations with respect to above categories. The distribution of average fluoride level is indicated in Table 3.

In the present study, the level of fluoride ranges between 0.52 in summer (pre monsoon season) to 2.19 mg/L during winter season in selected ground water samples, with lowest value 0.52 mg/L (HW-30) in Kallahalli- Kaniverayan Gudi, location and highest value 2.19 mg/L (HW-6) in SeetharamTanda (N R Camp) location. The study reveals that out of 50 selected locations of Hospet taluk, Bellary district (60%) have fluoride concentration below 1.0 mg/L in the entire study and all the seasons. On the other hand, 4 locations (10%), 5 locations (12.5%) and 3 locations (7.5%) have fluoride concentration ranges between 1.0 to 1.5 mg/L during monsoon, summer and winter season respectively. As per the WHO guidelines, the people consume these types of fluoride contaminated water and fluoride intake through drinking water is more than 4 mg/day is may possible to causes dental fluorosis (Gautam, et al., 2011 and V K Naik and Suresh B, 2015).

The results reveals that, 12 locations (30%), 11 locations (27.5%) and 13 locations (32.5%) 14 villages (28%) have ground water with fluoride concentration equal to 1.6 mg/L and below or equal to 3.0 mg/L during monsoon, summer and winter seasons respectively. As per the BIS and WHO 1.6-3.0 mg/L is above the maximum permissible limit. If this contaminated water is consumed, teeth lose their shiny appearance and chalky black, gray, or white patches develop known as mottled enamel. In the entire study, in 11 locations (27.5%) fluoride concentration in ground water is more or equal to 1.5 mg/L and below or equal to 2.5 mg/L. The intake of fluoride per day by population in these habitations is very high and cause dental as well as skeletal fluorosis. In the entire study 12 locations (30%), 11 locations (27.5%) and 13 (32.5%) locations falls in category III, in these locations fluoride concentration is above 2.5 mg/L, which may result in all types of fluorosis among residents.

The source fluoride content depends upon various factors like rock and soil crust, porosity of the soil, water flow, existence of geological minerals, interaction of water and rocks, rainfall, and temperature of the earth crust (Tailor and Chandel 2010; Singh P et al. 2011; Arif, M. Hussian et al. 2012).

IV. CONCLUSIONS

In the present study, estimation of level of fluoride content in the ground water of Hospet taluk, Bellary district. Variation in the seasonal also studied in the present study. Study reveals that there is acute problem in Hospet Taluk, Bellary district as only 12 locations (30%), 11 locations (27.5%) and 13 (32.5%) locations falls in category III during summer, monsson and winter season respectively have fluoride content with in the permissible limit (> 1.5 mg/L, WHO) and remaining 60% of selected locations are having very low (<1.0) fluoride concentrations. Study provides the positive factor which adds to rise of fluoride in ground water is presence of fluoride rich rock salt classification. The result of current study also reveals that there is an immediate requirement of defluoridation techniques and public awareness programmes to prevent the population from fluorosis in fluoride contaminated location in the study area.

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Figure 1. Showing Location map of the North East of the Hospet Taluk, Bellary District

			Fluoride level			
SI No.	Locations	Sampling Point Code	Monsoon (Rainy Season)	Summer (Pre monsoon)	Winter Season	
1	Nagenahalli	HW-1	2.10	1.45	1.77	
2	Nagenahalli (Basavadurga)	HW-2	1.20	0.97	1.19	
3	Kamalapaura (oppSriKari College)	HW-3	1.80	1.28	1.57	
4	SeetharamTanda Cross	HW-4	0.98	0.94	0.96	
5	SeetharamTanda (Mustafa Darga)	HW-5	1.90	1.76	1.88	
6	SeetharamTanda (N R Camp)	HW-6	2.02	1.97	2.19	
7	Bukkasagara (76 Venkartapura)	HW-7	2.12	2.10	1.99	
8	Bukkasagara (76 Venkartapura) Near Anjaneya Temple	HW-8	1.89	1.76	1.93	
9	Bukkadagara (SC-ST Keri)	HW-9	1.46	1.68	1.84	
10	Ramasagara (Near SugandiRenukamma House)	HW-10	0.89	0.71	0.87	
11	Ramasagara (Near SugandiShivamurthy House)	HW-11	0.92	0.94	0.91	

Table 1. Location of the bore wells in the North East of the Hospet Taluk, Bellary District

12	Sanaapura (near Narasimha House)	HW-12	0.78	0.79	0.81
13	Devasamudra (Near Health Centre)	HW-13	0.72	0.74	0.76
14	Devasamudra (Harejayagnuru)	HW-14	0.78	0.71	0.87
15	Hampadevanahalli (ChikkaJayaganuru)	HW-15	0.79	0.76	0.79
16	Hampadevanahalli (Near Dugulamma Temple)	HW-16	0.76	0.74	0.79
17	Devalapura (OppMahadevana House)	HW-17	0.62	0.71	0.62
18	Devalapura (Nallapur)	HW-18	0.72	0.71	0.74
19	Gadiganuru (OppMallikarjuna House)	HW-19	0.68	0.72	0.78
20	Gadiganuru (Opp Hospital)	HW-20	0.99	0.97	0.99
21	Bylavaddigeri (Dharmasagara)	HW-21	1.62	1.58	1.59
22	Bylavaddigeri (Kakubalu)	HW-22	1.82	1.86	1.84
23	P K Halli (Ganesh Tample)	HW-23	0.89	0.97	0.92
24	P K Halli (Ingalagiri)	HW-24	0.82	0.86	0.92
25	Hosapete (T B Dam) Muttumariyamma Temple	HW-25	0.78	0.79	0.76
26	Hosapate (Industrial Area)	HW-26	0.68	0.69	0.72
27	Hosapete (Sanakiveerabadra temple)	HW-27	0.78	0.81	0.79
28	Hosapete (Chittavadigeppa temple)	HW-28	0.68	0.72	0.69
29	Kallahalli (Vyasanakere Station)	HW-29	0.72	0.72	0.75
30	Kallahalli (KaniverayanGudi)	HW-30	0.56	0.52	0.57
31	Kallhalli (JambaiahHola)	HW-31	0.68	0.69	0.67
32	Danaapura (Galemma temple Hola)	HW-32	0.72	0.76	0.74
33	Danaapura (Hampinkatte)	HW-33	0.82	0.76	0.93
34	Danaapura (Ayyanhalli)	HW-34	1.09	0.94	1.06
35	M MHalli (Anjinappa Home)	HW-35	1.03	1.08	1.04
36	D N Kere (Devalapura) ShyariDurgammanaGudi	HW-36	2.04	1.94	1.89
37	D N Kere (Gollarahalli) near GowdruVenkatesh House	HW-37	1.92	1.85	1.95
38	Nagalapura (Hullinamane)	HW-38	1.82	1.78	1.84
39	Nagalapura (Byalakundi)	HW-39	0.78	0.76	0.82
40	Chilakanahatti (Ajanta Nagalingamata)	HW-40	2.10	1.45	1.77

Table 2. Table showing the fluoride categorization of sampling locations in Hospet Taluk, Bellary District

	Representing Samples					
	Monsoon (Rainy Season)	Summer (Pre monsoon)	Winter Season			
Category I (< 1.0)	HW-4, HW-10, HW-11, HW	-16, HW-17, HW-18, HW-19,				
	HW-20, HW-23, HW-24, HW-25, HW-26, HW-27, HW-28, HW-29, HW-30, HW-31, HW-32,					
	HW-33, HW-39					
Category II (1.0 - 1.5)	HW-2, HW-9,	HW-1, HW-2, HW-34, HW-35,	HW-2, HW-34,			
	HW-34,HW-35	HW-40	HW-35			
Category III (1.6 - 3.0)	HW-1, HW-3, HW-5, HW-6,	HW-3, HW-5, HW-6, HW-7,	HW-1, HW-3, HW-5, HW-6,			
	HW-7, HW-8, HW-21, HW-	HW-8, HW-9, HW-21, HW-22,	HW-7, HW-8, HW-9, HW-			
	22, HW-36-, HW-37, HW-	HW-36, HW-37, HW-38	21, HW-22, HW-36, HW-37,			
	38, HW-40		HW-38, HW-40			

Table 3. showing the abstract of fluoride distribution in Hospet Taluk Bellary District

No. of	Minimum		Maximum		<1.0		1.0 - 1.5		1.6 - 3.0						
Locations	Monsoon (Rainy Season)	Summer (Pre monsoon)	Winter Season												
50	0.56	0.52	0.57	2.12	2.10	2.19	24 (60%)	24 (60%)	24 (60%)	4 (10%)	5 (12.5%)	3 (7.5%)	12 (30%)	11 (27.5%)	13 (32.5%)



Figure 2. Picture Showing the Variation in Fluoride (mg/L) with sampling locations in Hospet Taluk, Bellary District



Figure 3. Picture Showing the Number of Locations as per Fluoride (mg/L) level in Hospet Taluk, Bellary District

	Fluoride (F-)						
Seasons	Monsoon (Rainy Season)	Summer (Pre monsoon)	Winter Season				
Mean	1.1023	1.0718	1.1210				
Standard Error	0.0806	0.0758	0.0792				
Median	0.82	0.81	0.91				
Mode	0.78	0.76	1.84				
Standard Deviation	0.5033	0.4734	0.4944				
Sample Variance	0.2533	0.2241	0.2444				
Kurtosis	-0.7940	-0.5919	-0.7751				
Skewness	0.9344	1.0176	0.9328				
Range	1.56	1.58	1.62				
Sum	42.99	41.8	43.72				

Table 4. Comparison of statistical data of different metals during the study period