

Studies on Ground Water Fluoride Content and Water quality in Phagi Tehsil of Jaipur District

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ABSTRACT

The problem of high fluoride in ground water is one of the most important health related geo-environmental issue. It is beneficial up to certain limits but excess intake (i.e. > 1.5mg/L) may cause fluorosis. Therefore, fluoride in groundwater was studied in Phagi Tehsil of Jaipur district where some villages were under surveillance. Groundwater's samples were periodically collected and analyzed for physico-chemical parameters including fluoride, nitrate, pH, total dissolved solid (TDS), total hardness, calcium hardness, magnesium hardness, chloride and total alkalinity. The analytical results revealed considerable variations in the chemical composition of water samples. Fluoride concentration varies from 2.07 to 12.3 mg/L and which is a serious threat for health of the people living in these villages.

Keywords: Drinking water, Fluoride content, Analytical technique, Phagi Tehsil.

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INTRODUCTION

Fluoride is one of important life elements to human health. It is essential for normal mineralization of bones and formation of dental enamel with presence in small quantity [6]. When fluoride is taken up more than permissible limit, it become toxic and causes clinical and metabolic disturbance in animals and human being such as dental and Skeletal Fluorosis [4, 11, 12, 21]. Owing to the universal presence of fluorides in earth's crust, all water contains fluorides in varying concentrations ranging from trace levels to several milligrams per liter [26] in surface. Fluoride has been used as a therapeutic agent in dental caries but excess intake (>1.5 mg/L) may cause serious health hazards including dental fluorosis, skeletal fluorosis and non-skeletal fluorosis in children as well as in adults along with secondary neurological complications [27,28,20,24,5,19]. During the last three decades high fluoride concentration in water resources and the resultant disease fluorosis is being highlighted considerably throughout the world. Nearly three million people of our country are consuming excess fluoride containing water, especially rural population [2]. In Rajasthan groundwater is characterized by comparatively high concentration of fluoride ions 22 districts out of 32 are presently consuming water contaminated with fluoride [21]. Earlier some workers reported that fluoride and fluorosis was correlated with high concentration of fluoride ion in drinking water [10, 25, 6, 9, 1]. Thus water samples were randomly collected from various location of the study area to assess the quality of groundwater bodies, with special attention to fluoride.

MATERIALS AND METHODS

Sample Collection

Groundwater samples were randomly and periodically collected in pre cleaned polyethylene bottle from various villages of Phagi Tehsil (Jaipur district) of Rajasthan as given in Table 1. A total of 64 water samples were collected in pre cleaned polyethylene bottle and brought to the laboratory for analysis using standard techniques for physico-chemical parameters.

Water Analysis

Physico-chemical parameter like fluoride, nitrate, pH, total dissolved solid, total hardness, calcium hardness, magnesium hardness, chloride and total alkalinity, were determined as per standard methods APHA [3].

Fluoride Analysis

Fluoride concentration was determined with the help of selective ion meter (Thermo Scientific Orion). Standard procedure for determining the fluoride was followed APHA [3]. In order to achieve satisfactory results total Ionic strength adjustment buffer (TISAB) was used to maintain a suitable ionic strength and also to avoid complex formation.

Table-1: Analytical data of ground water of some villages of Phagi Tehsil

S. N.	Village/ Habitation	source	location	pH	Total alkalinity	Total hardness	Calcium hardness (as CaCO ₃)	Magnesium hardness (as CaCO ₃)	Chloride(as Cl ⁻)	Nitrate (as NO ₃ ⁻)	Fluoride (as F ⁻)	Total dissolved solids (TDS)
1	Renwal Mazi	HP	Infront of Govt. Middle School, Phagi Road	7.6	750	130	50	80	400	20	6.5	1890
2	Renwal Mazi	HP	Near Hameed Pancharwala, Phagi Road	7.5	1220	200	80	120	380	30	4.6	2240
3	Renwal Mazi	HP	Nidhi Beauty Parlar, Phagi Road	7.4	1150	440	200	240	830	222	2.4	3010
4	Renwal Mazi	HP	Shiv Raj Shop, Manpur Gate, Phagi Road	7.5	1040	350	160	190	640	110	3.7	2590
5	Renwal Mazi	HP	Main Road, Harsuliya	7.5	440	260	110	150	120	4	2.2	1050
6	Renwal Mazi	HP	Near Police Choki, Renwal Mazi	7.6	740	250	100	150	40	4	2.9	1260
7	Phagi	HP	In front of Sharwan Meena, Subhash Colony, Phagi	7.8	610	130	50	80	330	50	3.1	1610
8	Phagi	HP	In front of Kailash Vyas, Subhash Colony, Phagi	8.0	460	110	40	70	170	20	6.2	1120
9	Phagi	HP	Keriya Mor, Phagi	8.1	650	740	300	440	570	20	6.9	3010
10	Lashadiya	HP	At Lashadiya Mor	7.9	770	630	280	350	680	2	6.5	3080
11	Keriya	HP	Near School, Keriya	8.1	660	230	100	130	360	66	8.9	1820
12	Keriya	HP	Near Shoram, Keriya	8.0	690	780	300	480	1280	40	6.9	3290
13	Keriya	HP	Near Chhitar, Keriya	7.8	650	290	120	170	330	22	4.9	1820
14	Keriya	HP	Near Talab, Keriya	7.8	660	260	110	150	330	32	6.4	1680
15	Keriya	HP	Near Veer Tejaji Mandir, Keriya	7.9	700	250	100	150	310	50	7.4	1820
16	Keriya	HP	Near Bawadi, Keriya	7.9	710	400	160	240	420	28	5.9	2310
17	Khandoj	HP	Near Laxman, Khandoj	7.9	510	440	170	270	470	114	3.9	1960
18	Mohanpura	HP	Near Jai Ambe Public School, Mohan Nagar	7.7	490	150	60	90	150	6	2.8	1050
19	Jai Chand ka Bas	HP	Infront of Heeraman Sthan, Jai Chand ka Bas	7.7	750	430	180	250	440	202	3.3	1960
20	Jai Chand ka Bas	HP	Outside Govt. Up. Pri. School, Jai Chand ka Bas	7.8	650	250	110	140	250	186	3.7	1400

21	Gopal Nagar	HP	Mangalji, Tut ki dhani, Gopal Nagar	7.7	470	310	130	180	800	40	2.6	2380
22	Phagi Road	HP	Thala Mor, Phagi Road	7.8	450	220	90	130	350	38	2.7	1470
23	Thala Road	HP	Jagdish Mali, Bag ki dhani, Thala Road	7.9	670	490	220	270	960	52	2.9	2520
24	Thala	HP	Govt. Up. Pri. School Thala	7.8	750	90	30	60	90	48	5.0	1190
25	Bichi	HP	Mali Mohalla	7.8	140	120	50	70	40	22	2.11	462
26	Jharana Khurd	HP	Bairawa Basti	8.0	380	360	160	200	540	98	3.8	2310
27	Jharana Khurd	HP	Near Road	7.7	360	520	220	300	840	52	2.42	2620
28	Jhonpariya	HP	In School	7.8	160	100	40	60	140	102	3.42	1260
29	Jugal Kishorpura	HP	In UPS	7.9	480	240	100	140	500	32	2.7	3080
30	Hanootiya Kalan	HP	Near School	7.8	140	280	120	160	140	48	2.25	1050
31	Mukandpura	HP	Near Road	7.7	160	1220	690	530	1600	58	2.58	3500
32	Sarswatipura	HP	Near UPS	7.8	200	240	100	140	280	22	6.18	1540
33	Sehdariya	HP	In UPS	7.9	200	220	90	130	140	32	2.4	1260
34	Sehdariya	HP	Jat Basti	8.0	140	360	160	200	240	114	2.13	1330
35	Sehdariya	HP	Jat Mohalla	7.8	180	340	150	190	280	38	9.08	1680
36	Thala	HP	Bag KD, Ward No. 7	7.9	100	880	410	470	1180	156	2.09	2800
37	Thala	HP	Jat Mohalla	7.7	200	540	250	290	260	62	2.97	2660
38	Thala	HP	Near Balaji Mandir	7.8	160	260	110	150	340	84	4.16	1610
39	Thala	HP	In UPS	7.9	240	100	30	70	140	104	5.17	1330
40	Datooli	HP	Thakur ji ka Mohalla	7.8	180	340	150	190	460	58	2.07	1820
41	Jhadla	HP	Near Road	7.9	480	260	110	150	1100	32	5.13	3010
42	Rata Khera	HP	Near UPS	7.8	220	1040	590	450	2020	20	2.45	4760
43	Rata Khera	HP	Meena Basti	8.0	160	1560	820	740	3460	8	2.57	6370
44	Teekel Narukan	HP	Near Talai	7.8	80	120	40	80	660	26	3.89	1960

45	Balapura	HP	Gauchar	7.7	160	300	130	170	500	76	3.12	2100
46	Deonagar	HP	Gadotiya KD	7.8	140	100	30	70	240	22	3.16	1610
47	Gopal Nagar	HP	Jat Mohalla	7.9	120	480	220	260	900	62	5.83	2400
48	Mandor	HP	Near BNRGSC	7.7	180	160	60	100	480	30	3.02	1960
49	Mandor	HP	Gujar Mohalla	7.8	160	400	180	220	880	102	3.34	2450
50	Pinch	HP	In UPS	7.9	200	120	40	80	440	98	8.61	2030
51	Pinch	HP	Kalbeliya Basti	7.7	240	80	20	60	360	82	12.3	1960
52	Rewantpura	HP	Banjara Basti	7.9	280	180	80	100	760	82	6.99	2660
53	Rewantpura	HP	Banjara Basti	7.8	220	320	150	170	900	102	4.97	2800
54	Teekel Purohitan	HP	Near Tejaji	7.9	280	500	220	280	2220	248	3.48	3570
55	Rampura Railway	HP	Near Road	7.8	140	900	410	490	1420	58	5.9	3430
56	Awandiya	HP	Near Talai	7.9	140	1020	560	460	1340	62	2.14	3430
57	Pachala	HP	In School	8.0	180	180	80	100	1060	22	3.52	2100
58	Sewa ka bas	HP	Near Road	7.9	180	240	100	140	760	88	4.61	2380
59	Sultaniya	HP	Gujar Basti	7.9	180	320	140	180	300	14	2.7	1540
60	Bheempura	HP	Near GPS	7.8	160	540	250	290	720	58	2.77	2450
61	Harbanshpura	HP	Gujar Basti	7.8	240	260	110	150	740	24	5.61	3450
62	Harbanshpura	HP	Near UPS	7.9	100	220	90	130	180	60	3.37	1120
63	Koonchyawas	HP	In GPS	7.9	120	360	160	200	500	26	2.3	1610
64	Koonchyawas	HP	Biarawa Basti	7.8	100	480	220	260	1040	16	2.65	2520

Table-2: Standards of drinking water parameters WHO and USPH (Except pH all parameters are in mg/l)

Parameters	WHO	USPHA
pH	6.5-8.5	6.5-8.5
Total Alkalinity	-	600
Total Hardness	500	600

Calcium Hardness	-	-
Magnesium Hardness	-	-
Chloride	250	1000
Nitrate	45	45
Fluoride	1.5	1.5
Total Dissolved solids	1000	2000

RESULTS AND DISCUSSION

The physico-chemical examinations including fluoride content are presented in the Table 1. The results reveal that fluoride content in groundwater samples of some villages varied from 2.07 to 12.3 mg/L. In sixteen water samples of some villages, fluoride contents ranged from 3.0 to 6.0 mg/L (Table 1). Fluoride content in fourteen samples of villages was very alarming having 6 to 12.3 mg/l. The maximum content of fluoride were recorded in Pinch (12.3mg/l), Sehdariya (9.081mg/l) and Keriya (8.09 mg/l). The permissible limit for fluoride content is 1-1.5 mg/L according to W.H.O. [28]. The data revealed that some villages of Phagi Tehsil are affected with high concentration of fluoride, where as 52% villages it was within limit. As, teeth appear to be most susceptible organs to fluorine poisoning and concentration higher than 2 ppm of fluorine initiate mottling [23,18] showed that even concentration 1.2 ppm, cause dental fluorosis during period of tooth mineralization. The pH in almost all of the sources was slightly alkaline in the range of 7.5 to 8.1. In the groundwater samples of Phagi Tehsil, Ratakhera village area has maximum TDS (6370mg/l) while Bichi area had minimum (462 mg/l). The Rajiv Gandhi National Drinking Water Mission [17] identified high total dissolved solids as a water quality problem in Rajasthan along with high nitrates and high fluorides. The increase in TDS is due to increase in salts containing carbonates, bicarbonates and chlorides [14]. The measured chloride concentration in the water samples ranged from 90mg/l to 2220 mg/l. Maximum chloride was recorded at Ratakhera (6370mg/L) minimum (462mg/l) was found at Bichi. W.H.O. recommended safe permissible limit for chloride (200-600 mg/l). The chloride in groundwater may be contributed from minerals like mica and apatite as also from the liquid inclusions in the igneous rocks [8]. Moreover, higher content of chloride may have deleterious effects on metallic pipes as well as aquatic flora and crops [15]. Hardness of water is a complex mixture of cations and anions. The principal hardness causing ions are calcium and magnesium. The total hardness, calcium and magnesium in the water are interrelated. In the present study concentration of Total hardness varied from 80 to 1560 mg/l. Minimum and maximum was reported from Bichi and Ratakhera villages respectively. The permissible limit of total hardness for drinking water is 100-500 mg/l as per W.H.O. Further, calcium hardness was recorded minimum 20 mg/l in Bichi and maximum 820 mg/l in Ratakhera. The permissible limit for calcium is 75-200 mg/l as per W.H.O. [16] have attributed high fluoride content in water of Northern Tanzania to their exceptionally low calcium and magnesium concentrations. In a study of forty seven bore wells, that low calcium and negligible magnesium concentrations corresponded to relatively high fluoride values [13]. High value of alkalinity gives an undesirable taste to water. Among the total samples 35 samples were beyond permissible limit (200 mg/l). The maximum value of alkalinity was found in sample of Ratakhera village (160 mg/l) and minimum (240 mg/l) was observed from Bichi village. The adverse effects on human health are due to consumption of fluoridated water. It is recommended to take some measures for defluoridation of drinking water. Otherwise major health hazards will inevitably experienced as some of the areas have very high fluoride content in the drinking water.

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