Int. J. Chem. Sci. : 3 (1), 2005, 129–134

PHYSICO–CHEMICAL STUDIES OF FLUORIDE IN GROUND WATER OF PATAN REGION (GUJARAT)

J. D. JOSHI[a], JABALI VORA, SANGITA SHARMA, NAVIN PATEL, OJAS KOTHARI and KRUTIKA SALVI

Department of Chemistry, Hemchandracharya North Gujarat University, PATAN – 384 265 (Gujarat) INDIA
[a]Department of Chemistry, Sardar Patel University, VALLABH VIDYANAGAR – 388 120, (Gujarat) INDIA

ABSTRACT

A study has been undertaken for the determination of fluoride in drinking water at Patan Taluka and its nearby villages. Fluoride was measured with the help of ion selective electrode method. Most of these villages have more concentration of fluoride than suggested by WHO and ISI. Samples taken from this region have been analyzed and it was found that 75 villages are prone to the excess fluoride concentration in drinking water. The values of fluoride were found to be 0.454 mg/L to 11.4 mg/L.

Key words: Drinking Water, Fluoride, Patan region, Fluorosis.

INTRODUCTION

Large–scale incidences and severity of fluorosis in different parts of India suggested that out of the various components of the environment, water is the major contributor to the fluorosis problem[1]. Water is the first need for human beings. About 25 million people in 8700 villages in India are using ground water having fluoride concentration more than 1.5 mg/L[2,3].

Surface water seldom has fluoride in excess of 0.3 mg/L. Ground water sources such as dug wells, shallow and deep hand pumps and especially tube wells may contain excess fluoride where minerals like cryolite, biotite and fluorapatite are present. This is mainly due to the dissolution of fluoride from fluoride bearing minerals. About 96 per cent of the fluoride in the body is found in bones and teeth. Fluoride is also essential for the normal mineralization of the bones and formation of dental enamel. Fluorite (CaF_2) is a scarce industrial mineral and major source of fluoride contamination in water and soil. Fluorspar is commonly known as an ore of mineral fluorite. Fluorite/Fluorspar occurs in many rocks in varied forms[4]. Gujarat, Rajasthan and Madhaya Pradesh are the only fluorite producing states. In Gujarat, Amba Donger (Kadi pani) in Chhota Udaipur taluka of Vadodra district is the principal producing region. The fluoride content of the rocks due to repeated weathering gets slowly dissolved in water when the water acquires acidic nature. In this procedure, water gets contaminated by fluoride[5].

Permissible limits of fluoride concentration in drinking water as per WHO guidelines is up to 1.5mg/L. The probable relationship between fluoride concentration in drinking water and its effects are here.

Fluoride Concentration mg/L	Effect
Less then 1.5	No effect
1.5 to 3.0	Dental Flurosis
3.1 to 6.0	Mild Skeletal Fluorosis
More then 6.0	Crippling Skeletal Fluorosis

The excessive amount of fluoride in water and environment is poisonous[6]. Fluoride endemicity has been reported in several districts of 19 Indian states and Union territories. The affected population is 25 million and at least 15 Indian states (including Gujarat) have been identified as having excess fluoride in drinking water.

In Gujarat, 200 samples were analyzed in Mahesana district, 116 samples having more than 1.5 mg/L fluoride concentration and 64 samples having fluoride above 1.5 mg/L but TDS and nitrate were within limit[8].

Symptoms

In dental flurosis, the common symptoms observed are discloration of the teeth. It may start with white yellow and become brown to black. The discoloration may be in sports/streaks, invariably horizontal in orientation; during its development, new layers of the matrix are added. Dental fluorosis is usually reversible if no permanent damage is done[9]. The recovery has been observed in case of several patients using fluoride reduced water during treatment.

In skeletal fluorosis, high dose of fluoride replaces bone calcium by calcium fluoride, bones become soft, crumble and chalky white. Maximum effects of fluoride are detected in the neck, knee, pelvic, shoulder joints, small joints of the hands and feet.

In children, dental fluorosis is observed but skeletal manifestations are not observed. In old age patients, disease like osteoporosis, rheumatoid arthritis etc. are chief causes of knee joint affection. In young patients, fluorosis is chiefly responsible for knee joint problems.

EXPERIMENTAL

In the present study, bore well water samples were collected from Patan Taluka, North Gujarat, India. Samples are collected in the brown glass bottles without adding any preservative. Samples are collected with necessary precautions[10], during March 2003 to May 2003. Hundred samples were collected of this region.

All chemicals used in this analysis were of A.R. grade. The concentration of fluoride was determined by ion selective electrode No. ORION 9409 B.N., Ref electrode No. 900100 and THERMO ORION NO. 920 A^+ ion meter. 10 mL of aliquot was taken in polythene beaker and 1 mL of TISAB II (Total Ionic Strength Adjuster Buffer, ORION Application solution) was added. Ion meter was calibrated by known concentration of fluoride like 1mg/L, 10 mg/L and read directly on the meter scale. The concentration of fluoride was determined in terms of mg/L. The standard permissible value of fluoride according to APHA, BIS, WHO and Ministry of Urban Development are given in Table 1[11].

Table 1. Limits of fluoride concentration (mg/L)

International Standards		Indian Standards		Ministry of Urban–Development		WHO (2003)	
Min. Acc. Conc.	Max. Allow. Conc.	Min. Acc. Conc.	Max. Allow. Conc.	Min. Acc. Conc.	Max. Allow. Conc.	Min. Acc. Conc.	Max. Allow. Conc.
0.7	1.5	0.7	1.5	1.0	1.5	1.0	1.5

Min. Acc. Conc. = Minimum Acceptable Concentration.
Max. Allow. Conc. = Maximum Allowable Concentration.

RESULTS AND DISCUSSION

The results of different samples taken from about hundred places of Patan Taluka (Gujarat) are given in Table 2. The results of given samples show that 75 samples out of 100 contain fluoride above the permissible limits of World Health Organization. (WHO–2003) i.e. 1.5 mg/L At some places the concentration of fluoride ion is very high. As per our observation, in Patan region nearby university location, the concentration of fluoride is form 10.5 mg/L to 11.4 mg/L. The number of villages having fluoride concentration within the permissible limit is 25.

Table 2. Concentration of fluoride in different samples

S. No.	Name of Village/ Farm	Depth (feet)	F^- (mg/L)	S. No.	Name of Village/ Farm	Depth (feet)	F^- (mg/L)
1.	Rajpur	900	1.13	51.	Dudharampura	800	0.94
2.	Gadosan	1200	1.08	52.	Audhav	910	0.71
3.	Khimiyana	900	2.09	53.	Vadli	1200	0.50
4.	Mithi Vavdi	1000	1.08	54.	Anawada	600	3.52
5.	Sankhari	1200	0.62	55.	Vayad	450	3.60

Table 2. Continued.,...

Tabl

S. No.	Name of Village/ Farm	Depth (feet)	F– (mg/L)	S. No.	Name of Village/ Farm	Depth (feet)	F– (mg/L)
6.	Borsan	1000	2.23	56.	Ghacheli	900	3.61
7.	Norta	850	3.38	57.	Dharusan	830	2.54
8.	Ranuj	1000	2.22	58.	Melosan	830	2.48
9.	Sander	1000	1.97	59.	Veloda	750	3.63
10.	Manund	900	1.94	60.	Nayta	800	2.27
11.	Ruvavi (Well)	100	0.97	61.	Balva	850	2.30
12.	Matpur	1100	2.54	62.	Pt–B.Ed. College	800	5.98
13.	Hansapur	425	3.08	63.	Sujanipur	1100	1.89
14.	Mandotri	600	2.77	64.	Pt–Ghemariyavir	1200	3.01
15.	Dharpur	1000	2.81	65.	Pt–G.E.B.	1200	6.55
16.	Vishal vashana	800	1.89	66.	Matarvadi	450	7.80
17.	Kani	1000	2.91	67.	Paldi	500	3.09
18.	Balisana	1200	2.99	68.	Pt–Politeqniq	400	6.48
19.	Runi	400	1.48	69.	Pt–Anawada F1	560	5.89
20.	Hajipur	750	2.45	70.	Pt–Bhurapir F2	300	3.65
21.	Kamliwada	1000	2.43	71.	Pt–Dhokapir F3	410	8.31
22.	Dar	950	2.54	72.	Pt–Magalwada F4	500	5.48
23.	Samoda	1000	3.38	73.	Pt–Ranimahal F5	340	8.46
24.	Sarva	850	2.18	74.	Pt–Khalipur1 F6	660	3.97
25.	Aajimana	700	4.40	75.	Pt–Khalipur2 F7	800	3.54
26.	Sagodiya	850	1.25	76.	Pt–Samalpati F8	550	3.97
27.	Vamaiya	400	0.45	77.	Pt–Barotwada F9	550	5.75
28.	Kotvada	980	1.32	78.	Pt–Samalpati F10	350	5.37
29.	Agar	1300	3.28	79.	Pt–Sekotariwado F11	350	5.52
30.	Kimbuva	1000	1.54	80.	Pt–Munawadi F12	550	9.54
31.	Chandrumana	900	0.65	81.	Pt–Harawado F13	400	4.90
32.	Khanpur	1300	0.87	82.	Pt–Phanguriya F14	400	5.43

Table 2. Continued.....

Table 2. Continued.,...

S. No.	Name of Village/ Farm	Depth (feet)	F^- (mg/L)	S. No.	Name of Village/ Farm	Depth (feet)	F^- (mg/L)
33.	Manpur	950	0.66	83.	Pt–Miyawado F15	510	11.00
34.	Kunger	1250	1.35	84.	Pt–Jodiyawada F16	730	4.79
35.	Khari vavdi	850	1.75	85.	Pt–Jodwala F17	390	3.43
36.	Sariyad	700	1.04	86.	Pt–Vagvadi F18	550	10.50
37.	Undra	750	1.17	87.	Golapur F19–1	600	11.10
38.	Sampara	830	1.11	88.	Golapur F20–2	950	5.11
39.	Bepadar	750	0.61	89.	Gaja F21	750	3.86
40.	Vareda	700	1.43	90.	Rajpur F22	635	8.02
41.	Khanpurda	700	0.52	91.	Golapur F23–3	720	3.70
42.	Pt–Kalikapump	600	2.05	92.	Pt–Uni. Qua.	600	10.50
43.	Pt–Damaji 1	1200	0.82	93.	Pt–Police Qua1	500	10.20
44.	Pt–Damaji 2	700	2.72	94.	Pt–Police Qua2	500	10.40
45.	Pt–Ghandhi bag 1	Dharoi	1.75	95.	Pt–Railways Sta.	750	10.10
46.	Pt–Ghandhi bag 2	700	2.96	96.	Pt–Navagunj	800	9.58
47.	Pt–Kajiwada	500	2.97	97.	Pt–Adarsh High Sc.	600	8.74
48.	Pt–Bokarwada	800	2.75	98.	Pt–Talav F24	460	7.78
49.	Pt–Laxmipura	1200	1.38	99.	Pt–Jimkhana F25	550	7.39
50.	Pt–Sardarbag	1200	1.19	100.	Pt–University	600	11.40

Pt – Paten

CONCLUSION

Due to high fluoride contents in potable water of Patan town and many other villages of North Gujarat, a large number of people are having known symptoms of dental fluorosis and the onset of a symptomatic skeletal fluorosis. Amidst the reported and unreported aliments, some problems have orthopedic solutions but majority of aliments are non–curable, hence, it is preferable to use water having permissible fluoride contents. Many people are unaware of the excess fluoride menace.

ACKNOWLEDGEMENT

We thankfully acknowledge the kind help of Dr. D.V. Joshi, Associate Professor, Dept. of Pathology, Gujarat Agriculture University, Dantiwada.

REFERENCES

1. P. S. Datta, Proceedings of National Seminar ENVIRON & HEALTH (1999).
2. B. K. Handa, BHU – Jal News, 3, (2), **31**, (1988).
3. A. K. Susheela, Rajiv Ghandhi Nat. Drinking Water Miss. Health Abst. **vol.1** (1993).
4. Environ and Health (1999), ''Fluoride, Fluorosis and Defluoridation Techniques'', (1999) p(3).
5. IIT Kanpur: ''Defluoridation of Water using Activated Alumina''. 7–8, March (1996), p 48.
6. National Environmental Engineering Research Institute, Defluoridation (Revised), Nagpur, Sept. (1987).
7. N. Madhavan and V. Subramaniam, Curr. Sci., **80**, 1312 (2001).
8. NEFRI, Nagpur, Defluoridation, (1992), p. 61.
9. Sangita Sharma, Jabali J. Vora, and J. D. Joshi, Proceedings of the National Seminar Environ and Health. SARITA, Udaipur (1999) p. 143.
10. W. Fresenius, E. K. Quentin and W. Schneider. "Water Analysis in a Practical Guide to Physico–Chemical and Micro–Biological Water Examination and Quality Assurance", Springier Verlag, (1988), p 804.
11. Anil Kumar Yadav, P. K. Jain, Sunderlal, Res. J. Chem. Environ., **7(3)**, 43 (2003).
12. D. K. Sharma, C. P. S. Chandel and C. M. Gupta, J. Indian Water Works Association., **10(2)**, 121 (1990).
13. APHA, "Standard Methods for the Examination of Water and Waste Water. 17th Ed American Public Health Association", New York, U.S.A. (1989).
14. WHO. "Guidelines for Drinking Water Quality", **2**, 231 (1996).
15. D. T. Rao, and M. Purushottam, J. Indian Water Works Association **18**, 87 (1986).
16. P. S. Datta, D. L. Deb, and S. K. Tyagi, J. Contaminant Hydrology, **24(1)**, 85 (1996).
17. Jabali Vora and J.D. Joshi, Curr. Sci., **75 (4)**, 25 (1998).

Accepted : 28.11.04