

A Study on the Levels of Fluoride in Ground Water and Prevalence of Dental Fluorosis in Certain Areas of Virudhunagar District

S. Manimegalai and L. Muthulakshmi

V.P. Muthaiah Pillai Meenakshi Ammal Engineering College for Women, Department of Chemistry, Krishnankovil - 626 190, Virudhunagar

The present work aims to study the level of fluoride in bore well, open well, and in handpump water samples of different places of Virudhunagar district, Tamil Nadu, and also to analyse other water quality parameters, like pH, electrical conductivity, turbidity, acidity, alkalinity, total solids, chlorides, iron, sodium, potassium, fluorides and total hardness. The analysis shows a low fluoride level of 0.2 mg/L and high level of 1.8 mg/L in Virudhunagar district.

KEYWORD

Water, Fluoride, Dental fluorosis.

INTRODUCTION

The element fluorine occupies the VII A group in the periodic table. This element does not occur as free fluoride in nature. Elemental fluorine exists as a diatomic molecule with a remarkably low dissociation energy (38 k cal/mol). The natural ores of fluoride are fluorapatite, cryolite, apatite and fluorospar. High fluoride intake over a period of time can cripple one for life (Chand, 1999). It is found that fluoride bearing well waters to be high in sodium and bicarbonate alkalinity and low in calcium hardness. High fluoride containing ground water is chemically distinctive in that, it is soft, has high pH and contains large amount of silica (Hem, 1959). In Rajasthan, a heterogenous pattern of fluoride distribution has been observed in 18 districts. A total of 270 drinking water sources were examined for the evidence of fluoride, 64 % showed the presence of excess fluoride with varying ranges.

It is well known that excess fluoride ion intake beyond a limit is responsible for dental and skeletal fluorosis which is a serious health problem in many areas of the world. Drinking water is considered to be the main source of fluorides and standards are fixed by various authorities for the permissible limit of fluorides (Table 1). An attempt has been made to assess the prevalence of fluorosis among school children in Virudhunagar district. Besides an analysis of fluoride ion in the water samples, analysis the other water quality parameters in Virudhunagar district are

Table 1. Drinking water standard for F prescribed by various authorities

Authority	Permissible F, mg/L
I.S.I. recommendation	1.5
I.C.M.R. recommendation	1.0
Recommendation of the Committee on Public Health Engineering Manual and Code of Practice constituted by Government of India	1.0
U.S. Public Health standard	0.8
W.H.O. International standard for drinking water	0.5

also discussed.

MATERIAL AND METHOD

Water samples were collected from various locations in Virudhunagar district and the water quality parameters, like pH, electrical conductivity, turbidity, acidity, alkalinity, total hardness, calcium and magnesium hardness, total dissolved solids, chlorides, iron, sodium and potassium were analysed. Fluoride was estimated by Zirconyl-Alizarin method. Dental fluorosis survey was carried out at different schools in Sivakasi and Mamsapuram in Virudhunagar district.

RESULT AND DISCUSSION

The results of the study were correlated with water quality parameters, including fluoride content in 23 samples were collected. The maximum fluoride ion concentration is found to be 1.8 mg/L at Sivakasi and Mamsapuram. This may be due to the presence of

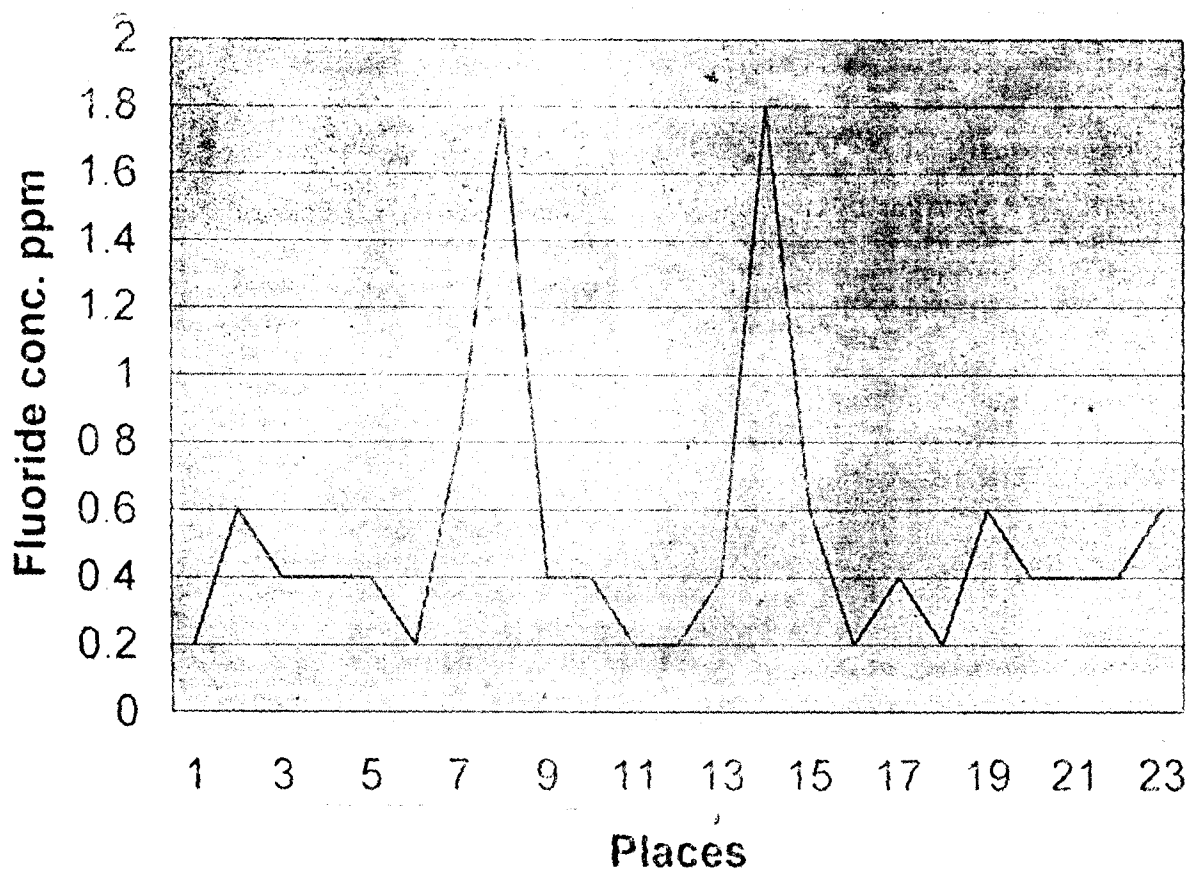


Figure 1. Fluoride ion concentration in Virudhunagar district

Table 2. Percentage of children affected by dental fluorosis in various schools of Sivakasi and Mamsapuram, Virudhunagar district

Name of School	Class	Age	Number of children				Percentage of victims	
			Examined		Affected		M	F
			M	F	M	F		
S.H.N.V. Middle School, Sivakasi	III	7-8	48	44	36	32	75.00	72.72
	IV	8-9	44	40	23	20	54.54	50.00
	V	9-10	30	50	20	30	66.66	60.00
Municipal Muslim Primary School, Sivakasi	III	7-8	15	3	10	1	66.66	33.33
	IV	8-9	10	4	3	2	30.00	50.00
	V	9-10	-	34	-	24	-	70.58
S.H.N.G. Middle School, Sivakasi	III	7-8	-	35	-	20	-	57.14
	IV	8-9	-	41	-	25	-	60.97
	V	9-10	-	34	-	24	-	70.58
Muslim Middle School, Sivakasi	III	7-8	20	25	12	16	60.00	64.00
	IV	8-9	22	28	15	12	68.18	42.85
	V	9-10	24	18	19	12	79.16	66.66
P.M.T. High School, Mamsapuram	III	7-8	20	10	12	7	60.00	70.00
	IV	8-9	24	14	13	9	54.16	64.28
	V	9-10	17	15	10	11	58.82	73.33

natural resources around these areas. These area people depend on ground water for drinking as well as cooking. Figure 1 represents the fluoride ion conce-

centration in Virudhunagar district. As the concentration of fluoride is higher in Sivakasi and Mamsapuram than the prescribed limit, a dental survey was con-

Table 3. Average of physico-chemical parameters of the samples, in mg/L

Place of water samples	pH	Electrical conductivity, mS	Turbidity, NTU	Acidity	Alkalinity	Total dissolved solids
Tolerance limit (ICMR standards)	7.0-8.5	1	5	-	100	500
Rajapalayam-Main	6.5	1.815	0.4	175.0	250.0	1300.0
Rajapalayam-Housing Board Colony	6.5	0.789	0.2	177.5	280.0	3474.0
Krishnankoil V.P.M.M. Arts and Science	6.5	0.810	1.2	362.5	175.0	1324.0
V.P.M.M. Engg.	5.9	0.745	0.2	487.5	150.0	1220.0
V.P.M.M. Hostel	6.5	0.493	1.0	250.0	205.0	962.0
Srivilliputhur	7.1	1.009	0.6	115.0	480.0	2522.0
Watrap	6.8	1.239	0.4	280.0	270.0	1865.0
Sivakasi	7.3	1.861	0.3	107.5	497.0	1725.0
Koomapatti	6.3	1.221	0.8	187.5	590.0	1950.0
Chenkalanatchipuram	6.2	0.899	1.7	200.0	205.0	1974.0
Virudhunagar	6.9	1.490	0.5	337.5	390.0	1999.0
Sattur	7.1	.0230	1.8	65.0	250.0	302.0
Aruppukottai	6.5	1.907	0.4	230.0	330.0	4798.0
Mamsapuram	6.7	1.425	0.5	152.5	685.0	1976.0
Muhavoor	6.7	0.730	0.7	95.0	295.0	1310.0
Malli	6.9	0.890	0.3	130.0	380.0	1514.0
Vadamalapuram	6.1	1.853	0.9	235.0	355.0	3999.0
Thiruthangal	6.2	1.866	1.1	187.5	360.0	4324.0
Kunur Puthur	6.9	1.330	7.8	62.5	425.0	1784.0
Sundarapandiyam	6.7	1.355	1.7	175.0	580.0	1897.0
Chatthirapatti	6.5	1.365	0.7	185.0	350.0	1834.0
Vanniyampatti	6.8	0.427	0.2	230.0	355.0	469.0
Devadhanam	6.6	0.912	1.1	287.5	225.0	1270.0

Table 3. (continue)

Total hardness	Ca ²⁺ hardness	Mg ²⁺ hardness	Cl ⁻	Fe ²⁺	Na ⁺	K ⁺	F ⁻
300	75	30	200	0.3	10	10	1.0
563.40	69.79	493.61	268.0	-	4.1	5.6	0.2
474.89	212.77	262.12	219.68	2.2	4.5	5.4	0.6
480.0	170.22	309.78	63.9	0.1	4.2	5.1	0.4
517.44	177.02	340.42	75.26	-	3.8	6.7	0.4
577.02	234.19	342.12	66.74	1.2	4.0	6.2	0.4
445.95	37.44	408.51	303.1	0.8	4.5	7.1	0.2
348.93	30.64	318.29	130.2	0.1	5.8	8.4	0.8
461.27	32.34	428.93	302.9	0.7	5.9	8.4	1.8
663.82	224.68	439.14	440.0	-	5.9	7.0	0.4
641.70	199.15	442.55	454.4	1.0	4.6	8.1	0.4
628.08	396.60	231.48	306.72	-	4.0	9.0	0.2
199.14	44.25	154.89	32.66	0.6	5.9	6.6	0.2
1222.12	653.61	568.51	1047.8	0.2	6.6	7.7	0.4
759.14	221.27	537.87	511.2	0.9	5.2	7.1	1.8
631.48	330.21	301.27	336.54	-	5.6	7.6	0.6
631.48	137.87	493.61	428.84	0.4	5.5	6.3	0.2
1455.81	508.93	946.38	836.38	0.2	6.1	8.1	0.4

1157.44	343.84	813.6	917.32	0.4	4.6	6.8	0.2
748.93	260.42	488.51	433.1	0.4	5.2	6.6	0.6
793.19	202.56	590.63	506.94	0.4	5.9	7.2	0.4
779.57	248.51	531.06	657.46	—	4.3	7.1	0.4
440.85	136.17	304.68	127.8	0.3	5.8	6.9	0.7
537.87	78.3	459.59	208.74	—	6.0	6.2	0.6

ducted among the school children of these area and the results are discussed.

Five different school comprising 274 male and 361 female were selected for the dental fluorosis survey in Virudhunagar district. Table 2 shows the percentage of children affected by dental fluorosis in various schools in Sivakasi and Mamsapuram. Overall, children affected by dental fluorosis is found to be 60.36 %. It is also found that affected children to greater extent are in the age group of 7-8 and 9-10. The results indicates the fact that fluoride ion concentration seems to accumulate over a period and shows stronger sign of symptoms in this age group of children. The water samples were analysed for physico-chemical parameters and the representative results are shown in table 3. The pH ranges from 5.9 to 7.3. Generally, the pH value of water varies due to changes in temperature, biological activities, disposal of industrial waste and photosynthetic activities. These factors may cause a drastic change in pH and in turn reduce the potability of water.

The electrical conductivity is found to be 0.230 to 1.907 mS. Increase in electrical conductivity is due to the presence of the ionic substance present in water. The average turbidity is between 0.2 to 7.8 NTU. The maximum value is due to the presence of suspended solids in water sample. The level of acidity varies 62.5 to 487.5 mg/L (pH-5.9). It may be due to the presence of CO₂, and organic acids formed by the decay of organic matter. The alkalinity ranges from 150 to 685 mg/L. The maximum alkalinity is due to the contamination of bicarbonates, phosphates, borates and silicates. The total dissolved solid is found to be 302 to 4798 mg/L. The dissolved solid originates from weathering of rocks, soils, dissolving of lime, agricultural activity and other sources.

The level of total hardness is between 199.14 to 1455.8 mg/L. The maximum level of total hardness is due to the presence of carbonate and non-carbonate hardness. The chlorides ranges from 32.66 to 1047.8 mg/L. It may be due to the presence of domestic sewage disposal, irrigation drainage and the discharge of effluents from industries. The iron concentration is

found to be 0.1 to 2.2 mg/L. The maximum value is due to the presence of dissolution of rocks and minerals, release of acid-mine drainage, landfill leach-ares and also due to sewage. The level of sodium varies from 3.8 to 6.6 mg/L and potassium 5.2 to 9 mg/L in Aruppukottai area, the maximum level of electrical conductivity (1.907 mS) was present, its ionic species, like Na⁺ level is maximum to other areas.

CONCLUSION

In this study, it was observed that the prevalence of fluorosis in Sivakasi and Mamsapuram areas possessing very high values against tolerance limit.

ACKNOWLEDGEMENT

Authors are thankful to the Management of S.P. Muthaiah Pillai Meenakshi Ammal Educational Institutions, Krishnankoil and the special thanks to Dr. S. Meenakshi, Reader, Gandhigram Deemed University, Dindigul, for her kind advise and suggestion to improve the quality of this work.

REFERENCE

- Apparao, B.V. and G. Karthikeyan. 1986. Permissible limits of fluoride ion drinking water in Indian rural development. *Indian J. Env. Prot.*
- Chand, Dinesh. 1999. Fluoride and human health-Cause for concern. *Indian J. Env. Prot.*, 19 (2) : 81-99.
- Hem, J.D. 1959. A study and interpretation of chemical characteristics of natural water. U.S. Geological Survey Water Supply Paper 1973.
- Isaiah, S., et al. 2003. Study of fluoride content in ground water, survey of dental fluorosis in Salem district. *Eco. Env. Cons.*, 9 (3) : 297-300.
- WHO. 1984. Guidelines for drinking water quality recommendations (vol II). World Health Organization, Geneva.

AUTHOR

1*. Ms. S. Manimegalai, Lecturer in Chemistry, V.P. M.M. Engineering College for Women, Krishnankoil - 626 190, Virudhunagar.

2. Ms. L. Muthulakshmi, Lecturer in Chemistry, V. P. M.M. Engineering College for Women, Krishna - 626 190, Virudhunagar.