

A Preliminary Report on Fluoride Content in Ground Waters of Vallioor Union, Tirunelveli District, Tamil Nadu, India

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Ground water is one of the major sources for drinking water in many parts of Vallioor Union. A survey was conducted in these villages by a specially prepared questionnaire. This survey reveals the fact that majority of the residents of these villages were affected by fluorosis. The primary aim of this survey was to find out the concentration of fluoride in the samples of drinking water. Monthly changes in physico-chemical parameters such as temperature, pH, electrical conductivity, total alkalinity, total hardness, calcium, magnesium, fluoride, sodium, sulphate, chloride and salinity were recorded by means of collecting thirty six samples of drinking water from different parts of these areas.

INTRODUCTION

The drinking water naturally contains excess of fluoride ion in most of the villages of Vallioor Union. The long term consumption of water containing excessive amount of fluoride leads to fluorosis on teeth and bones¹. Being an electronegative element, fluoride has a negative charge which is attracted by positively charged ions like calcium (Ca^{2+}). Bone and tooth having the highest amount of calcium in the body, attract the maximum amount of fluoride and consequently it is deposited as calcium fluoroapatite crystals².

Endemic fluorosis is commonly prevalent in India where large quantities of water containing comparatively high level of fluorides is consumed because of its hot climatic condition. As a result, more than a million people in India are affected with dental as well as skeletal fluorosis.

The authors are the first to explore the extent of fluorosis attack in 36 villages of Vallioor Union in Tirunelveli District.

EXPERIMENTAL

The samples of underground water collected in high density polythene bottles from 36 fluorotic areas were analysed to find out fluoride content by using Orion ion selective electrode at CECRI in Karaikudi. While collecting the samples the temperature of those areas was measured by 110°C thermometer. pH was determined by Systronics pH meter, electrical conductivity was measured using Elico conductivity bridge Type CM 82T, sodium was analysed by flame photometer and sulphate³ was analysed by UV spectrophotometer. Total alkalinity, total hardness⁴, calcium, magnesium, chloride and salinity were determined by the titration methods.

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RESULTS AND DISCUSSION

On experimental analysis, it is found that the water samples contain different amounts of fluoride. Wide variations have been observed in the distribution of fluoride in the endemic areas in Vallioor Union ranging from 1.36 ppm to 5.04 ppm. As a result of this analysis, it also reveals that dental and skeletal fluorosis in varying degrees of severity could be associated not only with the fluoride level in drinking water but also with alkalinity⁵. In such water samples fluoride ion is associated with more of sodium ions than calcium⁶. The absorption of calcium itself decreases with increase of alkalinity. Sodium fluoride has been shown to be more toxic than calcium fluoride. Besides, decreased amount of calcium increases concentration of sodium and excessive alkalinity of water contributes to greater toxicity of fluoride in these regions.

Fluoride level in ground water and other parameters of ground water in ppm are presented in Table-1.

The pH in all samples of water ranges from 6.68 to 8.38. The pH has no direct effect on human health. However, all the biochemical reactions are sensitive to the variation of pH. The limit of pH value in the quality of drinking water is specified at 6.5 to 8.5 (ICMR, 1975).

The electrical conductance of samples ranges from 520 mho/cm to 5480 mho/cm. Actually conductivity values are indicative of solute content of waters and general nature of water quality. It may be noted that according to the investigations of Tripathi *et.al.*⁷ samples of water containing higher salinity are associated with higher electrical conductance.

Alkalinity of all water samples ranges from 173.58 ppm to 954.69 ppm. Salinity of all water samples ranges from 21.65 ppm to 1563.95 ppm. Association of salinity with high fluoride ground water is a general concept. The investigations of Gupta *et.al.*⁸ reveal the fact that water samples containing low fluoride are characterised by high salinity and those containing high fluoride are characterised by low salinity respectively. This is in conformity with the present investigations which show that whenever fluoride level becomes higher, salinity of water becomes low.

The amount of chloride in all samples of water ranges from 11.98 ppm to 866.44 ppm. Actually chloride imparts a salty taste to water. Samples of water containing low fluoride are characterised by high chloride⁷. Sulphate content of water samples ranges from 0.31 ppm to 9.73 ppm which is within the permissible limit prescribed by ICMR (1975).

Fluorosis and the severity of the symptoms are governed by various factors. Nutritional deficiencies, high ambient temperature, high alkalinity and low calcium and magnesium content in drinking water lead to fluoride toxicity⁹.

On the basis of the investigations in U.S.A., Galagan *et al.*¹⁰ have found (1953) that even the lower fluoride concentration may easily cause dental fluorosis in the high temperature areas because the residents in such areas consume much water. In the villages under the present study the daily intake of fluoride depends on:

- (i) concentration of fluoride in drinking water, and
- (ii) total intake of water per day.^{11,12}

The amount of water ingested itself depends upon a number of variables such

FLUORIDE LEVEL IN GROUND WATER AND OTHER PARAMETERS OF GROUND WATER QUALITY, IN PPM

Sample number	Description of sources from which it was collected	Fluoride ppm	pH	Electrical conductivity mho/cm	Total alkalinity ppm	Total hardness ppm	Calcium ppm	Magnesium ppm	Sodium ppm	Sulphate ppm	Chloride ppm	Salinity ppm
1.	Water from public hand pump near Mutharamman temple at Sivagamipuram	4.06	8.07	840	824.505	130	80	12.20	120.06	1.03	27.96	50.50
2.	Water from public hand pump at Leppaikudieruppu	4.36	7.52	4440	781.110	880	680	48.80	243.11	6.72	547.14	987.62
3.	Public well water at Peryanayakupuram	3.28	8.09	1320	954.690	130	70	14.64	140.30	2.54	87.86	158.62
4.	Water from public well at Ganapathiapuram	4.82	8.00	850	650.925	190	150	9.76	55.20	3.26	47.93	86.54
5.	Water from public hand pump at Kavalkinaru Puthoor	4.46	7.31	2560	564.135	620	580	9.76	361.10	5.12	315.51	569.53
6.	Water from public hand pump near Esakkiamman temple at Perunkaliapuram	2.48	7.39	6600	650.925	1210	1070	34.16	680.80	7.61	854.66	1542.69
7.	Water from public hand pump at North Perungudi	4.78	7.51	960	564.135	300	220	19.52	57.50	1.84	59.91	108.17
8.	Borewell water from Esakkimuthu's house at South Perungudi	4.56	7.74	2230	564.135	710	610	24.40	140.30	5.73	299.53	540.68
9.	Water from public hand pump near Govt. High School at Kavalkinaru	3.18	7.38	1120	650.925	170	110	14.64	135.7	5.86	83.87	151.42

Sample number	Description of sources from which it was collected	Fluoride ppm	pH	Electrical conductivity mho/cm	Total alkalinity ppm	Total hardness ppm	Calcium ppm	Magnesium ppm	Sodium ppm	Sulphate ppm	Chloride ppm	Salinity ppm
10.	Water from public hand pump on the southern side of Shunmugapuram	3.18	7.90	1820	694.320	410	370	9.76	259.90	6.79	187.71	338.85
11.	Water from public hand pump at Kilakulam	5.00	7.79	920	477.345	200	170	7.32	120.06	4.09	67.90	122.59
12.	Well water from Subramania Nadar's house at Avaraikulam	1.50	7.70	520	520.740	1100	990	26.84	830.30	11.63	575.10	103.81
13.	Borewell water from Natesan's house at Sivagnanapuram	3.38	8.14	1320	520.740	210	190	4.88	224.94	6.16	151.76	273.96
14.	Water from public hand pump at Ambalavanapuram	2.66	7.76	2460	520.740	490	435	13.42	485.30	6.79	271.58	490.23
15.	Water from public hand pump at Pillaiyarkudieruppu	2.96	8.10	720	694.320	150	135	3.66	120.06	0.91	31.95	57.70
16.	Water from public well near the Sudalai temple at Sangnanapuram	2.26	7.95	3660	433.950	980	780	48.80	880.90	0.91	555.13	1002.04
17.	Water from public bore well near the school at Adankarkulam.	3.28	8.38	920	564.135	100	85	3.66	177.56	0.48	67.89	122.57
18.	Water from public hand pump on the western side of Uralvoymoli	2.56	6.68	375	260.370	50	45	1.22	40.02	0.47	27.96	50.50
19.	Water from public hand pump, Soochikulam	2.58	7.62	620	520.740	80	70	2.44	100.05	0.53	23.96	43.28

Sample number	Description of sources from which it was collected	Fluoride ppm	pH	Electrical conductivity mho/cm	Total alkalinity ppm	Total hardness ppm	Calcium ppm	Magnesium ppm	Sodium ppm	Sulphate ppm	Chloride ppm	Salinity ppm
20.	Water from public tank at Uralvoymoli colony	1.36	7.69	1560	347.160	400	295	25.62	230.0	1.49	183.71	331.63
21.	Water from public hand pump in front of Amman temple at Keelkulam	2.18	7.82	503	433.950	40	35	1.22	82.8	0.52	11.98	21.65
22.	Water from public hand pump at Marankulam colony	1.96	7.15	5480	477.345	1460	1280	43.92	1000.04	2.83	866.44	1563.95
23.	Water from public hand pump near the church at Marankulam	1.88	7.17	3620	433.950	900	670	56.12	355.12	1.21	539.16	973.21
24.	Well water from Thangadurai's garden at Kottankulam	5.08	7.56	1310	564.135	550	440	26.84	500.02	2.26	419.34	756.76
25.	Water from public hand pump at Sivasakthipuram	4.44	7.38	1730	564.135	310	215	23.18	239.89	1.32	195.69	353.25
26.	Water from public hand pump at Chettikulam Pudumanai	4.24	7.20	2820	694.320	550	355	47.58	395.6	1.74	367.43	663.24
27.	Water from public tank at Sriranganarayanapuram	4.36	8.03	650	477.345	170	140	7.32	100.05	0.95	19.97	36.08
28.	Well water from Rajan's garden near Perumanal	3.38	7.76	910	433.950	300	170	31.72	102.58	1.10	95.85	173.04
29.	Water from hand pump in Govt. Hr. Sec. School at Chettikulam	2.96	7.69	940	477.345	180	130	12.2	149.96	2.79	55.91	100.95

Sample number	Description of sources from which it was collected	Fluoride ppm	pH	Electrical conductivity mho/cm	Total alkalinity ppm	Total hardness ppm	Calcium ppm	Magnesium ppm	Sodium ppm	Sulphate ppm	Chloride ppm	Salinity ppm
30.	Water from public hand pump on the southern side of the pool at Chettikulam	2.66	7.75	2120	520.740	400	310	21.96	414.92	5.33	275.57	497.43
31.	Water from public hand pump at Palavoor Colony	3.98	7.84	580	216.975	150	110	9.76	80.04	1.38	23.96	43.28
32.	Water from public tank at Palavoor	2.70	8.01	1340	347.160	240	200	9.76	230.00	2.77	119.81	216.29
33.	Water from public hand pump at South Karunkulam Colony	2.54	7.66	1210	390.555	300	230	17.08	209.99	2.56	107.83	194.66
34.	Bore well water from Murugan's house near the Middle School at South Karunkulam	2.02	8.01	2330	260.370	780	620	39.04	485.30	2.20	259.59	468.59
35.	Water from public hand pump at west of Chellapa's house at Madanpillaittharpanam	1.96	7.80	710	303.765	200	160	9.76	100.05	2.35	59.91	108.17
36.	Water from public hand pump near the panchayat union school at Madanpillaittharpanam	3.40	7.61	1330	347.160	360	240	29.28	220.11	1.20	99.84	180.24

as body size, food habit, environmental temperature and extent of physical activity. Hot climate and sweating lead to consumption of large quantity of water.

Fluoride concentrations in drinking water ranging between 1 ppm and 5 ppm cause 'mottled enamel' in teeth and those above 5 ppm cause skeletal fluorosis. This is applicable to the villages under investigation. Despite the concentrations of fluoride in the range of 1 ppm to 5 ppm in these villages above 60% of people have been affected with dental fluorosis and traces of skeletal fluorosis.

Conclusion

1 ppm of fluoride present in drinking water is the safe limit prescribed by Indian Council of Medical Research and Committee on Public Health Engineering Manual and Code of Practice and World Health Organisation. In these villages fluoride concentration in drinking water ranges between 1.5 ppm and 5.08 ppm. This causes dental and traces of skeletal fluorosis.

In view of preventing these health problems it is suggested that the drinking water of these fluorotic villages may be boiled with magnesium oxide, cooled down and then filtered. The filtered water may be consumed so that the fluoride content is decreased by ten times. Another method to prevent dental fluorosis is either by way of diluting the high fluoride water with the help of low fluoride water or to consume water derived from control areas, where fluoride concentration is less than 1 ppm.

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