

Concentration of Fluoride Ion in Surface Soils in Vallioor Union of Tirunelveli District, Tamil Nadu, India

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The excessive intake of fluoride ion in drinking water beyond the prescribed limits leads to dental and skeletal fluorosis. Similarly the surface soils and rocks containing fluoride in many parts of the world lead to health problems even to cattle and human beings by means of plants and crops. Physico-chemical properties *viz.*, pH, electrical conductivity, fluoride content of surface soils in fluorotic as well as control areas were analysed by comparative study in the southern parts of Vallioor Union of Tirunelveli district, Tamil Nadu. More than 50% of the people are affected by fluoride in drinking water and surface soils. This study unfolds the fact that the presence of fluoride in surface soils is highly sporadic in the areas under study and the fluorotic concentration varies from 2.88 ppm to 9.82 ppm.

Key words: Concentration fluoride, surface soils, Vallioor.

INTRODUCTION

Small concentration of fluoride, an element in drinking water, has beneficial effect on human body if taken in a controlled quantity of less than 1 ppm so as to prevent dental caries. Nevertheless higher concentration causes serious dental and skeletal fluorosis if present in higher concentration exceeding 1 ppm and 5 ppm respectively^{1, 2}

The incidence and severity of fluorosis is related to the content of fluoride in various components of environment, *viz.*, air, soil, besides water. Of these, water particularly ground water is the major contributor to the health problem³. The presence of fluoride in soil, water and food is almost a universal phenomenon and its intake in the diet virtually becomes inevitable⁴.

Fluoride is known to have contaminated surface soil reserves globally. It is evident that retention of most fluoride on the surface soil due to the continuous use of irrigation water carrying high concentration of fluoride having accumulated beyond a limit affects the quality of crops. Toxic concentrations of fluoride in surface soils through irrigation waters have been reported from Haryana, Punjab, Rajasthan, etc.⁶ The toxicity of fluoride is also influenced by high ambient temperature⁷.

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The authors are the first to find out the concentration of fluoride in surface soils of both fluorotic and control villages of Vallioor Union in Tirunelveli District, India.

EXPERIMENTAL

The samples of surface soils collected in polythene bags from fluorotic and control areas were analysed to find out fluoride content by using orion ion selective electrode and pH was determined by Systronics pH meter. Electrical conductivity was measured using Elico conductivity meter Type CM 82T. Before these analyses, water extract was prepared first by using soil samples. 10 g of air dry soil samples were taken in a wide-mouth reagent bottle and 20 mL of distilled water was added. Stoppered the bottle and shaken for 30 min in a reciprocating shaker. The suspension was allowed to stand for 15 min, and filtered the solution through a dry Whatman No. 42 filter paper into a dry bottle. The extract thus derived was used for analysis.

RESULTS AND DISCUSSION

Table-1 reports the findings of the concentration of fluoride ion in ppm, pH and electrical conductivity in mho/cm in the samples of surface soils.

In soil samples of fluorotic areas, pH ranged from 6.92 to 9.34 whereas pH values in all the soil samples in control areas were ranging between 7.13 and 8.83. In the present study, most of the soils revealed higher pH than that of their underground water. In general, soil pH gives an overall picture of the basic status of a soil, *i.e.*, the amount of clay complex or the amount of cations that the clay holds in its exchange position. Nevertheless, it is influenced by several interrelated factors such as the nature of cations present and the rate of loss of leaching⁹.

The electrical conductance of soil samples in fluorotic areas ranged from 94 to 390 mho/cm while that in control areas ranged from 211 to 620 mho/cm. Actually, the conductivity values are indicative of solute content of soil and general nature of soil quality. It may be noted that according to the investigations of Tripathi *et al.*¹ higher salinity is associated with higher electrical conductance.

The amount of fluoride ions in all samples of surface soils ranged between 2.88 ppm and 9.82 ppm in fluorotic areas whereas that in control areas ranged between 1.01 ppm and 1.28 ppm. In control areas the values are within the permissible limits while in fluorotic areas the values are beyond the prescribed limits causing healthy hazard.

The present study reveals the fact that the incessant use of irrigation water having high concentration of fluoride is retained on the surface soils and beyond the prescribed limits it affects the quality of crops. Accordingly, Agarwal *et al.*⁶ observed that irrigation water having an average of 7 ppm fluoride was found detrimental to the growth of crops, particularly wheat. The average of fluoride content in the areas under study was 5.3 ppm.

TABLE- 1
 FLUORIDE CONTENT (ppm) AND PHYSICO-CHEMICAL PROPERTIES (pH, EC
 AND SALINITY) OF SURFACE SOILS OF FLUOROTIC AND CONTROL AREAS

Sample No.	Description of source	Fluoride (ppm)	pH	EC (mho/cm)	Salinity (ppm)
1.	Western side of Sivagamipuram	7.72	7.25	194	25.44
2.	Southern side of Leppaikudieruppu	8.05	7.02	116	31.80
3.	Northern side of Periyanyakipuram	3.46	7.60	362	63.57
4.	Near the public well at Ganapathipuram	9.63	7.28	152	31.80
5.	Near the Public hand pump at Kavalkinaru puthoor	7.55	7.18	160	25.44
6.	Northern side of Perunkaliapuram	2.88	7.79	130	34.97
7.	Near the public hand pump at North Perungudi	3.34	8.55	160	44.50
8.	Near the public hand pump at Kavalkinaru	3.17	8.06	94	25.44
9.	Northern side of Shunmugapuram	3.77	8.47	240	47.68
10.	Eastern side of Kilakulam	4.82	7.87	142	44.50
11.	Southern side of Avaraikulam	6.39	8.23	233	44.50
12.	Northern side of Sivagnanapuram	6.26	7.97	160	44.50
13.	Near Northern public hand pump at Ambalavanapuram	5.23	9.34	290	47.68
14.	Near the Western Side public hand pump at Pillaiyarkuideruppu	5.42	8.40	194	47.68
15.	Near the public well at Sanganapuram	7.54	8.24	342	95.33
16.	Near the public hand pump at Adankarkulam	7.77	7.79	280	44.50
17.	Eastern side of Uralvoymoli	6.74	8.30	132	38.15
18.	Near the public hand pump at Soochikulam	9.82	8.81	314	50.86
19.	Western side of Keelkulam	9.56	8.10	202	44.50
20.	Near the public hand pump Marankulam	5.31	8.62	134	38.15
21.	Near the well of garden at Kottankulam	5.09	8.49	295	89.00
22.	Near the public hand pump at Sivasakthipuram	4.37	8.21	194	63.57
23.	Rajan's garden soil at Srirenganarayanapuram	8.80	7.12	352	31.80
24.	Southern side of Chettikulam	5.63	7.11	390	31.80
25.	Northern side of Palavoor	4.71	7.03	320	38.15
26.	Southern side of South Karunkulam	4.86	6.92	290	31.80
27.	Near the public hand pump at Madanpillaittharmam	6.53	8.60	250	102.04
<i>Control Area:</i>					
1.	Near the public hand pump at Levinchipuram	1.13	8.34	620	82.64
2.	Northern side of Chidamrapuram	1.28	8.83	211	47.68
3.	Western side of Vadakkankulam	1.08	7.13	312	44.50
4.	Near the public bore at Punniavalanapuram	1.01	7.15	230	54.04

Conclusions

In these villages the fluoride concentration in surface soil ranged between 2.88 ppm and 9.82 ppm. Hence it affects the growth of crops depending upon the intensity of fluorosis which is found to be directly proportional to the concentration of fluoride in surface soils. This also causes dental and traces of skeletal fluorosis in inhabitants who consume these crops.

In view of preventing the high range of fluorotic concentration, the soils from the control areas may be mixed with the surface soils in fluorotic areas. Thereby, the fluoride content may considerably reduce to the prescribed limits.

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