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ASSESSMENT OF FLUORIDE IN SOME GROUND WATER SAMPLES OF THIRUVERUMBUR TALUK OF TRICHY DISTRICT, TAMIL NADU

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ABSTRACT

Fluoride is naturally found in all water sources like river, lake, well and also the ocean. For the past 70 years, fluoride has been added to public water supplies to bring fluoride levels up to the amount necessary to prevent dental caries (tooth decay or demineralization). Before teeth break through the gums, the fluoride taken from foods, beverages and dietary supplements makes tooth enamel (the hard surface of the tooth) stronger, making it easier to resist. After teeth erupt, fluoride helps remineralize, weakened tooth enamel and reverses early signs of tooth decay. When you brush your teeth with fluoride toothpaste, or use other fluoride dental products, the fluoride is applied to the surface of your teeth. But high fluoride concentration in potable water leads to dental and skeletal fluorosis. Excessive fluoride concentrations have been reported in groundwater of more than 20 developed and developing countries including India where 19 states are facing acute fluorosis problems. Presence of fluoride-bearing minerals in the host rocks and their interaction with water is considered to be the main cause for fluoride in groundwater. The decay, detach and suspension are the three main processes for the occurrence of fluoride in groundwater. In this study a total of 10 groundwater samples were randomly collected from different parts of villages in and around thiruverumbur taluk, Trichy district. All 10 samples collected had no colour, odour and turbidity. Temperature of the samples varies between 30 to 34^{o}C. Among 10 Water samples, five were slightly alkaline (7.13–7.76) and another five were slightly acidic (5.20–6.91). The fluoride Concentration was determined by SPADNS method using UV-VIS spectrophotometer. Fluoride concentration ranged from 1.6 to 2.8 mg/L with a mean of 1.88 mg/L. Fluoride concentration of All 10 samples exceeded the permissible limit of WHO. There is no cure for dental fluorosis, the condition of the damaged teeth cannot be restored. In children between the age group 6 to 13years, the teeth lose their white colour and develop yellowish spots. So, proper defluoridation methods should be carried out for the treatment of water in this area.

Key words: Ground water, Fluoride, Remineralization, Dental caries, dental Fluorosis, SPADNS method, Defluoridation methods.

Introduction:

Five elements namely Earth, Air, Water, Fire and Space constituted Universe, '[1]'. Next to Air, the other important requirement for human life to exist is water. It is the basic element of social and economic infrastructure and is essential for healthy society and sustainable development, '[2]'. Water is a clear transparent liquid

composed of one molecule of oxygen and two molecule of hydrogen. It is the principal constituent of all animal and vegetable matter.

Fluoride is a common constituent of most soils and rocks. The element fluorine occupies the VII group of the modern periodic table. The ionic form of fluorine is widely distributed in nature, '[3]'. It is thirteenth in the order of abundance representing about 0.3g / kg of the earth's crust,'[4]'. For the past 70 years, fluoride has been added to public water supplies to bring fluoride levels up to the amount necessary to prevent dental caries (tooth decay or demineralization). Nearly 100 million people in the world drink water containing excessive fluoride.

Sources of Fluoride

- The industrial effluent and sewage discharged from domestic water supply supplemented with fluoride contribute to the fluoride levels in aquatic systems, '[3]'.
- Combustion of coals and volcanic activity also contribute fluorine containing dusts and gases to the atmosphere. During rainfall, these get dissolved in water and contaminate the water bodies, '[5]'.
- The greatest amount of fluoride discharge into the environment occurs during the mining of phosphate rock when silicon tetra fluoride is freed and released or leached into nearby waters, '[7 to 9]'.

Effects of fluoride

Fluoride in drinking water is beneficial when present in low concentration (0.8 to 1 ppm), '[10]'. However; excessive intake of it is a cause for dental and skeletal fluorosis results in physiological disorders thyroxin changes and kidney damage, '[11,12]'.

What is dental fluorosis?

Dental fluorosis is a tooth defect that is caused by excessive intake of fluorides in the drinking water. Although the permanent teeth are affected, occasionally even the primary teeth may be involved.

Symptoms?

It is easy to recognize dental fluorosis. Initially there may be a few white flecks or small pits on the enamel of the teeth. Later there may be brown stains. Dental fluorosis and dental caries seem to go hand in hand.

What is the cause?

Dental fluorosis occurs in children who are exposed to a high intake of fluoride before the teeth fully mineralise, that is before 12-14 years of age. In one district of Kerala, nearly 40% of school children were found to have dental fluorosis. The disease is more prevalent in rural areas where drinking water is derived from shallow wells or hand pumps. The disease is more likely to occur in areas where the

drinking water has a fluoride content of more than 1ppm (part per million), and in children who have a poor intake of calcium.

Skeletal Fluorosis

Skeletal Fluorosis has been observed in persons when water containing fluoride between 3.0 – 6.0 mg/l is used for drinking purposes,'[14]'. Skeletal fluorosis is only recognizable in an advanced stage, detectable only in radiograph (X-ray). Maximum ill effects detected in the neck, spine, knee, pelvic, shoulder and small joints of hand and feed, producing pain and rigidity around the affected area, restricting the movement,'[6]'. About 1.70 million people suffer from skeletal fluorosis,'[13]'.

- In recent past, evidences convincing soft tissue involvement by fluoride have lead to certain vital information on fluoride action on red blood cells as result of which the shape of the RBC's get changed, which in turns are destroyed by the body leading to low heamoglobin level,'[15]'.

Fluoride contamination in Ground water – Indian Scenario

- Fluorosis, a slow, progressive, crippling malady known to be prevalent in 150 districts in 15 states of India for 6 decades is caused by the intake of water contaminated with fluoride beyond the tolerable limit of 1.5 ppm,'[6]'.
- 50-100% districts are affected in Uttar Pradesh, Rajasthan, Gujarat, Andrapradesh and Tamil Nadu,[6]'.
- 30-50% districts are affected in Punjab, Haryana, Madhya Pradesh, Bihar and Maharashtra,'[6]'.
- Less than 30% districts are affected in Jammu-Kashmir, Delhi, Kerala and Orissa,'[6]'.
- Fluorosis was first reported from India by short *et al.*, (1937),'[16]'.
- Fluoride occurs in traces in many waters but higher concentration, are observed in ground water. The highest natural level of fluoride in ground water reported is 2800 mg/litre.'[17]'.

Material and methods:

Study area

Ground water samples were collected randomly from 10 villages in and around Thiruverumbur Taluk, trichy district. Ground water samples collected had no colour, odour and turbidity.

The temperature of each sample was recorded at the site itself with the help of a thermometer. pH and Electrical

conductivity were analysed in the lab using pH meter and conductivity meter. Calcium (Ca), Magnesium (Mg) and Total Hardness were analysed by titration method (EDTA). Total alkalinity is also done by titration method. Total solids (TSS, TDS) were determined as the residue left after evaporation of the unfiltered sample. Finally Fluoride was estimated by Colorimetric method (SPADNS).

Results and discussion:

Following are the graphical representation of Physico chemical parameters of ground water samples analysed.

Temperature ranges from Min 30ºC to Max 34ºC which is shown in figure1.

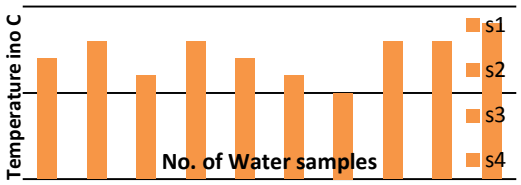

Figure:1

pH: figure 2 represents, Among 10 Water samples, five were slightly alkaline (7.13–7.76) and another five were slightly acidic (5.20–6.91).

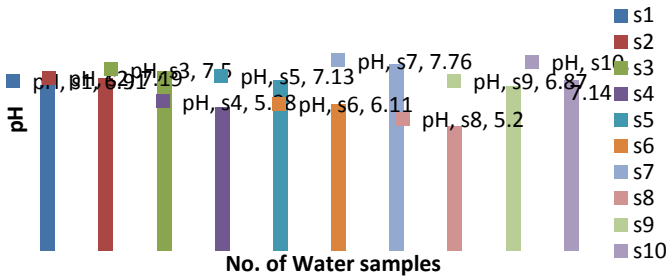

Figure:2

Total Alkalinity: s6 Exceeded the permissible limit (625mg/L>600mg/L). All other samples except s1,s7 and s10 exceeds the desirable limit(>200mg/L), '[18]' which is shown in figure 3.

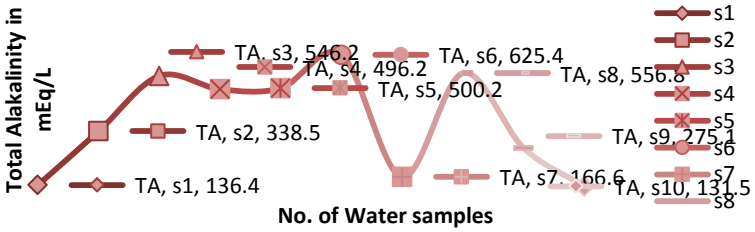

Figure:3

Calcium Hardness: s5 exceeded the permissible limit that is (293>200mg/L). Except s3(55.5mg/L) all other samples exceeds the desirable limit (>75mg/L) '[18]'which is represented in figure4

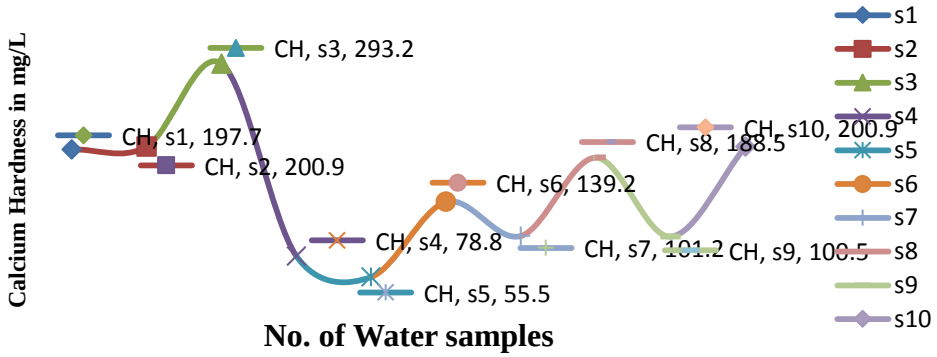

Figure:4

Magnesium Hardness: All ten samples were exceeded both desirable and permissible limit is shown in figure 5

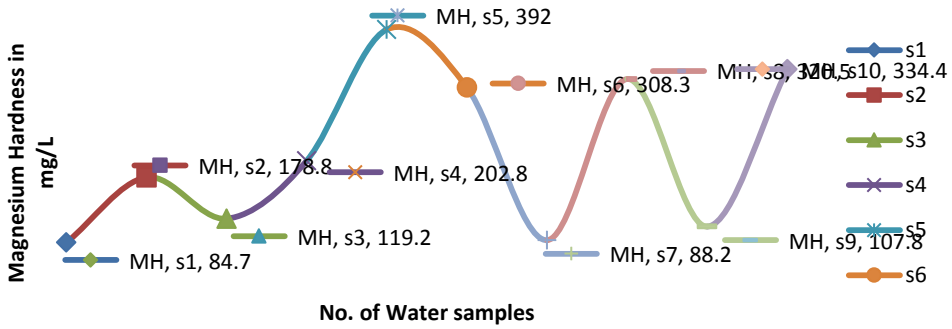

Figure:5

Total Hardness: Except four samples that is s1,s4,s7,s9, remaining samples exceeded the desirable limit (>300mg/L), '[18]'. which is shown in figure 6

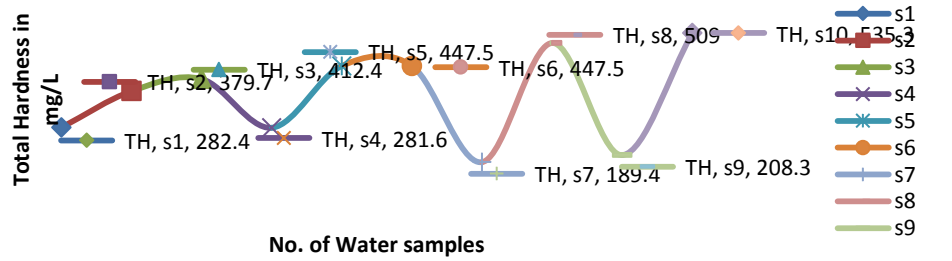

Figure:6

Total Dissolved Solids: six water samples Exceeded the desirable limit (>500mg/L), '[18]' which is shown in figure 5,6 and 7 respectively.

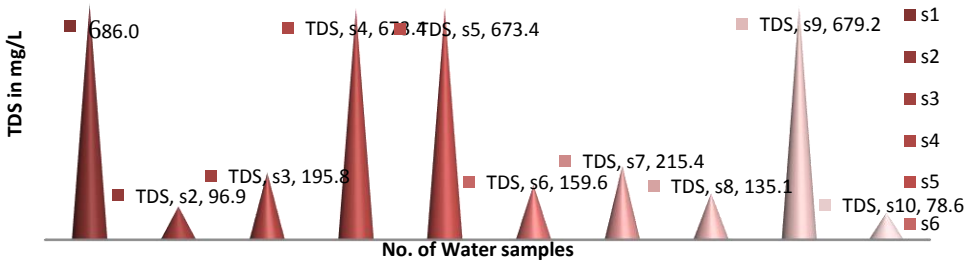

Figure:7

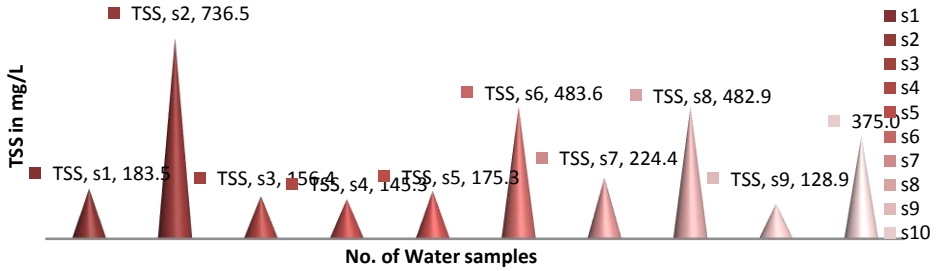

Figure: 8 variations in Total Suspended solids

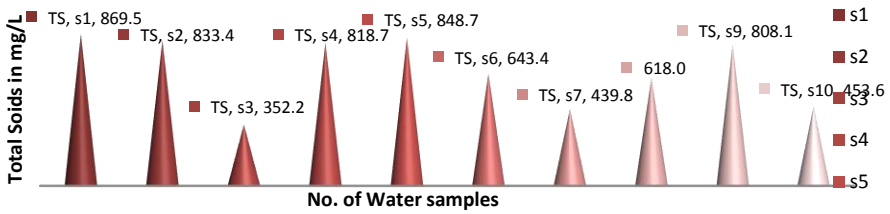

Figure: 9 variations in total solids

Fluoride: All the ten (s1 to s10) ground water samples were exceeded the WHO prescribed desirable and also permissible limit. (1 to 1.5mg/L), '[17]'.

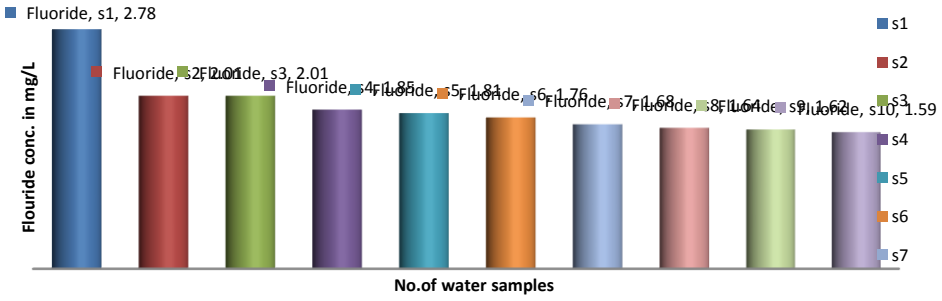

Figure: 10

It should be noted that all other water quality parameters were atleast comes under permissible in the prescribed limit. Only fluoride is exceeded prescribed limit. Min, max, mean, median and SD values were given in table1.

Table:1 Descriptive statistics of the physico chemical parameters in the ground water samples

PARAMETER	MIN	MAX	MEDIAN	SD
TEMP	30	34	32.5	1.23
pH	5.2	7.76	7.02	0.78
EC	0.32	1.716	0.909	0.407
TOTAL ALAKALINITY	131.5	625.4	1.785	190.42
CALCIUM HARDNESS	55.5	293.2	417.35	73.09
MAGNESIUM HARDNESS	84.7	392.0	163.85	115.75
TOTAL HARDNESS	189.4	535.4	190.8	122.38
TDS	78.6	686.0	396.05	277.2
TSS	128.9	736.5	205.6	203.07
TS	352.2	869.5	203.9	195.5
FLUORIDE	1.59	2.78	725.8	0.352

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After the analysis of samples, school children were examined in the study area by going to the schools located nearer sampling site. The results were shown in table 2

Table: 2 Survey among school children

study area	% of victims	
	Boys	Girls
1	14.6	8.1
2	14.8	14.6
3	23.53	16.35
4	21.6	17.9
5	35	47.62
6	50	36.84
7	36.84	50
8	21.6	23
9	42.06	37.1
10	24.5	21.7

From figure 11, Both Boys and girls were almost equally affected with dental fluorosis was clear.

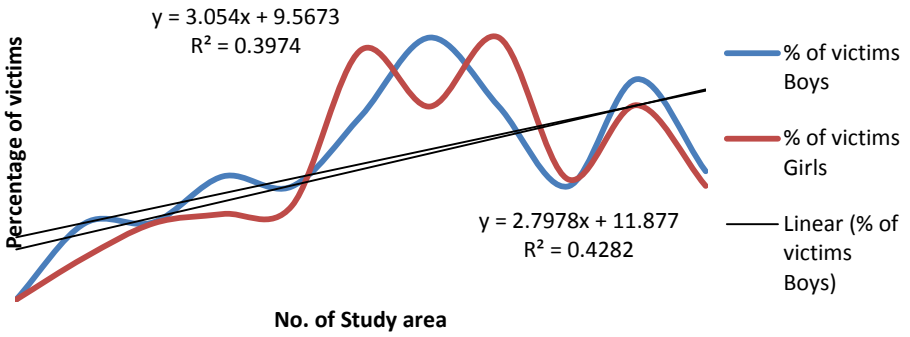

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Figure:11

Conclusion: All 10 samples found to contain high fluoride conc. (>1.5 ppm). s1 found to have excess fluoride content 2.78mg/L. defluoridation has to be done or water from other sources has to be supplied to that area. 35% of Boys and 34% of girl children to the total had been affected with dental fluorosis in the study area (between age group of 6 to 13yrs old)

Recommendations: To summaries three approaches are suggested:

1. Health education
2. Treatment of the children
3. Preventive measures
   - ✓ Creating disease awareness
   - ✓ Creating awareness about the sources of the fluoride
   - ✓ Providing defluoridated water for drinking purpose

Methods of defluoridation recommended so far are aimed at bringing the fluoride levels to the WHO standards. Desirable characteristics of defluoridation process

- ❖ Cost-effective
- ❖ Easy to handle/operate by rural population - the major sufferer
- ❖ Independent of input Fluoride concentration, alkalinity, pH, temperature
- ❖ Not affect taste of water

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