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Assessment of Fluoride Concentrations of Groundwater in Tiruchendur, Thoothukudi District, Tamilnadu by SPADNS Method

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Abstract: Fluoride is ingested primarily through consuming water. When water contains fluoride concentrations >0.7 parts per million (ppm), consuming such water can be toxic to the human body; this toxicity is called "fluorosis."Therefore, it is critical to determine the fluoride concentrations in water. The objective of this study was to determine the fluoride concentration in the ground water of Tiruchendur, Thoothukudi District, Tamilnadu. The Thoothukudi Dis-trict is a hard rock and alluvial plain marked as one of the Fluoride-increase area in Tamilnadu due to occurrence of various rock types including fluoride-bearing minerals. The F^- content of groundwater can thus originate from the dissolution of Fluoride-bearing minerals in the bed rock. Chronic exposure to fluoride at such concentrations produces harmful health effects, the first sign of which is dental fluorosis. Therefore, it is essential that the government authorities implement water defluoridation programs and take preventative measures to reduce the ingestion of this toxic halogen.
Keywords : Fluoride, surface water, groundwater, fluorosis.

Introduction

Among the water quality parameters, fluoride ion exhibits unique properties as its concentration in optimum dose in drinking water is advantageous to health and if the concentration exceeds the limit, this affects the health [1]. High fluoride concentration in the ground water and surface water in many parts of the world is a cause of great concern. The main source of fluoride in ground water is fluoride-bearing rocks such as fluorspar, fluorite, cryolite, fluorapatite and hydroxylapatite [2]. Also the content in ground water is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, pH, temperature, concentrations of calcium and bicarbonate ions in water [3&4].Though fluoride enters the body through water, food, industrial exposure, drugs, cosmetics, etc., drinking water is the major source (75%) of daily in take [5]. Due to its strong electro negativity, fluoride is attracted to positively charged calcium in teeth and bones. Major health problems caused by fluoride are dental fluorosis, teeth mottling, skeletal fluorosis and deformation of bones in children as well as adults [6]. Excess fluoride affects plants and animals also. The effect on agriculture was also evident due to inhibition on plant metabolism leading to necrosis, needle scratch and tip burn diseases. In animals also prominent symptoms of fluorosis were observed. In human beings, effects on dental and skeletal tissues (genu valgum) can occur in adolescents and young adults. It can interfere with carbohydrates, lipids, protein, vitamins, enzymes and mineral metabolism when the dosage is high. Skeletal deformation and weakening of joints are typical forms of fluoride at high levels of fluoride intake [7]. Fluoride is primarily excreted in urine. The severity of injury is determined by duration of fluoride exposure and concentration. Fluoride concentrations in ground water in India vary significantly. In some parts of India, fluoride levels are

below 0.5 mg/L, while in other places, fluoride levels are as high as 30 mg/L [8]. According to WHO [9], permissible limit for fluoride in drinking waters is 1.0 mg/L. WHO has set a range of allowable concentration for fluoride in drinking water for a region depending on its climatic conditions, because the amount of water consumed and consequently the amount of fluoride ingested is being influenced primarily by the air temperature[1,10]. In this paper, the data pertaining to fluoride concentrations in the ground water of Tiruchendur, Thoothukudi district, Tamilnadu which is the state of India has been presented. For this, field samples from different sites were collected during the year 2014 and analyzed. The results obtained are presented and discussed in this paper.

Materials and Methods

Water samples were collected using 200 mL polyethylene bottles that were washed three times with deionized water; prior to collecting each sample, the bottles were labeled with the sample number and location for identification. Collection temperature of these areas was noted by 110^{o}C thermometer. All the chemicals and reagents used were of analytical grade. D.D water was used for the preparation of solutions. The analysis of parameters namely pH, temperature and Fluoride were carried out as per the methods described in APHA (1995) [11]. Determination of Fluoride has been carried out using SPADNS method.

Table 1. Physico – Chemical Parameters of Water Samples

S.No	Location Name	Temperature	Colour	pH	Chloride (mg/l)	Fluoride (mg/l)
L1	Velavan Nagar	32.12	Colourless	7.50	418	0.9
L2	Thoppur	32.46	Colourless	7.52	358	0.6
L3	Kandasamypuram	31.99	Colourless	7.95	410	0.85
L4	Ganesapuram	33.12	Colourless	7.61	452	1.0
L5	Alandalai	31.56	Colourless	8.02	290	1.1
L6	Soosaikudierupu	32.77	Colourless	7.57	322	0.7
L7	Chendur nagar	29.46	Colourless	7.61	401	0.9
L8	Kallamozhi	31.31	Colourless	7.77	422	0.8
L9	Ranimaharajapuram	32.08	Colourless	7.01	357	0.6
L0	Kumarapuram	31.18	Colourless	7.12	201	0.8
L11	Veerapandianpatnam	32.46	Colourless	7.58	350	0.12
L12	Tiruchendur	31.17	Colourless	7.77	388	1.3

Results and Discussions

Temperature

A rise in temperature of water leads to the speeding up of chemical reactions in water, reduces the solubility of gases and amplifies the tastes and odours. The average temperature of the present study ranged from 29.46 – 32.46^{O}C.

pH

It is known that pH of water (6.5 to 8.9) have no direct effect on health. But lower value below 5.0 produce sore taste and higher value above 8.9 are of alkaline taste. The pH values of the present investigation were within the ICMR standards (7.01 – 8.02).

Fluoride

Fluoride in ground water is due to fluorspar, cryolite, fluorspatite and hydroxylapatite. Excess fluoride consumption affects plants and animals. Out of twelve sampling stations studied, low fluoride concentration is noticed in all the samples except sampling station no L5 & L12 where the fluoride content is above the permissible limits. The reason for high level may be due to the use of phosphate fertilizers in the agriculture.

Conclusion:

It can be concluded form the above study that fluoride content in some areas was found above the permissible levels than required. Hence people in those areas should consume protected water containing fluoride within the prescribed limits in order to prevent dental and skeletal fluorosis for the future generation. The government authorities should implement water defluoridation programs and take preventative measures to reduce the ingestion of this toxic halogen.

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