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ASSESSMENT OF FLUORIDE STATUS CONTENT IN URBAN ENVIRONMENT AT COIMBATORE

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ABSTRACT

An attempt has been made to determine the distribution of fluoride status content in urban (Coimbatore) environment. There is a wide spread interest in determining fluoride content in natural water particularly in ground water. Much of fluoride entering the human body is obtained from water. Concentration of fluoride, ranging from more than 0.87 to 1.10 ppm in surface, subsurface waters in the twenty sample stations in Coimbatore, is within the permissible limit fixed by the WHO for human beings.

INTRODUCTION

Water is essential natural resource for sustaining life and environment which we have always thought to be available in abundance and free gift of nature. However, chemical composition of surface and sub-surface is one of the prime factors on which the suitability of the water for domestic, industrial or agriculture purpose depends (Mukhopadhyay 1996). The chemical nature of water is one of the most important criteria that determines its usefulness for a specific need and as such not all the waters are fit for drinking; hence the problems of scarcity of drinking water.

The presence of fluoride, in quantities in excess of limits is a serious matter of concern from a public health point of view. Like any other pollutant, the fluoride pollution can also occur due to both natural and man made reasons. Fluoride in drinking water is known for both beneficial and detrimental effects on health. Endemic fluorosis is related with the presence of fluoride in water is a public health problem in most of the Indian states. Drinking water is very important for good health. It is derived or obtained from various sources e.g. spring water, deep wells, lake, rivers etc. Groundwater forms a major source of drinking water in urban as well as areas.

Fluorine is considered as an essential element though health problems may arise from either a deficiency or an excess of fluoride. There is a wide spread interest in determining fluoride content in natural water particularly in ground water. Much of fluoride entering the human body is obtained from water. Human teeth are composed of calcium hydroxy apatite $Ca_5(PO_4)_3$ OH. The fluoride ion is readily taken up by calcium hydroxy apatite and displaces some hydroxide ions. Fluoride ions enhance the precipitation of calcium phosphate and so may accelerate demineralization. The formation of dental caries is initiated by the formation of plaque on the teeth surface. Acids produced by bacteria dissolve the enamel and is often not affected until substantial damage is caused to the subsurface regions. It is thought that fluoride ion can facilitate the formation of apatite at this stage, before the other surface is affected. Therefore, fluoride is also used to stabilize the enamel mineral against decay. It is done either by the use of fluoride in toothpaste or by fluoridation of the drinking water (Hughes 1981). The aim of this investigation is to determine the distribution of fluoride status content in urban (Coimbatore) environment.

MATERIALS AND METHODS

Thermo Orion Ion meter model 720 A plus which has an ion selective electrodes was used to determine the fluoride content. The standard fluoride solution of 100 ppm which was commercially supplied was used in standard solution preparation. From the above standard solution 1 ml was taken and made up to 100 ppm in a volumetric flask which makes 1 ppm. Similarly 10 ml is pipetted out to make 10 ppm standard solutions and mixed thoroughly. The meter was calibrated using the above solutions. The prepared standard solution is mixed with 2 ml of ion selection plus solution. The meter was calibrated using the above solutions. The sample (water collected from the sampling stations) of which 10 ml was transferred into a 25 ml breaker and 1 ml of ion-selective plus solution was added. Direct readings were taken from the meter by dipping the fluoride ion selective electrode into the prepared samples. Table 1 shows the description of the sample station location and its index.

Table 1. pH, EC and fluoride content in the water samples collected from different sampling stations

Sample Station	Source of Collection	pH	EC (dS m^{-1})	Fluoride content (mg L^{-1})
Thudiyalur (North)	Open well – depth 550 feet	7.08	1.40	0.13
Thobampatti(North)	Bore well – depth 370 feet	7.15	3.50	0.13
Vadamadurai (North)	Corporation bore well – depth 270 feet	7.07	1.30	0.12
Koudampalayam (North)	Bore well depth – 250 feet	7.73	3.20	0.14
Rakeripalayam(North)	Bore well depth – 220 feet	7.59	0.10	0.18
Ukkadam water tank (South)	Water Reservoir	8.82	5.20	0.17
Ukkadam sewage farm (South)	Sewage Farm	7.30	2.30	0.87
Ukkadam well water(South)	Well water near by Sewage farm – depth 120 feet	7.36	2.00	0.95
Ukkadam tap water(South)	Corporation supplied water bore well –depth 120 feet	7.27	0.60	0.36
Upplipalayam(South)	Bore well – depth 100 feet	7.61	2.80	0.89
Kattor (East)	Well water – depth 150 feet	7.32	0.10	0.78
Gandhi park (East)	Bore well – depth 300 feet	7.43	0.80	0.13
Veerakeralam(East)	Well water – depth 30 feet	7.55	0.60	0.96
Ram Nagar (East)	Bore well – depth 220 feet	7.56	0.40	0.17
Nehru Stadium(East)	Bore well – depth 300 feet	7.77	0.30	0.14
Vadavalli (West)	Corporation bore well – depth 270 feet	7.07	0.90	0.10
Kalveerapalayam(West)	TWAD supply water bore well – depth 270 feet	7.59	0.10	0.61
Vadavalli(West)	Wells water – depth 40 feet	7.88	0.90	0.12
TNAU Bore well (West)	PPC Hostel bore well depth 520 feet	7.07	0.30	0.18
TNAU Bore well (West)	Siruvani Water – Corporation Supplied	7.32	0.10	1.10
SD		0.40	1.40	0.37

RESULTS AND DISCUSSION

pH of water samples collected from different sampling stations ranged from 7.07 to 8.82 (Table 1). All the water samples were in neutral range except the water sample which was collected from Ukkadam water tank which tends to be alkaline in nature (8.82). EC of the water samples from different sample stations ranged from 0.1 to 5.2 dS m^{-1} (Table 1). Here also the water sample collected from Ukkadam water tank showed a high level of EC (5.2 dS m^{-1}). Fluoride content ranged from 0.87 to 1.10 mg L^{-1} which is below permissible limit (1.5 mg L^{-1}) of WHO (1994).

In the state of Bihar and West Bengal, the high fluoride values (26 ppm) is due to the leaching of fluoride from the hornblende gneiss and granulites (Mukhopadhyay 1996). The low fluoride content in the study area may be ascribed to absence of hornblende gneiss in the region.

It is well known that the excess fluoride intake is responsible for dental and skeletal fluorosis. The problem of fluorosis has been known in India for a long time. The disease earlier called "mottled enamel" was first reported by Vishanathan (1935) to be prevalent in human beings in Madras Presidency in 1933. Mahajan (1934) reported a similar disease in cattle in certain parts of old Hyderabad state. However, Shortt (1937) was the first to identify the disease as "fluorosis" in human beings in Nellore district of Andhra Pradesh.

Endemic fluorosis is a public health problem in India. Around 25 million people in 150 districts are affected by this disease (Survey report – Rajiv Gandhi National Drinking Water Mission, 1993). Medical advice recommends the drinking water should not contain more than 1.5 ppm of fluoride (WHO 1994).

Fluoride is present in the teeth, bones, thyroid gland and skin of animals. It plays an important role on the formation

of dental enamel and normal mineralization in bones but can cause dental fluorosis and adversely affect the central nervous system, bones, and joints at high concentrations (Agarwal et al.1997). The fate of fluoride in the soil environment and groundwater is of concern for several reasons. It is generally accepted that fluoride stimulates bone formation (Richards et al.1994) and small concentration of fluorides have beneficial effects on the teeth by hardening the enamel and reducing the incidence of caries (Fung et al. 1999). At lower levels (<2 mg/ml) soluble fluoride in the drinking water may cause mottled enamel during the formation of teeth, but at higher levels other toxic effects may be observed (Weast and Lide 1990). Excessive intake of fluoride results in skeletal and dental fluorosis (Czarnowski et al. 1999). Severe symptoms lead to death when fluoride doses reach 250-450 mg/ml (Luther et al.1995). It has been found that the IQ of the children living in the high fluoride areas (drinking water fluoride > 3.15 mg/ml) was significantly lower (Lu et al. 2000).

Fluoride enters the human body mainly through the intake of water and to a lesser extents by food. The foods which are rich in fluoride include fish and tea (EPA 1997). Ingested fluorides are quickly absorbed in the gastrointestinal tract, 35-48% retained by the body mostly in skeletal and classified tissues, and the balance is excreted largely in the urine. Chronic ingestion of fluoride rich fodder and water in endemic areas leads to development of fluorosis in animals e.g. dental discoloration, difficulty in mastication, bony lesions, lameness, de-ability and mortality (Patra et al. 2000). Naturally occurring fluorides in groundwater are a result of the dissolution of fluoride containing rock minerals by water while artificially high soil fluoride levels can occur through contamination by application of phosphate fertilizers, sewage sludge, or pesticides (EPA 1997).

Concentrations of fluoride below 1.5 ppm are helpful in prevention of toothy decay and such level of fluoride also assists in the development of perfect bone structure in human and animals. However, a dose of fluoride above 1.5 ppm increases the severity of tooth mottling and induces the prevalence of osteoporosis and collapsed vertebrate. The disease resulting from excessive consumption of fluoride. Fluorosis has no treatment and is considered to be deadly disease. High fluoride content in water even causes change in shape and colour of the fruits and vegetation.

Fluoride concentration ranging from more than 0.87 to 1.10 ppm in surface and subsurface waters in the twenty sampling stations in Coimbatore was within the permissible limit fixed by the WHO for human beings.

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