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Original Article

Effects of Fluoride Accumulation on Growth of Vegetables and Crops in Dausa District, Rajasthan, India

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ABSTRACT

The major part of fluoride ingested in areas endemic to fluorosis is water, although some food materials contribute considerable amount to total intake. Plants take up fluoride from irrigating waters and this uptake is influenced by some inorganic constituents in water and soil. The present study was carried out to assess accumulation of fluoride in vegetables and cereal crop grown in potentially fluoridated area in Dausa district, Rajasthan, India. Earlier it was believed that food was not a rich source of fluoride for humans but it is now well documented that certain types of food can have high fluoride content. In the present investigation food items were collected from Dausa district and analyzed. Variable fluoride accumulation occurs in crop (wheat) and vegetables (potato and tomato). The fluoride content of cereal crop was found to be higher than that of vegetables. Maximum fluoride concentration was found in wheat i.e. 14.3 µg/g where fluoride concentration in water samples was found 6.2 ppm.

Keywords: *Fluoride; Exposure; Assessment; Vegetables; cereals; Fluorosis*

INTRODUCTION

Fluoride beyond desirable amount (0.5-1.5 ppm) in ground water is a major problem in many parts of the world. Intake of fluoride ion into roots is largely dependent on the concentration of fluoride ion in the soil and the type of soil. Fluoride is more soluble in acid soils due to which its uptake by plants is enhanced. Most foods whether derived from plant or animal life, contain fluoride ion at least in minute amounts. Fluoride ions levels vary widely even between samples of the same kind of food. Some foods concentrate additional fluoride ion from boiling, processing or contamination. Some foodstuffs such as vegetables and fruits normally contain fluoride through at low concentration (0.1 mg/kg-0.4 mg/kg) and thus contribute to fluoride intake by man. The effect of fluoride on growth may be complex, varying from positive to negative effects. Fluoride and its effects on the plants have been the matter of serious reviews. The prescribed norm for fluoride limit in water is 0.8 - 1.5 mg/L. The excess accumulation of fluorides in vegetation leads to visible leaf injury, damage to fruits, changes in the yield [1]. Pathways and patterns of fluoride excretion associated with different intakes of fluoride have been described by various researchers [2,3, 4].

Leafy vegetables are particularly susceptible to air borne fluoride ion and this accounts for wide variations in the contents of vegetables grown in different areas. Cereals usually contain <1ppm fluoride, where fluoride tends to accumulate in the outer layer of the grain and in the embryo [5]. Potato peeling can contain as much as 75% of the total fluoride in the whole tuberenriched drinks. Phosphatic fertilizers especially the super phosphates are most important source of fluoruide in agricultural lands [6,7].

Fluoride in water contributes significantly to the total exposure of an individual to this element but it is not the only source of exposures. A person' diet, general state of health as well as the body's ability to dispose of fluoride all affects how the exposure to fluoride manifests itself [8].

Dausa district ($27^0$05' to $30^0$12' N latitude and $75^0$00' to $78^0$17' E longitude.) is situated nearly 56 km away from Jaipur city, where fluorosis has been known to be prevalent for some years, was selected as study area for conducting the present research because people of this village are not

only consuming F- contaminated drinking water but also the crops/vegetables cultivated in their own agricultural fields as food items. Apart from that study, no study of F accumulation in other crops and vegetables cultivated in the study area has been reported. This research is with the view of generating a database for fluoride levels in some vegetables and crop grown in some of the irrigation farms of Dausa district, Rajasthan, India.

MATERIAL AND METHODS

In order to evaluate the impact of the F pollution, samples of randomly collected crop and vegetables items from 7 villages of the study area were examined. In this study area, due to low rainfall vegetables and cereals of these villages were irrigated with the fluoridated ground water samples were analyzed for fluoride by ion-selective electrode method. Fluoride concentration in these areas were found beyond permissible limit (>1.5ppm) [9]. In the study area crop (wheat) and vegetables (potato and tomato) which were grown locally can easily absorb, translocate and accumulate fluoride. Food items which were taken from these plants dried for 40 hours at 80ºC. Grinded to pass through No. 40 sieve and stored in clean dry, tightly closed plastic bottles. Bottles were rotated to mix sample thoroughly before removing aliquots. Further these samples were powdered and analyzed in the laboratory for fluoride content using potentiometric method [10]. Fluoride is extracted from dry pulverized foliage with HNO_3 followed by aqueous KOH. Potentiometric method using Ion selective electrode was observed to give more authentic results for estimation of fluoride in food samples.

RESULT AND DISCUSSION

The level of fluoride concentration in the food items collected from different villages of dausa district are shown in Table 1. Fluoride concentration in ground water samples (Hand pumps and open well) of 7 villages was found to vary from 5.1 ppm to 14.7 ppm (Table 1). The present study revealed that fluoride concentration in wheat crop was found between 3.24 µg/g (village) to 14.3 µg/g (village). In this study area fluoride concentration in tomato and potato was estimated 1.10 µg/g to 4.6µg/g and 1.22 µg/g to 2.92 µg/g respectively.

Table 1: Fluoride content in crops and vegetables in study area, Dausa

S. No.	Name of the village	Fluoride content (ppm)	Fluoride content (µg/g) in food items		
			Wheat	Tomato	Potato
1	Bairwa mohalla hingotia	14.7	3.24	1.10	1.22
2	Bairwa Dausa	5.2-6.4	14.2	4.09	2.89
3	Jirotakalo Dausa	5.6	3.48	1.10	1.26
4	Malarana/ Dausa	5.8	9.11	2.15	2.9
5	Jhonpuria	5.6	10.72	4.6	2.92
6	Jag Sahaipura/Dausa	5.1	3.56	1.5	1.27
7	Khandelwal/ Dausa	6.2	14.3	4.19	2.92

DISCUSSION

Similarly to present research work earlier studies have also shown that fluoride has the tendency to be accumulated in the vegetable leaves and adversely affected the growth and productivity of many crops [2, 11, 12, 13]. Similarly Gautam *et. al*. [6] studied fluoride accumulation by vegetables and crops grown in nawa tehsil of Nagaur district and reported that among leafy vegetables spinach showed maximum fluoride concentration (25.70 µg/g) and cereals were also analyzed for fluoride out of which methi and chawla was found to have maximum fluoride concentration (18.98 µg/g).

According to Bhargava and Bhardwaj [14], fluoride is entering human food and beverages chain in increasing amount through the consumption of tea, wheat, cabbage, carrots and other Indian food. Various studies done in Chaina suggested that contribution from food can significantly contribute to the total fluoride uptake [15, 1]**.** Fluoride content in food should not be disregarded in assessing

the total fluoride uptake. Fluoride ion in plants is derived from contaminated air and soil. Fluoride ion in the air enters the plant through the leaves, and in the soil through the roots.

After evaluating the data of the present study it was observed that fluoride not only enters through water but also with many edible items. Fluoride of food items depends upon the fluoride contents of soil and water used for irrigation. Fluoride in water contributes significantly to the total exposure of an individual to this element but is not the only source of exposure. Fluoride in food plays a vital role in causing fluorosis whereas fluoride in drinking water plays major role. Fluoride content of the food items vary from place to place. Fluoride level vary widely even between samples of the same kind of food.

Thus, it can be concluded that role of diet in fluorosis has a double sword action so fluoride content in food should not be disregarded in assessing the total fluoride uptake.

CONCLUSION

From the above studies, in order to reduce the risk of human exposure to fluoride, the use of F-contaminated irrigation water, especially for crops that tend to accumulate fluoride, should be reduced as much as possible. It is therefore very important, if possible, not to irrigated crops with fluoride contaminated irrigation water. However, in areas fluoride contaminated irrigation water, it is advisable to grow crops with relatively low capacities to enrich fluoride, such as those with seeds or tubers as the main edible parts.

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