International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (03), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

FLUORIDE CONTENT OF LOCALLY GROWN PLANT FOODS IN RAW FORMS

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ABSTRACT

Fluoride related health hazards are major environmental problem in many regions of the world as well as in India. One of the state is Rajasthan,where almost all the districts, the distribution of high fluoride (beyond permissible level i.e. 1.5 mg /l) in ground water has been reported and in all the districts influence of fluorosis problem can be visualized at various levels i.e dental fluorosis, skeletal fluorosis, non skeletal manifestations etc. Besides water, fluoride present in foods also contribute in the increment of fluoride intake. Present study was based on the estimation of fluoride content in the locally grown plant foods (cereals, pulses, vegetables) of Tonk, Niwai and Banasthali. Among raw food samples of Wheat, Bajra, Maize, Barley, Greengram, Bengalgram, Lobia, Uraddal, Cabbage, Cauliflower, Brinjal, and Reddish the fluoride content was found to be 5.6 ppm, 31.6 ppm, 34.0 ppm, 9.6 ppm, 51.0 ppm, 66.0 ppm, 55.6 ppm, 49.6 ppm, 9.1 ppm, 5.6 ppm, 3.0 ppm and 11.3 ppm respectively. Results shows that Bengalgram was found to have highest fluoride content (66.0 ppm) and Brinjal was found to have least fluoride content(3.0 ppm).

Keywords: Banasthali, Bengalgram, Brinjal, Fluoride, Fluorosis, Newai, Rajasthan, Tonk

I. INTRODUCTION

Trace elements are essential and beneficial to human health in minute concentrations, as they play an important role in many metabolic processes and act as cofactors.Exceeding their permissible intake is known to be toxic and has adverse effects in general body metabolism.One such trace element which ubiquitously distributed in soil, earth and water is fluoride. Excess fluoride in drinking water and diet can lead to Fluorosis.In India, over 25 million people from 15 states namely Rajasthan, Tamil Nadu, Maharashtra , Bihar, Delhi, Jammu and Kashmir, Uttar Pradesh, Madhya Pradesh, Gujarat, Punjab, Haryana ,Karnataka, Andhra Pradesh, Kerala and Orissa are under the threat of Fluorosis due to high Fluoride content 2-20 ppm in potable water sources.Considerable amount of fluorides are also ingested though food and polluted atmosphere (Srikantia, 1977 ; Batra et al, 1995).

It is observed that fluorine content of food items grown in fluorosis endemic area is anomalously high and therefore fluoride ingestion of affected population through food is also significantly large(JyothiKumari et al, 1995).So keeping all these points in mind, present study was designed to undertake following objectives.

1. To analyze the fluoride content in different foods grown in the area of Newai, Tonk, and Banasthali of Rajasthan.

2. To compare the fluoride content of selected food samples of cereals, pulses, vegetables.

II. REVIEW OF LITERATURE:

The mean fluoride content of rocks lies between 0.1 and 1.0 g /kg. The main primary fluoride – containing minerals are fluorspar(CaF2), cryolite(Na3AlF6) and apatite(Ca5{PO4}3{OH,F,Cl}), but in most soils it is associated with micas and other clay minerals (Davison , in press). The mean fluoride content of mineral soils is 0.2 –o.3 g/kg(USNAS, 1971), whereas that of organic soils is usually lower. However , n soilds which have developed from fluoride containing minerals it may range from 7(Smith et. Al., 1979) to 38 g/kg.(Vnogradov, 1973; Danilova, 1944).In a recent review Davison (in press) calculated that phosphate fertilizers typically add between 0.005and 0.028 mg F/kg per year to soil.

Some fluoride compounds in the earth's upper crust are fairly soluble in water. Thus fluoride is present in both surface and groundwater. The natural concentration of fluoride in groundwater depends on such factors as the geological, chemical and physical characteristics of the water supplying area, the consistency of te soil, the porosity of rocks , the pH and temperature , the complexing action of other elements, and the depth of wells (Livingstone, 1963; worl et. Al., 1973).Owing to these factors, fluoride concentrations in ground water fluctuate wthin wide limits , e.g., from <1 to 25 mg or more per liter. In some areas of the world ,e.g.,India, Kenya, and South Africa, levels can be much higher than 25mg/liter (WHO, 1970).Data on the fluoride content of natural watersand drinking water are available from many parts of the world (WHO, 1970). Supplementation of drinking water with fluoride has been carried out since 1945. A procedure such as adding fluoride to drinking water occasionally carries with a risk of overexposure.

In North West India namely Gujarat and Rajasthan the normal concentration of fluoride ion is 0.4 to 1.9 mg /l. in fact, Rajasthan is the only state in India where almost all the districts , the distribution of high fluoride(beyond permissible level) in ground water have been reported and in all districts influence of fluorosis problem can be visualized at various level i.e.dental fluorosis, skeletal fluorosis, non skeletal manifestation etc. (Sharma et al. Dec. 2000)

A base line study involving analysis of subsurface water samples from Ajmer district was carried out in order to assess their geochemical sources of dissolved fluoride and its suitability for drinking and domestic purposes. Samples of groundwater in the Ajmer district , Rajasthan , specially from shallow aquifers , contain appreciable concentration of fluoride. Present water shortages have resulted in increased pressures to use such high fluoride content water for municipal purposes , as well as for irrigation. Groundwater fluoride in high level is present in all the 31 districts and has become a serious health related issue in 23 districts of Rajasthan. (Handa , 1975 and Patra et al , 2000)

Water is a major source of fluoride (F) in fluorosis endemic areas although food materials also contribute considerable amount to total intake. Plants take up F from irrigating waters and this uptake is influenced by some inorganic constituents in water and soil. (Khandari et .al.2006)

Fluoride is present in almost all foods. Fluoride content of foods is influenced to a great extent by soil condition , air borne fluoride emitted by industries and indiscriminate use of fluoride rich pesticides and fertilizers. Of the plant sources , tea leaves and other members of the family Theaceae contain the highest concentration (50-400 ppm) of fluoride. Fifty to ninety percent of fluoride are sea foods (5-35 ppm) , sea salt (14-20 ppm), some pulses like red gram (13-53 ppm), bengalgram(15-30 ppm) and greengram (21-62 ppm).

Betel nuts (4-12 ppm) and chewing tobacco (10-40 ppm) are other sources of this element. Meat products , eggs and fruits are negligible source of dietary fluoride.(Das, 1998)

TABLE 2.1

Flouride content in various food items

Food Item **Cereals**	**Fluoride (mg/kg)**	**Fruits**	**Fluoride (mg/kg)**
Wheat	4.6	Banana	2.9
Rice	5.9	Mango	3.2
Maize	5.6	Apple	5.7
Pulses		Beverages	
Gram	2.5	Tea	60-112
Soya Bean	4	Coconut Water	.32-.6
Vegetables		**Spices**	
Cabbage	3.3	Coriander	2.3
Tomato	3.4	Garlic	5
Cucumber	4.1	Ginger	2
Lady Finger	4	Turmeric	3.3
Spinach	2	**Food from Animal Source**	
Mint	4.8	Mutton	3-3.5
Brinjal	1.2	Beef	4-5
Potato	2.8	Pork	3-5
Carrot	4.1	Fishes	1-6.5

Source: Prevention & control of fluorosis in India: Vol 1 (Health Aspects) (Ed Susheela A.K,.) Rajiv Gandhi national Drinking Water Mission , New Delhi

Total intake of fluoride by different population groups varies depending upon the concentration of fluoride in drinking water as well as food. On normal or low levels of fluoride in water (about 1 ppm and below) the daily intake of fluoride by adults may range between 1-5 mg/day. On the other hand in endemic fluorotic areas this

level can be as high as 25 mg/day.(Das, 1998).Because of variations in the fluorine content of the diet and drinking water , the fluorine intakes may vary from 10 mcg per kg of body weight. (Rajalakshmi, 1984).

The contribution to the addition of fluoride varies from region to region and may be as high as 80% of the total intake of this element. Therefore while computing the daily intake of fluoride , it is essential to consider fluoride intake through foods. It was observed that cereals and vegetables grown in fluorosis affected villages contain higher concentration to those grown in non endemic village.(Weizan et. al, 1979).According to Waldbott et al" Virtually every food contain at least some fluoride. Plant take it up from the air, From the soil, fluoride is transmitted through fine hair rootlets into the stems, and some reaches the leaves. Plant absorb more fluoride from sandy than from clay soil and more from wet and acid soils than from dry and alkaline ones. (Waldbott et al)

III. PROPOSED METHODOLOGY

Present study was designed to estimate the concentration of fluoride in different food groups to determine the effect of fluoride present in water.

3.1. Selection of samples: Cereals(Wheat , Bajra, Maize, Barley) ,Pulses (Greengram , Bengalgram, Lobia, and Urad Dal) and Vegetables(Cabbage, Cauliflower, Brinjal, Raddish) were selected from local villages of Tonk district where they have been grown. Cereals and pulses were taken in triplicates from three different fields while vegetables were taken from local market in triplicate after the duration of 10 days and used to perform the tests for accuracy in results.

3.2. Estimation of Flouride: Standard method (Spectophotometric Method) was used to obtain reliable results using Zirconium Alizarin complex.(shodhgangainflibnet.ac.in-chapter IV-Spectrophotometric method for determination of fluoride in water samples using Alizarin red S.)

3.3. Procedure:

3.3.1. Sample Preparation:

a) Samples were dried at 150 degree celcius in the oven and crushed with mortal and pastle.
b) 6 ml of N NaOH was added to 0.5gm of sample taken in a nickel crucible.
c) The sample was kept in the oven at 150 degree Celsius overnight.
d) The content were dissolved in small amount of distilled water.
e) Nickel crucible was heated to boil the sample.
f) The sample was then cooled and neutralized with 8ml Conc.HCl till pH was 8-9
g) Then it was filtered through whatmann filter paper.
h) The final volume was made upto 100 ml, with distilled water.

3.3.2. Procedure for estimation:

a) Series of standard fluoride solution was prepared by taking 0-10 ml of stick and diluting it to 10 ml with the help of distilled water.
b) The blank was prepared which had only distilled water.

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (03), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

c) Sample was taken in a separate test tube (1 ml) its volume was upto10 ml with distilled water.

d) 0.5 ml of Alizarin red was added to each test tube.

e) 0.5 ml of zirconyl oxychloride solution was added to each test tube.

f) The test tubes were incubated for 1 hour.

g) Absorbance was read at 520 nm.

h) Standard curve was plotted and used to calculate concentration of fluoride in the given sample.

3.3.3.Statistical analysis of data **:**Methods for analysis of data used were Mean, Standard deviation and Bar Diagram.

IV. RESULTS AND DISCUSSION

Results depicting the mean fluoride content in cereals, pulses, vegetables grown in the area of Newai, Tonk, and Banasthali of Rajasthan are represented in Table 4.1 and Figure 4.1. Among the cereals, the highest fluoride content was found in Maize i.e. 34 ppm and least fluoride was found in wheat i.e. 5.6 ppm. Among the pulses, the highest fluoride content was found in Bengalgram i.e. 66 ppm and least fluoride content was found in Lobia i.e. 49.6 ppm. Among the vegetables ,Raddish had highest fluoride content of 11.3 ppm and Brinjal had least fluoride content of 3 ppm. In all the food items Bengalgram reported to have the highest fluoride content of 66.0 ppm while Brinjal had least fluoride content of 30 ppm

Fluoride Content in Raw Food Items					
Sr. No	Name of the Food Items	Fluoride Content (ppm)			Mean ± SD
		T1	T2	T3	
I	**Cereals**				
1	Wheat	7.2	5.2	4.6	5.6 ± 1.1
2	Bajra	26	40	29	31.6 ± 6
3	Maize	40	33	29	34 ± 4.5
4	Barley	13	6	10	9.6 ± 2.8
II	**Pulses**				
1	Greengram	43	50	60	51 ± 6.9
2	Bengalgram	67	71	60	66 ± 4.5
3	Urad	50	57	60	55.6 ± 4.2
4	Lobia	53	50	46	49.6 ± 2.9
III	**Vegetables**				
1	Cabbage	12	4.6	10.6	9.1 ± 3.2
2	Cauliflower	5.2	5.2	6.6	5.6 ± .7
3	Brinjal	6	3	0	3 ± 1.7
4	Raddish	13.4	10	10.6	11.3 ± 1.5

Note: In above table T1 , T2 ,T3 are three test readings of food items

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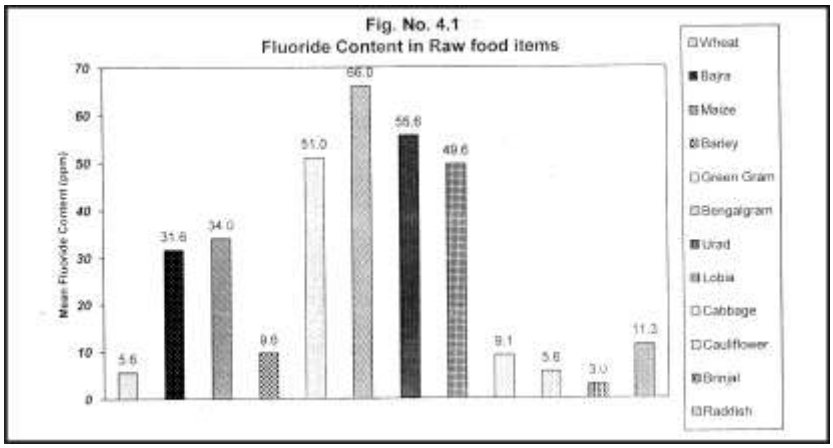
TABLE 4.1

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (03), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354



Results shows clearly that fluoride content of foods is influenced to a great extent by soil condition , ground water used for irrigation, air borne fluoride emitted by industries and indiscriminate use of fluoride rich pesticides and fertilizers. Different foods had different amount of fluoride ranging from 3.0ppm to 66.0 ppm which could be directly related to the plant physiology as every food crop has its own absorbing capacity to absorb fluoride. In above study Bengalgram showed highest fluoride uptake(66 ppm) which may be due to the nodules present in the pulse structure that caused more retention of minerals from soil as well as groundwater used for irrigation.

V. SUMMARY AND CONCLUSION

Present study has been directed towards knowing the impact of high fluoride level in water on the fluoride content of raw agricultural crops. Amongst cereals fluoride was found maximum in Maize(34 ppm) followed by Bajra(31.6 ppm),Barley(9.6 ppm) and Wheat(5.6 ppm). Amongst pulses fluoride content was maximum in Bengalgram(66 ppm) followed by Urad(55.6),Greengram(51.0 ppm) and Lobia(49.6 ppm) and amongst vegetables fluoride was found highest in Raddish(11.3)followed by Cabbage(9.1 ppm), Cauliflower(5.6 ppm) and Brinjal(3.0 ppm).

Hence following conclusions could be made from the present study

1. Using the fluoride values of local foods, people could be aware that which foods have to be consumed in less amount as pulses have more fluoride uptake compared to cereals and vegetables hence the consumption of pulses to be reduced compared to vegetables.
2. Study indicates the need of a large scale filtration method which can filter excess fluoride from water of Fluorosis prone areas.
3. Study also suggests not to use fertilizers and pesticides containing fluoride.
4. As people are dependent upon groundwater sources that already contain fluoride therefore fluoridation of water should not be done in fluorosis prone areas.

VI. ACKNOWLEDGEMENTS

It gives me immense pleasure in gratefully acknowledging the guidance and suggestions given by Mrs. Gita Bisla , Sr Lecturer of Home Science Department Banasthali Vidyapith during the research.

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