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A Case Study of Fluoride Bioaccumulation in Cauliflower in Neem ka Thana, Sikar District (Rajasthan)

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ABSTRACT

Fluoride is recognized as an important trace element playing a vital role in the dental and skeletal formation in human being. Fluoride concentration varied from 1.176mg/kg to 4.868 mg/kg in the cauliflower sample collected from site S_1, S_2, S_3, S_4, S_5, S_6, S_7, and S_8 of the Neem ka Thana, tehsil of district Sikar, Rajasthan. Fluoride estimation in the cauliflower was carried out by using selective ion meter.

***Keywords**: Fluoride, Cauliflower, Bio-Concentration Factor, Neem ka Thana.*

Introduction

Fluoride ion is wide spread in nature. It is estimated to be thirteenth in abundance among the elements of the earth. It has strong affinity for calcium and other metals with which it forms highly complex compounds. Some of its action has been ascribed to its calcarine effect. Fluoride is more soluble in acid soils due to which its uptake by plant is enhanced [1]. Most food whether derived from plants or animals, contain fluoride ion in minute amounts [14]. Some foods concentrate additional fluoride ion from boiling, processing or contamination. Fluoride ion level varies widely even between samples of the same kind of food [12]. Some food stuffs such as vegetables and fruits normally contain fluoride through at low concentration (0.1mg/kg-1.4 mg/kg) and thus contribute to fluoride intake by man. Higher levels (up to 10.11mg/kg of fluoride) have been found in cauliflower [2].

In a study on fluoride balance in patients suffering from endemic fluorosis, fluoride intake in certain countries through diet was in the range of 0.2mg/l to 2.7 mg/l [3, 10]. Relatively low levels of fluoride in the diet are recognized as being beneficial to tooth development in humans and the addition of fluoride to drinking water is a common practice in order to improve dental health. However, elevated levels can lead to fluorosis shown by mottling of teeth and in extreme cases, bone deformities [6, 7]. Diets high in fat have been reported to increase deposition of fluoride in bone and thus enhance toxicity [5, 8].

Intake of fluoride ion into roots is largely dependent on the concentration of fluoride ion in the soil and on the type of soil. In spraying experiments fruit contain more fluoride ion root than in stem and than in leaves [2]. High fluoride levels inhibit germination, cause ultra structural malformation, reduce photosynthetic capacities, and reduce productivity in plants. Role of diet is also responsible in causing fluorosis. Therefore, in the present studies, on fluoride uptake and accumulation were estimated using bud vegetables, crops and other food items grown in some villages of the study area, Neem Ka Thana tehsil is located between latitude $27^0 44'16.8''$ N and longitude $75^0 46'58.8''$ E.

Materials and Methods

Plant samples were collected from the agriculture field of Neem Ka Thana tehsil (Sikar district) at different flowering stages i.e. pre-flowering stage (after 75 days), peak-flowering stage (after 90 days), and post-flowering stage (after 130 days)

Fluoride in plant material of cauliflower was analyzed by selective ion meter Mettler Toledo MA 235. Fluoride concentrations in cauliflower crop vegetable were measured by the following method. After through washing with water, the fresh cauliflower crop harvested from the contaminated area were dried for 48 hours at 80°C and crushed into powdered form than 0.5 gm samples + HNO3 +KOH with digestion. Digested sample solution was transferred to a 100ml plastic volumetric flask, made up to 100 ml volume with distilled water and filtered through a What man no. 40 filter paper [4, 13]. The filtrate was used for estimation of fluoride by selective ion meter.

Fluoride Bio Concentration Factor was also estimated

For BCF estimated following formula was used.

$$BCF = \frac{\text{F concentration in vegetable (mg /kg)}}{\text{F concentration in soil (mg/kg)}}$$

Results and Discussion

Fluoride concentration varied from 1.176mg/kg to 4.868 mg/kg in the cauliflower (buds) sample collected from site S_1 to S_8. Cauliflower vegetable buds' fluoride analysis results are listed in table 1. Fluoride concentration was found to be 2.656mg/kg in root, 1.986mg/kg in shoot, 1.784mg/kg in leaves and 2.478 in fruit sample of plants in the field site S_1(Jhilo mod) at post – flowering stage. At field site S_2 (Raipur stand), fluoride was 4.184mg/kg in root, 3.07mg/kg in shoot, 2.872mg/kg in leaves and 3.964mg/kg in fruit plant sample. Table (1 &2 figure A, B& C)

Bioconcentration Factor

Fluoride concentrations along with mean BCF values of fluoride in vegetables are presented in table 1. The fluoride concentration and mean BCF value of fluoride was found to be highest in buds. Fluoride concentration of soil is higher than the fluoride concentration of vegetable of cultivated area. This may be the reason of higher BCF in soil in comparison to vegetable.

Table 1: Effect of Fluoride Toxicity on Root, Shoot, Leaf and bud Cauliflower at Pre- flowering stage and peak-flowering stage

	Pre- flowering (Fluoride mg/kg)			Peak-flowering (Fluoride mg/kg)			
Field Site	**Root**	**Shoot**	**Leaves**	**Root**	**Shoot**	**Leaves**	**Flower (bud)**
S_1 (Jhilo mod)	1.215±0.023	0.82±0.011	0.448±0.043	1.584±0.067	1.016±0.011	0.656±0.060	1.176±0.075
S_2 (Raipur stand)	2.058±0.031 (1.69)	1.528±0.133 (1.86)	0.55±0.048 (1.22)	2.15±0.042 (1.35)	1.644±0.191 (1.61)	0.78±0.041 (1.18)	1.804±0.268 (1.53)
S_3 (Rupawas)	2.954±0.364 (2.43)	1.784±0.518 (2.17)	1.60±0.072 (1.60)	3.178±0.212 (2.00)	1.956±0.597 (1.92)	0.946±0.227 (1.44)	2.594±0.551 (2.20)
S_4 (Naikothi)	3.672±0.110 (3.02)	2.176±2.65 (0.211)	1.02±0.060 (2.27)	3.86±0.044 (2.43)	2.306±0.246 (2.26)	1.222±0.084 (1.86)	3.08±0.168 (2.61)
S_5 (Godawas)	4.584±0.145 (3.77)	2.544±0.119 (3.10)	1.318±0.068 (2.94)	4.796±0.137 (3.02)	2.682±0.129 (2.63)	1.504±0.068 (2.29)	3.56±0.114 (3.02)
S_6 (Dhani Neemkali)	4.874±0.385 (4.01)	3.354±0.337 (4.09)	2.014±0.045 (4.49)	5.15±0.276 (3.25)	2.782±0.119 (2.73)	2.198±0.032 (3.35)	3.816±0.177 (3.24)
S_7 (Bharala)	5.186±0.425 (4.26)	4.202±0.375 (5.12)	3.04±0.352 (6.78)	5.394±0.420 (3.40)	2.938±0.152 (2.89)	3.202±0.287 (4.88)	4.43±0.453 (3.76)
S_8 (Thikaria 2)	5.78±1.0911 (4.75)	5.402±0.151 (6.58)	3.756±0.311 (8.38)	5.92±1.117 (3.73)	3.11±0.190 (3.06)	4.017±0.166 (6.12)	4.868±0.280 (4.13)

All values of mean ± S.D.

Data in parenthesis shows percentage increase in root, shoot, leaf and bud (fluoride)

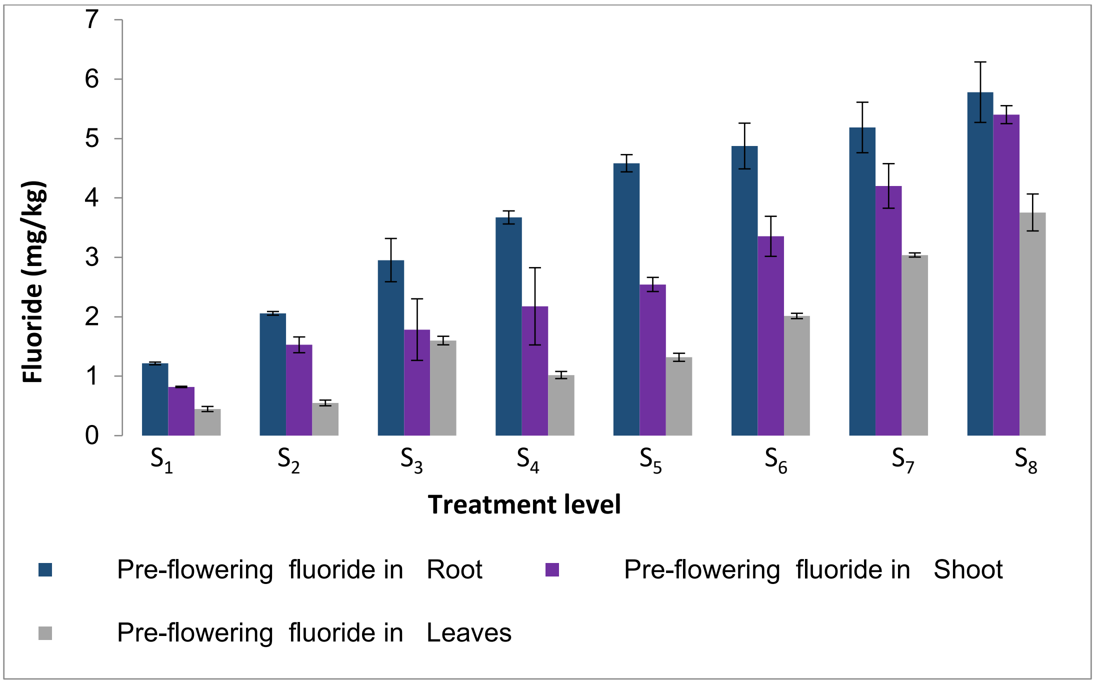

Figure A: Fluoride accumulation by Root, shoot, leaves at pre-flowering stage

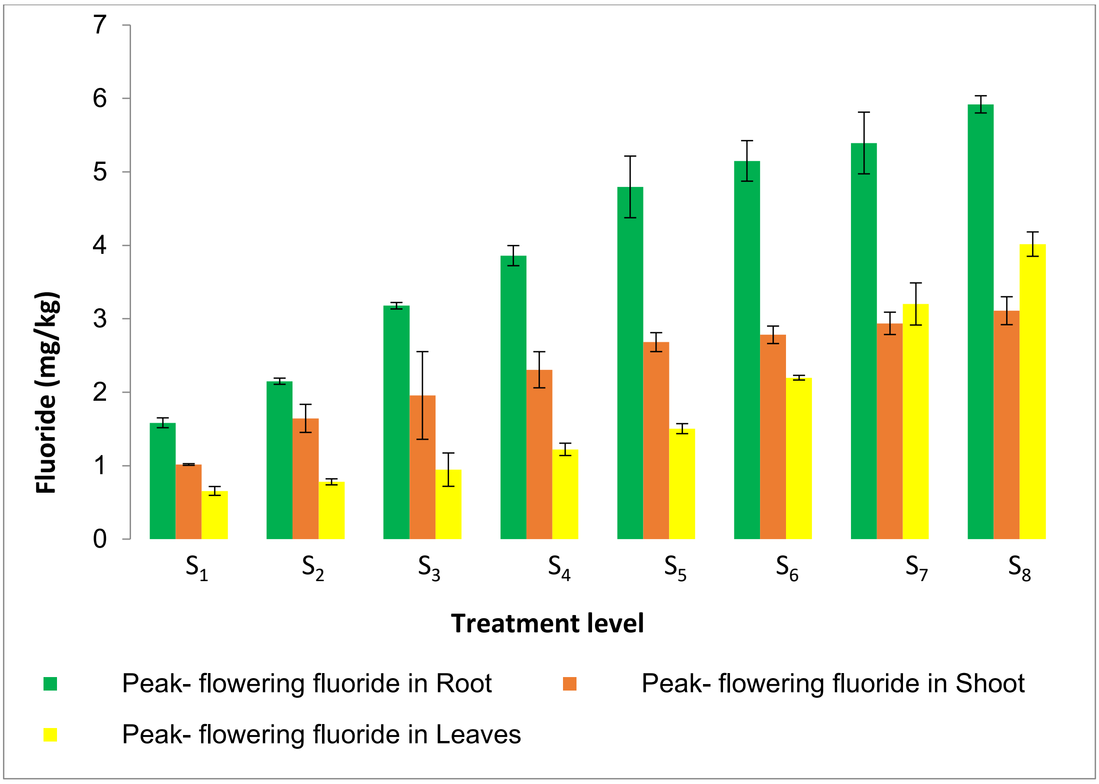

Figure B: Fluoride accumulation by Root, shoot and leaves at peak-flowering stage

Table 2: Effect of Fluoride Toxicity on Root, Shoot, Leaf and Fruit of Cauliflower at Post flowering stage and Total BC Factor (fluoride)

	Post-flowering (Fluoride mg/kg)				Total BC Factor (fluoride)
Field Site	**Root**	**Shoot**	**Leaves**	**Fruit (seeds)**	**Post flowering**
S_1 (Jhilo mod)	2.656±0.441	1.986±0.011	1.784±0.026	2.478±0.111	0.823416
S_2 (Raipur stand)	4.184±0.131 (1.57)	3.07±0.371 (1.54)	2.872±0.274 (1.60)	3.964±0.135 (1.48)	0.836818
S_3 (Rupawas)	5.612±0.506 (2.11)	3.93±0.041 (1.97)	3.744±0.034 (2.09)	5.172±0.394 (1.93)	0.756117
S_4 (Naikothi)	6.196±0.139 (2.33)	4.07±0.025 (2.04)	3.954±0.053 (2.21)	5.884±0.198 (2.19)	0.719832
S_5 (Godawas)	7.286±0.317 (2.74)	4.234±0.028 (2.13)	4.072±0.022 (2.28)	7.114±0.430 (2.65)	0.660425
S_6 (Dhani Neemkali)	8.406±0.161 (3.16)	4.658±0.127 (2.34)	4.532±0.132 (2.54)	7.916±0.173 (2.95)	0.63094
S_7 (Bharala)	9.324±0.359 (3.51)	5.174±0.348 (2.60)	5.052±0.303 (2.83)	9.006±0.446 (3.36)	0.720622
S_8 (Thikaria 2)	10.142±0.762 (3.93)	5.842±0.155 (2.94)	5.548±0.105 (3.10)	10.11±0.3458 (3.77)	0.70276

All values of mean ± S.D.

Data in parenthesis shows percentage increase in root, shoot, leaf and fruit (fluoride)

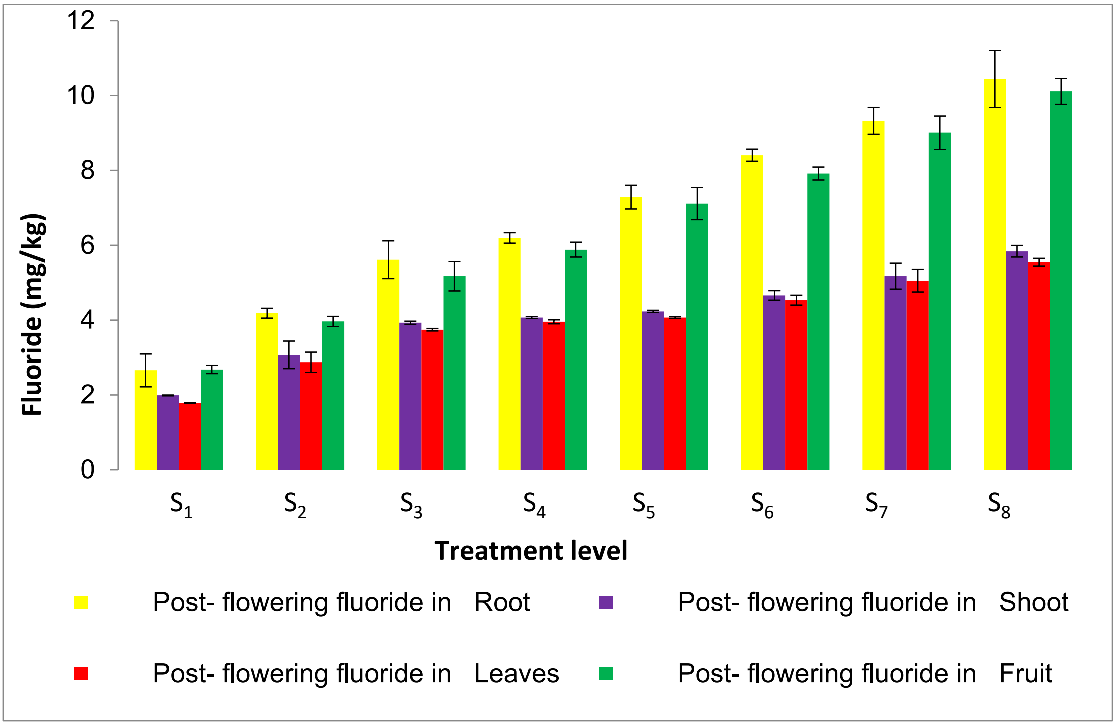

Figure C: Fluoride accumulation by Root, shoot, leaves and fruit at post-flowering stage

Conclusion

Study of BCF relieved that BCF are 0.823416, 0.836818, 0.756117, 0.719832, 0.660425, 0.63094, 0.720622 and 0.70276 at site S_1, S_2, S_3, S_4, S_5, S_6, S_7, and S_8 respectively (Table 2)

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References

1. Daines R.M., I. Leone, E. Brennane. 1952. The effect of fluoride on plants as determined by soil. Nutrition and Fumigation Studies. McGraw-Hill Book Co., New York.
2. Yang SF, Miller GW. Biochemical studies on the effect of fluoride on higher plants. *Biochem. J.*, 1963, 88: 505-509.
3. Jolly S., D. Oberoi, R. Sharma, S. Ralhan. 1974. Fluoride Balance Studies in Cases of Endemic Fluorosis. Proceeding of the Symposium on Fluorosis, Hyderabad, India.
4. Mc Quaker NR, Gurney M. Determination of total fluoride in soil and vegetation using an alkali fusion-selective ion electrode technique. *Anal. Chem.,* 1977, 49, 53-56.
5. Horvath I, Klasova, A Navara J. Some physiological and ultra-structural changes of *Vicia faba L* after fumigation with hydrogen fluoride. *Fluoride,* 1978, 11: 89-99.
6. WHO. 1986. Guideline for Drinking Water Quality. Second edition. Health Criteria and other Supporting Information, Vol.2. Geneva.
7. Fuge R., M.J. Andrews. 1988. Fluorine in the UK Environment. Environmental Geochemistry and Health 10: 96-104.
8. Department of Health and Human Services (U.S. DHHS). 1991. Review of Fluoride: Benefits and Risks. Report of the Ad Hoc Committee on Fluorides, Committee to Coordinate Environmental Health and Related Programs. Department of Health and Human Services, USA.
9. Miller GW, Shupe JL, Vedina OT. Accumulation of fluoride in plants exposed to geothermal and industrial water. *Fluoride*, 1999, 32: 74-83.
10. Elloumi N, Abdallah FB, Mezghani I, Rhouma A, Boukhris M. Effect of fluoride on almond seedlings in culture solution. *Fluoride,* 2005, 38: 193-198.
11. Ravichandran B, Roychowdhury A, Mukherjee AK, Gangopadhay PK, Saiyed HN. Estimation of fluoride content in the edible vegetables of an industrial area in Orissa. *Asian J. Water Environ. Poll.,* 2007, 5: 93-95.
12. Ahmad M, Berg LDVJ, Shah HU, Masood T, Büker P, Emberson L, Ashmore M. Hydrogen fluoride damage to fruit trees in the vicinity of brick kiln factories in Asia: an un recognized environmental problem? Environ Pol 2012; 162:319-24.
13. Saini P, and Khan T. I, Phytotoxicity of fluoride on a pearl millet (*pennisetum typhoides* var. jkbh-26) and its bioaccumulation at the different phase International Journal of Geology, Earth and Environmental Sciences 2014 Vol. 4 (1) January-April, pp. 121-125.
14. Saini P, and Khan T. I, Studies on the impact of sodium fluoride toxicity on crop plant (*Capsicum annum var. annuum*) and its bioaccumulation at the different phase: International Journal of Advanced Research in Biological Sciences 2014; 1(4):78-85.

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