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In Vitro Studies on Carbohydrate Metabolism in *Pennisetum Glaucum* R.Br. Irrigated with Fluorinated Water

Parikh Punita and Vyas Payal

Department of Botany, Faculty of Science, The M. S. University of Baroda, Vadodara

Abstract - Fluoride is an essential element. Fluoride concentration in low amount (0.5-1.0 mg/l) in drinking water is helpful in the prevention of dental caries and in treatment of osteoporosis. However, high intake of fluoride (>1.5 mg/l) in drinking water for a prolonged period is known to cause damage to the teeth enamel and eventually leads to skeletal complications that result in fluorosis. The major source for drinking and irrigation water in Gujarat is ground water. High concentration of fluoride in the groundwater posing health hazard has been observed in Gujarat. Earlier reports on fluoride toxicity in plants include impaired breakdown of food reserves like protein, carbohydrate and fats. Hence, the present study was conducted in vitro to check the influence of Fluoride on the carbohydrate level in root, stem and leaf of *Pennisetum glaucum* R.Br. Plants of *P. glaucum* R.Br. were grown and supplemented with fluorinated water at different concentration (1,3,5,7 ppm) along with control plants. Carbohydrate level was found to be significantly increased in treated plant parts i.e. from 1 ppm to 7 ppm in root, stem and leaf of the plants. The control plant parts showed less carbohydrate content than the treated plants. In *P. glaucum* , the percentage increase in the carbohydrate content was 29.31, 73.17 and 204.55 in root, stem and leaves respectively in comparison to control plants.

Keywords: ***Fluoride, Bajara, carbohydrate metabolism***

I. INTRODUCTION

Water is essential natural resources for sustaining life and environment that we have always thought to be available in abundance and free gift of nature. However, chemical composition of surface or subsurface is one of the prime factor on which the suitability of water for domestic, industrial and agricultural purpose depends. [9] Fluoride is the common element in the earth's crust as component of the rocks and minerals. Fluoride is the reduced form of fluorine which is the member of halogen series. Fluorine, the first member of the halogens, is an element with unique physical and chemical properties. It has the highest electron affinity or the most non-metallic nature, and therefore, its compounds often display different properties from those of other halogens. It is highly reactive and not found in the elemental state in nature. It is only found in solid salts or fluoride ions in aqueous solution.

Fluoride is an essential element, indispensable for maintenance of dental health. At high doses fluoride can interfere with carbohydrates, lipid, protein, vitamin, enzyme and mineral metabolism. Fluoride occurs naturally in plants. Certain plant species have been observed to be injured as a result of the accumulation of excessive fluoride from fluorinated water. The general symptoms of fluoride injury are necrotic lesions and burning, which appear first in the leaf tips and margins. The exact mechanism by which fluoride causes damage to plants is little understood. Nevertheless, certain physiological processes are known to be markedly affected by fluoride. For example, decreased plant growth [3] and increased respiration in growing plants [6] have been reported. An effect of fluoride on a physiological process may be a reflection that one or more enzyme systems are affected by fluoride.

Effects of Fluoride on Human Health

If fluoride concentration in drinking water is more than 1.5 mg/l, it would result in fluorosis for human beings, especially for children and pregnant woman. This is a result of the destruction of metabolic calcium and phosphorous, inhibition of active enzymatic process in the human body. Thus the function of the endocrine system gets interrupted, leading to fluorosis. [4]

Around 200 million people from 25 nations have health risks because of high fluoride in groundwater. [2] In India too, there has been an increase in incidence of dental and skeletal fluorosis with about 62 million people at risk due to high fluoride concentration in drinking water.[1] Dental fluorosis is endemic in 14 states and 1,50,000 villages in India with the problem most pronounced in the states of Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh.[8]

II. MATERIAL AND METHODS

P. glaucum R.Br (Bajara) seeds, locally obtained, were soaked in water for 24 h. Plants of *P. glaucum* R.Br. were grown and supplemented with fluorinated water at different concentration (1,3,5,7 ppm). Plants without fluorinated water served as control. Root, stem and leaves of treated and control plants were harvested after two months.

Estimation of total soluble sugars

The amount of total soluble sugars was determined by Anthrone Method. (1999) Carbohydrates are dehydrated by conc. H_2SO_4 to form furfural. Furfural condenses with anthrone to form a blue-green coloured complex which is measured colorimetrically at 630 nm.

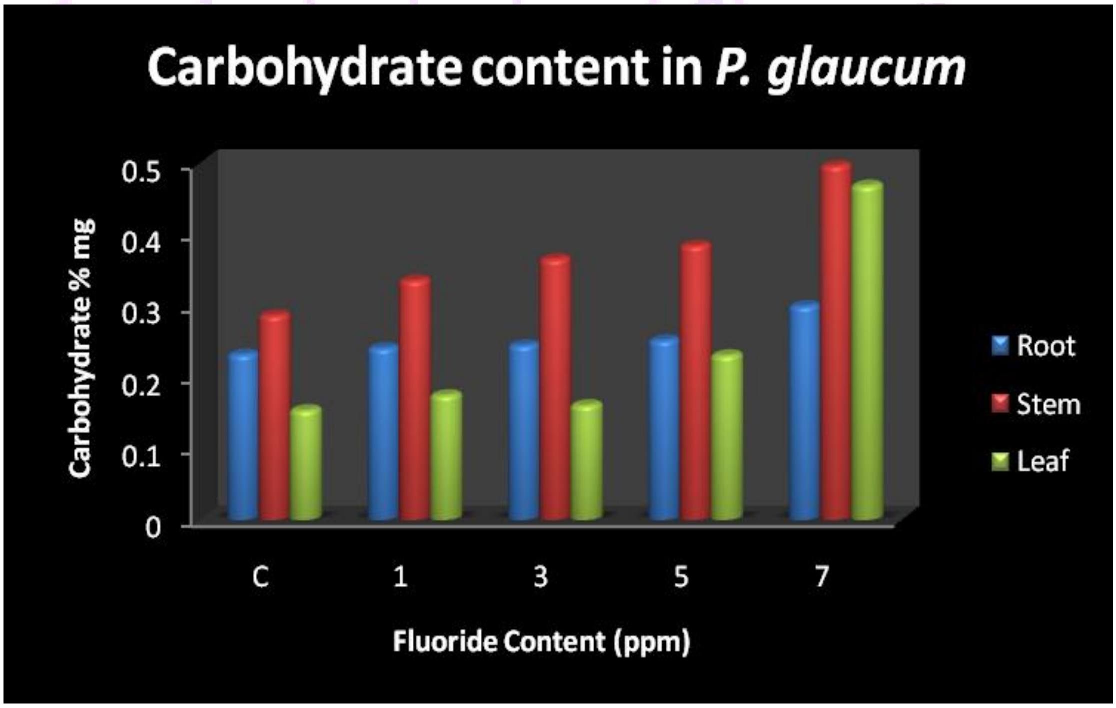
III. RESULTS AND DISCUSSION

The values of carbohydrate obtained by Anthrone method were high in treated experimental plant parts compared to control plants. The control plant parts showed less carbohydrate content than the treated plants. In *P. glaucum* ,the percentage increase in the carbohydrate content was 29.31, 73.17 and 204.55 in root, stem and leaves respectively in comparison to control plants. The abnormal metabolic processes of carbohydrate were found to be associated with fluoride content, but yet it is not known how these metabolic changes are related to the level of fluoride. Earlier reports showed decrease in the level of reducing sugars with increased fluoride concentration. [7] [11] Inhibition of Glucose, mannose and fructose like reducing sugars were generally observed in fluoride irrigated plants. This might be due to conversion of these sugars into non-reducing sugars which ultimately increased the total carbohydrate level. The reported enhanced carbohydrate content in fluoride irrigated plants indicates adaptive mechanism to reduce toxicity of fluoride. Such results were also reported. [5]

Table 1: Carbohydrate content (% mg) in *P. glaucum* plant parts

F- Conc.	Root	Stem	Leaf
Control	0.232	0.287	0.154
1 ppm	0.241	0.336	0.175
3 ppm	0.245	0.366	0.161
5 ppm	0.252	0.385	0.231
7 ppm	0.3	0.497	0.469

Fig. 1: Carbohydrate content in *P. glaucum*



IV. CONCLUSION

In vitro fluoride treated plants of *P. glaucum* when exposed to different concentration of fluoride showed increase in the level of total soluble sugars. Control plants were found to have less content of soluble sugars. Our results suggest that plants under stress condition convert reducing sugars into non-reducing sugars which enhanced the level of total sugars in plant parts.

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