 ISSN 1596-9770

Determination of Selected Metal Ions in Banana (*Musa Cavendishi*) and SUGAR CANE (*Saccharum officinarium*) From Farms around Ketaren Gwari Dumping Sites.

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Abstract

The concentrations of Lithium, sodium and potassium in banana (Musa Cavendishi) and sugar cane (Saccharun officinarum) samples obtained from farms at different dumping sites of Ketaren Gwari area in Minna have been studied. The positions of sampling were chosen with reference to the direction of flow of a river (Northeast to Southwest), the bank of which the dumping activities occur. Samples were obtained from the banks ~50m upstream, at the dumping site and at banks ~75m downstream of the site. Whole and peeled samples were digested using concentrated nitric acid and perchloric acid (3:1) mixture and analyzed for their levels of these metal ions using flame photometry. The concentration of Li^+, Na^+ and K^+ were higher in the whole samples at the dumping site than either before or after the dumping site. The increased pollution at this site may be responsible for these higher concentrations. The health implications of high doses of these ions in such popular food crops cannot be overemphasized.

Introduction

Sugar cane (*Saccharum officnarum*) popularly known as "Rake" in Hausa belongs to the genus *Saccharum* L, of the grass family *Andropogoneae*. It is a tall monocotyledonous crop that is cultivated and consumed in tropical and subtropical regions, primarily for the high amounts of sucrose it is able to store in its stem (Susan and Anne 1998). After extraction of sugar, molasses from sugar cane is used as a sweetener. The residue can also be used in the production of alcohol industrially through fermentation. The latter is one of now the main process in the industrial production of bioethanol. This alcohol is commercially employed as fuel or as an industrial raw material (Caret *et al* 1977).

Banana (*Musa Cavendishi*) also called "ayaba" in Hausa is of the genus *Musa* and the family *Musaceae*. Other members of this family include plantain or cooking banana (*Musa paradisaca*) and manila hemp (*Musa textiles*). Half of the world's banana crops are grown in Africa and used locally (Encarta Encyclopedia, 2004). The edible part of a banana fruit contains on average, 75% water, 21% carbohydrate and about 1% each of fat, protein fibre and ash (Encarta, 2004). Other parts of the plant abound in fibre which can be used in the manufacture of paper. Banana and sugar cane are widely consumed locally and also as a source of export because of their nutrient composition, cheapness and availability (Bishop *et al* 1983).

Nutritional elements widely required by human body structure and functions are derived essentially from the plants consumed as food. Metal ions such as copper, cobalt, sodium and potassium are essential to life due to their involvement in some physiological processes, although elevated levels have been found to be toxic (Awofolu, 2004). Potassium plays an important role along with sodium in the acid-base balance in animals. Potassium also functions as a principal cation in cells and in the nerve and muscular excitation and carbohydrate metabolism. The deficiency of potassium is reported to be very rare due to its abundance in diets. Symptoms of its deficiency have been reported in chickens served with diets containing low concentration of the element. In human, prolonged vomiting and diarrhea may cause deficiency of potassium resulting in weakness and drowsiness (MC Donald et al 1981, Merill *et al* 2001, Donald 1994). Sodium is concentrated in the soft tissue and body fluids of animals and humans. It plays a vital role in the acid-base balance and osmotic regulation of the body fluids. A deficiency of sodium in diet leads to lowering of the osmotic pressure, which results in dehydration. Symptoms of deficiency include poor growth and reduced utilization of digested protein and energy (Merill *et al* 2001). Lithium is essential in trace amounts. Its deficiency results in depressive behavior (Russel 1978, Herbert, 1981)

Loppi *et al* 1998, have shown that large portions of the consumed vegetables including sugar cane and banana are grown on contaminated plots within urban centres. Naturally, only very small concentrations of these elements are present in soils and plants. Dumping sites introduce waste products from both organic and inorganic sources and as a result of anthropogenic activities, the concentrations of these metal ions in food crops grown within such environment increases. (Chu-Fung, 1996).

The present investigation is to determine the levels of Na^+, K^+ and Li^+ ions in banana and sugar cane grown at the dumping site of Ketaren Gwari, Minna. The aim is to evaluate the concentrations of these metal ions and how the activities at the dumping sites affect their concentrations in the crops. Since these crops are popular, and are cultivated on these dump sites, a knowledge of the concentrations of these ions at the site cannot be overemphasized.

Materials and Method

Sample collection and preparation:

The samples of matured banana and sugar cane were collected from the farms located at the Keteren Gwari dumping site. They were collected from farms (about 50 m) before, at the site and (about 75m) downstream from the dumping site and labeled as:

U = Samples collected upstream from the dumping site

A = Samples collected at the dumping site

D = Samples collected downstream from the dumping site

They were thoroughly washed to free them from debris. The banana samples were kept in black polyethylene bags to aid ripening. One part was peeled leaving the flesh and the other part was left whole with the peel. Both samples were cut into pieces and allowed to dry at 105°C in the oven. Peeled and whole dried samples were made into powder using pestle and mortar and stored in plastic bottles prior analysis. The samples were digested using concentrated nitric acid and perchloric acid (3:1) mixture (Allen *et al* 1974, Puyaon *et al* 1970). Blank samples were prepared in the same way. Standards for Li^+, Na^+ and K^+ were prepared and were used for plotting the calibration curves. A Gallenkamp Flame Photometer was used to determine the concentrations of the metal ions in the banana and sugar cane samples. Triplicate determinations were made in each case and from the calibration curves; the concentrations of the metal ions were extrapolated.

Results and Discussion

The results of the concentrations of Li^+, Na^+ and K^+ in the whole and peeled samples of banana and sugar cane at the various locations of the dumping sites are shown in tables 1 and 2

Table 1: Concentration of Li^{+}, Na^{+} and K^{+} in whole and peeled banana samples.

Metal ions	Location	Conc. (g/kg) in whole sample	Conc. (g/kg) in peeled sample
Li^{+}	U	0.833	0.852
	A	0.872	1.223
	D	0.399	0.521
Na^{+}	U	5.264	4.891
	A	8.705	6.283
	D	6.192	5.583
K^{+}	U	4.084	3.118
	A	6.141	5.963
	D	4.846	3.740

Table 2.0: Concentration of Li^{+}, Na^{+} and K+ in whole and peeled sugar cane samples.

Metal ions	Location	Conc. (g/kg) in whole sample	Conc. (g/kg) in peeled sample
Li^{+}	U	0.130	0.136
	A	0.610	0.938
	D	0.588	0.421
Na^{+}	U	3.413	2.603
	A	5.613	5.193
	D	3.736	3.006
K^{+}	U	3.876	2.945
	A	5.541	5.233
	D	4.986	3.907

Discussion

From Table 1.0, the concentration of Li^{+} ranges from 0.399 – 1.223g/kg in whole and peeled samples of banana (*Musa cavendishi*). The highest Li^{+} concentration of 1.223g/kg was obtained from peeled samples at dumping site. The concentration of Li^{+} in all the samples is generally low. This is good since Li^{+} is needed only in trace amounts in living tissues (Herbert 1981), Plants usually are poor sources of lithium. Table 2.0 also shows low concentrations of Li^{+} in sugar cane samples with the highest concentration of 0.938g/kg in peeled samples. The two results reveal that more of Li^{+} is concentrated in the peeled samples of banana and sugar cane. This observation could mean that the plants under investigation selectively concentrate the metal ions in the flesh. There is therefore an observed dilution effect due to lower concentration of the ions in the whole sample compared to the flesh..

The concentration of Na^{+} ranged from 4.891 to 8.705g/kg in *M. cavendishi* samples. Whole samples at the dumping site recorded the highest concentration of the ion. Generally the concentration of Na^{+} is more than Li^{+} since plants absorb metal ions at different rates and concentrates same in different tissues. Moreover, Na^{+} is needed in higher amounts for water balance in plants and for the transportation of other substances (Shamberger 1979). In Table 2.0, the highest Na^{+} concentration (5.613g/kg) was found in whole *S.officinarum* sample at the dumping site.

The concentration of K^{+} ranged from 3.118 to 6.141 g/kg in *M. cavendishi* samples with the highest concentration in whole samples at the dumping site. This high concentration is not surprising because K^+ is known to perform functions such as carbohydrate metabolism as well as cell metabolism in plants (Webster and Willson 1986). A similar high concentration of K^+ was found in *S.officinarum.* whole sample at the dumping site as shown in Table 2.

Tables 1 and 2 showed that the amounts of the ions are higher at the dumping site for all the samples analyzed. The increased pollution at the dumping sites may be responsible for the higher concentrations of Na^+ and K^+ at these sites.

Conclusion

From the data obtained, there was a higher concentration of all the metal ions in samples collected at the dumping site, which indicates high accumulation of these ions at such sites. In banana (*M. cavendishi.*) the concentration of Li^+ is highest in the peeled samples while Na^+ and K^+ are highest in the whole samples. A similar trend is observed in sugar cane (*S.officinarum*). It is therefore evident that pollution at dumping sites increases the levels of these metal ions in banana and sugar cane.

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