DETERMINATION OF SUGAR CONTENT IN SOME NIGERIAN FRUITS

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Abstract

Sugar concentrations were determined in twenty-four local fruits, using the modified Lane and Eynon constant volume method. Highest concentrations of sugars were determined in plantain (9.30%), banana (8.62%), paw paw (8.60%) and soar sop (8.12%). Concentrations in citrus fruits range from 7.92% in tangerine to 4.60% in lemon. Lowest concentrations occurred in African star apple (3.80%), guava (3.52-3.64%), tomato (3.26%), avocado pear (3.24%) and egg fruit (3.04%). The Nigerian fruits seem to contain more sugar than fruits from British Columbia.

Keywords: Sugar content; Nigerian fruits.

Introduction

The dietary importance of sugar as efficient energy source cannot be over emphasised (Anderson, 1997). Fruits contain sugar in the form of sucrose, glucose and fructose in varying quantities, either in free state or as derivatives. The sugar content of fruits increases with maturity, reaching maximum concentration in ripe fruits due to hydrolysis of starch (Ayaz, 1999). Some fruits such as mango, peach, and apricot show high sucrose content at maturity, while others, such as tomato show very little or no sucrose during growth and maturity. Immature oranges have fairly high sucrose concentration, but during maturation this decreases slightly. A similar trend occurs in grapefruits. Mango shows a large increase in sucrose concentration and a small proportion of reducing sugars. However in storage, sucrose tends to disappear to be replaced by equal amounts of reducing sugars. In banana, almost complete hydrolysis of starch to glucose and fructose occurs during ripening, while in the avocado, total sugar content decreases during maturation, with a concomitant increase in oil. Most ripe fruits do not contain any detectable amount of sucrose due to hydrolysis to glucose and fructose by the enzyme invertase (Ayaz, 1999).

High sugar intake has been linked to several chronic diseases such as diabetes, obesity, coronary heart disease and hyperactivity in children. However recent developments indicate the contrary (Anne, 2001). Diabetes, for example, is known to be due to the inability of the body to produce sufficient insulin, which regulates the concentration of glucose in the blood. The regulation of sugar intake is a very critical factor in the management of diabetes once developed. Diabetic patients in Nigeria who freely consume the wide variety of fruits available in the country may be at risk of exposure to sugar concentrations beyond tolerable levels. At present no information on sugar concentrations in Nigerian fruits are available. Dieticians and other health workers are therefore handicapped in offering professional and informed advice with respect to the types and quantities of fruits that can be consumed at different levels of diabetic conditions. To this end, analysis of sugar levels in some Nigerian fruits was carried out.

Materials and Methods

Collection of fruits: Twenty four varieties of fruits were analysed. The samples were either bought from Nsukka market; or collected from farms around Nsukka, Enugu State, Nigeria. The fruits are namely; vilvet-tamarind (*Dialium guineense*), lemon (*Citrus limon*), orange (*Citrus sinensis*), cashew apple (*Anarcardium occidentale*), African star apple (*Chrysopplum cainils*), pineapple (*Ananas comoius*), three species of mango (*Mangifera indica*), tangerine (*Citrus reticulata*), ripe and unripe plantain, (*Musa paradisiaca*) ripe and unripe banana (*Musa sapientum*) avocado pear (*Persea amedricana*), tomato (*Hycopersicum esculentum*), bush mango (*Irvingia gabonensis*), sour sop (*Annona municata*), red and white pulp guava (*Psidium guagava*) and egg fruit (*Solanum melongena*).

The samples were collected between March 2002 and May 2002, during the period of abundance of each fruit. The fruits were either analysed on the same day or preserved for not more than two days by refrigeration

Preparation of standard solutions: Glucose stock solution, 10 mg/ml, was prepared by dissolving 1g pure glucose in distilled water and making up to the mark in a 100 ml standard flask. Standard glucose working solutions of concentrations, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, and 4.5 mg/ml, were prepared by pipetting 10, 15, 20, 25, 30, 35, 40 and 45 ml of the stock solution respectively into 100 ml standard flasks and diluting to the mark with distilled water.

Fehling's solutions A and B were prepared using a method described in Vogel (1968) as follows: Solution A (69.28g of $CuSO_4.5H_2O$) was dissolved in distilled water and made up to the mark in 1 litre volumetric flask. Solution B (100g of NaOH plus 345g of sodium potassium tartarate) was dissolved in distilled water and made up to the mark in 1 litre standard flask. Methylene blue indicator (1%) was prepared by dissolving 1g of methylene blue in water and made up to the mark in 100 ml volumetric flask. Potassium oxalate (1%) was prepared by dissolving 1g of potassium oxalate in distilled water and made up to the mark in 100 ml volumetric flask.

Extraction of sugar from fruits: Fruits were washed with distilled water and mashed in a mixer. To extract the sugar, 10g of the mashed fruit were boiled with distilled water for 2 mins and filtered (Kirk and Sawyer, 1991). Extraction is incomplete and must be continued if a drop of alkaline copper solution shows a red colouration. Total extract was made up to a final volume of 200 ml with distilled water. Clarification was done by adding 2 ml of 1% potassium oxalate followed by filtration.

Analysis of glucose extracts of fruits: Sugar determination was by titration using the modified Lane and Eynon constant volume method (Kirk and Sawyer, 1991). A standard calibration curve for glucose was obtained as follows: 10 ml each of Fehlings solutions A and B were pipetted into a conical flask, 15 ml of distilled water were added and allowed to boil over a Bunsen flame for about 2 mins. 3 drops of methylene blue were added and the hot liquid was titrated with glucose solution until end point was indicated by the disappearance of the blue colour of the indicator and the appearance of the reddish colour of cuprous oxide precipitates. The volumes of standard glucose solutions needed to titrate 20 ml of Fehling's solution were plotted against their respective concentrations to obtain the calibration curve.

Analysis of sample extracts followed the same procedure used for the standards. At the end, concentrations of sample extracts were determined by extrapolation on the calibration graph, and finally converted to percent concentrations in the fruits.

Results and Discussion

The average sugar levels determined in this study are presented in Table 1, while in Table 2, values published by Stranchan et al (1951), are shown. The Lane and Eynon constant volume method is a standard method (Kirk and Sawyer 1991) for determination of reducing sugar, although applied to much higher concentrations than those determined in this study. It has however proved to be reliable even for low concentrations. The calibration graph is a straight line (r = 0.97) and volumes of sample extracts required to titrate the same volume (20 l) of Fehlings solutions fell within the linear range.
Expectedly, the highest concentrations were determined in ripe plantain (9.30%), ripe banana (8.62%), paw-paw (8.60%) and soar sop (8.12%). These are fruits with large starch reserve. During ripening, the starch is hydrolysed into monosacharides (Ayaz, 1999), hence the increase from 5.98% in unripe plantain to 9.30% in ripe plantain, and from 5.42% in unripe banana to 8.62% in ripe banana. Next in magnitude are the concentrations determined in fruits of the citrus family, as well as in pineapple and mangoes.

Table 1: Average (%) reducing sugar content in fruits

Fruit	% conc. fresh wt)	Fruit	% conc. fresh wt)
Vilvet tamarind	6.74	**Unripe plantain**	5.98
Lemon	4.60	**Ripe plantain**	9.30
Orange	6.6	**Unripe banana**	5.42
Grape	6.50	**Ripe banana**	8.62
Lime	nd	**Avocado pear**	3.24
Cashew	5.32	**Tomato**	3.26
African star apple	3.80	**Bush mango**	7.46
Pineapple	7.70	**Sour sop**	8.60
Paw-paw	8.10	**Guava (white pulp)**	3.52
Mango (German)	7.10	**Guava (red pulp)**	3.64
Mango (local)	6.58	**Egg fruit**	3.04
Mango (sweet)	6.28	**Tangerine**	7.92

Their sugar contents range from 7.92% in tangerine to 4.60% in lemon. These fruits have little or no starch reserve. However, hydrolysis of sucrose occurs during ripening.

The lowest concentrations were determined in fruits without any starch reserve. They include African star apple (3.80%), red guava (3.64%), white guava (3.52%), tomato (3.26%), avocado pear (3.24%) and egg fruit (3.04%). With reference to the data in Table 2, the Nigerian fruits seem to be richer in sugar than those from the British Columbia.

Table 2: % Reducing Sugar Content of fruits grown in the British Columbia

Fruit	**Paw-paw**	**Lemon**	**Lime**
% Sugar	7.18	1.67	0.72
Fruit	**Mango**	**orange**	**Tangerine**
% Sugar	3.50	2.6-5.8	2.49

The data presented in this report are baseline and may be of value to Dieticians and health workers especially with respect to diabetic conditions. Moreover such data would enhance the value of Nigerian fruits particularly in international trade.

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