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Vitamin C and Elemental Analyses of Two Fruit Crops Grown in Ibesikpo-Asutan, Akwa Ibom State, Nigeria

Emmanuel Isaac Uwah, Eno Anietie Moses and Lucy Peter Effiong
Department of Chemistry, University of Uyo,
P. M. B. 1017 Uyo, Akwa Ibom State, Nigeria.

Abstract

Levels of vitamin C (*Ascorbic acid*) and some trace metals (Ni, Zn, Pb, Fe and Co) were analysed using standard analytical procedures in two fruit samples, pawpaw (*Carica papaya*) and banana (*Musa sp*.) obtained in Ibesikpo-Asutan, Akwa Ibom State, to ascertain their suitability for human consumption. The results revealed that the two fruit samples contain appreciable levels of vitamin C and variable levels of the analysed trace metals. The level of vitamin C in banana was 219.87mg/100g, while that of pawpaw was 122.47mg/100g. The levels of the analysed trace metals in banana, ranged from < 0.01 mg/kg Pb to 0.05 mg/kg Zn. In pawpaw, the levels of the trace metals ranged from < 0.03 mg/kg Pb to 0.07 mg/kg Fe. It could be concluded that pawpaw and banana fruits obtained in the study area are of good dietary or nutritive values in terms of vitamin C and are at the same time suitable for human consumption since the levels of the analysed trace metals in the two fruit samples investigated were below the acceptable levels of such trace metals in plants as recommended by the WHO.

Keywords: *Vitamin C, trace metals, levels, fruits, suitability, consumption, Ibesikpo-Asutan.*

1. Introduction

Vitamins are a group of small molecular compounds that are considered as essential nutrients in many multi-cellular organisms and humans in particular [1]. Vitamin C (*Ascorbic acid* or *ascorbate*), a water soluble vitamin is a six-carbon compound ($C_6H_8O_6$) structurally related to glucose, consisting of two inter-convertible compounds: L-ascorbic acid, which is a strong reducing agent and it's oxidized derivative, L-dehydroascorbic acid. It is synthesised from glucose by many animals [1]. Vitamin C is usually synthesised in the liver of some mammals and in the kidney of birds and reptiles. Humans, non-human primates, guinea pigs and fruit bats are unable to synthesise vitamin C endogenously, and as such, it is consumed as essential dietary component [1, 2]. Lack or insufficiency of vitamin C in the diet of humans will lead to the potentially lethal deficiency disease called scurvy [3]. Scurvy is characterized by weakness, small hemorrhages throughout the body that cause gums and skin to bleed and loosening of the teeth. Humans and primates lack the terminal enzyme called l-gulonolactone oxidase in the biosynthetic pathway of ascorbic acid due to the fact that the gene encoding for the enzyme has undergone substantial mutation so that no protein is produced [4]. Vitamin C is an electron donor (reducing agent or anti-oxidant) and probably all of its biochemical and molecular functions can be accounted for by this function [1]. Indeed it acts as electron donor for eleven enzymes [5, 6]. As an anti-oxidant, vitamin C is a free radical scavenger or neutralizer and protects the body against cancers, heart diseases and stress [7]. Vitamin C is part of the cellular chemistry that provides energy. It is essential for sperm production and for

making the collagen protein involved in the building and health of cartilages, joints, skin and blood vessels. Vitamin C helps in maintaining a healthy immune system [8], it aids in neutralizing pollutants, it is needed for antibody production, regeneration of other antioxidants like α-tocopherol (Vitamin E) within the body [8], acts to increase the absorption of nutrients in the gut and thins the blood. It prevents the oxidation of lipids or other molecules by inhibiting the initiation or propagation of an oxidizing chain reaction and thus prevents diseases [9]. Vitamin C is found ubiquitously in fruits, especially in citrus fruits like oranges, lemons, limes and tangerines as well as vegetables such as beans, melons, tomatoes, green and red peppers, peas, onions and green leafy vegetables such as spinach. The vitamin C content of food is strongly influenced by season, transport to market, shelf life, time of storage, cooking practices, and chlorination of water [1]. Vitamin C is also very labile; it can be destroyed by heat and exposure to copper or iron or to mildly alkaline conditions. Accordingly, too much of water can leach it from the tissues during cooking [1]. Trace elements are those transition metals having high relative atomic masses between 53.546 and 200.590, with specific gravity greater than 4.0g/cm^3 [10]. Living organism requires some amount of trace elements such as iron, lead, cobalt and chromium, but in excess they may be toxic [11]. Heavy metals contamination is a general term use to describe a condition in people having abnormally high levels of toxic metals in their body. Common ones are mercury, lead, cadmium, and arsenic. This contamination can be very real, detrimental to health and deadly [11].Contamination of plants by trace metals is common. Some occur as a result of untreated water used for irrigation, unapproved usage of chemicals and others as a result of combustion and discharging of fossil fuel from industries, vehicles and other machineries to the soils [11, 12]. Discharging of sewage sludge and animals wastes are all sources of trace metals contamination of soils and plants [13]. Continue eating of crops that contain high levels of trace metals may cause serious health problems.

Considering the importance of fruits and vegetables to human health with regards to vitamin C and since humans cannot synthesize ascorbic acid, their main sources of vitamin C are dietary fruits and vegetables. These plants are cultivated in Akwa Ibom State for both domestic and commercial purposes. To enhance increased productivity, fertilizers, agrochemicals and manures (in forms of animal dung, decay plant leaves and house whole domestic wastes) are occasionally applied to the soils. These may lead to accumulation and contamination of the soils with trace metals which are eventually taken up by plants growing on the soils. Trace metals are needed by the human system in small dosage. In excess, they are associated with pollution and toxicity. Therefore, there is every need to analyse the levels of vitamin C and some trace metals (Ni, Zn, Pb, Fe and Co) in fruit crops [pawpaw (*Carica papaya*) and banana (*Musa sp*)] grown in Ibesikpo-Asutan Local Government Area of Akwa Ibom State in order to ascertain their dietary values in terms of Vitamin C and suitability for human consumption in terms of trace metal levels.

2. Materials and Methods

2.1 Samples and sampling

Mature/ripe fruit samples (banana and pawpaw) were collected randomly by grab

sampling method from a farm land in Akpan Adok, Afaha Etok Ibesikpo, Ibesikpo-Asutan Local Government Area of Akwa Ibom State, where the fruit crops are cultivated in large quantities for domestic and commercial purposes with little or no application of fertilizers, agrochemicals and manures such as animal dung, decay plant leaves and house whole domestic wastes. The two collected fruit samples were pooled together to obtain two composite samples of banana and pawpaw. The samples were transported to the laboratory for subsequent preparation and analyses.

2.2 Samples Preparation

Small quantities of each fruit samples were washed, peeled, sliced into smaller sizes and dried in an oven at 105°C for 24 hours until they were brittle and crisp [14]. For pawpaw, the seeds were carefully removed before chopping into smaller sizes. The oven dried samples were ground, sieved to get uniform particles sizes, then kept in air tight containers, properly labeled and stored in a freezer prior to analysis.

2.3 Vitamin C Determination

Vitamin C levels in each fruit samples were determined by titration using the method described by [15]. About 10 g of ground fruit samples were soaked for 10 minutes in 40 cm^3 metaphosphoric acid- acetic acid (2%, w/v). The mixture was centrifuged at 3000 rpm for 20 minutes and the supernatant obtained was diluted and adjusted with 50 cm^3 of bi-distilled water. Ten (10) cm^3 of this mixture was titrated to the end point with dichlorophenol-indophenol (DCPIP) 0.5 g/L.

2.4 Digestion of Samples for Trace Metals Analyses

Portions (2g) of dried, disaggregated and sieved samples of fruit were placed separately in 100 cm^3 Teflon beakers and digested with 1 cm^3 concentrated nitric acid and 10cm^3 hydrochloric acid at 550°C for about 3 hours. The digests were filtered into 100 cm^3 volumetric flasks [16, 17]. Levels of Ni, Zn, Pb, Fe and Co in the samples were determined using an atomic absorption spectrophotometer (AAS).

2.5 Statistical analysis

The analyses were performed in triplicate and data were analysed using Excel and GraphPad InStat-[DATASET1.ISD].

3. Results and Discussion

The results obtained in this study are as presented in Figure 1 and Table 1. Figure 1 shows the levels of Vitamin C in the two fruit samples. The results revealed that banana had an appreciable level (219.87mg/100g) of vitamin C while that of pawpaw was 122.47mg/100g. From the results, it is seen that the levels of Vitamin C in the samples fluctuate between the two fruits. These could be attributed to the differences in the nature of the fruit crops, agricultural activities and environmental factors affecting the soils where the plants are grown as well as the time of harvest, method of transport to the laboratory and time of storage prior analysis. Table 1 shows the levels of the trace metals analysed in the two fruit samples. The levels of trace metals analysed in pawpaw ranged from < 0.01 mg/kg Pb to 0.05 mg/kg Zn. In banana, the levels of the analysed trace metals ranged from < 0.02 mg/kg Co to 0.07 mg/kg Fe. The levels of the analysed trace metals obtained in the fruit samples investigated in this study were below the acceptable WHO levels of such trace metals in plants. The acceptable levels of some of these trace

metals in plants as prescribed by the WHO are: Pb 0.3mg/kg, Cd 0.1mg/kg, Fe 425mg/kg, Ni 67mg/kg and Cr 0.8mg/kg. The low levels of the analysed trace metals obtained in the fruit samples investigated in this study could be attributed to good farming practices adopted by farmers in the study area. Investigation had revealed that the application of fertilizers and other agrochemicals in soils is not common in the study area. Hence, the possibility of contaminating the soils with trace metals which could be taken up by the plants is certainly very negligible in the study area.

4. Conclusions

Based on the analyses and results, we arrived at the following conclusions:

1. Pawpaw and banana fruits grown in Akpan Adok, Afaha Etok Ibesikpo, Ibesikpo-Asutan Local Government Area of Akwa Ibom State, contain appreciable levels of vitamin C and variable levels of the analysed trace metals.

2. The levels of the analysed trace metals in the two fruit samples were below the acceptable levels of such trace metals in plants as recommended by the WHO.

3. Considering the important roles of vitamin C in the body as antioxidant and in the area of regeneration of other antioxidants like α-tocopherol (vitamin E) as noted by [8], it could be concluded that pawpaw (*Carica papaya*) and banana (*Musa sp*) grown in the study area, have good dietary or nutritive values in terms of vitamin C.

4. Based on the low levels of the analysed trace metals in the two fruit samples, it could also be concluded that consumption of these fruits may not pose any possible health hazard to the consumers since the levels of the analysed trace metals in the two fruit samples investigated were below the acceptable levels of such trace metals in plants as recommended by the WHO.

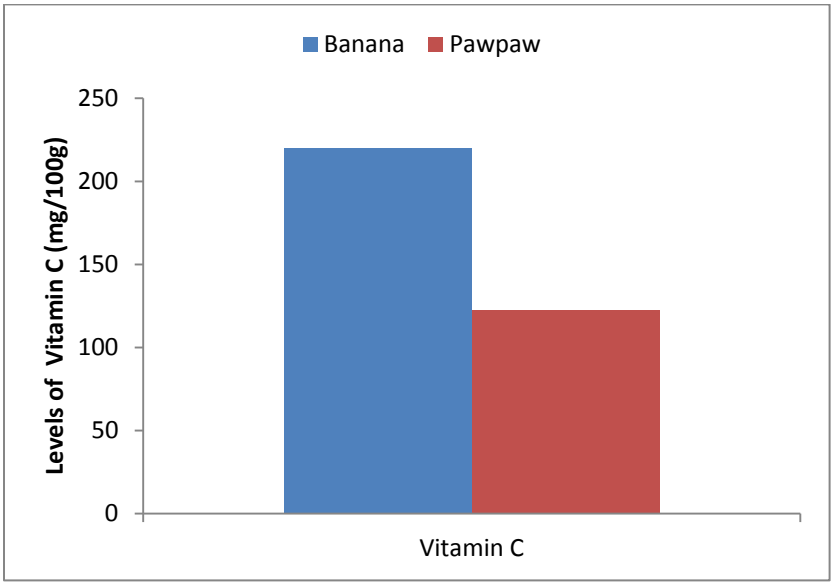

Figure 1: Levels (mg/100g) of vitamin C in pawpaw and banana.

Table 1: Levels (mg/kg) of some trace metals in pawpaw and banana.

Fruits	Trace metals (mg/kg)				
	Fe	Pb	Co	Zn	Ni
Pawpaw	0.03	< 0.01	< 0.02	0.05	0.01
Banana	0.07	< 0.03	< 0.02	0.04	0.02

The above values are means of triplicate analyses; < = Less than

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