GLOBAL JOURNAL OF PURE AND APPLIED SCIENCES VOL 14, NO. 2, 2008: 193 - 195
COPYRIGHT© BACHUDO SCIENCE CO. LTD PRINTED IN NIGERIA. ISSN 1118-0579

DETERMINATION OF THE PROXIMATE COMPOSITION, ASCORBIC ACID AND HEAVY METAL CONTENTS OF STAR FRUIT *(AVERRHOA CARAMBOLA)*

C. A. EDEM, M. I. DOSUNMU, A. C. EBONG AND M. JONES

(Received 11, June 2007; Revision Accepted 22, January 2008)

ABSTRACT

The proximate composition, ascorbic acid and heavy metal contents of *Averrhoa carambola* were evaluated using chemical analysis. The result of the proximate composition analysis showed that the unripe star fruit had the following composition; moisture (92.5%), carbonydrate (74.5%), crude fibre (10%), crude protein (7.9%), crude fat (3.5%) and ash (4.0%). It also contained 23mg/100ml of ascorbic acid. The ripe star fruit on the other hand contained moisture (85.1%), carbohydrate (72.2%), crude fibre (8.6%), crude protein (4.0%), crude fat (11.7%), ash (3.5%) and ascorbic acid (4.6mg/100ml). The heavy metal concentrations in the unripe star fruit is Pb (3.00ppm) Cr (0.45ppm) and Cu (0.085ppm) while the ripe fruit has the heavy metal concentrations of Pb (1.00ppm), Cr (0.42ppm). The concentration of Cu, As, Cd, Hg and Zinc in the ripe fruit were not detectable so were the concentration of As, Cd, Hg and zinc in the unripe star fruits. The Pb and Cr concentrations in both the unripe and ripe fruits were above the WHO (1991) permissible level of 0.005 and 0.05ppm in fruits for both Pb and Cr respectively. The result reveals that the unripe star fruits are reasonably good sources of ascorbic acid, carbohydrate and crude fibre and have a moderate amount of crude protein with very low level of fat, compared to the ripe star fruits. Though the high concentrations of Pb and Cr in both unripe and ripe fruits make the star fruit unfit for consumption.

KEYWORDS: Star fruits, Proximate Composition ,Ascorbic Acid and Heavy Metals

INTRODUCTION

Averrhoa carambola is a short tree that grows slowly with many branches and leaves. It is also broad and the mature trees resembles a canopy due to the bushy and round nature of the leaves. When the fruit is divided into smaller pieces cross sectionally, it produces beautiful star shapes. This give it the common name 'star fruit' (Morten, 1987). The tree ranges in height between 20 to 30 feets (6-9m). This makes it unique as an ornamental tree. The fruits are fleshy berries having four to five cells, a waxy cuticle, thin, smooth and light to dark yellow skin when fully ripe (Maharaji and Badrie, 2006). Star fruit has its origin traced to Ceylon and the Maluku Islands (Moluccas) although it has been grown for many centuries in places like, Malaysia and India in southeast Asia (Morten, 1987). The are many other places like Guyana, Florida Mexico etc that star fruits have been found.

In Nigeria, star fruit can be found in many of the major cities like Lagos, Port Harcourt, Calabar, Enugu, Ikom where they are used mostly as ornamental tree. The fruits of this tree which are oval or ellipsoidal in shape can be eaten raw as fresh fruits. They are also served in salads and as garnish on sea foods (Morten, 1987). The star fruit have also been prepared into a wide range of dishes (salads and deserts) and drinks. Much work have not been done on the proximate composition of star fruit found in Nigeria, although Morten (1987) had reported that the fruit can serve as a good source of ascorbic acid and contains much moisture with moderate level of carbohydrate and low level of crude fat, protein, fibre and ash. It was not specified if the study was done with the ripe or unripe fruit. Considering the fact that star fruit is used as food by many people in different forms, we consider it necessary to look at the heavy metal concentration in this fruit knowing the health hazards associated with the consumption of fruits with high concentration of heavy metals (Beavington, 1975). This work is aim at assessing the proximate composition and ascorbic acid content of *A. carambola* using both the unripe and ripe fruits, with the view of knowing their chemical composition. The heavy metal content of both the ripe and unripe fruits will also be determined in order to ascertain the health effect associated with the consumption of star fruits.

MATERIALS AND METHODS

Sample Collection

The star fruits used in this study were obtained within the University of Calabar premises in Calabar Municipality of Cross River state of Nigeria, between the months of August and October 2006. Forty fruits of *A carambola* were plucked from four different sets of trees randomly chosen. Ten (10) fruits from each tree (i.e five ripe and five unripe). The samples so collected were carried in four different polythene bags to the laboratory within an hour of harvesting. The samples were compositely analysed.

SAMPLE PREPARATION

Each sample was washed with deionised distilled water and wiped with kitchen tissue. The ripe and unripe samples were separated, chopped into smaller pieces using a knife with steel blade. Portions were taken for determination of moisture and ascorbic acid contents. The rest were dried in a hot air circulating oven (GallenKamp DV 330) at 65°C to constant weight (18-24h). The dried samples were ground using an electric blender with steel blades and stored in screw capped containers at 4°-6°C.

ANALYSIS

Moisture content was determined by drying about 3g of the fresh sample to constant weight in a hot air circulating oven at 100°C. Crude fat, crude protein, fibre and ash contents were determined according to the standard method of

C. A. Edem, Department of Chemistry, University of Calabar, Calabar, Cross River State, Nigeria.
M. I. Dosunmu, Department of Chemistry, University of Calabar, Calabar, Cross River State, Nigeria.
A. C. Ebong, Department of Chemistry, University of Calabar, Calabar, Cross River State, Nigeria.
M. Jones, Department of Chemistry, University of Calabar, Calabar, Cross River State, Nigeria.

the AOAC (1984) using dry sample. Ascorbic acid content was determined by titrating ascrobic acid extract prepared from 30g of fresh sample against N-bromosuccinimide by the method of Haddad (1977). The carbohydrate content of the sample (ripe and unripe) was determined by the difference obtained after subtracting the protein, ash, fat and fibre contents from the total dry mass. The determination of lead, chromium, copper, cadmium, mercury, arsenic and zinc was carried out using the atomic absorption spectrophotometer (Pye Unicam 2900) according to the procedure of the AOAC (1984) on dry sample

RESULTS AND DISCUSSION

Table 1: Proximate composition (g/100g) and ascorbic acid content(mg/100ml) of star fruit

Table 1	Moisture %	Fat %	Fibre %	Protein %	Ash %	Carbohydrate	Ascorbic acid (mg/100ml
Ripe fruit	85.1	11.7	8.6	4.0	3.5	72.2	4.6
Unripe fruit	92.5	3.5	10.0	7.9	4.0	74.6	23.0

Table 2: Heavy metal concentration (ppm) in star fruit

Table 1	Pb (ppm)	Cr (ppm)	Cu (ppm)
Ripe fruit	1.00	0.42	0.00
Unripe fruit	3.00	0.45	0.085

Table 1 shows the proximate composition and ascorbic acid contents of ripe and unripe star fruits. From the result in table 1, the ripe fruit has the following composition; moisture (85.1%), crude fat (11.7%), fibre (8.6%), protein (4.0), ash (3.5%), carbohydrate (72.2%) and ascorbic acid (4.6mg/100ml). The unripe fruit has the following composition; moisture (92.5%) crude fat (3.5%) fibre (10.0%), protein (7.9%), ash (4.0%), carbohydrate (74.6%) and ascorbic acid (23mg/100ml). The study revealed that the unripe fruits are good source of ascorbic acid, carbohydrate, fibre, ash and protein with a low level of fat when compared to the ripe fruits which is only higher in fat content. The result shows that the unripe fruit is more nutritive compared to the ripe fruits and could be used to promote healthy living and to protect one against scurvy and other ascorbic acid deficiency related ailments. This result compared favourably with those reported by Morten (1987). Table 2, shows the heavy metal concentration in both the ripe and unripe star fruits. From the result (Table 2), the ripe fruit had Pb (1.00ppm) and Cr (0.42ppm). The concentration of Cu, As, Cd, Hg and Zn were not detected. While the unripe fruits had Pb (3.00ppm), Cr (0.45ppm) and Cu (0.085ppm). The concentrations of As, Cd, Hg and Zn were not detected in the unripe fruits. The result revealed that the unripe fruit had higher concentration of Pb, Cr and Cu compared to the ripe fruit where Cu was not detected. The variation in the amount of Pb, Cr and Cu in the ripe and unripe fruits may be attributed to a detoxification process in the fruit that maybe associated with the ripening process (Cheng, 2003). The presence of higher concentrations of Pb, Cr, and Cu in the unripe fruit compared to Pb and Cr in the ripe fruit makes the unripe fruit more toxic than the ripe ones. This result supports the report by Chang, et al (2000) and Chen et al (2001) that star fruit is toxic and thus unfit for consumption since, when people eat them they are indirectly ingesting their heavy metal contents and continue to accumulate the heavy metals in their bodies. The cumulative effectof these metals on human health are generally disastrous as the metals are known to cause nephropathy agitation, confusion, constipation and slight anaemia ((Ademoroti, 1996; Tahoven, 1998; Mannino, 1996 and MAFF, 1997). The result also shows that lead and chromium concentrations in both the ripe and unripe star fruits are all above the WHO (1991) permissible levels in fruits which are 0.005ppm and 0.05ppm for lead and chromium respectively. Though the high concentration of Pb and Cr in both the unripe and ripe fruits might be due to the locality of the fruit and may not necessarily make all stair fruits unfit for consumption. It may be necessary to study star fruits from other localities and find out if there is source nearby where the lead and chromium could be traced to.

CONCLUSION

The unripe fruits of *A. carambola* have been shown to contain a reasonably good amount of ascorbic acid, carbohydrate, and moderate amount of fibre and protein, while the ripe fruits contain a moderate amount of fat, fibre and carbohydrate. Although the high concentrations of lead and chromium in both the unripe and ripe fruits from the study area makes them unfit for consumption. We do not have enough data to confirm whether star fruits are generally not unfit for human consumption as is indicated in the work.

REFERENCES

Ademoroti, C. M. A., 1996. Environmental chemistry and toxicology Ibadan Foludex press Ltd.

AOAC, 1984. Official methods of analysis (14th edn) Association of Official Analytical chemists, Washington, DC USA.

Beavington, F., 1975. Heavy metal contamination of vegetation and soils in domestic gardens around a smelting complex. *Environmental Pollution*, 9: 211-221.

Chang, J. M., Hwang, S. J. and Juo H. T., 2000. Fatal outcome after ingestion of Star fruit (Averrhon caramboia) in Uremic patients. *Am. J. Kidney Dis.*35,189-93.

Chen, C. L. Fang, H. C. Chon K. J., Wang, J. S. and Chung, H. M., 2001. Acute oxalate nephropathy after ingestion of star fruit. *Am. J. Kidney Dis.* 37, 418-422.

Cheng, S., 2003. Effects of Heavy metals on plants and resistance mechanisms; Chines Academy of Science, 10(4): 256-264.

Haddad, P., 1977. Vitamin C. content of commercial oranges juices. *J. Chem. Edu.*, 54 (3): 192-3.

Maharaji, L. K. and Badrie, N., 2006. Consumer acceptance and physicochemical quality of osmodehydrated carambola slices. *Inter. Journal of consumer studies* 30(1): 16 - 24

Mannino, S., 1996. Determination of heavy metals in fruit juices and vegetables by potentiometric stripping analysis: *The Analyst* 107, 1466-1470.

Ministry of Agriculture Food and Fisheries (MAFF), 1997. Total Diet study in plants 1st Edition, London; Ellis Horwood Prentice Hall.

Morten, J., 1987. Fruits of warm climates. Miami, Purdue University Press.

Tahoven, I., 1998. Lead and cadmium In Food Additives and Contaminants 15: 446-450.

World Health Organisation, 1991. International programme on chemical safety (I PCS): Environmental Health Criteria. Geneva, 134: 321-342.