

Vitamin C content of some processed green leafy vegetables

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ABSTRACT

Vegetables serve as sources of vitamins and minerals in foods. Vitamin C is well documented as an antioxidant but can also be lost on processing being a water soluble vitamin. The effect of some drying methods on the vitamin C content of green leafy vegetables was investigated. Standard method of analysis was used for the determination. *Telfairia occidentalis* (pumpkin), *Gnetum africanum* (afang), *Amaranthus hybridus* (green) and *Abelmoschus esculentus* (okra) were analyzed fresh, sun-dried (cut and uncut) and indoor-dried (cut and uncut). The results in mg/100g of the fresh vegetables ranged from 64.33±0.02 in pumpkin to 4.33±0.01 in greens. The results of the vegetables when cut and sun-dried were 17.67±0.04, 1.44 ±0.01, 0.84 ± 0.01 and 4.27 ± 0.02 for pumpkin, afang, greens and okra respectively while the uncut and sun-dried vegetables were 36.00 ± 0.3, 2.17 ± 0.00, 1.26 ± 0.01 and 28.67 ± 0.02. The values for the cut and indoor-dried vegetables ranged from 1.17 ± 0.01 to 24.67±0.02 for *Amarantus hybridus* and *Telfairia occidentalis* respectively while the uncut and indoor-dried ranged from 1.87 ± 0.02 to 52.33 ± 0.02 for the same vegetables. The results showed a significant ($P<0.05$) loss of vitamin C in both the cut and uncut states except for the uncut and indoor-dried pumpkin leaves which had a relatively low percentage loss, when compared to the fresh vegetables.

Keywords: Vitamin C, *Telfairia occidentalis*, *Gnetum africana*, *Amarantus hybridus*, *Abelmoschus esculentus*.

INTRODUCTION

Green leafy vegetables are cultivated all the year round in Nigeria but they are more abundant towards the end of the rainy season and the beginning of the harmattan season.

Vegetables are a store house of vitamins, such as beta carotene, ascorbic acid and riboflavin as well as minerals, such as iron, calcium and phosphorus [1]. They are highly perishable and require careful processing in order to preserve the nutrients, especially the water soluble vitamins. The minerals in vegetables contribute to the alkaline substance in the body, which enables the body to maintain acid-base balance [2]. Some vegetables also contain anti-nutrients which can interfere with the bioavailability of some nutrients. Vegetables also contain carbohydrate in form of dietary fibre and a substantial quantity of water. Consumption of fruits and vegetables in diets has been reported to protect the human body from degenerative diseases [3]. Amaranths and *Telfairia* are popular in the rural areas as vegetables used to boost low red blood cell count as vitamin C in the fresh vegetables promotes iron absorption [1]. Of all the vitamins, vitamin C is the most easily destroyed by oxidation, and in extracts, juices and foods with cut surfaces, it may be oxidized by exposure to air [4]. It is a water-soluble anti-oxidant known to be important to health and for proper functioning of the human body. Anti-oxidants can prevent the chemical damage caused by reactive oxygen species such as free radicals that are generated by a variety of sources including pesticides, tobacco smoke, exhaust fumes, certain pollutants and organic solvents [3]. The amount of ascorbic acid

present in vegetables is greatest when in the fresh active state but processing in any form tends to reduce the content. As much as 75% of the ascorbic acid present in green leafy vegetables may be lost during cooking [4].

Post harvest losses also result in nutritional and economic losses but processing and preservation can help to bridge the seasonal gaps in nutrient supply and reduce economic and nutritional losses [5].

The sample vegetables are commonly consumed in Nigeria particularly in the South-South region of the country. They are preserved either sun-dried or indoor-dried for use when the vegetables are scarce especially in the rainy season. They are also preserved in these forms by women whenever on visits abroad to enjoy a feel of home cuisine. Afang, green, pumpkin and okra were cut and some left uncut after washing. They were then sun and indoor-dried. The study was designed to determine the effect of the two processing methods on the vegetables.

MATERIALS AND METHODS

Two kilograms each of four green leafy vegetables, Pumpkins (*Telfairia occidentalis*), Afang (*Gnetum africana*), Greens (*Amaranthus hybridus*) and Okra (*Abelmoschus esculentus*) commonly consumed in Calabar, in the South-South region of Nigeria were purchased in a local market. The samples were sorted to remove any dead twigs or insect-infested leaves and washed under running tap water before being used for analysis. They were then each divided into five groups. One group was analyzed fresh, the second group was chopped, sun-dried for five hours for two days, finely ground and stored in colored air-tight container for analysis. The third group was left uncut and processed the same way as the second group. The fourth and fifth groups were treated as in the second and third groups but indoor-dried at room temperature before analysis.

Vitamin C in all the samples was extracted with 20% trichloroacetic acid (TCA) and determined by the titrimetric method of [6] using 2,6-dichlorophenol indophenol dye.

RESULTS AND DISCUSSION

Table 1: Vitamin C content of green leafy vegetables (mg/100g)

PROCESSING METHODS	PUMPKIN (<i>Telfairia occidentalis</i>)	AFANG (<i>Gnetum africanum</i>)	GREENS (<i>Amaranthus hybridus</i>)	OKRA (<i>Abelmoschus esculentus</i>) leaves
Fresh	64.33 ± 4.48	4.56 ± 0.14	4.33 ± 0.06	53.00 ± 4.58
Cut and Sun-dried	17.67 ± 1.76	1.44 ± 0.05	0.84 ± 0.04	4.27 ± 0.07
Cut and Indoor-dried	24.67 ± 1.20	1.83 ± 0.06	1.17 ± 0.03	15.00 ± 0.58
Uncut and Sun-dried	36.00 ± 0.58	2.17 ± 0.04	1.26 ± 0.03	28.67 ± 0.33
Uncut and Indoor-dried	52.33 ± 1.76	2.78 ± 0.02	1.87 ± 0.03	36.67 ± 1.67

All values in mean ± SEM, n = 3

Table 2: Percentage loss

Processing methods	Pumpkin (<i>Telfairia occidentalis</i>)	Afang (<i>Gnetum africanum</i>)	Greens (<i>Amaranthus hybridus</i>)	Okra (<i>Abelmoschus esculentus</i>) leaves
Cut and sun-dried	72.53	68.42	80.60	91.94
Cut and indoor-dried	61.65	59.87	72.98	71.70
Uncut and sun-dried	44.04	52.41	70.90	45.91
Uncut and indoor-dried	18.65	39.04	56.81	30.81

% loss is when compared to the fresh vegetables.

The results of all the samples analyzed in mg/100g are as shown in table 1. The percentage losses in vitamin C when compared with the fresh vegetables are as shown in table II. The values for the fresh vegetables ranged from 64.33±4.48 for *Telfairia occidentalis* to 4.33±0.06 for *Gnetum africanum*. The values for the vegetables when cut and sun-dried ranged from 17.67±1.76 for *Telfairia occidentalis* to 0.84±0.04 for *Amaranthus hybridus*. The % loss for *Telfairia occidentalis* ranged from 72.53% in the cut and sun-dried vegetable to 18.65% in uncut and indoor-dried. The result showed significant differences ($P < 0.05$) between the vegetables using the two drying methods. Cut and Indoor-dried vegetables had values ranging from 24.67±1.20 to 1.17±0.03 for pumpkin and greens respectively. The % loss in *Gnetum africanum* for the same processing method was 59.87% when compared to the fresh vegetable. *Amaranthus hybridus* had values ranging from 4.33±0.06 to 0.84±0.04 for the fresh and the cut and sun-dried vegetables respectively. The % loss was 80.60. The results for *Abelmoschus esculentus* ranged from 53.00±4.58 to 4.27±0.07. The % loss ranged from 91.94 in cut and sun-dried to 30.81 in the uncut and indoor-dried

vegetable when compared to fresh. Green leafy vegetables are highly perishable and require careful processing in order to preserve the nutrients especially the water soluble vitamins. They are good sources of nutrients especially to the rural population in Africa. Drying of vegetables is a popular practice in many homes in Nigeria for preservation for future use especially when vegetables are expensive in the rainy season. Both drying methods caused significant ($P < 0.05$) losses of vitamin C in the vegetables (Table 2). However, direct sun-drying of the vegetables caused the greatest loss which may be attributed to the direct ultra-violet rays of the sun. The results also showed that the uncut dried vegetables retained higher vitamin C content than the cut and dried samples, which suggests that cutting of the vegetables caused further loss of vitamin C due to the volatile nature of the vitamin. [7] reported vitamin C content of fresh *Telfairia occidentalis* as 62.50mg/100g which is in agreement with the result reported in this study and 20.69mg/100g for sun-dried, which also agrees with the result of the cut and sun-dried method of the same vegetable in this study. The authors also reported a 100% loss in vitamin C for *Amaranthus hybridus* compared with 80.60% loss reported in this study. [8] observed that direct sun exposure of vegetables as it is practiced in the tropics resulted in marginal retention of vitamin C while [9] in their study on the change in ascorbic acid, total phenol and antioxidant activity of sun-dried vegetables in Nigeria, concluded that despite the significant loss in the vitamin C content of the vegetables, the antioxidant activity was still retained due to the contribution of the phenol constituents of the green leafy vegetables.

CONCLUSION

Vegetables generally are good sources of vitamin C, however, processing leads to its significant loss. Uncut and Indoor-drying of the vegetables seemed to conserve some vitamin C but any necessity to preserve vegetables in forms adopted in this study would require supplementation with other sources of vitamin C. Vitamin C could be conserved by storing vegetables in the refrigerator.

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