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Effect of Processing on the Vitamin C Content of Seven Nigerian Green Leafy Vegetables

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Abstract: This study was designed to determine the effect of processing on the Vitamin C content of seven Nigerian green leafy vegetables, *Telfaria occidentalis* (*ugu*), *Talinum triangulare* (waterleaf), *Basella alba* (indian spinach), *Celosia argentea* (*soko*), *Vernonia amygdalina* (bitter leaf), *Amaranthus hybridus* (*tete*) and *Crassephalum crepidioees* (*rorowo*). Processing methods employed are, blanching, boiling, sundrying, squeeze-washing, squeeze-washing with salt and squeeze-washing with boiling. Raw *ugu* had highest Vitamin C content of 62.50 mg/100g while raw waterleaf had the lowest value of 9.30 mg/100g. Blanching and boiling reduced the Vitamin C content of *soko* and *tete* tremendously with a value of 91.50% reduction for boiled *tete*. The percentage loss for sundried vegetables was the lowest when compared with other processing methods with a reduction of 6.50 and 12.40% in indian spinach and *rorowo*, respectively. Squeeze washing reduced the Vitamin C content of *ugu* from 62.50 mg/100g to 6.47 mg/100g (89.65%) and bitter leaf from 42.40 mg/100g to 4.28 mg/100g (89.90%). Squeeze-washing followed by boiling of bitter leaf reduced the Vitamin C content from 42.40 mg/100g to 2.18 mg/100g recording the highest loss of 94.90% when compared with other processing methods.

Key words: Nigerian green leafy vegetables, processing methods, vitamin C

INTRODUCTION

Vegetables and fruits are valuable components of the daily diet contributing carbohydrate in form of dietary fibre, vitamins and minerals to the body. Vitamin C or ascorbic acid is widely found in many fruits and vegetables (Deman, 1973). It is a water-soluble antioxidant known to be important to health and for proper functioning of the human body (Benzie, 1999; Davey *et al.*, 2000). It prevents diseases like scurvy and also tends to control to some extent many infectious diseases, both viral and bacterial. It is also important for the healing of wounds, burns and broken bones as it is required for the synthesis of all connective tissues (Heimann, 1980). Diets rich in fresh fruits and vegetables are also protective against chronic, degenerative diseases (Joshipura *et al.*, 1999; Lampe, 1999; Cox *et al.*, 2000).

Leafy vegetables have been known to be very vulnerable to ascorbic acid loss (Favell, 1998). The vitamin C in fruits are readily available but the content in vegetables might not be readily available due to various processing methods it undergoes such as blanching, squeeze-washing, boiling and sun drying. It is the most easily destroyed of all the vitamins. It is oxidized by oxidases contained within the cells of vegetables, which are set free on cutting, chopping or crushing (Fox and Cameron, 1980). A great percentage of it is lost to the water used for washing and boiling vegetables because it is a water-soluble vitamin. In- home cooking has been known to have quite a significant effect on the ultimate nutrient delivery to the consumer particularly that of the labile, water-soluble ascorbic acid (Davey *et al.*, (2000).

This study was therefore conducted to determine the effect of various processing methods on the vitamin C content of some Nigerian green leafy vegetables with the aim of determining the change in concentration and suggesting the best method that maintains or looses minimal amount of the vitamin.

MATERIALS AND METHODS

Seven green leafy vegetables were purchased from the King's (central) market in Ado-Ekiti, Ekiti State of Nigeria. The research was conducted in May 2007. The edible parts of the vegetables as would normally be eaten were plucked, weighed and subjected to various processing methods as described below:

- Blanching: This technique involved dipping of the vegetable into boiled water for a very short while (1 min)
- Boiling: This involved placing the vegetable in boiling water for some minutes (5 min)

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Table 1: The vitamin C (mg/100g fresh wt.) content of green leafy vegetables as affected by various processing methods

Common/local/ name	Raw	Sundried	Blanched	Boiled	Squeeze-washed	Squeeze-washed with salt	Squeeze-washed and boiled
Waterleaf	9.30±2.05	4.60±1.36	-	-	-	-	-
Rorowo	13.79±1.6	212.08±2.28	-	-	-	-	-
Soko	15.66±3.29	-	5.56±1.84	4.00±1.62	-	-	-
Indian spinach	22.40±4.26	20.80±2.69	-	-	-	-	-
Green/*Tete*	24.00±7.32	-	5.00±1.98	2.05±1.25	-	-	-
Bitter leaf	42.40±4.95	-	-	-	4.28±1.59	4.04±1.10	2.18±1.09
Ugu	62.50±9.27	20.69±3.45	-	-	6.47±2.15	-	-

Mean of 3 determinations ± standard deviation

Table 2: Loss of vitamin C (%) of green leafy vegetables with each processing method

Common/local name	Sundried	Blanched	Boiled	Squeeze-washed	Squeeze-washed with salt	Squeeze-washed and boiled
Waterleaf	50.50	-	-	-	-	-
Rorowo	12.40	-	-	-	-	-
Soko	-	64.50	74.50	-	-	-
Indian spinach	6.50	-	-	-	-	-
Green/*Tete*	-	79.23	91.50	-	-	-
Bitter leaf	-	-	-	89.90	90.50	94.90
Ugu	66.90	-	-	89.60	-	-

- Sun drying: This required a thorough drying until crisp with solar energy after cutting the vegetable with a sharp knife
- Squeeze-washing: This process involved the tearing apart of the tissues with hand and subsequent rinsing in water
- Squeeze: Washing with salt - As in (iv) above but with addition of 10% table salt (w/w of vegetable)
- Squeeze: Washing with boiling - As in (iv) above but with subsequent boiling in water

The vitamin C present in the samples was extracted with 20% trichloroacetic acid and thereafter determined by titrimetric method using 2,6-dichlorophenol indophenol dye as described by Sadasivam and Manickam (1996).

RESULTS AND DISCUSSION

The vitamin C contents of seven green leafy vegetables as affected by different processing methods are shown on Table 1. Vitamin C values for the raw leaves ranged from 9.30 mg/100g in waterleaf to 62.50 mg/100g in *ugu*. These values were generally high for all the raw vegetables when compared with their processed counterparts. Blanching and boiling reduced the vitamin C content of *soko* and *tete* tremendously with a value of 91.50% reduction for boiled *tete* (Table 2). Sundrying had the least effect on vitamin C content when compared with other processing methods with a reduction of 6.50 and 12.40% in indian spinach and *rorowo*, respectively. Squeeze-washing reduced the vitamin C content of *ugu* from 62.50 mg/100g to 6.47 mg/100g (89.65%) and bitter leaf from 42.40 mg/100g to 4.28 mg/100g (89.90%). Squeeze-washing followed by boiling of bitterleaf reduced the vitamin C content from 42.40 mg/100g to 2.18 mg/100g (94.90%) recording the highest loss when compared with other processing methods.

The loss of vitamin C in green leafy vegetables is a function of the processing method employed in its preparation. The losses observed in this study are very high most especially when the vegetables were subjected to boiling and squeeze-washing with or without salt. Loss as a result of boiling is justified since vitamin C is water-soluble and heat labile (Egerg *et al.*, 1977). Thus vitamin C is easily leached into the boiling medium. Rumm-Kreuter and Demmel (1990) reported that average losses from spinach were 60% through boiling, 46% through steaming and 58% through pressure-cooking. Squeeze-washing involves cutting, tearing apart and crushing of vegetables by which oxidases contained within the cells are set free to oxidize and thereby destroy the vitamin C content (Fox and Cameron, 1980). Ejor *et al.* (2005) also observed high losses (as much as 77%) when *vernonia* (bitterleaf) species were squeeze-washed, squeeze-washed and boiled and squeeze-washed with natron. The losses observed when the vegetables were sundried are in agreement with the work of Oshodi (1992) who confirmed that Vitamin C levels in vegetables are temperature dependent.

CONCLUSION

Green leafy vegetables are good sources of vitamin C. The vitamin is however lost due to various processing methods. Boiling and squeeze washing lead to more loss than blanching. It is therefore advisable to blanch vegetables in hot water to inactivate the oxidase enzyme that destroys vitamin C and also to remove field soil and destroy microorganisms present. Above all, it is better to add fresh, raw vegetables into your stew and cook for a few minutes. Finally, since processing of most vegetables

is inevitable, it is advisable to add fruits to your daily meal alongside vegetables to ensure regular and adequate intake of vitamin C to meet up with the US daily reference intake of 75 and 90mg/day for women and men respectively (Szeto *et al.*, 2002).

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