

Original Research Article

THE EFFECT OF PROCESSING ON ASCORBIC ACID AND DEHYDROASCORBIC ACID IN DIFFERENT VARIETIES OF YAM (*DIOSCOREA ROTUNDATA*, *D. CAYENENSIS*)

ABSTRACT

Two cultivars of yam namely *Dioscorea rotundata* (white yam), *D. cayenensis* (yellow yam) which are widely grown and utilized in Nigeria were analyzed qualitatively and quantitatively. The assay of ascorbic acid in the two cultivars ranged from (5.0 – 9.2 mg/100g fresh tissue). There is evidence that ascorbic acid is unstable in yam. Three samples of each variety were analysed. The moisture contents of the samples were 40-55% except roasted yam which had a moisture content of 30% in *D. rotundata* while 48-60% in *D. cayenensis* except roasted yam which had moisture content of 30%. The pH values were similar in all the varieties examined. The level of ascorbic acid after 0-8 days of storage ranged from 5.2 - 7.3mg/100g fresh tissue on a moisture -free basis (mfb). The dehydroascorbic acid content varied from 5.0-9.2 mg/100g fresh tissue on a moisture- free basis. The retention in ascorbic acid of the various treatments varied from 4.9 - 6.2mg/100g respectively and dehydroascorbic level of the various treatments varied from 5.2- 8.9mg/100g.

Keywords: Ascorbic acid, Dehydroascorbic acid, *D. cayenensis* and *D. rotundata*.

INTRODUCTION

Yam is one of the staple foods in Nigeria and other tropical African countries. The yams are members of the genus *Dioscorea*. *Dioscorea* is the largest genus of the family Dioscoreaceae, containing between three and six hundred species (Vernier *et al.*, 1998). Annual world production of yam is about 40 million tonnes and per capita consumption is estimated to be 256.4 g per day in the major production zones (FAOSTAT, 2005).

Yam is grown and cultivated for its energy-rich tuber. Only a few species of yams are cultivated as food crops. The most important species of *Dioscorea* include *D. rotundata*, *D. alata*, *D. cayenensis*, *D.*

dumetorum, *D. esculenta* and *D. bulbifera*. *Dioscorea alata*, called "water yam", "winged yam" and "purple yam", is the species most widely spread throughout the world and in Africa is second only to white yam in popularity (Mignouna *et al.*, 2004).

Yam is of higher nutritional value than some other root and tuber crops such as cassava (Latham, 1969). Its protein content is about 3 - 6% as compared to 1 - 2% in cassava (Charles *et al.*, 2004). Yams are reported to contain relatively high levels of minerals (Afoakwa and Sefa-Dedeh, 2001). Yams are also known to contain some antinutritional components that may have adverse effects on human nutrition (Dipak and Mukherejee, 1986). These are mainly tannins, phenols and phytic acid.

Two principal traditional methods used for preparing yams for consumption in coastal West Africa, especially Nigeria, are boiling tuber pieces and pounding into a dough after boiling (Omonigho and Ikenebomeh, 2000). Several traditional household food-processing methods can affect the bioavailability of nutrients in plant-based diets. These include thermal processing, mechanical processing, soaking, fermentation and germination, (Hotz and Gibson, 2007).

Ascorbic acid is a water-soluble vitamin, well recognized as an anti-scorbutic food factor. Its ready oxidation to DHAA is the most prominent chemical property of the vitamin. The two biologically active forms of vitamin C present naturally in foods are L-ascorbic acid and L-dehydroascorbic acid (Christie and Wiggins, 1978). The objective of this study is to determine the effect of processing on ascorbic acid and dehydroascorbic acid level in different varieties of yam (*Dioscorea rotundata* and *Dioscorea cayenensis*).

MATERIALS AND METHODS

Two cultivars of yam tuber namely *Dioscorea Rotundata* (white yam), *D. Cayenensis* (yellow yam) were obtained directly from Owena market in Osun state, Nigeria. The tubers were peeled, washed and cut into cubes of about 2cm and subjected to different treatments. Fifty (50kg) of the yam tuber cubes/dices were cooked for 15minutes in aluminum pot while the same quantity of yam cubes were pressure cooked (15psi, 121⁰c) for 10 minutes. The same quantity were fried, cooked by steaming for 12minutes and roasted for 30 minutes.

Chemical analysis

The moisture content and pH level of the samples were determined in triplicate according to the method of AOAC (2005). The dye-titration method used was essentially that of the AOAC procedure (AOAC, 1984) to determine the ascorbic acid and dehydroascorbic acid. Metaphosphoric acid extracts of the foods were prepared and pH adjusted to about 1.2. The reducing capacity of the extracts was then measured by titrating with 2, 6-dichlorophenolindophenol (DCIP). In this oxidation-reduction reaction, ascorbic acid in the extract was oxidised to dehydroascorbic acid and the indophenol dye reduced to a colourless compound. End point of the titration was detected when excess of the unreduced dye gave a rose pink colour in acid solution.

Result and Discussion

The levels of ascorbic acid (AA) and dehydroascorbic acid (DAA) after 5 days and 8 days of storage are shown in Table 1. At room temperature there was a reduction in the ascorbic acid level to about 72% of the original value in 5 days. After 8 days of storage the ascorbic acid content dropped to insignificant levels. There was a general increase in the level of DAA in the stored samples indicating that some of the AA was converted to DAA.

Table 1: Changes in the levels of ascorbic acid in *D.rotundata* and *D.cayenensis*

Raw yam	DAYS	AA	DAA
White yam	0	7.3	6.8
	5	5.3	8.7
	8	5.2	9.2
Yellow yam	0	6.7	5.0
	5	5.4	6.4
	8	5.3	7.8

Means in the same column with different superscripts are significantly different at $p < .005$.

AA- ascorbic acid

DAA- dehydroascorbic acid

The results of the moisture content and pH level are presented in (table 2). The moisture content of the various treatments varies from 30 – 60%; cooked yam has the highest moisture content while roasted yam has the lowest moisture content along the various treatments. The increase in the moisture content of cooked yam, steam cooked yam and pressure cooked yam depends on the cooking time of each treatment. Cooked yam has the highest cooking time (20 minutes) which aids the absorption of water in the treated sample; roasted yam has the lowest moisture content due to high temperature treatment for 30 minutes. This treatment yields a significant loss in the moisture content of the sample. The pH value of the various treatments varies from 4.67 – 5.83 mol/l. The retention in AA of the various treatments varies from 4.9 - 6.2 mg/100g respectively. There is no significant difference between steam cooked yam, cooked yam and pressure cooked yam because AA dissolve in water during the treatment. Fried yam retained a substantial amount of AA in the sample than roasted yam because roasted yam are subjected to high temperature for a Long time (30 minutes) which reduces the level of AA in the sample. The DAA level of the various treatment varies from 5.2- 8.9.

Table 2: Effect of Processing on Moisture and pH level of Yam Varieties

Treatment	Dioscorea rotundata		Dioscorea cayenensis	
	moisture (%)	pH (mol/l)	moisture (%)	pH(mol/l)
Roasted yam	30.67±1.00 ^a	5.73±0.32 ^d	30.00±1.00 ^a	5.73±0.16 ^c
Fried yam	40.00±1.00 ^b	4.53±0.74 ^b	48.00±1.00 ^b	4.67±0.36 ^a
Raw yam tuber	44.33±1.00 ^c	4.10±1.00 ^a	52.33±0.17 ^c	4.73±0.36 ^a

Pressure cooked yam	50.67±1.00 ^d	4.87±1.00 ^c	56.33±1.00 ^d	5.13±1.00 ^b
Steam cooked yam	52.67±1.00 ^e	5.63±0.32 ^d	53.33±0.17 ^c	5.83±0.16 ^c
Cooked yam	55.33±1.00 ^f	4.50±0.74 ^b	60.33±1.00 ^e	4.67±0.36 ^a

Means in the same column with different superscripts are significantly different at $p < .005$.

Table 3: Effect of processing on level of ascorbic acid and dehydroascorbic acid

Treatment	Time (min)	Dioscorea rotundata		Dioscorea cayenensis	
		AA	DHAA	AA	DHAA
Cooking	15	5.3±0.25 ^b	6.3±0.38 ^b	5.4±1.00 ^b	8.3±1.00 ^c
Pressure cooking	12	5.4±0.25 ^b	6.5±0.38 ^c	5.4±1.00 ^b	8.5±1.00 ^b
Steam cooking	20	5.4±0.25 ^b	6.2±0.38 ^b	5.4±1.00 ^b	8.5±1.00 ^b
Frying	4	6.2±1.00 ^c	6.5±0.38 ^c	5.8±1.00 ^c	8.9±1.00 ^d
Roasting	30	4.9±1.00 ^a	5.5±1.00 ^a	5.0±1.00 ^a	5.2±1.00 ^a

Means in the same column with different superscripts are significantly different at $p < .005$.

Conclusion and Recommendation

The result shows that cooking, especially roasting, leads to greater loss of ascorbic acid and dehydroascorbic acid. For maximum retention of ascorbic acid yam tubers should be processed immediately after harvesting as ascorbic acid decreases rapidly during storage. Since surface areas enhance loss of ascorbic acid, the yam tubers should be cooked whole before peeling as being practiced by some local processors. This measure will greatly reduce leaching of nutrients into cooking; however it may require higher energy and cost.

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