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Chemical Composition of *Artocarpus communis* (Breadfruit) Seed flour as Affected by Processing (Boiling and Roasting)

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Abstract: *Artocarpus communis* (Breadfruit) seed flour was subjected to boiling and roasting to determine their effects on the chemical composition. Proximate composition showed a significant difference ($p>0.05$) in the raw and processed flour samples. The moisture content was lowest (14.77%) in the roasted *A. communis* seed flour and highest (24.08%) in the boiled seed flour. Percentage ash, fat and protein were highest (3.66, 3.74 and 4.67%) in the raw while ash and fibre contents were least (2.75 and 1.81%), respectively in the boiled flour. Carbohydrate was highest (87.29%) in the boiled and least (85.60%) in the raw. Boiling and roasting indicated that the vitamin C content and the mineral contents were significantly higher in the raw *A. communis* seed flour. The effects of boiling and roasting with regards to loss and retention of the nutrients differed significantly ($p>0.05$), with only the roasting retaining more of the nutrients than boiled seed flour. Sodium and potassium contents of boiled (0.27 and 0.75 mg/L), respectively and roasted (0.34 and 0.78 mg/L, respectively) *A. communis* seed flours compared well ($p<0.05$) with the raw (0.37 and 0.83 mg/L, respectively).

Key words: Chemical composition, *Artocarpus communis* seed flour, boiling, roasting

INTRODUCTION

Indigenous food crops and edible seeds and plant products which are widely grown but neglected and rarely consumed by people in urban areas are much more highly nutritious than most exotic foods (Okafor and Okolo, 1974; Okigbo, 1975). *Artocarpus communis* (Ukwa bekee) is one of the seeds which is neglected, underutilized, underdeveloped and even going into extinct. *A. communis*, a breadfruit belongs to the Mulberry family Moraceae. The name *A.communis* is derived from the Greek Word Artos, bread and karpus which refer to the bread like quality of breadfruit when baked. The fruit is Achene but not a drupe. Other names of *A. communis*, which can be interchanged are *A. atilis* and *A. incisa*. The seeds are edible and are of high nutritional values (Kaey *et al*., 1989). As a leguminous crop, A. communis is considered as a good source of nutrients such as protein, fats and oils and a reasonable amount of carbohydrates for both man and livestock feeds for animals (Onana, 1995). When, *A. communis* seeds are cooked, they are fair source of thiamine and vitamin C (Amusa *et al*., 2002).

In Nigeria, *A. communis* is regarded as the poor man's substitute for yam (*Dioscorea esculenta* and *Dioscorea cayenensis)* due to the fact that it is used in several traditional food preparations of yam and also costs <1/3 the price of yam at the market (Mayaki *et al*., 2003). The seeds could be cooked for main dish, roasted for snacks or even converted to flour, which can be used for snacks making or as soup thickner (Anazonwu-Bello, 1986). Informations are limited on the processing (boiling and roasting) effects on the nutrients of *A. Communis* seed flour: Consequent upon this, this research aims at evaluating the processing (boiling and roasting) effects on the chemical composition of *A communis* seed flour.

MATERIALS AND METHODS

A. communis seeds were purchased from Assa market in Assa town in Ohaji/Egbema Local Government Area, Imo State. Nigeria.

Production of *Artocarpus communis* seed flour: The seeds of *A. communis* were cleaned and sorted to remove dirts, etc. One thousand, five hundred grams (1,500 g) of the whole seeds were divided into three portions. Two portions of 500 g each were given boiling and roasting treatments for 35 and 40 min, respectively. Boiling was in a distilled water in the ratio of 1:5 w/v at the temperature of 100°C. The seeds of the boiled portion were drained, cooled, dehulled and then dried in a hot air oven at 80°C for 4 h and milled with a hammer mill to produce flour.

Roasting was in a hot air oven at 130°C. The seeds were cooled, dehulled and further milled with a hammer mill to produce flour.

The raw portion (500 g) was dehulled and dried in a hot air oven at 80°C for 4 h before milling with a hammer mill. The flours (boiled, roasted and raw) were sieved using a metal sieve of mesh size 1.0 mm and packaged with a polyethylene bags and kept for analysis.

Chemical analysis: Moisture content was determined by the standard method of AOAC (1995). Carbohydrate (by difference), protein, ash and fat were determined according to the method described by James (1995). Crude fibre was determined by the method described by Pearson (1976). Calcium and magnesium were determined by the Verant EDTA Complexiometric titration method according to Pearson (1976) and James (1995). Sodium and potassium were determined by flame photometry method described by James (1995). Phosphorus was determined by the Vanedomolydrate Colorimetric method according to Udoh and Ogunwale (1986) and James (1995). Iron and vitamin C were determined by the standard method of AOAC (1995).

RESULTS AND DISCUSSION

Proximate composition of *Artocarpus communis* flour from boiled and roasted seeds: The result (Table 1) showed the proximate composition of the raw and processed *A. communis* seed flours. The boiled sample was the highest (24.08%) in moisture content and the least (14.77%) in the roasted. Also, there was a significant difference (p>0.05) in moisture content between boiled *A. communis* flour sample and the other two samples. This increase in the boiled sample was due to the absorption of water into legumes by simple diffusion (Rosario and Flores, 1981). The reduced (14.77%) moisture content of roasted sample was as a result of the treatment which caused loss of moisture in legume seeds (Kabirullah *et al*., 1977).

In terms of ash content, the raw *A. communis* seed flour had the highest value of 3.66% and it is significantly different (p>0.05) from the boiled and roasted samples. The result of the boiled sample of *A. communis* seed flour decreased (2.75%) in ash content. The loss in ash content of the boiled sample was caused by leaching of nutrients into the water and time involved in boiling (Fox and Cameron, 1984). Roasting increased the crude fibre content from 2.34-2.41%. Statistically, the value (2.41%) of roasted *A. communis* was significantly better (p>0.05) than raw and boiled samples. The decrease in crude fibre content of the boiled sample was attributed to loss of solid particles by boiling (Albercht *et al*., 1966). Percentage fat content was highest (3.74%) in the raw sample and least (3.63%) in boiled sample but there was no significant difference (p<0.05) among the raw, boiled and roasted samples. Boiling and roasting decreased the protein content of *A. communis* seed flour from 4.67% (raw) to 4.51 and 5.53%, respectively. In other words, the raw *A. communis* seed flour sample was significantly different (p>0.05) from the boiled and roasted sample in protein content. The reduced level of protein in boiled and roasted *A. communis* seed flour sample was due to leaching loss and solubility of nitrogen as explained by Edijale (1980) in his research on cowpea.

The processing methods employed (boiling and roasting) affected the carbohydrate content of *A. communis* seed flour. Boiling had an appreciable increase (87.29%) in carbohydrate content of the *A. communis* seed flour than roasting (86.57%). It can be observed that boiled sample was significantly different (p>0.05) from the raw and roasted samples. The decrease in carbohydrate content of the roasted sample may be due to heat treatment.

Table 1: Mean values of the proximate composition of *Artocarpus communis* flour samples from boiled and roasted seeds

Parameters	Raw	Boiled	Roasted
Moisture content (%)	$21.53\pm0.10_b$	$24.08\pm0.37_a$	$14.77\pm0.00_c$
Ash content (%)	$3.66\pm0.02_a$	$2.75\pm0.00_c$	$2.81\pm0.01_b$
Fibre content (%)	$2.34\pm0.00_b$	$1.81\ 0.01_c$	$2.41\pm0.01_a$
Fat content (%)	$3.74\pm0.03_a$	$3.63\pm0.02_a$	$3.67\pm0.00_a$
Protein content (%)	$4.67\pm0.01_a$	$4.51\pm0.01_b$	$4.53\pm0.00_b$
Carbohydrate content (%)	$85.60\pm0.02_c$	$87.29\pm0.01_a$	$86.57\pm0.00_b$

Means with the same subscripts in the same row are not significantly different (p<0.05)

Table 2: Mean values of the mineral and vitamin c contents of *Artocarpus communis* flour samples from boiled and roasted seeds

Parameters	Raw	Boiled	Roasted
Calcium (mg/L)	$0.18\pm0.00_a$	$0.12\pm0.00_c$	$0.14\pm0.00_b$
Magnesium (mg/L)	$0.24\pm0.00_a$	$0.17\pm0.01_c$	$0.19\pm0.00_b$
Sodium (mg/L)	$0.37\pm0.00_a$	$0.27\pm0.01_a$	$0.34\pm0.00_a$
Phosphorus (mg/L)	$0.47\pm0.00_a$	$0.39\pm0.00_b$	$0.41\pm0.01_b$
Iron (mg/L)	$0.85\pm0.01_a$	$0.38\pm0.00_c$	$0.44\pm0.01_b$
Potassium (mg/L)	$0.83\pm0.00_a$	$0.75\pm0.01_a$	$0.78\pm0.00_a$
Vitamin C (mg)	$8.55\pm0.01_a$	$7.25\pm0.01_c$	$7.43\pm0.01_b$

Means with the same subscript in the same row are not significantly different (p<0.05)

Mineral and vitamin C contents of *Artocarpus communis* flour samples from boiled and roasted seeds: The result of mineral and vitamin C contents of raw, boiled and roasted *A. communis* seed flours are shown in Table 2. Boiling and roasting as processing methods decreased the calcium, magnesium, iron and vitamin C contents. In effect, the Calcium (Ca) magnesium (Mg) and iron (Fe) contents and the vitamin C contents of the raw *A. communis* seed flour were significantly better (p>0.05) than the minerals and vitamin C contents of the boiled and roasted samples, respectively. The calcium contents decreased from 0.18 mg/L (raw) to 0.12 mg/L (boiled) and 0.14 mg/L (roasted) while, that of magnesium also decreased from 0.24 mg/L (raw) to 0.17 mg/L (boiled) and 0.19 mg/L (roasted).

In the case of the vitamin C content, it decreased from 8.55 mg (raw) to 7.25 mg (boiled) and 7.43 mg (roasted). Although, boiling and roasting decreased the sodium and potassium contents of the raw *A. communis* seed flour, there was no significant difference (p<0.05) between the raw and processed samples. Sodium content in raw *A. communis* seed flour decreased from 0.37 mg/L (raw) to 0.27 mg/L (boiled) and 0.34 mg/L (roasted) while, potassium decreased from 0.83-0.78mg/L (roasted). Processing also affected the

phosphorous content of raw *A. communis* by decreasing it from 0.47-0.39 mg/L (boiled) and 0.41 mg/L (roasted). Raw *A. communis* seed flour significantly differed ($p>0.05$) in phosphorus content from the boiled and roasted samples. However, boiled and roasted samples compared well.

Comparatively, it will be observed that boiling decreased the mineral and vitamin C content more than the roasting method. This occurred probably because soluble minerals and vitamin C leached into the processing water with long cooking time and higher temperature. This result agreed with the research of Fox and Cameron (1984) and Edem *et al*. (1994), that soluble minerals get lost by dissolving into cooking water.

Conclusion: Boiling and roasting as processing methods reduced the chemical composition of breadfruit (*Artocarpus communis)* seed flour when compared with the raw sample. It was also observed from the result that processing of *Artocarpus communis* by roasting retained more nutrients than boiling.

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