

Effects of Processing Methods on Proximate Composition, Mineral Content and Functional Properties of 'Ofor (*Detarium microcarpum*) Seed Flour

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Abstract: Effect of processing on the proximate composition, mineral contents and functional properties of 'ofor' (*Detarium microcarpum*) seed flour was evaluated. Undehulled 'ofor' seeds were subjected to three different processing methods: soaking (12hrs at room temperature), boiling (1hr) and roasting (15mins). The treated seeds were dehulled, milled, sun-dried and sieved to obtain the 'ofor' seed flour samples. The samples were analyzed for proximate composition, mineral contents and functional properties. The results obtained showed that the different treatments had significant effects on almost all the parameters studied. Roasted sample had the highest value of crude protein (17.70%) and fiber (5.2%) while the soaked sample had the highest values in crude fat (23.01%) and ash (3.5%). The results of the functional properties showed that the roasted sample had 1.09 and 0.688 g/ml in swelling index and bulk density respectively while the soaked sample had the highest value (1.42 ml/g) in oil absorption and 1.35 ml/g for the boiled sample. The mineral contents of the samples were 21.30 mg/kg, 21.21mg/kg and 19.43mg/kg calcium, 14.13mg/kg, 15.71mg/kg and 15.71mg/kg phosphorus and 19.67mg/kg, 19.43mg/kg and 18.73mg/kg magnesium for roasted, boiled and soaked samples respectively. The results showed that processing methods had significant ($P < 0.05$) effects on the parameters evaluated.

Keywords: processing, proximate, mineral, functional, Detarium

1. Introduction

Detarium microcarpum tree is one of the underutilized tree legumes that grow uncultivated in Sub-Saharan African. It belongs to the *Fabaceae* family (legumes) and is popularly known as sweet detar, sweet dattock or tallow (Abdalbasit *et al.*, 2011; Contu, 2012). In Nigeria it is known by Ibos as 'ofor', by Yorubas as 'ogbogbo' and by Hausas as 'taura'.

D. microcarpum; 'ofor' is a useful plant that finds applications in food, medicine and other commodities. In rural communities, the leaves and flowers are eaten as condiments or vegetables. The leaves are used to thatch roofs of houses while the fruits are eaten fresh or cooked. The fruit pulp is used as local sweetener or can be transformed into flour. The seeds are majorly used as soup thickener. Decoctions or infusions of different parts (root, stem, bark, fruit, leaves) of this plant are used traditionally for the treatment of varying kinds of diseases ranging from syphilis, dysentery, bronchitis, leprosy, sore throat to malaria and meningitis (Keay *et al.*, 1989; Eromosele *et al.*, 1994; Burkil, 1995; Abreu *et al.*, 1998).

2. Literature Survey

Studies have shown that the seeds of *D. microcarpum* can be dried, ground into flour and be used as emulsifying, flavoring and thickening agent (Kouyate and Damme, 2006). This is because the seeds have high content of water-soluble polysaccharides known as gums which solubilize in water to form a viscous gel (Dipiyoti and Bhattacharya, 2010). The gum of *D. microcarpum* has been shown to significantly lower shrinkage, increase water holding capacity and give better stability to raw beef burger than gum tragacanth

(Onweluzo *et al.*, 2004). Gum from *D. microcarpum* can also be used to increase water absorption and mixing tolerance index of dough (Onweluzo *et al.*, 1999). Addition of this gum to fruit products also improved their stability during storage (Dipiyoti and Bhattacharya, 2010).

Nutritionally, *D. microcarpum* seed contains carbohydrates, proteins, crude fibre, crude fat predominantly linoleic acid and essential minerals such as Na, K, Mg, Ca, S, P and Fe (Abreu *et al.*, 1998; Abreu and Relva, 2002). The seeds also contain some anti-nutrients such as saponins, phytates and cyanides (Anhwange *et al.*, 2004). The Proximate and functional properties of the 'ofor' seed flour has been shown by Akpata and Miachi (2001). However, the traditional method of processing 'ofor' seed flour is not left without some challenges such as difficulty in removal of seed coat and grinding into flour due to the hardness of the seeds. Because of these, 'ofor'; *D. microcarpum* seeds are usually boiled or roasted to aid seed coat removal, followed with soaking in water, usually overnight to soften the seeds prior to grinding, after which it is then sun-dried (Kordylas, 1990).

3. Problem Statements

The method employed in the production of the 'ofor' seed flour affects the quality, most noticeably the colour of the flour. In literature, much scientific information has not been given concerning the effects of different processing methods on nutritional and functional properties of 'ofor' seed flour. Thus, the aim of this work is to evaluate the effects of processing methods on the nutritional and functional properties of 'ofor' seed flour as this will better inform on the proper method to employ for processing of 'ofor' seed flour for different food applications.

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4. Methodology

Material procurement

Raw 'ofor' (*Deterium microcarpum*) seeds were sourced from Owerri in Imo State and identified by a senior Taxonomist in the Department of Crop Science, Federal University of Technology, Owerri, Nigeria.

Chemicals and reagents

Chemicals and reagents used for this research were of analytical grade (Analar) and includes Sodium hydroxide (NaOH), Sulphuric acid (H₂SO₄), n-Haxane, refined soybean oil, Ethanediarninetetracetic acid (EDTA), masking agent (hydroxylamic, hydrochloride, potassium cyanide), Erichrome Black T and silichrome dark blue etc.

Equipment

Equipment and instruments used in this study were; Arthur Thomas Laboratory mill, Colab electric centrifuge, Cabolite electric stove, excello kjeldahl apparatus, electric muffle furnace, satorious weighing balance, retort stand, general laboratory glass wares, atomic absorption spectrophotometer (AAS) model 703, 23.etc.

Production of 'ofor' flour samples

3kg of *D. microcarpum* (ofor) seeds was divided into 3 equal portions. Each portion was either soaked, boiled or roasted. After the seed coats were removed, the seed were ground into flour, sun-dried, sieved and packaged as 'ofor' seed flour.

Determination of proximate composition

The proximate composition of the 'ofor' seed samples were determined using the methods as described by AOAC (1990).. The crude fiber content was determined on 5g sample by dilute acid and alkali hydrolysis. The carbohydrate content was calculated by difference as the nitrogen free extractive (NFE).

Determination of functional properties

The swelling index, bulk density, water and oil absorption, and gelation temperatures of the samples were analyzed as described by Ukpabi and Ndimele (1990), Okezie and Bello (1988), Abbey and Ibeh (1988) and Onwuka (2005) respectively.

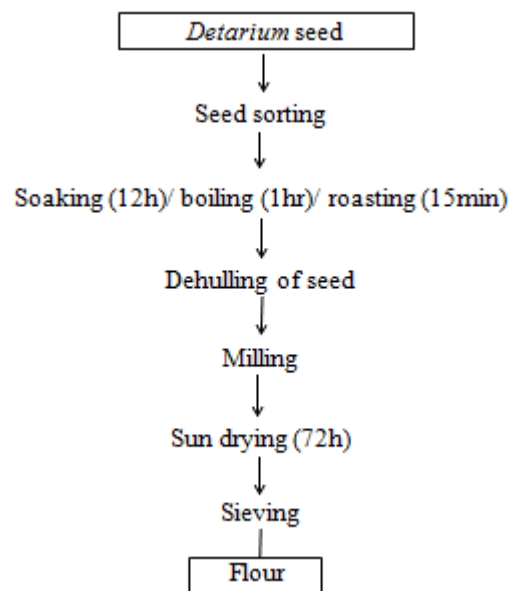


Figure 1: Flow diagram for the production of 'ofor' seed flour samples

Mineral content determination

The samples were analyzed for calcium, magnesium and phosphorus following the dry ash acid extraction method described by James (1995).

Statistical analysis

The results of the proximate compositions, functional properties and mineral contents of the samples were obtained in triplicates. One-way Analysis of Variance (ANOVA) and Fishers least Significant Difference (LSD) test were used to establish significant differences among the samples values at P>0.05 level of confidence. The statistical analyses were performed using Microsoft office Excel 2007 for Window program (Microsoft Corporation, Redmond, WA,USA)

5. Results and Discussion

Proximate Composition of *Detarium microcarpum* (Ofor) Seed Flour

The results of the proximate compositions of the 'ofor' seed flour samples are shown in Table 1. The moisture contents of the samples ranged from 11.67% to 15.33%, with the soaked sample having the highest value of 15.33% which was significantly higher (P>0.05) than the other two samples (boiled and roasted). The moisture contents of the boiled and roasted 'ofor' seed samples were below 15% which is the moisture content regarded as safe storage moisture limit for dry food materials (Sena *et al.*, 1998), indicating that they will be more shelf stable during storage than the soaked sample.

The ash contents of the samples varied from 2.13% to 3.50% with the soaked sample having the highest value of 3.50%, followed by the boiled sample (2.30%) and then the roasted sample (2.13%). The significant difference (p>0.05) in the ash contents of the samples could be attributed to higher leaching and degradation of food minerals during boiling and roasting respectively as suggested by Iwuoha and Kalu (1995).

Dietary fibres have been shown to have a lot of physiological benefits. They give bulk to food and aid in food digestion by facilitating peristaltic movement of food in the gut thus reducing intestinal transit time, increases bowel movement and reduces constipation and colon cancer (Ene-obong and Carnoalue, 1982; Vahouny and Kritchevsky, 1986). The boiled sample had the lowest value of 3.2% indicating that boiling could have caused the soluble fibres such as pectin and gums to solubilise out in the boiling water more than in cold water leading to higher reduction of crude fibre in boiled sample than in soaked sample.

The soaked sample had a crude fat content of 23.01% which was significantly higher ($P < 0.05$) than that of the boiled and the roasted samples showing that exposure to heat causes reduction in fat probably because of loss of volatile fatty acids such as butyric, capric, lauric etc from the samples. The significance of fats in foods cannot be over-emphasized as they contribute greatly to the energy value of foods. They also slow down the rate at which carbohydrates are utilized during starvation and could also be metabolized by the process of beta oxidation to provide energy to the body.

The protein contents of the samples showed that the heat treated samples (boiled and roasted) had higher protein contents than the non-heat treated sample (soaked). This probably suggests that denaturation of protein which took place during boiling could have reduced leaching of proteins in the boiled sample unlike in the soaked sample in which no protein denaturation took place resulting to its significant low protein content (12.89%) when compared with that of the boiled (15. 57%) or the roasted sample (17.70%) in which no leaching occurred.

Nutritionally, roasting gave the sample that had the highest value of crude protein and crude fibre which are highly needed for physiological processes. However, the results of the proximate compositions of the 'ofor' seed samples (soaked, boiled and roasted) were close to those reported by Akpata and Miachi (2001) and Uhegbu *et al.* (2009). The little variations observed could be attributed to differences in processing, environmental factors such as the soil where the ofor tree is planted and variety of the plant as suggested by Abdalbasit *et al.* (2009).

Table 1: Mean Value for The Proximate composition of, D. microcarpum Seed Flour

SAMPLES	MC (%)	Ash (%)	CF (%)	Fat (%)	CP (%)	CHO (%)
Soaked ofor	15.33 ^a	3.5 ^a	4.2 ^b	23.01 ^a	12.89 ^c	41.07 ^c
Boiled ofor	12.40 ^b	2.3 ^b	3.2 ^c	16.09 ^c	15.57 ^b	50.40 ^a
Roasted ofor	11.67 ^b	2.13 ^b	5.2 ^a	16.37 ^b	17.70 ^a	46.79 ^b
LSD	0.75	0.84	0.20	0.17	0.26	1.15

Mean values in the column followed by different superscript are significantly ($p < 0.05$) different.

CP = crude protein; CF = crude fibre; MC = moisture content; CHO = carbohydrate.

Functional properties of 'Ofor' Seed flour samples

The results of the functional properties of the 'ofor' seed flour samples are shown in table 2.

The results showed that the different processing methods given to the 'ofor' seed flour caused significant effects ($P > 0.05$) on swelling index, bulk density, water absorption and oil absorption capacities of the 'ofor' seed flour samples. The roasted sample had the highest values in swelling index and bulk density but least in water and oil absorption while the soaked sample had the highest values in water and oil absorption. This calls for different applications of these samples in food systems. The soaked and boiled samples could be better utilized as soup or sauce thickeners where water and oil absorption capacities are highly needed while the roasted sample could be used in bakery products because of its higher swelling power and bulk density which could contribute to the baking performance of dough.

Table 2: Functional Properties of 'Ofor' Seed Flour Sample

	SI	BD (g/ml)	WA (ml/g)	OA (ml/g)	GT (°C)
Soaked ofor	1.03 ^b	0.625 ^c	5.47 ^a	1.42 ^a	23 ^a
Boiled ofor	1.00 ^c	0.646 ^b	5.47 ^a	1.35 ^a	23 ^a
Roasted ofor	1.09 ^a	0.688 ^a	3.47 ^b	0.97 ^b	23 ^a
LSD	0.01	0.01	0.12	0.14	0.0

Mean values within the same column with different superscript are significantly different ($P < 0.05$). BD= Bulk density; WA= Water absorption capacity; OA= Oil absorption capacity; SI= Swelling index; GT= Gelation temperature.

Mineral Content of 'Ofor' Seed Flour

The result of the mineral contents of the 'ofor' seed flour samples are shown in Table 3. The results obtained showed that the samples were rich in minerals and significant differences ($p < 0.05$) were observed in their calcium and phosphorus contents while their magnesium contents did not differ significantly ($p > 0.05$). The results indicate that the resident time in water had significant effect on the calcium, magnesium and phosphorus contents of 'ofor' seed flour samples. The minerals decreased in sample soaked for 12hrs than in sample boiled for 1hr. For maximum retention of minerals in 'ofor' seed flour, roasting could be suggested as soaking or contact with water could result to leaching of these minerals thereby leading to losses.

Table 3: Mean Value for The Mineral Content of D. microcarpum Seed Flour

Samples	Calcium (mg/kg)	Magnesium (mg/kg)	Phosphorus (mg/kg)
Soaked ofor	19.43 ^b	18.73 ^a	15.27 ^b
Boiled ofor	21.21 ^a	19.43 ^a	15.71 ^a
Roasted ofor	21.30 ^a	19.67 ^a	14.13 ^c
LSD	1.68		0.04

Mean values within the same column followed by different superscript are significantly ($p < 0.05$) different.

6. Conclusions

The results obtained from this work have shown that the method of processing of 'ofor' seed flour goes a long way to determine the nutritional and functional properties of the flour and hence its end use. Soaking at room temperature for 12hrs and boiling for 1hr could be used for production of 'ofor' seed flour; used as thickener for soup and sauce while

the roasted 'ofor' seed flour could serve better in bakery products where the roasted flour, high swelling index and bulk density will be an advantage.

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