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The Nutritional and Functional Properties of the Seed Flour of Three Varieties of *Carica papaya*

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ABSTRACT

The aim of this research work is to analyse qualitatively the *Carica papaya* seed flour for nutritional and functional property components. The nutritional and functional properties of the seed flour of three varieties of *Carica papaya* were determined. The nutritional properties involve proximate analysis, anti-nutrients and mineral analysis of the seed flour the functional parameters carried out were water and oil absorption capacities, foaming and emulsion capacities, foaming and emulsion stabilities, bulk density and least gelation capacity. The samples were found to be rich in potassium and sodium. The potassium and sodium content of the samples A, B and C (32.0, 17.0 and 47.7 mg/100 g) and (26.3, 16.2 and 33.6 mg/100 g), respectively may help control the osmotic balance of the body fluid as well as body pH. The presence of magnesium, zinc, calcium, iron and manganese were also observed, but in relatively small quantities. The protein and Fat content of the samples A, B and C (31.6, 29.4 and 29.6%) were high making these samples fairly good sources of protein and fat. However, the carbohydrate content (9.9, 8.38 and 12.3%) for samples A, B and C, respectively were relatively low. They can as well be used as a source of carbohydrate. The functional properties observed for the samples compared favourably well with other values already reported by earlier scientist for cowpea flour, *Sorghum bicolor* L. stem flour and pigeon pea. The water and oil absorption capacities range from 223.3-265.0 and 189.3-319.6%, respectively. The foaming and emulsion capacities range from 4.0-11.0 and 21.5-24.5%, respectively. The foaming and emulsion stabilities range from 2.0-4.0 and 40.7-43.3%, respectively. The bulk density ranges from 37.5-40.3 g cm⁻¹ and least gelation capacity ranges from 6.0-6.67% w/v the overall data suggest that the papaya seed have some nutritional value and functional properties.

Key words: Nutritional, functional, proximate, *Carica papaya*, mineral, anti-nutrients, physico-chemical

INTRODUCTION

Food is a basic need of mankind. Food provides energy for everything we do, some of which are walking, talking, working and even reading. It also provides energy for metabolic activities in the body. Apart from human beings, other living things must have food to live. Green plants use the energy of sunlight to make food out of carbondioxide in a process called Photosynthesis. Other living things depend on the food made by green plants.

The food we eat comes chiefly from plants and animals. The most important foods obtained from plants are grains, fruits and vegetables. The early man obtained his food from plants by collecting the edible seeds, berries, nuts and roots of wild plants. The plant matter eaten by the early man

includes the acorns, barley grains and yams (Encyclopedia Americana, 2001). Grains/cereals include rice, oats, sorghum, wheat, meat, corn and wheat. Popular fruits include apples, bananas, cherries, orange, pawpaw, pineapples and strawberries.

Carica papaya also called pawpaw is native to the tropical American lowlands. It belongs to the family caricaceae and the subclass dicotyledoneae (Encyclopedia Americana, 2001). The papaya tree has a straight unbranched palm-like trunk with crown of a largely deeply lobed leaves. These spirally arranged, palmately-divided leaves are attached to the trunk by long hollow petioles. The yellow funnel shaped flowers grow in the leaf axil-the male flower in clusters on long stalks and the female flowers usually singly on short stalk. The papaya fruit vary in shape, they may be round, oval or elongated, usually weighing five hundred to one thousand grams (500-1000 g). The exocarp of the young fruit is smooth, leathery and green turning yellow or bright orange on ripening. The inside hollow of the fruit is lined with numerous grey seeds as large as pepper corns and surrounded by a mucilaginous material derived from their arils. The fermented Papaya shows a strong anti-oxidizing activity on *in vitro* cerebra cells as well on the *in vivo* epilepsy experimental model where the epileptogenic monoamine neutral release was consistently reduced (Jackson, 2000). It has also been proven that *Carica papaya* leaf extract may potentially provide the means for the treatment and prevention of selected human diseases such as cancer, various allergic disorder and may serve as Immunoadjuvant for vaccine therapy (Otsuki *et al.*, 2010; Rimbach *et al.*, 2000).

There are numerous varieties of *Carica papaya* and analyses have been carried out on the exocarp, mesocarp and endocarp, of these varieties with respect to the nutritional and functional properties. The mesocarp has been reported to have a medicinal property used in curing typhoid fever. However, there has never been any report of any analysis done on the seed based on the nutritional and functional properties. Therefore the importance of this research work can not be over emphasized. The fermented papaya shows a strong anti-oxidizing activity on *in vitro* cerebra cells as well on the *in vivo* epilepsy experimental model where the epileptogenic monoamine neutral release was consistently reduced.

The proximate analysis show that the three varieties of papaya seed flour can be used as sources of protein. It's been proven that the percentage crude protein of some commonly consumed oil seed in Nigeria namely *Colocynthis citrullus*, Peanut flour, rapeseed and sunflower are 28.44, 24.3, 25 and 28.7%, respectively (Oshodi, 1992), which are relatively lower to that of the papaya seed flour. The three varieties of Papaya seed flour are also good sources of carbohydrate and fat.

MATERIALS AND METHODS

***Carica papaya* seed flour, nutritional and functional analyses:** The papaya fruits were collected from a farmland along Oda road, Akure in year 2006. The papaya fruits were cut opened, the seeds been carefully scraped out of the endocarp and spread in a clean tray. The seeds were sun dried for some days until no traces of water was left. They were then blended in a high speed blender into flour. The seed flour was then packed into clean airtight polythene bags and stored in a cool place prior to laboratory analyses.

Nutritional property analyses

Proximate analysis of the papaya seed flour: The Proximate Analyses include: Moisture content determination, crude fibre, crude protein, Ash content, Fat content and Carbohydrate determination. All of these were carried out using the method described by Pearson (1976).

Mineral analyses: The atomic absorption spectrophotometer was used for the analysis of the following metals: Na, K, Ca, Fe, Mg, Zn, Mn, Cu and Pb. One gram of the sample was placed in a dish and heated gently on a burnsen burner in a fume cupboard until the charred mass had ceased to emit smoke and it was transferred to a dessicator to cool after which 0.1 m HCl solution was added to the ash. This was filtered and diluted appropriately. Standards were made for each of the metals using their suitable salts. The lamp for each metal was fixed and the analysis done (Oshodi, 1992).

Functional property analyses: The functional property analyses include water and oil absorption capacity determination, foaming capacity/stability, emulsion capacity/stability, bulk density and least gelation concentration determination. All of these were carried out using the method described by Coffmann and Garcia (1977) and Ige *et al.* (1984).

RESULTS

The proximate composition of the three varieties of papaya seed flour are shown in Table 1. The moisture content of the three samples ranges from 7.55-8.13%. The Ash content ranges from 9.94-11.5% for the three samples. The Protein ranges from 29.1-31.9%. Crude fibre ranges from 7.8-9.4%. The percentage fat and carbohydrate range from 29.4-31.6 and 8.4-12.13%, respectively.

Table 1: Proximate composition of the papaya seed flour varieties

Samples	Parameters (%)					
	MC	CP	CF	ASH	FAT	CA
A	7.6±0.02	31.9±0.40	8.9± 0.2	9.9±0.03	31.6±0.30	9.9±0.90
B	7.6±0.04	36.3±0.23	7.8±0.03	10.6±0.03	29.4±0.04	8.4±0.20
C	8.1±0.02	29.1±0.50	9.4±0.03	11.5±0.02	29.6±0.04	12.13±0.5

Results are mean of triplicate with standard deviation. A: Elongated yellow papaya seed flour, B: Round yellow papaya seed flour, C: Elongated red papaya seed flour, MC: Moisture Content, CP: Crude Protein, CF: Crude Fibre, CA: Carbohydrate

Table 2: Mineral composition of the papaya seed flour varieties

Parameters (mg/100 g)	Samples		
	A	B	C
Na	26.32± 0.005	16.21±0.005	33.62±0.005
K	32.01±0.005	17.03±0.00	47.66±0.00
Ca	2.91±0.005	2.52±0.005	4.14±0.005
Mg	1.137±0.005	0.527±0.005	2.813±0.005
Zn	2.09±0.005	1.26±0.00	2.88±0.005
Fe	0.763±0.005	0.387±0.005	1.470±0.00
Mn	1.270±0.00	1.113±0.005	1.263±0.005
Cu	0.19±0.00	0.05±0.00	0.07±0.00
Pb	0.00010±0.00	0.00013±0.005	0.00010±0.00
P	55.98±0.005	28.54±0.005	58.61±0.005

Results are mean of triplicate with standard deviation. The samples A, B and C are same samples mentioned above. Na: Sodium K: Potassium, Ca: Calcium, Cu: Copper, Pb: Lead, P: Phosphorus. Mg: Magnesium, Zn: Zinc, Fe: Iron, Mn: Manganese

Table 3: Antinutrient evaluation of the papaya seed flour varieties

Samples	Parameters			
	TA (%)	PA (mg g ⁻¹)	PP (mg g ⁻¹)	OX (mg g ⁻¹)
A	0.25±0.02	19.77±0.8	5.57±0.2	7.65±0.09
B	0.26±0.08	23.62±0.9	6.65±0.3	7.65±0.09
C	0.28±0.06	26.36±1.7	7.43±0.5	9.24±0.23

Results are mean Triplicate with Standard Deviation. Samples A, B and C remains the samples mentioned above. TA: Tannin, PA: Phytic Acid, PP: Phytic Phosphorus, OX: Oxalate

Table 4: Functional property evaluation of the papaya seed flour varieties

Parameters	Samples		
	A	B	C
WAC (%)	265.0±5.0	230.0±10.0	223.3±13.2
OAC (%)	319.6±5.4	224.9±2.7	189.3±5.4
FC (%)	10.0±0.0	4.0±0.01	1.0±1.0
FS (%)	4.0±0.0	2.0±0.0	2.0±0.0
EC (%)	21.5±0.5	22.5±0.6	24.5±0.5
ES (%)	43.3±5.8	47.0±6.1	40.7±0.6
BD (g cm ⁻³)	37.5±0.04	44.9±0.02	40.3±0.03
LGC (%W/V)	6.67±1.2	6.0±2.0	6.67±1.2

Results are mean triplicate with Standard Deviation. Samples A, B and C remains the same samples mentioned above. WAC: Water absorption capacity, OAC: Oil absorption capacity, FC: Foaming capacity, FS: Foaming Stability, EC: Emulsion capacity, ES: Emulsion stability, BD: Bulk density, LGC: Least Gelation capacity

The mineral composition of the three varieties of papaya seed flour are shown in Table 2. The Na, K and Ca content of the papaya seed flour samples range from 33.62-16.21, 47.66-17.03 and 2.52-4.14 mg/100 g, respectively. The Mg, Zn and Fe content of the papaya seed flour range from 0.527-2.813, 1.26-2.88 and 0.387-1.470 mg/100 g, respectively. While the Mn, Cu, Pb and P content of the samples range from 1.113-1.270, 0.05-0.19, 0.00010-0.00013 and 28.54-58.61mg/100 g, respectively.

DISCUSSION

The nutritional composition of the three varieties of Papaya seed flour were investigated in the proximate analysis, mineral composition and antinutrient analyses (Table 1-3). The proximate analysis show that the three varieties of papaya seed flour can be used as sources of Protein. Its been proven that the percentage crude protein of some commonly consumed oil seed in Nigeria namely *Colocynthis citrullus*, peanut flour, rapeseed and sunflower are 28.44, 24.3, 25 and 28.7%, respectively (Jackson, 2000), which are relatively lower to that of the papaya seed flour. Even though the percentage Carbohydrate of the *Sorghum bicolor* L. stem flour (44.52%) as reported by Adetuyi and Akpambang (2005) is relatively higher than that of the three varieties of papaya seed flour, however they may still be used as sources of carbohydrate. The percentage fat has its range from 29.4-31.6% which is reasonably high, these also show a reliable source of fat in these samples. The crude fibre content (the insoluble and combustible organic residue) is also an indication that the Papaya seed flour contains a proportion of Cellulose, hemicelluloses and Lignin.

Moreover, the mineral content of the three varieties of Papaya seed flour as revealed in Table 2 show a great deal of mineral composition. Its a proven fact that the level of sodium in

Nigerian food plants are much lesser than the potassium level (Rimbach *et al.*, 2000). This is also shown in Table 2. It has also been established that Potassium is the most abundant mineral in Nigerian agricultural products (Oshodi *et al.*, 1999; Rimbach *et al.*, 2000). This is confirmed with the level of Potassium on the Table compared to other minerals, except for phosphorus that is higher in value. However, since these two are needed as diet supplements, required to maintain the osmotic balance of body fluid and the pH of the body (NRC, 1989), these samples may be used as sources of Sodium and Potassium. The level of calcium in the Papaya seed flour is relatively low compared to the level reported for the African yam bean varieties (70-128 mg kg⁻¹) as reported by Fagbemi (2004). The magnesium level is also relatively low compared to the reported level in Sorghum grain flour (30-280 mg/100 g) by Jacob *et al.* (1997). However, the two minerals are present in considerable amount. And since high amount of calcium, potassium and magnesium may help to lower the blood pressure (Otsuki *et al.*, 2010) the Papaya seed flour may be good sources of Calcium and magnesium. Micro minerals like manganese and copper occur in traces and zinc too. Iron is important in the formation of hemoglobin and normal functioning of the central nervous system (Otsuki *et al.*, 2010). These samples contain a significant amount of Iron and can be used as good sources of this mineral. Phosphorus, the vital mineral in bone formation (Adetuyi and Akpambang, 2005) is also present in a wide range (more than the other minerals) in the three samples. So the Papaya seed can be a good source for a wide range of minerals that can be useful to the human Health. However, there is a trace of lead in the samples as well. This could be due to bioaccumulation of this metal from the soil.

The antinutrients were also investigated. The tannin ranges from 0.25-0.28% for the samples. Tannins are known for their ability to precipitate with iron and other metals, thereby reducing their absorption. This shows that there is presence of inhibitor in seed flour. Phytic Acid, Phytic phosphorus and oxalate have their ranges from 19.77-26.36, 5.57-7.43 and 7.65-9.24 mg g⁻¹, respectively. These are considerable levels of inhibitors that may inhibit the absorption of the minerals.

The functional properties investigated are also of paramount importance (Table 4). The water and oil absorption capacities of the samples indicate the ability of the dietary protein in the Papaya seed flour to retain water and oil respectively. These are vital properties used in food formulations when interchanging protein sources. The OAC of sample A (319.6%) is higher than the reported OAC value (245.6%) for cowpea flour by Olaofe *et al.* (1993). But OAC values (224.9 and 189.3%) of samples B and C are lower. However, these samples have considerable level of WAC and OAC. The FC and FS of the samples are comparable to the reported values of FC and FS of *Sorghum bicolor* L. stems flour (6 and 2%), respectively by Adetuyi and Akpambang (2005). The EC and ES values of the samples are also of reasonable levels. The LGC values show that the Papaya seed flour may be used as gel forming agent in food formulations and new products development for animals (Adetuyi and Akpambang, 2005). Further studies on the Papaya seed flour are encouraged to certify whether the trace amount of lead found is due to bioaccumulation or part of the minerals present.

CONCLUSION

The analyses carried out on three different species of *Carica papaya* seeds-Elongated yellow papaya seed, round yellow papaya seed and elongated red papaya seed indicate the nutrient and functional properties of the seeds. The proximate analysis indicates high level of protein and fat in seeds. A little bit of carbohydrate was also found in the seeds. The mineral analysis also indicate

the presence of major/macro elements which are required in large quantities in meals. Examples of these are Na, K, Ca and some others. Few micro elements like Cu, Fe were also found to be present. All these afore mentioned parameters are indication of good nutritional values of the Papaya seeds. Moderate values of wter and oil absorption capacities, foaming and emulsion capacities depicts the level of flexible protein in the samples. The physico-chemicals parameters also show that the seed have remarkable nutritional value. However, some anti-nutrients were discovered which are inhibitors. These anti-nutrients-oxalate, tannins, phytic acid and phytic phosphorus are know for their ability to reduce the absorption of mineral elements, but they are present in minute quantities.

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