QUANTITATIVE EVALUATION OF NUTRIENT AND PHYTOCHEMICAL CONTENT OF PAWPAW (*Carica papaya*) SEEDS

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ABSTRACT
This study evaluated the nutrient and phytochemical composition of pawpaw (*Carica papaya*) seed flour. Fresh ripe pawpaw fruits purchased from a local market in Enugu State, Nigeria, were washed and cut into two vertical halves. The seeds were extracted manually, sun dried for five days and milled into fine flour with the dry component of electric Molinnex blender. The seed flour was analyzed in triplicates for nutrients and phytochemical compositions using the standard methods. Data was analyzed using Statistical Package for Social Sciences (SPSS) Version 15 for means and standard deviation. Results showed that pawpaw seed flour contained 30% protein, 32% fat, 3.16% crude fibre and 18.11% carbohydrate. Mineral and vitamin content of the flour zinc (3.30mg/100g); iron (0.71mg/100g); calcium (0.78mg/100g); phosphorus (47.71mg/100g); potassium (32.23mg/100g); magnesium (1.57mg/100g); vitamin C (2.34mg/100g) and vitamin A (63.83µg/100g). The seed flour in addition had low amount of alkaloids (3.57mg/100g); saponin (8.88mg/100g) and flavonoids (4.10mg/100g) in relation to their safe levels. The results of this study showed that pawpaw seed flour has good nutrient profile and could be incorporated into existing foods to improve the nutritional value.

Keywords: Carica papaya seeds, flour, nutrients, phytochemical composition

INTRODUCTION
Food is a basic need of mankind. It provides energy for metabolic activities in the body. The early man obtained his food from plants by collecting the edible seeds, berries, nuts and roots of wild plants (Encyclopedia Americana, 2001).In most developing countries like Nigeria, food shortage is becoming evident as a result of population growth,competition for fertile land and poverty (FAO, 2007).

Carica papaya is a vital plant that is predominant in tropical Africa, moreso Nigeria has been identified as the 3rd largest producer in the world (FAO, 2004).The economic and nutritional potential of the plant has made it a fruit and vegetable of choice. Papaya is a first rate source of vitamins A and C. It contains in small quantity thiamine, riboflavin, calcium, iron, potassium, magnesium and sodium (Khuda, 2006). One beneficial effect of seeds of *Carica papaya* is its ability to cure intestinal worms when chewed. *Carica papaya* fruit is used in remedying dyspepsia, utilized for the clarification of beer as well as the usage of the juice in meat tendering (Wilson, 1974). Imaga*et al* (2010) and Okeniyi*et al* (2007) reported that treatments of sickle cell diseases and poisoning related disorder is a possibility using seeds of *Carica papaya*. It behoves on people to increase their nutritional status by eating fruits such as pawpaw.

Carica papaya belongs to the fruits and vegetable food group; it is abundant and commonly known as pawpaw in Nigeria. It is an invaluable plant that is prevalent throughout tropical Africa. Nigeria is the third largest producer of papaya globally and its annual production is estimated to be 765,000 metric tonnes (FAO, 2007). Practically every part of the papaya plant is of economic value. Its uses range from nutritional to medicinal. Both fruit and seed of the ripe papaya are edible. The usefulness of fruits, roots and several parts of this plant has been largely reported with some minor negative effects (Onibon, 2007). However pawpaw seeds are currently undervalued in this part of the world. The Papaya seeds are often discarded due to lack of knowledge of its nutritional values. This study evaluated the nutrient and phytochemical content of pawpaw seed flour.

MATERIALS AND METHOD
Fresh ripe pawpaw fruits were purchased from a local market in Enugu State, Nigeria. The fruits were cut vertically into 2 halves, the seeds were extracted manually, washed to remove particles of the fruits pulp and sun-dried for 5 days. The dried seeds were milled with using the dry component of Molinnex electric blender and kept in an air tight container for analyses.

METHOD

Moisture, ash, crude fibre,fat, protein contents of the seed flour were determined using the methods described by Pearson (1996). Carbohydrate was determined by difference. Vitamin A and C were also determined by Pearson (1996) methods. AOAC (2000) procedures were used to determineiron, calcium, zinc, magnesium, phosphorus and potassium. Flavonoid and alkaloid contents determination were carried out using Medal et *al*., (2005) while Saponin content was determined by Obadoni and Ochuko (2001).

Data analysis: The data analysis coded into computer software, Stastical Packaged for Social Sciences (SPSS) version 15 to analyze for descriptive statistics: means and standard deviation.

RESULTS

The value for moisture content in pawpaw seeds flour was 9.30%. The ash content for pawpaw seeds flour was 7.40% while the protein content was 30.03%. The *Carica papaya* seed flour also had 32% fat and 3.16% crude fibre content as shown in

Table 1: Proximate analysis (g/100g dry weight) of pawpaw (*Carica papaya*)

Parameter	Values
Moisture (%)	9.30 ± 0.00
Ash (%)	7.40 ± 0.01
Protein (%)	30.03±0.00
Fat (%)	32.00±0.05
Crude fibre (%)	3.16 ± 0.01
Carbohydrate (%)	18.11±0.01

Mean ± S. D of triplicate determinations

Table 2 shows the value of some vitamins and mineral contents in pawpaw seeds flour. The value for retinol and ascorbic acid content of the seeds flour were 63.83mg and 2.34mg respectively. The value for zinc, iron, calcium, phosphorus, potassium and magnesium of pawpaw seeds flour were 3.30mg, 0.71mg, 0.98mg, 47.71mg, 32.23mg and 1.57mg.

Table 2: The vitamin and mineral analyses of ripe *Carica papaya* seeds flour (mg/100g)

Vitamin	Values
Ascorbic acid(c)	2.34 ± 0.06
Vitamin A (RE)	63.83±1.03
Zinc (Zn)	3.30±0.02
Iron (Fe)	0.71±0.02
Calcium (Ca)	0.98±0.01
Phosphorus (p)	47.71±0.01
Potassium (k)	32.23±0.00
Magnesium (mg)	1.57± 0.01

Mean ± S. D of triplicate determinations

Table 3 shows the phytochemical constituent of pawpaw seeds flour. The alkaloids, flavonoids and saponincontents of the seed flour were 3.57mg, 4.1 mg and 8.88mg per 100 grammes respectively.

Table 3: Phytochemical compositions of C. papaya seeds flour (mg/100g)

Phytochemical	Values
Alkaloids	3.57±0.02
Flavonoid	4.10±0.35
Saponin	8.88±0.04

Mean ± S. D of triplicate determinations

table 1.

DISCUSSION

The moisture content of the seed flour 9.30% which was indicative of low moisture content and the flour can be preserved for long period of time. This value is similar to that reported for almond seeds flour by Olatidoye, Sobowale, Akinlotan and Olorode ,(2011) but higher than the value (5.47%) of pumpkin seeds flour (Hamed,Hassan, Hassan, Eltayab&Babiker, 2008). The ash content of *Carica papaya* seeds flour (7.40%) was lower than that in pumpkin seeds flour (9.04%) (Hamed,Hassan, Hassan, Elta`yab&Babiker, 2008) but higher than the value in guava seeds flour (0.96%) and orange seeds (2.50%)*(Samia El-Safy, Rabab Salem and Abd El-Ghany , 2012).*

The protein contents of 30.03% in the study sample was lower than 65.05% in Pumpkin seed flour (Hamed,Hassan, Hassan, Eltayab&Babiker, 2008) but similar to the value in almond seeds (32.6%) (Olatidoye, Sobowale, Akinlotan and Olorode , 2011) and watermelon seeds (30.11%) (Samia El-Safy, Rabab Salem and. Abd El-Ghany, 2012). This showed that Carica papaya seeds are rich source of protein and can be used to fortify foods that are low in protein. The fat content of pawpaw seed flour was 32%. This suggested that the pawpaw seeds is oily. Pawpaw seeds flour contained low amount of crude fibre and carbohydrate.

Pawpaw seed flour contained phosphorus and potassium in appreciable amounts**.** Studies have reported that potassium was the most abundant mineral in Nigerian agricultural products (Oshodi et al., 1999; Rimbach,Guo, Akiyama &Matsugo, 2000). This was confirmed in the result of this work as compared to other minerals, except for phosphorus that was higher in value. However, since these phosphorous and potassium are needed as diet supplements, required to maintain the osmotic balance of body fluid and the pH of the body (NRC, 1989). It has also been proven the high amount of potassium in the body was reported to increase iron utilization (Adeyeye, 2002) and beneficial to people taking diuretics to control hypertension and suffer from excessive excretion of potassium through the body fluid (Arinanthan, Mohan and Britto, 2003). The potassium content was 32.30mg/100g which is low when compare with almond seeds 42.17mg/100g (Olatidoye**,** Sobowale, Akinlotan and Olorode , 2011) and 1078.55mg/100g of pumpkin seeds (Hamed,Hassan, Hassan, Eltayab&Babiker, 2008). The value of iron content of the sample was 3.71mg/100g.

The value of iron was low when compared with the value obtained from almond seeds 6.38mg/100g (Olatidoye, Sobowale, Akinlotan and Olorode , 2011) and watermelon seeds 10.70mg/100g , (Samia El-Safy, Rabab Salem and. Abd El-Ghany 2012). Iron serves as a carrier of oxygen to the tissues from the lungs by the red bloods cell hemoglobin, as a transport medium for electrons within cells, and as an integrated part of important enzyme systems in various tissues (World Health Organization, 2004). The zinc content 3.30mg/100g was high when compared to the value obtained from guava seeds 1.84mg/100g but low when compared with value obtained from pumpkin seeds 17.17mg/100g (Hamed, Hassan, Hassan, Eltayab&Babiker, 2008). Zinc is known for boosting the health of our hair, it is believed to play a role in the proper functioning of some sense organs such as ability to tastes, sense and smell

protein and carbohydrate metabolism and also help in mobilizing vitamin A from its storage site in the liver and facilitates the synthesis of DNA and RNA necessary for cell production, (Guthrie, 1989).

The calcium content was 0.98mg/100g. It was low when compared to the value obtained from almond seeds 27.17mg/100g (Olatidoye, Sobowale, Akinlotan and Olorode , 2011) and pumpkin seeds 152.50mg/100g (Hamed,Hassan, Hassan, Eltayab&Babiker, 2008). Calcium helps to ease insomnia and helps regulate the passage of nutrients through cell walls, without calcium the muscles in the body cannot contract correctly, the blood in the body will not clot and the nerves will not carry message. If the body does not get enough calcium from the food we eat. The body automatically takes the calcium needed from the bones. If the body continue to tear down more Calcium than it replaces over a period of years the bones will become weak and break easily (Payne, 1990). Calcium ions are also necessary for the normal functioning of nerves and muscles. The magnesium content was 1.57mg/100g, it was low when compared to almond seeds 26.4mg/100g (Olatidoye, Sobowale, Akinlotan and Olorode, 2011) and pumpkin seeds (Hamed, Hassan, Hassan, Eltayab&Babiker, 2008).

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). Magnesium is a constituent of bone and teeth and is closely associated with calcium and phosphorus. Magnesium is necessary for the release of parathyroid hormone and for its action in the backbone, kidney and intestine and for the reactions involve in converting vitamin D to its active form. Magnesium deficiency results in uncontrollable twisting of muscles leading to convulsion and tetanus, which may both lead to death (Guthrie, 1989).

The pawpaw seed flour content of vitamin C was 2.34mg/100g. It was low compared to Cola milleni seeds 144.26mg/100g (Bello, Farade, Adewusi and Olawore, 2008) and green amaranth seeds 4.5mg/100g (Becker et al., 1981).vitamin C is an antioxidant, in the eyes, the concentration maybe 50times higher than in the plasma and may protect against the oxidative damage of light. It promotes the absorption of soluble non-haem iron simply by maintaining the iron in the reduce form. Vitamin C is also plays a role of immune-stimulating effect e.g, important for defence against infections such as common cold, prevent theformation of potentially carcinogenic nitrosamines in the stomach(due to consumption of nitrite-containing foods, such as smoked meat.

The vitamin A value obtained is 63.83mg/100g, which signifies that the sample is rich source of this vitamin. Vitamin A is an essential nutrient needed in small amounts by humans for the normal functioning of the visual system, growth and development, and maintenance of epithelial cellular integrity, immune function, and reproduction.
The saponin content was 8.88mg/100g which was higher when compared to the saponin content of mushroom 0.08mg/100g. It was within World Health Organization range of saponin (Jordan, 2006) permissible limit of (48.50mg/100g). The alkaloid and the flavonoid composition of the pawpaw seeds flour were within the safe level (52.02mg/100g) (WHO, 2003), indicating that the pawpaw seeds are equally safe and could be good sources of anti-oxidants that boosts body immunity.

CONCLUSION

The results of the study showed that pawpaw seed flour is a good source of micronutrients, macronutrients and phytochemicals. It has been shown to be high in fat and protein; it is also high in micronutrients such as vitamin A and phosphorus. The phytochemical compositions observed in this study have shown the presence ofsome vital phytochemicals. The observed phytochemicallevels suggest that these pawpaw seeds would be a good source of some natural antibiotics andantioxidants.However publicizing of pawpaw seeds to the population still have a long to go.

RECOMMENDATION

- Pawpaw seed is a good source of minerals and phytochemicals,
- Great awareness of this seed flour to the populance through the media, product promotion, posters.
- It should be incorporated in different products such as biscuits, snacks,

condiments, spices, butter etc.

- ❖ More research should be done on the vitamins and nutrients composition of fresh pawpaw seeds, fermented ones
- ❖ More research should be done on how to reduce the pungent taste of the seeds and other forms to make it acceptable to the population

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