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Nutrient, Anti-nutrient and Phytochemical Composition of Bread fruit (*artocarpus communis*) Pulp

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Abstract

The study assessed the nutrient, phytochemical and anti-nutrient composition of breadfruit (*artocarpus communis*). Chemical analysis was carried out on raw breadfruit pulp using standard procedures. Some of the nutrients analysed such as carbohydrates (24.05), protein (1.35%), fat (0.95%), moisture (71%), fibre (1.2%), ash (1.0%) B-carotene (0.07mg), calcium (0.5mg) and iron (0.87mg) had values which compared favourably with that from other cultivars, while vitamin C (3.90mg), niacin (0.05mg) and zinc (0.04) values were low. The breadfruit contained some anti-nutrients such as oxalate (2.18mg) phytate (1.3mg) and tannin (4.0mg) as well as phytochemicals which include flavonoids (8.0mg) Alikaloids (25.5mg) and saponin (23.0mg). It is recommended that more research should be carried out to identify best processing techniques that can eliminate the ant- nutrients present in breadfruit before its consumption can be encouraged for maximum benefit.

Introduction

Households are food secure when they have year round access to the amount and variety of safe foods their members need to lead active and healthy life (Food and Agricultural Organization (FAO), 2010). In most developing countries like Nigeria, food shortage has become quite evident as a result of population growth, competition for fertile land and poverty. The diet of many rural and urban dwellers is deficient in protein and high in carbohydrates. The implication is high incidence of malnutrition and increased dietary disease, a situation in which children and especially pregnant and lactation women are most vulnerable (Sadik, 1991).

It is often stated that only a few staple crop produce the majority of the food supply. This is quite true; however, the important contribution of many minor species should not be under estimated. Agricultural research has traditionally focused on these staples such as cassava, corn and yam while relatively little attention has been given to minor (or underutilized or neglected crop, particularly by scientists in developing countries (Rayone, 1997). One of such underutilized and neglected crop particularly in

southeastern Nigeria is breadfruit *(Artocarpus communis).*

Artocarpus communis belongs to the family of *moraceae.* It is a tropical fruit, native of Malasia and it is an important food in these areas (Taylor and Tuia, 2007). *Artocarpus communis* was derived from the Greek word Artos, bread and karpus which refers to its bread like quality when baked. It has both seeded and seedless varieties. The seeded variety is known as breadnut while the seedless variety is commonly referred to as breadfruit (*ukwa oyibo or ukwa bekee).* The tree has a great productive ability with an average sized tree producing 400-600 fruits per year (National Tropical Botanical Garden (NTBG), 2009). It has been reported that breadfruit yields in terms of food are superior to other starchy stapes such as cassava and yam (Singh, 2009).

Breadfruit pulp can be made into various dishes. In countries such as Sri-lanka, it is either cooked as a curry using coconut milk and spices, consumed after boiling or made into fritter. In Seychelles, it is traditionally eaten as a substitute to rice as an accompaniment to the main meal. It is either consumed boiled or grilled. In Nigeria, Amusa, Kehinde and Ashaye (2002) observed that it can be fried, boiled or mashed to make porridges or ground into flour and used in breads and biscuit making. According to Adepeju, Gbadumosi, Ademiran and Omobuwajo (2011), the fruits are boiled, pounded and eaten with soups just like pounded yam.

Limitation imposed on the use of bread fruit have been attributed to anti-nutritional factors such as tannin, oxalate, phytate, heamagglutinin and trypsin inhibitor. Anti-nutrients are substances in foods that interfere with the absorption of nutrients. According to Helminstine (2012), Lecitins and tryipsin inhibitor interfere with digestion, tannins chelate and reduce iron and zinc absorption, while phytate chelates zinc iron, calcium and many other metals. On the other hand, studies have shown that breadfruit contains some photochemicals such as flavonoids and saponin (Ajayi, Ajibade and Oderinde, 2011). These phytochemicals are non-nutritive plant chemicals that have protective or disease preventing properties. Some of the well known phytochemicals are lycopene in tomtoes, iIsoflavones in soy and flavonoids in fruits.

Some studies on breadfruit have been carried out in southwestern Nigeria where its consumption has gained some grounds. Oladunjoye, Ologhobo and Olaniyi (2010), studied the nutrient composition, energy value and residual anti-nutrient factors in differently processed breadfruit meal. Amusa, Kehide an Ashaye (2012), looked at the bio-deterioration of breadfruit in storage and its effects on the nutrient composition. Adepeju, Gbadamosi, Adeniran and Omobuwajo (2011), studied the functional and pasting characteristics of breadfruit flour. In the southeast Nigeria, Okorie (2010) assessed the chemical composition of breadfruit seed flour as affected by processing (boiling and roasting). Information on the nutritive, photochemical and anti-nutrient composition of raw bread fruit found in

south eastern Nigeria is quite scanty. Such baseline information will serve as a major tool that nutrition educators can use to advocate for an increased cultivation and consumption of this quite neglected food crop, hence the importance of this study.

Objectives

The general objective of the study was to assess the nutritional, physiochemical and anti-nutrient composition of breadfruit. Specifically, the study determined the:

1) proximate, vitamin and mineral content of breadfruit.
2) anti-nutrient content of breadfruit
3) photochemical composition of breadfruit

Research questions

1) What is the proximate, vitamin and mineral values of breadfruit?
2) What is the anti-nutrient content of breadfruit?
3) What is the photochemical composition of breadfruit?

Materials and methods

***Area and design of the study*:** The area of the study was Nsukka Local Government Area. Gross underutilization of bread fruit (*artcarpus communis*) made it quite uncommon in the study area. The study adopted an experimental design. The following procedures were followed: procurement of the material (bread fruit), sample preparation, nutrient, photochemical and ant-nutrient analysis.

***Procurement of sample*:** Freshly harvested ripe breadfruit was purchased from a breadfruit tree owner in the study area.

***Sample preparation*:** The breadfruit was washed, peeled, cored and washed again to obtain a clean sample. This sample was sent to the Department of Home Science, Nutrition and Dietetics, University of Nigeria Nsukka, analytical laboratory for nutrient phytochemical and anti-nutrient analysis.

***Nutrient analysis*:** The proximate value of the sample was determined using standard procedure. Moisture content of the sample was determined by hot air oven method of Pearson (1976). The sample was dried at 100^{o}c and the dry weight was subtracted from the sample's initial weight.

Fat was determined using the soxholet extraction method as described by AOAC (1995). Crude protein content was determined using the Micro-kjedahl method of AOAC, (1995). This involved digestion, distillation and titration. The acid hydrolysis method of AOAC (1995) was used for crude fibre determination. Ashing was also done in a hot air oven at 100^{o}c as described by AOAC (1995). The dish plus the sample was place in a cool muffle furnace and the temperature of the furnace was maintained until its content (residue) appeared grayish white. This was cooled and weighed. The percentage total ash content of the sample was then calculated. Carbohydrate was determined by difference that is 100-(c,b,d,e). where a = % moisture, b= % fat c-% protein, d= % fibre and e = % ash.

For the vitamins and mineral content determination, the samples were prepared using the method described by

Pearson (1976). After the preparation, the exact wave length for each sample was used to measure absorbence in a spectrophotometer. For β-carotene, vitamin C, thiamin, riboflavin, niacin, iron, phosphorus, calcium, sodium and zinc absorbence were measured at 328m, 420nm, 360nm, 510nm, 420nm, 500nm, 470nm, 425nm and 420nm respectively.

***Anti-nutrient Analysis*:** Oxalate, phytate and tannin were determined by photometric method of Pearson (1976), Lata and Eskin (1980), and Van-Burden and Robineson (1981) respectively. Readings were then taken in a spectrophotometer at 490nm for Oxalate, 500nm for phytate and 720nm for tannin.

***Photochemical Analysis*:** For alkaloid determination, Harborne, (2000) method was used. Five grams of the sample was weighed and 10% oxalate in ethanol was added. It was filtered and concentrated. Ammouium hydroxide was added drop wise until precipitation was complete. The precipitate was collected washed and the residue filtered.

The method used for saponin determination was described by Obadoni and Ochuko (2001`). Twenty grams of the sample was weighed and heated at 55^0c. The mixture was filtered and the residue extracted. About 20ml of diethyl ether was added to the concentrate and shaken vigorously. The aqueous layer was recovered and n-butanol added. It was then washed and heated. After evaporation, the sample was dried in the oven to a constant weight.

The total flavonoid content was determined using the method of Pearson, (1976). The sample was diluted, mixed with reagents and allowed to incubate at room temperature for 30 minutes. Aborbence of the mixture was measured at 415nm in a spectrophotometer.

Result presentation

Table 1: Proximate, vitamin and mineral content of breadfruit pulp

Proximate (%)					
Carbohydrate	protein	fat	moisture	fibre	ash
24.0	1.35	0.95	71.5	1.2	1.0
Vitamins (mg)					
vitamin C	β-carotene	Thiamin	niacin	Riboflavin	
3.90	0.07	0.2	0.05	0.56	
Mineral (mg)					
calcium	phosphorus	iron	zinc	sodium	
0.52	0.08	0.87	0.04	0.14	

Table 1 shows that the moisture content of breadfruit was high (71.5%). Carbohydrate was 24% while protein was only 1.33%. Breadfruit contains 3.90mg of vitamin C, 0.07, 0.2, 0.05 and 0.56mg of β-carotene, thiamin niacin and riboflavin respectively. Iron content of the breadfruit was 0.87mg. Calcium, phosphorus, zinc and sodium values

were 0.05, 0.08, 0.04, and 0.14mg respectively.

Table 2 Anti-nutrient content of breadfruit pulp (mg/100g)

Oxalate	2.18
Phytate	1.3
Tannin	4.0

Table 2 reveal that breadfruit contains some anti-nutrients in varying concentration such as oxalate (2.18 mg), phytate (1.3mg) and tannin (4.0mg).

Table 3: Phytochemical composition of breadfruit pulp (mg/100g)

Flavonoids	8.0
Alkaloids	25.5
Saponin	23.0

Table 3 shows that photochemical analysis of breadfruit revealed the presence of Flavonoids (8.0mg), Alkaloids (25.5mg) and Saponin (23.0mg).

Discussion

The carbohydrate, protein, fat, moisture, fibre and ash values of the raw breadfruit were 24.0, 1.35, 0.95, 71.5, 1.2 and 1.0 respectively. According to Stadlmayr, Charrondiere, Enujiugha, Bayili, Faghohoun, Samb, Addy, Barikmo, Ouattara, Oshaug, Akinyele, Annor, Bomfeh, Ene-Ogong, Smigh, Thiam, and Burlingane (2012), breadfruit contains about 23.9g of carbohydrates 1.5g of protein, 0.3g of fat, 71.7g moisture, 1g of fibre and 0.9g of ash. The study carried out by Rayone (1997), on different culuvars of breadfruit revealed that the carbohydrate, protein and moisture of the cultivars ranged from 22.8-33.4, 0.7-1.8 and 63.8-74.4g respectively. In another study by Jones, Ragone, Tavane, Bernotus and murch (2011), the carbohydrate content ranged from 21.5-33, protein was 0.6-2.24, fibre 0.9-7.37, fat 0.1-2.36 and ash 0.56-1.20%. These studies have confirmed that the proximate values of breadfruit found in south eastern Nigeria falls within range with those ones found other parts of the world. The β-carotene (90.07mg) thiamin (2mg) and riboflavin (0.056) were high, while vitamin C (3.90mg) and niacin (0.05mg) values were low when compared with the study of Jones *et al*. (2011) which were 0.00-0.01, 0.09-0.15, 0.02-0.05 1.6- 34.4 and 0.75-1.4 mg. All these observed differences could be attributed to environmental influences such as soil on the nutrient composition of food.

The calcium (5.2mg), and iron (0.8mg) values were within the range while sodium (0.14mg) and zinc (0.04mg) were below the minimum values observed by Jones *et al*. (2011). None of the breadfruit mineral values from this study was up to that observed by Stadlmayr *et. al*. (2012). Apart from the influence of soil on nutrient

composition, method of chemical analysis could also have resulted in the above observed differences.

The oxalate, phytate and tannin values were 2.18, 1.30 and 4.0mg respectively. The study by Bello, Falade, Adewusi and Oluwore, (2008) on lesser known Nigerian fruits, revealed phytate and oxalate to range from 0.20-6.65 mg/g and 0.23-1.17g/100g. The oxalate and tannin values were lower while phytate was higher than that of Oladunjoye Ologhobo, And Ama (2010), who observed that the oxalate, phytate and tannin values of raw breadfruit meal were 2.70, 0.58 and 6.05 respectively. In another study by Oladunjoye, Ologhobo and Olaniyi (2010), higher values of oxalate (3.30mg) and tannin (6.70mg) and lower value of phytate (0.75mg) were observed. These differences could be attributed to differences in cultivar, soil type and or method of analysis used.

The study revealed that the breadfruit contained some phytochemicals such as flavonoids (8mg), saponin (23mg) and Alkaloids (25.5mg). This is in agreement with the study done by Ajayi, Ajibade and Oderinde (2011) who isolated flavounoids and saponin from breadfruit seeds. According to Jagtap and Bapat (2010), Artocarpus species are rich in phonelic compounds including flavonoids. American Cancer Society (2013) stated that phytochemicals are found in plant-based foods such as fruits, vegetables, beans and grains. These phytochemcials according to Kush, Doyle, McCullough, Rock, Wahnetfried, Bandera, Gapster, Patel, Andrews and Ganslen (2012), are promoted for the prevention and treatment of many health conditions, including cancer, heart disease, diabetes and high blood pressure. The presence of these photochemical in breadfruit could be the reason why it is used traditionally in Cameroon to treat several ailments including infections and associated diseases (Kuete, Ango, Folso, Kapehe, Dzoyem, Wouking, Ngadjui and Abegaz, 2011).

Conclusion

The proximate, vitamin, mineral and phytochemical constituent of breadfruit obtained in southeastern Nigeria were found to be appreciable. This makes it superior to yam and cassava. It's use should therefore be advocated for to complement the already existing starchy staples.

Recommendations

- Processing methods that can eliminate the anti-nutrients in breadfruit should be identified.
- Sensory evaluation should be carried out on different dishes prepared with breadfruit to ascertain the most acceptable ones.
- The preparation and consumption of such acceptable dishes should be advocated through nutrition education at women gatherings.

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