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The Nutrient Composition of Pili Fruit (*Canarium Ovatum*) Kernel

Ogbuagu, M.N* and Chukwuka, U.V

Department Of Chemistry, Michael Okpara University Of Agriculture, Umudike P.M.B. 7267 Umuahia, Abia State Nigeria.

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ABSTRACT

The proximate, mineral, vitamins and phytochemical compositions of a sample of pili fruit kernel have been investigated. The result revealed low values of ether extract (12.77±0.3%), crude fibre (4.72 ±0.2 %) and a very low crude protein value of 3.94 ±0.002.. It has a high value of carbohydrate (65.91±0.7%). The calculated metabolizable energy value (1659.94KJ/100g) shows that pili fruit kernel flour is a good source of energy. The pili fruit kernel has high values of the essential mineral elements: sodium (158 mg/100g), potassium (513 mg/100g), calcium (230 mg/100g), magnesium (365 mg/100g) and phosphorus (131 mg/100g) as well as the trace elements: iron (229.75 mg/kg), zinc (72.01 mg/kg), copper (121.75 mg/kg) and manganese (156.25 mg/kg).These values indicate that pili fruit kernel is a very rich (good) source of dietary minerals. The Ca/P (1.75) and Na/K (0.308) ratios have favorable health implications. The pili fruit kernel sample has high values of vitamin A (455.1mg/kg), niacin (8.50mg/kg), riboflavin (5.50 mg/kg) but low values of thiamin (1.25 mg/kg), vitamin C (8.60 mg/100g) and vitamin E (8.98mg/100g). The pili fruit kernel sample has high values of alkaloid (3.94±0.008%), flavonoid (4.82±0.003%) but low values of saponin (0.62±0.05%) , tannin (0.28 ±0.001_mg/100g), cyanogenic glycoside as HCN (0.52±0.002mg/kg) , phytate (0.02±0.0007%) and trace amount of trypsin inhibitor.

Introduction

The pili fruit tree (*Canarium ovatum*) is one of 600 species in the family of *Burseraceae*. It is native to the Philippines and is abundant and wild in Southern Lazon and parts of Visayas and Mindanaoin low and medium primary forests [1].The fruit is a stone fruit, approximately 5-6 centimeters long with a thick black skin. The young shoots and the hairy, green pulp of the fruit are edible. Within the pulp is embedded the seed with a hard shell which protects the kernel. Much of the kernel weight is made up of the cotyledons, which are about 4.1 to 16.6% of the whole fruit [2]. The most important part (product) of the fruit is the kernel. The kernel, when eaten raw, is crispy and has a delicious flavor resembling the flavor of roasted pumpkin seed [3]. It is also eaten roasted, fried or sugar-coated and is frequently used as an ingredient in cakes, pudding and ice cream and sometimes used in chocolate – making [4]. Pili fruit kernel is crispy and delicious and when cooked in syrup, makes a good preserve.

The pili fruit has been quite under- exploited and under-utilized. Hence, there is dearth of information on the potentials of the plant material as a source of essential nutrients necessary for good health. This paper therefore, presents the nutrient composition of pili fruit kernel.

Materials and Methods

The seeds of the pili fruit (*Canarium ovatum engii*) samples used for the study were obtained from Umuchu forest in Aguata Local Government Area of Anambra State, Nigeria. The seeds were cracked to obtain the kernels. The kernels were sun-dried for fourteen (14) days and milled to obtain the powdery sample used for the study. The moisture and crude protein contents of the sample were determined according to A.O.A.C. methods [5].The ash, crude fat, crude fiber, total carbohydrate as well as sodium, potassium and phosphorus were determined according to the various methods as described by James [6]. The Vitamins A and E were determined according to the methods of the Association of Vitamins Chemists described by Kirk and Sawyer [7].Vitamin C, thiamin, riboflavin and niacin were also determined according to the methods described by Barakat *et al*., [8]. Calcium and magnesium were determined using EDTA titrimetry methods as described by Pearson [9]. The trace elements; Fe, Zn, Cu and Mn as well as the cyanogenic glycoside, as HCN, were determined by the AOAC [10] methods. The alkaloids, saponins, flavonoids and tannins were determined by the methods described by Harbone [11]. The trypsin inhibitor Arntfield, *et al.*, [12] as well as phytate (Hang and lantzsch [13] were determined.

Results And Discussion

The proximate composition of the pili fruit kernel sample used for the study is presented in table 1.

The result reveals values for moisture (6.14±0.2%), ash (6.52±0.5%), crude protein (3.94±0.002%), fat (12.77±0.3%), fibre (4.72 ±0.2 %) and carbohydrate (65.91± 0.7 %). The ash content (6.52±0.5%) is fairly high. A lower value of 2.9% had been reported for a species of pili fruit kernel [14]. Ash contains essential mineral components which are necessary to nourish the blood and tissue. Food material with high percentage of ash is quite encouraging because it is highly needed by children and pregnant/lactating mothers for substantial supply of calcium and magnesium needed for bone formation [15]

The ether extract (crude fat) with a mean value of 12.77±0.3% is very low compared to reported values of 68.5% for a species of pili fruit kernel [14], 49.2% [16] and 47. 01% [17] for pumpkin seed as well as 36.7 ± 0.1% for cashew nut [18]. Fat is important in diets because it promotes fat soluble Vitamin absorption [19]. It is a high energy nutrient and does not add to the bulk of the diet.

Tele:
E-mail addresses: ogbuagumn@yahoo.com

The crude protein value of 3.94 ±0.002 is very low when compared to a reported value of 14.2%for a species of pili fruit kernel [14]. These values are however; lower than reported values of 25.25±0.2% for cashew nut [18] and as well as the values for some protein rich foods such as melon, pumpkin and gourd seeds ranging between 23.1- 33.0% [20]; This suggests that pili fruit kernel is not a good source of protein when compared to protein rich foods.

Table 1: Proximate Composition Of The Pili Fruit Kernel Sample

Parameter	Composition (%)
Moisture content(%)	6.14±0.2
Ash (%)	6.52 ±0.5
Crude Protein (%)	3.94 ±0.002
Fat (%)	12.77 ±0.3
Fibre (%)	4.72 ±0.2
Carbohydrate (%)	65.91± 0.7
Energy KJ / 100g	1659.94 ±0.02

The crude fibre content of the pili nut sample (4.72 ±0.2 %) is low. However, a lower value of 3.2% had been reported for a species of pili fruit kernel [14]. The crude fibre content of the pili nut sample (4.72 ±0.2 %) is comparable with crude fibre contents of legumes, with reported mean values ranging between 5%and 6 % [21, 18]. Crude fibre plays physiological role of maintaining internal distention for a normal peristaltic movement of the intestinal tract.

The value obtained for carbohydrate (65.91±0.7%) is very high when compared to a reported value of 26.8% for cashew nut flour [18] and legumes with a range of values of 20-60% of dry weight [22]. Thus, it is a rich source of carbohydrate.

The calculated metabolizable energy value (1659.94KJ/100g) shows that pili fruit kernel flour used for this study is a good source of energy.

Table 2: Mineral Composition Of The Pili Fruit Kernel Sample

Mineral	Composition
Sodium (mg/100g)	(158± 0.01)
Potassium (mg/100g)	(513± 0.003)
Calcium (mg/100g)	(230± 0.1)
Phosphorus (mg/100g)	(131 ±0.01)
Magnesium (mg/100g)	(365 ±0.04)
Zinc (mg/kg)	72.01
Copper (mg/kg)	121.75
Manganese (mg/kg)	156.25
Iron (mg/kg)	229.75
Ca/P Ratio	1.75
Na/K Ratio	0.308

The mineral composition of the pili fruit kernel is presented in table 2. The result shows that the pili fruit kernel has high values of the essential mineral elements: sodium (158 mg/100g) potassium (513 mg/100g), calcium (230 mg/100g), magnesium (365 mg/100g) and phosphorus (131mg/100g) as well as the trace elements: iron (229.75 mg/kg), zinc (72.01 mg/kg), copper (121.75mg/kg) and manganese (156.25mg/kg). Lower values of sodium (3.0 mg/100g) ,potassium (489.0 mg/100g), calcium (135.0mg/100g) copper (71.1mg/kg) iron (26mg/kg) and higher values of phosphorus (520.0 mg/100g), magnesium (606.0mg/100g) and zinc (111.7mg/kg)had earlier been reported for a species of pili fruit kernel [14].These values indicate tha tpili fruit kernel is a very rich (good) source of dietary minerals.

Table 3: Vitamin Composition Of The Pili Fruit Kernel Sample

Vitamin	Composition
Vitamin A(β-carotene) (mg/kg)	455.1
Vitamin E (mg/100g)	8.98
Ascorbic aci (mg/100g)	8.60
Riboflavin (mg/kg)	5.5
Thiamin (mg/kg)	1.25
Niacin (mg/kg)	8.5

The sample used for this study has K (513± 0.003mg/100g) as the most abundant essential mineral and P (131 ±0.01mg/100g) as the least. This observation is in agreement with an earlier study that reported K as the most predominant mineral in Nigerian Agricultural Products [23, 24].

The pili fruit kernel sample used for this study has iron (229.75mg/kg) as the most abundant trace element and zinc as the least (72.01mg/kg).

These minerals play various important roles in the body. Magnesium is an activator of many enzymes systems and maintains the electrical potential in nerves [25]. Calcium mean value (230 ± 0.1mg/100g) of the present study is higher than reported values of 130.7 mg/100g for melon, 72.3 mg/100g for pumpkin and 54.9mg/100g for gourd seeds [20]. Calcium, in conjunction with phosphorus, magnesium, manganese, vitamins A, C and D, chlorine and protein are all involved in bone formation [26]. Calcium is also important in blood clothing, muscle contraction and in certain enzymes in metabolic processes. Calcium and phosphorous are important in the diets of children and adults for effective bone development. Food is considered 'good' if the Ca/P ratio is above one and 'poor' if the ratio is less than 0.5 [27]. The Ca/P ratio of the pili fruit kernel sample used for the study (1.75) indicates that it would serve as a good source of minerals for bone formation.

Table 4: Phytochemical Composition Of The Pili Fruit Kernel Sample

Phytochemical	Composition
Alkaloid (%)	3.94±0.008
Flavonoid (%)	4.82±0.003
Saponin (%)	0.62±0.05
Tannin (mg/100g)	0.28 ±0.001
HCN (mg/kg)	0.52±0.002
Phylate (%)	0.02±0.0007
Trypsin inhibitor (TIU/100g)	Trace

The deleterious effect of high sodium intake that frequently increases blood pressure has been severally reported. Potassium has a beneficial effect on sodium balance. A high intake of potassium has been reported to protect against increasing blood pressure and other cardiovascular risks [28, 29]. The sodium to potassium (Na/K) ratio in the body is of great concern for the prevention of high blood pressure. A Na/K ratio less than one is recommended. Hence, the pili fruit kernel sample used for the study with a Na/K ratio of 0.308 would probably reduce blood pressure disease since it has Na/K ratio less than one.

Copper, Zinc and iron are essential trace elements and play important roles in maintaining health and nutrition of humans.

The vitamin composition of the pili fruit kernel sample used for the study is presented in table 3.The result shows that the pili fruit kernel sample has high values of vitamin A (455.1mg/kg), niacin (8.50mg/kg), riboflavin (5.50 mg/kg) and but low values of thiamin (1.25 mg/kg) vitamin C (8.60 mg/100g) and vitamin E (8.98mg/100g).

Lower values of vitamin A (b-carotene) (250mg/kg), niacin (4.0mg/kg) and higher values of Vitamin C (29.0mg/100g), riboflavin (120mg/kg) and thiamin (9.5mg/kg) had been reported for a species of pili fruit kernel [14].The vitamin A value of the pili fruit kernel sample used for the study (455.1mg/kg) is higher than that of soybean with range of reported values of 0.20 – 2.4µg/g [30] and bambaara groundnut with reported value of 30 IU/100g [31].Vitamin A (retinol) is necessary for growth, good vision, healthy tissue and reproduction. Lack of vitamin A results in night blindness [32].The vitamin E (8.98mg/100g) and C (8.60mg/100g) contents of the pili fruit kernel sample used for the study are low. However, the vitamin C value is higher than the reported values of 5.8mg/100g for groundnut [33] and 1mg /100g for bambara groundnut [31]. Vitamin C (ascorbic acid) is vital for a general body performance. It is used for the treatment of common cold and control of other diseases like prostate cancer. Vitamins C and E work together as antioxidants in the body.

The pili fruit kernel sample used for the study has very high value of riboflavin (5.5mg/kg) but low values of thiamin (1.25mg/kg) and niacin (8.50mg/kg) when compared to the reported values of riboflavin for the most common legumes ranging from 1.05mg/kg in groundnut [33] to 2.3 μ g/g in soybean [30] and thiamine ranging from 2.8mg/kg in bambara groundnut [31] to 11-17.5mg/kg in soybean [30] as well as the values of niacin ranging from 8mg/kg in groundnut [33] to 23mg/kg in cowpea [34].These B-vitamins act as coenzymes and catalyze numerous important biological oxidation- reduction reactions in the body.

The Phytochemcial composition of the pili fruit kernel sample used for this study is presented in table 4. The result shows that the pili fruit kernel sample used for this study has high values of alkaloid (3.94±0.008%), flavonoid (4.82±0.003%) and low values of saponin (0.62±0.05%) , tannin (0.28 ±0.001mg/100g), cyanogenic glycoside as HCN (0.52±0.002mg/kg) , phytate (0.02±0.0007 %) and trace amount of trypsin inhibitor.The saponin content of the pili fruit kernel sample used for this study (0.62±0.05%) is comparable to a reported value of 0.65% for Soyabean [35]. However, a higher value had been reported for *Adenanthera pavonina* [36]. Saponins are useful in the treatment of cardiovascular diseases and other health-related problems [37].

The alkaloid content of the pili fruit kernel sample used for this study (3.94±0.008%) is quite high. Most (but not all) alkaloids are toxic to animals. Many have been exploited as drugs. In spite of the medicinal uses of alkaloids, they cause gastrointestinal upsets and neurological disorders.

Flavoniods act as anti-oxidants and have strong anti-cancer activities and even help to lower the risk of heart disease [37].
Phytate is one of the anti-nutritional principles commonly found in some plant food products.

The phytate content of the pili fruit kernel sample used for this study (0.02±0.0007%) is much lower than the reported phytate contents of some soybean products [30]. This indicates that pili fruit kernel sample used for this study is relatively free from the anti-nutritional effects of phytate.

The tannin content of the pili fruit kernel sample used for this study (0.28 ±0.001 mg/100g) is very low. The tannin contents of legumes have been reported to range from as high as 2000mg/100g in faba beans to as low as 45mg/100g for soybeans. The very low value of tannin in soybean has been virtually ignored in terms of the possible anti-nutritional significance [38]. Thus, the value of 0.28 ±0.001 mg/100g tannin in the pili fruit kernel sample used for this study is very insignificant and not likely to present any anti-nutritional effects in food products of the kernel. The pili fruit kernel sample used for this study has only trace amount of trypsin inhibitor. It can therefore, be inferred that the pili fruit kernel sample used for this study has good nutritional potentials. The HCN content of the kernel (0.52±0.002mg/kg) has no toxic significance as the value is quite below the value of 50-60mg/kg considered to be toxic to adult man [39].

Conclusion

The pili fruit kernel is a rich source of carbohydrate, vitamin A, niacin and riboflavin, the essential mineral elements: sodium, potassium , calcium, magnesium and phosphorus as well as the trace elements: iron , zinc , copper and manganese. The Ca/P and Na/K ratios have favorable health implications. The low values of tannins, cyanogenic glycosides as HCN, phytates and trace amount of trypsin inhibitors suggest that the consumption of pili fruit kernel will have no adverse health or anti-nutritional implications associated with the principles.

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