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Nutritional Potential of the Fruits of Black Olive (*Canarium schweinfurthii* Linn) from Plateau State, Nigeria

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Abstract: The nutritional potential of the fruits of Black Olive (*Canarium schweinfurthii* Linn) were assessed by determining proximate and elemental composition. Anti-nutrient factors were also assessed. Results indicate crude fat of the fruit as 64.04%, protein 6.39%, fibre 16.37%, carbohydrate 3.85%, respectively. Mineral analysis revealed the order P>N>Mg>I>K in the fruits. Phosphorus and sodium levels were 1.74 and 1.369 mg/100 g, respectively. The result of anti-nutritional factor revealed high tannins (240 mg/100 g), phytic acid 162 and 26 mg/100 g oxalate which is relatively low. These results suggest that Canarium schweinfurthii variety with thick mesocarp is nutritive despite the presence of some anti-nutritive components like oxalate in very low levels. The final products will contain even less.

Key words: Black olive, Carbohydrate content, fibre content, oxalate

INTRODUCTION

The early man lived on wild game, fruits and succulent herbage which provided him with adequate nutrition and food security. Today, some of the plant species have been identified and are maximally used while a vast assemblage of them are yet to be identified and utilized. Black-olive (*Canarium schweinfurthii* Linn) is no exception.

Currently, there is a growing realization among nutrition experts that fruits should no longer be considered a luxury but a necessity, since they are essentially good for maintenance of health (Kochhar, 1981). Experts recommend the consumption of at least 5.7 g of fruits in our daily diet in addition to cereals, pulses, milk and vegetables (Gordon, 1999).

Canarium schweinfurthii Linn belongs to the family *Burseraceae* and the genus *Canarium* which contains about 75 species (Keay, 1989; Wikipedia, 2007). It is a perennial plant that is found in Africa, so it is usually referred to as African olive or black olive. The plant is branched, 90-150 ft tall (Keay, 1989) and thrives well in the rocky and flat lands of Plateau state of Nigeria. There are many varieties of the plant producing oblong fruits of different sizes ranging from 1.84-3.06 cm long (Nyam, 1998). The fruits have a sharp point at the apex and a persistent calyx at the base. The fruit contains a hard fluted stone which contains a seed inside; the seeds are edible and oily (Nyam and Wonang, 2004). The fruits are similar in structure and colour to the well-known fruits of olive (*Olea europaeae*) of the Israel, though from different families.

The plant produces throughout the year, depending on the variety. The fruits have served man for centuries as snack and oil from the fruits have served man for domestic, pharmacological and industrial purposes. Some individuals have complained of irritation and purging after consumption of some varieties of the fruits to their satisfaction but little literature regarding the nutritive value and anti-nutrient of the fruit seems to abound, especially on *Canarium schweinfurthii* variety with thick oily mesocarp. The study therefore, intends to determine the proximate and elemental composition of the fruit variety and determine its anti-nutritional status in order to encourage or discourage the consumption of the variety.

MATERIALS AND METHODS

Ripe fruits of African olive variety with thick mesocarp were obtained from two locations, Fobor and Wokkos villages, all in Plateau state at the peak of harvest (December). The ripe fruits were plucked manually and carried in jute bag to the laboratory, then cleaned and spread on the cool floor of the laboratory. Methods of analyses used are those described by AOAC (1990).

The clean fruits were weighed 1kg, prewarmed in sterile water 18°C for 10 min then removed from the water, remove kernel and oven dried the fleshy fruits at 60°C for 24 h. After drying, the mesocarp that the fluted-stone had been removed was ground into powder using a mortar and a pestle, sieved and stored in an air-tight bottle kept in a desiccator for analysis.

Moisture content determination: Methods employed are those described by Karl-Fischer (AOAC, 1990). In this method, a clean petri-dish was dried in an oven at 80°C for 30 min, cooled in a desiccator and weighed (W_1).

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About 4 g of the ground *Canarium* fruit powder was poured into the weighed petri-dish and accurately weighed again (W_2). The sample and the petri-dish were then dried in an oven (at 50-60°C and 25 mmHg) for 5 h. It was then quickly transferred to a desiccator to cool and then reweighed again with minimum exposure to atmosphere. The procedure of drying for 3 h was repeated for each subsequent drying, until constant weight (W_3) was obtained. Triplicate determination on the sample was carried out and calculated as:

$$\text{Moisture (\%)} = \frac{\text{loss in weight due to drying}}{\text{Weight of sample taken}} \text{x100}$$

Therefore,

$$\frac{W_2\text{-}W_3}{W_2\text{-}W_1} \text{x 100}$$

Determination of ash content: A porcelain crucible with a lid was ignited in a muffle furnace for 1 min, it was quickly transferred to a desiccator to cool and was weighed (W_1). About 4 g of the powdered *Canarium* fruit was weighed into the crucible and weighed again (W_2), it was then heated gently on a Bunsen burner in a fume cupboard until smoking ceased, then the crucible was transferred to a muffle furnace, heated at 550-570°C to burn off all the organic matter; the carbon chars then burn off as CO_2 leaving a white ash. The crucible was then taken off immediately, covered and placed in a desiccator to cool and reweighed (W_3):

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \text{x100}$$

$$\frac{W_3\text{-}W_1}{W_2\text{-}W_1}$$

Determination of crude fat: This was carried out using Soxhlet extractor. Exactly 5 g of the *Canarium* powder was weighed into a fat-free extraction thimble which had been dried in an oven and weighed (W_1). It was plugged lightly with cotton wool and weighed again (W_2). It was then placed in a thimble in the extractor and solvent was added until the barrel of the extractor was halt-full, condenser was replaced, placed in water bath, source of heat was adjusted so that the solvent boiled gently and left for about 6 h until it had siphoned over and the barrel of the extractor was emptied. The condenser was then detached and the thimble removed and dried in a fat-free clean beaker. The thimble in the beaker was then placed in the oven at 50°C and dried to constant weight. It was cooled in a desiccator and weighed (W_3).

$$\text{Lipid (\%)} = \frac{\text{Weight of loss of sample (Extracted fat)}}{\text{Weight of sample}} \text{x100}$$

$$\frac{W_2\text{-}W_3}{W_2\text{-}W_1}$$

The solvent with the extracted fat in the flask was then concentrated on a rotary evaporation and further dried in a desiccator and weighed:

$$\text{Lipid (\%)} = \frac{\text{Weight gain of flask}}{\text{Weight of sample}} \text{x100}$$

Determination of protein content: The Kjeldahl devised by Johann Kjeldahl (1948-1900) was used (AOAC, 1990). In this method, exactly 0.10 g of the moisture-free sample of *Canarium* fruit was weighed and transferred into Kjeldahl digestion flask, few crystals of Kjeldahl digestion mixture were added, followed by a few granule crystals of antibumping, 10 mL of concentrated H_2SO_4 was added to the sample then digested for 3 h to ensure complete oxidation.

Content was then diluted after cooling in a 100 mL volumetric flask and made up to mark with distilled water. Here, nitrogen in the protein molecule was converted to ammonium sulphate. The solution after digestion was steam-distilled using Markham's distillation apparatus in the presence of 40% NaOH. During the distillation process, ammonia was liberated from the sample to form the ammonium borate which caused the change in colour of the solution from pink to pale green. After about 100 mL of distillate was collected, the process was stopped and the flask removed. The 100 mL conical flask containing the distillate was titrated against 0.11 MNa_2CO_3 to a pink colour.

Calculation:

$$\text{Nitrogen (\%)} = \frac{0.014 \text{ x T x C x 100}}{\text{d x e}}$$

Total crude protein = % Nitrogen x 6.25
I = Titre Value
N = Concentration of acid
C = Vol. of digested sample used
d = Aliqoute distilled
c = weight of sample

6.25 conversion factor based on the fact that protein contains 16% nitrogen. 0.014 = molar mass of nitrogen.

Determination of crude fibre: Exactly 2.0 g moisture-free sample was weighed, poured into a quick fit-flask followed by 100 mL of digested mixture and allowed to digest for 4 min by refluxing with occasional shaking. The digested sample was then filtered through ashless filter paper using gentle suction. The residue was then washed with 100 mL of distilled water and 50 mL of ethanol followed by petroleum ether (60-80%) 50 mL. It was then dried in the oven at 100°C, allowed to cool and weighed. The filter paper and the content were transferred into pre-weighed crucible and ashed in muffle furnace for 4 h at 600°C and then removed, allowed to cool, then reweighed.

Loss in weight on ignition was expressed as crude fibre carried out in duplicate.

Calculation:

Weight of sample digested, a
Weight of sample after digestion, b
Weight of ash, c

$$\text{Fibre crude of (\%)} = \frac{b\text{-}c}{a} \text{x100}$$

Determination of carbohydrate content of *Canarium schweinfurthii* fruit pulp: Carbohydrate content of the mesocarp fruit of *C. schweinfurthii* was determined using AOAC (1990) by subtracting the total ash content, crude fat plus crude protein and crude fibre from the total dry matter.

Determination of mineral content of the *Canarium schweinfurthii* fruit pulp: Exactly 10 mL of the fruit sample was digested with perchloric acid and nitric acid in the ratio (1:6 w/u) in a 250 mL beaker on a hot plate in a fume cupboard and when it was about to dry, 5 mL of concentrated hypochloric acid was added and heated to dryness, the residue was then dissolved in distilled water, transferred into a 100 mL volumetric flask and made to mark with distilled water.

The mineral contents sodium, potassium, magnesium and iron of the fruit were determined based on the methods in AOAC (1990) using Unican 969 Atomic Absorption Spectrophometer (AAS) with serial number 501361 V5:50.

The phosphorus content of the fruit was analyzed using Hach DR240 machine. Twenty-five millilitres of the sample was taken and 1.0 mL molybdovanate reagent added then swirled to mix thoroughly for 3 min before measurement was taken.

Determination of anti-nutrients of the fruit: Tannins and phytic acid of the fruits were determined by alkaline titration (AOAC, 1984). Total oxalate of the fruit was determined by the permanganate titration (Dye, 1956).

RESULTS AND DISCUSSION

Proximate composition of the *Canarium schweinfurthii* fruit is as presented in Table 1, ash content, crude fat, crude protein, fibre, carbohydrate and moisture content. The ash content (9.35%) is comparable with that of *Solanum nigrum* seeds (8.05%) as reported by Akubugwo *et al.* (2007) and higher than that of Date palm (1.2%), Banana (0.8%) and cashew fruits (2.5%). The lipid content observed is similar to those reported for African oil palm (*Elaeis guineensis*) which ranges between 65-75% (Kochhar, 1981), dry coconut (62.3 g/100 g) and higher than that of groundnut (40.1 g/100 g) as reported by Garrow and James (1993), olive (5 g/100 g) as reported by Tous and Ferguson (1996), thus indicating that the fruit is rich in crude fat. The result obtained is in conformity with that of Abayeh *et al.* (1999) who reported that the fruit of *Canarium schweinfurthii* had 68.3% crude fat. India is one of the major oil seed producing countries of the world. The oils obtained from plant origin provide dietary requirements for energy and also provide a feeling of satiety. They are also sources of lipid-soluble vitamins and poly-unsaturated fatty acids, thus indicating that consumers of *C. schweinfurthii* mesocarp in the rural areas are nutritionally well-fed.

The fruits of *Canarium schweinfurthii* were not so rich in protein (6.39 ≠ 0.01), hence, cannot be compared with the protein content of groundnut (23.4 g/100 g), beans (21.5 g/100 g) or that of baobab-*Adansonia digitata* (21.47%) as reported by Ihekoronye and Ngoddy (1985), Onwuliri and Yakubu (1999) or 20% in cashew as reported by Kochhar (1981). However, Tous and Ferguson (1996) reported that olive (*Olea europapeae*) has about 8 g/100 g protein which is a bit higher than what was recorded in this study (6.39%), but the value (6.39%) recorded in this study is higher than that of date palm (1.9%), banana (0.86%), potato (2-3%) (Kochhar, 1981). The result obtained in this study is in conformity with many researchers' results which showed that fruits are low in proteins. Proteins are necessary for the biosynthesis of new cells, enzymes, hormones, antibodies and other substances required for healthy functioning and development of the body cells as well as for protection (Cheesbrough, 1987). The result obtained in this study suggests that consumers of *Canarium schweinfurthii* need to eat the fruit with other foods rich in protein to meet up with their protein requirements.

The fibre content of the fruit mesocarp recorded in this study (11-16.37%) is lower than crude fibre content of olive (*Olea europapeae*) 20.0 g/100 g as reported by Tous and Ferguson (1996), date palm copra 20.43% and cotton seed 21/100 g as reported by Kochhar (1981). Fibre plays an important role in the gastrointestinal tract activities, thus preventing cancer, appendicitis, diverticular disease (Gibney, 1989).

The carbohydrate content observed in this study was low (2.85%) and far less than that recorded for cashew (26%) as reported by Kochhar (1981). The low carbohydrate content makes the fruit of *Canarium schweinfurthii* useful in health-related carbohydrate problems such as diabetes.

Table 1: Proximate composition of *Canarium schweinfurthii* fruit

Ash content	9.38 ≠ 0.01
Crude fat	64.04 ≠ 0.03
Crude protein	6.39 ≠ 0.01
Fibre	16.37 ≠ 0.02
Total carbohydrate	2.85 ≠ 0.03
Moisture content	5.77-27.77%

Table 2: Elemental composition of the fruit mesocarp of *Canarium schweinfurthii* Linn

Element	Concentration (mg/100 g)
Phosphorus	1.74
Sodium	1.1369-1.5361
Magnesium	0.2188-0.2861
Potassium	0.0508-0.1616
Iron	0.0859-0.2062

Table 3: Anti-nutrients composition of the fruit of *Canarium schweinfurthii*

Anti-nutrient	Composition (mg/100 g)
Phytic acid	162
Tannins	240
Oxalate	26

The moisture content of the *Canarium* fruits 5.77% is comparable to the value of moisture content of palm oil copra (3-5%), cashew kernel seed-*Anacadium accidentale* (5%), mango fruit (4%) as reported by Kochhar (1981). Muller (1988) reported 15% moisture content for olive (*Elaeis europaeae*), 15% for soybeans and 15% also for palm oil. High moisture content of fruits may speed up the deterioration of the fruit since excess water aids microbial spore germination. This is true as many fruits with high moisture values can easily be deteriorated; such fruits like grapevine with 80-90% water, banana 76.6% moisture, citrus fruits 80-92% water can easily be deteriorated by microorganisms. Moisture of the fruit is an index of the fruit stability and quality (Joslyn, 1970).

Mineral elemental analysis as shown in Table 2 indicates that *Canarium schweinfurthii* fruits contain moderate levels of phosphorus and sodium, 1.74 and 1.369-1.5361 mg/100 g, respectively. Phosphorus and sodium are components of phospholipids, proteins, bones and teeth and also important in the conduction of nerve impulses and maintenance of water balance. The fruit contains low levels of magnesium, potassium and iron. The elemental results of this study showed that the *C. schweinfurthii* fruits are low in elements when compared with other fruits such as Avocado fresh which contained 82 mg of phosphorus, 1204 mg/1 fruit of potassium, 20 mg of sodium, 78 mg/1 fruit of magnesium and 21 mg of iron. It is also lower than what is found in orange fresh (1 fruit), iron 1 mg, magnesium 13 mg, phosphorus 18 mg, potassium 237 mg, sodium 0 mg. However, the *Canarium schweinfurthii* fruit is high in minerals than the well-known green olive (*Olea europaeae*) which has in five (5) fruits recorded 0mg of phosphorus, 0 mg of potassium, 0 mg of iron but rich in sodium 65 mg/5 fruits as reported by Gordon (1999), which is contrary to what was obtained in this study.

The anti-nutrient analysis recorded in this study indicates that the fruit species with thick mesocarp contains high levels of tannins and phytic acids but moderate levels of oxalate. Phytic acid 162 mg/100 g, tannins 240 mg/100 g, oxalate 26 mg/100 g.

Phatate have been recorded in soy products and whole grains (Gordon, 1999). Studies have shown that phatate, either alone or with fibre to a meal can decrease the absorption of zinc, calcium, magnesium and iron. Tannins are complex phenolic polymers and the condensed ones are widely distributed in plants but pass through the digestive system unchanged. They are generally non-toxic but large doses can give rise to gastroenteritis (Williams, 1999). They have the ability to tan leather and are known to play active roles in the healing of wounds and burns and reduction of iron absorption (Muller, 1988). The result obtained is in conformity with the use of the *Canarium* oil traditionally, for the treatment of wounds and burns (Nyam, 2011).

Oxalates are organic acids which have been reported in spinach, chocolates (Gordon, 1999). Large doses have been reported to depress the absorption of calcium (Gordon, 1999). These non-mineral substances in diet may elicit adverse physiological responses, but initial processing such as pre-warming the fruit and fermenting fruit before oil extraction from the fruit is known to significantly reduce oxalate contents of vegetables (Akwaowo *et al*., 2000). Fermentation processes as noted by Odunfa (1985) improves nutrient value and removes anti-nutritional factors of food. Though few individuals complained of purging after consuming the soft fruits in large quantities, this could possibly be attributed to the high levels of tannins in the fruit. The oxalate level obtained in this study 26 mg/100 g is far lower than that reported for *Solanum nigrum* leaf and seeds, 78.65≠0 and 58.81 ≠ 0.01 mg/100 g; 800 mg of oxalate have been reported in whole grains (Garrow and James, 1993).

Conclusion: This study showed that *Canarium schweinfurthii* thick mesocarp fruits from Plateau state, Nigeria are rich in crude fat and tannins. The fruits contain appreciable levels of fibre, protein and ash. The study further revealed that the fruits contain appreciable levels of phosphorus and sodium. The fibre percentage (16.37%) is below the recommended dose per day for adults, which is 20-35%, because intake above this, can lead to problems. Though the fruits contain relatively high levels of tannins and phytic acids, condensed tannins found in plants are non-toxic and phytic acid levels after processing will be less than 26 mg/100 g and cannot decrease the absorption of other minerals.

In summary, therefore, the fruit has high nutritional values and is recommended as a cheap source of plant lipid, mineral elements such as phosphorus and sodium and also a cheap material for tannins and pharmacological industries.

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