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Evaluation of Phytochemical, Proximate and Nutritive Potentials of *Cocos nucifera* (Coconut) Seeds

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ABSTRACT

The phytochemical, proximate, vitamins and mineral element composition of Coconut (*Cocos nucifera)* were investigated in this research. The phytochemical properties of the sample were screened qualitatively and also quantified and the result revealed a significant amount of alkaloids, flavonoids, tannins, and reducing sugars while saponins, glycosides, soluble carbohydrate and terpenoids were found in trace amount, hydrogen cyanides not detected qualitatively. The proximate analyses of the *Cocos nucifera* sample was carried out using the *methods described by Pearson and the results* showed high level of crude fats 56.36±0.04% and carbohydrate 31.29±0.14%, a considerable amount of moisture and crude protein 8.33±0.03 and 7.53±0.05%, respectively and also, ash 2.43±0.03% and fibre 2.38±0.07%. This composition shows that the sample could be a good source of oil, carbohydrate, dietary fibre and protein. However, the methods outlined by AOAC, 2000 were used to determine the mineral composition of the *Cocos nucifera* seeds. The results revealed that the sample posses preponderance amount of mineral elements; magnesium 318.11±7.07 mg, calcium 25.87±0.09 mg, potassium 29.92±0.04 mg, sodium 16.92±0.06 mg, phosphorus 4.54±0.03 mg and copper 1.24±0.02mg per 100g dry weight respectively; with trace amounts of manganese 0.64±0.01 mg, zinc 0.76±0.06 mg and iron 0.62±0.01 mg. This implies that *Cocos nucifera* seeds no doubt is a good source of minerals despite the negligible amount of iron, zinc and manganese. The method of Association of Official and Analytical Chemists AOAC, 1990 was used for the vitamins analyses and the seed sample was also found to contain an appreciable amount of vitamin A 3.12±0.01 mg/100g, vitamin C 14.71±0.05 mg/100g, vitamin B_2 1.76±0.41 mg/100g and vitamin B_6 1.61±0.04mg/100g. Other vitamins analysed on the seed extract though found in trace amount were vitamin D, E, K, B_1, B_3, B_5, B_9 and B_{12}. The results from the present study implicitly showed that *Cocos nucifera* seed is nutritionally potent and could be good for dietary supplements in human and animal nutrition.

Keywords: *Cocos nucifera*, phytochemical, proximate, mineral, vitamin, human nutrition.

INTRODUCTION

Cocos nucifera is a large palm, growing up to 30 meters (98 ft) tall, with leaves 4–6 meters (13–20 ft) long, and pinnae 60–90 cm long. Coconut (*Cocos nucifera* L. Family-*Palmae*) is one of the most extensively grown and used nut in the world and is rated as one of the most important of all palms (Onifade and Jeff-Agboola, 2003; Popenoe, 1969). Coconuts are generally classified into two general types: tall and dwarf. On very fertile land, a tall coconut palm tree can yield up to 75 fruits per year, but many often yields less than 30 fruits mainly due to poor cultural practices. In recent years, improvements in cultivation practices and breeding have produced coconut trees that can yield more fruits. It is found throughout the tropic and sub-tropic area, the coconut is known for its great versatility as seen in many domestic, commercial, and industrial uses of its different parts including the dietary use of its parts by many people (Chan and Elevitch, 2006). Coconuts contain a large quantity of "water" and when immature they are known as tender-nuts or jelly-nuts and may be harvested for drinking and this differentiates them from any other fruits. When mature they still contain some water and can be used as seed nuts or processed to give oil from the kernel, charcoal from the hard shell and from the fibrous husk.

A lot of products are directly or indirectly made from coconuts. These include whole coconut copra, coconut oil, coconut oil cake, coir, desiccated shredded coconut, coconut skin milk and coconut protein (Onifade and Jeff-Agboola, 2003). Coconut can also be

used to produce desired texture in cookies, candies, cakes pies, salads and desserts. It is commercially viable because of its rich nutritive values (Child, 1964; Akubugwo et al. 2008; Kyari, 2008).

George, (1993) reported that Coconut water is composed of many amino acids, nitrogenous compounds, inorganic elements, organic acids, sugars and their alcohols, vitamins, growth substances (Cytokines and auxins) and many other unknown components. Abdulhameed and Zafar, (2011) also reported on the physicochemical properties of coconut meat and water from three varieties (tall, dwarf and Hybrid) and showed high percentages of mineral elements especially sodium and potassium in the studied varieties. Coconut water has also been reported as rehydration fluid in diarrhoea. Oral rehydration has been recommended for patients with diarrhoea to replace the fluid loss from gastrointestinal tract (Khan et al., 2003). Jackson et al., (2004) reported that fat, protien, soluble solds, acidity and turbidity increased steadily with maturity, while pH and ash showed variation throughout maturation. Ewansiha et al. (2012) evaluated the proximate and mineral composition of the cocnut shell and reported that the shell can be an effective material precursor in water and waste treatment among other uses. This study therefore, was designed to quantify the physicochemical and nutritional values of coconut kernelfor human consumption and animal feeds.

MATERIAL AND METHODS:

Collection and preparation of plant material: Healthy seeds of coconut were obtained from Nkwo-Ibagwa, Igbo Eze South L.G.A., Enugu State. The seeds were identified and authenticated at the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka (UNN), Enugu, Nigeria.The freshly collected seeds of *Cocos nucifera* were dehulled, chopped, sun-dried to constant weight, and milled to powder using a hand mill. Portions of the powdered sample were then used for the various analyses.

Qualitative Phytochemistry: Qualitative phytochemical analysis of the sample for alkaloids, glycosides, saponins, flavonoid, tannins, terpenoid, reducing sugar and soluble carbohydrates were carried out by methods described by Harborne (1973).

Quantitative Phytochemistry: Quantitative phytochemical screening of the samples for relative abundance or absence of alkaloids, glycosides, saponins, flavonoids, tannins, terpenoid, reducing sugar and soluble carbohydrates were carried out using the method outlined by Pearson (1976).

Proximate Analysis: The proximate analysis of the seed extract for crude protein, crude fiber and fat contents were determined using the methods described by Pearson (1976). Crude protein determination was done using Kjedhal's method, while crude fibre determination was done using acid and alkaline digestive method. Fat content was determined using continuous solvent extraction method. Total ash content was determined by ignition at 550°C in a muffle furnace for 4hr.Moisture and carbohydrate contents were determined using the methods described by AOAC (1990).

Mineral Analysis: The methods outlined by AOAC (2000) were used for the determination of minerals in the test sample. Calcium, sodium, potassium, magnesium were determined by flame photometric method while iron, zinc, manganese and copper were determined by atomic absorption spectrophotometric method. The sample (2g) was weighed and put into a clean dried crucible. Then it was transferred to a muffle furnace, ashed at 700°C for 3hr and cooled in a dessicator. 30% HCl (5ml) was added, with 10ml of distilled water and diluted to 50ml with distilled water. The resulting solution was use in the analysis of iron, zinc, manganese and copper respectively.

Vitamin analysis: The composition of the water soluble vitamins such as thiamine, niacin, pantothenic acid, pyridoxine, cobalamin, folate were determined by the method of Association of Official and Analytical Chemists (AOAC, 1990). Vitamins A, C, D, E and K contents were determined by the method described by Okwu (2004).

RESULTS

Table 1 showed the results of proximate analysis of the *Cocos nucifera* extract which revealed the following: the results showed that *Cocos nucifera* contained appreciable amounts of crude fats (56.36±0.04%) and carbohydrate (31.29±0.14%). The kernel also contained significant amounts of moisture content (8.33±0.03%), crude protein content (7.53±0.05%), ash content (2.43±0.03%) and crude fibre (2.38±0.07%). Results also showed energy value of 662.65±0.14 kilocalories per gram dry weight.

Table 1: Proximate composition of *Cocos nucifera* seed extract

Nutrient composition	Mean Composition
Moisture (%)	8.33±0.03
Ash (%)	2.43±0.03
Crude Fats (%)	56.36±0.04
Crude Fibre (%)	2.38±0.07
Crude Protein (%)	7.53±0.05
Carbohydrate (%)	31.29±0.14
Energy Value (kcal)	662.65±0.14

Values are means of three Determinations ± S.D.

Table 2 revealed the presence of an appreciable amount of alkaloids, tannins and reducing sugar while flavonoid, glycosides and soluble carbohydrates were found in a moderate amounts. However, the presence of saponin and terpenoid were observed in minute quantities while hydrogen cyanide was not detected.

Table 2: Qualitative Phytochemicals result of coconut kernel

Phytochemicals	Observations
Alkaloid	+++
Flavonoid	++
Saponins	+
Glycoside	++
Tannins	+++
Soluble Carbohydrate	++
Hydrogen Cyanide	ND
Terpenoid	+
Reducing sugar	+++

KEY: + Trace amount present
++ Moderate amount present
+++ Appreciable amount
ND Not detected.

Result in table 3 shows the phyto-nutrient composition of coconut kernel. The result indicates an appreciable amount of reducing sugars (10.07±0.07mg/100g). The analysis also shows that alkaloids (1.57±0.02mg/100g), flvonoids (1.86±0.02mg/100g), tannins (2.77±0.11mg/100g) are present in reasonable amounts. Other phytochemicals quantified though found in trace amount include saponins (0.77±0.01mg/100g), glycosides (0.98±0.0mg/100g), soluble carbohydrate (0.76±0.21mg/100g), hydrogen cyanide (0.14±0.02mg/100g) and terpenoid (0.13±0.07mg/100g).

Table 3: Quantitative Phytochemical result of coconut

Phytochemicals	Mean Composition (mg/100g dry weight)
Alkaloid	1.57±0.02
Flavonoid	1.86±0.02
Saponins	0.77±0.01
Glycoside	0.98±0.0
Tannins	2.77±0.11
Soluble Carbohydrate	0.76±0.21
Hydrogen Cyanide	0.14±0.02
Reducing Sugar	10.07±0.03
Terpenoid	0.13±0.07

Values are means of three Determinations ± S.D.

The *Cocos nucifera* kernel contains a significant amount of important minerals as reported in Table 4. The magnesium concentration (318.11±7.07mg/100g) was the highest, followed in descending order by potassium (29.92±0.04mg/100g), calcium (25.87±0.09mg/100g), sodium (16.92 ± 0.06mg/100g), phosphorus (4.54 ±0.03mg/100g), copper (1.24±0.02mg/100g), zinc (0.76±0.06mg/100g), manganese (0.64±0.01mg/100g) and iron (0.62± 0.01mg/100g).

Table 4: Mineral Analysis of *Cocos nucifera*

Mineral Elements	Mean Composition (mg/100g dry weight)
Copper (mg/100g)	1.24±0.02
Manganese (mg/100g)	0.64±0.01
Zinc (mg/100g)	0.76±0.06
Iron (mg/100g)	0.62±0.01
Phosphorus (mg/100g)	4.54±0.03
Magnesium (mg/100g)	318.11±7.07
Calcium (mg/100g)	25.87±0.09
Potassium (mg/100g)	29.92±0.04
Sodium (mg/100g)	16.92±0.06

Values are means of three determinations ± S.D.

Table 5 shows the results of the vitamins analyses of *Cocos nucifera* seed and it revealed an appreciable amount of vitamin A 3.12±0.01 mg/100g, vitamin C 14.71±0.05 mg/100g, vitamin B_2 1.76±0.41 mg/100g and vitamin B_6 1.61±0.04mg/100g dry weight. Other vitamins were also analysed on the seed sample though found in trace amount as shown on the table below.

Table 5: Vitamins analysis of coconut (*Cocos nucifera*)

Vitamins	Mean Composition (mg/100g dry weight)
VitaminA	3.12±0.01
VitaminC	14.71±0.05
VitaminD	0.52±0.01
VitaminE	0.67±0.02
VitaminK	0.03±0.01
VitaminB_1	0.76±013
VitaminB_2	1.76±0.41
VitaminB_3	0.88±0.02
VitaminB_5	0.24±0.02
VitaminB_6	1.61±0.04
VitaminB_{12}	0.75±0.03
Folate	0.25±0.03

Values are means of three Determinations ± S.D.

DISCUSSION

The proximate analyses (table 1) gives the overall nutritional composition of the sample in question, this is briefly complemented by antinutrient and mineral composition of the sample (Adesuyi et al. 2012).The values were fairly in agreement with earlier reports of proximate compositions of *Cocos nucifera* seeds by Obasi et al. 2012. Too much of moisture in any food sample can make the sample viable for microbial growth. This accounts for most of the biochemical and physiological reactions in a plant (Guisseppe and Baratta, 2000). The moisture content is also an important parameter as it affects the percentage yield of oil during extraction. Therefore, the low moisture content observed in the sample could lead to an increased yield of its oil (Mansor et al. 2012). Fortunately, the moisture content was relatively low. The high percentage of fats also makes this sample a distinct potential for the oil industry. The fibre and protein contents of the sample show that it is nutritionally rich and could be regarded as valuable source of dietary fibre in human nutrition. Adequate intake of dietary fibre can lower cholesterol level, risk of coronary heart diseases, hypertension, constipation, diabetes, colon and breast cancer. The ash content is an indication of the presence of carbon compounds and inorganic components in the form of salts and oxides in the kernel of coconut. Carbon plays a vital role in the adsorption of substances due to its porous nature which is an indication that powdered carbon form of coconut shell can effectively serve as good adsorbent in the removal of metallic ions, odour, colours and other particulate matter from aqueous medium of water and waste water.

The results of the qualitative and quantitative phytochemical screening are shown in table 2–3. Phytochemicals are biologically active compounds, found in trace amounts, which are not established nutrients but which nevertheless contribute significantly to protection against degenerative diseases (Dreosti, 2000; Ojobor et al. 2015). Flavonoids have protective effects including anti-inflammatory, anti-oxidants, antiviral, and anti-carcinogenic properties. They are generally

found in a variety of foods, such as oranges, tangerines, berries, apples and onions (Middleton et al. 2000). The presences of tannins in the samples suggest that it could be used for healing of haemorrhoids and varicose ulcers in herbal medicine (Igboko, 1983; Maduiyi, 1983). Alkaloids are heterogeneous group of naturally occurring compounds found in the leaves, bark, roots or seeds of plants. They are the most effective plant substance used therapeutically as analgesic, antimicrobial and antibacterial agents. However, the amount of saponins in the coconut kernel was very low, and it is an indication that coconut has a low cytotoxic effect such as permealisation of the intestine. The bitter taste of any plant is attributed to the amount of saponin present. Saponin also has relationship with sex hormones like oxytocin. Oxytocin is a sex hormone involved in controlling the onset of labour in women and the subsequent release of milk (Okwu and Okwu, 2004).

The results of table 4 showed that *Cocos nucifera* is rich in some minerals and nutrients like calcium, magnessium, potassium and sodium. It is a proved fact that the level of sodium in Nigerian food plant is lesser than that of potassium (Rimbach et al., 2000) and this is confirmed by the values of the minerals in question, Sodium (16.92±0.06mg/100g) and Potassium (29.92±0.04mg/100g). It is also reported that Potassium is the most abundant mineral in Nigerian Agricultural products (Oshodi et al. 1999). This is also confirmed by the values of the minerals except for Magnesium (318.11±7.07mg/100g) which is the highest. These elements support human biochemical processes by serving structural and functional roles as electrolytes (Nelson and Cox, 2008). They also play important roles in health and nutrition. However, the Na and K content of the sample is an added advantage because of the direct relationship of sodium intake with hypertension in human (Dahl, 1972). Calcium and phosphorus are very essential for bone metabolism and assist in teeth development. Calcium is also a cofactor of three enzymes pyruvate dehydrogenase complex, isocitrate dehydrogenase and α-ketoglutarate dehydrogenase complex in the citric acid cycle (Ojobor et al. 2015). The presence of copper may be responsible for the absorption of iron, it is therefore, often seen with iron naturally. Copper is also important for cellular defense and protection of the mucous membrane, anti-anaemic and essential for the formation of haemoglobin from iron (Claude and Paule, 1979). Iron plays important roles in many proteins and enzymes, notably in haemoglobin to prevent anaemia. The amount of Manganese determined on coconut though very small indicates that the plant may be used to protect bone disease to an extent (James, 2000). The activity of this element is noticeable in the metabolism of food incorporated into the bone. Manganese is also necessary for the functioning of the pituitary gland, the pineal gland and the brain (Claude and Paule, 1979), it promotes hepatorenal function, combat anaemia and also essential for growth. The amount of zinc (0.76±0.06mg/100g) found in coconut sample was very minute and as such keeping a doubt that the seed may have some effect on the nerve function and male fertility. Zinc is also important for normal sexual development, especially for the development of testes and ovaries, it is essential for reproduction. Zinc stimulates the activity of vitamins, formation of red and white corpuscles (Claude and Paule, 1979), healthy functioning of the heart and normal growth (Elizabeth, 1994). Zinc is also an antioxidant, as it is a cofactor for many antioxidant enzymes such as glutamate dehydrogenase, alcohol dehydrogenase, lactate dehydrogenase, DNA and RNA polymerase, superoxide dismutase etc. Magnesium is a cofactor of many enzymes such as kinases, phosphatase, transketolase, ribonuclease, carboxylase, peptidase and adenylyl cyclase (Ojobor et al., 2015).

The results of the vitamins analyses (table 5) proved that *Cocos nucifera* contained preponderance amount of vitamin A (3.12±0.01mg/100g), vitamin C, vitamin B_2 (1.76±0.41 mg/100g) and vitamin B_6 (1.61±0.04 mg/100g). The high value of vitamin C (14.71±0.05 mg/100g) is an indication that the plants may contribute to the treatment of skin conditions, including eczema,

pruritus, psoriasis and parasitic skin conditions (D'Amelio, 1999). This vitamin can also be used for the treatment of common cold and other diseases like prostate cancer (Okwu and Okeke, 2003; Okwu and Okwu, 2004). There is also an interesting ability of ascorbic acid as an antioxidant, to prevent or at least minimises the formation of carcinogenic substances from dietary material (Hunt et al. 1980). Deficiency of ascorbic acid is associated with pains in the joint and defect in skeletal calcification, anaemia, manifestation of scurvy haemorrhage from mucous membrane of the mouth and gastrointestinal track (Hunt et al. 1980). The second highest vitamin analysed in the sample was vitamin A (3.12±0.01mg/100g). Vitamin A is necessary for several parts of the eyes including rhodopsin in the retina of the eyes, needed for night vision. It is needed for growth (e.g. bone growth) and for normal tissue development. Vitamin A also has specific roles in maintaining the skin and mucous membranes (e.g. linings of the nose, eyes and throat) which helps to stop bacteria and viruses from entering and for normal immune function, protecting against bacteria and viruses. Vitamin B_6 (which includes pyridoxal, pyridoxine and pyridoxamine) serves as a coenzyme in various enzymatic reactions, such as the transamination and decarboxylation reactions. It is the coenzyme of γ-cystathionase, which catalyses the cleavage of cystathionine, releasing α-ketobutyrate and cystein (Matsuo and Greenberg, 1958). The α-ketobutyrate molecule is subsequently converted into succinyl-CoA and fed to the tricarboxylic acid (TCA) cycle while cystein is involved in protein and gluthathione biosynthesis (Conn and Stumpf, 1972; Lieberman et al., 2007). Vitamin B_6 deficiency can affect various processes of the body, such as inflammation and renal function (Depeint *et al.*, 2006). Coconut water contains folate (Table 1), also known as vitamin B9. It was identified in the late 1930's as the nutrient required for reducing anemia during pregnancy Goh and Koren, 2008). It can prevent mitochondrial toxicity induced by methanol metabolites. In addition, the active form of folate, 5-methyltetrahydro-folate is believed to be one of the central methyl donors required for mitochondrial protein and nucleic acid synthesis (Shenkin, 2006). Lower blood levels of vitamin B6 and folate can increase the risk for atherosclerosis and other vascular diseases (Robinson et al., 1998). Another study found that high plasma levels of vitamin B6 and folate may reduce the risk for breast cancer (Zhang et al., 2003).

Other vitamins determined in this work were vitamin D (0.52±0.01 mg/100g), vitamin E (0.67±0.02 mg/100g), vitamin K (0.03±0.01 mg/100g), vitamin B_1 (0.76±013 mg/100g), vitamin B_3 (0.88±0.02 mg/100g), vitamin B_5 (0.24±0.02 mg/100g), vitamin B_{12} (0.75±0.03 mg/100g), vitamin B_9 (0.25±0.03 mg/100g). These vitamins though in trace amount are essential for body metabolism.

CONCLUSION

This study showed that Cocos nucifera kernel is rich in crude fat and carbohydrate. Also, good source of essential vitamins and minerals necessary for metabolic activities in the body. The presence of tannin supports its anti-inflammatory property. High content of ascorbic acid also indicates that the plant can be used to prevent or at least minimize the formation of carcinogenic substances from dietary material.

Conflict of Interests

There was not any conflict of interest declared.

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