PROXIMATE ANALYSIS AND LIPID QUALITIES OF COCONUT *(Cocos nucifera)* SEEDS OIL OBTAINED IN MINNA METROPOLIS

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ABSTRACT

The suitability of coconut (Cocos nucifera) seeds as source of good quality oil was investigated. Proximate analysis of the seeds revealed high lipid and carbohydrate contents of 49.8 % and 15.90 % respectively, as well as high levels of K^{+}, Fe^{2+}, Ca^{2+} and phosphorus. Analysis of the oil revealed Acid (AV), Saponification (SV), Peroxide and Iodine values of 11.6, 252.4 mgKOH/g, 1.22 mmol/kg and 8.5 gI$_2$/100g respectively. The low iodine value and the fatty acid profile showed that the oil is composed mostly of saturated fatty acids. The nutritional and industrial application of Cocos nucifera oil are also discussed.

Key words: Cocos nucifera, lipid composition, proximate analysis, physical and chemical

INTRODUCTION

The coconut tree *(Cocos nucifera Linn.)* belongs to the family *palmae*. It is a monocotyledonous plant containing up to 400 species distributed over 200 genera. It is a multipurpose plant grown throughout central Africa and it is used as both an ornamental and food crop. It is grown in Nigeria for a variety of purposes but its main use has been for its fruit which is eaten widely in Nigeria.

The shells are used by blacksmith to generate energy to melt irons (Ikpendu 2002, Ukot *et al.*, 2004).The coconut tree can grow as high as 25m and bears the coconut in bunches. Each nut has a hard shell with a layer of white meat on the inside. When not fully matured, the nut contains large amount of coconut milk, a pale whitish liquid with a strong taste of coconut. This liquid is gradually absorbed as the nut matures. The meat is sun-dried or kin-dried and referred to as "copra", which has very high oil content (Ishiwu and Iwouno, 2006). Since ancient times, coconut oil has been used as plant oil. The tree is still grown largely by small land holders instead of on large plantations (Woodroof, 1979). Copra meal is a by-product after oil has been extracted from the coconut seed. (http:/www.coconutoil.com 2007, www.org.edu/fruit/htm.2006).

Coconut oil is commonly used in cooking especially when frying. It has a high smoke point temperature (136-140°C) which makes it good for this purpose. The oil is rich in

short and medium chain saturated fatty acids such as myristic, palmitic and stearic acids and therefore does not have those toxic effects of unsaturated oils although it does contain a small amount of the unsaturated oils. Infact, the oil is used as the basis for intravenous fat feeding because it contains saturated essential fatty acids (http://www.efn.org/-raypeat2007).

It is well established that dietary coconut oil reduces the need for dietary vitamin E, and that it has both direct and indirect antioxidant activities (Savendson, 2000, Ukoh *et al.*, 2004).The present study was undertaken to provide data on the proximate and lipid qualities of coconut seed and its oil as a pre-requisite for the subsequent evaluation of its nutritional and pharmaceutical potential in continuation of our efforts on the systematic studies of the lesser known tropical seeds.

MATERIALS AND METHODS

All chemicals and reagents used were of analytical grade.

Sample collection and preparation

The coconut seeds (*Cocos nucifera*) were bought from different parts of the central market in Minna, Niger State, Nigeria. The hard shell was removed manually and the soft inner pulp was sun dried for three days. The dried samples were crushed with pestle and mortar to provide a large surface area during extraction. The powdered sample was kept in a polythene bag at room temperature pending analysis.

The moisture content, crude fiber and crude protein were determined using methods specified by Oyeleke (1984) and A.O.A.C. (2000). The ash content was determined by heating 5.0 g of the sample to a constant weight in a muffle furnace at 550 °C, while the carbohydrate was estimated by difference. The oil component of the samples was obtained by solvent extraction of 3.0 g in a continuous soxhlet extractor using petroleum ether (40-60 °C) for 4 hours (Oyeleke, 1984; Akanya and Akanya, 1989).

The metal ions were obtained by dry ashing the ground sample in a muffle furnace. The ash was dissolved in 10 % HCl and the resulting solution used for the mineral content determination using a flame photometer and a PYE UNICAM-9 Atomic Absorption Spectrophotometer (AAS).

Characterization of coconut seed oil

The physical and chemical qualities of the extracted oil were carried out according to standard methods developed by Paquot and Hauffen (1987) and A.O.A.C. (2000). Free fatty acid and acid values were determined using A.O.A.C. (1990), while iodine value was obtained by the Wijs method described

by Josyln (1970). Saponification value was determined by refluxing alcoholic KOH solution of the oil and titrating with 0.5M HCl using phenolphthalein indicator. The peroxide value, relative density, and refractive index were determined using methods described by Pearson (1976), A.O.A.C. (2000), ISO 3960 (1977, 1989) respectively.

Fatty acid methyl ester (FAME) of the oil was prepared using the method of Gunstone (1969). The FAME extracts were co-chromatographed with authentic FAME standards of known structure. The GLC equipment used was an AGILENT gas chromatograph (96890N model) coupled with a Mass Selective Detector. The start temperature, injection, oven and column temperatures were according to user's manual. Results are mean ± SD of three determinations.

RESULTS

Tables 1.0 and 2.0 show the mean values of the proximate and metal ion compositions of coconut seed. Also shown in Table 3.0 are the physical and chemical properties of the oil extracted from the coconut seed.

Table 1.0: Mean values of the proximate composition of *Cocos nucifera* Seeds

Parameters	Values (%)	
Total Ash	7.40	0.11
Moisture content	11.40	0.17
Crude protein	7.50	0.11
Crude fiber	13.10	0.19
Oil content	49.80	0.75
Total carbohydrate	15.90	0.24

Table 2.0: Mean values of mineral content of *Cocos nucifera* Seeds

Elements	concentration (mg/kg)
Sodium	Sodium
Potassium	Potassium
Calcium	Calcium
Zinc	Zinc
Copper	Copper
Iron	Iron
Phosphorus	Phosphorus

Table 3.0: Mean values of some physical and chemical properties of *Cocos nucifera* seed oil

Properties	**Values**	
Colour	Yellow	
Odour	Characteristic	
Specific gravity	0.9146	0.0132
Refractive index at 29^0C	1.455	0.022
Density at 29^0 C	0.88	10.013
PH	7.30	0.11
Acid Value (mgKOH/g)	11.60	0.17
Saponification Value (mgKOH/g)	252.40	3.79
Iodine Value (gI_2/100g) Wijs	8.50	0.13
Peroxide Value (mmol/kg	1.22	0.02
Smoking point (^{0}C)	138.00	2.07

Table 4.0: Mean percentage composition of major fatty acids in *Cocos nucifera* seed oil

Fatty acid	Composition (%)	
Myristic acid (C 14:0)	8.00	0.12
Palmitic acid (C 16:0)	12.00	0.18
Oleic acid (C 18:1)	5.00	0.08
Stearic acid (C 18:0)	4.00	0.06
Linoleic acid (C 18:2)	2.00	0.03

DISCUSSION

The proximate composition of coconut seed flour shown in Table 1.0 has total ash content of 7.4 %. This value is higher than 4.9 % and 6.8 % reported for peanut and palm kernel seed flours (Amoo and Asoore, 2006).

This ash content correlates with the high mineral content in Table 2.0. Although the moisture content is higher than 9.2 %, 5.6 % and 3.5 % quoted for Palm kernel seed, barteri fruit and Peanut seeds respectively by Amoo and Lajide (1999), Amoo and Asoore (2006), this value is still advantageous since it may enhance the shell life of the seeds. Osagie and Odutuga (1988), reported similar moisture content in cashew nuts and water melon seeds and observed that the finding was indicative of their long shell life. Coconut seeds although low in crude protein content, has high carbohydrate content which along with the high oil content and crude fibre could be a good source of energy and an ingredient in feed formulation. The oil content of 49.8 % as shown in Table 1.0 is higher than 44 % for palm kernel seeds. Osagie and Odutuga (1986) reported that more than ten local seed species have more than 40 % oil content. Essien and Amadi (2002) have reported the oil content of shear buttermuts to be as high as 46.15 %. Lower oil content have been reported for some seeds such as cowpea (22.7 %), chick beans (19.4 %), by Aletor and Aladetimi (1989). This high oil content suggests that coconut seeds are potential seed crops for oil production.

The mineral content (mg/Kg) in Table 2.0 shows high sodium, calcium, iron, phosphorus and potassium content. These

minerals are essential compositions of body fluid balance, impulse conduction, normal development and maintenance of acid-base balance of the blood.

The concentration of copper and zinc though low, the flour is a good source of these trace elements essential for formation of red blood cells and components of enzymes (Amoo and Asoore, 2006).

The specific gravity (0.9146) although lower than that of castor oil (0.958) quoted by Weiss (2000) and value of 0.963 quoted by Paiko *et al.*(2007) for shear nut oil, is not surprising as this may be due to different extraction methods.

This value is in agreement with the values reported for most oils and fats by Standards Organisation of Nigeria, SON (1992). Etukudo (1988) reported values of 0.915-0.917 as the specific gravity of coconut oil.

The refractive index of 1.455 of the oil is very close to values of 1.453 - 1.456 quoted for coconut oils by Goff and Balachly (1973).

The refractive index is related to the molecular weight and degree of saturation and is used to classify fatty acids. This value is therefore not surprising since coconut oil has been confirmed to be predominantly saturated.

The peroxide value (1.22) is lower than that obtained for *Curcubita maxima* (2.08) seeds by Oladejo (2001). The peroxide value is used as an indicator of deterioration of oils. The low value obtained above suggests that coconut oil may not undergo oxidative rancidity easily which in addition to the low moisture content means little storage problems. It has been observed that coconut oil kept at room temperature for a year when tested showed no evidence of rancidity (*http://www.efn.org/-raypeat).*

Since we would expect the small percentage of unsaturated oils naturally contained in coconut oil to become rancid, it seems that the other saturated oil have an antioxidative effect. This is because the dilution keeps the unstable unsaturated oil molecules spatially separated from each other, so that they cannot interact in destructive chain reaction that occurs in other oils.

The saponification value which is a measure of the molecular weight of fatty acids in the oil is comparable to values of 250 264 mgKOH/g quoted for coconut oil by Goff and Balachy (1973). Etukudo (1988) reported saponification values for coconut oil as 248 264 mgKOH/g and suggested the suitability of the oil for soap production.

The iodine value is used to obtain a measure of the average degree of unsaturation of oil.

A low iodine value is indicative of low unsaturated fatty acid content and the ability of the oil to go rancid. The low acid value of coconut oil obtained above together with low peroxide value and moisture content classifies the oil as non drying which can be used for cooking, baking and as plasticizers in polymer industries (Norman and Joseph, 1996). FAO (1988), quoted the iodine value of coconut oil to be between 6.0 10.0. Etukudo (1988) reported the iodine value for coconut oil as 7.5 10.5.

The fatty acid composition of coconut oil determined from its methyl esters using an AGILENT Gas chromatograph coupled with a Mass spectrometer is as shown in Table 4.0. It contains essentially five major fatty acids with palmitic acid being the most dorminant. Ikpendu (2002) earlier identified palmitic, myristic and stearic acids as the major fatty acids in coconut oil.

CONCLUSION

The proximate and mineral composition of the coconut seed have been determined. The physical and chemical characteristics and the fatty acid profile of the oil extracted from the seeds have also been evaluated. Results show that the seed is a good source of potassium, calcium, sodium and phosphorus which are essential in diets. The oil is rich in short chain saturated fatty acids suggesting it may not go rancid easily. The oil could be used in cooking and frying because of the high smoke point, and also in soap production as well as in pharmaceutical formulations.

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