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Comparative Studies on Oils from Some Common Plant Seeds in Nigeria

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Abstract: Oil were extracted from seeds of Nigerian plants *Pentaclethra macrophylla*, *Treculia africana*, *persea gratesima* and *Telferia occidentalis* using n-hexane and their physicochemical properties compared with oils from seed of *Cocos nucifera*. Percentage oil yield were 20.80, 18.00, 14.00, 18.00 for *P. macrophylla*. *T. africana*, *P. gratesima* and *T. occidentalis* respectively while the value for *C. nucifera* seed oil is 32.00. All the five seed oil were odourless and at room temperature liquids. Specific gravity of the seed oils ranged from 0.81-0.90 while peroxide value for all the oil seed were less than 6.00. Saponification values were as low as 106.60 in *P. gratesima* and as high as 246.00 in *C. nucifera* seed oils. Iodine values were between 9.60 and 52.40 in the extracts. These results suggest that oil seeds examined may be viable source of oil going by their oil yield. The studied characteristics of all oil extracts in most cases compared favourably with C. *nucifera* seed oil which is presently used for both domestic and industrial purposes in Nigeria.

Key words: Oil seeds, physicochemical properties, coconut, conventional seed oils

Introduction

The nutritive and calorific values of seeds make them good sources of edible oils and fats diet (Odoemelam, 2005). Oil seed (groundnut, soyabean, palm kernel, cotton seed, sunflower seed, melon seed olive and locust bean) are the second most valuable commodity in the world trade today (Ige *et al*., 1984).

African oil bean seed (*Pentaclethra macrophylla*) is fermented and consumed. It is consumed alone, mixed with other food ingredients or as a condiment in soup and salads (Achinewhu, 1986). Unfermented seeds are bitter to taste and contain a toxic alkaloid, paucine and a growth depressant, cafeoyl-putrescine (Mbadiwe, 1979). Fermentation renders the seed nutritious and non-toxic (Uzogara *et al*., 1990).

African breadfruit (*Treculia africana*) is commonly roasted, cooked, mashed and consumed either directly as snack food or as flour for use in soup thickening and cake (Fasasi *et al*., 2004). *Treculia africana* seeds are rich in amino acids, minerals and fatty acid (Lawal and Bassir, 1987).

Avocado pear (*Persea gratesima*) Gaerth. F belongs to the family lauraceae. Undocumented ethno-medical sources had it that the seed is used for the treatment of obesity, high blood pressure, heart problems, internal heat and hypertensions (Hutchinson and Dalziel, 1964).

Fluted pumpkin (*Telferia occidentals*) is a creeping vegetable shrub that spread low across the ground with large lobed leaves (Horsfall and Spiff, 2005). The seed contain 13% oil (Okoli and Nyanayo, 1988) and is used for cooking and marmalade manufacturing (Egbekun *et al*., 1998).

Coconut (*cocos nucifera*) is commercially viable. The coconut oil is particularly useful.

Except for *C. nucifera* seed the potential of the other plant seed are presently under-utilized. Our attention has been recently drawn to underutilized plant seeds in Nigeria (Akubugwo and Ugbogu, 2007).

Materials and Methods

Healthy seeds of *P. macrophylla*, *T. africana*, *P. gratesima*, *T. occidentalis* and C. *nucifera* were collected from Isiala Ngwa, Abia State Nigeria between June and November, 2006. They were taken to the department of Biochemistry Abia State University, Uturu. The seeds were authenticated by a taxonomist. They were dehauled (where applicable) sun-dried, wrapped in polyethylene bags and kept in a desiccators until needed.

Extraction of oil: Exactly 300g each of the samples were milled into paste using thermal Willey Mill (model Ed-5), the paste was transferred into a thimble and oil extracted using normal hexane in vacou with soxhlet apparatus. The extracting solvent was evaporated leaving the concentrated oil sample for analysis. Extracted oil was quantified gravimetrically.

Chemicals used: All chemical used were of the analytical grade and products of British drug House Poole England.

Statistical analysis: All extractions and analysis were performed in triplicates. Results were expressed in mean±S.D. statistical significance was established using Analysis of variance (ANOVA). Means were separated according to Duncans multiple range analysis ($p<0.05$).

Experimental: Specific gravity was determined using specific gravity bottle according to the method described by Pearson, 1980.

Iodine value (Wiji's method), saponification number, acid value, peroxide values were as recommended by the AOAC, 1984.

For Iodine value of each sample 0.20g of oil was dissolved in 15 mL carbon tetrachloride in 100 mL glass stoppered flask. 25 mL of Wiji's solution was added, the flask stoppered and allowed to stand for 2 hours in the dark at 25°C 20 mL of 10% potassium iodide (kI) solution was added and mixture titrated with 0.2N sodium thiosulphate ($Na_2 S_2 O_3$) using starch indicator. A blank determination was carried out and the Iodine value calculated using the formula

$$\text{Iodine value} = \frac{12.69N\,(V_2-V_1)}{W}$$

Where N = Normality of thiosulphate
V_1 = Volume (mL) of thiosulphate solution used in test.
V_2 = Volume (in mL) of thiosulphate solution used in blank
W = Weight of sample (0.20g).

Saponification value of the oil samples were determined as described below: 1g of each oil was dissolved in 12.5 mL of 0.5% ethanolic KOH and the mixture refluxed for 30 minutes. 1 mL of phenolphthalein indicator was added and the hot soap solution titrated with 0.5N HCl. A blank determination was also carried out under the same condition and saponification value determined using the equation.

$$\text{Saponification value} = \frac{56.1N\,(V_1-V_2)}{W}$$

Where N = Normality of Hydrochloric acid used
V_1 = Volume of Hydrochloric used in test
V_2 = volume of Hydrochloric acid used in blank
W = Weight of oil used (1g)

For peroxide value (Pv), 1g of each oil sample was weighed into a 200 mL conical flask then 25 mL of 2:1 v/v glacial acetic acid chloroform solvent was added 1 mL of saturated potassium iodine was then added and mixture left in the dark for 1 minute. Next, 30 mL of water was added and the mixture titrated with 0.02N thiosulphate solution using 5 mL starch as indicator. A blank determination was similarly carried out.

Pv was calculated from the equation

$$\text{Peroxide value (PV)} = \frac{\{100\,(v_1-v_2)\ \text{meg/kg}\}}{W}$$

W = weight of sample
V_1 = volume (mL) of thiosulphate used in test
V_2 = volume (mL) of thiosulphate used in blank
N = Normality of thiosulphate ($Na_2S_2O_3$)

Acid value was determined for each oil sample by dissolving 0.20g of each oil in 2.5 mL of 1:1 v/v ethanol: diethylether solvent and titrating with 0.1N sodium hydroxide while swirling using phenolphthalein as indicator. Calculation is as follows

$$\text{Acid value} = \frac{\{56.1\times N\times V\}}{W}$$

Where N = Normality of NaOH used
V = Volume (mL) of NaOH used
W = Weight of sample used

Percentage free fatty acid (%FFA) as oleic) was determined by multiplying the acid value with the factor 0.503. Thus %FFA = 0.503×acid value.

Results and Discussion

The studied physical properties of oil extracts of five Nigerian seeds are shown in Table 1. The n-hexane extractable oil from the four seeds were lower than the 32.00±0.40% obtained for coconut in this study. The percentage oil yield were 20.80±1.20% for *P. macrophylla*, 18.00±1.00% for *T. africana*, 16.00±0.20% for *P. gratesima* and 18.00±2.00% for 1. *occidentalis*. The oil yields for the five studied seeds except (*P. gratesima*) are equal to or higher than 18% reported for soyabean but lower than 43% reported for groundnut seed (Ene-Obong and Carnovale, 1992; Apata and Ologhobo, 1994). They are however, higher than 12.00±0.28 reported for seeds of C. *albidum* an under exploited plant found in Nigeria (Akubugwo and Ugbogu, 2007). The oil yields of all the seeds may be classified as average yielding except for C. *nucifera* seed which is high oil yielding. At room temperature (29°C) all the seed oil are liquids. The Avocado pear oil is Reddish brown while the other seed oils are pale to yellow in colour. The specific gravity of the oils ranged between 0.81 for *T. africana* and 0.90 for *P. gratesima* oil. These values are within the range of specific gravities reported for other fats and waxes (Ajayi and Oderinde, 2002). None of the seed oils had offensive odour.

The chemical properties of the studied seed oils are shown in Table 2. It indicates that the iodine values ranged from 9.60±0.02 in C. *nucifira* to 52.40±2.0 in *P. gratesima*. These values classify the oils as non drying. The relatively low iodine numbers may be indicative of the presence of few unsaturated bond and low susceptibility to oxidative rancidity (Eka, 1980). Acid value is used as an indicator for edibility of oil and suitability for use in the paint industry. The acid value ranged from

Table 1: Physical Properties of oil extracts of five selected Nigerian seed oils

Plant	Percent oil yield	Specific gravity	State at 29°C	Colour	Odour
Pentaclethra macrophylla	20.80^{C}±1.20	0.89^{a}±0.02	Liquid	Yellow	Agreeable
Treculia africana	18.00^{b}±1.00	0.81^{a}±0.02	Liquid	Yellow	Agreeable
Persea gratesima	16.00^{a}±0. 20	0.90^{a}±0.02	Liquid	Reddish brown	Agreeable
Telferia occidentalis	18.00^{b}±2.00	0.83^{a}±0.02	Liquid	Yellow	Agreeable
Cocos nucifera	32.00^{a}±0.40	0.86^{a}±0.01	Liquid	Pale Yellow	Agreeable

Figures are mean±S.D. Figures bearing different alphabets differ significantly ($p<0.05$): N = 3

Table 2: Chemical Properties of oil extracts of five selected Nigerian seed oils

Plant	Acid value (Meq kg^{-1})	Percentage free fatty acid	Peroxide value	Iodine value	Saponification value
Pentaclethra macrophylla	2.81^{a}±0.01	1.40^{a}±0.01	2.35^{b}±0.41	20.50^{b}±2.0	209.40^{C}±5.0
Treculia africana	8.41^{b}±0.01	4.22^{b}±0.01	1.75^{a}±0.70	27.50^{C}±1.5	212.90^{C}±5.10
Persea gratesima	11.46^{C}±0.16	5.77^{C}±0.07	5.73^{C}±0.22	52.4^{d}±2.0	106.60^{a}±3.60
Telferia occidentalis	3.97^{a}±0.09	1.98^{a}±0.03	2.90^{b}±0.50	49.4^{a}±2.0	158.40^{b}±3.40
Cocos nucifera	11.31^{C}±0.12	4.80^{b}±0.06	0.39^{a}±0.08	9.60^{a}±0.02	246.00^{d}±4.20

Figures are mean±S.D. Figures bearing different alphabets differ significantly ($p<0.05$) according to Duncan's Multiple range analysis N = 3

2.81±0.01 for *P. macrophylla* to 11.46±0.16 for *P. gratesima*. Pearson (1976), reported acid values of 4 for sesame, soybean, sunflower and rape seed and 7 for olive seed oil. Free fatty acid values of less than 3 were obtained for *P. macrophylla* and *T. occidentalis* seed oils are within allowable limits for edible oil while the value for *T. africana*, *P. gratesima* and *C. nucifera* are slightly above (Eckey, 1954). The oils could therefore be used as edible oils.

Peroxide values of less than 6 were obtained in all the seed oils. Peroxide value is used as an indicator of deterioration of oils. Fresh oils have values less than 10 mEqkg. Values between 20 and 40 result to rancid taste (having a disagreeable odour) (Pearson, 1976).

Saponification value is used in checking adulteration. Saponification values were *P. gratesima* 106.60±3.60, *T. occidentalis* 158.40±3.40, *P. macrophylla* 209.40±5.0, *T. africana* 212.90±5.10 and C. *nucifera* 246.00±4.20. The relatively high saponification value recorded for all the seed oils is indicative that they have potential for use in the industry (Amoo *et al.*, 2004).

Conclusion: All the physicochemical properties of the seeds oils studied compared favourably with coconut oil and other conventional seed oils such as groundnut and soyabeans. Their colour and odour are agreeable. The seed oils therefore have potential for development for use as industrial oils.

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