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Physicochemical Studies on Oils from Five Selected Nigerian Plant Seeds

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Abstract: Oils were extracted from four underutilized seeds of the Nigerian plants *Chrysophylum albidum, Dacryoides edulis, Landolphia owariensis* and *Napoleona imperialis* using n-hexane and their physicochemical properties compared with oils from seeds of *Elaeis guinensis*. Percent oil yield were 12.00, 15.80, 6.40 and 8.00 for *C. albidum D. edulis, L.* owariensis and *N. imperialis* respectively while the value for *E guinensis* seed is 28.00. The four seed oil were odourless and at room temperature liquids as against *E. guinensis* seed oil that were semi-solid under the same condition. Specific gravity of the seed oils ranged from 0.82-0.94 while peroxide value for all the oil extracts except that from *D. edulis* seed were less than three. Saponification values were as low as 42.40 in *L.* owariensis and as high as 246.60 in *E. guinensis* seed oils. Iodine values were between 15.10 and 45.00 in the extracts. These results suggest that *C. albidum* and *D edulis* seeds may be viable sources of oil going by their oil yield. However the studied characteristics of all oils extracts in most cases compared favourably with *E. guinensis* seed oil which is presently used for many domestic and industrial purposes in Nigeria.

Key words: Nigerian seeds oils, physicochemical properties, palm kernel oil, conventional seed oils

Introduction

Trees and shrubs with medicinal and nutritional potentials abound in Nigeria (Burkill, 1985). Several of these plants have fruits which have been identified to be nutritionally important (Ihekoronye and Ngoddy, 1985).

In recent times, the desire to conserve resources spent on importation of oil for domestic and industrial use gave renewed impetus in the search for novel sources to complement the traditional ones. Attention has therefore, been focused on under-utiliised local seeds for possible development and use. There are several of these under-exploited plant seeds in Nigeria.

Chrysophyllum albidum Linn (African Star apple) belongs to the family sapotaceae. It is found in many ecozones of Africa, Nigeria inclusive (Bada, 1997). Its leaves are used in ethnomedicine (Adewusi, 1997). The fruit pulp is rich in iron and vitamin C and is good source of raw material for some industries (Asenjo, 1946; Cenrad, 1999; Adisa, 2000). While the pulp is eaten, the seeds are usually thrown away.

Dacryodes edulis G.don (African pear) is a Burseracea and has many medicinal and nutritional uses (Burkill, 1985). The fruit pulp is eaten and the seeds usually thrown away (Ajayi and Oderinde, 2002). Obasi and Okolie (1993) studied the potential of the seeds for food supplement.

Landolphia owariensis P.Beauv (Vine rubber) belongs to the family apocynacea. It has many medicinal and nutritional uses (Gill, 1992; Ebi and Ofoelue, 1997; Owoyele *et al*., 2001). The fruit pulp which is contained in a pod is eaten and the seeds usually thrown away.

Napoleana imperidis is of the family Lecythidacea. Its leaves have many medicinal uses. (Obute, 2005) the pulp is eaten and the seeds, thrown away.

Eleais guineansis (Palm tree) is commercially very relevant. The nutritional uses. The palm kernel all (PKO) is particularly useful.

Therefore, except for *E.guinensis* seed, the potential of the other four plant seeds are presently under-exploited. The present study was therefore undertaken to explore their potential as possible sources of oil for domestic and industrial uses, relative to the established potentials of palm kernel oil (PKO) from *E.guineensis* seed.

Materials and Methods

Healthy seeds of *C. albidum*, *D. edulis*, *E. guineanisis L. Owariensis* and *N. imperialis* were collected from Isiala Ngwa, Abia State Nigeria between January and June, 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 desiccators until needed.

Extraction of oil: 250g each of the seed samples were milled into a 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 chemicals 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±SD. Statistical significance was established using Analysis of Variance (ANOVA). Means were separated according to Duncan's 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, peroxide values were as recommended by the AOAC 1984.

For iodine value of each sample, 0.20g of oil was dissolved in 15ml carbon tetrachloride in 100ml glass stoppered flask. 25ml of Wiji's solution was added, the flask stoppered and allowed to stand for 2 hours in the dark at 25°C. 20ml of 10% potassium iodide (KI) solution was added and the mixture titrated with 0.2N sodium thiosulphate ($Na_2S_2O_3$) using starch indicator. A blank determination was carried out and the iodine value calculated using the formular:

Iodine value = $12.69N \quad V_2\text{-}V_1 / W$

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 12.5ml of 0.5% ethanolic KOH and the mixture refluxed for 30 minutes. 1ml of phenolphthalein indicator was added and the hot soap solution titrated with 0.5NHCL. A blank determination was also carried out under \the same condition and saponification value determined using the equation;

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

Where N = Normality of Hydrocloric acid used
V_1 = Volume of Hydrochloric acid 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 weighted into a 200ml conical flask, then 25ml of 2:1 v/v glacial acetic acid: chloroform solvent was added. 1ml of saturated potassium iodide was then added and mixture left in the dark for 1 minute. Next, 30ml of water was added and the mixture titrated with 0.02N thiosulphate solution using 5ml starch as indicator. A blank determination was similarly carried out. PV was calculated from the equation.

Peroxide value (PV) = $[100(V_1\text{-}V_2)$ 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 ($Na_2 S_2O_3$).

Acid Value was determined for each oil sample by dissolving 0.20g of each oil in 2.5ml 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:

Acid Value = [56.1 x N x 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 etermined by multiplying the acid value with the factor 0.503. Thus % FFA = 0.503 x acid value.

Results and Discussion

The studied physical properties of seed oil from the five plant are shown in Table 1. The n-hexane-extractable oil from the four underexploited seeds were lower than the 28.00% obtained for palm kernel in this study. The percentage oil yield were 15.30±0.10% for *D.edulis;* 12.00±0.90 for *C. albidum;* 8.00±0.05 for *N. imperialis* and 6.40±0.80 for *L.Owarieusis* The oil yield obtained for *D edulis* seed in this study is higher than the 10.44±0.80% reported by Ajayi and Oderinde 2002).

The oil yields for the five studied seeds (except *E guinensis* seed) are lower than 18% reported for soybean seed and 43% for groundnut seed (Ene-Obong and Carnovale 1992; Apata and Ologhobo, 1994). They are however, higher than 1.42±0.03% reported for seeds of *Piliostigma thonningii* - another under exploited plant found in Nigeria (Jimoh and Oladiji, 2005). The oil yields for *C. albidum* and *D. edulis* seeds may classify them as average yielding while *L. owarienssis* and *N. imperialis* seeds are low yielding: *E guinensis* seed is high yielding.

At room temperature (29°C) all the seed oil (except palm kernel oil which is semi solid) are liquids. They palm kernel oil is milk white while the other seed oil are pale to dark yellow in colour. The specific gravity of the oils ranged between 0.82 for *L. owariensis* seed oil to 0.92 for *N. imperalis* seed oil. These values compare with 0.82 and 0.84 reported for the pulp and seed oil of *D. edulis* respectively by Ajayi and Oderinde (2002). Non of the seed oils had offensive odour.

The chemical properties of the studied seed oils are shown in table 2. It indicate that the iodine values ranged from 15.10±0.08 in *L. owariensis* to 45.86±80±2.00 in *N. imperialis*. These values classify the oils as non drying. Similar non-drying oil values have been reported for

Table 1: Physical Properties of five selected Nigerian Seed Oils

	Percent oil yield	Specific gravity	Slate at 29°C	Colour	Odour
Chrysophyllum albidum	12.00±0.28^{c}	0.92±0.17^{a}	Liquid	Pale yellow	agreeable
Dacryodes edulis	15.30±0.10^{d}	0.87±0.03^{a}	Liquid	Dark Yellow	agreable
Elaeis guineensis	28.00±0.17^{e}	0.88±0.01^{a}	Semi solid	Milk white	agreable
Landolphia owariensis	6.40±1.00^{a}	0.82±0.04^{a}	Liquid	Yellow	asgreable
Napoleana imperialis	8.00±0.22^{b}	0.90±0.17^{a}	Liquid	Dark yellow	agtreable

Figures are mean ±SD. Figures bearing different alphabets differ significantly (P< 0.05): N=3

Table 2: Chemical Properties of five selected Nigerian seed oils

Plant	Acid value mEqKg^{-1}	Percent Free Fatty acid	Peroxide value	Iodine value	Saponification value
C. albidum	3.56±0.20^{a}	1.76±0.10^{a}	1.80±0.28^{a}	31.06±0.80^{c}	
D. edulis	5.56±0.07^{b}	2.78±0.02^{b}	21.23±1.50^{c}	40.20±2.50^{d}	191.10±3.80^{c}
E. guinensis	14.04±0.22^{c}	7.06±0.01^{c}	2.12±0.41^{a}	18.30±1.10^{b}	246.60±4.20^{d}
L. owariensis	15.33±0.27^{c}	7.70±0.11^{c}	2.80±0.50^{b}	15.10±0.80^{a}	42.40±3.00^{a}
N. imperialis	15.15±0.16^{b}	2.60±0.07^{b}	1.55±0.35^{a}	45.80±2.00^{e}	77.06±40^{b}

Figures are mean ±SD. Figures bearing different alphabets differ significantly (P< 0.05) according to Duncan's multiple range analysis N = 3.

D. edulis pulp and seed and *Cucurbita maxima* seed (Ajayi and Oderinde, 2002; Amoo *et al.* 2004). This non-drying" attribute qualifies them for use in the paint industry (Dosumu and Ochu, 1995). The iodine value is also an index for assessing the ability of an oil to go rancid (Eka, 1980, Amoo *et al.*, 2004). The iodine values obtained in this study indicate that the oils contain appreciable level of unsaturated bonds. Storage procedure used should ensure protection of oil from oxidative deterioration.

Acid value is used as an indicator for edibility of oil and suitability for used in the paint industry.

The acid values of the seed oils ranged from 3.56±0.20 for *C albidum* to 15.33±0.20 for *L. owariensis*. The obtained acid value for palm kernel oil is 14.04±0.022. Pearson (1976), reported acid values of 4 for sesame, soybean, sunflower and rape seed and 7 for olive oil.

Free fatty acid values of less than 3 were obtained for *C. albidum, D. edulis* and *N. imperalis* seed oils are within allowable limits for edible oils while the values for *E. guinensis* and *L. owariensis* are slightly above (Eckey, 1954). The oils could therefore be used as edible oils.

Peroxide values of less than 3 (except for *D. edulis*) seed oils were obtained. The high value (21.23±1.5) recorded for *D. edulis* seed oil can be reduced by alkaline refining. The peroxide value is used as an indicator of deterioration of oils. Fresh oils have values less than 10 mEq Kg^{-1}. Values between 20 and 40 result to rancid taste.

Saponification value is used in checking adulteration. Saponification values were *L. owariensis* 42.40, *N. imperalis* 77.40 C. albidum 126.30, *D. edulis* 191.10, and *E. guinensis* 236.70. The low saponification value obtained for. *L. owariensis* and *N. imperalis* suggests that they may not be industrially, useful. The relatively high value recorded for the other three seed oils is indicative that they have potential for use in the industry. (Amoo *et al.*, 2004).

Conclusion: Based on the extractable oil the seeds can be classified as high (*E. guinensis*, average (*C. albidum, D.* edulis) as low (*L. owariensis*), *N. imperalis*) yielding. Many of physicochemical properties of the seed oils studied compared favourably with palm kernel oil and other conventional seed oils such as groundnut oil, and soybean. Their colour and odour are agreeable. The seed oils therefore have potential for development for use as domestic and industrial oils.

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