

Full Length Research Paper

# The Physiochemical properties and fatty acid profile of oil extracted from *Irvingia gabonensis* seeds

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The physiochemical and fatty acid profile of the oil extracted from *Irvingia gabonensis* was determined. Soxhlet extraction method using n-hexane as solvent was employed for the extraction. The extraction process yielded 65% of oil. The physiochemical determination was done using standard method while fatty acid profile was done using Gas Chromatographic technique. The result of the study is as follows: Relative density (0.82), pH (6.19), Saponification value (182.3 mgKOH<sup>-1</sup>), Iodine value (4.17/100 g Fat), Peroxide value (3.02 mgEqKg<sup>-1</sup>). The fatty acid profile of the oil revealed the presence of six fatty acid fractions viz: C14:O(51.85%), C12:O(35.12%), C16:7.95%, C10:O(1.01%), C18:0(0.62%) and C18:1(2.99%). The overall result revealed that the oil is highly unsaturated and thus should not be consumed in high quantity by cardiovascular patients.

**Key words:** Physiochemical, fatty acid, *Irvingia gabonensis*, chromatographic technique.

## INTRODUCTION

*Irvingia gabonensis* is a non timber forest product made up of tree trunk, leaves, roots and fruits. The fruits comprise of a fleshy part and the nut which consist of a hard shell and the kernel seed (Ladipo, 1995). Their seeds have an outer brown testa (hull) and two white cotyledon. They belong to plat of irvingiaceae family and a subfamily simaraoubaceae (Okafor, 1978; Harris, 1996).

They are commonly called bush mango, Africa mango, wild mango or dikanut plant and also locally called Ujuru (Enugu-Ezike), Ogbono (Ibo), Ororgbije (Yoruba) and mangoron kurmi (Hausa) of Nigeria and Ewewe (Gabon) (Okafor 1978).

The juicy fruit pulp of *Irvingia gabonensis* is rich in Vitamin C and is widely reported to be consumed as a

dessert fruit or snacks through Western and Central Africa (Ejiofor, 1994; Leaky et al., 2005). The *Irvingia gabonensis* pulp can be used in making jam, jelly and juice (Ejiofor, 1994; Okolo et al., 1999).

*Irvingia* seeds constitute an important part of the rural diet in Nigeria. Usually the sun dried seeds are ground in flour and used as soup thickener (Ayuk et al, 1999).

Fats extracted from the kernels are used for food applications such as in margarine or cooking oil and also suitable for soap, cosmetics and pharmaceuticals (Ejiofor et al., 1987). Agbor (1994) stated that the roots, leaves and bark of *Irvingia* spp. are used medically. *Irvingia gabonensis* bark is mixed with palm oil for use in the treatment of diarrhea and is taken by women to shorten their breast feeding period (Ngodi et al., 2005). It is thus pleasantly surprising that almost all part of this plant is useful and hence our interest in investigating further the physiochemical and fatty acid profile of the oil extract from the so as to unravel more useful properties and possible application of the oil.

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## MATERIALS AND METHODS

### Sample collection

*I. gabonensis* seeds were collected from Late Musa Omeh's community farm in Olido Enugu-Ezike, Igbo-Eze Local Government Area of Enugu State of Nigeria. The seeds of the plant were identified by Mr. Nwogbaga Andrew, a botanist at Ebonyi State University, Abakiliki, Nigeria. Voucher specimen was deposited at the Herbarium of the same Department.

### Sample preparation

The fruits were harvested manually from the tree and the seeds taken out fresh from the kernel after splitting it open with a knife. The fresh seeds are then collected, washed clean and air dried for 72 h to remove moisture. The dried seeds were reduced into small sizes with Electric hopper and ground into powder using electric blender. The powdered seed were sieved using 2 mm steel and stored in a labeled plastic container until required for analysis.

### Oil extraction procedure

The Franz von Soxhlet extractor method described by AOAC (2000) was used for the extraction and determination of the percentage oil yield.

Five grams (5.0 g) of the powdered seeds was wrapped in a weighed filter paper and placed in the thimble and about 200 ml of normal hexane was poured into a weighed round bottomed flask. The hexane was heated to boil with electrothermal heater for 4 h continuous extraction. The defatted sample was removed and solvent recovered. The flask and its oil content was further dried in the oven at 60°C for 30 min and cooled in a desiccator. The flask and its content were reweighed to determine the weight of the oil. The experiment was repeated two more times to get an average. The percentage oil yield was obtained by expressing the oil weight as a percentage of the weight of the sample.

### Physiochemical analysis

The physiochemical parameters were determined using standard methods of analysis. The parameters analyzed include:

Specific gravity (Pycrometer bottle method)

Melting point (Fisher-John melting Apparatus)

Setting Time (Pour point Refrigerator)

Smoke, Flash and Fire point

pH Determination (pH meter method)

Acid value (AOAC, standard 969.17, 1997);

Saponification value: Saponification value was determined according to AOAC Official Method 920.160, 1997.

Unsaponifiable matters (AOAC method, 1997)

Iodine value (Iodine value of seed oil was determined according to AOAC Official Method 993.20, 1997.

Peroxide value (AOAC method, 1997)

All the experiments were conducted trice and an average taken to get the values.

### Fatty acid profile

The fatty acid profile was determined using Gas Chromatographic technique. After saponification, the methyl esters of constituent fatty acid was prepared using methanol and boron fluoride catalyst and then separated and identified by Gas chromatography. Fatty acid separation, detection and identification were carried out in gas chromatographer model HP5890 series 11. Potassium hydroxide prepared in 2 N of methanol was added to one gramme of the oil sample to saponify the oil. The oil was emulsified by addition of prepared conc.HCL with methanol (1:4) in a soap solution. This is followed by the addition of n-heptane to select the oil. Brine was added to salt out the outer composition. 0.5 µl micro syringe was used to measure out the sample extract and to inject into the chromatographer. After 10 min, the fatty acids were indentified in a graph, having peaks, area and carbon numbers. Fatty acid are indentified by comparing retention time (tr) of the methyl esters of the fatty acid with that of authentic fatty acids. All the assays were done in triplicates and the average calculated. The experimental data were analysed using one-way analysis of variance (ANOVA) and Duncan Multiple Test Range. Differences were considered significant at  $P \leq 0.05$ .

## RESULTS AND DISCUSSION

The oil appeared butter-yellow in colour, showing that it contains some pigments that may be of biological importance and thus can be recommended for nutritional and medicinal purposes. Since the oil has no smell, any case of adulteration can be easily detected.

The results obtained for the physiochemical and fatty acid analysis of the *I. gabonensis* oil are shown in Tables 1 and 2.

The observed oil yield of 65% in *I. gabonensis* is

**Table 1.** Physicochemical properties of the *Irvingia gabonensis* oil.

Properties	Value
Specific gravity	0.88
Relative density	0.82
Refractive index	1.48
Melting point	13°C
Setting point	21°C
Smoke point	78°C
Flash point	120°C
Fire point	168°C
pH Value	6.19
Acid value	22.36 mgKOHg <sup>-1</sup>
Saponification value	182.32% FFA as Oleic
%Unsaponifiable	0.44
Iodine value	4.17/100 g Fat
Peroxide value	2.02 mEq/kg
%Yield	65

**Table 2.** The fatty acid profile of *I. gabonensis* oil.

Fatty acid fractions	%Concentration
C10:0	1.01
C12:0	35.12
C14:0	51.85
C16:0	7.95
C18:0	0.62
C18:1	2.99

indicative that the seed is a good source of oil. The specific gravity of Irvingia oil of 0.88 and the values of the smoke, flash and fire points were probably as a result of increase in chain length and thus high molecular weight (Christie, 1982). The pH of 6.19 and the acid value of 22.36 mgKOHg<sup>-1</sup> observed in the oil shows that the oil is acidic and thus highly recommended for soap making and other cosmetic application because these level of acidity are compatible with the skins acid mantle which is about 5.5 (Reiger, 1986). High acid value can also be indicative of poor storage methods. The saponification value of 182.32 mgKOHg<sup>-1</sup> for Irvingia oil is in agreement with the earlier finding by (Omogboi, 1990). The iodine value of 4.17/100 g fat indicates that the oil is highly saturated and falls into the class of lipid called non-drying oil (0-100). The peroxide value of 2.02 also shows that the oil is saturated and may not be so reactive as to go rancid. It may also indicate that the oil did not stay long before the analysis was carried out, thus the oil is stable (Pearson, 1976). The low percentage (0.44) of

unsaponifiable matters shows that the levels of sterols, carbohydrates and higher alcohols are very low, thereby classifying the oil as of normal purity. With a melting point of 13°C the oil is expected to be liquid at room temperature but surprisingly the oil is solid, this variation may be due to its high molecular weight, increased chain length and thus high density. The analysis of the fatty acid profile also suggests that the oil is highly saturated as can be seen in Table 2. The most abundant fatty acid in the Irvingia oil are Myristic (C14:0), Lauric (C12:0) and Palmitic acid (C16:0) with myristic and lauric adding up to 86.97% (Womeni et al., 2006a; Womeni et al., 2006b). This level of saturation may have resulted in the oil becoming solidified at less than room temperature (26 to 28°C). Also due to their level of saturation it will not be advisable for cardiovascular patients to consume the oil or the seed in high quantity which unfortunately is widely consumed as soup thickener in Nigeria.

In Conclusion, the oil extracted from *I. gabonensis* shows high level of saturation and the analysis revealed

that it is rich in myristic and lauric acid which makes it very suitable for cosmetics and pharmaceuticals. Nutritionally it may not be recommendable to individuals with cardiovascular disposition. We hereby recommend that further studies should encompass the characterization of the pigments that made the oil to appear yellow.

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