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PHYSICOCHEMICAL CHARACTERISTICS OF *Gambaya albidium.* Linn SEED OIL

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ABSTRACT

In recent times, the use of vegetable oil extracted from seeds played an important role in industrial products and food items, however, the availability of these raw materials varies, so the search for new sources of novel oils is required. This study, therefore, investigated the Physicochemical properties of *Gambaya albidium* seed oil to determine its potential as a viable feedstock in manufacturing industries and also domestic use. The seed oil of *Gambaya albidium* was extracted using n-hexane as extracting solvent, at a temperature of 65 °C for 3-4 hours. The oil was characterized for iodine value, acid value, saponification value, peroxide value, free fatty acid, color, odor, ash content, pH, moisture content, and specific gravity using standard methods. The results obtained showed the oil to have a fine colour, be in the liquid state at 28 °C, and sweet-smelling indicating a viable source of edible oil. The iodine value which is the measure of the degree of unsaturation was found to be 50mg/100g classifying it as a non-drying oil useful in soap making, food products, and lubricating oil. It has a low peroxide value of 1.32meq/KOH/indicates that it cannot deteriorate easily thus can be stored over a long period while the acid value and free fatty acid value of 4.70mg/KOH/g and 2.25mg/KOH/g respectively indicate its freshness and edibility. The saponification value which is 192.70mg/KOH/g indicates its usability in cosmetics and food manufacturing industries. It has an ash content of 2.10 and a moisture content of 3.40 % all of which indicates that *G. albidum* seed oil can, therefore, be used for both domestic and industrial purposes as against the disposal of the seeds after consumption, thereby turning waste to wealth.

Keywords: Physicochemical, Seed oil, Extraction, *Gambaya albidum*

Introduction

The extraction and use of vegetable oils have for centuries played an important role in the manufacturing of a large number of industrial products and food items (Puangsri *et al.,* 2005). Nigeria, as a tropical country has a wide variety of domestic plants that produce oil-bearing seed of sufficient volume potential; for example, edible seed like Soy bean, peanut, and corn, although not all seed oil is edible (Frank, 1998, O'Berien 1998, Sangha *et al.,* 2004)

However the availability of these raw materials varies, so the search for new sources of novel oils is required. Several plants are now growing, not only for food and fodder but also for the striking range of products with industrial applications (Miladi *et al*., 2008). The chemical composition of the oil extract consequently gives a qualitative identification of oils and is a very important area in the selective application guide for the commercialization and utility of oil products. Fats and oils are also very important indigenous raw materials for many edibles and non-edible purposes (Ali *et al.,* 2008).

Gambaya albidum is a very common tropical perennial non-timber producing trees in the forest. It is known as African Star Apple and distributed in tropical rain forest and coastal region of West Africa. It is an edible tropical fruit known by various tribal names. It is called Utieagadava in Urhobo, agbalumo in Yoruba, udara in Ibo, Efik and Ibibio, ehya in Igala, agwaluma in Hausa tribes of Nigeria . The skin of the seed is orange or golden yellow when ripe and the pulp within the peel maybe orange, pinkish or yellow while the seeds are dark brown or blackish, obliquely ellipsoid to obovoid and it is about 2.88cm long and 1.2cm wide. The coats of the seed are hard, bony, and dark brown and when broken it unveils the white-colored cotyledons (Jayeoba *et al*., 2007; Ehiagbonare *et al*., 2008; Emanuel and Francis, 2010). The seed has been discovered to contain vitamin, iron, flavors and are a very essential source of oil that can be used for diverse purposes especially in manufacturing industries as major raw-materials (Okafor *et al.,* 1981). Report from Derksen *et al*., (1996) and Ahmed *et al.*, (1996) indicate that apart from its industrial uses, petroleum and coat can also be obtained from seed oil. It is strongly opened that if fossil fuel should suddenly become unavailable, the oil derived from the seed could be used to run tractors, turbines, and other agriculture implements. This study therefore find it necessary to ascertain physicochemical characteristics of Gambaya albium seed oil

Materials and Methods

Sample Collection and Preparation

Fresh fruits of *G. albidum* were procured from a local market at Ibadan, Oyo State, South-Western Nigeria. The seeds were removed and dehulled mechanically to separate the seed coat from the seed. The seed coat was cracked and cotyledon removed, air-dried for a week under ambient condition, and shredded using a blender.

Oil Extraction

Two hundred (200 ml) of n-Hexane was poured into a round bottom flask. 30 g of sample was placed in the thimble and was inserted in the center of the extractor. The Soxhlet was heated at 65 ^{o}C. When the solvent was boiling, the vapor rises through the vertical tube into the condenser at the top. The liquid condensate drips into the filter paper thimble in the center, which contains the solid sample to be extracted. The extract seeps through the pores of the thimble and fills the siphon tube, where it flows back down into the round bottom flask. This was allowed to continue for 3 h. it was then removed from the tube, allowed so cooled and weighed to determine the amount of oil extracted (Adegoke et al., 2015).

The oil was filtered and distilled using a rotary evaporator. The oil was weighed and placed in an air-tight container. The resulting oil was later heated to recover the solvent from the oil in accordance to Manzoor *et al.* (2007).

Physicochemical Analysis

The colour, odour, and physical state of the oil were estimated using the sensory evaluation while the percentage oil yield was calculated. The moisture content was evaluated by oven drying, the pH, using pH meter, specific gravity using specific gravity bottle, ash content using a furnace to heat to dryness. The other analysis like saponification values were determined using titrimetry method by Palm Oil Research Institute of Malaysia (Anon, 1995) acid value, iodine value and peroxide were determined using titrimetry according to FAO, (1991) while percentage free fatty acid (as oleic) was determined by multiplying factor 0.503 by the acid value (Ejilah and Asere, 2009; Ibeto *et al.*, 2012).

Results and Discussion

Table 1 presents the physical properties of the extracted oil. The physical appearance of the oil is deep red, pleasant smelling agreeable of edible oils and in liquid form at 28 ^{o}C. However, Abdullahi *et al.* (1991) reported groundnut and neem to have an oil yield of about 46 % which is far higher than the result obtained in this study of less than 12 %, this indicates that the seed may not be a good source of abundant oil but research can further be enhanced to genetically improve its oil yield. The refractive index of oils depends on their molecular weight, fatty acid chain length, degree of unsaturation, and degree of conjugation, it was found to be 1.46 which is close to the value obtained for the African apple seed oil (Ochigbo and Paiko, 2011), *Lannea kerstingii* seed oil (1.47) and also similar to the values of *Acacia senegal* (1.47) and *Lannea microcarpa* (1.47) and higher than *Phoenix canariensis* (1.45) seed oils (Oboh *et al.*, 2009 and Balley, 1982). This indicates that the oil is less viscous compared to most drying oils with refractive indices between 1.48 and 1.49 (Oluba *et al.*, 2008). The refractive index is positively related to iodine value, which is a measure of the degree of unsaturation of the oils and gives an idea of their oxidative stability. It also shows the level of optical clarity of crude oil samples relative to water, this indicates that the oil is as thick as most drying oils whose refractive indices fall between 1.475 and 1.485 according to Akinhanmi and Akintokun, (2008).

Table 1: Physical properties of the extracted oil

Characterization	Value
Specific Gravity	0.78
Odor	Agreeable
Colour	Deep red
Solidification Point	-20
State at 28 ◦C	Liquid
Refractive index	1.46 at 20 ◦C
Percentage of Oil Yield	11.78

Proximate Composition of Seeds

The chemical characteristics of the extracted oil reveals shown in table no. 2. The moisture content of the seed was 3.40 %, which is a bit low when compared with that of the non-edible oils which were up to 8.27 %, but far exceeding that of *Arachis hypogaea* oil (0.089 %) and also the stipulated ASTM standard (0.05 %) (Ibeto *et al.*, 2012) and therefore beneficial for prolonging the shelf life of the seed oil. The ash content of the oil was of the considerable quantity being up to 2.1 % but a bit higher than the trace amount in *Arachis hypogaea* oil and *Pentaclethra macrophylla* (Galadima *et al.*, 2008) but also exceeding the ASTM standard of 0.02 maximum.

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Table 2: Chemical properties of the extracted oil

Characterization	Value
Saponification	192.70meq/KOH/gram
Acid	4.70mg/KOH/g
Free Fatty Acid	2.36km/KOH/g
Peroxide	1.32meq/kg
Iodine	39mg/100g of sample
Ash content	2.10 ± 0.62
Moisture Content	3.4
pH	5.72

Chemical Composition of Seed

The iodine value of 39 mg/100 g of oil was lower than that of *Moringa oleifera* oil (65.90 g of I2/100 g) and those of olive, cotton, groundnut, and sunflower oils, which ranged from 86 to 145 g of I2/100 g of oil (Balley, 1982) but is in close agreement with the value 31.06 mg/100g from previous work on African star apple seed by Akubugwo and Ugbogwu (2007). The relatively low iodine value implies low nutritional value, but high oxidative stability.

Oils with iodine value above 125 are classified as drying oils; those with iodine value 110–140 are classified as semi-drying oils. Those with iodine value less than 110 are considered as non-drying oil thus *G. albidum* seed oil could only be classified as a non-drying oil. The low iodine value also indicates that the oil has a low content of unsaturated fatty acids thus resembling olive oil and groundnut oil, therefore, it could be employed for the manufacturing of soaps, lubricating oils and lighting candles which traditionally requires fats or saturated oils (Dosunmu and Ochu 1995) thus, the oil will not attract high interest in the paint and coatings industry unless it. This makes the oil an attractive option as it is lesser-known for commercial consumption and can also help minimize dependence on the use of known edible oils for making such products (Ochigbo and Paiko, 2011).

However, its Peroxide Value of 1.32 meq/kg is below the maximum acceptable value of 10 meg/KOH/g set by the Codex Alimentarius Commission for such oils as groundnut seed oils but close to the value obtained for *Lannea kerstingii* seed oil which was 0.99 meq (Oboh and Aluyor, 2009; Balley 1982), lower than that obtained for non-edible oils investigated by Ibeto *et al.*, (2012) which were in the range of 4.36–9.82 meq/kg, that of *Arachis hypogaea* oil (22.25 meq/kg), but close to that of jatropha seed oil (1.93meq/kg) and higher than shea-nut oil (0.28 meq/kg). Low peroxide values indicate the ability of the oil to resist lypolitic hydrolysis and oxidative deterioration (Akanni *et al.*, 2005) and higher values between 20 and 50 results to the rancidity of the oil (Akubugwo and Ugbogwu, 2007).

The Saponification value obtained (192.70 mg/KOH/g) compares favorably with values obtained for sesame seeds (189 to 190 mg/KOH/g) by Mohammed and Hamza, (2008) and some common oils like palm oil (196-200 mg/KOH/g), groundnut oil (188-196 mg/KOH/g), corn oil (187-196 mg/KOH/g) and 190.34 for *Psophocarpus tetragonolobus* seed oil (Ali *et al.*, 2008), but lower than that of coconut oil (253 mg/KOH/g) and palm kernel oil (247 mg/KOH/g) as reported by Pearson (1976), and shea-nut oil having 195 and also that of 193.55 for jatropha oil (Akbar *et al.*, 2009). It indicates the presence of a high percentage of fatty acids in the oil and therefore implies the possible potential for use in the soap making and cosmetics industry. The acid value and free fatty acid values which are a measure of the level of spoilage of oil, obtained are 4.70 and 2.36 mg/KOH/g and this agrees with those obtained by Akubugwo and Ugbogwu, (2007) for African star apple oil and also with Pearson, (1976) who reported acid values of 4.0 for sesame, soybean, sunflower, and rapeseed and 7.0 for olive oil. The low value obtained also indicates that the oil is fresh and edible.

Conclusions

It could then be concluded based on the results obtained from the physicochemical analysis of *G. albidum* seed oil that it can serve as an alternative source of raw material in the production of soap, lubricating oil, and lighting candles, this helps in reducing total dependence on other sources of oil and this also enhances the transformation of waste to wealth. Though this study observed a percentage yield of less than 12 %, this indicates that the seed may not be a good source of abundant oil but research can further be enhanced to genetically improve its oil yield.

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