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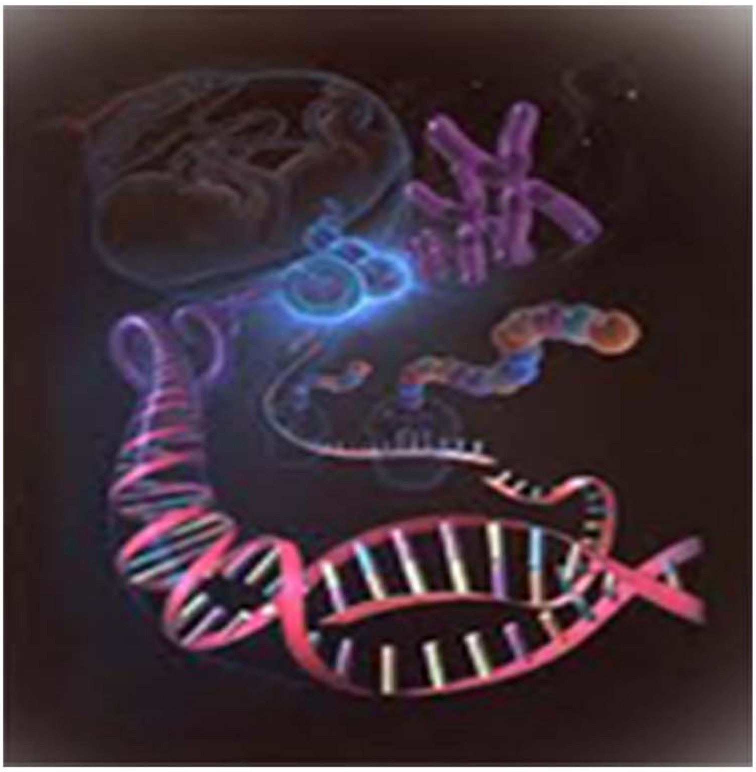

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Research Paper

PROXIMATE COMPOSITION, CHARACTERIZATION AND SPECTROSCOPIC ANALYSIS OF *LUFFA AEGYPTIACA* SEED

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This research aimed at determining the proximate composition of *luffa aegyptiaca* seed, characterization of its oil, and determination of the composition of the seed oil and seed coat oil using spectroscopic methods. The pulverized seed and oil from seed were analyzed. Results of the proximate analysis showed that the seed contains 7.5% moisture, 41% oil content. 2.0% ash, 7.5% crude fibre, 25.38% crude protein, 24.12% carbohydrate, and 567 kcal/g calorific value. Characterization of the seed oil showed that it contained 38.64 mg/g acid value, 19.32 mg/g free fatty acid, 1.33 meq/kg peroxide value, 23^{o}C melting point and saponification value of 231.41. The oil from the seed as well as from the seed coat was subjected to spectroscopic analyses which include Fourier Transform Infra Red spectra (FTIR) and Ultra-Violent /Visible spectra (UV) analyses. The results obtained from the (FTIR) analysis showed the presence of the functional groups such as O - H, N - H, C - H, C = C, C ≡ C and their various absorption at different wave lengths. Ultra violent/visible spectra analysis showed that both the seed oil and seed coat oil contained mainly unsaturated compounds.

Keywords: *Luffa aegyptiaca*, Seed-oil, Extraction, Characterization, Proximate composition and Spectroscopic analysis

INTRODUCTION

*Luff*a *aegyptica* (asisa) commonly called smooth loofah is classified under the cucurbitaceae family. The family Cucurbitaceae consists of members commonly known as melons and gourds that include cucumbers, squashes, luffas and melons. Cucurbits are among the economically most important vegetable crops (Loukou *et al.,* 2007). It is a climbing, hairy, smooth vine, reaching a length of 12 or more meters. Stems are four-angled. Leaves are rounded-ovate to kidney-shaped, 10-20 cm wide, shallow 5 to 7 anged or lobed, with pointed tips and heart-shaped bases. Calyx is green; corolla is yellow, 5-7 cm in diameter. Fruit is oblong, cylindrical, smooth and green. Seeds are black,

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1 cm long, and smooth (Burkill*,* 1985) Smooth loofa, sponge or vegetable vegetable gourd are very popular vegetables in China. *Luff*a a*egyptica* is a herbaceous annual climber or trailer to 6 m or more long, a cultivated plant but naturalized in all kinds of vegetation, and commonly found in countries where rainfall is high enough, but not excessive, or adequate watering can be given. Igbos call it *asisa* (Peter and George*,* 1986). The Luffa genus encompasses seven species among which two are domesticated: *Luffa aegyptiaca and luffa acutangula* (Achigan *et al.,* 2011)

The entire seeds are emetic. An aqueous or alcoholic emulsion is reported usefully anthelmintic and seeds are eaten for this purpose with meat in Quinea. The oil extracted are described variously as colorless, green, brownish green and dark red, perhaps depending on the method of extraction, and of a faint odor . It consists of a mixture of mainly linoleic, 43%, and oleic acids, 40%, with smaller amounts of palmatic, and stearic acids (Burkill, 1985). It is proposed as a good substitute for culinary olive oil and had been used in the USA in soap manufacture. The seed cake is bitter and toxic and is unfit for cattle feed, but by virtue of being rich in nitrogenous matter, 41% and phosphorus (P_2O_5), 1.8% could be used in agricultural fertilizers. The seed or oil is said in various countries to have medicinal uses.

Luffa is primarily grown for its fibre production. The young fruits and leaves can be cooked as vegetable (fruits can be used in India to make curry) or eaten fresh or dried. When the fruit matures it becomes fibrous: the fibre is used as sponge for washing and scrubbing utensils as well as the human body. In Central Africa, Luffa fibre is used to brush clothes. Luffa fibre can be used to make hats, soles of shoes, car-wipers, mats, sandals and gloves. The fibre has shock and sound absorbing properties that can be used in helmets and armored vehicles. The fibre can be used as a filter in engines or to treat water or palm wine (in Ghana). Fungal biosorbents can be immobilized on Luffa cylindrica sponges in order to absorb heavy metals from olive oil mill wastewater and other wastewaters. Luffa oil meal is suitable as a fertilizer (Dairo*,* 2008).

Luffa seeds and oil meal contain bitter substances toxic that may be toxic to livestock. As of 2014, successful use of luffa products has only been reported for luffa seeds in rabbits (Jimoh *et al.,* 2013) and for luffa oil meal African catfish *Clarias gariepinus* (Malzy*,* 1954). Luffa seeds can be extracted for their edible oil which is rich in linoleic acid and has a high unsaturated-saturated fatty acids ratio (Elemo *et al.*, 2011). The use of luffa oil meal was considered inadvisable in cattle (Achigan *et al.,* 2011). Leaves can be eaten by horses, cattle, sheep and goats (Ei-Hag *et al.,* 2013). Luffa fruits and foliage are palatable and browsed by goats (Joshi *et al.,* 2004).

Other authors (Botone *et al.,* 1994; Karaye *et al.,* 2012; Sangh *et al.,* 2012) have undertaken to study on this plant. This research, however, focused its study on the proximate analysis and characterization of *luffa aegyptica* seed and oil respectively to deduce the possible food values and industrial uses of this all-purpose plant. The spectroscopic analysis of seed oil and seed coat oil also provides additional information to the already existing literature on this plant.

MATERIALS AND METHODS

The *Luffa aegyptica* fruit was plucked dry from its shrub at Oby Okoli Avenue, Awka and at Nkwelle-Ezunaka village in Oyi local government Area, Anambra State, Nigeria.

Extraction of Oil from Seed

The sample seed was removed and air-dried for about 4 days after which the seeds were separated from its seed coat and was ground into powdered form. Solvent extraction method was used to obtain oil from *luffa aegyptica* seed using the soxhlet apparatus and n-hexane as the solvent, boiling at the temperature range of (40-60°C). Then analysis was carried out on the ground seed, seed oil, and on oil extracted from the seed coat: proximate composition of the seed was determined; oil from the seed was characterized, and the oil from both the seed and the seed coat were subjected to spectroscopic analysis.

Proximate Analysis of the Seed

The parameters that were determined include the following: Oil content, Ash, crude fibre, crude protein, moisture content as described by AOAC (1990) while carbohydrate was determined by difference: % Carbohydrate = 100 – (% Moisture + %Ash + %Protein + %Fat + %Fibre). For the crude protein, the total nitrogen was determined by a modified kjedahl method and the result was multiplied by 6.25 to give crude protein.

Characterization of Seed Oils

The oil was extracted using soxhlet extractor while the characterization (the acid value, Free fatty acid, the saponification Value, the Iodine Value and Peroxide Value of the seed oil) was determined by the AOCS (1960) methods.

Spectroscopic Analysis

Both oils from the seed and that from the seed coat were subjected to spectroscopic analysis. The FTIR was carried out using Fourier Transform Infra Red Spectrometer of the type Nicolect Avatar 330 FTIR while the ultra violet/visible spectra analysis was carried out using UV/Visible spectrometer consisting of source radiation, a monochromatic that is capable of scanning the range 190 nm to 400 nm emitted by the source, a photomultiplier and a detector (Gillaim, 1957).

RESULTS AND DISCUSSION

Proximate Analysis and Characterization of *Luffa aegyptica* Seed

The results of proximate analysis of the seed and characterization of the oil are shown in the Tables 1 and 2, respectively.

Table 1: Proximate analysis of *Luffa aegyptica* seed

Parameters	Values
Oil content (%)	41.00
Moisture Content (%)	7.50
Crude protein (%)	25.38
Crude fibre (%)	7.50
Ash content (%)	2.00
Carbohydrate (%)	24.12
Calorific value (Kcal/g)	567.00

Table 2: Characterization of *Luffa aegyptica* seed oil

Parameters	Values
Melting point (1°C)	23.00
Peroxide Value (Meq/g)	1.33
Acid value (mg/g)	32.54
% Free fatty acid	16.27
Saponification value	231.41

The results obtained from the proximate analysis of luffa aegyptica seed showed that it had high oil content and thus could be used for commercial purpose. The oil from the seed is dark brown in color and did not solidify at room temperature. This indicated that it is unsaturated oil (Ibemesi, 1991). The moisture content of the seed (7.5%) after oven drying was good enough for its keeping or storage safe quality. Its moisture content falls within storage safe limit (Pearson, 1976; Kirchmann, 1996). The high fibre content (7.5%) showed that it contained indigestible material and volatile matters while low ash content 2.5% showed that it contained low quantity of microelements. Furthermore, the high calorific value of the seed (567 Kcal/g) showed that the seed has very high energy content; hence it would give out high energy when utilized. The results of the characterization of *Luffa aeguptica* seed oil are shown in Table 2.

The acid value generally indicates the amount of free acid present and hence the purity of the oil. High values imply high content of fatty acids, which in turn implies low purity. On the other hand, low value means that the oil has low fatty acid content and is pure. Acid value may also indicate the aging of the oil. Oils with high acid values (seed oil - 41.08 mg/g) served better for liquid soap making whereas those with low acid (seed oil – 12.6 mg/g) were good for human consumption and could be used to produce edible fats (Apsimon, 1981). The seed oil of *luffa aegyptica* is not edible due to its high acid value. Excess of acid value could be removed by purification and alkaline wash. The high saponification value of oil suggested that the oil was good for soap making.

Spectroscopic Analysis

The results of Fourier Transform infra Red (FTIR) and Ultra-violet/Visible spectra analysis are shown in the Tables 3 and 4 below respectively.

From the FTIR spectra for the Luffa seed oil above, the peak at 560.10 cm^{-1} are due to C – H bond out of plane bending at the range (400-800 cm^{-1}) with intense band. The peat at 1273.11 cm^{-1} shows the presence of C-H for alkane in plane deformation, range (1120-1280). The peak at 1384 cm^{-1} shows the presence of C-H bending of alkyl range (1400 cm^{-1}). The peak at 1462.47 cm^{-1}

Table 3: Fourier Transform Infra Red (FTIR) Result for Luffa Seed Oil[16]

Wave Number(cm^{-1})	Functional Group (Bonding Description)	Intensity
560.10	C – H bond of plane bending	15.777
1273.11	C – H for alkane in plane deformation	49.732
1384.16	C – H bending of alkyl group	50.378
1462.47	C = C stretching for aromatics	50.764
1662.30	C = C stretch for alkene	13.125
2069.55	C ≡ C stretching for alkyne	52.559
2348.77	N – H stretch for tertiary amine	62.796
3449.80	O – H and N – H stretch for bonded Hydrogen	61.652

Table 4: Fourier Transform Infra Red (FTIR) Result for Luffa Seed Oil[16]

Wave Number(cm^{-1})	Functional Group (Bonding Description)	Intensity
578.98	C – H bond of plane bending	20.983
1160.41	> $C(CH_3)_2$ skeletal	42.353
1382.12	C – H bending for alkyl group (alkane)	41.867
1632.83	C = C stretching for alkanes	42.234
2073.63	C ≡ C stretching for alkane	17.306
2854.15	C – H stretching for alkane and aromatics	43.300
2925.91	C – H stretch for alkane (alkyl group)	42.150
3444.18	O – H and N – H stretch for bonded Hydrogen	45.013

Table 5: Ultraviolent/Visible Spectra (Uv/Vis) of Luffa seed oil[16]

Wavelength λ max (nm)	Chromophore	Absorbance Emax /10^{-2} m^2 mol^{-1}
31 6	– C = C = O	0.541
265	– $(C = C)_3$ –	1.226
253	Benzene	1.060
235	– C = C – C = C	1.325
225	– C = C –	1.220
215	– C = C – C = C	1.218
190	– C = C –	1.790

Table 6: UV/Vis of Luffa seed coat oil

λ max (nm)	Chromophore	Absorbance Emax /10^{-2} m^2 mol^{-1}
295	– C = C = O	2.167
262	– $(C = C)_3$ –	0.851
229	– C = C – C = C –	0.724

shows C=C stretch for aromatics. Peak at 1635.30 cm^{-1} shows C=C stretch for alkenes or unsaturated hydrocarbon, range (1600-1700 cm^{-1}) the band is usually sharp of medium to low intensity. The peak at 2069.55 cm^{-1} correspond to C=C stretch of alkyne with a sharp of medium to low intensity. The peak at 3449.80 cm^{-1} showed O - H and N – H stretch for bonded hydrogen. It has intense and broad band. Range (3500-3300 cm^{-1}). Table 4 shows the results of Fourier Transform Infra Red (FTIR) for Luffa seed coat oil.

The FTIR Spectra for Luffa seed coat oil above shows that the peak at 1160.41 shows > C $(CH_3)_2$ skelletal. The peak at 2854.15 show C – H stretch for alkane and aromatics .Other peaks show the same bond description like that of loofah seed oil from the peak of 578.98 cm^{-1} to 3444.18 cm^{-1}. Tables 5.0 and 6.0 below show the results of Ultraviolent/Visible Spectra (UV/Vis) of Luffa seed oil while Table 6 shows the results of Ultraviolent/ Visible Spectra (Uv/Vis) of Luffa seed coat oil.

The results of Ultraviolet/Visible spectra for both luffa aegyptica seed oil and seed coat oil were obtained by scanning from 190 nm to 400 nm. Several absorption bands were seen at the wavelength of 316 nm to 190 nm which is associated with – C= C, -C=C-, C = C – C= C, -C = C – C = C, and C= C – C = O chromophoric groups which show colors and therefore absorbed in the UV/Vis region. Hence there is $\sigma\rightarrow\sigma^*$, $\pi\rightarrow\pi^*$ and $n\rightarrow\pi^*$ transition.

CONCLUSION

From the results of the extraction, it was obvious that *luffa aegyptica* seed has high oil content, which could be isolated by solvent extraction. Also, it has high saponification value and this could be recommended for soap production. Being rich in nitrogeneous matter, the seed cake could be used in agricultural fertilizers. The results of the Fourier Transform Infra Red and Ultraviolent/Visible spectroscopic analyses showed that Luffa seed oil and seed coat oil contain mainly of unsaturated compounds. From the graph of FTIR, the seed oil contains more of the functional groups present in the oil. This degree of unsaturation makes the oil suitable to be used mostly in paint industries as a drying agent, in the production of cosmetics and may be edible for human consumption and animal feeds.

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