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Short communication

Characterization of sponge gourd (*Luffa aegyptiaca* Mill.) seed oil

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Abstract

Oils were extracted from whole and dehulled seeds, and hulls of *Luffa aegyptiaca* and their physico-chemical and fatty acid properties determined using standard methods. Oil extracted from the whole seeds had a higher (p<0.05) acid value compared to dehulled seeds,which however, had higher unsaponifiable matter. Iodine value was high for both oils and a higher (p<0.05) saponification value was observed for whole seed oil. Linoleic acid was the major constituent of dehulled and whole seeds oil while stearic acid was the major fatty acid of oil extracted from hulls. Hull oil also had the highest total saturated fatty acid content (p<0.05). Trans-isomers present were less than 1%. Fractionation studies showed that the total lipids consisted mostly of neutral lipids and triacyl glycerol. *Luffa aegyptiaca* seed oil appears to be edible and has satisfactory nutritional value as it is rich in linoleic acid and has a high unsaturated-saturated fatty acids ratio.

Keywords: Iodine Value, Linoleic acid, Phospholipids

Sponge gourd (*Luffa aegyptiaca* Mill.) belongs to the family of Cucurbitaceae. It is a crawling plant that grows wild and on abandoned buildings and fence walls in Nigeria (Dairo, 2008). The plant with yellow flowers bears fruits that are cucumber-shaped but larger in size and contain a fibrous sponge in which the hard black seeds are enmeshed (Dairo, 2008). In oriental medicine, *L. aegyptiaca* is used in the treatment of fever, enteritis, swell etc. The extracts from vines are also used as ingredients in cosmetics and medicine and the immature fruits are used as vegetable. One of the main uses of sponge gourd, however, is in the cosmetic industry for production of various bath and cosmetics products (Tanobe et al., 2005). The seed also contains an oil with potential for a range of applications; however, its chemical properties are less known. This study aimed to characterise the oil extracted from *L. aegyptiaca* seeds and thus contribute to the knowledge base on underutilized crops.

Fruits of *L. aegyptiaca* were collected from the bush at Ojo community in Lagos, Nigeria. Whole seeds, dehulled seeds, and hulls were air-dried and ground to a fine powder before being subjected to soxhlet extraction for 3 h using petroleum ether (40-60°C boiling point). Thereafter, the solvent was distilled off, concentrated over a rotary vacuum evaporator, and stored in freezer at ≤2°C, until further use. The refractive index was measured at 40°C with a Zeiss refractometer. Iodine value, saponi-fication value, unsaponification matter, acid value, hydroxyl value and peroxide value were determined according to standard methods (Christie, 1998), using a 10 g sample. Fatty acid methyl esters of the extracted oils were prepared according to Christie's method (1998). One gram oil was weighed and made up to 1.5 ml using hexane and treated with a solution of 2% (v/v) concentrated H_2SO_4 in methanol to prepare the FAME. The reaction mixture was left overnight at 50°C in a thermostat-controlled water bath. Saturated NaCl solution (15 ml) was added and allowed to cool after thorough mixing. The lower aqueous methanol

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layer was discarded while the upper hexane layer was separated and transferred to a dry test tube. The hexane layer was washed with 4 ml of 2% $KHCO_3$ and dried over Na_2SO_4. Four drops of 0.05% butylated hydroxytoluene (BHT) in methanol was added to prevent auto-oxidation of esters. Gas chromatography analysis of the oils FAME was performed using Agilent 6890 series gas chromatography powered with HP Chem Station Rev. A 09.01[1206] software under standard operating conditions.

Quantitative identification of *L. aegyptiaca* seed oil fatty acid was achieved by comparing their retention times with standard FAME (Sigma chemical Co.) and enhanced integration using the system's software. Total lipids (TL) of dehulled *Luffa* were fractionated into neutral lipids (NL), glycolipids (GL), and phospholipid (PL) on a silicic acid column using chloroform, acetone, and methanol respectively (Christie, 1998). NLs were estimated gravimetrically, while GLs and PLs were quantified by estimation of total sugars and phosphorus (Zheng et al., 2008) respectively. Neutral lipids were separated by thin layer chromatography (TLC) on cellulose using hexane: diethylether: acetic acid: (80:20:1 v/v). Individual components of GL and PL were separated on TLC using chloroform: methanol: acetic acid: water (65:15:10:4 v/v). The different components of phospholipids were identified by comparison with authentic standards and by specific spray reagents. Individual GL and PL separated on preparative TLC were scraped and extracted with chloroform: methanol: water (1:2:0.8 v/v) and quantified by estimation of total sugars and phosphorus (Zheng et al., 2008) respectively. One way analysis of variance (ANOVA) was performed using SPSS for Windows, version 14.0 (SPSS Inc. Chicago, IL.USA).

Oil from the dehulled and whole seeds of *L. aegyptiaca* differed in physical (e.g., light brown colour with some greenish tint vs. greenish) and biochemical properties (Table 1). Acid and saponification values were significantly higher ($p<0.05$) for the oil extracted from whole seeds compared to that from dehulled ones. But the unsaponifiable matter from dehulled seed was higher than that of the whole seeds. Iodine value was high for both oils but whole seeds had modestly higher values, suggesting its high proportion of unsaturated fatty acid glycerides. The values reported compared favourably with the iodine values of corn oil (107–128 per 100 g), but was much lower than linseed oil (170–203 per 100 g) and sunflower (118–145 per 100 g) (O'Brien, 2004). Free fatty acid (FFA) as a percentage of oleic acid was quite low in both seed oils indicating no particular problem during refining. The saponification values suggest that the oil contain mainly fatty acids of high molecular mass and the results are comparable to that of palm oil (196–205 mg KOH g^{-1}), olive oil (185–196 mg KOH g^{-1}), soy oil (193 mg KOH g^{-1}), cotton seed (193–195 mg KOH g^{-1}), and linseed oil (193–195 mg KOH g^{-1}) (Pearson, 1976).

Linoleic acid was a major constituent of dehulled and

Table 1. Characteristics of *Luffa aegyptiaca* seed oil.

Characteristics	Dehulled seed	Whole seed
Oil (% in seed)	44.8 ± 1.62^a	25.7 ± 0.70^b
Colour	Greenish light brown	Greenish
Weight/ml at 2°C	0.93 ± 0.14	0.92 ± 0.10
Refractive index n_D 40°C	1.46 ± 0.07	1.46 ± 0.05
Iodine value	99.3 ± 0.70^b	106.0 ± 0.75^a
Saponification value	197 ± 0.61	201 ± 1.37
Unsaponifiable matter	1.13 ± 0.23	0.96 ± 0.06
Acid value	10.1 ± 0.57	9.36 ± 0.51
Hydroxyl value	1.79 ± 0.21	1.2 ± 0.30
Peroxide value	13.7 ± 0.60^a	12.8 ± 0.60^b

Note: Values = mean ± SD (n = 3); means with the same superscripts do not differ significantly ($p<0.05$).

whole seeds oil, with the whole seeds having a higher (p<0.05) value (Table 2), an indication that the luffa seed oil can help in meeting the essential dietary fatty acid requirements. Stearic acid was a major fatty acid of oil extracted from hulls (37.7%), which was significantly (p<0.05) higher than that of dehulled and whole seeds. Seed hull had the highest total saturated fatty acid content (p<0.05), while there was no significant difference for total unsaturated fatty acid content between dehulled and whole seeds. Trans-isomers were less than 1%, implying that luffa oil, especially the dehulled seed oil, is a semi-drying type and are comparable with other vegetable oils with respect to its unsaturated fatty acid composition, and also similar in characteristics to other Cucurbitaceae oils like melon oil (Oluba et al., 2008). In view of its fatty acid contents, luffa oil could be used as a substitute for other vegetable oils such as olive, sunflower and rapeseed oil.

Table 2. Fatty acid composition (wt %) of *Luffa aegyptiaca* seed oil % of total fatty acid methyl ester.

Fatty acid	Dehulled seed	Whole seed	Hull
Myristic acid 14:0	0.27 ± 0.08	Trace	ND
Palmitic acid 16:0	20.2 ± 1.4[a]	12.3 ± 0.65[b]	ND
Palmitoleic acid 16:1	ND	ND	14.2 ± 0.35
Stearic acid 18:0	5.8 ± 0.32[c]	6.86 ± 0.26[b]	37.7 ± 1.10[a]
Oleic acid 18:1	26.3 ± 1.06	28.3 ± 0.91	19.8 ± 0.86
Linoleic acid 18:2	46.2 ± 0.64	50.1 ± 1.11	28.3 ± 0.87
Linolenic acid 18:3	ND	ND	ND
Arachidic acid 20:0	1.2 ± 0.35	2.02 ± 0.36	ND
Total saturated acid	27.5 ± 0.76[b]	21.2 ± 0.35[c]	37.7 ± 0.75[a]
Total unsaturated acid	72.5 ± 0.60	78.4 ± 0.70	62.3 ± 0.70
Total transisomer	0.20 ± 0.07	0.18 ± 1.23	ND

Note: Values = mean ± SD (n = 3); means with the same superscripts do not differ significantly (p<0.05); ND = not detected.

Fractionation of the total lipids showed that they contained neutral lipids (83.7%), mostly triacyl glycerol. Phospholipids formed 9.2% of total lipids, while glycolipids were 3.5%. The phospholipid fraction was further resolved by TLC to five major components and one unidentifiable spot. The major components (as % weight of the phospholipids) were: phosphatidyl inositol (4.4); phosphatidyl choline (52); phosphatidyl ethanolamine (33.8); phosphatidyl serine (5.2); and phosphatidyl glycerol (2.9) respectively. The principal glycolipid fractions were triacyl glycerol (86.3% of total neutral lipids). In conclusion, *L. aegyptiaca* seed oil appears to be edible and has satisfactory nutritional value. It is rich in linoleic acid and has a high unsaturated-saturated fatty acid ratio. However, more work needs to be done identification of the separated components of the various fractions and its toxicology.

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