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Characterization of nutritional constituents of *Garcinia morella* seeds and seed oil

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Abstract

The chemical analysis of *Garcinia morella* seeds and seed oil have been carried out in order to determine the possibility of using them as a source of food and industrial oil. Proximal analysis showed that the seeds had a high amount of carbohydrates and were rich in oil (38.08 g/100g) but have low protein content. The physical properties of the oil extracts showed the state to be liquid at room temperature (25 ± 1˚C) and the colour of the oil, orange yellow. The specific gravity of the oil was 0.89±0.01. Among the chemical properties of the oil extracts, acid value (16.83±0.43 mg NaOH/ g), saponification number (258.06±0.42 mg KOH/ g oil), iodine value (39.89 ± 0.57 mg/100 g), free fatty acid (11.50 ± 0.94%), peroxide value (0.01 ± 0.81 mg/g oil) compared well with those of conventional edible oils. Gas chromatography analysis of the oil revealed the presence of ten different fatty acids such as myristic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, behenic acid, heptadecanoic acid and the prominent ones were oleic acid (45.38%) and stearic acid (45.95%). Seed oil *G. morella* could be used as edible oil and also suitable for industrial applications. The oil showed antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

Introduction

The continued increase in world population and ever-increasing demand for vegetable oils for food and industrial use have resulted in the increase in the prices of oils (Lu *et al.*, 2001). It is further realized that the present resources of conventional oil seed crops may not prove adequate to meet increasing demand for vegetable oils for human consumption as well as industrial uses, especially in developing countries. There is a need for investigating new sources of oil especially among the non-conventional and under-exploited oil-seeds. The search for alternative oil sources, especially in developing countries is of utmost importance (Ajayi *et al*., 2007).

Garcinia morella (Gaerth.) Desr. is commonly known as 'Indian gamboge' is a tropical under-exploited tree species, belongs to family Clusiaceae. *G. morella* is found wild in evergreen and semi-evergreen forests of Western Ghats region of India (Anonymous, 1956). It also occurs in Sri Lanka and Indo-China Himalayan regions. It is a multipurpose tree grown in home gardens of Karnataka along with *G. indica* (Kokum) and *G. cambogia* (Malabar tamarind). The fruit rinds are used as condiment and garnish. Various bioactive compounds such as moreollin (Subba Rao *et al*., 1978), gambogic acid (Yates *et al.*, 1963; Tang *et al*., 2011) were isolated from fruits and bark respectively and evaluated for their antibiotic and anticancer properties.

Although the tree bears a large amount of seed yearly, the seeds are usually left to waste at the foot of each tree. The aim of this work is to characterize the chemical composition of *G. morella* seeds and seed oil to ascertain its potential for food and industrial uses.

Materials and methods

Plant material

Garcinia morella (Gaertn.) Desr. fruits were collected from Yana, Uttar Kannada District, Karnataka, India. The seeds were removed from the fruits, washed with water and left to air-dry for two weeks.

Sample preparation

The seeds of *G. morella* were decorticated manually and ground into a paste using mortar and pestle. The paste was then stored in an air-tight

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contained in a refrigerator (4˚C) prior to analysis.

Proximate analysis

The moisture content of the seed was determined gravimetrically by placing 1 g of the sample in an oven at 102 ˚C for 6 h to reach constant weight (Femenia *et al*., 1995). The seed oil was extracted using the continuous soxhlet solvent extraction technique with petroleum ether as solvent (b. p. 40-60˚C) for 8 h. Crude fiber content was determined in accordance with the standard methods (AOAC, 1980). The value of protein, carbohydrate content was measured by standard methods (Ajayi *et al*., 2007)

Physical properties

Oil from the seed was subjected to physical characterization. The colour and state of oil at room temperature were noted by visual inspection while, density was determined by the method of the AOAC (AOAC, 1980). The refractive index of the oil at room temperature was estimated using the Abbe refractometer.

Chemical composition

The analysis of peroxide value, iodine value and saponification number were carried out by following the official method (AOAC, 1984). The estimation of the percentage of free fatty acids as the oleic acid was done, by following the method described by Cocks and Rede (1966).

Fatty acid analysis

The fatty acid composition of the oil sample was analyzed by GC after trans esterification. Fatty acid methyl esters were analyzed on a Chemito GC 8610 gas chromatograph equipped with equipped flame ionization detector and capillary column B P × 70 (50 m × 0.32 mm × 0.25 µm films). The detector temperature was programmed for 260˚C with a flow rate of 0.3 ml/min. The injector temperature was set at 240˚C. Nitrogen (purity 99.95%) was used as the carrier gas. Identification of the peaks was performed by comparing retention times with those of genuine standards analyzed under the same conditions. All results are expressed as means and with standard errors of three separate contents.

Results and Discussion

Proximate analysis

The results of the proximate analysis of *G. morella* are shown Table 1. The seeds contained 38.08 ± 0.33 g/100 g oil which was quite higher than the oil content reported for *G. mangostana* (Ajayi *et al*., 2007) and it was also higher when compared to soybean cultivars 18.30-21.53 g/100 g dry matter (Vasconcelos *et al*., 1997). The amount of seed oil in *G. morella* was also higher than other non-conventional oil seeds like *Citrullus lanatus*, 21.0% (Al-Khalifa, 1996) and *Monodora myristica*, 21% (Ajayi *et al*., 2004), *Thunbergia fragrans*, 21.7% (Payamalle *et al*., 2015), *Lavandula bipinnata*, 27.2% (Murthy *et al*., 2014) and it was comparable favorably with *Jatropha gossipiflora,* 35.8 g/100 g (Ogbobe and Akano, 1993), *Catha edulis,* 35.5% (Murthy *et al*., 2015) and *Cucumis melo*, 30.8-32.3% (de Melo *et al*., 2000, 2001). The protein content of the seeds was quite low (8.50 ± 0.24 g/100 g), but it was much higher than 5.29 g/100 g reported for *G. mangostana* (Ajayi *et al*., 2007). The carbohydrate content, 36.25 ± 0.50 g/100 g and crude fiber content, 16.58 ± 1.12 g/100g indicate that seeds are the good source of roughage in animal feed. The ash content, 3.90 ±0.29 g/100 g, was greater than the values determined for seeds such as *Garcinia mangostana* (Ajayi *et al*., 2007), *G. xanthochymus* (Manohar *et al*., 2014).

Table 1. Proximate composition of seeds of *Garcinia morella*

Components	*Garcinia morella* seed
Moisture content of seed (g/100 g)	1.96 ± 0.00
Ash (g/100 g)	3.90 ±0.29
Total Fat (g/100 g)	38.08 ± 0.33
Total protein (g/100 g)	8.50 ± 0.24
Total Fibre (g/100 g)	16.58 ± 1.12
Total carbohydrate content (g/100 g)	36.25 ± 0.50
Nutritive value (Cal/100 g)	521.72

[a]Values are means of three determinations ± SE.

Physical and chemical properties

Table 2 presents the data on physical and chemical properties of seed oil of *G. morella.* The oil was liquid at room temperature (25 ± 1˚C), and had orange-yellow colour. The specific gravity and refractive index of the oil were 0.89 ± 0.01 and 1.462 respectively. The value of the refractive index was in accordance with mangosteen seed oil (1.482) (Ajayi *et al*., 2007). The acid value was 16.83 ±0.43 mg NaOH/g oil and was very high compared to *G. mangostana*, 4.58 mg NaOH/g oil (Ajayi *et al.*, 2007). The peroxide value of the oil was very low (0.01 ± 0.81 mg/ g oil) suggesting that it can be stored for a long period without deterioration. According to Ojeh (1981), oils with high peroxide values are unstable and can easily become rancid. Pearson (1982) also reported that fresh oils have been shown to have peroxide value below 10 mg/g oil and oils become

Table 2. Physicochemical analysis *Garcinia morella* seed oil

Component	*Garcinia morella* seed oil
Colour	Orange Yellow
State at RT	Liquid
Specific gravity	0.89 ± 0.01
Refractive index	1.462
Acid value (mg NaOH/g oil)	16.83 ± 0.43
Saponification value (mg KOH/g oil)	258.06 ± 0.42
Free fatty acid (%) as oleic acid	11.50 ± 0.94
Iodine value (mg/100 g)	39.89 ± 0.57
Peroxide value (mg/g oil)	0.01 ± 0.81
Ester value (mg/KOH)	241.23 ± 0.28

rancid when the peroxide value ranges from 20.0 to 40.0 mg/g oil. The saponification number of the *G. morella* oil was 258.06 ± 0.42; it suggests that oil could be useful for making soaps and shaving creams (Nzikou, 2007). The saponification value of *G. morella*, was higher than that of palm oil (196-205 mg KOH/g), olive oil (185-196 mg KOH/g), soybean oil (193 mg KOH/g) and linseed oil (193 mg KOH/g) (Folkard and Sutherland, 1996). The iodine value of this oil, 39.89 ± 0.57 mg/100 g, placed it in the non-drying group of oils. The free fatty acid value of *G. morella*, 11.50 ± 0.94 was greater than that of *Garcinia mangostana* (Ajayi *et al.*, 2007).

Fatty acid composition

Table 3 shows the fatty acid composition of *G. morella* seed oil. The most prevalent fatty acids were oleic acid (45.38%) and stearic acid (44.95%). The linoleic acid content was (7.77%) and the oil also possessed myristic acid, palmitic acid, palmitoleic acid, linolenic acid, arachidic acid, behenic acid, Heptadecanoic acid in tracer quantities (Table 3). The *G. morella* seed oil is rich in oleic acid and its concentration is comparable to peanut oil (36-67%) (Moore and Knauft, 1989) could be used as edible oil. Stearic acid rich oils are used mainly in the production of detergents, soaps, and lubricants (Pritchard, 1991) and the stearic acid content of *G. morella* seed oil was also very high (44.91-49.53%) and hence this oil could be also be used as industrial oil as well.

Conclusion

In this study, the nutritional constituents of *G. morella* seeds were carried out and results showed that seeds were rich in lipids and carbohydrates. The physicochemical characteristics of *G. morella* seed oil were comparable with other edible oils like peanut especially in oleic acid content (45.38%).

Table 3. Fatty acid composition of *Garcinia morella* seed oil

	Fatty acid	Percentage of occurrence
1.	Myristic acid	0.02
2.	Palmitic acid	1.04
3.	Palmitoleic acid	0.02
4.	Heptadecanoic acid	0.12
5.	Cis 10 Heptadecanoic acid	0.02
6.	Stearic acid	44.95
7.	Oleic acid	45.38
8.	Linoleic acid	7.77
9.	Linolenic acid	0.09
10.	Arachidic acid	0.31
11.	Behenic acid	0.24
12.	Total saturates	46.78
13.	Total unsaturates	53.29

Other parameters like high saponification value and high percentage stearic acid (44.91-49.53%) suggest the suitability for the preparation of soaps, detergents and lubricants.

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