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RESEARCH ARTICLE

Fatty Acid Composition of Seeds of Three Native *Garcinia* Species from Andaman and Nicobar Islands, India

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Abstract

Garcinia L. is an important genus, comprising of species revered for their edible fruits and exploited as sources of industrially valuable compounds. Andaman and Nicobar Islands in the Bay of Bengal have considerable diversity for the genus and a number of aspects are yet to be studied in most of the species. To understand the potential of native species of these islands, the fatty acid composition of seed fat of three *Garcinia* species, *viz.* *G. kurzii* Pierre, *G. cowa* Roxb. ex Choisy and *G. dulcis* (Roxb.) Kurz was determined using GC-MS-MS analysis. Results revealed that seeds of *G. cowa* and *G. dulcis* were rich in unsaturated fatty acids, while seeds of *G. kurzii* had higher saturated fatty acids content. Oleic acid (44.24%) and Stearic acid (34.94%) were dominant in *G. cowa*, Oleic acid (39.82%) and Palmitic acid (33.48%) in *G. dulcis*, whereas Stearic acid (41.34%) and Oleic acid (23.27%) were major fatty acids in *G. kurzii*. Arachidic, Eicosenoic, Linoleic and Palmitoleic acids content were also found in varied quantities. Thus, the present report opens up avenues for the utilisation of seeds of the studied species for different industrial purposes.

Keywords: *Garcinia cowa*, *Garcinia dulcis*, *Garcinia kurzii*, GC-MS

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Introduction

The genus *Garcinia* L. is one of the important genera of the Clusiaceae family, species of which have been valued for their multifaceted uses, including as fresh fruits, natural colourants, acidulants, functional foods, saturated and unsaturated fats, varnishes, etc. (Baruah *et al.,* 2012; Parthasarathy *et al.,* 2013; Bohra *et al.,* 2020). Identification of bioactive compounds of high pharmaceutical and industrial significance, such as hydroxycitric acid, flavonoids, xanthones, benzophenones, biphenyls, acyl phloroglucinols, etc., has further increased their utilization potential (Aravind *et al.,* 2016).

As per the Plants of the World Online database, ca. 414 accepted species of the genus *Garcinia* have been reported so far (https://powo.science.kew.org). Of these species, a few are being deliberately cultivated, and a larger number of it is yet to be brought into mainstream cultivation due to a lack of scientific studies, especially on the phytochemical potential of their plant parts (Aravind *et al.,* 2016). Most of the reported *Garcinia* species produce edible fruits; yet, considering the sour to highly sour taste, most of these species may not be suitable for direct consumption (Te-chato, 2007; Baruah *et al.,* 2012; Ellina *et al.,* 2015). Under such circumstances, identification of their non-fruit uses could be beneficial.

The Andaman and Nicobar Islands are one of the important agro-biodiversity regions representing the flora of Indo-Burma and Sundaland (Singh *et al.,* 2016). This agro-biodiversity holds potential for the identification of novel sources of medicines, industrial compounds, genes, foods and novel crops, if studied systematically. However, when compared with the other biodiverse regions of the country, limited research work has been done on the species distributed in these islands, especially on the genus *Garcinia* (Parthasarathy *et al.,* 2013; Bohra *et al.,* 2021a). Hence, research on various aspects of these potential species is envisaged.

Seeds in fruit-bearing species have been the default material of perpetuation naturally and their utilization from an economic point of view is largely negligible. In fact, they largely remain a waste resource in a number of cases (Abraham *et al.,* 2006). Heavy bearing capacity of various *Garcinia* species and presence of multiple seeds in each fruit in most of the species makes their seeds a potential resource for utilization (Te-chato, 2007; Ellina *et al.,* 2015; Shameer *et al.,* 2016; Bohra and Waman, 2019). Traditionally, in the Western Ghats, seeds of species such as *G. indica* and *G. gummi-gutta* have been utilized as sources of fats for cosmetic and medicinal purposes (Joshi, 2005; Baliga *et al.,* 2011). However, such traditional knowledge in other *Garcinia* species is largely unavailable.

Recently, *Garcinia* fat is being considered as an ingredient for various industries, including a substitute for cocoa butter, personal care products, pharmaceuti cals, biofuels, edible oils etc. (Parthasarathy and Nandakishore, 2014; Ananthakrishnan and Ramesh kumar, 2016). Studies on fatty acid content in Indian *Garcinia* species are limited (Parthasarathy and Nandakishore, 2014; Patil *et al.,* 2016). Considering this, the present study was undertaken to understand the composition of seed fat of three native *Garcinia* species of the Andaman and Nicobar Islands of the Bay of Bengal.

Materials and Methods

Field surveys were conducted in different parts of the Andaman group of Islands, India and ripe fruits of

Fig. 1: Fruit of *Garcinia kurzii.*

Fig. 2: Fruit of *Garcinia cowa.*

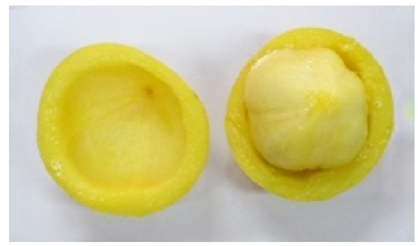

Fig. 3: Fruit of *Garcinia dulcis.*

Garcinia kurzii (*Ghat kau phal,* Fig. 1), *G. cowa* (*Kau phal*, Fig. 2), *G. dulcis* (*Tok phal,* Fig. 3) were collected from the identified locations of Middle Andaman Island. Fruits were brought to the ICAR-Central Island Agricultural Research Institute, Sri Vijaya Puram and used for the studies. Morphological parameters, including fruit colour, fruit surface, fruit length (cm), fruit width (cm), peel thickness (mm) and number of seeds per fruit were recorded using the standard procedures. Seeds were extracted, the adhering pulp was washed, and seeds were air-dried to facilitate the removal of the seed coat. Such seeds were used for measurement of seed length (cm), seed width (cm) and seed thickness (cm).

In order to carry out fatty acid profiling, air-dried seeds were immediately transported to the ICAR-Indian Institute of Horticultural Research, Hessarghatta, Bengaluru, India. The procedure for lipid fractionation, esterification and subsequent Gas chromatography-mass spectrometry (GC-MS/MS) described elsewhere (Bohra *et al.,* 2021a) was followed. For identification of fatty acid compounds, relative retention times of FAME peaks were compared with those of reference standards (Sigma-Aldrich, USA) along with spectral comparison with reference (Wiley and NIST-2007). Analysis was carried out in duplicate, and data were presented as mean ± standard error of the mean.

Results and Discussion

General description

G. kurzii is an endemic species distributed in the Andaman and Nicobar Islands (Nissar *et al.,* 2025). Fruits were 3.2-3.8 cm × 2.9-3.2 cm in dimension, purple to black with an inedible rind of 1.5 to 2.5 mm thick. Each

Table 1: Basic information about the studied *Garcinia* species

Parameter	*G. kurzii*	*G. cowa*	*G. dulcis*
Edible portion	Pulp	Peel and pulp, young leaves	Peel and pulp
Fruit colour	Purple to black	Orange	Yellow
Fruit surface	Smooth	Ridged	Smooth
Fruit length (cm)	3.2 - 3.8	3.5 - 4.6	4.5 - 5.6
Fruit width (cm)	2.9 - 3.2	3.8 - 5.8	5.5 -6.4
Fruit weight (g)	13.8 - 16.0	40.1 - 66.0	68.5 – 111.2
Rind thickness (mm)	1.5 - 2.5	4.0 - 6.5	0.8 - 1.4
No. of seeds per fruit	1 - 4	1 – 6	3 – 5
Seed length (cm)	1.7 - 2.1	1.8 - 2.1	1.6-2.7
Seed width (cm)	0.7 - 0.9	1.1 - 1.5	1.4-1.7
Seed thickness (cm)	0.6-0.8	0.7 - 1.0	0.8- 1.4

fruit weighed between 13.8 and 16.0 g. White, sweetish-sour pulp is eaten by local settlers and the Nicobarese tribe of these islands. Fruits had four segments with one seed each measuring 1.7-2.1 cm long, 0.7-0.9 cm wide and 0.6- 0.8 cm thick (Table 1).

G. cowa had orange fruits with a ridged surface. Fruits are dried and used as an acidulant, while orange coloured pulp is eaten fresh. Further, green fruits are also used against food poisoning in Northeastern India (Hazarika *et al.,* 2016). In the present study, fruits weighed between 40.1 and 66.0 g, while dimensions were 3.5-4.6 cm × 3.8-5.8 cm with 4.0 to 6.5 mm thick rind. An earlier study from Bangladesh (Hossain *et al.,* 2023) has suggested comparatively smaller-sized fruits (18.26 to 31.29 g), whereas fruits of 3-6 cm size and 40-120 g weight have been reported from China (Liu *et al.,* 2005). In the present study, each fruit had 1 to 6 seeds with dimensions of 1.8-2.1 cm × 1.1-1.5 cm × 0.7-1.0 cm; while Hossain *et al.,* (2023) reported the presence of 5.00 to 7.33 seeds per fruit.

G. dulcis is a large fruited species, the fruits of which are suitable for preparation of value-added products such as jams and preserves; whereas bark exudates are used in dyeing (Maheshwari, 1964). A recent study has shown antioxidant and antielastase activities of this species (Ambarwati *et al.,* 2024). Fruits of *G. dulcis* were of 4.5-5.6 cm × 5.5-6.4 cm dimensions. Fruits were the heaviest among all the studied species and weighed between 68.5 and 111.2 g. Fruits had a smooth yellow surface with yellowish, sweetish, sour edible pulp. Fruits had 3-5 seeds each of 1.6-2.7 cm length, 1.4-1.7 cm width and 0.8-1.4 cm thickness.

Fatty acid composition

Seed fatty acid profiling suggested the presence of seven compounds, irrespective of the species (Table 2). These compounds contributed to 99.12% of total composition in *G. cowa*, 98.09% in *G. dulcis* and 97.81%

Table 2: Fatty acid composition of three *Garcinia* species

Fatty acid	*C number*	*Class of compound*	*Peak area (%)*		
			G. kurzii	*G. cowa*	*G. dulcis*
Palmitic acid	16:0	Saturated	11.08 ± 0.284	10.52 ± 0.051	33.48 ± 1.501
Stearic acid	18:0	Saturated	41.34 ± 0.470	34.94 ± 1.206	9.00 ± 1.081
Arachidic acid	20:0	Saturated	1.12 ± 0.794	0.45 ± 0.170	1.41 ± 0.608
		Σ Saturated fatty acid	53.54	45.91	43.89
Palmitoleic acid	16:1	Monounsaturated	0.32 ± 0.071	0.20 ± 0.062	7.20 ± 0.270
Oleic acid	18:1	Monounsaturated	23.27 ± 0.771	44.24 ± 1.606	39.82 ± 2.028
Eicosenoic acid	20:1	Monounsaturated	1.56 ± 0.933	1.13 ± 0.202	2.70 ± 0.751
		Σ Monounsaturated fatty acid	25.15	45.57	49.72
Linoleic acid	18:2	Polyunsaturated	19.12 ± 1.638	7.64 ± 0.072	4.48 ± 1.182
		Σ Polyunsaturated fatty acid	19.12	7.64	4.48
		Σ Unsaturated fatty acid	44.27	53.21	54.20
		Total	97.81	99.12	98.09

in *G. kurzii*. Of these seven compounds, three were saturated fatty acids (SFA), three were monounsaturated fatty acids (MUFA), and one was polyunsaturated fatty acid (PUFA). Relative abundance of these compounds varied among the species studied. In *G. cowa* and *G. dulcis*, proportion of unsaturated fats was higher (53.21% and 54.20%, respectively) than SFAs. Higher proportions of unsaturated fatty acids have been reported in *G. multiflora* (84.19%), *G. xanthochymus* (65.79%), *G. gummi-gutta* (59.64%) and *G. andamanica* (53.24%), as well (Manohar *et al.,* 2014; Patil *et al.,* 2016; Phuong *et al.,* 2018; Bohra *et al.,* 2021a), which support the findings of the present study. On the other hand, in *G. kurzii*, higher amounts of saturated fatty acids (53.54%) were present than the unsaturated ones. *G. dhanikhariensis,* the endemic species of the Andaman Islands has recently been reported to have higher proportions of SFAs (52.69%) apart from exotic *G. hanburyi* (53.11%) and *G. gaudichaudii* (61.15%) (Phuong *et al.,* 2018; Bohra *et al.,* 2021b). The composition of unsaturated fatty acids showed higher quantities of MUFAs than that of PUFAs. This observation was in line with the earlier reports in *Garcinia* species (Phuong *et al.,* 2018; Bohra *et al.,* 2021a; Bohra *et al.,* 2021b).

PUFAs are considered healthier compounds, and the highest amounts of PUFAs were reported in *G. kurzii* (19.12%), which was followed by *G. cowa* (7.64%) and the lowest (4.48%) in *G. dulcis*. As low as 25.15% MUFAs were observed in *G. kurzii*, while they were 49.72% in *G. dulcis*. Proven beneficial effects and health-promoting properties of the unsaturated fatty acids have been reported by earlier researchers (Ajayi *et al.,* 2007; Patil *et al.,* 2016). Hence, *G. cowa* and *G. dulcis,*with higher quantities of such compounds, could be utilized for blending purposes, in line with*G. gummi-gutta* that has been conventionally utilized for culinary preparations in Kerala state of India (Abraham *et al.,* 2006).

In case of *G. cowa*, Oleic acid was found to be the most abundant compound (44.24%), followed by Stearic acid (34.94%), Palmitic acid (10.52%), Linoleic acid (7.64%) and Eicosenoic acid (1.13%), while Arachidic acid and Palmitoleic acid were present in minute quantities. Similarly, Oleic acid was the most dominant compound (39.82%) in the seeds of *G. dulcis*. Palmitic acid (33.48%), Stearic acid (9.00%), Palmitoleic acid (7.20%), Linoleic acid (4.48%), Eicosenoic acid (2.70%) and Arachidic acid (1.41) were the other compounds present in *G. dulcis*.

Several reports have described the presence of Oleic acid in *Garcinia* seeds, which is an important constituent from a health point of view (Grundy, 1989).*G. andamanica*, an endemic species of these islands, has been reported to contain 44.35% Oleic acid in its seed fat (Bohra *et al.,* 2021a), whereas another endemic species *G. dhanikhariensis* had 42.40% of it (Bohra *et al.,* 2021b). Higher quantities of Oleic acid in the presently studied species could be of great practical utility as healthy oil for commercial utilization as already advocated for the Vietnamese species (Phuong *et al.,* 2018). *Camellia oleifera*- an oleic acid-rich species has been reported to have high moisturizing properties (Sang *et al.,* 2023), useful for hair care products.

Stearic acid and oleic acid were the dominant compounds in *G. kurzii* (41.34% and 23.27%, respectively). Linoleic acid (19.12%), Palmitic acid (11.08%) and Eicosenoic acid (1.56%) were the other compounds observed in *G. kurzii*. These findings are in accordance with the reports on *G. dhanikhariensis*, *G. gaudichaudii* and *G. hanburyi*, with 43.62%, 50.12% and 58.87%, of stearic acid, respectively (Phuong *et al.*, 2018; Bohra *et al.*, 2021b). Saturated fats such as Stearic acid and Palmitic acid are known to have surfactant, softening and reparative effects and hence, are used as key ingredients in soaps, shaving creams, and related cosmetic formulations (Parthasarathy and Nandakishore, 2014). *G. kurzii* and *G. dulcis* could also be promising alternative sources for these industries. *G. dulcis* in the present study exhibited a trend of Oleic acid > Palmitic acid >Palmitoleic acid, which was similar to*G. xanthochymus* (Manohar *et al.,* 2014).

Conclusion

In conclusion, fatty acid composition of seeds varied with species, in which *G. cowa* and *G. dulcis* had higher content of unsaturated fatty acids, while *G. kurzii* showed higher saturated fatty acids. Oleic acid and Stearic acid (*G. cowa*), Oleic acid and Palmitic acid (*G. dulcis*), and Stearic acid and Oleic acid (*G. kurzii*) were dominant compounds apart from other minor constituents. Considering the natural diversity present in different parts of the Andaman and Nicobar Islands, intra-specific variability needs to be screened for the identification of superior types.

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