SHORT COMMUNICATION

Seed Oils of *Acacia holosericea* A. Cunn. ex G. Don.: Characteristics and Composition

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ABSTRACT: Like the fruits of *Elaeis guineensis*, the seeds of *Acacia holosericea* have two types of oils. One is present in the yellow aril (56%), which is attached to the black seed, and the other is in the kernel of the seed (12%). The proximate composition of seed and the physicochemical characteristics of the solvent-extracted oils are reported. The aril fat is quite different from the seed oil in all respects. In descending order, the major fatty acids in aril fat are 18:1 (54.35%), 16:0 (29.3%), and 18:2 (8.0%), whereas in seed (– aril) oil, the order is 18:2 (59.45%) 18:1 (20.2%), and 16:0 (10.0%). In whole seed (+ aril) oil, the order is 18:2 (53.3%), 18:1 (25%), 16:0 (12.6).
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KEY WORDS: *Acacia holosericea*, aril, fatty acid methyl esters (FAME), Junior laboratory mill, nondrying oil, oxirane oxygen (epoxy group), semi-drying oils, single-pair roller reduction mill, Soxhlet extractor, miscella.

Acacia holosericea A. Cunn. ex G. Don., belonging to *Mimosaceae* of the *Leguminosae* plant family, is a small shrubby thornless, attractive, ornamental, multistemmed tree with a large dense crown. It is native to Australia and was introduced only recently for trials in Africa and South Asia (1), particularly in India under afforestation projects by Tamil Nadu Agricultural University (TNAU) (2). The tree grows on a variety of soil types of low fertility (3) and can tolerate severe drought, frost, salinity, and periodic waterlogging (4). It promises to be an outstanding multipurpose tree for the semi-arid and arid tropics. The rapid early growth rate makes it a highly productive source of fuel wood (2). Advantage can be taken of its fast growth, nitrogen fixing ability and vigorous colonizing capacity. One of the characteristic features of this plant is its ability to revegetate and restore degraded sites and mining areas (5,6). It is also used to form the lower part of a multistory windbreak (7). It shows promise for use in sand dune fixation. The tree appears to be relatively free of pests and diseases in cultivation and also shows great resistance to termite attack. It propagates readily by self-seeding and is potentially weedy if underutilized (1,3,4). Well-developed trees of *Acacia holosericea* lack leaves but are thickly covered with large phyllodes, which are densely covered with fine hair, giving the tree an attractive silvery foliage. Flowers are small, bright yellow in color and conspicuous with cattail-like spikes, and the pods are narrow, long coiled in dense clusters. Mature seeds may be formed within two years of planting. Threshing by beating with sticks and sieving yields clean seeds (1–3). An exhaustive survey of the literature reveals that no information is available on the characteristics and chemical composition of seeds and seed oils of *A. holosericea* grown in India, and this fact stimulated the present investigation.

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MATERIALS AND METHODS

The seeds of *A. holosericea* were procured from the National Pulses Research Centre (NPRC), Tamil Nadu Agricultural University (TNAU), Vamban, Pudukottai, India. All chemicals and solvents were of AnalaR and Guaranteed Reagent grades and were purchased from reputable firms in India. The seed sample was prepared by grinding in a C&N Junior laboratory mill, size 5″ (Christy & Norries Limited, Engineers, Chelmsford, England). Protein content (N × 6.25) was determined by the Kjeldahl method (8); moisture, oil, fiber, ash, and insoluble ash were determined by American Oil Chemists' Society (AOCS) methods (9). For recovery of oils from whole seed (+ arils) and seed (– arils), the seed materials were moistened, flaked in a single-pair roller reduction mill, separately, and thoroughly extracted with *n*-hexane in a Soxhlet extractor at ambient temperature. For recovery of oil from arils of the seed, the separated arils were directly extracted with *n*-hexane in a Soxhlet extractor. All three types of miscella were desolventized, and residual traces of solvent were removed in vacuum at 80°C. The extracted seed meal was thoroughly air-dried to remove the last traces of solvent.

The seed and extracted meal characteristics are given in Table 1. The physicochemical characteristics of the oils [color, specific gravity, refractive index, melting point, percentages of iodine value, saponification value, unsaponifiable matter, oxirane oxygen (epoxy group), and free fatty acids] extracted from whole seed (+ arils), seed (– arils), and from arils only were determined by American Oil Chemists' Society (AOCS) methods (9) and are given in Table 2.

Fatty acid methyl esters (FAME) were prepared by acid-catalyzed transmethylation (BF_3-CH_3OH method) (10) of lipids. The FAME were analyzed on a Shimadzu GC 9A chromatograph (Shimadzu Scientific Instruments, Columbia,

TABLE 1
Characteristics of *Acacia holosericea* Seed[a] and Meal[b,c]

	Seed	Meal
Seed index (wt of 100 seeds) (g)		
(+ arils)	1.2230	—
(– arils)	1.1340	—
Moisture (%)	2.0	4.0
Oil (%) (*n*-hexane extraction)	14.0	0.8
Crude protein (%)	21.0	24.7
Ash (%)	3.0	3.4
Acid-insoluble ash (%)	0.3	0.4
Crude fiber (%)	11.4	13.24

[a]Seed means whole seed (+ arils).
[b]Data are the mean of three determinations.
[c]Except for moisture, all analyses are on a dry-weight basis.

TABLE 3
Fatty Acid Composition[a] of Seed and Aril Oils of *Acacia holosericea*

Fatty acid	Whole seed (+ aril) oil	Seed (– aril) oil	Aril fat alone
16:0	12.60	9.95	29.30
16:1	1.00	0.65	3.05
18:0	2.60	2.80	2.95
18:1	24.90	20.15	54.35
18:2	53.30	59.45	8.05
20:0	1.00	1.25	1.25
20:1	0.80	0.80	Nil
22:0	2.80	3.45	trace[b]
24:0	1.00	1.50	trace

[a]Percentage by weight.
[b]Trace amounts (< 0.5%).

TABLE 2
Physicochemical Characteristics[a] of *Acacia holosericea* Seed Oils

	Oil from		
Characteristic	Whole seed (+ aril)	Seed (– aril)	Arils alone
Free fatty acids (%) (as oleic)	11.0	3.0	73.0
Iodine value (Wijs)	130	140	43
Saponification value	189	187	196
Nonsaponifiable matter (%)	1.50	1.57	2.70
Oxirane oxygen (epoxy group) (%)	ND[b]	0.23	0.06
Refractive index at 40°C	1.4670	1.4680	1.4561
Specific gravity 30°C/30°C	0.9145	0.9163	0.8934[c]
Color[d] (0.635-cm cell)	5.6Y 3.4R (22.6)	10.0Y 0.3R (11.5)	5.9Y 5.0R (30.9)

[a]Values represent the average of duplicate experiments.
[b]ND, not determined.
[c]Measured at 40°C.
[d]The color of the oil is determined with a Lovibond Tintometer in a 0.635-cm cell, and the total units are in terms of Y + 5R units, given in parentheses.

MD), equipped with a flame-ionization detector (FID) and a glass column 183 cm × 3 mm (i.d.) packed with Altech CS-10 on 80–100 mesh chromosorb-AW support. The column oven was operated at an initial temperature of 90°C for 4 min then increased at 10°C/min to a final temperature of 250°C and held there for 2 min. Injection port and FID temperatures of 260°C were maintained; helium was the carrier gas with a flow rate of 50 mL/min. The peak area and relative percentage of FAME were obtained with a Shimadzu integrator. The component of each peak was identified on the basis of a calibration curve by using peak retention times *vs.* equivalent chainlength, and by comparison with those of authentic methyl ester standards. All determinations were performed in triplicate, and mean values are reported in Table 3.

RESULTS AND DISCUSSION

Acacia holosericea seeds are small, oval and slightly flattened, shiny black, with yellow aril at the base. Whole seed (+ aril) contains 14% reddish-yellow oil, seed (– aril) contains 12% greenish-yellow oil, and arils only contain 56% yellowish-red soft fat with a melting point of 38.0°C. The ratio of seed (– aril) to aril is 93:7. A pale yellow kernel is present inside the black seed; it is difficult to separate the kernel manually from the seed because the shiny black seed coat is tough and smooth. The seed and oil characteristics compare well with those of other species of *Acacia* (11).

Fatty acid profiles for *A. holosericea* whole seed (+ aril) and seed (– aril) oils were in general agreement with those found by other investigators (12). Linoleic acid was the major fatty acid (53.3%, 59.45%), followed by oleic acid (24.9%, 20.2%) and palmitic acid (12.6%, 10.0%) for whole seed (+ aril) and seed (– aril), respectively. Behenic acid (22:0) is also present in small amounts (2.8% and 3.5%, respectively), as is often found with *Leguminosae* seeds (13). Oleic acid constituted over 50% of the total fatty acids of aril oil, and palmitic acid was the other major constituent (29.3%). Linoleic acid was present only in a small proportion (8%), and there was little behenic acid. With an increasing contribution from the arils to the total lipid content of the seed material, there is a decrease in the linoleic acid proportion and a corresponding increase in palmitic and oleic acids. Saponification values of the oils extracted indicate that these are normal fatty acids of triglycerides.

High iodine values and high refractive indices of the oil extracted from whole seed (+ aril) and seed (– aril) oils indicate that they are semi-drying oils, whereas the fat from arils, having low iodine value and also low refractive index, falls in the category of nondrying oils. Oils from whole seed (+ aril) and seed (– aril) may have use in formulations of paints and surface coatings and as additives in plastics, whereas the soft fat extracted exclusively from arils may find application in the preparation of high-quality toilet soaps.

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