SHORT COMMUNICATION

Determination of Cyclopropenoid Fatty Acids in *Sterculia* Seed Oils from Senegal

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Seed oils of *Sterculia tomentosa* and *S. tragacantha* (Sterculiaceae) were found to contain malvalic (5.8 and 5.1%), sterculic (11.3 and 30.2%) and dihydrosterculic (0.9 and 0.5%) acids. The total amount of these two cyclopropenoid fatty acids was established by ^{1}H nuclear magnetic resonance and their cooccurrence by gas chromatography. Besides these unusual compounds, the main common fatty acids were palmitic (20 and 24%), oleic (21 and 15%) and linoleic (30 and 16%) acids.

KEY WORDS: Malvalic acid, ^{1}H NMR, sterculic acid, *Sterculia setigera, S. tomentosa, S. tragacantha.*

Sterculia species are well represented in West Africa. Among them, two species are commonly used in folk medicine: *S. tomentosa* Guill. et Perr. (1) and *S. tragacantha* Lindl (2).

Sterculia tomentosa (syn. *S. setigera* Del., local name Bepp) is a large tree whose bark exudes gum. The bark is used against cough. The gum (Karaya or Kutera gum) is used as a thickener in local sauce preparations. The red seeds give a yellow oil.

S. tragacantha (local name Poré Poré) is a large tree with ash-colored bark and is commonly encountered in West tropical Africa. The water extract of young stems is used against tapeworm. The black seeds give a yellow-to-brown oil, used by some tribes of Senegal as a cooking oil.

Cyclopropenoid fatty acids (CPEFA) are known to occur in *Sterculia* species (3–13), and their biological effects on animals (14–16) have been the subject of a number of investigations including cocarcinogenic (17–19) and carcinogenic activity (20). *S. tomentosa* and *S. tragacantha* seed oils, which are used by the local population, have not been studied although ten oils from various *Sterculia* species have been investigated for their CPEFA content (3–13).

This paper is the first report on the fatty acid compositions of these two species. Two analytical procedures, gas chromatography (21) and ^{1}H nuclear magnetic resonance (NMR) (22), have been used for constituent identifications.

EXPERIMENTAL PROCEDURES

S. tomentosa and *S. tragacantha* seeds were collected in the Casamance area of Senegal. Crude neutral lipids were extracted by using published methods (23).

Halphen color test on oils. The original method (24) was used for characterization of CPEFA. The two samples gave the characteristic red-pink color.

Preparation of methyl esters. Fatty acid methyl esters (FAME) were prepared from oils by base-catalyzed transmethylation (21).

Gas chromatography (GC). A Delsi (Lyon, France) 300 gas chromatograph equipped with a flame ionization detector (FID) was used for FAME separation with a fused silica capillary column (50 m × 0.32 mm i.d.) coated with Carbowax 20 M (phase thickness 0.15 μm). Column temperature was 170°C, and detector and inlet temperatures were 200°C. Helium was used as carrier gas at a pressure of 0.7 bar. The injections averaged 1 μL of a 2% solution of FAME in hexane.

Nuclear magnetic resonance. ^{1}H NMR spectra were recorded on a Bruker AC-100 (Bruker Analytische, Karlsruhe, Germany). Oil samples were prepared in a 5-mm o.d. tube by mixing the oils in a mixture of $CCl_4/CDCl_3$ (90:10, vol/vol) in a volume ratio 1:20 according to Pawlowski's method (22). Tetramethylsilane was used as internal standard. The high-field region (δ 0.5–1.5 ppm) of the NMR spectra showed a singlet peak at δ 0.8 ppm due to the two hydrogens on the cyclopropene ring and a triplet at δ 1.0 ppm due to ther terminal methyl groups of all fatty acids. The percent CPEFA was calculated by dividing the area of cyclopropene absorption by the area of the methyl absorption and multiplying by 150 (22). Scanning of samples was done in duplicate with a 250 Hz sweep width.

RESULTS AND DISCUSSION

The seeds of *S. tomentosa* and *S. tragacantha,* when extracted with hexane, gave 26.3% and 23.4% of oil. The two oils gave positive Halphen tests showing the presence of CPEFA (24). Therefore, we choose transmethylation of the oils in methanol with sodium methoxide as catalyst because CPEFA are unstable compounds. The methyl esters obtained were directly analyzed by GC as previously described (21). Results are given in Table 1. The main fatty acids for *S. tomentosa* and *S. tragacantha* were, respectively: palmitic (20.5 and 23.6%), stearic (5.7 and 5.6%), oleic (20.5 and 14.8%) and linoleic (29.8 and 15.9%) acids. The occurrence of malvalic (8,9-methylene-8-octadecenoic), sterculic (9,10-methylene-9-octadecenoic) and dihydrosterculic (9,10-methylene-octadecanoic) acids was confirmed by comparison with kapok seed oils (21). As shown in Table 1 the content of malvalic acid was relatively low for the two species (5–6%), but *S. tragacantha* seed oil was characterized by a higher amount of sterculic acid (35.3% *vs.* 11.3%). These results are in agreement with previously reported contents of CPEFA in the *Sterculia* genus because the highest content of malvalic acid was 32.2% in *S. alata* (5) and of sterculic acid was 65.1% in *S. foetida* (9). The total amount of CPEFA obtained by GC was compared to the ^{1}H NMR determination of Pawlowski (22). The high-field region showed the cyclopropenoid

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TABLE 1

Fatty Acid Composition of *Sterculia tomentosa* and *S. tragacantha* Seed Oils

Fatty acid[a]		Composition (%)[b]	
		S. tomentosa	*S. tragacantha*
Myristic	14:0	0.5	0.2
Palmitic	16:0	20.5	23.6
Palmitoleic	16:1(n-7)	0.5	0.6
Margaric	17:0	0.7	0.2
Stearic	18:0	5.7	5.64
Oleic	18:1(n-9)	20.5	14.8
Vaccenic	18:1(n-11)	0.9	0.0
Linoleic	18:2(n-6)	29.8	15.9
Dihydrosterculic[c]	19:CA	0.9	0.5
Linolenic	18:3(n-3)	2.1	1.8
Arachidic	20:0	0.5	0.9
Behenic	22:0	0.3	0.6
Malvalic[d]	18:CE	5.8	5.1
Sterculic[e]	19:CE	11.3	30.2
Total CPEFA by GC[a]		17.1	35.3
Total CPEFA by NMR[f]		17.3	9.53

[a] Determined from equivalent chain lengths of fatty acid methyl esters on a Carbowax 20 M fused silica capillary column at 170°C. GC, gas chromatography. CPEFA, cyclopropenoid fatty acids.

[b] Percent by weight of total fatty acids.

[c] Dihydrosterculic acid: 9,10-methyleneoctadecanoic acid.

[d] Malvalic acid: 8,9-methylene-8-heptadecenoic acid.

[e] Sterculic acid: 9,10-methylene-9-octadecenoic acid.

[f] Determined from the ^1H nuclear magnetic resonance (NMR) high-field region (δ 0.5–1.5 ppm).

peak at 0.8 ppm and quantitation (Table 1) gave results in agreement with those obtained by GC.

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