Characteristics and Composition of *Abutilon pannosum* and *Hibiscus panduriformis* Seeds and Oils

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ABSTRACT

The seeds of *Abutilon pannosum* (Forst.) Schlecht., syn. *A. muticum* (DC.) Sweet, and *Hibiscus panduriformis* Burm. (Malvaceae), respectively, contained 13.4 and 15.4% oil, and 23.0 and 22.2% protein. The respective seed oil had iodine values of 118.4 and 132.4, and saponification values of 194.3 and 188.8. The fatty acid composition (wt %), as determined by gas liquid chromatography, was: palmitic, 21.3, 12.3; stearic, 2.8, 3.2; oleic, 11.7, 10.2; linoleic, 60.7, 74.3; malvalic, 2.2, trace; sterculic, trace, none; and dihydrosterculic, 1.3, none, respectively.

INTRODUCTION

The characteristics and composition of seeds and oils of 2 species, *Abutilon pannosum* (Forst. f) Schlecht., syn. *A. muticum* (DC.) Sweet, and *Hibiscus panduriformis*, Burm. of Malvaceae family (1) are reported here for the first time as a part of our studies to locate new oilseed resources. *A. pannosum* is a tomentose undershrub widely distributed in India, North Africa, S.W. Asia and Australia, and bears spherical fruits having about 25 carpels, each of which contains 3 tasteless seeds. *H. panduriformis* is a herbaceous, hairy plant widely distributed from tropical Africa to Australia through Asia. It grows to a height of 2 m and bears small, ovoid fruits which contain tasteless seeds.

MATERIALS AND METHODS

Mature fruits of *A. pannosum* and *H. panduriformis* were collected from the forest near Dharwad in Karnataka State during Oct.-Nov. 1980. The fruits were dried in shade and the seeds were obtained by pelting in a mortar. The seeds were powdered with a pestle in a mortar and extracted with petroleum ether (40-60 C) in a Soxhlet apparatus. The solvent was removed in a rotary evaporator at 30-35 C and by flushing with nitrogen. The contents of moisture, oil, protein, crude fiber and ash in the seeds and the characteristics of the extracted oils were determined according to the Official and Tentative Methods of the AOCS (2).

The oils were qualitatively examined for the presence of hydroxy, epoxy and cyclopropene fatty acids by the turbidity (3), picric acid (4) and the Halphen (5) tests, respectively. The oils, as well as their methyl esters, were also examined by infrared (IR) and ultraviolet (UV) spectrophotometry and thin layer chromatography (TLC). The methyl esters were prepared by transesterification of the oil using 1% sodium methoxide in dry methanol. IR spectra were taken as a liquid film on a Perkin-Elmer 221 spectrometer and UV spectra on a Beckman 26 UV-visible spectrophotometer. TLC was done on 0.25-mm thick layers of Silica Gel G (ACME Chemical Works, Bombay) using a mixture of *n*-hexane, diethyl ether and acetic acid (80:20:0.5, v/v/v) as developing solvent and concentrated sulfuric acid as detecting agent. The methyl esters of groundnut oil and castor oil and 9,10-epoxystearic acid were used for reference.

The methyl esters were treated with methanolic silver nitrate solution to convert cyclopropene fatty acids into their ether and keto derivatives (6). The total methyl esters were analyzed by gas liquid chromatography (GLC) using a Toshniwal gas chromatograph fitted with a hydrogen flame ionization detector. A stainless steel column (2.4 m × 3.2 mm) packed with 10% Silar 10 C on Chromosorb W (HP), 80-100 mesh and maintained at 200 C was used. Nitrogen was used as carrier gas at a flow rate of 40 mL/min. The peak area was measured as the product of the peak height and the peak width at half-height. The peaks were identified using reference compounds. As the methyl esters of linoleic acid and dihydrosterculic acid were eluted together, those of dihydrosterculic acid were estimated separately by isolation of the saturated esters through preparative TLC followed by GLC, using methyl heptadecanoate as internal standard. Preparative TLC was done on a 0.5-mm Silica Gel G layer impregnated with 9% silver nitrate using *n*-hexane/diethyl ether mixture (90:10, v/v) as developing solvent and 2′,7′-dichlorofluorescein as indicator.

RESULTS AND DISCUSSION

The characteristics and composition of the seeds and oils of *A. pannosum* and *H. panduriformis* of Malvaceae are given in Table I. *A. pannosum* seeds are oval-shaped, small, and

TABLE I

Characteristics and Composition of *A. pannosum* and *H. panduriformis* Seeds and Oils

	Abutilon pannosum	*Hibiscus panduriformis*
Seeds		
Weight (g/1000)	3.4	5.3
Volume (mL/1000)	3.1	4.0
Moisture and volatiles (%)	6.5	7.0
Oil (%)[a]	13.4	15.4
Protein (%)[a]	23.0	22.2
Crude fiber (%)[a]	21.1	27.3
Ash (%)[a]	2.7	3.4
Oil		
Color	Reddish-yellow	Pale yellow
n_D^{30}	1.4652	1.4681
Acid value	1.9	2.7
Iodine value	118.4	132.4
Saponification value	194.3	188.8
Unsaponifiable matter (%)	1.3	2.4
Fatty acid (wt %)		
Palmitic	21.3	12.3
Stearic	2.8	3.2
Oleic	11.7	10.2
Linoleic	60.7	74.3
Malvalic	2.2	Trace
Sterculic	Trace	ND[b]
Dihydrosterculic	1.3	ND

[a]Dry basis.
[b]None detected.

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brownish-black. *H. panduriformis* seeds are shaggy, small, and deep brown. The oil contents in the seeds of both the species are rather low (13.4 and 15.4%). The oils can therefore be recovered economically only by solvent extraction. The protein contents were appreciable (23.0 and 22.2%) but fiber contents were high (21.1 and 27.3%), which would have to be reduced for use in feeds.

The responses to the turbidity (3) and picric acid (4) tests on the oils were negative, indicating the absence of hydroxy and epoxy fatty acids. TLC of the oils and the derived methyl esters confirmed their absence. The Halphen test (5) gave a positive response showing the presence of cyclopropene fatty acids. The IR and UV specta showed no *trans* or conjugated unsaturation, respectively. The GLC analysis showed that the predominant acid in both the seed oils was linoleic (60.7 and 74.3%). On the basis of fatty acid composition, *A. pannosum* and *H. panduriformis* seed oils can be classified, respectively, as semidrying and drying (7). As these seeds belong to Malvaceae family, the presence of trace-to-significant quantities (2.2%) of cyclopropene fatty acids is not surprising. *A. pannosum* seed oil contained dihydrosterculic acid (1.3%), a suggested intermediate in the biosynthesis of sterculic and malvalic acids in seedlings of some species of Malvaceae family (8,9). In view of the potential for use of the oils in surface coatings, short crop period and ease of seed collection, cultivation of *A. pannosum* and *H. panduriformis* may be considered.

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Triacylglycerol Structure of an African Peanut Oil

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ABSTRACT

Triacylglycerols were isolated from an African peanut oil, then fractionated by unsaturation into classes, and the triacylglycerol structure was determined on these classes using pancreatic lipase hydrolysis. Fatty acid analysis of monoacylglycerols and, in some cases, of 1 or 2 classes of diacylglycerols, allowed the proportions of 84 isomers to be calculated. The oil had a high oleic acid content (60.3%) and contained nearly 25% of trioleoylglycerol, the major triacylglycerol. The 4 most abundant isomers together represented more than one-half of the total triacylglycerols. In 30 isomers, the 2-position was occupied by linoleic acid, and in 39 isomers, by oleic acid. The very long-chain saturated fatty acids (20:0, 22:0, 24:0) that formed 5.1% of the fatty acid content of the oil, were not found in the 2-position. In most cases, each was associated with 2 molecules of an unsaturated fatty acid. The placement of fatty acids, respectively, at the 1,3-position and the 2-position was relatively close to a 1,3-random-2-random distribution, except for trioleoylglycerol (24.7% instead of 21.7% by the random hypothesis).

INTRODUCTION

The study of the triacylglycerol structure of peanut oil from *Arachis hypogoea*, initiated by Crawford and Hilditch (1) in 1950, was then developed, using modern techniques (2), by several authors (3-6).

Interest for such studies was renewed recently, following observations that peanut oil presented atherogenic effects in several species (7-13). This atherogenicity has been attributed to the triacylglycerol structure of peanut oil (14-16), because treatment of the oil with a base to bring about randomization reduced the atherogenicity to that of corn oil (17).

The mechanism by which randomization of peanut oil leads to a reduced atherogenicity is not evident. However, the specificity of pancreatic lipase and of lipoprotein lipases for the 1- and 3-positions of the triacylglycerol molecules (18,19) can make the fatty acid in the 2-position less available metabolically, and, if this fatty acid is linoleic acid, can make the oil more saturated (15).

For this reason, it was of great interest to determine the precise triacylglyercol structure of peanut oil (20-22), especially the fatty acid esterified in the 2-position. In 1977, Myher et al. (15) determined the proportions of 18 molecular species of triacylglycerols. Recently, a more complete study was published by Manganaro et al. (16) for 3 varieties of peanut oil comprising an African oil. They have proposed the proportions of 37 molecular species of triacylglycerols.

This work proposes another detailed study of the triacylglycerol structure of an African peanut oil, leading to a precise determination of the proportion of 84 triacylglycerols, of which the 3 component fatty acids and the fatty acid in the 2-position are known.

MATERIALS AND METHODS

The materials and methods used have been detailed in 2 previous publications (23,24).

To summarize, the peanut oil studied was a crude oil from Upper Volta (Africa) prepared by pressing the ground seeds. The triacylglycerol fraction was isolated by silicic acid column chromatography (25) and its purity checked

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