refining factor improve when the miscella contains 60% oil. Degumming and dewaxing by calcium chloride at 15 ± 1 C in hexane also gives oil color with a refining factor of 1.9. Rice bran oil of 30.2% FFA refined well in the miscella phase with refining factor 1.9; however, the color is slightly darker than the samples with lower FFA. Rice bran oil dewaxed in the miscella phase without additives and then refined in the miscella phase can be converted into good quality rice bran oil with a refining loss factor of 1.4-1.6, as shown in Table 2. Bleaching in the oil phase effectively improves the color. The refining factor improves remarkably, and the unsaponifiable matter in refined oil is 1.6 to 1.7%. Dewaxing in hexane with lipofrac agent can be combined with miscella neutralization. The results obtained are included in Table 3. Lipofrac dewaxing before alkali neutralization in hexane enhances the refining factor in comparison with the hexane dewaxing by cooling only. Degumming and dewaxing by lipofrac process in hexane followed by miscella refining indicates (Table 4) that the unsaponifiable matter in two samples of rice bran oil decreases significantly without a significant change in the refining factor. The color of the samples also improves after bleaching.

The results shown in Tables 1-4 demonstrate the suitability of the miscella refining process preceded by miscella dewaxing for converting high FFA rice bran oils into edible quality oils that can be used in cooking.

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Cyclopropenoid Fatty Acids in *Gnetum scandens* and *Sterculia pallens* Seed Oils

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Seed oils of *Gnetum scandens* (Gnetaceae) and *Sterculia pallens* (Sterculiaceae) were found to contain sterculic (28.57, 6.97) and malvalic (11.27, 3.87) acids, respectively. Gas chromatographic analysis of silver nitrate/methanol-treated methyl esters was used to establish the co-occurrence of these two acids. *Sterculia foetida* methyl esters were used as a reference standard.

Cyclopropenoid fatty acids (CPFA) have been a subject of many investigations due to their carcinogenic (1,2), cocarcinogenic (3-5) and other biological effects on animals (6,7). As a part of our screening program aimed at the search for biologically active cyclopropanoid acids in minor seed oils, the present paper reports the results of the analysis of CPFA-containing seed oil of *Gnetum scandens* (Gnetaceae) and *Sterculia pallens* (Sterculiaceae). The seeds of *S. pallens* are eaten and the plant of *G. scandens* is used as a fish poison. Gnetaceae seed fats are rarely known for CPFA content.

EXPERIMENTAL PROCEDURES

The experimental procedures have been discussed elsewhere (8).

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RESULTS AND DISCUSSION

The analytical values of the seeds and oils are summarized in Table 1 (9). GLC chromatograms clearly established the presence of malvalic (11.27, 3.87) and sterculic (28.57, 6.97) acids in *G. scandens* and *S. pallens* seed oils. The GLC data (Table 2) were found close to those obtained by HBr-titration (10).

TABLE 1

Analytical Data of *Gnetum scandens* and *Sterculia pallens* Seed Oils

	G. scandens	*S. pallens*
Seeds		
Oil content (%)	15.7	30.2
Protein content N × 6.25 (%)	14.3	20.1
Moisture (%)	6.2	4.3
Seed oils		
Iodine value (Wijs)	85.93	85.30
Saponification value	191.51	195.39
Refractive index n_D	1.4769	1.4772
Halphen test	positive	positive
HBr equivalent	39.84	10.84

TABLE 2

Fatty Acids Composition of $AgNO_3$/Methanol-Reacted Methyl Ester (% wt) Derived from *Gnetum scandens*, *Sterculia pallens* and *Sterculia foetida* Seed Oils

Fatty acids	*G. scandens*		*S. pallens*		*S. foetida*	
Myristic (14:0)	0.35		3.15		—	
Palmitic (16:0)	15.51		21.14		—	
Palmitoleic (16:1)	—		—		1.0	
Stearic (18:0)	10.20		2.85		3.4	
Oleic (18:1)	16.22		40.20		9.4	
Linoleic (18:2)	15.00		21.79		1.3	
Linolenic (18:3)	2.85		—		—	
Malvalic						
(Ether derivative)	10.36	11.27	3.31	3.87	6.5	7.1
(Ketone derivative)	0.91		0.56		0.6	
Sterculic						
(Ether derivative)	27.25	28.57	6.06	6.97	48.8	51.2
(Ketone derivative)	1.32		0.91		2.4	

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Chemical Evaluation of Egyptian Citrus Seeds as Potential Sources of Vegetable Oils

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Seeds of the citrus fruits orange, mandarin, lime and grapefruit were analyzed. Petroleum ether-extracted oils of such seeds amounted to more than 40% of each. Physical and chemical properties of the extracted oils are presented. Samples of the extracted oils were saponified and the unsaponifiables and fatty acid fractions isolated. The isolated unsaponifiables and fatty acids were analyzed by GLC. GLC analysis of the unsaponifiables revealed compositional patterns different in number, type and relative concentration of fractions according to type of citrus seed oil, depending on the solvent system used for oil extraction and unsaponifiable matter isolation. The compositional patterns of the unsaponifiables were similar to that of cottonseed oil. Mandarin and grapefruit oils are free of cholesterol. The data demonstrate that the fatty acid compositional patterns of the oils differ; Mandarin seed oil contains the largest number of fatty acids, and grapefruit seed oil contains the lowest. The total amounts of volatile fatty acids in these oils are generally higher than those of other edible oils. Lime seed oil is similar, in the degree of unsaturation, to soybean oil. The orange oil pattern is similar to cottonseed oil. The amount of total essential fatty acids in lime seed oil is the highest of the oils studied.

A number of workers have studied the fatty acid composition of citrus seed oils. Mehta et al. (1) studied the fatty acid composition of orange seed oil and found that saturated fatty acids represented 12.08%. French (2) identified the fatty acids palmitic (28%), stearic (5.4%), oleic (22.6%), linoleic (37.2%) and linolenic (6.5%) in citrus seed oils. Braddock and Kesterson (3) stated that the properties and characteristics of citrus seed oils are similar to cottonseed oil. One notable difference is that linolenic acid is present in appreciable amounts in citrus seed oils but only traces are found in cottonseed oil. They added that from the nutritional aspect citrus seed oils are similar to other vegetable oils having a relatively high content of the essential linoleic and linolenic acids.

Abdel-Baki and Hassan (4) reported that in Egyptian orange seed oil oleic acid is the major fatty acid. Abdo (5) studied the fatty acid composition of Egyptian orange seed oil and identified palmitic, stearic, palmitoleic, oleic, linoleic and linolenic acids at 22.46%, 4.73%, 0.73%, 30.3%, 38.88% and 1.86%, respectively.

At present no citrus seed oils are produced commercially in Egypt. Braddock and Kesterson (3) reported that the commercial production of citrus seed oils in Florida (USA) had reached 13 million kg in 1970-1971.

The present investigation was therefore performed to