Fruit Oil Composition and Characteristics of Two Spurge Species of Turkish Origin

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Content and characteristics of the triglyceride fruit oils of two spurge (*Euphorbia* L.) subspecies, namely *E. glaerosa* Pallas ex Bieb. (var. *lasiocarpa* Boiss.) and *E. niciciana* Borbas ex Novak, were investigated. For both taxa, oil content of the capsules enclosing the seeds ranged between 15.7 and 16.4% on dry basis, while the decapsulated seeds contained 33.0–34.0% oil, also on dry basis. The average saponification, iodine and acid values were 192, 190 and 6.0, respectively; linolenic acid was detected as the major constituent fatty acid. Consequently, these seed oils are characterized as typical drying oils.

Present production of triglyceride oils and fats for food as well as for industrial purposes is somewhat insufficient in Turkey. However, in other parts of the world blends of triglyceride oils with diesel oil or their direct application as such are considered as a potential renewable source of liquid fuels (1–3). To increase oil production potential in Turkey, we investigated seed specimens of two subspecies of *Euphorbia* for oil content and chemical characterization.

Spurge or Wolf's Milk, botanically designated as *Euphorbia L.*, is one genus of the plant family Euphorbiaceae and includes a rather large number of species and subspecies. Most of the species of this genus bear seeds containing highly unsaturated fatty oils (4). In Turkey, spurge species grow as wild herbs on all kinds of fields, hills, mountains, dry places, sands and forests. Khan identified 84 species of this genus in Turkey (5). The two different subspecies of *Euphorbia* evaluated for this report are *E. glaerosa* Pallas ex Bieb. (var. *lasiocarpa* Boiss.) and *E. niciciana* Borbas ex Novak. Both of the herbs occur in European as well as in inner Anatolian regions of Turkey (6,7).

MATERIALS AND METHODS

As raw materials for this investigation, specimens of *Euphorbia glaerosa* Pallas ex Bieb. (var. *lasiocarpa* Boiss.) were collected in the Avcılar district of Istanbul during the summer season of 1986. *Euphorbia niciciana* Borbas ex Novak was collected in the same period of time from the Uzunköprü district of Edirne.

Reagents and solvents used for the laboratory investigation were all of pure chemical grade. For determination of moisture and oil content, air-dried material was crushed on a laboratory mill. The oil content was determined with a standard analytical Soxhlet extractor and n-hexane as solvent. For the analytical investigation preparative samples of oil also were obtained through solvent extraction, and for this purpose only the crushed whole fruits (capsules with seeds) were used.

The physical and chemical properties of the oil samples thus obtained were investigated according to the usual test methods of fat and oil analysis (8,9). Among them the refractive index was determined with an Abbe refractometer, while for the iodine value the method of Kaufmann was applied. For the determination of qualitative oil structure, thin layer chromatographic analyses of whole oil samples and of their unsaponifiable matter content have been performed according to E. Stahl (10). Silica gel G was used as adsorbent, and a mixture of petroleum ether-diethyl ether-acetone (65:35:2, v/v/v) was used for development. Oil samples were transformed into the corresponding methyl ester derivatives and the fatty acid composition was determined by gas liquid chromatography, using a Varian 3700 apparatus fitted with a hydrogen flame detector and a stainless steel column (2 m × 5 mm) packed with 10% diethylene glycol succinate on Chromosorb W. Temperature was held at 180 C. Nitrogen carrier gas flow rate was fixed at 17 ml/min.

TABLE 1

Some Technological Characteristics of Fruits and Seeds

Euphorbia subspecies	Average length mm	Average width mm	Weight of 100 pieces g	Moisture content %	Oil content (air dry basis) %	Oil content (dry basis) %
E. glaerosa (var. *lasiocarpa*)						
Capsules	3.28	3.42	1.69	7.46	15.2	16.4
Seeds	—	—	0.29	4.22	31.6	33.6
E. niciciana						
Capsules	2.27	2.65	0.74	10.22	14.1	15.7
Seeds	—	—	0.09	8.51	30.1	32.9

TABLE 2

The Constituent Fatty Acid Composition of Spurge Fruit Oil Samples

Constituent fatty acids	*E. glaerosa* (var. *lasiocarpa*) (wt %)	*E. niciciana* (wt %)	*E. terracina* (wt %) (13)
Palmitic acid	6.5	8.0	8[a]
Oleic acid	8.4	4.9	12
Linoleic acid	8.6	12.6	21
Linolenic acid	76.4	74.3	55

[a]Includes 1% stearic acid.

TABLE 3

Physical and Chemical Characteristics of Some Euphorbia Fruit Oils

	E. glaerosa (var. *lasiocarpa*) (fruits)	*E. niciciana* (fruits)	*E. helioscopia* (seeds) (11)	*E. terracina* (seeds) (13)
Refractive index, n_D^{20}	1.4855	1.4852	1.4821[a]	1.4751[b]
Density, 20 C g/ml	0.9383	0.9346	0.9346	—
Saponification value	193	191	191	—
Iodine value	189[c]	190[c]	204	197
Acid value	6.32	5.77	—	—
Unsaponifiable matter, %	6.89	7.62	0.70	—
Ester value	186.80	185.36	—	—

[a]n_D^{22}.

[b]n_D^{40}.

[c]Kaufmann.

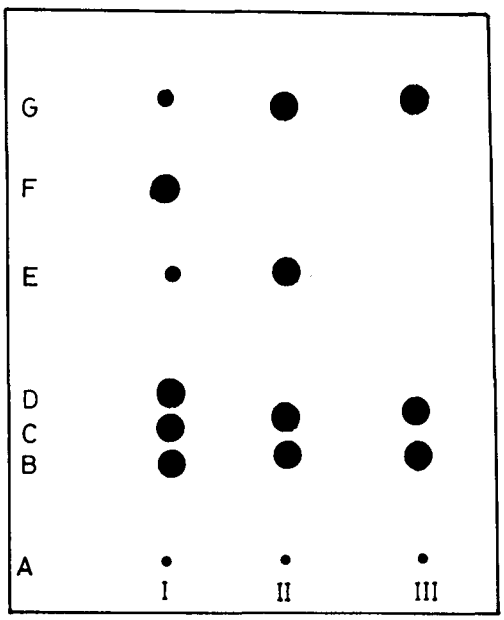

FIG. 1. Thin layer chromatography of *E. glaerosa* (var. *lasiocarpa*) oil sample. Legend: I, oil sample as such; II, reference mixture; III, unsaponifiable matter of the oil sample. A, Points of start; B, cholesterol; C, oleic alcohol; D, diglycerides; E, oleic acid; F, triglycerides; G, squalene.

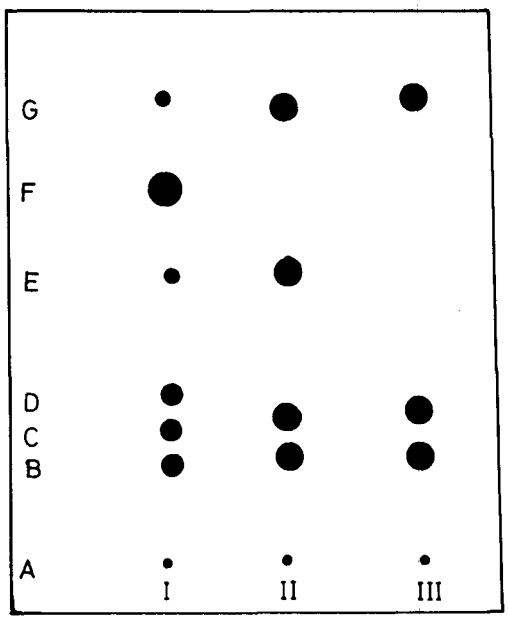

FIG. 2. Thin layer chromatography of *E. niciciana* oil sample. Legend: I, oil sample as such; II, reference mixture; III, unsaponifiable matter of the oil sample. A, Points of start; B, cholesterol; C, oleic alcohol; D, diglycerides; E, oleic acid; F, triglycerides; G, squalene.

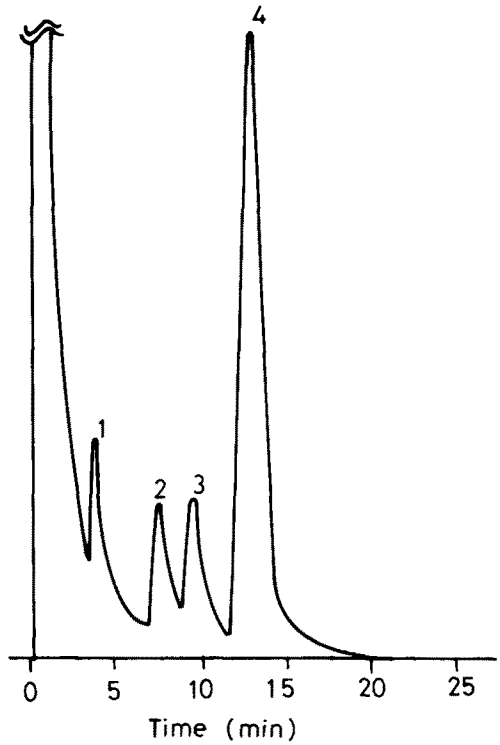

FIG. 3. Gas liquid chromatogram of the methyl ester derivative of *E. glaerosa* (var. *lasiocarpa*) fruit oil. Peak 1, methyl palmitate; peak 2, methyl oleate; peak 3, methyl linoleate; peak 4, methyl linolenate.

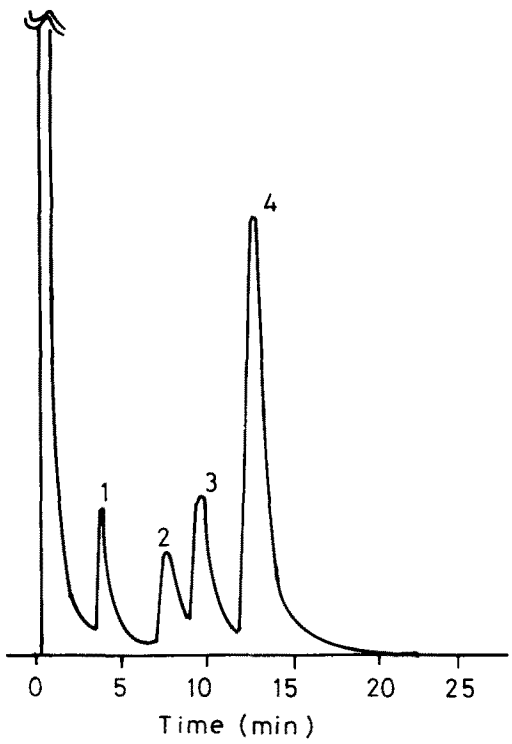

FIG. 4. Gas liquid chromatogram of the methyl ester derivative of *E. niciciana* fruit oil. Peak 1, methyl palmitate; peak 2, methyl oleate; peak 3, methyl linoleate; peak 4, methyl linolenate.

RESULTS AND DISCUSSION

Some characteristics of the fruits (capsules with seeds) and of the seeds alone are summarized in Table 1.

Figures 1 and 2 show schematically the thin layer chromatography plates for the qualitative structure of the oil samples and of their unsaponifiable matter content, respectively. Figures 3 and 4 are the results of the liquid-gas chromatographic analyses of the respective oil samples.

Based on these chromatograms the calculated constituent fatty acid compositions of both oil samples are summarized in Table 2. For comparison the composition of *E. terracina* L. seed oil reported by Kleiman is included in the table (13). *E. terracina L.* is another member of the same subsection (6).

The physical and chemical characteristics of these oils are compared in Table 3 with seed oils of two other Euphorbia species already reported elsewhere.

In this study the seed oil characteristics of two spurge species originating from Turkey have been investigated for the first time. The physical characteristics and the saponification values of the oil show close resemblance to the results of P. Gillot (11,12), R. Kleiman et al. (13) and F. R. Earle et al. (14), who have studied many other species of this genus, even those differing in their regions of occurrence. There seems to be a discrepancy concerning the unsaponifiable matter content and the iodine values. This difference may be due to the wax, sterol or hydrocarbon contents of the capsules which probably are passed to the oil sample through our extraction process. On the other hand, the lower iodine values may be due to the special method applied, which shows generally a lower value than do other methods.

Evaluating the above results, it can be concluded that triglyceride oils originating from the fruits of *E. glaerosa* Pallas ex Bieb (var. *lasiocarpa* Boiss.) and *E. niciciana* Borbas ex Novak can be classified as typical drying oils, which is also the case for many other species of *Euphorbia* genus seeds. Moreover, additional examinations, which will be the subject of a further report, showed that derivatives of these oil samples obtained through transesterification with ethyl alcohol can be used to some degree as diesel fuel substitute.

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