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SEED OILS OF FIVE SPECIES OF THE FAMILY ROSACEAE

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The family Rosaceae includes about 3000 species, and of them more than 150 grow in the territory of Uzbekistan. The fatty-acid compositions of the seed oils of woody-bushy species of plants have been studied in most detail [2-8], while herbaceous species have been less studied [9, 10].

We give information on the seed oils of herbaceous species of the family Rosaceae collected in the central band of mountains of the western Tien-Shan (Uzbek SSR) in 1975-1976.

The results of the thin-layer chromatography of the oils according to the classes of lipids showed that the neutral lipids contain predominantly triglycerides (main zone). In fact, all the oils investigated have low acid numbers and a low content of unsaponifiables. In the remaining 6-7 zones of neutral lipids of each of the oils, by comparing the R_f values with those of model samples (the hydrocarbons of the seed oil of the Scotch thistle, the free fatty acids of cottonseed oil, β-sitosterol) we identified hydrocarbons, free fatty acids, and free sterols.

The total fatty acids were isolated from the oils by cold saponification. Part of the combined fatty acids was methylated with diazomethane and investigated by gas–liquid chromatography (GLC) and thin-layer chromatography (TLC). The peaks of the fatty acid methyl esters in GLC were identified from their relative retention times using the linear dependence of the logarithms of these magnitudes on the number of carbon atoms [11-14]. As model samples we added the methyl esters of the fatty acids of the seed oil of Lindelofia macrostyla (Bunge) M. Pop., family Boraginaceae [15]. Another part of the total fatty acids was separated by paper chromatography (PC). This gave 5-6 fatty-acid zones, which confirmed the GLC results and additionally showed the presence of traces of arachidic and behenic acids in the oils.

The characteristics, the oil content of the seeds, and some physicochemical indices of the oils isolated and of the mixtures of fatty acids are given in Table 1.

No oxidized fatty acids were detected by PC and TLC.

The satisfactory correlation between the refractive index, the iodine number, and the IR and UV spectra of each oil leaves no doubt on the main components of the fatty-acid composition found by the GLC method. For correlation we used the regression equation: I. No. = $8555.559 \cdot n_D^{40} - 12425.928$.

The results of analyses of the fatty-acid compositions of the five oils show that the triglycerides of these oils contain considerable amounts of linolenic acid.

Information on the fatty-acid composition of the seed oil of Poterium polygamum was obtained previously [9] by calculation using the iosmerization of the oil and of the mixture of fatty acids followed by spectrophotometry in the near ultraviolet. These results concerning the amount of linolenic acid agree well with those which we have obtained by the GLC method. We also found similarly the amount of linolenic acid in the fatty acids of the seed oil of Potentilla transcaspica Th. Wolf. (~ 50%) [10]. At the same time, we found no linolenic acid whatsoever in the seed oils of woody-bushy species of plants, for example, in the cherry [8], or found it in an amount of about 2% in four species of almond [7].

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TABLE 1

Index	*Agrimonia asiatica* Juz.	*Potentilla asiatica* Juz.	*Potentilla orientalis* Juz.	*Potentilla dese-torum* Bunge	*Poterium polygamum* W. et K.
Seeds					
Weight of 1000 seeds, g	32,00	0,35	0,37	0,18	5,99
Petroleum-ether extract					
Amount (on the absolutely dry matter) or oil content of the seed, %	11,26	21,74	17,18	21,08	17,73
Refractive index, n_D^{20}	1,4788	1,4848	1,4814	1,4822	1,4807
Iodine No., %, I_2 (Kaufmann)	165,92	212,43	187,49	194,55	181,29
Saponification No., mg KOH/g	184,84	185,88	182,13	183,44	182,94
Acid No., mg KOH/g	3,58	1,97	2,89	3,01	2,74
Amount of unsaponifiables, %	3,40	1,50	1,03	2,04	1,38
Total fatty acids					
Iodine No., %, I_2 (Kaufmann)	177,70	214,41	199,45	205,29	184,36
Neutralization No., mg KOH/g	200,35	200,22	198,87	198,98	198,83
Mean mol. wt.	280,01	280,20	282,10	281,94	282,16
Composition of the methyl esters of the fatty acids according to GLC					
Amounts of the acids, mol. %					
palmitic	6,74	4,51	4,37	4,45	7,66
stearic	2,84	1,81	0,94	2,55	2,52
arachidic	—	Tr.	Tr.	Tr.	Tr.
behenic	—	—	—	—	Tr.
oleic	21,83	10,30	19,49	15,97	16,48
linoleic	33,58	24,39	26,14	21,48	34,86
linolenic	35,01	58,99	49,06	55,55	38,48

Since the woody-bushy species of plants are present in a lower degree of evolution than the herbaceous plants, the point of view on the evolution of the chemistry of oils [16] that is shown in a rise in the degree of unsaturation of the saturated acids may be considered as confirmed.

EXPERIMENTAL

The oil was extracted with petroleum ether by the steeping method at room temperature from the seeds previously comminuted in a disk mill. The indices of the petroleum-ether extracts and of the mixtures of fatty acids were determined by methods given in a handbook [17].

The mixtures of fatty acids from the oil were isolated by saponifying it with 1 N caustic potash in methanol at room temperature. The soaps were dissolved in water, and the unsaponifiables were extracted from the resulting solution with petroleum ether three times. The soaps were decomposed with 10% sulfuric acid under a layer of diethyl ether.

Thin-layer chromatography was performed on activated KSK silica gel (150 mesh) in the hexane–diethyl ether–acetic acid (70 : 30 : 1) solvent system.

The paper chromatography of the fatty acids has been described previously [18].

The gas–liquid chromatography of the methyl esters of the fatty acids was performed on Chromaton N-AW-HMDS with 15% of Reoplex-400 at 203°C on a UKh-2 instrument.

SUMMARY

Some physicochemical characteristics of the seed oils of five species of plants of the family Rosaceae have been studied, confirming the information on the fatty-acid compositions of these oils that we obtained by the GLC, TLC, and PC methods. It has been shown that a high content of linolenic acid is characteristic for each of the five seed oils of herbaceous plants of this family.

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PHENOLIC LIPID FROM Azotobacter chroococcum

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In an investigation of the combined cell lipids of the nitrogen-fixing bacterium Azotobacter chroococcum 92 [1] by thin-layer chromatography (TLC) we found that one of its main components is an unusual comparatively feebly polar lipid giving the positive reaction with ferric chloride that is characteristic for phenols and enols. The present paper describes the isolation and structural identification of this substance (I).

The combined lipids of A. chroococcum 92 obtained by extracting the freeze-dried cells with mixtures of chloroform and methanol were subjected to ion-exchange chromatography on DEAE-cellulose [2]. The lipid (I) was eluted in the same fraction as the neutral glycerides with chloroform–methanol (9 : 1), which indicates the absence of strongly anionic groupings in its molecule.

The subsequent chromatography of this fraction on a column of silica gel led to the isolation of the lipid in the form of a crystalline substance which, on TLC in various solvent systems behaved as an individual lipid fraction. The lipid isolated was stable under the conditions of acid and alkaline methanolysis and did not change on treatment with sodium tetrahydroborate and lithium tetrahydroaluminate. Under the action of acetic anhydride in pyridine it gave an acetyl (II) or benzoyl (III) derivative, and under the action of diazomethane it was slowly converted into a methyl ether (IV). Analysis of the UV, IR, PMR, and mass spectra of the native lipid (I) and its derivatives (II-IV) permitted an unambiguous conclusion concerning its structure.

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