A STUDY OF THE OILS OF Ocimum Basilicum AND Cardaria repens

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The present paper gives the results of a study of the oil of the seeds of Ocimum basilicum (sweet basil), family Labiatae, and Cardaria repens (Schrenk) Jarm., family Cruciferae.

Some indices of basil oil published previously [1] do not agree with ours. There is no information on the oil of C. repens in the literature.

C. repens is a common weed growing in fields, gardens, and woods [2].

Sweet basil is a cultivated plant. It is grown in the whole of Central Asia in several varieties. The people of Uzbekistan distinguish ash-raikhon, kara-raikhon, and sada-raikhon [3]. We have investigated the last-mentioned variety. The following indices were found for the seeds:

Index	Ocimum basilicum	Cardaria repens
Weight of 1000 seeds, g	1.195	1.8073
Bulk density, g/liter	–	515.9
Oil content (petroleum ether extraction), %	22.14	14.026

The seeds of both plants were ground and extracted with petroleum ether with steeping. The Cardaria oil is yellow and odorless, and the basil oil is golden yellow with a pleasant smell. Some physicochemical indices of these oils and of the mixtures of fatty acids isolated from them were studied (Table 1).

In order to determine the qualitative and quantitative compositions of the fatty acids of the oils, we used paper and gas-liquid chromatography. Mixtures of fatty acids isolated from these oils by the usual method [4] with the preliminary separation of the unsaponifiables, and individual fatty acid fractions isolated by the methods of Bertram [5] and Twitchell [6] were subjected to chromatography. The fatty acid compositions of the oils were determined by gas-liquid chromatography (Table 2).

TABLE 1. Physicochemical Indices of the Oils and Fatty Acids

Index	Units of measure	Ocimum basilicum		Cardaria repens	
		oil	acids	oil	acids
Density	g/cm^3	0,9284	–	0,9203	–
Refractive index	–	1,4828	–	1,4786	–
Absolute viscosity	–	0,5162	–	0,8103	–
Acid No.	mg *KOH*/g	6,38	–	3,475	–
Hehner's No.	%	93,36	–	92,06	–
Neutralization No.	mg*KOH*/g	–	205,58	–	194,75
Mean molecular weight	–	–	272,94	–	288,11
Iodine No.	%	185,32	188,09	147,13	160,58
Thiocyanogen No.	%	106,02	109,06	93,14	95,3
Content of phosphatides	%	0,165	–	0,33	–
Content of unsaponifiables	%	0,83	–	1,145	–

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TABLE 2. Fatty Acid Composition of the Oils of Ocimum basilicum and Cardaria repens

Acid	Index	Ocimum basilicum	Cardaria repens
Undecylic	$C_{11:0}$	traces	2
Lauric	$C_{12:0}$	1,14	0,12
Tridecylic	$C_{13:0}$	0,11	0,15
Myristic	$C_{14:0}$	0,13	0,18
Palmitic	$C_{16:0}$	6,75	6,45
Palmitoleic	$C_{16:1}$	0,24	0.51
Stearic	$C_{18:0}$	2,14	1,49
Oleic	$C_{18:1}$	9,40	14,35
Linoleic	$C_{18:2}$	17,56	16,99
Linolenic	$C_{18:3}$	62,53	42,89
Arachidic	$C_{20:0}$	—	0,93
Erucic	$C_{22:1}$	—	11,51
Unknown	Unidentified	—	2,43

TABLE 3. Triglyceride Composition of the Oils of Common Basil and Cardaria repens

Triglyceride	Ocimum basilicum	Cardaria repens
	%	
Gl SSS	0,07	0,05
Gl SSU	0,72	0,84
Gl USU	1,80	3,59
Gl SUS	2,72	1,06
GL SUU	27,08	18,04
Gl UUU	67.61	76,42

Notes: Gl) glycerol radical; S) saturated acyls; U) unsaturated acyls.

In addition, arachidic, behenic, and lignoceric acids were detected on paper chromatograms of the mixture of fatty acids and of the individual fractions of these acids obtained from basil oil. These acids were visible only on the chromatograms of the Bertram and Twitchell fractions of the fatty acids. It was impossible to detect them in the initial mixture of fatty acids because of their extremely small amounts. However, the chromatogram of the initial mixture of fatty acids exhibited a spot of an acid migrating with the solvent front. We did not find this spot in the fractions of saturated and solid fatty acids. In all probability it is a hydroxy acid, and at the present time we have succeeded in isolating it and are now studying it.

A paper chromatogram of the same fractions of the fatty acids of Cardaria also showed the presence of arachidic + erucic, behenic, and lignoceric acids.

Just as in the initial fatty acids of basil oil, the spot of a hydroxy acid was found at the solvent front in the chromatography of a mixture of the fatty acids of Cardaria.

The quantitative fatty-acid compositions given in Table 2 are corrected to some extent by combination with the results of gas-liquid chromatography of the individual fractions of the fatty acids isolated by Bertram's and Twitchell's methods. Thus, the saturated fatty acid fraction of basil oil was found to contain arachidic acid ($C_{20:0}$). The same acid is found among the solid acids. Moreover, the solid-acid fraction exhibits the peak of an acid occupying, in respect of relative retention time, a position between the $C_{20:0}$ and $C_{22:0}$ acids. Since this acid is present in the solid-acid fraction but not in the saturated fatty acid fraction, it may be regarded as a solid unsaturated acid. It is proposed to investigate the structure of this acid subsequently.

The saturated and solid acids of the oil of the Cardaria showed the peak of behenic acid ($C_{22:0}$), although this is not shown in Table 2.

It was found that when basil oil was stored, even under refrigerated conditions, changes took place in the quantitative composition: the content of unsaturated acids decreased. A UV-spectroscopic investigation showed that the content of conjugated dienes rose from 0.6 (for the freshly isolated fatty acids) to 18.5% (for acids stored for almost a month).

The IR spectra of freshly isolated mixtures of the fatty acids of Cardaria and of basil show the absence of the bands characteristic for trans compounds and compounds with conjugated systems of double bonds.

Such changes in the fatty acids of basil oil during storage indicate the presence in it of some fatty acid or acids capable of rapid double-bond migration in the direction of conjugation.

We established the presence of an unusual trienic acid among the fatty acids of basil oil during the determination of the hexabromide No. The hexabromide obtained had mp 169-172°C (after four recrystallizations from CCl_4, mp 171-173°C), in place of the 178-180°C characteristic for the hexabromide of α-linolenic acid.

Found %: C 28.8; H 4.09; Br 62.66. $C_{18}H_{34}O_2Br_2$. Calculated %: C 28.52; H 3.96; Br 63.26.

The triglyceride compositions of the Cardaria and basil oils were determined by enzymatic hydrolysis [7] (Table 3).

EXPERIMENTAL

The oil was extracted from the previously comminuted seeds in the cold with petroleum ether (bp 50-60°C). The ether was distilled off in a current of nitrogen and the extract was dried in a vacuum-drying chest. The fatty acids were isolated by cold saponification with subsequent separation of the unsaponifiables.

The gas-liquid chromatograms of the methyl esters of the fatty acids were recorded on a UKh-2 chromatograph. The stationary phase was PES [poly(ethylene succinate)].

The hexabromide of the oil of sweet basil was obtained as described in the literature [5, p. 920].

The paper chromatography of the mixtures of fatty acids was carried out by the method of Astvatsatur'yan [8] on "M" ("slow") paper of the Leningrad No. 2 paper mill. The paper was impregnated with a 10% solution of paraffin oil in benzene. The mixtures of fatty acids to be analyzed were chromatographed in comparison with standard fatty acids. The mobile phases used were 90% acetic acid–85% formic acid (3:1) and, for rechromatography, 98% acetic acid–85% formic acid (3:1).

The spots were revealed with a solution of copper acetate and with rubeanic acid.

SUMMARY

The seed oils of the plants Ocimum basilicum and Cardaria repens have been studied. Their physicochemical properties and fatty acid and glyceride compositions have been determined. Both oils contain a hydroxy acid of undetermined structure. The oil of Ocimum basilicum contains an unusual trienic acid.

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