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OILS OF THE SEEDS OF NINE SPECIES OF THE GENUS *Crambe*

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Of the 18 species of *Crambe* (colewort) growing in the territory of the USSR [1], *Crambe abyssinica* (Abyssinian colewort) has been intensively studied and introduced into cultivation, since it gives a fatty oil valuable for food purposes [2]. At the present time, Abyssinian colewort is grown as an oil crop in the southern regions of Povolzh'e and the central zone of Russian [3]. The fatty oil of this plant contains about 60% of erucic acid, which is used to prepare polyamide resins, polyesters, surface-active agents, etc. [4, 5]. Other species of colewort also contain large amounts of fatty oil [6-8].

We have investigated the oil of the seeds of nine species of colewort: *Crambe abyssinica* Hochst., *C. amabilis* Butk. et Majlum, *C. cordifolia* Stev., *C. koktebelica* (Junge) N. Busch., *C. kitschyana* Boiss., *C. orientalis* L., *C. pinnatifida* R. Br., *C. steveniana* Rupr., and *C. tataria* Sebeók.

The species of the genus *Crambe* are close phylogenetically and therefore the oils from their seeds differed little in their physicochemical properties. The seeds of the species studied had a high oil content — 29.42-38.73%, the highest being found in the seeds of the Abyssinian colewort — 38.73%. Some physicochemical indices of the oils are also characterized by the following facts: refractive index — 1.4715-1.4748; relative viscosity, $^{\circ}E_{20}$ — 10.86-11.42; acid No., mg KOH/g — 1.78-3.56; saponification No., mg KOH/g — 170.34-178.54; iodine No., % iodine — 100.18-110.82; thiocyanogen No., % iodine — 74.88-78.13; Reichert—Meissl No., % — 0.62-0.87; Polenske No., % — 0.24-0.58.

When the oil was saponified with alcoholic alkali, fatty acids were isolated having the following characteristics: iodine No. — 105.64-116.71; cyanogen No. — 78.03-81.34; neutralization No. — 178.28-185.50 mg KOH/g; mean molecular weight — 302.48-314.73.

It can be seen from the facts given that the iodine numbers of the oils are considerably lower than those of many species of the family Cruciferae and coincide with the iodine numbers of other species of colewort such as common colewort (*Crambe maritima*) (111.5) [7], and *Crambe pontica* (109.60) [8].

The qualitative and quantitative compositions of the fatty acids of the oils were determined by gas—liquid chromatography with the characteristics given previously [8]. The methyl esters of total fatty acids, and also of the saturated and unsaturated fatty acids separately, their separation being performed by the acetone method, were subjected to gas-chromatographic determination. The acids were identified by the internal-standard method

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TABLE 1. Fatty-Acid Compositions of the Oils (%)

Symbol of the acid	Crambe								
	abyssinica	amabilis	cordifolia	koktebelica	kotschyana	orientalis	pinnatifida	steveniana	tataria
$C_{8:0}$	—	—	—	—	—	—	—	0,02	—
$C_{10:0}$	—	—	—	—	—	—	—	0,03	—
$C_{14:0}$	0,05	0,05	0,05	0,03	0,05	0,05	0,06	0,06	0,05
$C_{15:0}$	—	—	—	—	—	—	—	0,05	0,02
$C_{16:0}$	1,53	2,50	2,31	1,32	2,36	2,09	1,99	1,26	1,72
$C_{16:1}$	0,29	0,31	0,31	0,21	0,30	0,22	0,39	0,20	0,32
$C_{17:1}$	—	—	—	—	—	—	—	—	0,10
$C_{18:0}$	0,73	0,36	0,75	0,29	0,42	0,43	0,77	0,50	0,65
$C_{18:1}$	15,24	19,35	27,11	31,14	29,29	18,14	17,95	19,59	28,69
$C_{18:2}$	9,46	12,94	14,44	19,11	16,57	13,07	11,66	23,37	22,17
$C_{18:3}$	5,22	8,05	7,59	4,68	7,66	9,07	9,09	8,54	7,81
$C_{20:0}$	1,34	—	—	—	—	—	—	—	
$C_{20:1}$	2,80	19,92	17,28	17,47	17,10	19,39	3,62	18,47	16,46
$C_{20:2}$	Tr.	0,89	0,74	0,99	0,59	1,05	0,30	2,01	1,29
$C_{22:0}$	2,42	—	—	—	—	Tr.	—	Tr.	
$C_{22:1}$	57,07	34,82	28,04	24,71	25,66	34,69	47,37	24,49	20,72
$C_{22:2}$	0,84	0,81	Tr.	—	Tr.	0,81	2,02	0,49	—
$C_{24:0}$	1,45	—	1,35	—	—	0,99	3,20	0,94	—
$C_{24:0}$	1,62	—	—	—	—	—	—	—	—
Others	—	—	0,03	0,05	—	—	1,58	—	—

and from the retention times on the chromatogram of methyl esters of fatty acids of known oils and samples. The fatty-acid compositions of the oils are given in Table 1.

Colewort oils contain a considerable amount (not less than 20%) of erucic acid, which is characteristic for oils of species of the family Cruciferae. It was present in the greatest amount in the oil of the Abyssinian colewort (57.01%) and there was somewhat in the oil of *Crambe pinnatifida* (47.37%). No marked differences between the fatty-acid compositions of the oils investigated and those given in the literature were found, and the fatty-acid composition of the *Crambe orientalis* oils practically coincided with that given in the literature [9].

EXPERIMENTAL

The comminuted seeds were extracted with petroleum ether (bp 40-60°C). The physicochemical indices were determined by known methods [10]. The fatty acid methyl esters were obtained as described in the literature [10].

Separation of the Triglycerides into those Containing Unsaturated and those Containing Saturated Fatty Acids. A mixture of 10 ml of an oil of one of the coleworts and 50-100 ml of acetone was heated in the water bath until the oil had dissolved completely (all the oils dissolved completely in 100 ml of acetone at room temperature). The acetone solutions of the oils were cooled in the refrigerator at +1°C for 4-5 h, whereupon the solution separated into layers. In each case the upper layer was poured off and the lower layer was mixed with 50 ml of acetone, the mixture was cooled in the refrigerator, and the upper layer was again poured off. This operation was repeated 4-5 times.

Triglycerides of the saturated fatty acids collected in the lower layer and triglycerides of the saturated and the unsaturated fatty acids in the upper layer, these being separated again by the method described.

SUMMARY

The physicochemical properties of the oils of nine species of the genus *Crambe* have been studied and their fatty-acid compositions have been determined. The fatty acids of the oils contain not less than 20% of erucic acid. Its highest amounts are found in the oils of *C. abyssinica* and *C. pinnatifida* – 57.01 and 47.37%, respectively.

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ACTION OF A COMPLEX LIPASE PREPARATION FROM *Oospora lactis* ON TRIGLYCERIDES

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In a study of microbial enzymes it has been established that some of them exhibit a specific action on primary ester groupings [1] and others catalyze the splitting off mainly of oleic acid, regardless of its position in the triglyceride molecule [2].

We have studied the action on cottonseed oil triglycerides of a microbial lipase isolated from the culture liquid of the fungus *Oospora lactis*, strain UzLM-2. The activity of the lipase was 2000 units/g. For comparison, in parallel we performed the hydrolysis of the triglycerides with pancreatic lipase isolated from porcine pancreatic gland. As is well known, the latter splits off the fatty acids from positions 1 and 3 of triglycerides.

After separation by the TLC method, the hydrolysis products were saponified, the fatty acids were isolated, and they were esterified with diazomethane and their composition was determined by the GLC method. The results of the analysis are given in Table 1.

It can be seen from Table 1 that the microbial lipase does not possess position specificity with respect to fatty acids. It is known that unsaturated liquid fatty acids mainly occupy position 2 in the triglyceride molecule [3]. The high content (more than 30%) of palmitic in the monoglyceride fractions shows that the microbial lipase splits off fatty-acid radicals regardless of their positions.

We determined the optimum concentration of the microbial lipase necessary for the hydrolysis of triglycerides. All the experiments were performed by a time of 60 min. Below we give information on the influence of the amount of enzyme on the completeness of the hydrolysis of 1 g of oil:

Amount of enzyme, g	0.02	0.04	0.06	0.1	0.15
Acid No. of the hydrolyzate, mg of KOH	58.3	84.6	91.5	110.7	103.5

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