

THE OILS OF SOME PLANTS OF THE FAMILY  
MALVACEAE

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UDC 547.915.3

Since the main agricultural crop of Uzbekistan is cotton, which has been studied in all its aspects, it appeared of interest to us to investigate the properties and compositions of the oils of a series of other plants belonging to the same family (Malvaceae). In the present paper we give information on the nature and properties of the oils of the plants *Althaea rhuticarpa*, *A. nudiflora*, *Abutilon theophrasti* (chingma abutilon), and *Hibiscus inebrium* (a hybrid hibiscus) in comparison with the properties of the oil of the seeds of the cotton plant of variety 108-F.

The characteristics of the seeds of these plants are given in Table 1, the physical and chemical indices characterizing the oils in Table 2, and the fatty-acid and glyceride compositions of the oils in Table 3.

TABLE 1 Properties of Seeds of Plants of the Family Malvaceae

Index	<i>Althaea rhuticarpa</i>	<i>Abutilon theophrasti</i>	<i>Althaea nudiflora</i>	Hybrid hibiscus
Wt. of 1000 seeds, g	12,2	8,78	6,74	36,84
Bulk density, g/liter	212,01	324,1	164,0	—
Oil content on the dry matter, %	9,44	18,57	11,75	13,17

TABLE 2 Characteristics of the Oils and Fatty Acids of Seeds of Plants of the Family Malvaceae

Index	<i>Althaea rhuticarpa</i>	<i>Abutilon theophrasti</i>	<i>Althaea nudiflora</i>	Cotton	Hybrid hibiscus
Oils					
Specific gravity, $d_{20}^{20}$ , g/ml	0,9215	0,9229	0,9259	0,9270	0,9688
Refractive index, $n_D^{20}$	1,4759	1,4760	1,4737	1,4722	1,4695
Absolute viscosity, P	0,62	0,55	0,52	—	—
Iodine No., %	125,61	128,62	124,25	109,25	96,58
Thiocyanogen No., %	74,75	76,92	74,29	—	—
Hehner No., %	95,41	95,01	96,53	95,90	94,99
Saponification No., mg/g	195,15	188,16	202,19	194,10	187,89
Reichert-Meissl No.	0,95	1,17	1,42	0,54	—
Polenske No., ml KOH	—	0,85	0,59	—	—
Acetyl No., mg/g	33,61	26,67	—	11,20	29,46
Content of unsaponifiables, %	3,41	0,83	2,69	1,61	1,36
Content of phosphatides, %	0,43	0,83	0,67	—	0,22
Fatty acids					
Iodine No., %	132,45	133,15	128,87	114,71	101,59
Thiocyanogen No., %	77,73	81,15	78,48	—	—
Neutralization No., mg/g	198,81	202,51	204,12	204,90	204,22
Mean mol. wt.	282,23	277,56	274,88	273,84	274,75

Order of the Red Banner of Labor Institute of the Chemistry of Plant Substances of the Academy of Sciences of the Uzbek SSR. Translated from *Khimiya Prirodnykh Soedinenii*, No. 3, pp. 252-255, May-June, 1971. Original article submitted February 19, 1971.

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TABLE 3. Compositions of the Oils of Plants of the Family Malvaceae, %

Components	Althaea rhuti- carpa		Abutilon theo- phrasti		Althaea nudi- flora		Cotton		Hybrid hibiscus	
	stat.	act.	stat.	act.	stat.	act.	stat.	act.	stat.	act.
Fatty-acid composition										
Undecylic acid	—	—	0,26	—	—	—	—	—	—	—
Lauric acid	—	—	0,47	—	—	—	—	—	0,26	—
Myristic acid	0,25	—	0,18	—	—	—	1,31	—	0,25	—
Palmitic acid	14,91	—	13,19	—	17,78	—	21,26	—	23,78	—
Stearic acid	—	—	2,90	—	1,12	—	3,73	—	3,39	—
Arachidic acid	Traces	—	Traces	—	Traces	—	Traces	—	Traces	—
Behenic acid	Traces	—	Traces	—	Traces	—	—	—	Traces	—
Palmitoleic acid	—	—	1,28	—	—	—	2,50	—	0,76	—
Oleic acid	13,25	—	10,44	—	18,55	—	18,35	—	22,82	—
Linoleic acid	71,59	—	71,28	—	62,55	—	52,85	—	47,95	—
Linolenic acid	—	—	—	—	—	—	—	—	0,79	—
Glyceride composition										
G1 SSS*	0,28	—	0,35	—	0,33	—	1,12	—	1,00	—
G1 SSU	2,38	—	2,46	—	1,90	—	5,36	—	3,28	—
G1 SUS	3,27	—	4,44	—	6,37	—	11,56	—	13,47	—
G1 SUU	28,16	—	31,72	—	36,46	—	29,97	—	43,88	—
G1 USU	5,17	—	4,42	—	2,72	—	5,48	—	2,67	—
G1 UUU	60,74	—	56,61	—	52,22	—	36,51	—	35,70	—

\*G1 - glycerol; S - radicals of saturated acids; U - radicals of unsaturated acids.

TABLE 4. Distribution of the Fatty-Acid Radicals between the Glyceride Molecules in the Oils of the Family Malvaceae, %

Position of the acid radicals	Althaea rhuticarpa		Abutilon theophrasti		Althaea nudiflora		Cotton		Hybrid hibiscus	
	stat.	act.	stat.	act.	stat.	act.	stat.	act.	stat.	act.
Saturated acids in the $\beta$ position	15,16	7,83	17,00	7,23	18,90	4,95	26,30	11,96	27,68	6,95
Unsaturated acids in the $\beta$ position	84,84	92,17	83,00	92,77	81,10	95,05	73,70	88,04	72,32	93,05

We have determined the distribution of the fatty acid radicals between the  $\alpha$ ,  $\alpha'$ , and  $\beta$  positions in the glyceride molecules on the basis of the principle of random (statistical) distribution [1-3] and from the indices of the glyceride structures of the oils (Table 3). The results of the calculations are given in Table 4.

Certain conclusions can be deduced from the figures in the tables.

From the predominating content of three fatty acids in them, the oils of the plants of the family Malvaceae must be assigned to the palmito-oleo-linoleic group with a considerable predominance of unsaturated acids (72-85%), particularly linoleic acid (48-72%, as compared with 10-27% of oleic acid).

In accordance with the fatty-acid composition of the oils, among the triglycerides the monosaturated-diunsaturateds and triunsaturateds predominate (82-94%).

The indices of the glyceride structures of the oils calculated from the statistical principle do not agree with the values found experimentally. In all the oils studied 90-95% of the  $\beta$  positions in the glyceride molecules are occupied by radicals of unsaturated acids, so that the saturated acids are present almost completely in the  $\alpha$ ,  $\alpha'$  positions. Thus, the oil-forming process under the action of the enzymatic apparatus leads to a selective distribution of the fatty acids resulting in a concentration of the unsaturated radicals in the  $\beta$  positions.

No gossypol or other pigments of the gossypol group were found in the oils studied. A spectroscopic study of the pigment complexes of the oils showed the presence of  $\alpha$ -carotene in the oils of both species of Althaea and  $\beta$ -carotene and neo- $\alpha$ -carotene in the oil of Abutilon theophrasti.

## EXPERIMENTAL

The physical and chemical indices characterizing the properties of the oils were determined by the generally accepted methods [4], the fatty-acid compositions of the oils by GLC [5], and the glyceride compositions by enzymatic hydrolysis with the use for this purpose of the lipase of the pancreatic gland of large-horned cattle [6].

## SUMMARY

1. The physical and chemical properties and the fatty-acid and glyceride compositions of the oils of four plants of the family Malvaceae have been studied. They all belong to the palmito-oleo-linoleic group.
2. Their glyceride structure does not correspond to the principle of statistical distribution, since almost all the unsaturated-acid radicals are concentrated in the  $\beta$  position.

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