THE DRYING PROPERTIES OF CATALPA OIL

L. N. Andrianova, A. L. Markman, and I. U. Yusupova

UDC 665.35:547.426.21/23.001.5/

The capacity of an oil for drying in the air is connected with the number of double bonds in its fatty acids, their positions in the molecule (conjugated or isolated), and the geometric arrangement of the substituents around the double bonds (cis or trans configuration) [1]. Consequently, knowing the fatty-acid composition and the iodine numbers of sunflowerseed, linseed, tung and catalpa oils [2], it may be expected that their drying capacities will increase in the sequence sunflowerseed–linseed–catalpa–tung in parallel with the rise in the iodine numbers and numbers of conjugated bonds:

Oil	Iodine No.	Amount of Acid with a Conjugated System of Double Bonds, %
Sunflowerseed	139,1	—
Linseed	190,4	—
Catalpa	198,5	46,0
Tung	234,0	75,6

According to the figures given above, the drying capacity of tung oil should far exceed that of catalpa oil. However, in the literature [3] it is stated that the drying capacity of catalpa oil is in no way inferior to that of tung oil, which shows the inadequacy of a knowledge of the fatty-acid composition for explaining the drying properties of oils. For this purpose, we have studied the glyceride composition of the oils by the method of enzymatic hydrolysis.

The fatty-acid compositions of the triglycerides and of the monoglyceride fraction and also the "enrichment factors" are given in Table 1. The enrichment factor, which characterizes the affinity of each of the acids for the central or extreme position of glycerol, was calculated from the formula $EF = [A]_2/[A]$ [4], where $[A]_2$ is the amount of acid in position 2 and [A] is the amount of acid in the triglycerides.

As can be seen from Table 1, in all four oils the saturated acids have an affinity for positions 1 and 3 of glycerol that rises from palmitic acid to stearic.

TABLE 1

Acid	Amount of the acid, %		Enrichment factor $EF=[A]_2/[A]$	Amount of the acid, %		Enrichment factor $EF=[A]_2/[A]$
	in the triglycerides [A]	in the 2-monoglycerides $[A]_2$		in the triglycerides [A]	in the 2-monoglycerides $[A]_2$	
	Sunflowerseed			Linseed		
Palmitic	5,5	1,6	0,29	5,2	0,5	0,10
Stearic	4,1	0,6	0,15	3,8	0,0	0,00
Oleic	21,6	16,9	0,78	20,4	22,1	1,08
Linoleic	68,8	80,9	1,17	18,1	23,4	1,29
Linolenic	—	—	—	52,5	54,0	1,03
Sum	100,0	100,0		100,0	100,0	
	Chinese catalpa			Tung		
Palmitic	2,0	0,5	0,25	2,0	0,8	0,40
Stearic	1,7	0,0	0,00	2,4	0,0	0,00
Heneicosanoic	1,4	0,0	0,00	—	—	—
Gadoleic	—	—	—	5,1	0,0	0,00
Oleic	5,8	14,8	2,55	6,5	12,9	1,99
Linoleic	39,9	81,0	2,03	8,4	24,6	2,93
Linolenic	1,7	1,1	0,65	—	—	—
Unidentified	1,5	0,6	0,40	—	—	—
Eleostearic	46,0	2,0	0,05	75,6	61,7	0,82
Sum	100,0	100,0		100,0	100,0	

Kalinin Polytechnic Institute. Moscow Branch of the All-Union Scientific-Research Institute of Fats.
Translated from Khimiya Prirodnykh Soedinenii, No. 5, pp. 617-619, September-October, 1977. Original article submitted April 20, 1977.

0009-3130/77/1305-0513$07.50

In the oils studied, apart from the catalpa oil, of the unsaturated acids linoleic has the greatest affinity for position 2 of glycerol. The linolenic acid of the catalpa and linseed oils enriches position 2 of glycerol to a smaller degree than the oleic and linoleic acids. The eleostearic acid of catalpa and tung oils esterifies the extreme 1,3 positions of the glycerol predominantly, to a greater extent in the case of the catalpa oil than in the tung oil.

On the basis of the fatty-acid compositions of the triglycerides and of the monoglyceride fractions of the oils (see Table 1), we calculated the position-type compositions of the triglycerides by a method described previously [5].

By summing the position-type compositions for the characteristics of saturation and unsaturation and taking position isomerism into account, we obtained the position-type compositions of the triglycerides of the oils studied (%):

Sample	SSS	SSU	SUS	SUU	USU	UUU	X_g	Total
Sunflowerseed	0,02	0,51	1,74	22,55	1,65	73,51	—	99,98
Linseed	—	0,11	1,75	22,87	0,37	74,87	—	99,97
Tung	—	0,08	0,38	11,50	0,68	87,06	—	99,70
Catalpa	—	0,05	0,51	13,22	0,39	81,20	4,36	99,78

(X_g is the sum of the glycerides of catalpa oil containing an unidentified acid; the figures in the "sum" column do not coincide with the sum of the components, since the digital computer rounds off the sums of still-unrounded-off percentage contents of the triglycerides). However, the position-type composition does not give information on the relative drying properties of the oils.

On summing the triglycerides containing an acid that determines the capacity of the oils for drying in different position in the glyceride we obtain a pattern of the position specificity of the arrangement of linoleic acid in the triglycerides of the sunflowerseed oil, of linoleic acid in the triglycerides of linseed oil, and of eleostearic acid in the tung and catalpa oils (%):

Sample	*1* or *3*	*1, 3*	*2, 3* or *2,1*	*1, 2, 3*	*2*	Sum
Sunflowerseed	8,93	6,89	37,82	31,85	9,24	94,73
Linseed	22,96	12,32	26,98	14,46	1,29	76,72
Tung	9,45	26.06	17,72	41,99	1,87	95,22
Catalpa	42,77	45,31	0,87	0,92	0,18	89,87

Thus, the overall sums of these triglycerides of each oil vary only slightly, but the distributions of these acids over the 1, 2, and 3 positions are completely different.

In sunflowerseed oil, triglycerides with linoleic acid in the 2,3 and the 1,2,3 positions of the glyceride predominate (according to Drinberg's classification [6] the oil belongs to the slow-drying group), and in linseed oil the triglycerides with linolenic acid in the 1 or the 3 and in the 2,3 positions of the glyceride predominate (highly drying oil). In the case of tung oil, the bulk of the triglycerides contain eleostearic acid in the 1,3 and, particularly, the 1,2,3 positions (superdrying oil).

A feature of the catalpa oil is its almost complete concentration of eleostearic acid in the extreme positions of the glyceride, as a result of which the amount of triglycerides with this acid in the 1 or 3 and in the 1,3 positions is considerably higher than in the other oils studied. It is apparently this distribution of eleostearic acid in the triglycerides of catalpa oil that is responsible for its high drying capacity.

EXPERIMENTAL

The main methods of isolating the oils and determining their fatty-acid and glyceride composition have been described in preceding papers [2, 5].

SUMMARY

A study of the glyceride composition of the oil of catalpa seeds in comparison with the well-known sunflowerseed, linseed, and tung oils which belong to the group of oils with slow, high, and superhigh drying properties, respectively, has shown that the high drying capacity of the catalpa oil is due to the specific structure of the triglycerides, namely: an exceptional affinity of the eleostearic acid of this oil for the extreme positions of the glycerol.

LITERATURE CITED

1. D. Solomon, The Chemistry of Organic Film-Forming Agents [in Russian], Moscow (1971).
2. L. N. Andrianova, A. L. Markman, and I. U. Yusupova, Khim. Prirodn. Soedin., 331 (1977).
3. V. A. Abdurazakov, M. D. Bodnya, and V. V. Stypinskii, Catalpa – a Valuable Technical and Decorative Crop [in Russian], Tashkent (1962), p. 4.
4. A. G. Vereshchagin, The Biochemistry of the Triglycerides [in Russian], Moscow (1972), p. 176.
5. L. N. Andrianova, A. L. Markman, and I. U. Yusupova, Khim. Prirodn. Soedin., 487 (1977).
6. A. Ya. Drinberg, The Technology of Film-Forming Substances [in Russian], Leningrad (1955).

THE CHANGE IN THE PROPERTIES OF FATS ON THERMAL TREATMENT

L. N. Zaushitsina and A. I. Glushenkova

UDC 665.3/35:66.097.3:542.925.665.335.9

Plant oils containing a large amount of polyunsaturated fatty acids rapidly oxidize even at relatively low temperatures and are extremely unstable to the action of high temperatures. On the other hand, animal fats, which contain a large amount of saturated fatty acids, possess a high resistance to oxidative processes, but they are assimilated less readily.

A variety of artificial mixtures of fats consisting of cottonseed oil and mutton fat, which is widely used in the diet of the population of Central Asia, enables a food fat to be obtained which is more stable than cottonseed oil and is better assimilated than animal fat. The production of a modified fat by the catalytic transesterification of such a mixture has been considered by Mirkhalikov et al. [1].

One of the authors of the present paper has previously established that the optimum, from the point of view of technical properties, is a ratio of the components of a mixture of cottonseed oil and mutton fat of 1:1 [2]. In addition, M. N. Ismailov [3] has shown that the addition to the diet of a fat with such a ratio of the components lowers the level of lipids and the concentration of vitamin A in the blood and increases the resorbability of fat and protein to 92-94%.

We have investigated the initial mixture of cottonseed oil and mutton fat (1:1) and that subjected to thermal treatment (Table 1). As can be seen from Table 1, when the fats are mixed the amounts of unsaturated and saturated fatty acids and their ratio change. Thus, while cottonseed oil contains 25% of saturated fatty acids and 75% of unsaturated fatty acids and mutton fat contains 68% and 32%, respectively, in the new fat the composition is 43% of saturated fatty acids and 57% of unsaturated.

The qualitative and quantitative fatty-acid composition of the mixture changed. In the new mixture of fats capric, lauric, pentadecanoic, arachidic, margaric, linolenic, and myristoleic acids, which are absent from cottonseed oil, were detected, in addition, the amount of such fatty acids as myristic, palmitic, stearic, oleic, and palmitoleic increased while the amount of linoleic acid decreased.

Thus, the mixing of the fats led to a more uniform ratio of saturated and unsaturated fatty acids and, as compared with the cottonseed oil, the amount of unsaturated fatty acids fell, which increased the resistance of the fats to the action of heat. However, as compared with mutton fat the amount of unsaturated fatty acids – oleic and linoleic – had risen. This must improve the assimilability of the mixture.

Another advantageous factor in the mixing of the fats in the given proportions is the fall in the melting point as compared with mutton fat. The mixture of fats obtained had mp 38-40°C as compared with 54-63°C for mutton fat. As a result of heating the amount of linoleic acid in the samples of fats investigated fell, but in cottonseed oil the fall in its amount took place intensively during each 10-h period of heating, and in the mixture of fats it took place only in the first 10 h, after which the amount of this acid was stabilized.

Institute of the Chemistry of Plant Substances, Academy of Science of the Uzbek SSR, Tashkent. Turkmen Branch of the Central Institute of the Scientific Organization of Labor and Control and Rationalization, Ashkhabad.

Translated from Khimiya Prirodnykh Soedinenii, No. 5, pp. 620-622, September-October, 1977. Original article submitted May 5, 1977.

0009-3130/77/1305-0515$07.50