

INFLUENCE OF SOLVENTS ON ISOMERIZATION
IN THE HYDROGENATION OF COTTONSEED OIL

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The use of solvents for the hydrogenation of fats leads to an increase in the rate of this process without an appreciable rise in the content of iso-acids [1-3].

We have performed the hydrogenation of 10 ml of cottonseed oil with 0.05% of Pd/Al in 25 ml of various solvents and without them at 50°C to determine the influence of the solvents on the formation of position isomers and geometric isomers. Hydrogenation of the oil to an iodine number of ~60% I₂ took place in alcohol in 13 min, in acetone in 26 min, in hexane in 15 min, and in the absence of a solvent in 50 min.

The fatty-acid compositions and the properties of the hydrogenates obtained are given in Table 1, from which it can be seen that the products obtained in the hydrogenation of cottonseed oil to an iodine number of ~60% I₂ in the presence of solvents contains about 40% of trans bonds; hydrogenation under the same conditions without a solvent gives 44.6% of trans bonds, which explains the rise in the melting point of the hydrogenate from 33-34°C to 37°C.

The influence of the solvents on the migration of the double bonds was studied for the dicarboxylic acids obtained in the destructive oxidation [4] of the hydrogenation products (Table 2).

TABLE 1

Solvent	Fatty-acid composition						Iodine No., % I ₂	trans-Iso-mers, % by wt.	trans-Bonds, %	Mp, °C
	C _{14:0}	C _{16:0}	C _{16:1}	C _{18:0}	C _{18:1}	C _{18:2}				
Cottonseed oil	0,5	26,1	1,6	2,3	17,5	52,0	103,8	—	—	—
None	0,5	25,8	1,2	10,3	55,8	6,4	60,1	31,1	44,6	37,0
Ethanol	—	27,5	1,6	7,2	59,7	4,0	59,8	27,4	39,5	33,5
Acetone	—	27,2	1,3	5,8	61,7	4,0	61,2	28,6	40,2	33,0
Hexane	—	26,7	2,2	4,4	63,7	3,0	60,6	29,5	41,0	34,0

Note. The amount of trans bonds was determined from the total amount of unsaturated bonds.

TABLE 2

Dicarboxylic acids	Amount of fragments on hydrogenation, %			
	without a solvent	in ethanol	in acetone	in hexane
C ₇ - pimelic	—	1,7	1,0	2,8
C ₈ - suberic	9,3	13,7	12,1	12,3
C ₉ - azelaic	40,4	44,3	42,1	39,8
C ₁₀ - sebacic	15,3	13,5	15,4	15,0
C ₁₁ - nonanedicarboxylic	14,1	7,9	11,0	9,9
C ₁₂ - decanedicarboxylic	20,9	18,9	18,4	20,2
Fragments of the acids without migration	61,3	63,2	60,5	60,0
with approach of the double bonds	29,4	21,4	26,4	24,9
with divergence of the double bonds	9,3	15,1	13,1	15,1

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The figures of Table 2 show that solvents have no appreciable influence on the distribution of the double bonds. The amount of bonds not subjected to migration is ~40%; position isomerization on hydrogenation in ethanol is somewhat lower (36.8%). So far as concerns the direction of migration of the double bond, in all the hydrogenation products the sum of the acids in which they have approached one another ($C_{10} + C_{11}$) considerably exceeds the sum of the acids in which they have diverged ($C_7 + C_8$).

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