

Guarantee of Food Safety of Fat by Technology of Interesterification

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Introduction

At reception of hard fats with the special purpose the particular attention is given to an arrangement of fat acids (acyls) in the molecule of triacylglycerides as their structurally-mechanical and rheological properties essentially depend on it [1]. It is known that process of hydrogenation is accompanied with interesterification of the fat acids, depending by nature of applied catalyst [2].

Purpose of Work

The work is devoted on research of hydrogenation and interesterification technology of cotton oil and products of its processing on highly effective catalysts and reception of safe food fats.

Research Course:

Researches on improvement of hydrogenation and interesterification technologies were made in laboratory and experimental-industrial plants [3]. The analysis and estimation of quality indicators of a chemical compound and arrangement of acyls in triacylglycerides were conducted by modern methods of physical and chemical research [4].

Results and Discussion

Results of research of interesterification activity of four disperse catalysts are presented at Table 1. From Table 1 we can see that in triacylglyceride structure (TAG) of the refined cotton oil, as one would expect, sn-2-position on 95% is occupied by non-saturated acyls. The similar picture is observed in TAG of fat-oil, where sn-2-position by such acids etherified on 88-90 %. Concerning mono-oleic acids, it is necessary to notice that they almost identical etherify sn-1 and sn-3 positions. Mono-oleic acid is localized basically in sn-2-position and in sn-1, except TAG of hydrogenate.

Product type	Fat* Acids	The maintenance of acyls, mole %			
		TAG	sn-1	sn-2	sn-3
The refined cotton oil (The first sort)	C16:0	28.8	44.0	4.7	36.9
	C' 18:0	1.5	2.4	0.3	0.3
	C' 18:1	19.2	21.0	23.0	15.4
	C18:2	50.5	32.6	72.0	47.4
Fat-oil, received on nickel-fossil meal catalyst GM-3	C16:0	29.6	40.5	5.6	40.3
	C' 18:0	4.9	6.1	5.0	7.3
	C' 18:1	51.1	43.3	67.7	44.7

Fat-oil, received on nickel-copper catalyst NM-4	C18:2	14.4	10.1	21.7	7.7
	C16:0	29.4	41.8	5.4	40.0
	C' 18:0	6.2	7.0	4.8	6.4
Fat-oil, received on the nickel catalyst HOECAT-882 FA	C' 18:1	50.6	39.9	69.5	45.1
	C' 18:2	13.8	11.3	20.3	8.5
	C16:0	29.7	40.3	5.7	40.5
	C' 18:0	4.8	6.0	5.1	7.4
Fat-oil, received on nickel catalyst NYSOSEL-222	C' 18:1	51.3	43.5	67.9	44.9
	C' 18:2	14.2	10.2	21.3	7.2
	C16:0	29.9	40.4	5.8	40.6
	C' 18:0	4.7	5.9	5.0	7.2
Note: C' 18:0 – including the general maintenance of stearin and myristinic acids (C' 18:0=C16:0 + C14:0); C' 18:1 - the general maintenance of monoenoic acids.	C' 18:1	51.0	43.4	67.7	44.6
	C18:2	14.4	10.3	21.5	7.6
				5	

Table 1: Arrangement of fat acids TAG in sn-1, 2 and 3-positions in cotton oil and fat-oil depending on the catalyst nature.

As we see from Table 1 interesterification of fat acids in TAG occurs practically to all fat acids. Results of calculation of interesterification degree of investigated catalysts at reception of the modified fats are presented at Table 2.

As we see from Table 2 the greatest regrouping of fat acids in TAG occurs on nickel catalyst NYSOSEL-222. Hence, on interesterification activity the studied catalysts can settle down in a following order of decrease: nickel catalyst NYSOSEL-222>nickel catalyst NOESAT-882 FA>nickel-fossil meal catalyst - GM3> nickel-copper the catalyst NM-4.

Research of various kinds of catalysts, has shown that the nickel catalysts restored and protected high-melting fat, have high enough hydrogenating, isomerization and interesterification activity that is very important at reception of firm fats of a special purpose.

The combination of processes hydrogenation cotton oil with the subsequent interesterification of fat-oil with vegetable oil is of interest at reception of fats from high food safety.

Therefore the expedient hydrogenate the cotton-palmitic oil, received by way of low-temperature fractionating of the refined cotton oil [5].

Type of catalyst	Maintenance of C16:0. %			П, % Р, %	Exponent
	MGo	MG	MG		
GM-3	4,7	5,6	0,9	19,2	3
NM-4	4,7	5,4	0,7	15,0	4
HOECAT 882 FA	4,7	5,7	1,0	21,3	2
NYSOSEL 222	4.7	5,8	1,1	23,4	1

P - interesterification degree;
MGO and MG - initial and final maintenance of C16:0 in sn-2-position.

Table 2: Interesterification abilities of catalysts at modifying of cotton oil.

The analysis of dilatometric characteristics of fat-oil has shown that hydrogenation of cotton-palmitic oil allows to receive fats with the raised maintenance high-melting TAG.

Proceeding from requirements to food safe hard fats received from vegetable oil, following conditions are accepted:

- The maintenance of firm glycerides in the mix of fat firm oil at temperature 70°C should be not less than 70 %;
- Offered firm fat in mix with oil in conditions of tempering should have stable β -form;

- Thermal effects at phase transitions in a mix of fat with oil should be characteristic for highly hard fat;

- The temperature of hardening of a mix of offered fat with oil on Jackson should be not lower than 28°C.

Results of comparison mechanical and interesterificated mix of oil with fat-oil are presented at Table 3.

Structure of a fatty mix	Mechanical mix before interesterification		Mix after interesterification	
	Melting temp, °C	Hardness., g/cm at 15°C	Melting temp, °C	Hardness, g/cm at 15°C
Natural oil	35.0	796.0	-	-
Highly hard cotton fat-oil	37.6	580.0	-	-
Mix of highly hard fat-oil with oil at a parity 1:1 (50:50)	35.5	585.5	33.0	578.5
Mix of highly hard fat-oil with oil at 1:2 (33.3:66.6)	36.2	680.0	33.5	634.8
Mix of highly hard fat-oil with oil at 1:3 (25:75)	36.5	692.0	33.8	683.4
Mix of highly hard fat-oil with oil at 1:4 (20:80)	36.7	700.5	34.0	677.9
Mix of highly hard fat-oil with oil at 1:7 (12.5:87.5)	37.0	719.0	34.2	635.6

Table 3: Physical and chemical indicators of the mix of natural cotton oil with highly hard fat-oil at various parities before and after interesterification.

From Table 3 we can see that entering of highly hard fat in quantity of 12.5% from a mix mass considerably reduces hardness of natural oil. The further growth of the maintenance of fat-oil leads to decrease on 25% of initial hardness of natural oil. Thus fats, received after interesterification, have fusion temperature on 2.0-3.0°C below initial, and their hardness after interesterification decreases slightly. Results of interesterification of mixes of highly hard fat-oil with cotton oil at various parties are presented at Table 4.

Data from Table 4 shows that introduction in structure of fat-oil at interesterification 10-15% of the refined cotton oil allow to lower its

temperature of fusion to 34.5-36.0°C. Thus hardness of the received fats remains at level of 790-897 g/cm at 15°C. The further increase in the maintenance of the refined cotton oil in a mix (more than 15 %) leads to sharp decrease in hardness of received highly hard fat.

Hence, combining processes of hydrogenation of product of processing of cotton oil with interesterification of received fat-oil with liquid oil, it is possible to receive the fats close on the indicators to highly hard fat.

Structure of a fatty mix	Indicators of a mechanical mix before interesterification		Indicators of a mix after interesterification	
	Melting temp, °C	Hardness., g/cm at 15°C	Melting temp, °C	Hardness., g/cm at 15°C
Highly hard cotton fat-oil	44.5	930	41.3	905
Mix of highly hard fat-oil with cotton oil at a parity 95:5	43.0	905	38.0	897
Mix of highly hard fat-oil with cotton oil at 90:10	42.1	855	36.0	790
Mix of highly hard fat-oil with cotton oil at 85:15	40.5	708	34.5	560

Table 4: Indicators of a mix of highly hard fat-oil with cotton oil at various parities of components before and after interesterification.

Conclusion

On the basis of hydrogenation cotton fat-oil to melting temperature 44-46°C and its subsequent interesterification with cotton oil can be received highly hard fat, close to the physical and chemical indicators to natural safe food oil.

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