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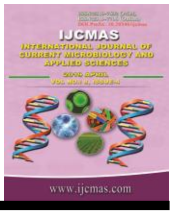

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Solid Fats with a Minimum Content of Trans Acids

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ABSTRACT

Consumption of excessive big quantity of trance-isomers leads to organism dysfunction at cellular level. It is established that trance-isomers metabolized in an organism much more slowly than natural cis-isomers. The work is aimed at research of technologies of reception of firm fats with the minimum maintenance of trance isomerized fat acids. At hydrogenation of vegetable oils there are various collateral reactions, including trance isomerization during which natural cis-isomers of fat acids turn to trance-isomers. Shown results of reception of fat-oils with the minimum maintenance of trance isomerized fat acids at hydrogenation of sample of cotton oil on the catalyst of new generation. Degree of trance-isomerization depends basically on conditions of hydrogenation: temperature, type, quantity and activity of the catalyst, pressure and quantity of hydrogen, intensity of agitation. Experimental researches establish positional distribution of fat acids (FA) in triacylglycerids (TAG) of initial cotton oil and hydrogenated fats. Conditions at which is possible to direct hydrogenation process by course of least formation of trance isomers are low temperature of process, high pressure of hydrogen and low concentration of the catalyst in raw materials. Technological parameters, at which formation of trance isomers is minimum (high pressure of hydrogen, high velocity of agitating, low concentration of the catalyst) at their sharing will lead to reception of non-selective hydrogenated fat-oil with the big maintenance of sated glycerides, high melting point and the low maintenance of nonsaturated fat acids. Such fat-oil practically does not contain trance isomers, however cannot be used directly for manufacture of fatty basis of margarine.

Keywords

Solid fats, Trans acids, Technological modes, Catalysts, Food value

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Introduction

Consumption of excessive big quantity of trance-isomers leads to organism dysfunction at cellular level. It is established that trance-isomers metabolized in an organism much more slowly than natural cis-isomers. Unlike cis-isomers, having bent spatial structure with bends of a carbon chain at double bonds and angle close to 30 °, molecules of trance-acids are almost rectilinear and remind a spatial structure of the sated acids (1.2). For the purpose of decrease the maintenance of trance-isomers is changed by hydrogenation conditions, replace the hydrogenated natural fats widely use interesterification and fractioning of fats (3). The quantity of trance isomers in the refined oils is influenced by duration and temperature of refining process (4).

Purpose of work

Research of technologies of reception of firm fats with the minimum maintenance of trance isomerized fat acids.

Materials and Methods

At hydrogenation of vegetable oils there are various collateral reactions, including trance isomerization during which natural cis-isomers of fat acids (for example, oleic, linoleic) turn to trance-isomers. Thus their hardness and melting point sharply vary: from liquid state at room temperature they turn into firm state. Such changes have been studied at catalytic hydrogenation of cotton oil on new generations of catalysts (5).

Results and Discussion

In table 1 are shown results of reception of fat-oils with the minimum maintenance of trance isomerized fat acids at hydrogenation of sample of cotton oil on the catalyst of new generation.

Trance-isomers are more similar to the sated acids than to cis-isomers. It also is reflected in structure of triglycerides in which trance isomers and the sated acids are mainly in 1st and 3rd positions, and cis-acids are localized in 2nd position (6).

Degree of trance-isomerization depends basically on conditions of hydrogenation (table 2): temperature, type, quantity and activity of the catalyst, pressure and quantity of hydrogen, intensity of agitation (7).

Completely hydrogenated fats do not contain trance isomers. At incomplete hydrogenation the maintenance of trance isomers is defined by thermodynamic cis/trance balance responding of 75 % from total number of double bonds.

Experimental researches establish (table 3) positional distribution of fat acids (FA) in triacylglycerids (TAG) of initial cotton oil and hydrogenated fats.

It is established that at the first stage there is isomerization of linoleic acids in cis-9, trance 11-oktadecadien acid. This intermediate bond then is hydrogenated with formation of the mix consisting, mainly, from elaidic acid. As a result of it in the hydrogenated oil contains from 2 to 8 % trance isomers.

There were established technological parameters of process of hydrogenation at which the maintenance of trance isomers can be reduced. However formation of trance isomers is a property of modern selective catalysts: the more selectivity of process of hydrogenation, the more formed trance isomers and vice versa.

The margarine product made from of fat-oil, received on bases of cotton oil, differs with the high maintenance of isomerized fat acids, lowered concentration of natural linoleic acids, is insufficiently plastic and, as a rule, has macrocrystalline, unstable at storage structure.

For the best understanding of processes at hydrogenation of the fats influencing commodity properties of fat-oil, we will consider the mechanism of interactions in system « triglyceride (fat acid) - hydrogen - catalyst».

In the beginning the hydrogen dissolved in oil, will be sorbing on nickel. During sorbing process hydrogen molecules dissociating to very active atoms.

Let's consider the major factors influencing to change of energy condition. At high pressure enough quantity of hydrogen should move from vials of the gas arriving in an autoclave through oil to particles of the catalyst, covering them almost completely. Usually semihydrogenated intermediate product finds set of atoms of the hydrogen kept by nickel in proximity to it for immediately enter reaction with one of atoms of the carbon, located on the neighborhood with to what the first atom of hydrogen is already bonded. Most likely it can happen before the molecule will be developed round C—C bond which at first was double. For this reason in the conditions of a high pressure can be formed very small quantity trance isomers. Accordingly, at low pressure upon the surface of nickel deprived of hydrogen the semihydrogenated intermediate product not always will find atom of hydrogen for immediate reaction. In this case more intermediate product will have possibility to round C—C bond and to form trance isomers.

At low concentration of hydrogen on a nickel surface it is improbable that at meeting of triglyceride with a catalyst particle second bond in this molecule would be hydrogenated (for example in linoleic acid). Hence, at low pressure of hydrogen more triglyceride molecules will leave the catalyst only with one hydrogenated double bond, than at high pressure. At high pressure possibility of joining of the second, the third and even more numbers of atoms of hydrogen is more probable, therefore in these conditions is formed more tristearin. Thus, selectivity of hydrogenation inversely proportional to pressure of hydrogen.

At temperature rise of reaction will be increased its velocity. Thus concentration of hydrogen on a catalyst surface decreases. As a result of it increase velocity of formation of trance isomers and selectivity of process.

Table.1 Reception of fat-oil on nickel-copper catalyst of new generation

Conditions of hydrogenation		**Fat-acid structure (C),**					**Factor of selectivity, %**	**The maintenance of trance-acids, %**
Pressure, kPa	Velocity of oil feed, h^{-1}	14:0	16:0	18:0	18:1	18:2		
100	1.6	0.6	22.0	6.9	53.9	16.6	91.2	**17**
300	1.6	0.6	21.7	8.0	51.4	18.3	90.0	**15**
300	1.1	1.0	22.4	6.0	63.6	7.0	94.8	**13**
100	**1.1**	**1.7**	**22.2**	**8.2**	**50.3**	**18.0**	**89.3**	**14**

Table.2 The characteristic of fat-oils, received by continuous modification of cotton oil on catalyst of new generation

Conditions of modification			**Y.n % J_2**	**Maintenance of trans-acids, %**	**Acid number, mg KOH /g**	**Melting temperature, ^{0}C**	**Hardness g/cm**
Temperature, ^{0}C	Pressure kPa	Velocity of oil feed, h^{-1}					
200	300	1.8	74.1	11	0.20	34.5	**420**
200	300	1.5	72.1	14	0.21	36.1	**500**
200	100	1.0	64.2	18	0.27	37.2	**540**
180	100	1.0	63.7	19	0.29	37.1	**600**
180	**100**	**1.2**	**66.4**	**21**	**0.35**	**38.3**	**620**

Table.3 Positional distribution of FA in TAG of initial cotton oil and refined hydrogenated fats

Iodic number, % J_2	Acids, C	The maintenance of acyls, mole %			
		In triglycerides	In sn-1 position	In sn-2 position	In sn-3 position
110.9 (Initial oil)	14:0	1.1	1.5	-	**1.8**
	16:0	28.5	42.3	3.3	**39.9**
	18:0	2.1	3.5	-	**2.8**
	18:1	17.8	16.9	25.0	**11.5**
	18:2	50.5	35.8	71.7	**44.0**
71.7 (Food fat-oil)	14:0	1.0	1.5	-	**1.5**
	16:0	28.9	42.7	3.7	**40.3**
	18:0	3.9	5.5	2.2	**4.0**
	18:1	49.3	40.3	71.7	**35.9**
	18:2	16.9	10.0	22.4	**18.3**
68.4 (Highly firm fat-oil)	14:0	1.0	1.4	-	**1.6**
	16:0	28.7	42.8	3.5	**39.8**
	18:0	15.9	14.0	15.6	**18.1**
	18:1	52.2	40.3	77.9	**38.4**
	18:2	**2.2**	**1.5**	**3.0**	**2.1**

At increase of concentration of the catalyst the hydrogen expense increases. Thus formation of trance isomers and selectivity will rise with increase in concentration of the catalyst.

In conclusion, conditions at which is possible to direct hydrogenation process by course of least formation of trance isomers are low temperature of process, high pressure of hydrogen and low concentration of the catalyst in raw materials.

For development of the hydrogenated fats with the low maintenance of trance isomers it is necessary to change technological mode of process of hydrogenation, to suppress diffusive reaction braking (on hydrogen), having transferring it in kinetic area. For this purpose it is desirable to apply autoclaves of periodic action with the increased velocity of rotation of the mixing device (more than 120 rpm) at elevated pressure of hydrogen. Technological parameters, at which formation of trance isomers is minimum (high pressure of hydrogen, high velocity of agitating, low concentration of the catalyst) at their sharing will lead to reception of non-selective hydrogenated fat-oil with the big maintenance of sated glycerides, high melting point and the low maintenance of nonsaturated fat acids. Such fat-oil practically does not contain trance isomers, however cannot be used directly for manufacture of fatty basis of margarine.

References

1. Ipatova, L.G., Kochetkova, A.A., Nechaev, A.P. New directions in the creation of functional fatty products // Fat-and-oil industry,2006, – No.4, 12-14 c.
2. Levachev, M.M., Yazeva, L.I. Nutritional value of modified fats // Fat-and-oil industry, 1993, No. 11, 6-8 p.

3. Harutyunyan, N.S. Fat processing technology. / N.S. Arutyunyan (et al.) -M .: Pishepromizdat, 1999. - 452 p.
4. Tyutyunnikov, B.N., Smooth, F.F. (and etc.). Chemistry of fats. -M .: Kolos, 1992. -448 p.
5. Mazhidova, N.K. Improving the quality and ensuring the food safety of salomas obtained by hydrogenating cottonseed oil / N.K.Mazhidova: dis .... Cand. tech. sciences. - Tashkent: TashHTI, 2010. - 26 p.
6. Mazhidova, N.K., Shokhidoyatov, F.Kh., Ashurov, F.B. About fatty acid isomerization processes in the technology of hydrogenation of cotton oil // Chemistry of natural compounds. Special edition, 2001. 21-22 p.
7. Mazhidov, K.Kh. Research and Improvement of Cotton Oil Hydrogenation Technology on Modified Alloy Stationary Catalysts / K.Kh.Mazhidov: Author. dis. dok-ra tech. sciences. - L .: 1987, - 48 p.

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