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THE PHYSICOCHEMICAL CHANGES THAT OCCUR URING STORAGE OF VEGETABLE OILS AND STANDARD REQUIREMENTS FOR THEIR DELIVERY TO THE POPULATION

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Abstract

In the production and storage of fat products, it is recommended to pay attention not only to its performance in the standard norms, but also to its fatty acid content, as well as to add antioxidants to its natural composition for their long-term storage. Changes in the levels of acid, peroxide and anisidine during storage of vegetable oils were found to depend on its moisture content. It has been proven that the higher the humidity, the higher these values over time, lowering the nutritional value of the product and rendering it unusable. It has been found that when storing vegetable oils, we need to pay attention not only to its moisture, but also to the external environment. To increase the shelf life of the product in the summer, it is recommended to store it in a cool or refrigerated place.

Keywords: Gliserid, kislorod, oksidlanish, korroziya, uglevodorod, perekis, destruktiv, yog’ kislotalar, lipaza, ferment, namlik, saqlash, keton, aldegid, triglitserid.

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Introduction

The concept of oxidation of glycerides is understood to mean the oxidation of glycerides in more fats. Glycerides in fats dissolve in oxygen through a surface bounded by air. This oxygen is mainly glycerides that react with fatty acid hydrocarbons to form substances with new properties. If the oxidation state is not very deep, only the organoleptic characteristics of the oil and fat will change, and only the process of "fat breakdown" will occur. However, when the oxidation is strong, new physical and chemical properties of the oils appear. One of these properties is the drying of oils by oxidation, which is used to protect metals from corrosion [1-7].

When glycerides are exposed to molecular oxygen, over time, various substances are formed in the fat that have the properties of peroxides, which can separate iodine from potassium iodide.

Knowledge of the laws of the oxidation process is of theoretical and practical importance. One such law is that it turns out that it is very difficult for oxygen to react with non-oxidized fats. It was found that this effect does not occur or occurs at very low speeds. This time is called the induction period. The duration of this period depends on the presence of antioxidants in the fat and the temperature. The rate of subsequent oxidation is directly proportional to the degree of unsaturation of the fatty acids in the glycerides. The second stage of oxidation is the autooxidation period, when the reaction rate reaches a maximum. In the third stage, the rate of oxidation is maintained for some time and then decreases [3-6].

The rate of oxidation of glycerides also depends on the fatty acid content:

– The rate of oxidation of polyunsaturated fatty acids is higher than that of monounsaturated fatty acids;

– The rate of oxidation of unsaturated fatty acids is higher than that of saturated fatty acids;

– The rate of oxidation in monobasic fatty acids is inversely proportional to the molecular weight;

– Polyunsaturated high molecular weight fatty acids are oxidized faster than fatty acids with smaller molecular weight and fewer double bonds;

– Free fatty acids oxidize faster than fatty acids containing glycerides;

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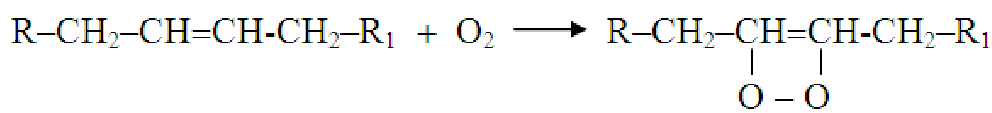
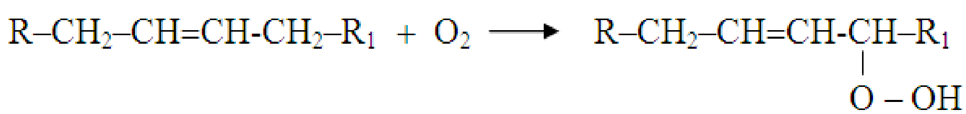
– The rate of oxidation of glycerides increases with increasing temperature and short-wavelength light [2-8].

The oxidation products of fats can be divided into three groups. The first group includes the products of the decomposition of unsaturated fatty acids in glycerides. The destructive breakdown of saturated fatty acids is much slower [9-11]. The second group includes substances that have the same number of carbons as the fatty acids in the glycerides of the fats, but differ in functional groups other than the original fatty acids, and the isomerization products of the primary acids. The third group includes products with polymerization, condensation, and additional oxygen functional groups of fatty acids. All oxidation products can be divided into two groups, thermally stable and non-thermally stable [4-5].

Oxygen oxidation is faster in cold pressed oils. This is because the lipase enzyme is retained in such fats, and the free fatty acids formed under its influence are oxidized faster. In the process, peroxides are formed, which are very active non-precipitating substances. Therefore, they form by-products - aldehydes, ketones, low molecular weight acids and other substances. Most oxidation occurs in the pairs of unsaturated hydrocarbon radicals to form peroxides [10-12].



In addition, the carbons adjacent to the twins also oxidize, and in the methylene groups farther away from the twins, hydroperoxides are formed:



If the oxidation takes place at a temperature above 50-100 ° C and the glycerides contain unsaturated fatty acids, especially adjacent double acids, more peroxides are formed in such oils. If the oxidation reaches a temperature of 50 ° C, the main products of the reaction are hydroperoxides [

The methylene group between the two pairs of linoleic acid is more actively oxidized than the other methylene groups. Therefore, linoleic acid absorbs oxygen 10-12 times faster than oleic acid and forms hydroperoxides:

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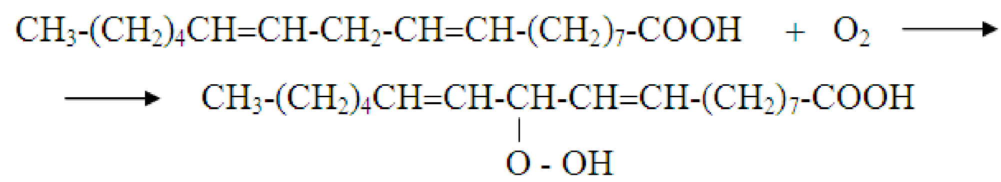
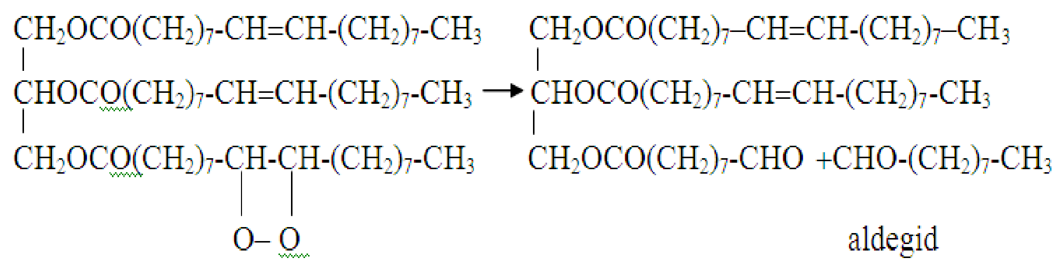
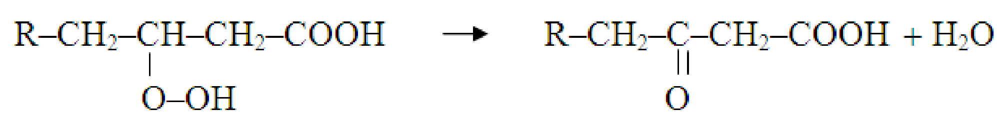


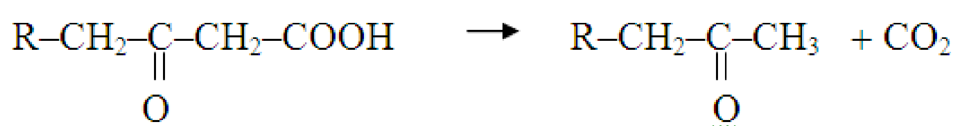
The oxidation rate of linoleic acid is twice the oxidation rate of linoleic acid. Secondary products of complete oxidation can be aldehydes, ketones, and carbon dioxide, depending on the type of raw material. Aldehydes are formed from peroxides:



Aldehyde is removed from water and oil by deodorization. The ketone oxidation characteristic of coconut or milk fat, which contains medium molecular weight saturated fatty acids, is accompanied by the conversion of the rapidly formed hydroperoxides into ketones:



Because β-ketones are not stable, they decompose rapidly into methyl alkyl ketones and carbon dioxide:



It is advisable to add natural tocopherols to increase the oxidation resistance of oils and fats. Antioxidants in the form of some artificial phenols and amines are not added to feed oils.

Experimental Part Standard requirements for the supply of vegetable oils to the population

The Republic of Uzbekistan has a temperate climate, which can fluctuate from -5 to + 5 °C in winter and from +35 to + 50 °C in summer. Under these conditions, food

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spoilage, especially the oxidation of fatty foods, progresses faster than the climatic conditions of the northern countries (Russia, Belarus, Ukraine, etc.). In this regard, changes are being made to the storage conditions of food products, including fatty foods, in order to increase their shelf life.

A number of factors play a role in the decomposition or oxidation-reduction reactions of products. These include ambient temperature, exposure to sunlight, humidity, and so on.

Before the product can be sold, it must fully meet the requirements of the standard. In our research, we used high-grade refined, deodorized cotton (UzDSt 816: 2015), sunflower (GOST 1129-2013) and soybean (UzDSt 3093: 2016) oils. The standard specifications for these products are given in Table 1.

Table 1. Requirements for high-grade refined, deodorized cotton, sunflower and soybean oils

Name of indicators	High grade refined, deodorized oil		
	Cotton	Sunflower	soybean
The color, in the red units of the constant 35 yellow units, is not much	5	Not detected	Not detected
Color, mg J_2, not much	-	6	12
The number of acids, mg KOH / g, is not large	0,2	0,3	0,3
Mass fraction of moisture and **v**olatiles,%, not more	0,1		
Mass fraction of non-fat mixtures (sediment by mass),%, not more	Not available		
Soap (quality reaction)	Not available		
Mass fraction of phosphorus, mg / kg, not much	Not detected	Not available	20
Mass fraction of non-soapy substances,%, not more	1,0	1,0	Not detected
The number of peroxides, mmol of active oxygen / kg, is not large	10	4,0	4,0
The number of anisides is not large	Not detected	3,0	3,0

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As can be seen from Table 1, the requirements for almost all refined, deodorized oils are different, due to the fact that each oil has its own storage conditions. This is because cottonseed oil is relatively high in saturated fatty acids, while sunflower and soybean oils are high in unsaturated fatty acids. Therefore, their peroxide number should not exceed 4.0 mmol of active oxygen/kg and the anizidine number should not exceed 3.0 units, while in cottonseed oil, the peroxide number should not exceed 10 mmol of active oxygen/kg and the anisidine number should not exceed.
To illustrate this further, let's compare the fatty acid content of these oils as specified in the standards. Table 2, shows the fatty acid content of sunflower (GOST 1129-2013) and soybean (UzDSt 3093: 2016) oils.

Table 2: Fatty acid content of soybean and sunflower oil

Name of fatty acids	The name of the oils	
	Sunflower	Soybeans
$C_{14:0}$ Miristin	0,2 until	0,2 until
$C_{16:0}$ Palmitin	5,0-7,6	8,0-13,5
$C_{16:1}$ Palmitoolein	0,3 until	0,2 until
$C_{18:0}$ Stearin	2,7-6,5	2,0-5,4
$C_{18:1}$ Olein	14,0-39,4	17,0-30,0
$C_{18:2}$ Linol	48,3-77,0	48,0-59,0
$C_{18:3}$ Linolen	0,3 until	4,5-11,0
$C_{20:0}$ Araxin	0,5 until	0,1-0,6
$C_{20:1}$ Eykozen	0,5 until	0,5 until
$C_{22:0}$ Begen	0,3-1,5	0,7 until
$C_{22:1}$ Eruk	0,2 until	-
$C_{24:0}$ Pignotserin	-	0,5 until
$C_{24:1}$ Lignotserin	0,5 until	-

As can be seen from Table 2, the main component of sunflower and soybean oils is linoleic fatty acid with 2 compounds. This fatty acid changes its structure under the influence of oxygen in the air, moisture in the product, or sunlight. Therefore, we need to use natural antioxidants when storing these products or protect them from moisture, oxygen and sunlight.

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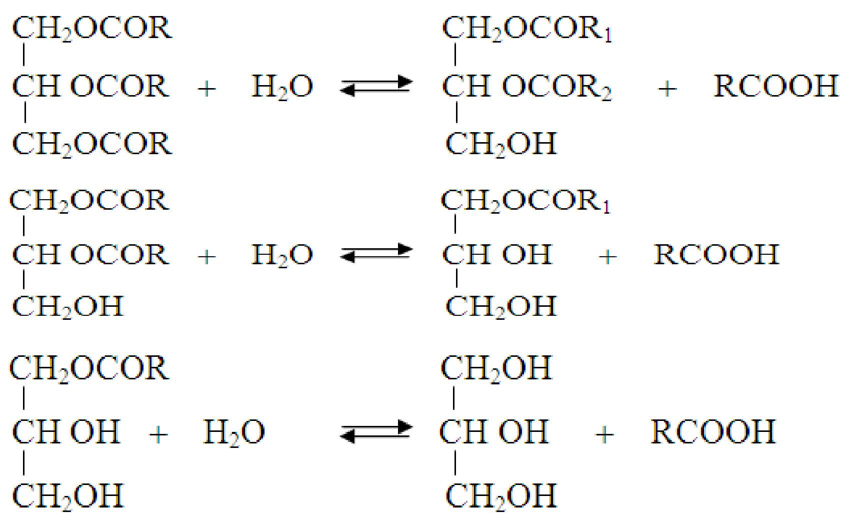
The Effect of Moisture During Storage Of Vegetable Oils

Moisture is the residual water in the product. Although oil products are hydrophobic, they retain water particles. As mentioned above, the mass fraction of moisture and volatile substances in the production of cotton, sunflower and soybean oils should not exceed 0.1%. However, due to the water in the air, there is a possibility of a noticeable increase in humidity in our products. When vegetable oils are used, their lids open and they inadvertently interact with atmospheric air, and from there they interact with moisture and oxygen [13-14]

We have already considered the effect of oxygen on fatty acids, and under this influence, we have seen the formation of primary and secondary oxidation products, such as peroxide, ketones, aldehydes, and others. Moisture can break the bonds of triglycerides, forming mono- and di-glycerides and free fatty acids. This can cause the acid count to exceed the set limits.

This reaction takes place in 3 steps as follows.



In our study, we observed changes in the content of free fatty acids in high-grade refined, deodorized cotton, sunflower, and soybean oils with different moisture content. Storage conditions were 20±5 °C in a dark room.

Moisture changes not only the number of acids but also the number of peroxides, according to a literature review. In our study, we studied the effect of moisture on the peroxide number of vegetable oils. The results obtained are presented in Table 3

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Table 3: Changes in the number of peroxides during storage of high-grade refined, deodorized cotton, sunflower and soybean oils with different humidity

Humidity, %	The change in the number of peroxides during the storage of fats (months), mmol of active oxygen / kg						
						10	12
High grade refined, deodorized cottonseed oil							
0,05						6,3	7,1
0,1						8,2	9,8
0,2						10,	10,8
High-grade refined, deodorized sunflower oil							
0,05						3,7	4,2
0,1						5,7	6,2
0,2						7,2	7,4
High grade refined, deodorized soybean oil							
0,05						5,8	6,5
0,1						6,2	6,8
0,2						7,4	7,6

As can be seen from Table 3, the increase in moisture content of vegetable oil affects not only the number of acids, but also the change in the amount of oxidizing substances in it. At the same time, as the humidity increases, the amount of oxidized substances increases. Based on the results, we can see that the increase in the number of peroxides has slowed down in recent months, mainly due to the fact that after the

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first stage of oxidation in the product, ie fatty acids with epoxy, ketoxy, hydroxyl groups are gradually decomposed into secondary products. Aldehydes, ketones, and the like.

In our study, we observed changes in the amount of secondary oxidized products of vegetable oils, i.e., the amount of anisidine, during storage at different humidity levels. The results obtained are presented in Table 4.

Table 4: Changes in anisidine levels during storage of high-grade refined, deodorized cotton, sunflower and soybean oils with different humidity

Humidity, %	hanges in the number of anisides during the storage of fats (months)						
						10	12
High grade refined, deodorized cottonseed oil							
0,05						1,6	1,8
0,1						1,9	2,2
0,2						2,5	2,9
High-grade refined, deodorized sunflower oil							
0,05						2,7	3,3
0,1						4,1	5,3
0,2						8,5	11,3
High grade refined, deodorized soybean oil							
0,05						3,8	4,8
0,1						5,5	7,3
0,2						9,8	13,7

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As can be seen from Table 4, an increase in moisture leads to an increase in the amount of secondary oxidized products in the oil. This lowers its nutritional value.

Conclusion

In short, the change in the number of acids, peroxides and anisides during the storage of vegetable oils depends on its moisture content, ie the amount of water it contains. The higher the humidity, the higher these values over time, lowering the nutritional value of the product and making it unusable.

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