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CHEMICAL, BIOLOGICAL AND NATURE PROTECTION TECHNOLOGIES

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RHEOLOGICAL PROPERTIES AND A NEW FUNCTIONAL MAYONNAISE MICROSTRUCTURE OF ENRICHED BY GRAPE SEEDS OIL*

One of priority directions in the food-processing industry development is work out the recipe and production of fatty products. A certain place occupies mayonnaise in which vegetable oil is in the dispersed state that increases their comprehensibility and nutritional value. In order to increase the biological value of mayonnaise it was offered to replace partially sunflower oil by grape seed oil which, as it is known, differs with the high maintenance of polynonsaturated fat acids (ω-3 and ω-6) and such natural antioxidants, as vitamin E (α, β, γ) and polyphenols (proanthocyanidins). To determine the optimality of vegetable oils, the influence of their mix on structure, rheological properties and the basic physical and chemical indicators of quality of investigated samples of mayonnaise emulsions is studied. We show the feasibility of grape seed oil utilization to increase the biological value and physical-chemical parameters of mayonnaise as compared with the traditional recipe.

***Keywords**: mayonnaise, grape seed oil, biological value, microstructure, rheology.*

Introduction. Mayonnaise represents difficult dispersed, stable food fatty emulsion of direct type in which the disperse phase is distributed in the form of the smallest droplets in the dispersive medium, differentiated by an interface [1]. Actual trend of the oil industry is to produce mayonnaise based on mixture of vegetable oils of different types according to their fatty acid composition. Grape seed oil was chosen as a fortifier due to high content of polyunsaturated fatty acids and natural antioxidants [2,3].

Particular attention is paid to the possible impact of insertion ingredients on quality parameters on enriched products. As in technological process of obtaining mayonnaise emulsion there is an interaction of various systems, a regrouping of making substances from products. Thus the disperse system finds certain rheological properties [4]. The purpose of this study is to develop a new kind of mayonnaise with a high biological value, contributing to improve the nutritional status of the population. In this regard, a comprehensive analysis of the physical properties of mayonnaise (rheology), microstructure, and organoleptic quality, is carried out.

1. Materials and research methods

1. 1. Materials. As components for obtaining experimental samples of mayonnaise sunflower oil, double-refined and deodorized, grape seed oil refined and deodorized, egg yolk, sugar, mustard, vinegar, salt are used. All foodstuff used correspond to requirements for quality of the specifications and technical documentation [5,6].

1.2. Technology of samples preparation. Four experimental samples of mayonnaise areprepared for researching which differ by the content of grape seed oil. To obtain samples of mayonnaise with a high biological value 10, 20 and 30% of sunflower oil was replaced grape seed oil. The obtained samples of mayonnaise are placed in sterile plastic food containers with sealable lids and stored for 24 hours at 4 ^{0}C, then corresponding analyses are carried out.

1.3. Determination of the basic quality properties. Mass fraction of moisture, fat and acidity of the mayonnaise samples are determined in accordance with the requirements of corresponded normative and technical documentation of the product [7]. The content of hydroperoxides is determined by using the method proposed by Shanta and Decker [8]. By a standard method of analysis proposed by IUPAC and researcher BIRD, respectively measurement of p-anithidin and thiobarbituric value was performed [7].

1. 4. Determination of rheological properties. Rheological properties of the compared samples of mayonnaise are investigated by measuring the dynamic viscosity of the rotational method. For this purpose, a rotary viscometer type „REOTEST-2", allowing to spend viscosity measurement in a range of 1-1,8 Pa·s with a relative error no more than 3-4 % is used. Researches in a range of speeds of shift (Dr) from 3 s^{-1} to 1,32 s^{-1} at the temperature 20 ^{0}C before and after the mechanical impact are performed.

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1.5. Definition of a microstructure and the sizes of fatty droplets. By using an optical microscope of digital model «Motic DMB 5-5» (China)t he microstructure of mayonnaise emulsions is determined. For this purpose a drop of the investigated sample of mayonnaise is placed on the subject glass, covered with its integumentary glass and then established in a microscope. Photos of mayonnaise samples are obtained by digital camera connected to a microscopc.

1.6. Statistical analysis. Experimental results are ± SD (standard deviation) of three parallel measurements and processed statistically by the method of those small squares with application of coefficient Student and determination of interval of investigation [9].

2. Results and discussions

2. 1. The main physico-chemical parameters of quality of vegetable oils used for preparing the samples mayonnaise emulsions

Compositions of vegetable oils for creating a fatty basis of mayonnaise emulsions with a high biological value were chosen as follows: firstly, the achievement ratio of ω-3:ω-6 polyunsaturated fatty acids in triacylglycerides close to optimal, which provides therapeutic and prophylactic properties of the product, secondly, achievement in triacylglycerides fat phase content of linolenic acid 0,1-0,2% (to total fatty acids), which is provided in combination with vitamins E, C and β-carotene antisclerotic action, and, thirdly, oxidation resistance of the finished product is provided.

Based on preliminary experiments two samples of refined and deodorized vegetable oils are selected: sunflower and grape seeds. Table 1 shows the main physico-chemical properties of the samples of vegetable oils.

Table 1

Physico-chemical parameters of vegetable oils and their mixtures the samples of quality

1	The parameter name	Sunflower oil	Grape seed oil	A mixture of vegetable oils ((% (W / W)) substitution of sunflower oil with grape seeds oil)		
				10%	20%	30%
		1	2	3	4	5
1	Acid value, mg ÊÎÍ/g oil	0,23±0,01	0,17±0,01	0,22±0,03	0,22±0,02	0,20±0,01
2	Peroxide value, meq/kg oil	8,41±0,01	8,17±0,02	8,4±0,02	8,32±0,01	8,32±0,02
3	Hyidroperoxides content, mM	0,079±0,004	0,072±0,003	0,077±0,004	0,075±0,002	0,075±0,003
4	Aniside value, c.u.	0,5492±0,0005	0,5179±0,0004	0,5457±0,0003	0,5319±0,0005	0,5293±0,0005
5	Thiobarbituric value, mg/g oil	0,6439±0,0003	0,5399±0,0003	0,6359±0,0003	0,6219±0,0003	0,6217±0,0003

From Table 1 it is visible that the mixtures of vegetable oils have high physical and chemical characteristics and correspond to requirements of the specifications and technical documentation quality of the fat components used to create a functional foodstuff.

2. 2. The main physico-chemical parameters of quality of the samples mayonnaise emulsions. Based on mixtures of vegetable oils mayonnaise samples are prepared and their basic physico-chemical parameters of quality are investigated (Table 2). The results of organoleptic analysis showed that compared samples of mayonnaise have a smooth consistency and delicate taste.

Table 2

Physico-chemical parameters of quality of the samples mayonnaise emulsions

№	The parameter name	The samples of investigated mayonnaise			
		Control	Mayonnaise with grape seed oil		
			10%	20%	30%
		№1	№2	№3	№4
1	Fat content,%, not less	50,0±0,01	50,0±0,01	50,0±0,01	50,0±0,01
2	Moisture content,%, not more	46,39±0,02	46,33±0,03	46,36±0,02	46,38±0,02
3	Acidity, in terms of acetic acid,%, not more	0,49±0,01	0,49±0,01	0,48±0,02	0,48±0,01
4	Effective viscosity (20 ^{0}C, speed of shift 3 s^{-1} Pa·s)	11,0	14,7	16,5	12,8

Designed mayonnaise emulsions have high organoleptic, physico-chemical characteristics and correspond to requirements of the normative-technical documentation quality for this product.

2. 3. Rheological properties of the investigated samples of mayonnaise emulsions. The introduction in structure of investigated samples of mayonnaise grape seed oil is accompanied by a change of rheological characteristics, such as effective viscosity and tangent pressure. The degree of change in these indicators depends on quantity of input grape seed oil and the gradient speed of shift of a product. Results of researches of rheological characteristics for compared samples of mayonnaise are shown in Fig. 1.

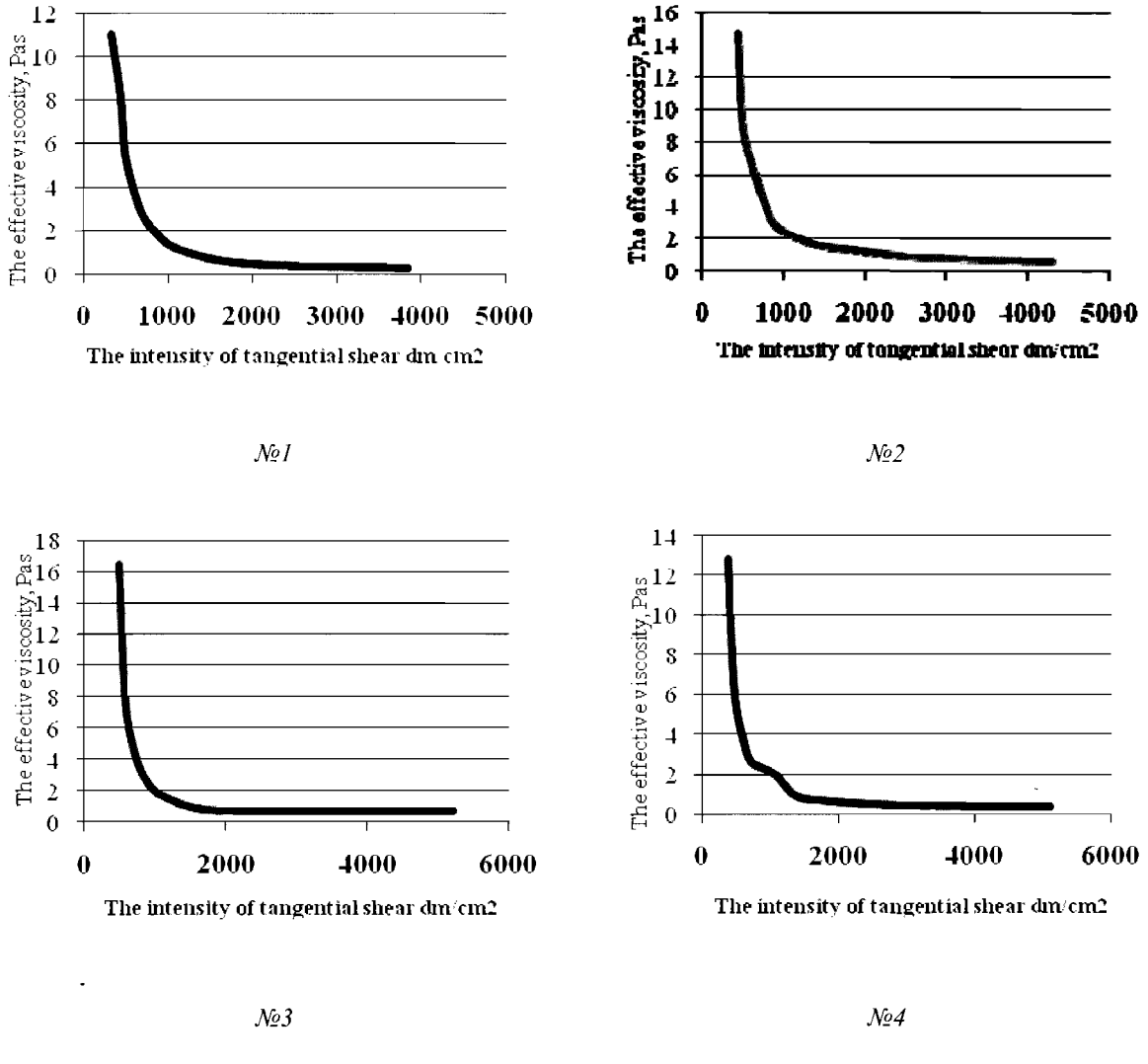

Fig. 1.The dependence of effective viscosity on tangent pressure of investigated sample shift of mayonnaise at 20 ^{0}C

It is seen from the experimental data that degree of change of effective viscosity and tangent pressure depends on a speed of shift gradient and quantity of added grape seed oil. It is established that effective viscosity of investigated samples of mayonnaise emulsions varies from 11,0 to 16,5 Pa·s at the temperature 20 ^{0}C and speeds of shift 3 c-1. Moreover, rheological properties are better kept at increase in speed of shift for the sample of mayonnaise containing 20% of grape seed oil. At increase of grape seed oil content to 30% is a reduction of viscosity of a mayonnaise emulsion to 12,8 Pa·s.

It is necessary to notice that rheogram of investigated samples of mayonnaise are close to each other. So, with increasing the pressure of shift the effective viscosity of compared samples of mayonnaise emulsions decreases to some limit, remaining further constant irrespective of shift pressure changes. There is a disintegration of the structure, the particles are guided in a current direction, and coupling between particles of a disperse phase weakens.

2.4. The structure of investigated samples of mayonnaise emulsions. The microstructure of investigated samples of mayonnaise is presented in Fig. 2.

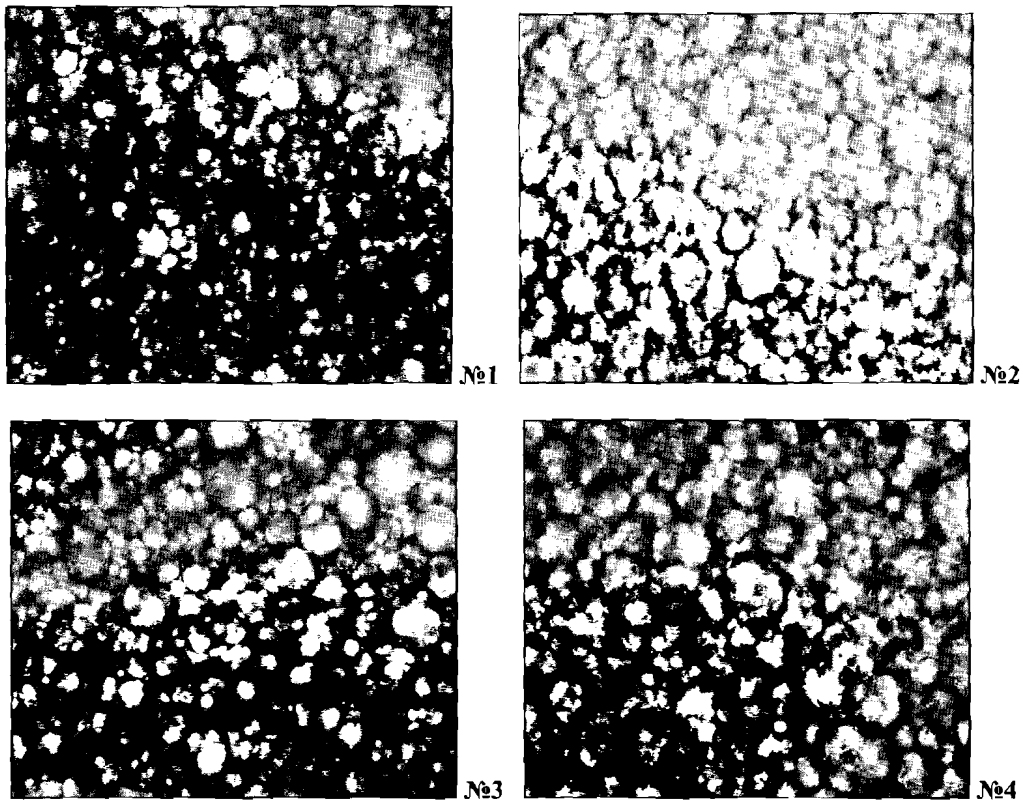

Fig. 2. Microstructures and distribution of fat droplets in investigated mayonnaise emulsions under an optical digital microscope with high permission

In photographs compared samples of mayonnaise under the number № 1 - № 4 show the effect of input grape seed oil (10, 20 and 30%) on quality parameters of the microstructure of mayonnaise emulsions compared with the control sample. It is possible to notice that the most dense spherical and uniform arrangement of fat droplets is typical for samples of mayonnaise emulsions numbered № 1 - № 3, moreover, the fat droplets of this emulsions differ by the smallest sizes. Increasing the size of fat droplets in sample №4 leads to a larger contact surface areas of spheres and, consequently, to reduce the viscosity of the mayonnaise emulsion.

Conclusion. The composition of vegetable oils (sunflower and grape) in a ratio of 80:20 (% (W / W)) used to create a fat basis mayonnaise emulsion with a high biological value is the most optimal ratio of polyunsaturated fatty acids ω-3: ω-6, providing, in combination with vitamins E, C and β-carotene antisclerotic action and giving oxidation stability to the finished product.

Based on the compositions of vegetable oils samples of investigated mayonnaises have been prepared. It is established that the obtained mayonnaise emulsions are characterized by high physical and chemical parameters.

The effect of injected grape seed oil on the rheological characteristics (the effective viscosity and tangent pressure of shift) of the mayonnaise emulsions samples is studied. The experimental data indicate that a sample of mayonnaise containing 20% of grape seed oil is better retaining their rheological properties with increasing values of speed of shift.

Studying a microstructure of compared samples of mayonnaise emulsions it is established that the sample containing grape seed oil 20% is characterized by the most dense spherical and uniform arrangement of fat droplets of emulsion.

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ԽԱՂՈՂԻ ԿՈՐԻԶՆԵՐԻ ՅՈՒՂՈՎ ՀԱՐՍՏԱՑԱԾ ՆՈՐ ՖՈՒՆԿՑԻՈՆԱԼ ՆՇԱՆԱԿՈՒԹՅԱՆ ՄԱՅՈՆԵԶԻ ՄԻԿՐՈԿԱՌՈՒՑՎԱԾՔԸ ԵՎ ՌԵՈԼՈԳԻԱԿԱՆ ՀԱՏԿՈՒԹՅՈՒՆՆԵՐԸ

Նշված է խաղողի կորիզների յուղի օգտագործման հնարավորությունը՝ մայոնեզի կենսաբանական արժեքի և ֆիզիկաքիմիական ցուցանիշների բարելավման նպատակով:

Առանցքային բառեր. *մայոնեզ, խաղողի կորիզի յուղ, կենսաբանական արժեք, միկրոկառույց, ռեոլոգիա:*

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РЕОЛОГИЧЕСКИЕ СВОЙСТВА И МИКРОСТРУКТУРА НОВОГО ФУНКЦИОНАЛЬНОГО НАЗНАЧЕНИЯ МАЙОНЕЗА, ОБОГАЩЕННОГО МАСЛОМ ВИНОГРАДНЫХ КОСТОЧЕК

Показана возможность использования масла виноградных косточек с целью увеличения биологической ценности и улучшения физико-химических показателей майонеза по сравнению с традиционной рецептурой.

Ключевые слова: *майонез, масло виноградных косточек, биологическая ценность, микроструктура, реология.*

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