PROSPECTS OF USING GRAPE SEED OIL FOR PRODUCTION OF FUNCTIONAL MAYONNAISE EMULSIONS

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Abstract: Solution of the problem of alimentation structure improvement is related to creation of functional food-stuff with a balanced content of the major nutrient materials enriched in missing micronutrients and, at the same time, being daily products. Multicomponent structure of vegetable oils provides ample opportunities for construction of products preventing deficiency in essential fatty acids, vitamins and other physiologically functional ingredients.
Grape-seed oil is of high bioavailability determined by a complex of biologically active substances, bioflavanoids, a group of vitamins, being the most important of them. Physiological effect of grape-seed oil includes anti-cholesterol property preventing cardio-vascular diseases.
This research covers studies of functional mayonnaise emulsion made on the basis of sunflower and grape-seed oils. The study covers oxidative stability of emulsions, based on determination of intensity of primary and secondary oxidation products formation.
Keywords: sunflower oil, grape-seed oil, mayonnaise emulsion, primary and secondary oxidation products, functional food-stuff.

INDRODUCTION

The development and production of food products with a balanced composition and high bioavailability, which are at the same time convenience food products, is one of priority directions of modern food industry.

Mayonnaises hold a special place among high-fat foods for prospective production, since they contain vegetable oil in dispersed state, which increases their assimilability and nutritional value. The complex composition of mayonnaises provides wide possibilities for constructing products that would help combat the deficiency of fatty acids, vitamins and other physiologically functional elements.

In this context, the research is aimed at developing formulas and evaluating physical, chemical and organoleptic quality indices of functional mayonnaises with prophylactic properties. With a view to enhancing mayonnaise bioavailability it was suggested that sunflower seed oil be partially replaced with grape seed oil which is represents a biological active composition that differs by an increased content of vitamin E and F as well as mineral substances: zinc, copper, selenium. But first of all it contains the so called protianidines that is 50 times a more powerful antioxidant agent than vitamin E and 20 times more powerful than vitamin C [1].

In order to determine the optimum proportions of vegetable oils researchers have studied the influence of their mixes on the structure, rheological properties of studied mayonnaise emulsion samples [2]. The advantage of using grape seed oil as the fat component is higher bioavailability and organoleptic quality indices of mayonnaise as compared to the traditional formula.

The purpose of this paper was to study the fatty acid composition of oil samples, specially of double mixtures and main physical, chemical indices of functional mayonnaise

emulsions. This direction of research is priority because the increased nutritional and biological value makes mayonnaise with functional properties.

2. MATERIALS AND RESEARCH METHODS

2. 1. Materials

As components for obtaining experimental samples of mayonnaise were used: sunflower oil, double-refined and deodorized, grape seed oil refined and deodorized, egg powder, sugar, mustar dpowder, vinegar, salt, emulsifier. All foodstuff used in work corresponded to requirements of quality of the specifications and technical documentation [3,4].

2.2. Technology of samples preparation

For research was prepared four experimental samples of mayonnaise, which differ on 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 with grape seed oil. The obtained samples of mayonnaise were placed in sterile plastic food containers with sealable lids and stored for 24 hours at 4 ^{0}C, then carry out corresponding analyses.

2.3. Determination of the basic indicators of quality

Acid, peroxid value of the mayonnaise / oil samples were determined in accordance with the requirements of corresponded normative and technical documentation of product [4]. The content of hydroperoxides was determined by the method proposed by Shanta and Decker [5]. Measurement of *p*-anisidine and thiobarbituric value, diene content was performed using a standard method of analysis proposed by IUPAC and researcher BIRD, respectively [6-8].

2.4. Gas chromatography (GC-2014)

Gas chromatography (GC-2014) allowed the analysis of fatty acids in vegetable oils samples on 5890 Hewlett-Packard chromatograph (Hewlett-Packard, Palo Alto, CA, USA), equipped with a data base and a device for taking and injecting samples. Fatty acids were separated according to their chain length and depending on their degree of unsaturated. Helium was used as the carrier gas with a constant stream of 1,2 ml/min. Pressure applied to the carrier gas is 142 kPa at 190oC. Conditions: temperature of 60 °C; detector and injector temperatures were maintained at 230 °C. Concentrations were determined in the areas of signal, using standard curve of oil and authentic data base.

2.5. Statistical analysis

Experimental results were means ± 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].

3. **RESULTS AND DISCUSSIONS**

3.1. The main physico-chemical parameters of quality of vegetable oils used to prepare the samples mayonnaise emulsions

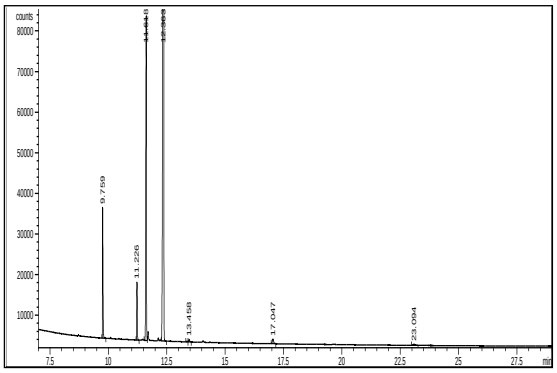

Fig. 1. HPLC chromatogram (GC-2014) of grape seed oil sample

It is known that the oil from the grape seeds represents a highly precious product from the nutritional point of view, first of all due to the increased content of vitamin E (127-135 mg/100g oil) and the composition of fatty acids. The comparative chemical composition of the fatty acids from the used sunflower oil and the grape seeds oil is indicated in table 1. A model chromatogram is shown in fig. 1

Table 1. The chemical composition of the fatty acids from the composition of the triglycerides from the sunflower and grape seeds oil and their mixtures

Refined and deodorized oil samples	The content of the fatty acids, %									
	Saturated				***Monounsaturated***				***Polyunsaturated***	
	Palmitic, C16:0	Stearic, C18:0	Arahidic, C20:0	Behenic, C22:0	Palmitoleic, C16:1	Oleic, C18:1	Eicosenoic, C20:1	Erucic, C22:1	Acid Linoleic **(ω6) C18:2**	Acid Linolenic **(ω3) C18:3**
Sunflower oil	6,22	3,15	0,42	0,48	0,12	22,4	0,14	0,08	66,97	-
Grape seeds oil	7,18	4,10	0,08	0,12	0,23	16,3	0,22	0,12	71,07	0,6
Mixture of sunflower and grape seed oils 10%	6,32	3,25	0,39	0,44	0,13	21,8	0,15	0,08	67,38	0,06
Mixture of sunflower and grape seed oils 20%	6,41	3,34	0,35	0,41	0,14	21,2	0,16	0,09	67,79	0,12
Mixture of sunflower and grape seed oils 30%	6,51	3,44	0,32	0,37	0,15	20,6	0,17	0,09	68,20	0,18

The analysis of these data proves that the grape seeds oil is richer in polyunsaturated fatty acids (omega 6 –linoleic acid) and contains, unlike the sunflower oil, an important quantity of linolenic acid (omega 3).

In the present work were experimentally determined the basic qualities of the compared samples of the vegetable oils and their mixtures. The obtained data are presented in the table 2.

Table 2. The physic-chemical parameters of the quality of the studied oils samples

№	Quality index	Research sample				
		Sunflower oil	Grape seeds oil	Mixtures of sunflower and grape seed oils		
				10%	20%	30%
1	Acid value, mg KOH/g, oil	0,17±0,01	0,23±0,01	0,17±0,01	0,19±0,01	0,20±0,01
2	Peroxid value, mmol/g oil	8,17±0,02	8,41±0,01	8,19±0,02	8,22±0,01	8,25±0,02
3	Hidroperoxides value, мМ	0,072±0,003	0,079±0,004	0,075±0,003	0,075±0,002	0,077±0,004
4	Conjugated diene content, μmol/g oil	15,87±0,04	17,87±0,04	16,07±0,03	16,27±0,04	16,48±0,05
5	Conjugated triene content, μmol/g oil	7,01 ±0,03	8,15±0,03	7,12±0,04	7,24±0,05	7,35±0,04
6	*p*-anisidine value, c.u.	0,550±0,003	0,644±0,003	0,55943±0,002	0,569±0,003	0,578±0,004
7	TBARS value, mg/kg oil	0,518±0,004	0,549±0,005	0,521±0,003	0,524±0,003	0,527±0,003
8	Density at 20 ^{0}C	0,922±0,002	0,923±0,002	0,922±0,002	0,922±0,002	0,922±0,002
9	Refractive value($n^{20}{}_D$)	1,474±0,001	1,476±0,001	1,474±0,001	1,474±0,001	1,474±0,001
10	Saponification value, mg KOH/g oil	197±7	191±5	196±6	195±5	192±5
11	Iodine value, g/kg	133±3	142±5	134±2	135±3	136±5
12	Unsaponifiable substances content, g/kg	6,3±0,1	11,2±0,2	6,8±0,3	7,3±0,2	7,8±0,1
13	Total stearine content, mg/kg	2134±47	2423±42	2163±43	2191±44	2221±47

*Average concentration of three measurements ± standard deviation.

From the data presented in table 2 is observed that bicomponent mixtures of vegetable oils are characterized by high quality value indices that correspond to the requirements for vegetable oils used to create functional foods and meet all the standards set by regulatory documentation for these products.

On the basis of calculation of fatty acids correlation were developed dual systems of vegetable oils (sunflower and grape seed), close to recommended correlation indicators by ω-3 and ω-6 fatty acids. Previous our studies were focused on developing of technology, recipes and evaluating organoleptic properties of functional mayonnaise emulsions with high biological value [10]. Because an important content of polyunsaturated fatty acids involves a high degree of rancidity, oxidative stability research was an essential criterion of acceptability.

3. 2. The main physico-chemical parameters of quality of the functional mayonnaise emulsions

To obtain mayonnaise emulsion with a high biological value 10, 20 and 30% of sunflower oil was replaced with grape seed oil. Mayonnaise samples were prepared according to the following technology: mayonnaise paste preparation of milk powder, egg powder, soda, mustard powder, emulsifier are mixed in a ratio of 1:2 with sunflower oil. All components were mixed with salt and sugar. Vegetable oils were added slowly through a thin jet mixing continuously in single direction.

To determine the dynamic accumulation of oxidation products in the emulsions were determined based indices, listed in regulatory documentation, and other parameters. Dynamic accumulation of oxidation products in mayonnaise samples was monitored during storage for 6 months. Research results are presented in table 3.

Table 3. Quality indices of functional mayonnaise emulsions

№	Quality indices	Period of storage	Research sample			
			Control	Mayonnaise with grape seed oil		
				10%	20%	30%
1	Acidity, in terms of acetic acid,%, not more	0 month	0,48±0,01	0,48±0,02	0,49±0,01	0,49±0,01
		1 month	0,50±0,02	0,52±0,03	0,57±0,01	0,59±0,01
		2 month	0,55±0,01	0,57±0,01	0,62±0,01	0,64±0,02
		3 month	0,59±0,01	0,61±0,02	0,66±0,02	0,69±0,01
		4 month	0,61±0,01	0,64±0,03	0,74±0,01	0,75±0,03
		5 month	0,65±0,01	0,69±0,01	0,79±0,02	0,81±0,01
		6 month	0,70±0,02	0,73±0,01	0,82±0,03	0,84±0,03
2	Peroxide value, meq/kg product	0 month	9,8±0,2	11,1±0,1	11,5±0,1	18,3±0,2
		1 month	10,2±0,1	11,3±0,1	11,8±0,2	18,7±0,2
		2 month	10,4±0,3	11,5±0,1	12,1±0,1	18,9±0,2
		3 month	10,8±0,2	11,9±0,2	12,4±0,1	19,3±0,3
		4 month	11,5±0,3	12,2±0,2	12,8±0,2	19,8±0,2
		5 month	11,9±0,	12,6±0,1	13,2±0,3	20,1±0,1
		6 month	12,2±0,2	13,1±0,2	13,5±0,2	20,4±0,2
3	Conjugated diene content, μmol/g product	0 month	14,03±0,04	14,39±0,06	14,63±0,04	14,89±0,03
		1 month	14,14±0,05	14,43±0,04	14,79±0,02	14,92±0,04
		2 month	14,69±0,04	14,76±0,02	14,83±0,02	15,05±0,08
		3 month	14,85±0,04	14,93±0,02	15,15±0,04	15,24±0,04
		4 month	14,94±0,07	15,05±0,08	15,21±0,03	15,35±0,09
		5 month	15,15±0,05	15,28±0,01	15,39±0,05	15,46±0,07
		6 month	15,35±0,04	15,41±0,01	15,58±0,07	15,60±0,04
4	Aniside value, c.u.	0 month	0,56±0,02	0,58±0,01	0,61±0,01	0,61±0,02
		1 month	0,58±0,01	0,60±0,02	0,64±0,02	0,65±0,01
		2 month	0,60±0,02	0,62±0,03	0,67±0,01	0,69±0,04
		3 month	0,63±0,02	0,65±0,02	0,69±0,03	0,72±0,01
		4 month	0,66±0,02	0,68±0,03	0,74±0,01	0,77±0,04
		5 month	0,69±0,03	0,71±0,02	0,81±0,01	0,85±0,02
		6 month	0,70±0,02	0,73±0,02	0,86±0,03	0,91±0,02

*Average concentration of three measurements ± standard deviation.

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

CONCLUTIONS

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 differs 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 have been prepared samples of investigated mayonnaises. It was established that the obtained mayonnaise emulsions are characterized by high physical and chemical parameters.

During this study was investigated the effect of grape seed oil on the oxidative stability characteristics of the mayonnaise emulsions samples. The experimental data indicate that a sample of mayonnaise containing 20% of grape seed oil differ relatively by a high stability for the accumulation of primary and secondary products of oxidation in the process of storage.

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