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### **ENRICHMENT OF THE PRODUCTS OF FAT-AND-OIL AND BIOTECHNOLOGY INDUSTRIES BY ANTIOXIDANTS AND PRESERVATIVES OF POWDERS FROM BARRY RAW MATERIALS**

It was found in investigation of amount of polyphenolic substances in samples of mixes with different contents of grape skin and mountain ash powders that varying the ratios of the mass fractions of the components practically did not affect the content of quercetin, which was not less than 6.7 %. Oxidated form of quercetin can influence on increase in resistance to microbiological spoil of a finished product. Inverse proportion between increasing in mass fraction of mountain ash berries powder and the sum of polyphenolic substances in terms of cyanidin-3,5-diglucoside was defined. It was shown in the study of sorbic acid content in samples of mixes of powders that content of sorbic acid increased from 0.43 % to 0.54 % with an increase (from 1 % to 3 %) in the mass fraction of mountain ash berries powder in the mixture. It was shown in the research of pectic substances content in selected samples of mixes of powders that total content of pectic substances also increased from 1.89 % to 3.28 % with an increase in the mass fraction of mountain ash berries powder and crude fiber values practically did not change. The conducted microbiological researches of samples of mayonnaise with 40.0 % fat mass fraction and yogurt with a 2.5 % fat mass fraction showed that adding of mix of grapes skin powder (2.0 % by weight) and mountain ash berries powder (3.0 % by weight) into the products slowed down the growth of yeast and mold.

**Key words:** mayonnais, yogurt, flavonoids, sorbic acid.

#### **Introduction.**

Every person needs nutrients, which is foodstuff, for satisfaction of vital needs of an organism (protective, power, regulatory). But the modern producers are capable to satisfy only energy needs in full. However nutritional and biological values of products are much lower in relation to actual needs of the person. Therefore experts in the field of science about a balanced diet of the person have been developing the specialized food enriched with necessary biologically valuable nutrients for several decades [1, 2]. It is necessary to give preference to enrichment of products of mass consumption during creation of compoundings of food products of improving appointment. It is possible to carry to them the oil and fat and biotechnology industries products, namely mayonnaise and fermented milk products [3–6].

By results of long-term researches it is proved that use the powders from vegetable raw materials as the functional ingredients of food products is capable to increase the nutritional and biological values of a finished product and to influence positively the person health state [7–10]. Besides, vegetable raw material powders are well assimilated by an organism and are an important energy source at the expense of a large amount content of carbohydrates, in particular pectins and a cellulose. It is known that pectins have ability to connect heavy metals and radionuclides and to bring them out of an organism [11]. Availability of various organic acids (in particular sorbic) in powders from vegetable raw materials is simultaneous both a source of valuable nutrients, and particular processing characteristics of raw materials (depressing of the pathogenic microflora growth processes in a finished product) [8].

#### **Characteristics of the objects, their relevance and the goal of the study.**

Fruit and berry raw materials also have a wide range of polyphenolic substances and bioflavonoids content. Some types of flavonoids, in particular quercetin and its derivants, have antifungal properties

together with high rates of antioxidative activity. More precisely it concerns to their oxidation products. For example, 3,4-dihydroxybenzoic acid, oxidated quercetin, has high rates on antifungal activity [13]. It is possible to use these flavonoids properties for the resistance to microbiological decay of foodstuffs increase.

**The subject of the study** – powder mixes of Black Perlina grape skins and black pepper pea berries.

**The tasks of the study** – 1) to determine the amount of flavonoids in powder mixes, which are proposed for inclusion in the composition of mayonnaise and yogurt for health purposes;

2) to definite a mass fraction of sorbic acid in powder mixes;

3) to determine the amount of soluble and insoluble food fibers in powder mixes;

4) to carry out the microbiological studies of samples of mayonnaise and yogurt with powder mixes regarding definition of the inhibiting effect of powders substances on the pathogenic microflora growth.

**Methods of the study** – when solving the set tasks, the following methods are used: methods of determination of polyphenolic substances content, methods of determination of sorbic acid content, methods of determination of fiber content and total pectin substances content, methods of determination of microbiological indicators of mayonnaise and yoghurt samples.

#### **Literature review.**

Deficiency of irreplaceable and scarce nutrients in a diet of the modern person is caused by tendency to the high energy food and refined food consumptions and minimum quantities of vegetables and fruit in a diet. The last several decades a situation only worsen in connection with the aggressive life rhythm and a lack of time for good nutrition.

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Alternative for a solution of the problem of correction of the food status of the population is targeted introduction of ingredients from vegetable raw materials (fruit and vegetable purees, powders etc) in foodstuffs production [14–17].

Foodstuffs of oil and fat and biotechnology industries are traditional and popular among the Ukrainian consumer. There are salads and sandwiches with mayonnaise at the table of practically each Ukrainian family every day, fermented milk products are an integral part of a daily diet. But it should be noted that ingredients which strongly reduce advantage of the consumed product are often used in production of the above-named products. Starches undesirable to the consumption by particular categories of people are often applied in production of mayonnaise and yogurts with additives. The use of synthetic preservatives can significantly extend the shelf life of finished products, but also can have a negative impact on the human body, especially children [18-22].

The fruit and berry raw materials powders application in compoundings of mayonnaise and fermented milk products is expedient not only thanks to enrichment of products by biologically valuable ingredients, but also thanks to existence of certain technological powders properties [23]. Researches in this direction have been continuing and thanks to new scientific data obtaining there are the prerequisites for the creation of food products new types, which are useful and attractive to the consumer, by technologists and experts of a healthy diet. Inclusion of powders from a wastages of juice and vegetable productions in structure of food products can become the alternate replacement of traditional and not always useful ingredients.

Powders from berry raw materials include flavonoids with high antioxidants activity. In particular, dark varieties of grapes are rich in anthocyanins which have high reactivity to free radicals and can color the products with low pH values in various shades of red color [24, 25]. That is use of powders from berry raw materials in mayonnaise and fermented milk products is expedient, firstly, on the part of organoleptic. These food systems which are emulsions have optimum pH level for anthocyanins hydrolysis and coloring of a product in shades of red.

Mountain ash berries, except flavonoids, incorporate a certain amount of organic acids [26]. Some of them have the specific preserving properties, because of capability to suppress pathogenic microflora development. The total content of organic acids in the mountain ash berries is not less than 8,0 %, including sorbic acid, malic acid, citric acid, etc. [27]. It is known that sorbic acid and its salts are used in the food industry as preservatives. Synthetic sorbic acid is applied in foodstuffs production but it can negatively affect to the person health state through the content of its industrial synthesis by-products [28, 29].

Except the high content of natural polyphenols powders from vegetable raw materials are a sources of soluble and insoluble food fibers (pectins, celluloses, hemicelluloses). Positive influence of food fibers on person health is proved in many scientific researches [30-33]. But the food diet of the modern, very active and busy person, does not provide the use of necessary standard daily rate of food fibers. Therefore these nutrients introduction to popular food products (yogurts and kefir drinks, mayonnaises and fruit dressing etc) in the form of powders is relevant. Besides increase in nutritional and biological value of a finished product it is also possible to regulate extent of condensation and to prevent premature stratification of emulsion oil and fat and fermented milk products. After all, pectin substances have moisture-retaining and gel-forming properties [34].

It is possible to receive the functional ingredients for enrichment of food products as the alternate replacement to traditional components by creation of mixed powders from berry and fruit vegetable raw materials. In particular the functional ingredients can be used instead of synthetic dyes, stabilizers, the preserving substances which are present at various sauces, dairy drinks for giving the attractive taste and color to a product. The scientific research continuing in this direction provides the basis for innovative solutions in the field of fat-and-oil products and biotechnology industries.

#### **Content of antioxidants of polyphenolic nature in the mixes of powders from berry raw materials.**

The studies results of the amount of polyphenolic substances (flavonoids) determination in samples of berry raw powder mixes are given in Table 1.

Table 1. Content of antioxidants of polyphenolic nature in the mixes of powders from Black pearl variety grape skin and from the mountain ash berries

Polyphenolic substances content in terms of	Sample № 1	Sample № 2	Sample № 3
Quercetin, %	6.81±0.03	6.74±0.07	6.71±0.02
Cyanidin-3,5-diglucoside, %	3.25±0.01	2.87±0.01	2.14±0.02

Analyzing results of researches, it can be seen that change of ratios of mass fractions of powders in mixes influences in different degree on total composition of polyphenolic antioxidants. Moreover,

the changes in the amount of polyphenolic substances in terms of quercetin are slight, this flavonoid is found in berries and fruits of any color. It is possible to see a tendency to decrease the total content of

anthocyanins in terms of cyanidin-3,5-diglucoside with mass fraction of grape skin powder decrease. Data of researches can be explained as follows: anthocyanins refer to the polyphenolic antioxidants which report red dark cherry and violet colors to fruits. The maximum quantity of anthocyanins is contained in the dark colors berries (blackberry, bilberry, dark varieties of grapes). So increase in a mass fraction of powder of mountain ash berries is in inverse proportion to the amount of polyphenolic substances in terms of cyanidin-3,5-diglucoside.

Based on the above data of experimental studies, all samples can be used in further researches because of almost identical content of quercetin which presence can affect positively on microbiological stability of finished products. The antioxidant, antimicrobial and fungicidal properties of quercetin

and other polyphenolic compounds have been confirmed by the studies reported in [8, 39-41]. Decrease of content of anthocyanin compounds will affect on shades of flowers of production, but due to the optimum pH for anthocyanins in the offered food systems discoloration (from gentle-pink to cherry-red) will be favorable for expansion of the range of production.

#### **Sorbic acid content in samples of mixes of berry raw materials powders**

Determination of sorbic acid content in samples of mixes of berry raw materials powders was the following stage of the experimental studies. Sorbic acid in fruit and berries is the natural preserving substance and is capable to suppress the processes of the fungal microorganisms growth. Results of the conducted researches are presented in Table 2.

Table 2. Sorbic acid content in mixes of powders from Black pearl variety grape skin and from mountain ash berries

Samples of mixes	Sample № 1	Sample № 2	Sample № 3
Sorbic acid content, mas. %	0.43±0.05	0.48±0.02	0.54±0.02

It has been shown that the content of sorbic acid increases with increase in a mass fraction of mountain ash berries powder in the mixes. Sorbic acid content prevail in № 2 and № 3 samples. And the mix of berry powders in the offered concentration addition can influence on increasing in microbiological decay resistance of production of oil and fat and biotechnology industries. Besides, it is known that sorbic acid shows the antifungal properties only at pH values of food system lower than 6.5 [29, 42-44]. That is fermented milk products and mayonnaise are

optimum products to show the preserving properties of sorbic acid from natural origin [27].

#### **Content of soluble and insoluble fibers in mixes of powders from berry raw materials**

The chosen samples of mixes of berry raw materials powders were used for further researches. In particular, the content of soluble and insoluble fibers in samples of mixes of powders was determined. Results of the conducted researches are presented in Table 3.

Table 3. Content of soluble and insoluble fibers in the mixes of powders from Black pearl variety grape skin and from mountain ash berries

Content of soluble and insoluble fibers	Sample № 2	Sample № 3
Crude fiber, %	7.08±0.02	6.97±0.02
Total content of pectin substances, %	1.89±0.01	3.28±0.01

Analyzing the obtained data, it is possible to observe that increase in total content of pectin substances with increasing in a mass fraction of mountain ash berries powder. This results can be explained by that the mountain ash berries powder represents spews which is received after juicing. The remnants are the prevailing amount of pulp which is rich in pectins, and a peel. Grape skin powder, first of all, consists of hemicellulose and insoluble protopectins. The results of the studies of dietary fiber amount ratio in fruit and vegetable raw materials are confirmed by the data of scientists in [45-47].

The presence of food fibers, soluble and insoluble, in a mixes of powders can affect the

technological properties of the offered functional ingredient and increase the moisture retaining, stabilizing and gelling ability. Besides, availability of food fibers reduces their deficiency in a food diet of the person.

#### **Microbiological studies of mayonnaise and yogurt samples with the addition of powders from berry raw materials**

The last stage of work consisted in conducting microbiological studies of the samples of mayonnaise and yogurt with the addition of berry raw materials powders with a different content of constituents which were chosen on the basis of trial tests.

Results of researches are presented in Table 4 and Table 5.

Table 4. Dynamics of changes in number of viable cells of yeasts in the samples of mayonnaise and yogurt with different content of powders from Black pearl variety grape skin and from mountain ash berries in mixes during storage

Mayonnaise with 40.0 % fat mass fraction		Yogurt with 2.5 % fat mass fraction	
Control 1		Control 2	
Shelf life, days	Yeast, CFU/cm <sup>3</sup>	Shelf life, days	Yeast, CFU/cm <sup>3</sup>
5	384	5	<10
10	405	10	<10
15	487	15	<20
20	543	20	45±2
25	588	25	80±3
Sample № 2 (3.0 % and 2.0 %)		Sample № 2 (3.0 % and 2.0 %)	
Shelf life, days	Yeast, CFU/cm <sup>3</sup>	Shelf life, days	Yeast, CFU/cm <sup>3</sup>
5	101	5	<10
10	131	10	<10
15	135	15	<20
20	141	20	32±2
25	289	25	44±2
Sample № 3 (2.0 % and 3.0 %)		Sample № 3 (2.0 % and 3.0 %)	
Shelf life, days	Yeast, CFU/cm <sup>3</sup>	Shelf life, days	Yeast, CFU/cm <sup>3</sup>
5	95	5	<10
10	97	10	<10
15	101	15	<20
20	128	20	30±2
25	181	25	45±2

Table 5. Dynamics of changes in number of viable cells of molds in the samples of mayonnaise and yogurt with different content of powders from Black pearl variety grape skin and from mountain ash berries in mixes during storage

Mayonnaise with 40.0 % fat mass fraction		Yogurt with 2.5 % fat mass fraction	
Control 1		Control 2	
Shelf life, days	Mold, CFU/cm <sup>3</sup>	Shelf life, days	Mold, CFU/cm <sup>3</sup>
5	<10	5	<10
10	<10	10	<10
15	<10	15	<30
20	<10	20	45±3
25	<20	25	68±3
Sample № 2 (3.0 % and 2.0 %)		Sample № 2 (3.0 % and 2.0 %)	
Shelf life, days	Mold, CFU/cm <sup>3</sup>	Shelf life, days	Mold, CFU/cm <sup>3</sup>
5	0	5	<10
10	0	10	<10
15	<10	15	<30
20	<10	20	37±2
25	<10	25	55±2
Sample № 3 (2.0 % and 3.0%)		Sample № 3 (2.0 % and 3.0 %)	
Shelf life, days	Mold, CFU/cm <sup>3</sup>	Shelf life, days	Mold, CFU/cm <sup>3</sup>
5	0	5	<10
10	0	10	<10
15	<10	15	<20
20	<10	20	32±2
25	<10	25	51±2

Data of researches (in Table 4, Table 5) show that introduction to a compounding of oil and fat and fermented milk products mixes of grape skin and mountain ashes berries powders slows down the

growth of a pathogenic microflora at concentration of 2.0 % mas. of grape skin powder and of 3.0 % mas. of mountain ash berries powder (sample № 3). It can be explained with presence of a flavonoid of quercetinum

in grape skin powder which has ability to be oxidized to compound with the expressed antifungal properties, and sorbic acid in mountain ash berries powder having the preserving properties at low pH levels of food systems. The obtained results are also corresponded by the results of scientific researches given in [8, 18, 39, 41–43]. Further increase in concentration of mountain ash berries powder is inexpedient because of deterioration in organoleptic quality control parameters

### Conclusions and prospects for the further development of this area

This article presents study of the content of the main biologically active substances of mixtures of powders of berry raw materials for their inclusion in the products of the oil and fat industry and biotechnology industry.

The total flavonoids maintenance (in terms of quercetin and cyanidin-3,5-diglucoside) in samples of mixtures of powders which were offered to be added into a compounding of mayonnaise and yogurts for healthy purposes was defined; it was proved that the increase in the mass fraction of the berries powder was in inverse proportion to the total content of polyphenolic substances in the amount of cyanidin-3,5-diglucoside; it was defined that variation of mass fractions of berry raw materials powders practically did not influence on the total polyphenolic substances maintenance in terms of quercetin.

Determination of a mass fraction of sorbic acid in mixtures of powders was shown that there was a gradual increase in content of sorbic acid with increase in mass fraction of a mountain ash berries powder in mixtures; samples with the maximal content of sorbic acid in mixtures were chosen for further researches.

The content of crude fiber and pectin substances in samples of mixtures of powders was determined; it was discovered that the total content of pectin substances increased with an increase in the mass fraction of a mountain ash berries powder in the mix.

It was defined that the mix of powders from Black pearl variety grape skin and from mountain ash berries, with concentration of 2.0 % and 3.0 % respectively, adding in samples of mayonnaise and yogurt reduced quantity of colony-forming units of yeast and a mold during products storage in comparison with control without mixtures of powders.

Results of experiments can be applied by scientific and production institutions which are engaged in development and introduction of new technologies of oil and fat and fermented milk products for health purposes.

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### **ЗБАГАЧЕННЯ ПРОДУКТІВ ОЛІЄЖИРОВОЇ ГАЛУЗІ ТА ГАЛУЗІ БІОТЕХНОЛОГІЇ АНТИОКСИДАНТАМИ ТА КОНСЕРВУЧИМИ РЕЧОВИНАМИ ПОРОШКІВ З ЯГІДНОЇ СИРОВИНИ**

Дослідження вмісту суми поліфенольних речовин у зразках сумішей із різним вмістом порошків шкірки винограду та горобини червоноплідної виявили, що варіювання співвідношень масових часток складових практично не впливає на вміст кверцетину, що не є меншим за 6,7 %. Продукт окиснення кверцетину може вплинути на підвищення стійкості до мікробіологічного псування готового продукту. Виявлено, що підвищення масової частки порошку ягід горобини зворотно пропорційно сумі поліфенольних речовин у перерахунку на ціанідин-3,5-диглікозид. Дослідження вмісту сорбінової кислоти у зразках сумішей порошків показало, що при збільшенні масової частки порошку ягід горобини червоноплідної у суміші (від 1 % до 3 %) збільшується вміст сорбінової кислоти (від 0,43 % до 0,54 %). Дослідження вмісту пектинових речовин в обраних зразках сумішей порошків показало, що при збільшенні масової частки порошку ягід горобини зростає також сумарний вміст пектинових речовин (від 1,89 % до 3,28 %), показники за сировою клітковиною практично не змінюються. Проведені мікробіологічні дослідження зразків майонезу з масовою часткою жиру 40,0 % та йогурту з масовою часткою жиру 2,5 % показали, що введення суміші порошків шкірки винограду (2,0 % мас.) та горобини червоноплідної (3,0 % мас.) до складу продуктів уповільнює ріст дріжджів та плісняви.

**Ключові слова:** майонез, йогурт, флавоноїди, сорбінова кислота.

**АНАНЬЕВА. В. В., ВАРАНКИНА А. А., ОВСЯННИКОВА Т. А., ЖИРНОВА С. В.**

### **ОБОГАЩЕНИЕ ПРОДУКТОВ МАСЛОЖИРОВОЙ ОТРАСЛИ И ОТРАСЛИ БИОТЕХНОЛОГИИ АНТИОКСИДАНТАМИ И КОНСЕРВИРУЮЩИМИ ВЕЩЕСТВАМИ ПОРОШКОВ ИЗ ЯГОДНОГО СЫРЬЯ**

Исследования содержания суммы полифенольных веществ в образцах смесей с разным содержанием порошков кожицы винограда и рябины красноплодной выявили, что варьирование соотношений массовых долей составляющих, практически не влияет на содержание кверцетина, которое не опускается ниже 6,7%. Продукт окисления кверцетина может влиять на повышение устойчивости к микробиологической порче готового продукта. Обнаружено, что повышение массовой доли порошка ягод рябины обратно пропорционально сумме полифенольных веществ в перерасчете на цианид-4,5-дигликозид. Исследование содержания сорбиновой кислоты в образцах смесей порошков показало, что при увеличении массовой доли порошка ягод рябины красноплодной в смеси (от 1% до 3%) увеличивается содержание сорбиновой кислоты (от 0,43% до 0,54%). Исследование содержания пектиновых веществ в выбранных образцах смесей порошков показало, что при увеличении массовой доли порошка ягод рябины так же растет суммарное содержание пектиновых веществ (от 1,89 до 3,28), показатели по сырой клетчатке практически не изменяются. Проведенные микробиологические исследования образцов майонеза с массовой долей жира 40,0% и йогурта с массовой долей жира 2,5% показали, что введение смеси порошков шкурки винограда (2,0% мас.) и рябины красноплодной (3,5% мас.) в состав продуктов замедляет рост дрожжей и плесени.

**Ключевые слова:** майонез, йогурт, флавоноиды, сорбиновая кислота.