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ДОСЛІДЖЕННЯ МІКРОБІОЛОГІЧНИХ ПОКАЗНИКІВ ЯКОСТІ КОНДИТЕРСЬКОЇ ГЛАЗУРІ З ДОДАВАННЯМ ПОРОШКІВ ВИНОГРАДНИХ КІСТОЧОК

О.В. Городиська, Н.В. Гревцева, О.В. Самохвалова, О.М. Савченко

Досліджено мікробіологічні показники якості кондитерської глазурі з додаванням порошків виноградних кісточок, сировини, що входить до її рецептурного складу, глазурованих цукерок із різними видами корпусів. Установлено, що порошок виноградних кісточок має кращі мікробіологічні показники якості, бактерицидні властивості і позитивно впливає на тривалість зберігання глазурі та глазурованих виробів.

Ключові слова: *порошок виноградних кісточок, какао-порошок, глазур, цукерки, мікробіологічні показники, бактерицидні властивості.*

ИССЛЕДОВАНИЕ МИКРОБИОЛОГИЧЕСКИХ ПОКАЗАТЕЛЕЙ КАЧЕСТВА КОНДИТЕРСКОЙ ГЛАЗУРИ С ИСПОЛЬЗОВАНИЕМ ПОРОШКОВ ВИНОГРАДНЫХ КОСТОЧЕК

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Исследованы микробиологические показатели качества кондитерской глазури с добавлением порошков виноградных косточек, сырья, входящего в её рецептурный состав, глазированных конфет с различными видами корпусов. Установлено, что порошок виноградных косточек имеет лучшие микробиологические показатели качества, бактерицидные свойства и положительно влияет на продолжительность хранения глазури и глазированных изделий.

Ключевые слова: *порошок виноградных косточек, какао-порошок, глазурь, конфеты, микробиологические показатели, бактерицидные свойства.*

RESEACH OF MICROBIOLOGICAL INDICES OF QUALITY OF CONFECTIONERY GLAZE WITH THE ADDITION OF GRAPE SEED POWDERS

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Glazed confectionery is extremely popular with consumers. The traditional technology of confectioner's glaze does not provide for a special use of microorganisms, however, they can get into finished products from the environment and cause their spoilage during storage.

The technology of confectioner's glaze based on lauric and non-lauric fats in which cocoa powder is partially replaced with grape seed powder (GSP) was developed. The additive selected has its microflora and contains substances having phytoncide properties. Microbiological points of cocoa and grape seed powders, the glaze and glazed confectionery with the addition of GSP were under research.

Six samples of natural and Dutch process cocoa powders of various producers of 2016–2017 and four samples of grape seed powders: the powder obtained by grinding grape seeds separated from grape pomace produced in 2015 and 2016 and grape seed cake powder from seeds remaining after obtaining grape oil produced in 2015 and 2016.

As for ready-to-cook products, finished glaze with a different content was under research.

The centers of sweets having a high moisture content and subject to bacteriological damage to a greater extent, namely, a jelly, milk-jelly and a nut brittle center with dry fruit were selected to produce glazed products. Each center was enrobed with all samples of the glaze.

Microbiological research was carried out in accordance with current methods. The aerobic mesophilic and facultative anaerobic count, availability of coliform bacteria, total yeast fungi and mold fungi count were determined. In addition, the quantity of sporegenous bacteria was checked. The study of GSP bactericidal properties was carried out applying a disk-diffusion method.

It is found that microbiological points of a quality of GSP samples under research are much better as compared with cocoa powders. It is proved that GSP bactericidal properties, owing to which microbiological susceptibility improves a lot, and, accordingly, a quality of confectionery glaze and glazed confectionery, are prerequisites for the extension of the term of product storage.

Keywords: *grape seed powder, cocoa powder, glaze, sweets, microbiological points, bactericidal properties.*

Statement of the problem. Among the wide range of confectionery products, glazed confectionery is extremely popular with consumers. The glaze of confectionery products performs several functions: slows down oxidation and staling processes and prevents the ingress of moisture. It is a barrier preventing the penetration of microorganisms inside the products and on sweet centers including. Sweet centers usually have higher moisture than their covering. Moreover, the glaze provides an attractive appearance, perfection of detail and product flavour release, as well as forms its nutritional value.

The traditional technology of confectioner's glaze does not provide for a special use of microorganisms, however, they can get into finished products from the environment and cause their spoilage during storage. Bacterial contamination of products is possible at all process steps. Raw materials, production equipment, packaging material, air of production rooms and enterprise's employees can be their sources. Glazed confectionery is not heat-treated before packing; microorganisms cannot be fully removed from them. Therefore, it is extremely important to observe strictly hygiene and sanitary production conditions and thorough microbiological control of raw materials, semi-finished and finished products, especially when using new types of raw material resources.

During recent years, confectionery technology has actively been using grape pomace derivative products, owing to their high content of biologically active substances as well as availability and a low cost of this raw material [1]. The use of grape seed powder (GSP) is considered future-oriented during confectioner's glaze production. This allows replacing a proportion of cocoa powder, obtaining high quality products with a high content of biologically active substances, such as micro-and macronutrients, food fibers, vitamins, polyphenols and expanding the range of confectionery products for health-improving purpose. Grape pomace used to obtain GSP is a secondary raw material contained in commercial quantities in Ukraine;

therefore, grape seed powder has an obvious advantage over imported cocoa powders according to the pricing policy. Confectioner's glaze with GSP added and glazed confectionery has lower production cost as compared with traditional types of products.

We have developed the technology of confectioner's glaze based on lauric and non-lauric fats in which cocoa powder is partially replaced with grape seed powder. The additive selected has its microflora and contains substances that can influence safety data of finished products; therefore, it is important to study microbiological data of a new glaze and products using this glaze.

Review of the latest reseurch and publication. The study of confectionery safety is paid much attention. For decades, scientists have been conducting research on microbiota of sweeties, its changes during storage depending on the raw material used [2–4]. It was deemed that due to low moisture this group of products was stable and safe in the context of microbiology, however, it was found that depending on the composition of raw materials, additives and processing conditions, sugar confectionery can be disseminated by microorganisms. Their quantity can increase during storage of sugar confectionery [2]. Typical representatives of bacterial microflora of sugar confectionery are sporegenous mesophilic aerobic and facultative anaerobic bacteria of Bacillus and Proteus types, and mold fungi of Aspegillus, Penicillium, Mucor, Rhizopus types etc. Aspegillus flavus is one of the most common enough among them. Aspegillus fumigatus can be often seen. Both of them refer to RG3 and impact confectionery safety [3]. The total viable count in confectionery can be several dozens to 10^6 CFU/g, coliform bacteria are found in quantity 0.001 g to 1 g of the product; yeast fungi and mold fungi are quite common [4]. There are studies focused on research of factors defining food safety, first of all, microbiological safety [5]. It is shown that a microbial growth rate depends on the water activity in products, the availability of nutrient substances and storage conditions (temperature and effect of oxygen). Any changes in the food composition affect its microbiological susceptibility too. Therefore, during the development of new confectionery technologies, which use non-conventional raw materials, greater focus is placed on issues of their microbiological safety. [6–8]. The effect of fructose and lactulose on the intensity of bacterial and fungi growth in sponge cakes [6], candied fruit jelly and souffle has been studied so far [7]. Moreover, it is shown that fructose has a low water activity, and microorganisms, which are typical for confectionery, do not digest lactulose. Therefore, adding new types of sugars leads to a drop in microbiological points of products. Microbiological susceptibility of confectionery also increases the use of extracts of plant raw materials, namely, basil, cinnamon, sage, shells of the

pomegranate etc. It is proved that biologically active substances of these plants, such as Vitamin C and polyphenol compounds, are able to show an antimicrobial effect [8].

Grape seed powder is characterized by a high content of polyphenol substances; therefore, its use can improve microbiological susceptibility of the glaze and glazed confectionery.

The objective of the article. Is to study microbiological points of a quality of cocoa powders, GSP, confectioner's glazes and glazed sweets with different types of centers, to identify bactericidal properties of grape seed powders and their possible impact on microbiological susceptibility of the glaze and finished products.

Prezentation of the research. Samples of confectionary glaze were prepared on Macintyre Turbo Conche-machine in a production environment. The following raw materials were in the glaze composition: confectionery fat, powdered sugar, cocoa powder, GSP and superficially active substances. GSP was added in quantity of 3.0–5.0% of the total product weight instead of cocoa powder. Additive metering was determined empirically, taking into account rheological properties of the glaze. As the additive was taken instead of cocoa powder, microbiological points were not determined in all raw materials, but in GSP and cocoa only to find out which of these raw materials is microbiologically unsafe. Two samples of the batch of natural and Dutch process cocoa powder of different years of production used in the enterprise as well as two samples of cocoa powder got in the retail store network were selected, namely:

natural cocoa powder (Poland, June 2015);
natural cocoa powder (Poland, December 2016);
Dutch process cocoa powder (Spain, May 2016);
natural cocoa powder (Spain, January 2017);
natural cocoa powder of "Rozumnyi vybir" TM (December 2016);
natural cocoa powder produced by "Mriya" TM (December 2016).

Grape seed powders produced in different years were selected for the purpose of studying microbiological points during storage:

grape seed powder obtained by grinding grape seeds separated from grape pomace (GSP No. 1) produced in 2015 and 2016;

grape seed cake powder from seeds remaining after obtaining grape oil (GSP No. 2) produced in 2015 and 2016.

The following ready-to-cook products were under study:

lauric fat-based confectioner's glaze:
without adding GSP, test (sample No. 1),
adding 3.0% of GSP No. 1 (sample No. 2),
adding 3.0% of GSP No. 2 (sample No. 3),
adding 5.0% of GSP No. 1 (sample No. 4),

non-lauric fat-based confectioner's glaze:
without adding GSP, test (sample No. 5),
adding 3.0% of GSP No. 2 (sample No. 6),
adding 3.0% of GSP No. 1 (sample No. 7).

Finished products are sweets with different types of centers. The centers of sweets having high moisture and subject to bacteriological damage to a greater extent, namely, a jelly center for "Vesniana Kapel" sweet, a milk-jelly center for "Desert" sweet and a nut brittle center with dry fruit for "Batonchyk" sweet were selected to produce glazed products. Each center was enrobed with all samples of the glaze.

Microbiological research was carried out in accordance with current methods. The total aerobic mesophilic and facultative anaerobic count (MAFAnM), availability of coliform bacteria (BGKP), total yeast fungi and mold fungi count were determined. In addition, the quantity of sporegenous bacteria (SUB) was checked in samples. Table 1 includes the research results on samples.

Analysis of the provided data showed that the total aerobic mesophilic and facultative anaerobic count in powders is low and it does not exceed the allowable level that is 10^5 conditional units in 1 g for cocoa powder according to DSTU 4391:2005. The quantity of sporegenous bacteria is also low. GSP dissemination is almost two times less than that one of cocoa powders that, probably, indicates low initial microbiological points of grape berries as compared with cocoa beans, better conditions of their handling, processing, packaging and storage.

Table 1

Microbiological Points of a Quality of Cocoa Powders and Grape Seed Powders

Samples of powders	MAFAnM, CFU/g	SUB, CFU/g	BGKP
Natural cocoa 2015	9.4×10^4	1.4×10^2	+
Natural cocoa 2016	$<30.0 \times 10^4$	0.9×10^2	+
Dutch process cocoa 2016	7.0×10^4	0.4×10^2	-
Dutch process cocoa 2017	6.8×10^4	0.3×10^2	-
Cocoa of "Rozumnyi vybir" TM	7.8×10^4	0.4×10^2	+
Cocoa of "Mriya" TM	8.3×10^4	0.4×10^2	+
GSP No.1 2015	4.3×10^4	0.2×10^2	-
GSP No.2 2015	5.4×10^4	0.2×10^2	-
GSP No.1 2016	3.4×10^4	0.1×10^2	-
GSP No.2 2016	2.9×10^4	0.1×10^2	-

Coliform bacteria are found in samples of natural cocoa only; their quantity is within permissible range that is no more than 0.01 in 1 g of the product. The content of yeast fungi and mold fungi in all the powder samples under research does not exceed the level prescribed by the normative document (no more than 10^2 in 1 g). Microbiological points of GSP produced in 2015 and 2016 are not significantly different, i.e. their degradation does not occur during storage of raw materials.

Based on the obtained results it can be assumed that owing to the best microbiological points of the grape seed powder, microbiological safety of the glaze and glazed confectionery will be improved when adding it; and the term of their storage will be extended.

The research results on microbiological points of a quality of confectioner's glaze samples (fig. 1) showed that the addition of GSP leads to reduction of MAFAnM points twice as much. The quantity of sporegenous bacteria in test samples of the glaze (No. 1 and No. 5) is three times as much as in the glaze with GSP but it is within normal range. No yeast and mold fungi and BGKP are detected in any sample.

Three types of sweet centers were covered with research samples of the glaze. It is found that all the sweets have high microbiological points of a quality that are considerably below as compared with the reference points (fig. 2, 3).

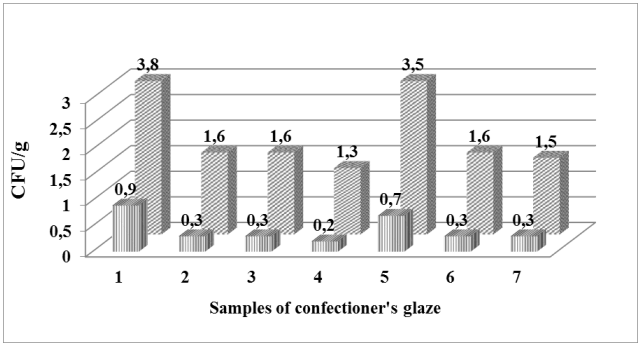

Fig. 1. Microbiological points of a quality of confectioner's glaze: – SUB (CFU/g × 10^{-2}), – MAFAnM (CFU/g × 10^{-4})

Glazed sweets coated with the glaze with added GSP have better indicators as compared with test samples. No yeast and mold fungi and BGKP are detected in any sample of sweets.

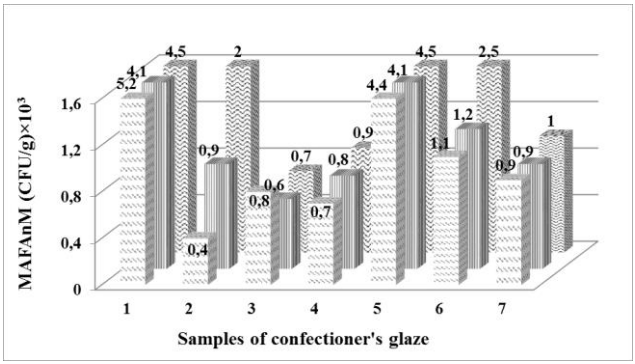

Fig. 2. MAFAnM (CFU/g) points of a quality of sweets:
– "Batonchyk"; – "Desert"; – "Vesniana Kapel"

High microbiological points of the glaze and covered goods subject to the addition of GSP may be caused not only by better microbial limits as compared with cocoa powder, but also by the fact that grape seed powders, probably, owing to their chemical composition, are able to show their bactericidal properties and to inhibit microbial growth in finished products.

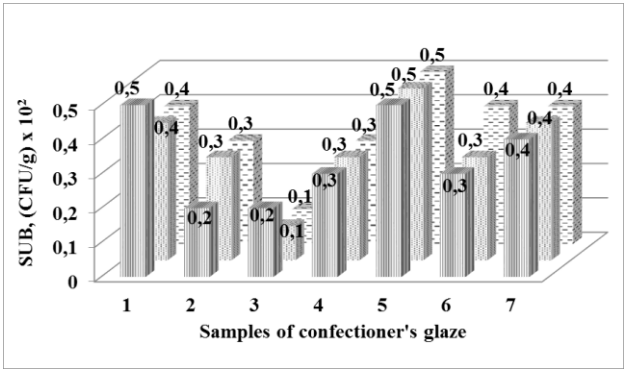

Fig. 3. SUB (CFU/g) points of a quality of sweets:
– "Vesniana Kapel"; – "Desert"; – "Batonchyk"

The study of GSP antimicrobial effect was carried out applying a disk-diffusion method. The principle of this method is based on the ability of antibiotic products to diffuse from steeped paper disks into the nutritional medium inhibiting microbial growth disseminated on the agar surface. Pure

cultures of Escherichia coli and Bacillus subtilis were used as models of microorganisms. The attribute of the antimicrobial activity of substances is zones of bacteria inhibition on the medium around the steeped paper disk. Depending on the antimicrobial activity, zones of bacteria inhibition having a different area are observed [9].

Grape seeds are rich in biologically active polyphenol substances which refer to fat-soluble (tocopherols), water-soluble (thiol-containing compounds and ascorbic acid) groups, and groups soluble in spirit (flavonoids). Depending on the quantity of extracted substances, bactericidal properties of the extract become apparent with varying intensity. Therefore, grape seed powders under research were mixed with distilled water, ethyl spirit (50.0%) and confectionery fat in the ratio of 2:1:1:1 accordingly. Active substances were extracted within 24 hours, disks were steeped, and an experiment was performed according to the current method. Statistical processing of the research results was performed for the probability level of 0.95 (quantity of measurements – 3).

Table 2 includes the research results. They prove that the best antimicrobial activity (in relation to both Gram-positive culture of Bacillus subtilis and Gram-negative culture of Escherichia coli) among

Table 2

Results of Action of Antimicrobial Substances of Grape Seed Powders in Various Solutions

Bacterial species	Model	Value of the zone of bacteria inhibition, mm
Bacillus subtilis	GSP No.1+ water	12.0 ± 0.2
	GSP No.2+ water	7.0 ± 0.3
	GSP No.1+ spirit	10.0± 0.2
	GSP No.2+ spirit	5.0 ± 0.3
	GSP No.1+ fat	0.0
	GSP No.2+ fat	0.0
Escherichia coli	GSP No.1+ water	19.0± 0.1
	GSP No.2+ water	9.0 ± 0.1
	GSP No.1+ spirit	24.0 ± 0.2
	GSP No.2+ spirit	19.0 ± 0.2
	GSP No.1+ fat	17.0 ± 0.3
	GSP No.2+ fat	13.0± 0.2

samples under research was shown by the extract of GSP No.1 and No.2 with spirit and water. That is, most of the biologically active substances with antibacterial properties are water- and spirit-soluble. When mixing

with fat, powders under research show a lower antibacterial activity. This can be explained by the fact that a fat medium rolls in powder particles and prevents displaying phytoncide properties. Confectioner's glaze contains up to 13% moisture that is sufficient to dissolve a certain amount of antibacterial agents and to provide higher microbiolical points of a quality of finished glaze and sweets with the addition of GSP as compared with test samples of products.

Conclusions. Grape seed powders are characterized by the best microbiological points of a quality as compared with cocoa powder. Models prove that GSP has bactericidal properties. Owning to that microbiological susceptibility improves a lot and, accordingly, a quality of confectionery glaze and glazed confectionery with the addition of GSP, which, in turn, gives the opportunity to extend the term of finished product storage. It is planned to investigate in future the influence of grape seed powder on microbiological quality of flour and sugar confectionery products.

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ФРУКТОВІ ТА ЖЕЛЕЙНІ МАРМЕЛАДНІ МАСИ З ГЛЮКОЗОЮ

Ю.В. Камбулова, Д.С. Матяс, Н.О. Оверчук, Т.С. Федій

Актуалізується питання виробництва кондитерської продукції з глюкозою. Розглядається проблема глюкозної кристалізації під час виробництва фруктової та желейної мармеладних мас. Науково обґрунтовано доцільність використання мальтозної патоки для запобігання кристалізації глюкози під час зберігання відформованого мармеладу. Оптимізовано рецептурний склад желейного мармеладу на агарі та фруктового (яблучного) мармеладу з глюкозою.

Ключові слова: *агар, пектин, гелеутворення, кристалізація глюкози, фруктоза, мармеладні маси, желейний мармелад, фруктовий мармелад.*

ФРУКТОВЫЕ И ЖЕЛЕЙНЫЕ МАРМЕЛАДНЫЕ МАССЫ С ГЛЮКОЗОЙ

Ю.В. Камбулова, Д.С. Матяс, Н.О. Оверчук, Т.С. Федий

Актуализируется вопрос производства кондитерской продукции с глюкозой. Рассматривается проблема глюкозной кристаллизации при производстве фруктовой и желейной мармеладных масс. Научно обоснована целесообразность использования мальтозной патоки для предотвращения кристаллизации глюкозы во время хранения отформованного мармелада. Оптимизирован рецептурный состав желейного мармелада на агаре и фруктового (яблочного) мармелада с глюкозой.