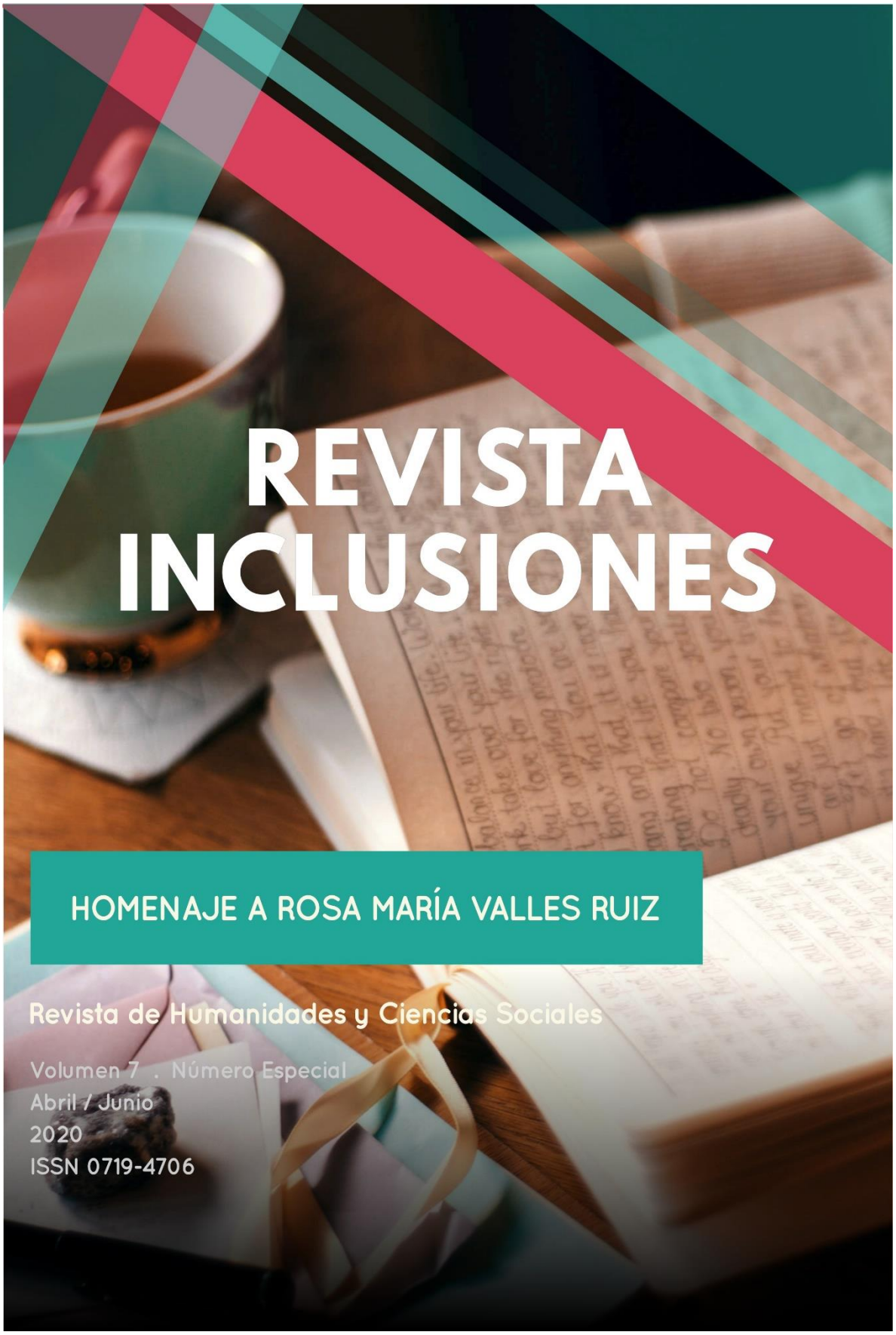

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PRODUCTION OF CONFECTIONERIES: OPPORTUNITIES FOR IMPLEMENTING NEW TECHNOLOGIES

Ph. D. (C) Manana Emelyanovna Tkeshelashvili
Plekhanov Russian University of Economics, Russia
ORCID ID: 0000-0002-5269-7933
Tkeshelashvili.MA@rea.ru
Ph. D. (C) Galina Alexandrovna Bobozhonova
Plekhanov Russian University of Economics, Russia
ORCID ID: 0000-0002-5421-0287
Bobozhonova.GA@rea.ru
Ph. D. Igor Petrovich Gaidukov
LLC OZRKD Biotech-pro, Russia
ORCID ID: 0000-0001-7081-8105
bioproten@mail.ru

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Abstract

The current trends forming a healthy diet dictate the need to create food products, including confectioneries, with high nutritional value. The use of nontraditional types of raw materials in food production can contribute to their enrichment with proteins and micronutrients. The secondary resources of vegetable raw materials are currently actively used in solving food problems, being an additional source of natural substances. A significant amount of secondary resources is generated during the processing of sunflower seeds. The data on the amino acid composition of high-protein flour from sunflower shrot have been presented in the article. The effect of various dosages of high-protein flour from sunflower shrot on the change in consumer and technological properties of chocolate masses has been explored. The expediency of using this additive in the manufacture of confectioneries, in particular chocolate, has been demonstrated.

Keywords

Confectionery – Chocolate mass – Chocolate – High-protein flour from sunflower shrot

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Introduction

According to the concept of proper nutrition, a balanced human diet should include a well-known set of nutrients, where proteins are particularly important. Proteins determine the intellectual and physical development of a person, ensuring harmony and vitality of the body.

There is a deficiency of dietary protein in the world today, and it is likely to persist in the coming decades. About 60 g of protein per day are consumed per inhabitant of the Earth, while the standard is 70 g. Russia belongs to the group of countries where from 2.5 % to 4.0 % of the total population are in a state of chronic protein deficiency, according to the FAO experts[1].

The most promising way to solve the protein problem is to include additional types of protein-containing raw materials and additives with higher content of protein and the most deficient essential amino acids in the food product formulation.

Secondary resources of vegetable raw materials can be a source of natural protein. When processing sunflower seeds, the oil and fat industry mainly extracts the only component from them – vegetable oil, with lots of shrot left, which is mainly used for agricultural purposes. Given that the share of the final high-protein waste – sunflower shrot – accounts for more than 36 % of the processed seed mass, its use as a protein source is a promising idea that allows to solve both the problem of rational utilization of oil and fat industry waste and the problem of protein deficiency and increasing biological values of food products[2].

Various types of protein products made from sunflower shrot are used in the food industry. For example, a recipe for hard-dough biscuits enriched with a modified protein isolate from sunflower meal has been proposed[3]. The use of sunflower baking flour made from sunflower shrot in the manufacture of butter biscuits has been justified[4].

Part of the development is aimed at improving the technology of bakery products enriched with protein isolate of sunflower shrot. As a result, new bakery products of high biological value from wheat flour have been developed[5].

Protein paste made from sunflower shrot with high protein content is recommended in the production of various food products[6].

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[6] T. V. Schekoldina, Sozdaniye proteinovoy pasty iz vtorichnykh produktov pererabotki. (Karsnodar: Modern aspects of the production and processing of agricultural products: Collection of articles on the proceedings of the V International Research-to Practice Conference dedicated to the 15th

Sunflower processing products have been proposed as components of medical parenteral nutrition for patients with liver failure[7].

Problem Statement

Confectioneries make a significant contribution to the diet of various age groups of the population, especially children and youth. These products are in the regular steady demand due to their high palatability, affordability, and ease of consumption. The nutritional value of confectioneries is determined by the significant content of carbohydrates and fats prevailing in comparison with proteins. In this regard, the chemical composition of confectioneries should be adjusted towards increasing biological value by enrichment with high-grade protein.

Based on a literature review, it has been found that promising sources of dietary protein that can be rationally used to increase the biological value of confectionery products are nontraditional sources, including protein-containing ingredients of secondary vegetable resources. High-protein flour Bioproten (grain size less than 160 microns), obtained from sunflower shrot, with protein content of 45 – 48 %, is recommended for use in the meat, bakery, confectionery, and animal feed industries[8] as a promising source of such protein substances. The purpose of the article is to study the effect of high-protein flour from sunflower shrot on the consumer and technological properties of chocolate mass to justify its use in the manufacture of confectionaries, in particular chocolate.

Chocolate remains one of the most popular foods not only among children, but also among adults. However, the spread of diabetes mellitus described by numerous side effects is increasing in the world. With this in mind, many nutritionists advise people with high blood sugar level to exclude chocolate from their diet in order to prevent diabetes mellitus. Specialized foods with a modified carbohydrate profile are offered as a source of carbohydrates in the diet[9]. The modification of the carbohydrate profile of chocolate in this study entailed the exclusion of sucrose from its composition, which was traditionally included in the formulation of chocolate products, and provided for the use of isomalt as a sweetener. Isomalt is a low-calorie carbohydrate derived from sucrose. It has a low glycemic index, does not cause dental cavities, and protects the body from surges in blood sugar levels[10].

Methods

High-protein flour from sunflower shrot (OZRKD Biotech-pro LLC) is a functional product of deep biotechnological processing of sunflower shrot with pleasant taste and smell, neutral color, produced in accordance with TC 10.41.42-001-10152018-2019 "High-

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[7] J. Bautista; R. Corpas y O. Cremades, “Sunflower protein hydrolysates for dietary treatment of patients with liver failure”, J. Am. Oil Chem. Soc Vol: 77 num 2 (2000): 121–126.

[8] I. P. Gaidukov; A. N. Eliseev y R. Kh. Kandrokov, Sposob polucheniya vysokobelkovykh rastitelnykh produktov, preimushchestvenno krupki, iz shrota/zhmykha podsolnechnika i ustroystvo dlya yego osushchestvleniya. Patent RU 2 602 841 S2. 2016.

[9] Kh. Kh. Sharafetdinov; O. A. Plotnikova; A. M. Churicheva; V. V. Pilipenko y R. I. Alekseeva, “Otsenka effektivnosti spetsializirovannogo pishchevogo produkta s modifitsirovannym uglevodnym profilem u bolnykh sakharnym diabetom 2 tipa”, Food Issues Vol: 85 num 6 (2016): 103-109.

[10] H. Mitchell, Podslastiteli i sakharozameniteli (SPb.: Publishing House "Profession", 2010).

protein flour Bioproten from sunflower shrot. Technical conditions". The amino acid composition of high-protein flour from sunflower shrot was determined by capillary electrophoresis on the Kapel 103R analyzer. The organoleptic characteristics of the test samples were evaluated by the profile method using a five-point scale and graphically presented as profilograms. The mass fraction of moisture in the chocolate masses was determined by drying; mass fraction of fat was determined by refractometric method; the degree of grinding was determined using the Reutov method; and plastic viscosity was determined using the Casson method. Chocolate color was measured using the instrumental method based on the analysis of the optical characteristics of the chocolate obtained using a Color i5 spectrocolorimeter (X-Rite Incorporated, USA). The reflection spectra of the samples were measured in the wavelength range of 360 – 750 nm with an interval of 10 nm, with the measurement geometry of d/8, light source of D65 and CIE colorimetric observer position of 10º. The coefficients of the reflection spectra were converted into the color coordinates of the CIEL*a*b* 1976 space: L* – lightness, a* – red (+a*)/green (-a*), b* – yellow (+b*)/blue (– b*).

Results and discussion

The information on the composition of the source ingredients is the rationale for the components for the production of fortified products. Studies have been conducted to establish the nutritional and biological value of high-protein flour from sunflower shrot (Table 1).

Product sample indicators		Content, %
General	Moisture, %	9.90
	Dry matter, %	90.10
Minerals		
Ash		9.44
including	Calcium	0.49
	Phosphorus	1.33
	Magnesium	0.77
	Potassium	1.93
	Sulfur	0.62
Protein	Crude protein	40.55
	Protein available	40.55
Fat		1.31
Carbohydrates		38.80
including		
Nonfiber carbohydrates,		22.92
including		
	Nonstructural carbohydrates	10.09
	Sugar	10.00
	Starch	0.09
	Other	12.83
Structural carbohydrates		15.88

Table 1
Qualitative composition of high-protein food flour according to average values of the samples

The results indicate that the amino acid composition of high-protein flour from sunflower shrot is described by the presence of nine essential amino acids (Figure 1), high content of glutamic and aspartic acids, arginine, as well as glycine, alanine, proline, serine, and tyrosine (Figure 2).

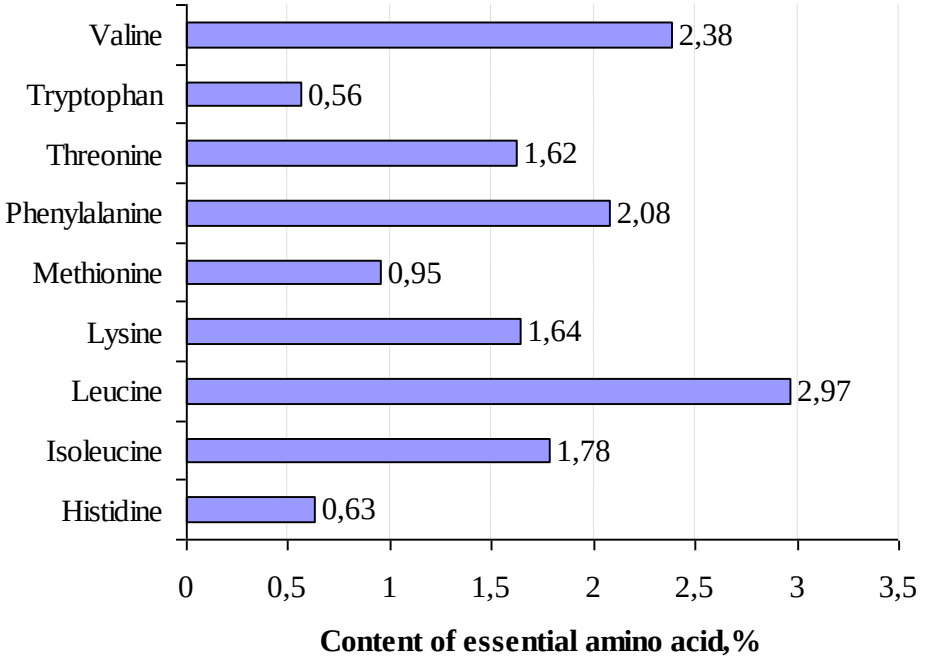

Figure 1
Content of essential amino acids in high-protein flour from sunflower shrot

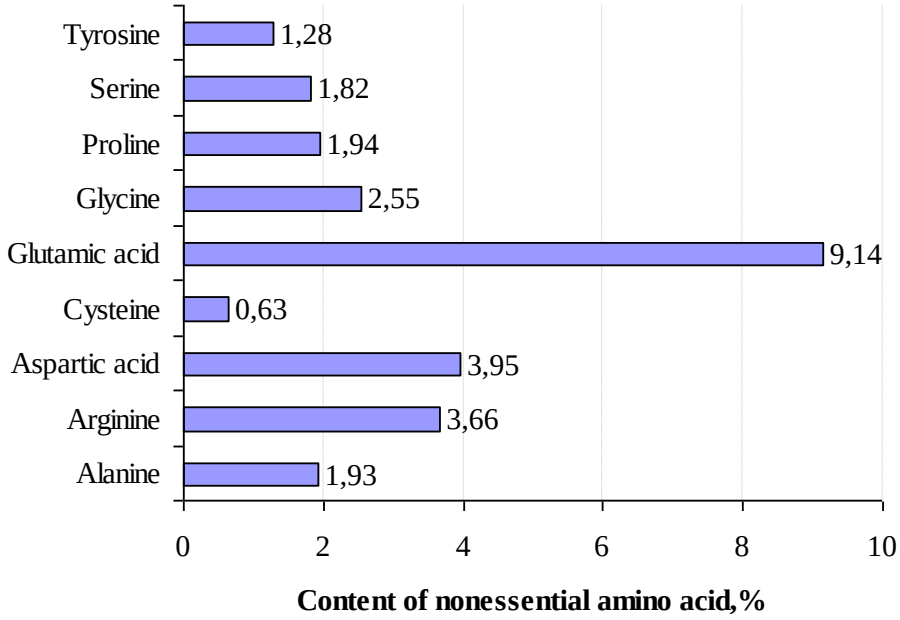

Figure 2
Content of nonessential amino acids in high-protein flour from sunflower shrot

A study was carried out on the possibility of using high-protein flour from sunflower shrot as a source of increasing the nutritional value of chocolate. For this purpose, chocolate masses were prepared using the dark chocolate recipe, where a part of the cocoa powder was replaced with high-protein flour from sunflower shrot in an amount of 5.0 wt%, 10.0 wt%, 15.0 wt%, 20.0 wt%, and 25.0 wt%. To compare the results of the study, another chocolate mass was prepared without the addition of high-protein flour from sunflower shrot (Table 2).

Contents	The number of the sample of the chocolate mass / Amount, wt%					
	control	1	2	3	4	5
Cocoa liquor	10.0	10.0	10.0	10.0	10.0	10.0
Cocoa butter	30.0	30.0	30.0	30.0	30.0	30.0
Cocoa powder	30.0	25.0	20.0	15.0	10.0	5.0
Sunflower flour	0	5.0	10.0	15.0	20.0	25.0
Isomalt	25.0	25.0	25.0	25.0	25.0	25.0
Stevia	0.01	0.01	0.01	0.01	0.01	0.01
Grated almonds	0.45	0.45	0.45	0.45	0.45	0.45
Emulsifier	0.04	0.04	0.04	0.04	0.04	0.04

Table 2
Composition of the chocolate masses with and without the addition of high-protein flour from sunflower shrot

The studies of the quality of the resulting chocolate masses revealed that the mass fraction of moisture did not exceed 2 %, which corresponded to the requirements of norms and specifications (Table 3).

The viscosity of the chocolate mass determines its technological properties, thus, it should have constant optimal value (up to 20 – 25 Pa·s according to Reutov) (Table 3). At this viscosity, the molding process proceeds under the most favorable conditions.

The degree of grinding determines the palatability of the chocolate mass and the chocolate made from it; therefore, chocolate of good quality should have a grinding degree of at least 92 % (Table 3). Lower degree of grinding makes the chocolate taste coarse and reduces its valuable organoleptic qualities.

Amount of additive, wt%	Plastic viscosity, Pa·s	Mass fraction of moisture, %	Mass fraction of fat, %	Degree of grinding according to Reutov, %
0 (control)	6.3	1.32	38.7	98.5
5.0	6.3	1.63	38.4	98.2
10.0	4.5	1.28	38.2	98.2
15.0	3.3	1.18	38	98.7
20.0	3.0	1.34	38.7	98.7
25.0	2.75	1.54	38.1	98.1

Table 3
Results of the study of physicochemical and technological properties of the chocolate masses

A decrease in the plastic viscosity of the chocolate mass is observed in the data presented in Table 3, with an increase in its composition in the proportion of high-protein flour from sunflower shrot with almost constant three other indicators that influence the viscosity of the chocolate mass. These results can subsequently be applied in modeling chocolate masses taking their viscosity properties into account.

The effect of adding high-protein flour from sunflower shrot on the content of basic chemicals and energy density of the chocolate is presented in Table 4.

Amount of additive, wt%	Content in 100 g of chocolate, g			Energy density, kcal
	Proteins	Fats	Carbohydrates	
0 (control)	9.0	40.1	30.2	517.8
5.0	9.8	39.6	31.9	523.3
10.0	10.6	39.1	33.5	528.8
15.0	11.4	38.7	35.1	534.3
20.0	12.2	38.2	36.7	539.9
25.0	13.0	37.8	38.4	545.4

Table 4
Effect of sunflower shrot on the content of basic chemicals and energy density of the chocolate

As can be seen from the above data, the use of high-protein flour from sunflower shrot in the chocolate production led to an increase in the protein content in the product. For example, 9.0 g of the proteins were contained in the control sample produced without the addition of high-protein flour from sunflower shrot. Replacing 15.0 wt% of the cocoa powder with high-protein flour from sunflower shrot resulted in an increase in the content of this component in the chocolate by 26.6 %. This directly relates to the fact that the additive is a high-protein raw material that contributes to the enrichment of the product.

The recommended dosage of high-protein flour from sunflower shrot was established as no more than 15.0 wt% instead of a part of the cocoa powder to obtain chocolate with good organoleptic quality indicators. This dosage of the additive gave the product a pleasant smell and halva taste, while the bright and rich taste of cocoa products characteristic of chocolate was clearly felt (Figure 3).

It was established in the previous studies[11] that the addition of the isomalt-containing additive in the chocolate mass helped increase the resistance of dark chocolate to sugar bloom and enhanced the resistance of this product containing milk fat to fat bloom.

[11] M. E. Tkeshelashvili; G. A. Bobozhonova; N. P. Kosheleva y G. O. Magomedov, “Development of the composition of chocolate mass that resistant to bloom”, Proceedings of VSUET Vol: 79 num 1 (2017): 209-214.

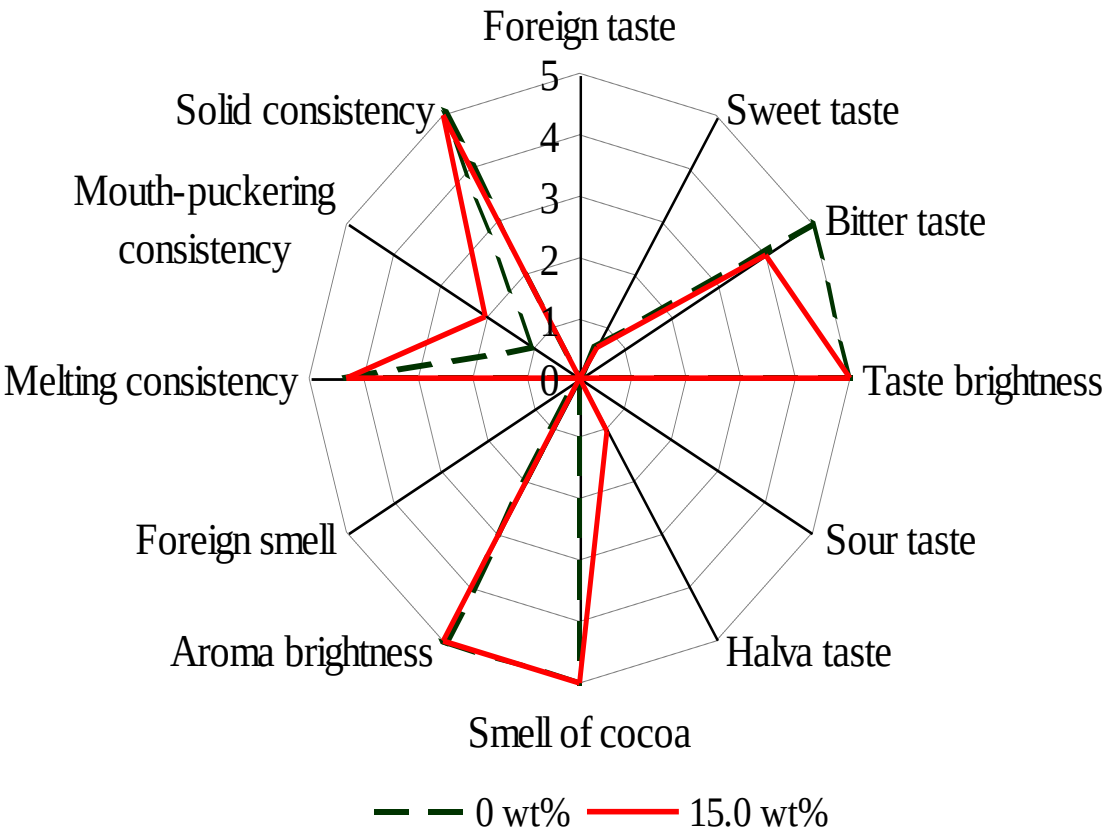

Figure 3
Chocolate organoleptic assessment profilogram

The authors in the patent[12] claim that the addition of solid particles of vegetable origin with the particle size of 0.06 to 1.0 mm into the chocolate mass increases the resistance of chocolate to bloom resulting from temperature fluctuations during storage. In their opinion, this is due to the fact that the crystallization characteristics of the fat components that make up the chocolate composition change in a homogeneous chocolate mass including particles of vegetable inclusions of a specified size, and the processes of melting and recrystallization of cocoa butter during temperature fluctuations occur less intensively both inside the chocolate and on its surface.

Therefore, it is advisable to examine the chocolate containing isomalt and high-protein flour from sunflower shrot for resistance to fat bloom.

[12] T. A. Eldarkhanov y I. B. Eldarkhanova, Shokoladnaya kompozitsiya s ponizhennoy kaloriynostyu i sposob yeye polucheniya. Patent RU 2 462 040 S2. 2012.

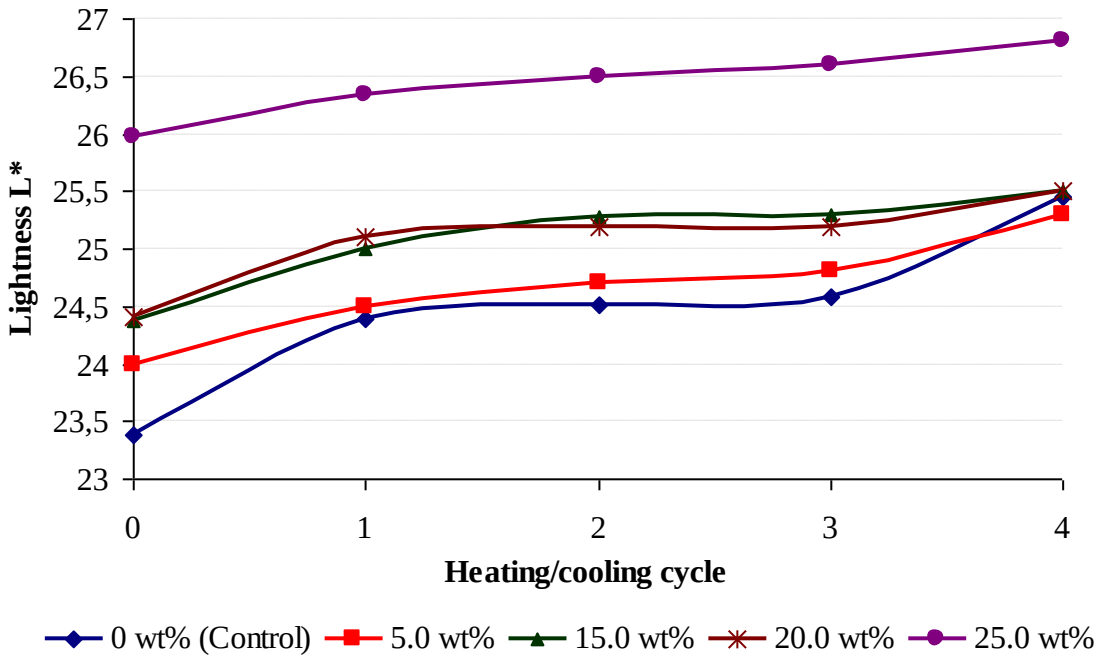

Figure 4
Curves of the dependence of lightness L* on temperature fluctuations during storage of the chocolate containing different amounts of high-protein flour from sunflower shrot

Conclusion

As such, the proposed high-protein flour from sunflower shrot is advisable to use to increase the biological value of confectioneries, in particular chocolate.

The technological properties of the resulting chocolate masses allow create a technology for their mass production, both in the preparation of liquid semi-finished products and in the process of molding finished products.

The composition of the chocolate mass has been presented, which does not worsen the taste characteristics of the finished chocolate product. A new technical result has been achieved – the resistance of chocolate to fat bloom, which improves its consumer properties.

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