COMMODITY BULLETIN
Journal homepage: https://c-bulletin.com.ua/en
DOI: 10.62763/ef/1.2024.55

Article's History: Received: 01.11.2023 Revised: 02.02.2024 Accepted: 26.04.2024

Vol. 17, No. 1, 2024, 55-64

UDC 641.561[664.149:635.62]

Technology development and study of properties of craft marshmallows with raspberry puree

Svitlana Panasyuk*

PhD in Technical Sciences, Associate Professor
Lutsk National Technical University
43018, 75 Lvivska Str., Lutsk, Ukraine
https://orcid.org/0000-0001-9734-3998

Vasylyna Shemet

PhD in Chemical Sciences, Associate Professor
Lutsk National Technical University
43018, 75 Lvivska Str., Lutsk, Ukraine
https://orcid.org/0000-0001-8952-5097

Abstract. The development of recipes with natural raw materials enriched with bioactive substances is an urgent task for providing the population with a complete and balanced diet. The aim of the study is to develop recipes of craft marshmallows for therapeutic, prophylactic and health-improving purposes. The research was conducted by means of the expert method, sensory analysis, and statistical methods of processing experimental data. Standard and generally accepted methods were used to determine physical and chemical parameters. To achieve this goal, it is proposed to replace part of the apple puree in the recipe with raspberry because of the raspberries' antibacterial and immunomodulatory properties. Models of marshmallow composition with different proportions of apple and raspberry puree, protein, sugar, glucose syrup and agar-agar were developed. The sensory analysis was carried out and the organoleptic characteristics of model marshmallow compositions (taste, odour, colour, consistency, structure, and surface condition) were determined. A sensory profilogram for model marshmallow compositions was created and the model composition with the best organoleptic characteristics was determined on the basis of the expert evaluation results. The content of pectin substances and L-ascorbic acid in the studied samples was determined. The physical and chemical parameters for the model marshmallow compositions were determined. It was found that due to the increase of raspberry puree content in the marshmallow recipe the moisture content of the marshmallow will increase from 21.3% ± 0.3% in MC1 with 30% raspberry puree content to 22.1% ± 0.3% in MC3 with 40% raspberry puree content. The density, active and titratable acidity of the marshmallow will decrease with the increase of raspberry puree amount in it. The expediency of using vitamin and pectin-containing raw materials (such as raspberry puree) for therapeutic, prophylactic and health-improving purposes in the marshmallow production technology has been experimentally proved. The marshmallow recipes with different proportions of apple and raspberry puree, possessing therapeutic, preventive and health-improving purposes and expanding the range of sugary confectionery products have been developed. The proposed marshmallows contain natural ingredients and are characterised by high organoleptic characteristics. Marshmallows on the developed recipes can be produced on confectionery production line of various capacities and in restaurant establishments

Keywords: pectin; L-ascorbic acid; moisture content; recipe; organoleptic evaluation; nutritional value

Suggested Citation:
Panasyuk, S., & Shemet, V. (2024). Technology development and study of properties of craft marshmallows with raspberry puree. *Commodity Bulletin*, 17(1), 55-64. doi: 10.62763/ef/1.2024.55.

*Corresponding author

Introduction

The development of functional food is an important phenomenon in the global food market. The task of developing marshmallow recipes with a high content of vitamins, dietary fiber and high organoleptic properties, remains relevant. This is due to the growing interest of consumers to maintain and improve their health through a healthy diet. In many countries much attention is paid to the development of functional food, which uses bioactive substances in traditional products and helps to improve human health (Liufu & Martirosyan, 2020).

Among the large number of confectionery products available on the Ukrainian market, sugary products, including marshmallows, are popular treats. Many manufacturers offer a wide range of marshmallows with different flavours, fillings, and glazes. I.M. Polishchuk (2020) noted that due to the use of natural raw materials in the marshmallow recipe, marshmallows can be classified as a healthy confectionery product. Fruit and berries, in particular raspberries, contain a large amount of bioactive substances, including organic and fatty acids, sugars and polysaccharides.

Many scientists and manufacturers have been trying to address the problem of development of a marshmallow recipe enriched with functional ingredients as well as to study its properties. Y. Pronina *et al.* (2024) suggest adding cranberries, Hypericum, blueberries, and sea buckthorn leaves to the marshmallow to contribute to its functional purpose and increase its nutritional value. The authors M. Artamonova *et al.* (2023) recommend to use of vegetable raw materials (coconut sugar, blueberry powder) for production of functional marshmallows enriched with dietary fiber, protein, and vitamins. The paper by A. Zahorulko *et al.* (2020) is devoted to the development of marshmallow technology with addition of fruit and vegetable paste of apple, pumpkin and beetroot; study of structural and mechanical properties and organoleptic analysis of marshmallows made according to this recipe. It is also proposed to replace part of the apple puree with a fruit and vegetable paste made from apple, beet, pumpkin, cranberries and hawthorn, using the methods described by M. Bondar *et al.* (2021) and V. Mykhailov *et al.* (2021). To produce marshmallows and pastilles recommended for people with diabetes, obesity, and other endocrine diseases, it is suggested to use stevia and sorbitol instead of sugar, and to improve the structure of marshmallows, such authors as I. Tsykhanovska *et al.* (2019) propose to include the food additive "Magnefood" to the marshmallow composition. G.V. Korkach *et al.* (2020) state that if a synbiotic complex of lactulose and microencapsulated bifidobacteria are added to the marshmallow recipe, it will acquire medicinal properties. To obtain a stable foamy structure of marshmallows with a synbiotic, it is recommended to add dry egg white. The nutritional value of marshmallows can be increased by adding pumpkin puree. O.P. Priss & V.F. Zhukova (2020) propose to add a natural gelling ingredient – pectin to ensure high technological parameters of such marshmallows. Pectins also provide pastilles with therapeutic and prophylactic properties. They are the basis for numerous medicines and dietary supplements. By their chemical nature, pectins are high-molecular compounds that belong to the group of heteropolysaccharides. Polygalacturonic acid derivatives provide a basis for these compounds. The molecular chain of pectin substances consists of D-galacturonic acid residues, which has a pyranose configuration and is connected by a 1.4-L-glycosidic bond. Pectin substances include insoluble protopectin, soluble pectin polysaccharides and their associated galactans, arabinans, and arabinogalactans (Teterev *et al.*, 2020). B. Yudhistira *et al.* (2018) proposed to add spinach and tomato puree to the marshmallow recipe to create a product for iron deficiency anemia prevention. Thus, the use of berry and vegetable purees in the marshmallow recipe for increasing its nutritional value is promising.

The purpose of the study was to create recipes for craft marshmallows with raspberry puree designed to improve health and prevent diseases as well as to determine organoleptic, physical and chemical characteristics of this product.

Materials and methods

The research was conducted in 2023 at Lutsk National Technical University for model samples of craft marshmallows made according to the recipe indicated in Table 1. Model compositions (MC) of craft marshmallows were created with different proportions of apple and raspberry puree. Part of the apple puree was replaced with raspberry to give the marshmallows therapeutic, prophylactic and health-improving properties. Raspberries have a pleasant taste and smell and are characterised by antibacterial and immunomodulatory properties (Polishchuk, 2020; Ponder & Hallmann, 2020). The marshmallow recipe uses agar-agar as a gelling agent, which is a natural product of plant origin with no odour or off-flavours. In addition, agar-agar contains a large amount of iodine and iron, and is characterised by antibacterial properties that contribute to the long-term storage of finished products. The study was conducted by means of physical, chemical and organoleptic methods in accordance with regulatory documents DSTU 6441-2003 Confectionery pastille products (2003), DSTU 4683:2006 Confectionery products. Methods for determination of organoleptic quality indicators, dimensions, net weight and components (2006). The organoleptic characteristics of marshmallows with raspberry puree were determined by sensory testing methods (Lawless & Heymann, 2010). Research samples made according to the recipe specified in Table 1 are shown in Figure 1. Evaluation was carried out at the 5-point scale (Table 2).

Table 1. *Model compositions of craft marshmallows with raspberry puree*

Raw materials	Mass fraction of solids, %	Raw material consumption per 1 t of marshmallow			
		MC1	MC2	MC3	MC4
For syrup					
Granulated sugar	99.85	260.0	260.0	260.0	260.0
Glucose syrup	72.0	140.0	140.0	140.0	140.0
Agar	85.0	15.7	15.7	15.7	15.7
Water	–	162.2	163.4	165	159.4
For marshmallow mass					
Granulated sugar	99.85	360.0	360.0	360.0	360.0
Apple puree	14.0	265.6	246.5	228.0	380.0
Raspberry puree	10.0	114.4	133.5	152.0	–
Egg white	12.0	70.0	70.0	70.0	70.0
Total		1387.9	1389.1	1390.7	1385.1
Output		1000	1000	1000	1000

Source: *developed by the authors*

a *b* *c* *d*

Figure 1. *Model compositions of marshmallows with raspberry puree*

Note: *a – MC1, b – MC2; c – MC3, d – MC4*

Source: *developed by the authors*

Table 2. *Marshmallow grading scale*

Parameter	Number of points				
	1 point	2 points	3 points	4 points	5 points
Taste and smell	The taste is too sour, with an aftertaste not typical of raspberries. Unpleasant, pungent odour	The taste is sour, with an aftertaste not typical of raspberries. Unpleasant odour	The taste is sour, with an indistinct aftertaste. The smell is inexpressive	The taste is sweet, with sourness, with a raspberry flavour. The smell is pleasant, with light berry and fruit aroma	The taste is sweet, with slight sourness and pleasant raspberry flavour. The smell is pleasant, with berry and fruit aroma
Colour	Very uneven, dirty pink, not peculiar to the natural colour of raspberries	Uneven, dirty pink, not peculiar to the natural colour of raspberries	Slightly uneven, from dirty pink to pink	Slightly uneven, from deep pink to light pink	Even, from deep pink to light pink
Consistency	Solid, inhomogeneous, with a significant amount of raspberry seeds, does not break	Semi-solid, inhomogeneous, with a significant amount of raspberry seeds, does not break easily	Semi-solid, slightly inhomogeneous, contains raspberry seeds, does not break easily	Soft, slightly inhomogeneous, contains raspberry seeds, breaks quite easily	Soft, homogenous, small amounts of raspberry seeds occur, breaks easily
Structure	Porous, with uneven pores, inelastic, unstable	Porous, with uneven pores, insufficiently elastic, unstable	Fine-porous, with uneven pores, elastic, insufficiently stable	Fine-porous, with even pores, elastic, stable	Fine-porous, with even pores, elastic, very stable
Surface	Uneven, deformed, roughly hardened, covered with drops of syrup and sugar crystals	Uneven, with partial rough hardening, drops of syrup are released, sugar crystals are present	Slightly uneven, with partial rough hardening, syrup may be released	Peculiar to marshmallows, with slight hardening on the side edges, without syrup release	Even, peculiar to marshmallows, without hardening and syrup release

Source: *developed by the authors*

A group of 7 experts was involved in the in-person expert evaluation. They quantified the marshmallow quality indicators by a set of its properties. The moisture content of the marshmallow model compositions was determined according to the method described in How to determine moisture content in food (2024). The methods described by V.V. Yevlash *et al.* (2017) were used to determine the content of pectin substances

and L-ascorbic acid. The active and titratable acidity of marshmallows was determined according to the generally accepted methods described by C. Mutlu *et al.* (2018). The study was conducted under the ethical standards (The Declaration of Helsinki, 2013).

Results and discussion

The results of the expert evaluation of marshmallow model compositions with raspberry puree are presented in Table 3. According to the experts, all marshmallow model compositions are form-stable, have good elasticity and uniform fine-porous structure. The colour of marshmallows changes with the increase of raspberry puree in its content. All model compositions are characterised by a pleasant taste with a slight sourness, which becomes more noticeable in the model composition with 40% raspberry puree. In the control sample (MC4), a pleasant taste of apple puree is perceptible. The taste of raspberry puree prevails in model compositions MC1, MC2 and MC3. This taste becomes richer with an increase of raspberry puree in the content, whereas the taste of applesauce is not felt. The surface of marshmallows in all model compositions has a clear pattern, corresponds to the shape of the nozzle, without signs of rough hardening and syrup release after proofing. According to experts, the model composition MC2, which contains 35% raspberry puree, got the highest number of points. The sensory profilogram of the marshmallow model compositions with raspberry puree is shown in Figure 2.

Table 3. *Organoleptic characteristics of marshmallows with raspberry puree*

Parameter	Characteristics of parameter			
	MC1	MC2	MC3	MC4
Taste and smell	Sweet taste, with slight sourness typical for raspberries. Pleasant smell, with a light raspberry aroma	Sweet taste, with greater raspberry flavour. Pleasant smell, with a raspberry aroma	Sweet taste, with sourness and a tangible good raspberry flavour. Pleasant smell, with a distinct raspberry aroma	Sweet taste, with a slight flavour of apple puree. Pleasant smell, with a light fruit aroma
Colour	Light pink	Pink	Bright pink	Creamy white with a greenish tint
Consistency	Soft, with a small amount of raspberry seeds; breaks easily	Soft, with a small amount of raspberry seeds; breaks easily	Soft, with presence of raspberry seeds; breaks easily	Soft, homogeneous; breaks easily
Structure	Fine-porous, elastic, uniform	Fine-porous, elastic, uniform	Fine-porous, elastic, uniform	Fine-porous, elastic, uniform
Surface	Peculiar to marshmallows, without rough hardening and syrup release	Peculiar to marshmallows, without rough hardening and syrup release	Peculiar to marshmallows, without rough hardening and syrup release	Peculiar to marshmallows, without rough hardening and syrup release

Source: *developed by the authors*

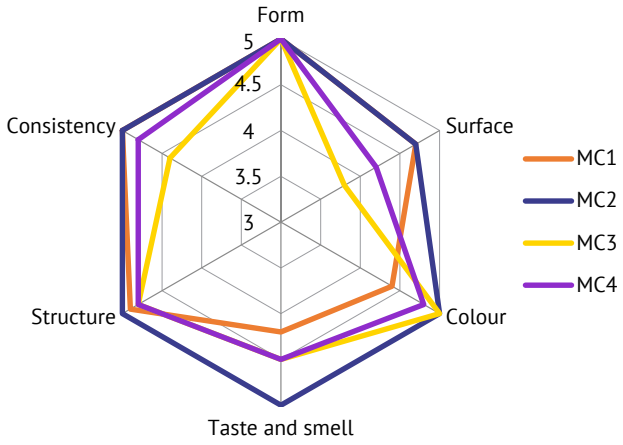

Figure 2. *Sensory profilogram of marshmallow model compositions*

Source: *developed by the authors*

A positive characteristic of marshmallow products is that its calorie content is lower than that of other confectionery products and its high pectin content is achieved due to use of fruit raw materials. The pectin content of marshmallows is one of the most important quality parameters of this confectionery product. The

structure of marshmallows depends on the pectin content, which also preserves the flavour and natural colour of the finished product. Pectin substances are essential and irreplaceable components in making food products for therapeutic, prophylactic and health-improving purposes. They have the ability to eliminate radionuclides, pesticides, heavy metals and other xenobiotics, which can cause serious diseases, from the human body.

Vitamin C (ascorbic acid) is a water-soluble vitamin that promotes cell metabolism, wound healing. It strengthens blood vessels, and increases the body's resistance to infectious diseases. It is a reducing agent (antioxidant) and a coenzyme of certain metabolic processes. Only one isomer of ascorbic acid, L-ascorbic acid, which is called vitamin C, has biological activity. Vitamin C is not synthesised or accumulated in the human body; it is supplied only from the outside, mainly from plant-based foods or herbal remedies (Shulga *et al.*, 2018). The quantification of vitamin C (L-ascorbic acid) in food is based on its chemical properties as a strong reducing agent.

The content of pectin substances and L-ascorbic acid in craft marshmallows was determined; Table 4 shows the content of pectin substances and ascorbic acid in apples, raspberries, and craft marshmallows which contain 35% raspberry puree.

Table 4. *Content of pectin substances and vitamin C in 100 g of product*

Apple	Pectin content, %	9.0 - 1.9
	Vitamin C content, mg	10.0 - 26.7
Raspberry	Pectin content, %	7.9 - 3.3
	Vitamin C content, mg	33.7 - 40.5
Marshmallows	Pectin content, %	1.04 ± 0.01
	Vitamin C content, mg	18.6 ± 0.02

Source: *developed by the authors based on E. Lemmens et al. (2020); A. Bashta et al. (2021); G. Simakhina et al. (2021)*

The results show that the total content of pectin substances in the obtained craft marshmallows is 1.04%. In addition, soluble pectin, which is characterised by high biological activity, only accounts for 31% of this content. The loss of vitamin C in finished products in ratio to its content in fruit and berry raw materials is 38.4%. Such a significant percentage of losses can be explained by destruction of vitamin C during heat treatment and the oxidation of vitamin C under the influence of air oxygen and oxidising enzymes in the process of whipping marshmallows. As a result, part of vitamin C is converted to dehydroascorbic acid.

The study of the physical and chemical parameters of the developed marshmallow model compositions was carried out. The results are presented in Table 5.

Table 5. *Physical and chemical properties of marshmallows*

Parameter	**Indicator value**			
	MC1	**MC2**	**MC3**	**MC4**
Moisture content, %	21.3 ± 0.3	21.8 ± 0.3	22.1 ± 0.3	20.08 ± 0.3
Active acidity	4.3 ± 0.03	3.7 ± 0.03	3.6 ± 0.03	4.6 ± 0.03
Titratable acidity, degree	6.6 ± 0.1	5.9 ± 0.1	5.6 ± 0.1	6.8 ± 0.1
Density, kg/m^3	721 ± 2	716 ± 2	698 ± 2	745 ± 2

Source: *developed by the authors*

The study found that with an increase in the content of raspberry puree in the marshmallow recipe, its moisture content increases: MC1, containing 30% raspberry puree, has a moisture content of 21.3% ± 0.3%. MC3, containing 40% raspberry puree, has a moisture content of 22.1% ± 0.3%. The moisture content of the control sample (MC4), which contains only apple puree, is 20.08% ±0.3%. The active and titratable acidity of the marshmallow model composition which contains 40% of raspberry puree in the recipe will have lower values (3.6 ± 0.03 and 5.6 ± 0.1, respectively) compared to the active and titratable acidity of the control sample MC4 (4.6 ± 0.03 and 6.8 ± 0.1, respectively). The density of the model marshmallow compositions will also vary: for MC3 containing 40% raspberry puree, the density is 698 ± 2 kg/m^3. For the control sample MC4, which contains only apple puree, it is 745 ± 2 kg/m^3 (Table 4).

The flow chart of production of craft marshmallows with raspberry puree is shown in Figure 3.

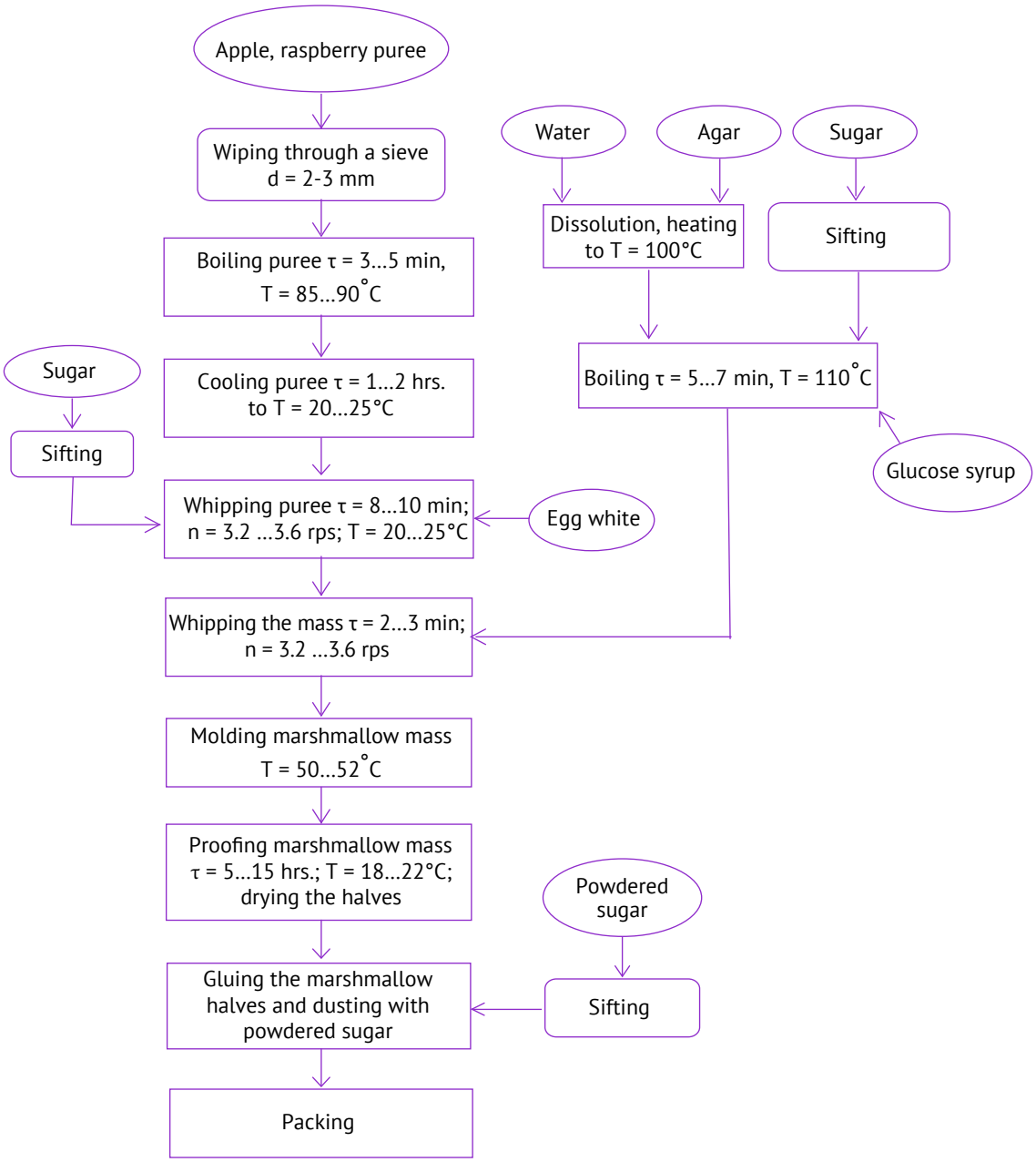

Figure 3. *Flow chart of production of craft marshmallows with raspberry puree*
Source: *developed by the authors*

The main technological operations in the production of craft marshmallows with raspberry puree are: preparation of sugar-agar syrup, boiling raspberry puree, whipping with egg white, whipping the marshmallow mass to create a fine-pore elastic structure, and proofing the formed marshmallow mass for structure formation. These stages of marshmallow production determine its quality indicators.

The study of craft marshmallows with raspberry puree results in defining its organoleptic, physical and chemical properties as well as pectin and vitamin C content. The analysis of the other authors' works devoted to the study of the properties of pastille products and, in particular, marshmallows, allowed to find out that a 5-point scale is used for the organoleptic evaluation of finished products. When comparing the model compositions of the marshmallows, the expert evaluation found that in terms of organoleptic characteristics the best one is the craft marshmallow, in which 35% of apple puree was replaced with raspberry.

The results of the study prove that the use of fruit and berry purees in the marshmallow recipe increases its nutritional value and gives it a functional purpose. In particular, scientists have noted that it is possible to obtain pastille products with original quality properties if to replace 75% of apple puree with a paste

of apple, pumpkin, beet, cranberry, and hawthorn (Bondar *et al.*, 2021). The colour characteristics, structural and mechanical as well as physicochemical properties of marshmallow masses with different concentrations of vegetable and berry paste are determined in the work. If to compare physical and chemical properties of marshmallows with raspberry puree and marshmallows with vegetable and berry paste, it is obvious that their moisture values do not differ significantly, but the density of marshmallows with raspberry puree is higher. The values of total acidity for marshmallows with vegetable and berry paste are higher than for marshmallows with raspberry puree, which can be explained by the high content of organic acids in raspberry puree.

The organoleptic, physical and chemical, structural and mechanical properties of marshmallows using blended fruit and vegetable paste from apple, pumpkin, and beetroot were studied (Zahorulko *et al.*, 2020). The content of pectin substances, ascorbic acid, and carotene in marshmallows was determined. Conducted comparison of the indicators for marshmallows with raspberry puree and marshmallows with blended fruit and vegetable paste proved that the content of pectin substances in marshmallows with raspberry puree is much lower, since raspberries contain much less pectin substances than pumpkins and beets.

O.P. Priss & V.F. Zhukova (2020) propose to introduce pumpkin puree and add pectin into the marshmallow recipe. The moisture content, density, and acidity of marshmallows with pumpkin puree were determined. When comparing the obtained values of the same indicators for marshmallows with raspberry puree, it was determined that moisture content and acidity are quite close in their values. The content of vitamin C in marshmallows with raspberry puree is significantly higher than in marshmallows with pumpkin puree.

The introduction of the food additive "Magnefood" into the recipe of marshmallows with apple puree and agar increases its moisture content and reduces its density and total acidity (Tsykhanovska *et al.*, 2019). The density of marshmallows with the food additive "Magnefood" is affected by the temperature and duration of whipping of the marshmallow mass. The comparison of the physical and chemical parameters of marshmallows with the food additive "Magnefood" and marshmallows with raspberry puree, proves that marshmallows with the food additive "Magnefood" have lower moisture content, and their density does not differ significantly from the density of marshmallows with raspberry puree, but with a decrease in the content of raspberry puree, the density difference increases.

Plant raw materials in the form of dry powders, in particular blueberry powder, are also used for increasing the nutritional value of marshmallows. For this purpose it is also possible to replace granulated sugar with coconut sugar (Artamonova *et al.*, 2023). The value of the moisture content of marshmallows with raspberry puree obtained in the study does not differ significantly from the value of the moisture content of marshmallows with blueberry powder and corresponds to the standard values. The content of pectin substances in marshmallows with raspberry puree is higher than in marshmallows with blueberry powder.

The physical and chemical as well as organoleptic characteristics of iron-enriched marshmallows with spinach and tomatoes were determined and their chemical composition was investigated (Yudhistira *et al.*, 2018). Spinach and tomato marshmallows also contain dietary fiber, which increases their nutritional value. The moisture content of marshmallows with spinach and tomatoes is lower than that of marshmallows with raspberry puree. The vitamin C content in marshmallows with raspberry puree is higher, but may decrease with increasing whipping temperature.

To make marshmallows medicinal, it was proposed to introduce synbiotic complexes into the recipe of pastilles (Korkach *et al.*, 2020). Egg white, which determines the structural and mechanical properties of the marshmallow mass and affects the quality of the finished marshmallow, was added as a foaming agent. The effect of temperature and intensity of whipping of the marshmallow mass on its density was studied and the optimal temperature for making marshmallows with a synbiotic complex was established. The obtained values of the density of marshmallows with the synbiotic complex are significantly lower compared to the density of marshmallows with raspberry puree.

There is a group of sugary products recommended for consumption by people with diabetes. In the recipe of such products, granulated sugar is replaced with natural or artificial sweeteners. The technology for the production of marshmallows with stevia and elamine as a source of iodine has been proposed (Radchenko *et al.*, 2016). The organoleptic evaluation of marshmallows was carried out on a 5-point scale. The developed evaluation scale reflects all the criteria that serve as comparative characteristics for marshmallow model compositions.

Sugary products can be enriched with biologically active ingredients by adding fruit, vegetable and berry purees to their composition. In particular, such authors as G.V. Khomych *et al.* (2022) proposed to introduce henomeles puree, which contains organic acids, phenolic substances, carotene, and pectin, into the recipe and reduce the agar content in marshmallows. The results of studies of the effect of henomeles puree on the foaming ability and the formation of structural and mechanical properties of marshmallows are presented. The content of L-ascorbic acid in marshmallows and pastille products with henomeles puree increases by 2-3 times compared to the model composition with apple puree, while in marshmallows with raspberry puree the content of L-ascorbic acid will increase by 1.5…1.8 times.

Conclusion

The research resulted in the development of a flow chart for the production of craft marshmallows with natural raw materials: apple and raspberry puree. The obtained marshmallows are enriched with vitamins and bioactive substances that a person needs for a complete and healthy diet. The recipe does not contain preservatives and artificial colours, and due to the antibacterial and immunomodulatory properties of raspberries, the finished product will have a therapeutic, prophylactic and health-improving purpose. The marshmallow recipe uses agar-agar as a gelling agent. Agar-agar is a natural product of plant origin with no odour or off-flavours and contains a large amount of iodine and iron. It also has antibacterial properties, due to which the finished product can be stored for a long time.

According to the results of expert evaluation of marshmallow model compositions, the best organoleptic characteristics are obtained for craft marshmallows, the recipe of which contains 35% raspberry puree and 65% apple puree. In this recipe the determined content of pectin substances is 1.04 ± 0.01% per 100 g of product, and L-ascorbic acid is 18.6 ± 0.01 mg per 100 g of product.

When determining the physical and chemical parameters of craft marshmallows, it was found that moisture content of the marshmallow increases with the increase of the puree content in it, while the values of density, active and titratable acidity decrease. The increase in moisture content ranges from 21.3 ± 0.3% in MC1 with 30% raspberry puree to 22.1 ± 0.3% in MC3 with 40% raspberry puree. The density decreases from 721 ± 2 kg/m^3 in MC1 with 30% raspberry puree to 698 ± 2 kg/m^3 in MC3 with 40% raspberry puree. The active acidity decreases from 4.3 ± 0.03% in MC1 with 30% raspberry puree to 3.6 ± 0.03% in MC3 with 40% raspberry puree, and the titratable acidity decreases from 6.6 ± 0.1% in MC1 with 30% raspberry puree to 5.6 ± 0.1% in MC3 with 40% raspberry puree.

Research on the use of cranberry, sea buckthorn, blackberry, and strawberry puree in the recipe of craft marshmallows for a functional purpose is promising.

Conflict of interest

None.

Acknowledgements

None.

References

[1] Artamonova, M., Piliugina, I., & Aksonova, O. (2023). Improvement of the technology of marshmallow with addition of plant raw materials. *Acta Innovations*, 48, 38-48. doi: 10.32933/ActaInnovations.48.3.

[2] Bashta, A., Ivchuk, N., Stetsenko, N., & Bashta, O. (2021). Rationale of fruit and berry raw materials choice to increase the confectionery nutritional value. *Ukrainian Journal of Food Science*, 9(1), 103-114. doi: 10.24263/2310-1008-2021-9-1-10.

[3] Bondar, M., Solomon, A., Fedak, N., Paska, M., Hotvianska, A., Polozhyshnikova, L., Mironov, D., & Kushch, L. (2021). Improving marshmallow production technology by adding the fruit and vegetable paste obtained by low-temperature concentration. *Eastern-European Journal of Enterprise Technologies*, 5(11(113)), 43-50. doi: 10.15587/1729-4061.2021.241969.

[4] DSTU 4683:2006. (2006). *Confectionery products. Methods for determination of organoleptic quality indicators, dimensions, net weight and components*. Retrieved from https://online.budstandart.com/ua/catalog/doc-page?id_doc=92395.

[5] DSTU 6441-2003. (2003). *Confectionery pastille products*. Retrieved from https://online.budstandart.com/ua/catalog/doc-page?id_doc=92692.

[6] How to determine moisture content in food. (2024). Retrieved from https://cwsimons.com/how-to-measure-moisture-content-of-food/.

[7] Khomych, G.V., Horobez, O.M., Honcharenko, V.F., & Podoynyk, Y.V. (2022). Improving the technology of the sugar products group. *Scientific Bulletin of Poltava University of Economics and Trade*, 1, 63-68. doi: 10.37734/2518-7171-2022-1-10.

[8] Korkach, G.V., Kotuzaki, O.M., Tolstykh, V.Y., & Shunko, G.S. (2020). Study of the foaming process of marshmallow mass with a synbiotic. *Scientific Bulletin of the LNUIPM named after S.Z. Grzycki. Series: Food Technologies*, 22(94), 80-86.

[9] Lawless, H.T., & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices* (2nd ed.). New York: Springer.

[10] Lemmens, E., Alós, E., Rymenants, M., De Storme, N., & Keulemans, W.J. (2020). Dynamics of ascorbic acid content in apple (*Malus x domestica*) during fruit development and storage. *Plant Physiology and Biochemistry*, 151, 47-59. doi: 10.1016/j.plaphy.2020.03.006.

[11] Liufu, J., & Martirosyan, D. (2020). FFC's advancement of the establishment of functional food science. *Functional Food in Health and Disease*, 10(8), 344-356. doi: 10.31989/ffhd.v10i8.729.

[12] Mutlu, C., Tontul, S.A., & Erbaş, M. (2018). Production of a minimally processed jelly candy for children using honey instead of sugar. *LWT*, 93, 499-505. doi: 10.1016/j.lwt.2018.03.064.

[13] Mykhailov, V., Zahorulko, A., Zagorulko, A., Liashenko, B., & Dudnyk, S. (2021). Method for producing fruit paste using innovative equipment. *Acta Innovations*, 39, 15-21. doi: 10.32933/actainnovations.39.2.
[14] Polishchuk, I.M. (2020). *Phytochemical study of common raspberry and development of new medicines based on it*. (Doctoral dissertation, National University of Pharmacy, Kharkiv, Ukraine).
[15] Ponder, A., & Hallmann, E. (2020). The nutritional value and vitamin C content of different raspberry cultivars from organic and conventional production. *Journal of Food Composition and Analysis*, 87, article number 103429. doi: 10.1016/j.jfca.2020.103429.
[16] Priss, O.P., & Zhukova, V.F. (2020). Development of technology and quality assessment of high nutritional value marshmallows. *Scientific Bulletin of the Tavria State Agrotechnological University named after Dmytro Motornyi*, 20(2), 220-230.
[17] Pronina, Y., Belozertseva, O., Nabiyeva, Z., Pirozzi, A., Carpentieri, S., Ferrari, G., Bazylkhanova, E., & Burlyayeva, A. (2024). Enhancing nutritional value and health benefits of gluten-free confectionery products: Innovative pastilles and marshmallows. *Frontiers in Nutrition*, 10, article number 1321004. doi: 10.3389/fnut.2023.1321004.
[18] Radchenko, L., Sokolovska, O., & Hasanova, A. (2016). Organoleptic evaluation of pastilles with stevia and elamine. *Goods and Markets*, 21(1), 137-149.
[19] Simakhina, G., Naumenko, N., & Kaminska, S. (2021). Estimation of the nutritional value of quick-frozen fruit and berry half-products obtained with the usage of cryoprotection methods. *Scientific Works of NUFT*, 27(1), 150-159. doi: 10.24263/2225-2924-2021-27-1-16.
[20] Shulga, O., Petukhova, T., Moiseeva, G., & Ryzhykh, A. (2018). Marker of general human health – vitamin "C". *Young Scientist*, 2(54), 56-62.
[21] Teterev, M.M., Sokolenko, N.M., Ostrovka, V.I., Moroz, O.V., Popov, E.V., & Ruban, E.V. (2021). Waste-free technology for obtaining pectin from food industry waste. *Bulletin of the Volodymyr Dahl East Ukrainian National University*, 5(269), 61-68. doi: 10.33216/1998-7927-2021-269-5-61-80.
[22] The Declaration of Helsinki. (2013). Retrieved from http://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/.
[23] Tsykhanovska, I., Aleksandrov, O., Kaida, N., Yevlash, V., & Kovalenko, Z. (2019). Improving the technology of white-pink marshmallows using the food additive "Magnetofood". *Scientific Works of the National University of Food Technologies*, 25(2), 186-203. doi: 10.24263/2225-2924-2019-25-2-21.
[24] Yevlash, V.V., Gorban, V.G., Dudenko, N.V., Pavlotskaya, L.F., Skurikhina, L.A., & Tsyban, L.S. (2017). Physiological aspects of product quality assessment. Kharkiv: HDUHT.
[25] Yudhistira, B., Affandi, D.R., & Nusantari, P.N. (2018). Effect of green spinach (*Amaranthus tricolor L.*) and tomato (*Solanum lycopersicum*) addition in physical, chemical, and sensory properties of marshmallow as an alternative prevention of iron deficiency anemia. In *IOP Conference Series: Earth and Environmental Science*, 102, article number 012007. doi: 10.1088/1755-1315/102/1/012007.
[26] Zahorulko, A., Zagorulko, A., Kasabova, K., & Shmatchenko, N. (2020). Improvement of zefir production by addition of the developed blended fruit and vegetable pasteinto its recipe. *Eastern-European Journal of Enterprise Technologies*, 2(11(104)), 39-45. doi: 10.15587/1729-4061.2020.185684.

Розробка технології та дослідження властивостей крафтового зефіру з додаванням малинового пюре

Світлана Панасюк
Кандидат технічних наук, доцент
Луцький національний технічний університет
43018, вул. Львівська, 75, м. Луцьк, Україна
https://orcid.org/0000-0001-9734-3998

Василина Шемет
Кандидат хімічних наук, доцент
Луцький національний технічний університет
43018, вул. Львівська, 75, м. Луцьк, Україна
https://orcid.org/0000-0001-8952-5097

Анотація. Розроблення рецептур харчових продуктів з використанням натуральної сировини, збагачених біоактивними речовинами є актуальним завданням для забезпечення населення повноцінним і збалансованим харчуванням. Метою дослідження є розроблення рецептур крафтового зефіру лікувально-профілактичного та оздоровчого призначення. Дослідження проводились з використанням експертного методу, сенсорного аналізу, статистичних методів оброблення експериментальних даних. Для визначення фізико-хімічних показників використовували стандартні та загальноприйняті методики. Для досягнення мети запропоновано у рецептурі частину яблучного пюре замінити малиновим, оскільки малина має антибактеріальні та імуномодулювальні властивості. Розроблені модельні композиції зефіру, що містять різні співвідношення яблучного та малинового пюре, білок, цукор, глюкозний сироп та агар-агар. Проведено сенсорний аналіз та визначено органолептичні показники модельних композицій зефіру (смак, запах, колір, консистенцію, структуру та стан поверхні). Побудовано сенсорну профілограму модельних композицій зефіру та за результатами експертної оцінки визначено модельну композицію з найкращими органолептичними показниками. Визначено вміст пектинових речовин та L-аскорбінової кислоти у досліджуваних зразках. Визначено фізико-хімічні показники модельних композицій зефіру і встановлено, що із зростанням вмісту малинового пюре у рецептурі зефіру його вологість буде зростати від 21,3 % ± 0,3 % у МК1 із 30 %-им вмістом малинового пюре до 22,1 % ± 0,3 % у МК3 із 40 %-им вмістом малинового пюре. Із збільшенням кількості малинового пюре у складі зефіру його густина, активна та титрована кислотність будуть зменшуватись. Експериментально підтверджено доцільність використання вітамінної та пектиновмісної сировини, такої як малинове пюре, у технології виготовлення зефіру для надання йому лікувально-профілактичного та оздоровчого призначення. Розроблені рецептури зефіру з різним співвідношенням яблучного і малинового пюре, який має лікувально-профілактичне та оздоровче призначення, і сприятиме розширенню асортименту цукристих кондитерських виробів. Запропонований зефір містить натуральні компоненти і характеризується високими органолептичними показниками. Зефір за розробленими рецептурами можуть виготовляти у кондитерських цехах різної продуктивності та закладах ресторанного господарства

Ключові слова: пектин; L-аскорбінова кислота; вологість; рецептура; органолептична оцінка; харчова цінність