This paper reports a study into the effect of different quantities and shapes of fresh pumpkin slices on the technological properties of the cupcake. A comparative analysis of the technological properties of the cupcake with the addition of different quantities and shapes of pumpkin slices has been carried out. A change in the technological properties of the cupcake depending on the volume of pumpkin slices has been established. The use of fresh pumpkin slices reliably improves shrinkage during baking, humidity, and acidity of the cupcake. The volume of the cupcake is significantly reduced in this case. Porosity is significantly impaired when adding 30–50 % of slices. The slice shape does not significantly affect the technological parameters of the cupcake.

Social research was conducted; the main priorities for buyers of flour confectionery products were established. It is proved that the greatest importance when choosing food by consumers is given to the physical appearance of the finished product.

Based on the research, it was found that in the technology of cupcake production, it is optimal to add 5–25 % of fresh pumpkin slices of different shapes by weight of the dough. Applying this volume of slices makes it possible to bake a cupcake with a porosity of 9 points, a shrinkage at baking of 6.9–8.5 %, humidity of 6.9–12.8 %, a volume of 176–203 cm^3, the acidity of 1.5–1.7 degrees. In addition, it is possible to use 30–35 % of pumpkin slices. The porosity of a cupcake with such a formulation is at the level of 6.5–8.0 points. The cupcake quality meets the requirements set out by DSTU 4505:2005 and ISO 22000:2018. The difference from the conventional technique of utilizing non-traditional raw materials is the use of different quantities and shapes of fresh pumpkin slices. The use of pumpkin slices makes it possible to reduce the volume of dough in the finished product.

The devised recommendations could be used by low-productivity grain processing enterprises when making flour confectionery products

Keywords: pumpkin slices, technological quality of cupcake, slice shape, volume of slices

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QUALITY FORMING PATTERNS IN THE CUPCAKE ENRICHED WITH PUMPKIN SLICES

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1. Introduction

The priority task in the industry of healthy food is to devise technologies for food products enriched with functional food ingredients [1]. One way to implement it is to use non-traditional raw materials of plant origin. A promising object of modification is flour confectionery as a mass segment of regular consumption products [2, 3]. Flour confectionery

is rich in protein, fat, and carbohydrates. It has high energy value and taste properties and is in great demand among people of all age groups [4]. Cupcakes belong to the category of high-calorie easily digestible food [5]. Each component plays an important role and affects the structure, physical appearance, and nutritional properties of the finished product [6]. A significant disadvantage of these products is the low content of biologically active substances [7, 8].

Numerous studies [9, 10] show that the use of plant raw materials in confectionery products contribute to an increase in the content of biologically active substances. This helps improve health and reduce the risk of many diseases. In addition, adverse environmental factors predetermine the adjustment of the biochemical composition of food [11, 12].

Pumpkin is a promising additive in the production of cupcakes since it has a number of advantages [13]. Pumpkins have high-stability productivity and nutritional value, long shelf life, and are easily transported [14]. Pumpkin color can be green, white, blue-gray, yellow, orange, or red depending on the species. Pumpkin is used both in full and technical ripeness as a vegetable. The flesh is tasty in fried, stewed, boiled, or baked forms [15]. Pumpkin contains water: 75.8–91.3 %; carbohydrates: 3.1–13.0; protein: 0.2–2.7; fiber: 1.0–1.8; fat: 1.0–1.4; ash: 0.5–2.1 %; carotene: 2.4–5.2 mg/100 g [16]. However, adding pumpkins to confectionery changes their technological properties [17]. The results of research into the use of pumpkin in cupcake technology are necessary for production because the range of products of higher biological value will increase. In addition, adding pumpkin to the cupcake will reduce the volume of sugar in it. Therefore, studies on the use of pumpkin in the technology of flour confectionery production are relevant.

2. Literature review and problem statement

An important role in nutrition belongs to confectionery. Cupcake technology typically involves fat, sugar, eggs, and wheat flour. The biochemical composition of fat and flour indicates an insufficient content of biologically active substances [18]. Several studies are underway aimed at improving the biological value of food [19]. Paper [20] proved the expediency of the use of uncommon crops in the technology of food production [20]. In cupcake technology, solid fat is replaced with vegetable oil [21]. In addition, fruit and vegetable raw materials are added, as well as products and waste from their processing [22].

Study [23] proved the advantages of adding dried apples, raspberries, medicinal calendula leaves, and pumpkin oil to the formulation of cookies. In the recipe of the filling, cherry plum and zucchini jam is used, enriched with the preparation of eggshell with lemon juice. The composition of «Clear Sun» cookies was supplemented with a powder of medicinal medunka leaves, apricot, and sea buckthorn oil. Sea buckthorn jam and calendula syrup were used as fillings. The advantages of applying such components according to technological parameters have been scientifically proved. However, the results of the research relate to cookies. The technological process of cupcake production is different from cookies. In addition, they used components that differ in properties from fresh pumpkins.

In the technology of bakery and flour confectionery products, fresh pumpkin pulp, juice, powder, paste, and peel are used [24]. Thus, the use of 0.85 and 1.7 % of pumpkin powder by weight of dough in cupcake technology improved its technological parameters. The porosity score of such products increased from 5.02 to 7.36–7.57 points [25]. Study [26] also proved the advantage of using pumpkin powder. The results of the research show that the highest biological value was obtained by adding 20 % of the powder to the product. However, sensory analysis confirmed the use of 15 % during the production of cupcakes.

The importance of pumpkin powder is also emphasized in a number of other studies. Thus, it is established that in cupcake technology it is advisable to use up to 20 % of pumpkin powder. Such a product had an attractive color and improved overall culinary rating [27]. However, the improved cupcake formulation parameters cannot be applied to fresh pumpkin slices. Study [28] examined in detail the biochemical component of pumpkin powder depending on drying modes. The powder was added during the manufacture of cookies, from 5 to 20 %. It was found that the addition of 10 % of pumpkin powder was optimal. It should be noted that its addition to the recipe of cookies improved the sensory quality indicators of the finished product. In addition, the nutritional value of the finished product was determined depending on the content of the pumpkin powder. The expediency of using pumpkin in cookie technology has been proved. However, the results can be used in the manufacture of cookies. Cupcake technology is significantly different from cookie technology. In addition, the properties of pumpkin powder differ from fresh pumpkin pulp. Moreover, the properties of the product with powder differ compared to the use of fresh pumpkins.

In study [29], pumpkin paste was used. Adding it to a cupcake in the volume of 27 % by weight of dough changed the properties of the product. Thus, the humidity of the cupcake increased from 34.4 to 35.7 %, and the porosity estimate – from 8.25 to 8.95 points. It should be noted that the paste in properties is similar to fresh pulp in moisture content. However, the paste in the cupcake is evenly placed without visible particles. The use of fresh pumpkin in the form of slices will change the appearance of cupcake crumb. In addition, the cited study considered only one option using pumpkin paste.

It was found that the addition of 15–25 % of fresh pumpkin puree contributed to an increase in the humidity of the cupcake dough from 23.8 % to 24.2–25.3 %. The porosity of the finished products was 62.8–65.5 % depending on the content of the puree [30]. However, the results of the research cannot be used for fresh pumpkin slices.

It is proven that the addition of unconventional raw materials can reduce moisture loss during baking [31]. Other studies have shown that the addition of ground nuts can improve the organoleptic properties of the product, but its volume decreases [32]. In the studies, the addition of non-traditional raw materials increased the volume and porosity of the finished product. However, the elasticity deteriorated [33].

The use of non-traditional types of raw materials changes the rheological properties of the dough and the need to adjust the technological parameters of making a cupcake. It is established that the addition of pumpkin seeds and buckwheat flour extends the baking time by 3 minutes. It is necessary to reduce the temperature in the chamber by 5 °C to ensure the better formation of the height of products and avoid burning their surface. Consequently, a slight increase in the duration of baking will not cause excessive electricity consumption [34].

It should be noted that in the cited studies, the use of fresh pumpkin and its paste helps reduce the energy value of the cupcake. At the same time, the content of carotene in it

increases significantly. The technological parameters of confectionery products meet the established requirements. However, those studies did not investigate the effects of different pumpkin content on the technological parameters of the cupcake. In addition, the addition of fresh pumpkins was not sufficiently studied.

3. The aim and objectives of the study

The purpose of our study was to determine the features of the formation of the quality of a cupcake enriched with pumpkin slices. The proposed solutions would make it possible to expand the range of finished products (cupcakes) through the use of common and cheap raw materials (pumpkin). The results could be valuable for farms that grow pumpkins. In addition, for enterprises of low productivity, the main activity of which is the production of confectionery products.

To accomplish the aim, the following tasks have been set:

– to establish indicators of the quality of the cupcake enriched with pumpkin slices depending on their shape and quantity in the finished product;

– to substantiate the rational formulation of the production of a cupcake enriched with pumpkin slices.

4. The study materials and methods

4. 1. Raw materials to produce a cupcake enriched with pumpkin slices

Pumpkin was added to the cupcake in the form of slices. Depending on the shape and size of the resulting pieces, four variants of pumpkin slices were obtained (Table 1).

Table 1

Characteristics of pieces of pumpkin slices depending on the shape and size

Variant	Size	Value, mm	Minimal volume, mm^3	Maximal volume, mm^3
No. 1	Length	3.4±0.1	22.4	27.9
	Width	4.1±0.1		
	Thickness	1.8±0.1		
No. 2	Length	3.4±0.3	7.1	11.1
	Width	2.4±0.1		
	Thickness	1.1±0.1		
No. 3	Length	5.5±0.9	140.4	169.7
	Width	7.6±0.1		
	Thickness	3.7±0.1		
No. 4	Length	3.4±0.1	5.0	7.4
	Width	2.0±0.1		
	Thickness	0.9±0.1		

We used nutmeg pumpkin (*Cucurbita moschata (Duch.) Duch. ex Poir.*), Dolya variety (UA).

4. 2. Program, methodology, equipment for studying the properties of a cupcake enriched with pumpkin slices

The research was conducted in the laboratory at the Department of Food Technologies, the Uman National University of Horticulture (Uman, Ukraine).

The dough for the cupcake was prepared according to the following recipe: flour – 70 g, powdered sugar – 50 g, margarine (fat content 72 %) – 50 g, eggs – 50 g, salt – 0.2 g, baking powder (baking soda+sodium phosphate) – 2.5 g, vanilla sugar – 0.3 g. First, we prepared the dough. Salt and vanilla sugar were added to margarine at room temperature. Then it was whisked for 5–7 minutes in a dough-mixing machine (Royalty Line RL-PKM1900.7, Germany) with a speed of 60–65 per minute. After that, sugar powder was added and whipped for another 5–7 minutes. Then we added eggs and whisked them for 10 minutes. After that, wheat flour of the highest grade was added and mixed in a mixer for 3–5 minutes. Fresh pumpkin slices were added to the prepared dough in accordance with the experiment scheme (Table 2). The baking temperature was 180–185 °C.

The added free moisture and the shape of pumpkin slices necessitated prolonging the duration of cupcake baking. The consolidated temperature regimes of cupcake baking are given in Table 2.

Table 2

The duration of baking cupcakes with fresh pumpkin slices, min

Volume		Variant of pumpkin slices			
pumpkin slices	dough	No. 1	No. 2	No. 3	No. 4
0	100	45	45	45	45
5	95	45	45	45	45
10	90	45	45	45	45
15	85	45	45	45	45
20	80	50	50	50	50
25	75	50	50	50	50
30	70	55	55	55	55
35	65	55	55	55	55
40	60	60	60	60	60
45	55	65	65	65	65
50	50	65	65	65	65

Cupcake shrinkage at baking was determined from the formula:

$$Y = \frac{m_1 - m_2}{100 \cdot m_1}, \quad (1)$$

where Y is the cupcake shrinkage at baking, %; m_1 is the mass of the dough, g; m_2 is the mass of a hot cupcake, g.

The specific volume was determined from the formula:

$$V_p = \frac{V}{m}, \quad (2)$$

where V_p is the specific volume, cm^3/g; V is the volume of a cupcake, cm^3; m is the weight of a cupcake, g.

The humidity of the cupcake was determined by the thermogravimetric method. The volume – from the difference between the volume of the container filled with fine-seed crop without a cupcake and with it. The acidity – by titration of 50 cm^3 of the filtrate with 0.1 nNaOH solution. The porosity – organoleptically on a scale: 9 – small, thin-walled, or thick-walled, uniform, 7 – pore-free or other parts of the crumb occupies up to 25 % of the cross-section, 5 – pore-free or other

parts of the crumb occupies 26–50 % of the cross-section, 3 – pore-free or other parts of the crumb occupies 51–75 % of the cross-section, 1 – pore-free or other parts of the crumb occupies 76–100 % of the cross-section.

4. 3. Statistical treatment of experimental data

The experiments were carried out four times and randomized over time. The results were treated by using the Microsoft Excel 2010 and Statistica 12 software in accordance with the guidelines from [35, 36].

4. 4. Social surveys

The initiators of the survey were scientists at the Department of Food Technologies, Uman NUS, Ukraine. The focus groups consisted of potential consumers from different age categories. The study place was the town of Uman, Ukraine. The number of respondents involved was 526. The study's period – Q4'2021.

5. Results of studying the cupcake quality depending on the shape and share of added pumpkin

5. 1. The properties of a cupcake enriched with pumpkin slices depending on their shapes and shares in the finished product

Previous studies [37] have revealed a low probability of the effect of varietal properties of grain raw materials on the technological properties of the cupcake and its culinary quality. In the case of adding raw materials with a high moisture content (pumpkin paste), there are more significant changes in the rates of shrinkage at baking, shrinkage at drying, the humidity, volume, and porosity of cupcakes [38].

Physical appearance is quite important for the modern consumer, which is especially important for modern food manufacturers. The opinions of potential consumers are valuable information for social analysis.

A significant number of respondents (22.2 %) regardless of their age are early innovators, and, therefore, the probability of their choosing a new product for themselves is quite high. At the same time, for most respondents, the physical appearance of the product is important. Only 5.6 % of the respondents said that they did not pay attention to the physical appearance of the product, while 5.5 % preferred only products with a good physical appearance. Other respondents indicated that the physical appearance of products was an important prerequisite for the purchase of food. A significant number of respondents are trying to join the current trends of «healthy eating» and systematically monitor their health; 38.9 % of the respondents say that they pay attention every time to the chemical composition of food products before purchasing them.

Our results of the survey of potential consumers indicate the relevance of creating new types of food, including the expansion of the range of cupcakes. The addition of vegetable raw materials will change the chemical composition of the product and increase its attractiveness to the modern consumer. At the same time, the physical appearance of the product plays a key role for a significant number of potential consumers, which should be taken into consideration when creating such products.

When making cupcakes, the formation of physical appearance significantly depends on the indicators of shrinkage at baking, porosity, and volume. The acidity of the cupcake and its humidity affect the condition of the finished product during the period of its storage [39].

The effect of the volume of added slices on the cupcake shrinkage during baking (Table 3) is reliable.

Table 3

ANOVA results regarding the effect of the volume of added pumpkin slices and their shapes on the cupcake shrinkage at baking

Effect	SS	Degree of Fr	MS	*F*	*p*	Partial eta-squared
Intercept	13,058.27	1	13,058.272	109,649.6	<0.001	0.99
A	245.1472	10	24.51472	205.84	<0.001	0.93
B	0.192727	3	0.064242	0.53	0.65	0.01
C	5.987272	30	0.1995757	1.67	0.02	0.27

Note: A is the volume of pumpkin slices, %; B is the type of pumpkin slices; C is the relationship between effects A and B

The indicator of cupcake shrinkage at baking reliably depended on the volume of pumpkin slices added (Partial eta-squared – 0.93). However, the effect of the shape of pumpkin slices on the indicator of cupcake shrinkage at baking was unlikely (p=0.65). It is highly likely that there is a relationship between the factors of the volume of pumpkin slices added and their shapes (Partial eta-squared – 0.27).

The lowest value of the indicator of cupcake shrinkage at baking, depending on the volume of slices added, was registered in the control sample (Fig. 1). The increase in the volume of added pumpkin slices led to an increase in the indicator of cupcake shrinkage at baking. With the maximum addition of pumpkin slices (50 %), the indicator of cupcake shrinkage at baking increased by 4 %. The most rapid increase in the indicator of cupcake shrinkage at baking was recorded when adding pumpkin slices in the volume of 5 to 15 %.

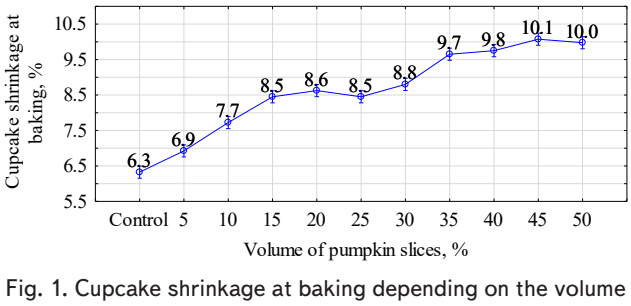

Fig. 1. Cupcake shrinkage at baking depending on the volume of pumpkin slices added

The shape of the added pumpkin slices had no effect on the humidity of the finished cupcake (p=0.70). In addition, there is no mutual effect of the shape of the slices and their content on the humidity of the cupcake (p=0.99). The formation of the humidity of the finished product was predetermined by the volume of pumpkin slices (Fig. 2).

An increase in the volume of added pumpkin slices increased the humidity of the product. With the maximum addition of pumpkin (50 %), there was an increase in the cupcake moisture content by 13 %, compared with the control value (5.9 %).

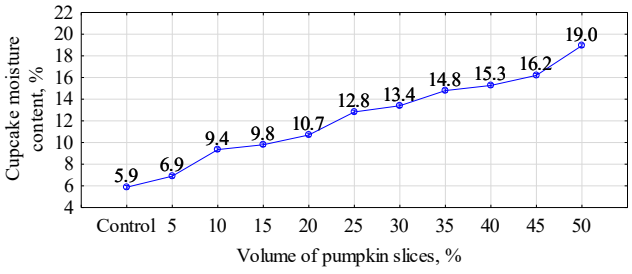

Fig. 2. The cupcake moisture content depending on the volume of added pumpkin slices

On the formation of the volume of the cupcake, the reliable influence was caused by factors A and B; in addition, a mutual relationship was registered between factors A and B and the indicator of the volume of the cupcake (Table 4).

The volume of the cupcake followed an inverse dependence on the volume of pumpkin slices added (Fig. 3). The actual reduction in the volume of the cupcake by adding the maximum volume of pumpkin slices (50 %) resulted in a 60 % reduction in the volume of cupcakes compared to the control.

The high indicators of cupcake volume were registered in samples that were enriched with slices of types No. 1 and No. 2, regardless of their volume added to the cupcakes (Fig. 3, *b*). The volume of the cupcakes when adding slices of types No. 3 and No. 4 was similar.

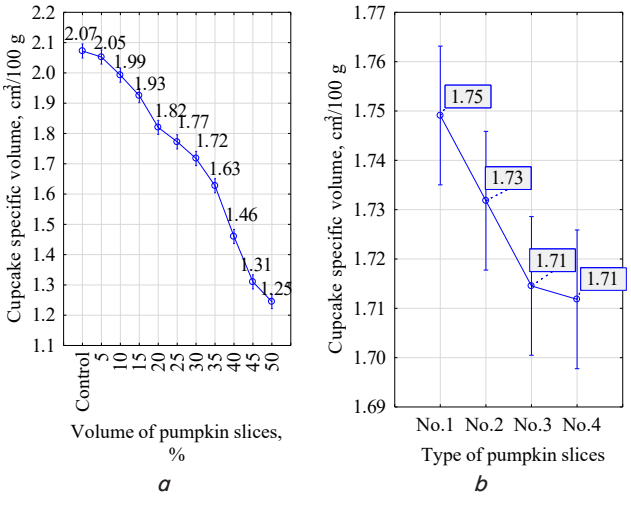

Fig. 4. The specific volume of the cupcake, depending on the shape and quantity of added pumpkin slices: *a* — the volume of pumpkin slices, %; *b* — the type of slices

The specific volume of the cupcakes decreased with an increase in the volume of added pumpkin slices, regardless of their shape.

At the same time, the specific volume of the cupcakes enriched with slices of different types was reliably different from each other. The largest specific volume was registered when adding slices of type No. 1, regardless of their volume (Fig. 4, *b*).

Table 4

ANOVA results regarding the effect of the volume of added pumpkin slices and their shapes on the cupcake volume indicator

Effect	SS	Degree of Fr	MS	*F*	*p*	Partial eta-squared
Intercept	4,936,560	1	4,936,560.09	440,883.58	0.000	0.999700
A	144,358.9	10	14,435.8909	1,289.267	0.000	0.989865
B	404.6363	3	134.878788	12.04600	0.000	0.214930
C	664.3636	30	22.1454545	1.977807	0.004	0.310107

Note: A is the volume of pumpkin slices, %; B is the type of pumpkin slices; C is the relationship between effects A and B

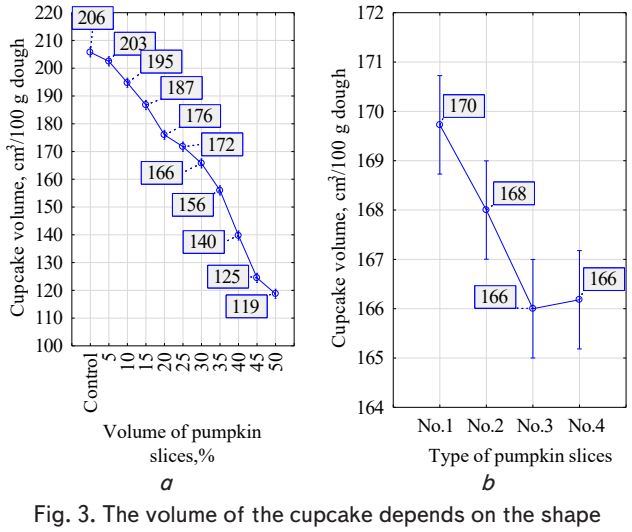

Fig. 3. The volume of the cupcake depends on the shape and volume of pumpkin slices added: *a* — the volume of pumpkin slices, %; *b* — the type of slices

Trends in a change in the specific volume of the cupcake depending on the type of pumpkin slices added and their total volume were similar to the cupcake volume indicator (Fig. 4).

The acidity of the cupcakes reliably depended on the volume of pumpkin slices (Fig. 5). The probability of the effect of the type of slices on the acidity index was low.

The increase in the proportion of pumpkin slices led to an increase in the acidity of the cakes. When adding the maximum volume of pumpkin slices (50 %), the acidity increased by 30 % compared to the control sample.

The porosity of the cupcake significantly depended on the volume of added pumpkin slices and their shape (Fig. 6).

Reliable differences in porosity were found in slice sample No. 4, which was 0.5 points smaller than in the samples of the cupcake enriched with other types of slices (Fig. 6, *a*). More significant changes occurred with the use of various formulations, in particular, with an increase in the volume of pumpkin slices, there was a decrease in the porosity of the finished product (Fig. 6, *b*). The porosity of the cupcake was at a high level (9.0 points) when adding pumpkin slices to 25 %.

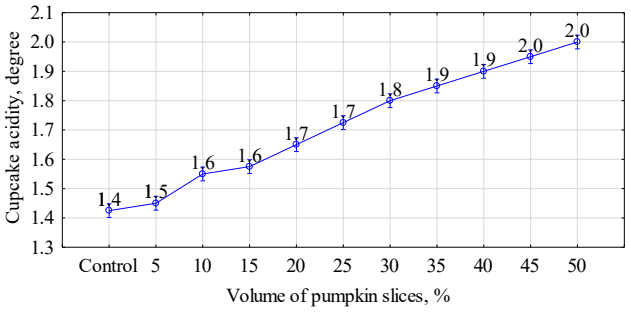

Fig. 5. The acidity of the cupcake, depending on the shape and volume of pumpkin slices

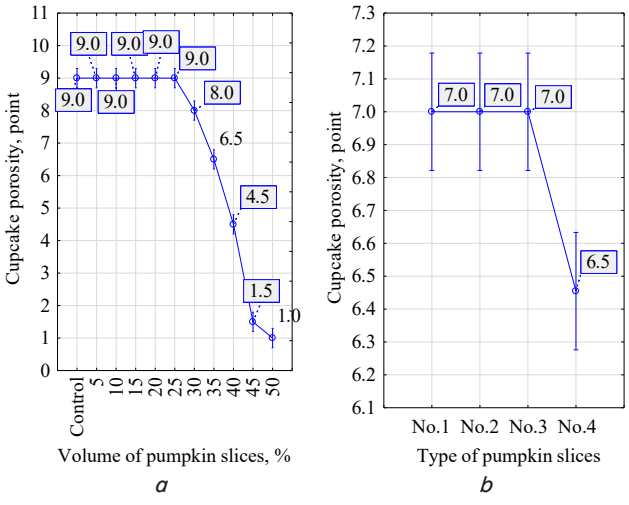

Fig. 6. The cupcake porosity depending on the shape and quantity of added pumpkin slices: *a* – the volume of pumpkin slices, %; *b* – the type of slices

A further increase in the proportion of pumpkin slices in the cupcake led to a sharp decrease in the porosity of the cupcake. With the addition of 30 % of pumpkin slices, the porosity value decreased by 11.1 % compared to control. With the addition of 35 % of pumpkin, we registered a decrease in porosity by 27.7 %; 40 % of pumpkin reduced the porosity by 50 %; 45 % of pumpkin – by 83.3 %, and 50 % of pumpkin – by 88.9 %.

5. 2. Improving the recipe to bake a cupcake enriched with pumpkin slices

The addition of pumpkin slices adversely affected the technological parameters of the finished product in a general case. Such a pattern may be associated with the influence of free moisture of the added raw materials. The best results in a comprehensive assessment were registered with the minimum addition of pumpkin slices. The level of expectation (desirability) with the minimum addition of pumpkin was maximal (89.9 %). Further increase in the volume of pumpkin added reduced the overall effect of desirability (Fig. 7).

The best results in terms of the shape of pieces of pumpkin slices were demonstrated by the second sample. However, given the minimal impact of the shape and size of pumpkin slices on the examined properties of cupcakes, the advantage of this option compared to other variants of the experiment was minimal.

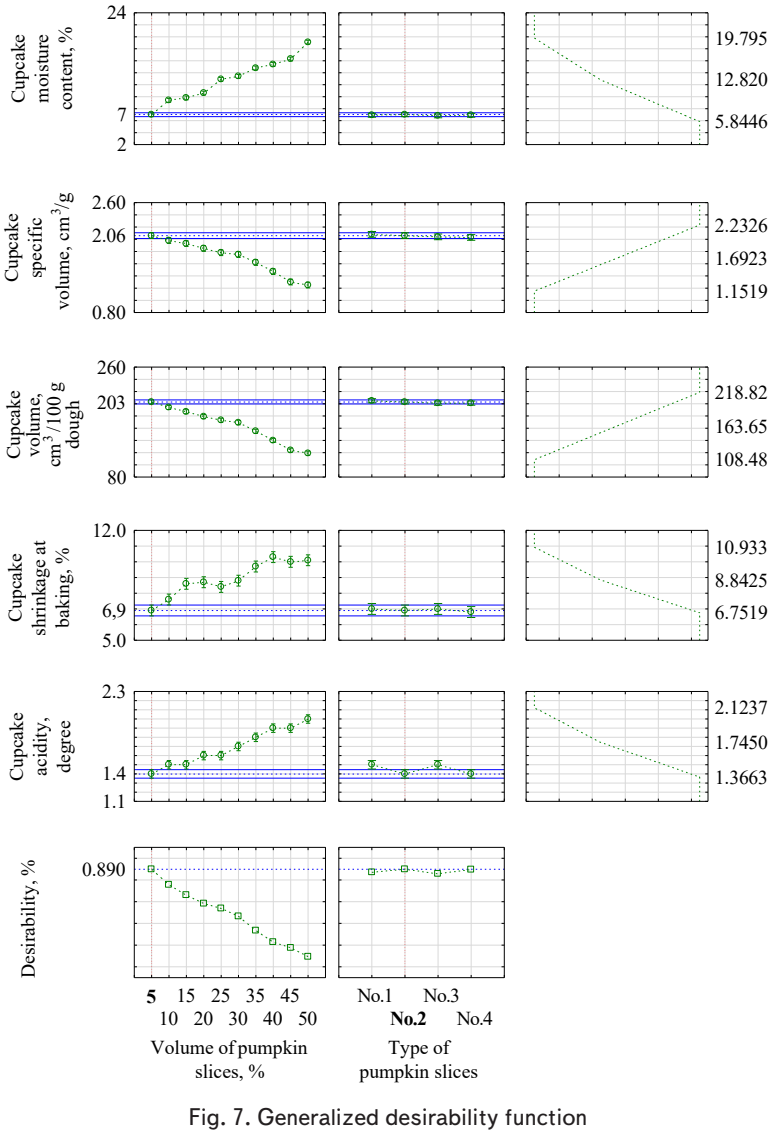

Fig. 7. Generalized desirability function

6. Discussion of results of studying the expansion of the range of cupcakes enriched with pumpkin

In general, the effect exerted on the condition and physical appearance of the finished product (cupcake), enriched with pumpkin slices, was negative. A large volume of added moisture caused significant changes in the structure of the dough, and reliably influenced the quality of the product. Therefore, the request of potential consumers to expand the range of products of increased biological value in the case of enrichment of cupcakes with pumpkin slices should be balanced, and the results of our study are to be taken into consideration when forming a strategy for the development of enterprises of manufacturers of such products.

The addition of slices No. 3 significantly reduced the volume of the cupcake (Fig. 3) since their linear dimensions were the largest. When baking, for the generated gas, it was more difficult to loosen the structure of such dough. Slices No. 3 were the smallest, which led to the release of free moisture into the dough. Therefore, the volume of the cupcake was also reliably smaller.

The tendency of the influence of slice type on the specific volume was similar (Fig. 4). The indicator was calculated using the volume of the cupcake.

Adding the smallest slices to the dough increased the content of free moisture in it (Fig. 6). During baking, for gas, it was also more difficult to loosen such a dough structure. Therefore, the porosity of the cupcake was significantly lower compared to the use of other types of slices. The use of other types of slices released less moisture into the dough. Therefore, the porosity of the cupcake was higher.

Along with a decrease in the indicators of the physical appearance of cupcakes enriched with pumpkin slices (Fig. 7), the samples containing from 5 to 15 % of the added moisture-containing raw materials demonstrated quite high indicators.

Based on a comprehensive analysis of the properties of cupcakes enriched with pumpkin slices, the reliable effect of the volume of slices and their shape has been proved. This predetermines the relevance of the further study of the possibilities of modernization of pumpkin processing technologies. There are new opportunities for enriching bakery products with pumpkin pulp in fresh form. The results of our study, including social, indicate a potentially attractive program for investors to expand the range of cupcakes.

A special feature of our results, in comparison with most available studies [26, 28], is the use of pumpkin fresh pulp instead of its powder. Currently, the formation of a moisture-containing product powder is an energy-consuming technological process, leveled by the possibility of using fresh pumpkin pulp, which is consistent with the results reported in [24]. At present, the relevant areas of scientific work are the energy efficiency of the technological process, and, therefore, one requires an additional comparative analysis of the energy intensity of the proposed technologic process in comparison with the alternative solutions given in [24, 28]. It is highly likely that the proposed technique to prepare pumpkin slices has lower energy costs compared to the production of fresh pumpkin paste, which requires additional investigation and is a disadvantage of this study.

The proposed solutions and recommendations could expand the ways of effective utilization of pumpkins.

The results reported in the current paper have limitations related to the properties of pumpkins used to enrich the cupcakes. To obtain identical results in the production, it is necessary to use nutmeg pumpkin (*Cucurbita moschata* (*Duch.*) *Duch. ex Poir.*).

The trends in the food market identified during the study predetermine the feasibility of further research into the purchasing power of potential consumers, their attitude to the culinary quality of the product, investigating the biological value and culinary quality of cakes enriched with pumpkin slices, establishing energy cost of pumpkin slice production.

7. Conclusions

1. The technological parameters for cupcake quality with the addition of fresh pumpkin slices of different shapes and quantities have been determined. The use of fresh pumpkin slices reliably increases the shrinkage at baking, the humidity, and the acidity of the cupcake. Its volume reliably decreases at the same time. The porosity is significantly impaired by adding 30–50 % of slices. The shape of the slices does not significantly affect the technological parameters of the cupcake. The use of 5–25 % of pumpkin slices does not reduce the porosity of the cupcake. The moisture content and acidity of the cupcake meet the current requirements. The use of 30–35 % of slices reduces porosity to 6.5–8.0 points, which corresponds to a high level.

2. In the technology of cupcake production, it is recommended to add 5–25 % of fresh pumpkin slices of various shapes by weight of the dough. The use of this volume of slices makes it possible to receive a cupcake with a porosity of 9 points, a shrinkage at baking of 6.9–8.5 %, moisture content of 6.9–12.8 %, and a volume of 176–203 cm^3, the acidity of 1.5–1.7 degrees. In addition, it is possible to use 30–35 % of pumpkin slices. A cupcake with such a formulation has porosity at the level of 6.5–8.0 points, a shrinkage at baking of 8.8–9.7 %, moisture content of 13.4–14.8 %, and a volume of 156–172 cm^3, and the acidity of 1.8–1.9 degrees.

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