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DEVELOPMENT OF THE RECIPE OF PASTA WITH PUMPKIN FLOUR

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Abstract

The object of research is the production technology of pasta with pumpkin flour. The problem of enriching pasta with pumpkin flour was solved.

In the studies, different replacement of semi-grain with pumpkin flour was studied according to the following scheme: 0 %,

2.5 %, 5.0 %, 7.5 %, 10.0 %, 12.5 %, 15.0 %. The formation of boiling coefficients, consumer smell and taste, the level of pumpkin smell and taste, and the sweet taste of pasta were studied. As a result of the conducted research, it was established that the use of pumpkin flour had the greatest effect on the sensory indicators of the quality of pasta. The coefficient of boiling by mass and volume did not change reliably. It was established that the smell and taste of pumpkin in pasta was absent only when 2.5 % of pumpkin flour was added. The use of 5.0–7.5 % pumpkin flour did not change the sensory evaluation of pasta in comparison with the control variant. The sweet taste of pasta was absent when 2.5–5.0 % pumpkin flour was added. It has been proven that pumpkin flour is characterized by specific sensory indicators. It is obvious that adding it to pasta will affect their organoleptic indicators. At the same time, the greater the amount of pumpkin flour in the pasta recipe, the higher the level of manifestation of the smell and taste of pumpkin. In pasta technology, it is optimal to add 5.0–7.5 % pumpkin flour.

A distinctive feature of the obtained research results is that it is optimal to add 5.0–7.5 % of pumpkin flour in pasta technology. With this amount of pumpkin flour, the smell and taste of pasta is 8.2–8.9 points, the boiling factor by mass is 2.20–2.21, and by volume – 1.71–1.81.

The developed recommendations can be used by enterprises with low productivity during the production of pasta products.

Keywords: pasta, semi-grain, pumpkin flour, sensory evaluation, physico-chemical parameters, smell, taste.

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1. Introduction

Pasta is a popular product made from durum wheat grain or semi-grain. They usually have a low glycemic index and a long shelf life [1]. Pasta is an ideal product for enrichment with functional ingredients of higher biological value [2].

Pumpkin flour is a promising raw material for enriching flour products with valuable nutrients [3]. It is known [4] that pumpkin flour contains 6.1 % water, 8.2 % protein, 0.7 % fat, 2.3 % ash, 27.4 % dietary fiber, which includes soluble (10.2 %) and insoluble (17.2 %) fiber.

The addition of pumpkin flour to the dough changed its farinographic properties – water absorption and the duration of dough formation increased, while the stability of the dough and the index of resistance to kneading decreased. In addition, the enrichment of flour products with pumpkin flour affects the technological parameters of the finished product. So, bakery products had a smaller volume and specific volume. The replacement of wheat flour with pumpkin flour by more than 5 % helped to reduce the bulge of the product, and also increased its hardness during storage. Enrichment of food products with pumpkin flour also affects its sensory properties [5].

Pasta [6] and pumpkin flour [7] are used in the technology of enriched products with pumpkin-containing semi-finished products. The use of pumpkin seed flour is very popular [8]. Much less is used of fresh pumpkin pulp (puree, straws of various shapes and sizes, slices, etc.) [9, 10]. The use of pumpkin flour has an advantage compared to other pumpkin processing products. The main advantage of pumpkin flour is the possibility of longer storage compared to fresh pumpkin [11]. In addition, the amount of fruit and vegetable flour in the product recipe is much smaller compared to moisture-containing semi-finished products [12].

In work [13], replacing 25 % of corn flour with pumpkin flour in the pasta recipe improved the color and texture. At the same time, the use of 25 % pumpkin flour provided the highest sensory evaluation among consumers. The use of 50 % pumpkin flour worsened the organoleptic evaluation of pasta. However, in a study [14] it was proven that the addition of 10 % pumpkin flour to the recipe of pasta was optimal, because it provided the highest sensory evaluation. So, the color, aroma, taste and consistency of the pasta had a rating of 8.2–8.8 points. At the same time, the use of 5–20 % pumpkin flour significantly increased the content of beta-carotene in pasta. It should be noted that in the work [15] pasta had a high organoleptic evaluation, in the recipe of which 20 % of wheat flour was replaced with pumpkin flour. However, in these studies, the experiment options had a large interval, which does not make it possible to establish the optimal amount of pumpkin flour. This is important, because the technology of obtaining pumpkin flour is significantly different from the technology of wheat flour production.

In the study [16], the addition of pumpkin flour significantly increases cooking losses. The highest cooking losses (6.6 %) were after adding 10 % pumpkin flour. In addition, with this amount of pumpkin flour, the water absorption of pasta increased from 181.0 % in the version without pumpkin flour to 211.2 % (10 % pumpkin flour). Sensory evaluation showed that pasta with pump-

kin flour had a worse evaluation in terms of color, aroma and taste. At the same time, the use of 10 % pumpkin flour in pasta technology was the most acceptable for tasters. However, in this study, the use of pumpkin flour, on the contrary, worsened the sensory evaluation of pasta. This could be due to the use of a variety or varieties of pumpkin with a strong vegetable smell and taste.

The analysis of scientific literature [14–16] shows that the use of pumpkin flour affects the quality of pasta. At the same time, pasta was enriched with beta-carotene by adding pumpkin flour. It should be noted that the optimal amount of pumpkin flour in pasta varies in different studies in a wide range – from 10 to 25 %. In addition, there is no sensory evaluation of the smell and taste of the pumpkin component in pasta after cooking. The level of sweet taste of pasta with the addition of pumpkin flour was not analyzed. Therefore, for the use of pumpkin flour, it is necessary to conduct scientific research on its rational use in pasta.

2. Materials and methods

2. 1. Raw materials

The experimental part of the work was carried out in the laboratory "Evaluation of the quality of grain and its processing products" of the Department of Food Technologies of the Uman National University of Horticulture (Ukraine). The study used durum wheat semolina (flour moisture content 12.1 %). Pumpkin flour (moisture content 12.3 %) was obtained from the pulp of large-fruited pumpkin (Cucurbita maxima Duch.) Atlant variety (Ukraine). The technology for the production of pumpkin flour included washing the pumpkin, grinding it into particles with a size of 550±21×1.1±2.0 mm. Drying was carried out in a hot air cabinet HS121A at a temperature of 60±2 °C to a constant mass. After that, the dried pulp was crushed in a KR-20S hammer crusher (China) and sieved on a sieve No. 19 with a hole size of 360 μm.

2. 2. Program, methodology, equipment

The pasta recipe included the use of pumpkin flour in an amount from 2.5 to 15.0 % with an interval of 2.5 % (Table 1). Pumpkin flour was added by replacing a certain amount of semolina. First, the flour mixture was mixed, and then water was added and the dough was formed. The resulting pasta was dried to a moisture content of 12.0–13.0 %.

Table 1

Recipe for pasta with pumpkin flour

Replacing pasta flour with pumpkin flour, %	Ingredients of the recipe	
	Semi-grain, g	Water, cm^3
0	100	18
2.5	97.5	18
5.0	95.0	18
7.5	92.5	18
10.0	90.0	18
12.5	87.5	18
15.0	85.0	18

The smell, taste of pumpkin in the finished product and the sweet taste of pasta were determined on a scale: 9 – absent, 7 – weak, 5 – perceptible, 3 – strong, 1 – very strong. Consumable smell and taste: 9 – extremely like, 8 – very like, 7 – quite like, 6 – slightly like, 5 – not like, 4 – slightly dislike, 3 – quite dislike, 2 – very dislike, 1 – extremely dislike.

The examination was conducted by a qualified commission (5 people) with a general level of competence in solving similar tasks of at least 80 %. The coefficient of boiling, indicators of sensory evaluation of pasta were checked for the consistency of the statements by the method of calculating the concordance index. For the analysis, the results of sensory culinary expertise of experts, which were agreed among themselves, were selected.

The ingredients were weighed on an Axis ADT 2200 electronic balance (Germany) with an accuracy of 0.5 g. The dough was kneaded on a Bosch MUM9B34S27 dough mixer (Slovenia).

After that, pasta was formed using a Unold press, model 68801 (Germany). Products were dried in a Sadochok S-1M drying cabinet (Ukraine).

The experimental part had four analytical repetitions, which were randomized in time to exclude the influence of other factors. Data processing was carried out using specialized software Microsoft Excel 2016 (Microsoft Corporation, USA) and Statistica 12 (StatSoft Statistica Ultimate Academic, Ukraine) in accordance with methodological recommendations [17, 18].

3. Results and discussions

Choosing a method of statistical data processing is an important stage of scientific research, as it minimizes the probability of making a mistake. The choice of statistical processing method is determined by the type of data distribution. According to the comprehensive evaluation of the obtained results (Gauss histogram analysis, conducted Shapiro-Wilk and Kolmagorov-Smirnov tests), the wrong type of distribution was established for all variants of the study (**Fig. 1**).

According to the result of the Kruskal-Wallis ANOVA by Ranks test, a low level of probability (p=0.56) of a change in the boiling factor by mass was established depending on the amount of added pumpkin (**Fig. 2, *a***).

With a probability of 85 %, it can be stated that the addition of pumpkin powder affected the boiling coefficient by volume (**Fig. 2, *b***). The highest value of the boiling coefficient by volume (1.85) was found in the control sample. Increasing the amount of pumpkin flour reduced this indicator. Such a feature was determined by the properties of pumpkin flour, the water absorption capacity of which is significantly different from that of semi-grain. In addition, pumpkin flour does not contain gluten, which keeps the shape of pasta during cooking. It is obvious that pasta with the addition of pumpkin flour lost more mass during cooking.

Pumpkin flour has a strong specific taste and smell, which can negatively affect the culinary quality of the finished product from the point of view of individual consumers. Therefore, the main condition during the formation of the pasta recipe was to obtain a product with high sensory quality indicators.

The main criteria for the organoleptic assessment of pasta products enriched with non-traditional raw materials are smell and taste. From the consumer's point of view, the smell of pasta significantly decreased with an increase in the amount of pumpkin flour (**Fig. 3, *a***). Under the condition of replacing semi-grain from 2.5 to 7.5 % with pumpkin flour, a product was obtained that had a high rating among consumers according to the smell indicator (from 8.2 to 8.8 points out of 9.0 maximum). Substitution of 10 % of semi-meal with pumpkin flour significantly reduced the smell index – by 3.0–3.5 points compared to samples containing 2.5–7.5 % of it. A further increase in the amount of pumpkin flour to 15 % led to a less significant, but reliable decrease in the smell evaluation from the consumer's point of view by 0.2–0.4 points.

The tendency to change the taste of pasta depending on the amount of pumpkin flour was similar to the change in smell (**Fig. 3, *b***). It was proved that for the consumer, the addition of pumpkin flour from 2.5 to 7.5 % resulted in a product with high taste indicators – 8.9-9.0 points, which were close to the control version. A further increase in the amount of pumpkin flour negatively affected the taste of the obtained products.

The minimum taste rating from the consumer's point of view was obtained with the addition of 15 % pumpkin flour. Analyzing the level of sensory evaluation, it can be stated that the addition of pumpkin flour changed the smell of pasta the most. At the same time, the taste of pasta remained at a high level. This was due to the presence of aromatic substances in the composition of pumpkin flour. Identifying such substances and further work on their minimization is an important task.

It has been proven [19] that the use of non-traditional components in product technology affects its sensory indicators. At the same time, the enrichment of products with biologically valuable components can both improve and worsen the organoleptic evaluation. The level of exposure is determined by the content of aromatic substances.

It has been statistically confirmed that it is optimal to add 5.0–7.5 % pumpkin flour in pasta technology. With this amount of pumpkin flour, the consumer smell and taste of pasta is 8.2–8.9 points,

the boiling factor by mass is 2.20–2.21, and by volume – 1.71–1.81. If semi-finished products containing pumpkin are well received, it is possible to increase the amount of pumpkin flour to 10.0–12.5 %.

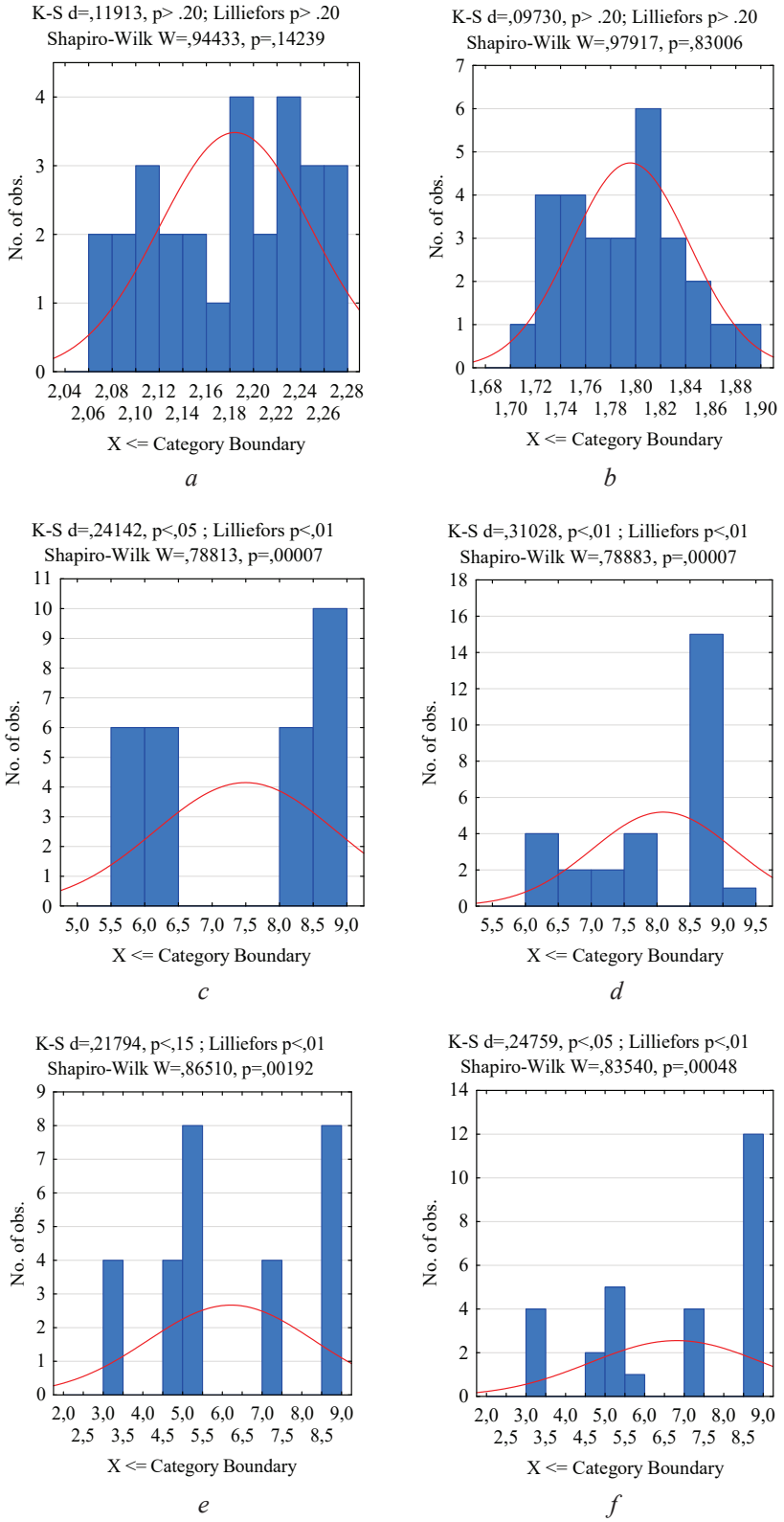


Fig. 1. Histograms of data distribution: *a* – coefficient of expansion by mass; *b* – boiling factor by volume; *c* – consumer smell; *d* – consumer taste; *e* – pumpkin smell; *f* – pumpkin taste

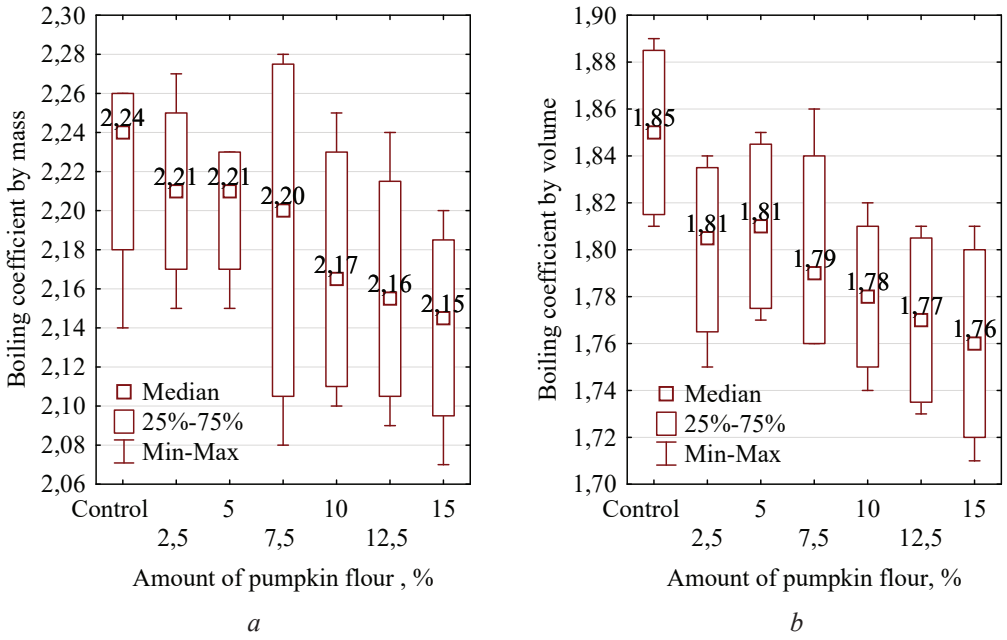


Fig. 2. Boiling coefficients: *a* – by mass; *b* – by volume

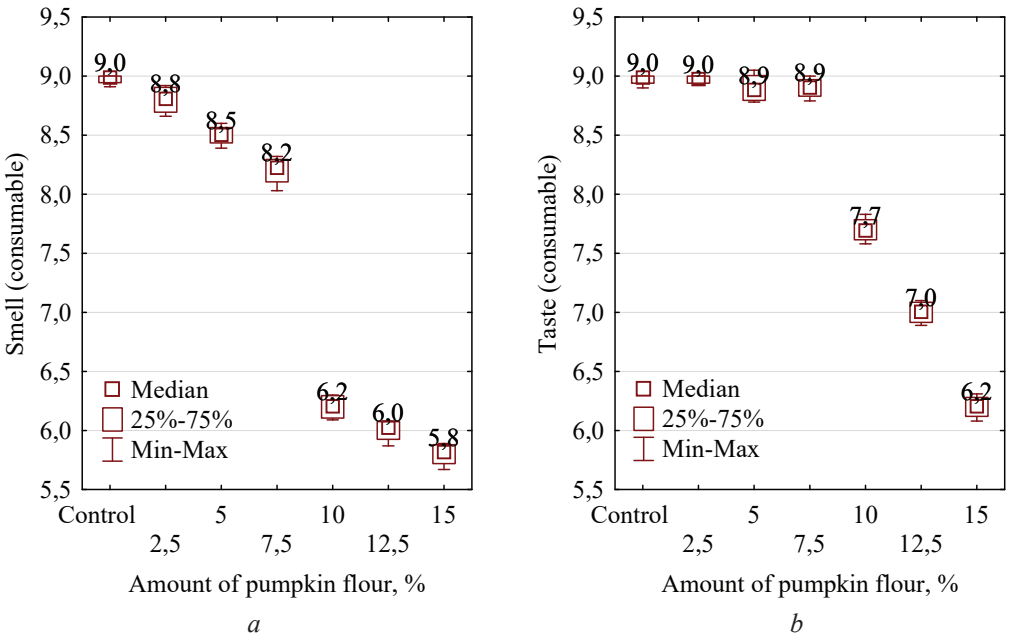


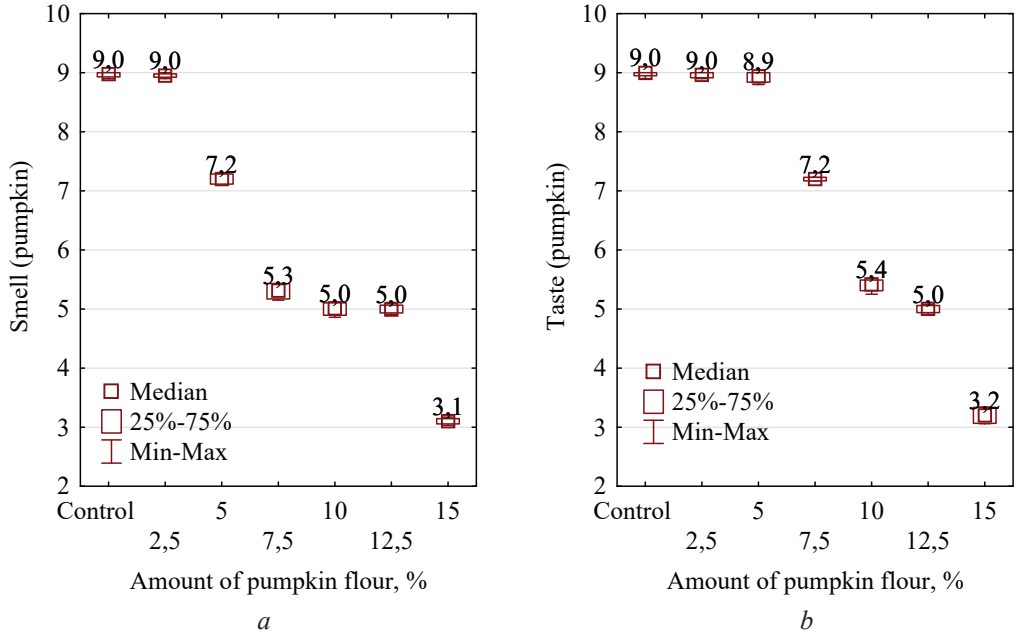
Fig. 3. Organoleptic evaluation of pasta from the point of view of the consumer: *a* – smell; *b* – taste

Despite the benefits of pumpkin and products containing it, there are a significant proportion of consumers who do not like such products. Therefore, it was important to establish the level of saturation with extraneous taste of pumpkin-enriched products. Such studies were conducted at the level of experts who had a sufficient level of competence in solving the specified task.

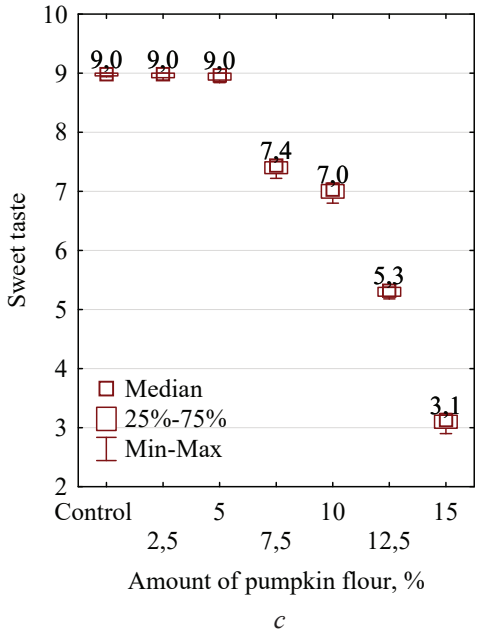
It was proved that the addition of a minimum amount of pumpkin flour (2.5 %) did not change the value of the odor level (**Fig. 4, *a***). At the same time, the smell of pumpkin was absent. Increasing the amount of such a product contributed to the formation of the smell of pumpkin from weak to strong. A similar trend was observed with the level of pumpkin flavor in pasta (**Fig. 4, *b***).

The addition of pumpkin flour changed the level of sweet taste of pasta (**Fig. 4, *c***). Thus, increasing its amount from 7.5 to 15.0 % contributed to the formation of the level of sweet taste

from weak to strong. It should be noted that the addition of 2.5–5.0 % pumpkin flour provided the missing sweet taste of pumpkin.



a *b*



c

Fig. 4. The level of smell, taste and sweet taste of pumpkin in pasta: *a* – smell; *b* – taste; *c* – sweet taste

Despite the drying of the pumpkin pulp, aromatic substances remain in its flour. When replacing a small amount of semolina with pumpkin flour, the level of its smell and taste is absent. An increase in the share of pumpkin flour contributes to a more intensive manifestation of the smell and taste of pumpkin in pasta. Scientists came to this statement during research on the production of pasta with pumpkin flour [20].

A feature of the obtained results compared to existing studies [21] in this direction is the determination of the level of expression of the smell and taste of pumpkin in pasta, as well as the level of sweet taste. In addition, the feature of the proposed method of pasta enrichment is the use

of pumpkin flour in a differentiated manner. So, for the production of pasta without a sweet taste, it is necessary to add 2.5–5.0 % of pumpkin flour. In the technology of obtaining pasta with a sweet taste, it is necessary to add 7.5–12.5 % of pumpkin flour.

Using the proposed method will allow enterprises of different productivity to use pumpkin flour in pasta technology without significant changes in the technological process. The obtained results regarding the sensory quality of the finished product will contribute to the minimization of financial risks.

A limitation of the conducted research is the use of flour from one type of pumpkin – Cucurbita maxima Duch. Atlant variety. The use of other types or varieties of pumpkin requires additional research. Sensory indicators of the quality of pumpkin pulp vary significantly depending on its variety [22]. This especially applies to the color, smell and taste of the pumpkin flesh. In addition, the optimal amount of pumpkin flour is designed for the traditional pasta recipe. If the main ingredient different from pasta flour is used in the recipe, additional research will be required.

The disadvantage of the study is the use of only one type and variety of pumpkin. In addition, it is necessary to carry out additional research on the conditions and duration of storage of pasta with pumpkin flour. The research results obtained in the article cannot be applied to pasta made from ingredients different from durum wheat semolina.

The development of this study consists in expanding information on the formation of sensory indicators of products enriched with pumpkin semi-finished products. In addition, the issue of optimal storage conditions and parameters for pasta with pumpkin flour requires more detailed research.

4. Conclusions

As a result of the conducted research, it was established that the use of pumpkin flour had the greatest effect on the sensory indicators of the quality of pasta. The coefficient of boiling by mass and volume did not change reliably. It was established that the smell and taste of pumpkin in pasta was absent only when 2.5 % of pumpkin flour was added. The use of 5.0–7.5 % pumpkin flour did not change the sensory evaluation of pasta in comparison with the control variant. The sweet taste of pasta was absent when 2.5–5.0 % pumpkin flour was added.

In pasta technology, it is optimal to add 5.0–7.5 % pumpkin flour. With this amount of pumpkin flour, the smell and taste of pasta is 8.2–8.9 points, the boiling factor by mass is 2.20–2.21, and by volume – 1.71–1.81. If pumpkin-containing semi-finished products are accepted, it is possible to increase the amount of pumpkin flour to 10.0–12.5 %. At the same time, the smell and taste of pasta is 6.0–7.7 points, the boiling factor by mass is 2.16–2.17, and by volume – 1.77–1.78.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this study, including financial, personal, authorship, or any other, that could affect the study and its results presented in this article.

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The study was conducted without financial support.

Data availability

The manuscript has no associated data.

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