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Szója okara hozzáadásával készült tészták minőségi analízise

Kulcsszavak: szója, szója okara, tészta, minőségértékelés, érzékszervi mutatók, fizikai és kémiai jellemzők

1. Összefoglalás

Munkánk során a szója okara főbb tulajdonságait és a tésztadúsító adalékanyagként való felhasználásának lehetőségeit vizsgáltuk egy tömegfogyasztási termék, a tészta esetén. Kísérleteinkben a szója okarát különböző hőmérsékleten szárítottuk. Három prototípust fejlesztettünk ki, amelyekben a liszthez 5, 10 vagy 15 tömegszázalékban adtuk hozzá a szárított szója okarát. A kapott tészták értékelését az érzékszervi, fizikai-kémiai jellemzők és a kontrollminta tulajdonságaival való összehasonlításuk alapján, valamint a szabványban szereplő követelményeknek történő megfelelés ellenőrzésével végeztük el. Az elméleti és kísérleti eredmények alapján javasoljuk azt a hozzáadott szója okara mennyiséget, amely a tészták tápértékének növelésére használható.

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Pastas Quality Evaluation with Addition of Soy Okara

Keywords: soy, soy okara, pasta, quality assessment, organoleptic indicators, physical and chemical indicators

1. Summary

In this work we analysed the main properties of soy okara and prospects for its use as an additive for pasta enrichment. Pasta, which is a mass consumer product, was chosen as the object of enrichment. During research, the process of drying soy okara at different temperatures was carried out. Three prototypes were developed with the addition of dried soy okara in the amounts of 5%, 10%, or 15% by weight of the flour. Assessments of obtained prototypes were carried out in terms of organoleptic, physico-chemical indicators and their comparison with indicators of the control sample, as well as verification of compliance with requirements presented in regulatory documentation. Based on theoretical and experimental studies, a certain amount of soy okara was selected to be used as a raw material to increase the nutritional value of pasta.

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2. Introduction

Soy is the main crop rich in complete protein, polyunsaturated fatty acids, as well as vitamins and minerals. It is an oval-shaped bean, coloured yellow, green or brown, depending on the variety. On average, soy contains 37-42% protein, 19-22% fat, and up to 30% carbohydrates (Litvinenko et al, 2020).

Soy is a traditional food in Asia. In Western countries, soybeans were introduced about a hundred years ago and used as feed for farm animals. Products made from soy began to gain popularity when studies were carried out confirming the ability of these products to prevent diseases such as atherosclerosis, cancer, and obesity. Soy products have a beneficial effect on human health due to the high content of isoflavone derivatives in soybeans - isoflavonoids. The main soy isoflavones are genestein and diadzein, with glycitein present in smaller amounts. (Statsenko et al, 2022).

Soybean seeds are considered a source of dietary fiber, represented by both swelling and water-insoluble fractions. Swelling fiber reduces cholesterol and glucose levels in the blood. Insoluble fiber enhances peristalsis and increases the speed of food movement through the gastrointestinal tract.

Soy seeds do not contain lactose and cholesterol. Due to this, they can be used as raw materials for the production of products for specialised and dietary nutrition, especially for people suffering from diseases of the gastrointestinal tract, heart disease, diabetes, etc.

Currently, soy is grown all over the world. It is used for food processing and for a balanced diet. Common soy products are soy milk, soy oil, soy isolates, tofu, etc. (Tikhomirova et al, 2019; Lyubimova et al, 2018; Dorokhov et al, 2019; Grain soy union of Volga Federal District, 2022).

Soy milk is a homogeneous soy mass of white colour with different shades of yellow and a milky-sweet taste, containing oil, protein and other valuable components of soy seeds. This product, having high nutritional properties, is intended for medical, dietary, and mass nutrition (Statsenko et al, 2019).

The technological process of soy milk production includes:

- intake of soybeans;

- cleaning and decortication: it is necessary to remove skin from grains in order to rid soybeans of the astringent effect and avoid any product contamination;

- shredding soybeans with water allows you to dissolve all the nutrients of soybeans and increase the yield of the product;

- filtration eliminates all fibres;

- sterilisation: processing of the product at high temperature;

- obtaining soy milk (Fedko és Bychenkova, 2021; Tikhomirova et al, 2019).

One of the main directions of development in industrial enterprises is the introduction of waste-free and low-waste technologies in order to reduce harmful effects on the environment. Waste-free production involves a closed cycle of processing raw materials with reuse of production by-products.

Raw materials enter the production process and further secondary waste is formed, which can be processed into a product and thereby reduce the amount of waste generated. Thanks to the introduction of non-waste technologies, it is possible to reduce the amount of raw materials used in the production process, reduce the cost of utilisation or disposal, and increase productivity (Tumalanov és Ivanov, 2020).

Currently, it is important to use secondary raw materials in the food industry, which will improve the finished product quality. Soy okara can be attributed to such raw materials.

Okara is a common source of fibre, namely cellulose (0.5–0.7%) and hemicellulose (4.7–5.3%). Due to this, this supplement has therapeutic and prophylactic properties, especially for people with diseases of the gastrointestinal tract who need a nutritional diet. Also, the fibre of soy okara provides the formation of stable emulsions (Grishina, 2018; O'Toole, 2016; Aliev és Mukailov, 2019; Nishinari et al, 2018).

The main disadvantage of soy okara is its high moisture content (about 85 g), which leads to rapid spoilage and processing costs. Therefore, okara has found its use as animal feed or as a fertiliser. In Japan this valuable waste is recycled and incinerated.

Nowadays, there is a growing interest in proper and nutritious nourishment. Soy okara due to its high nutritional value can be used as an enriching additive for food purposes. For example, fresh soy okara can be dried in a tumble dryer, then ground into flour and then used as a food ingredient.

In order to improve the organoleptic and physico-chemical parameters of the final product, soy okara is used in the production of bakery products, confectionery products, and in the meat industry (Petibskaya et al, 2001).

3. Materials and methods

Research materials: pasta, soy okara.

The experimental part of the work was carried out according to the following indicators:

1) organoleptic quality indicators of the enriched product (appearance, texture, colour, taste, and smell);

2) physical and chemical indicators of the enriched product quality (humidity, acidity, dry matter transferred to the cooking water, protein and fiber content).

In the course of the work, four samples of pasta were used:

1 - control sample;

2 – sample with 5% soy okara content;

3 – sample with 10% soy okara content;

4 – sample with 15% soy okara content;

Evaluation of organoleptic, physico-chemical parameters was carried out for all four samples.

Organoleptic and physico-chemical assessment of the quality of finished pasta products was carried out in accordance with GOST 31964-2012: “Pasta products. Acceptance rules and methods for determining quality”.

4. Results and discussion

Soy okara or soybean millcake, formed during the production of soy milk, has a soft, shapeless mass that remains after the liquid has been squeezed out of soybeans. Humidity ranges from 62 to 70%.

In order to use it in the future as a raw material for the production of various food products, it is necessary that it meets the requirements of GOST 8057-95: "Food soybean cake".

The organoleptic characteristics of soy okara must meet the requirements presented in table 1. The appearance of soy okara is shown in figure 1.

Table 1: *Organoleptic indicators of soy okara*

Indicators	*Characteristics*
Colour	From yellow to light brown
Smell	Peculiar to millcake without specific bean and other foreign odours
Taste	Peculiar to millcake without specific bean and other foreign tastes

Figure 1. Appearance of soy okara

In accordance with GOST 8057-95, the mass fraction of moisture in soybean millcake should be from 6 to 8%.

In this regard, soy okara was subjected to drying in a drying oven, type ShS-80-01 SPU. The appearance of dried and ground soy okara is shown in Figure 2.

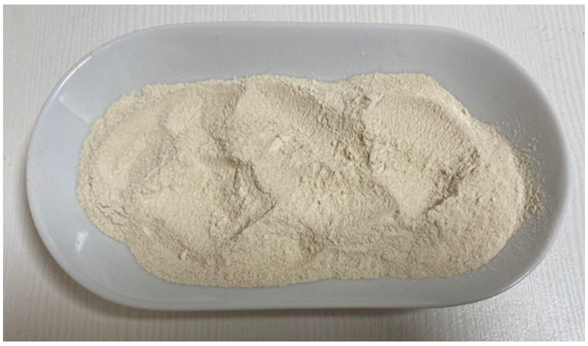

Figure 2. Appearance of dried and grinded soy okara

Pasta was prepared according to the traditional recipe presented in table 2.

Table 2: *Recipe for pasta*

Raw materials	*Contents, %*
Wheat flour of the highest grade	77
Water	23

The formation of pasta was carried out on a laboratory pasta press (extruder) with an installed matrix. The press carried out the mechanised kneading, pressing of the dough, shaping, and cutting of the pasta.

The kneading process was carried out for 20 minutes until the state of the dough reached the shape of small homogeneous lumps. Additionally, the required amount of water was added during mixing. After the end, the dough was pressed for 5 minutes through a bronze matrix with a fluoroplastic insert. Next, the pasta was cut into individual products up to 40 mm long.

After that, the resulting products were placed on a sheet covered with parchment, and sent to dry for 40 minutes at 60 °C. Drying of products was carried out in laboratory conditions (Figure 3).

Figure 3. Pasta: A – without adding of soy okara (control), B–D – with soy okara (sample 1, 2 & 3) (5, 10 & 15 g)

The developed pasta recipes are presented in table 3.

Table 3: *Developed pasta recipes*

Raw materials	*Control*	*Sample 1*	*Sample 2*	*Sample 3*
Wheat flour, g	300	295	290	285
Water according to the recipe + add. quantity, ml	90 + 20	90 + 20	90 + 15	90 +10
Soy okara, %	-	5	10	15

The resulting samples of pasta after drying are shown in Figure 4.

When kneading according to the traditional recipe, the dough for pasta turned out to be mealy. Therefore, the required amount of water was additionally added to create a finely lumpy, evenly moistened dough.

With an increase in the content of soy okara, the amount of additional water required decreased due to the water-holding capacity and good emulsifying properties of soy okara protein.

Control sample

Sample 1

Sample 2

Sample 3

Figure 4. Pasta samples after drying

Organoleptic indicators of finished pasta are presented in table 4.

Table 4: *Organoleptic indicators of finished pasta*

Indicator	**Research results**		
	Control sample	*Sample 1*	*Sample 2 / Sample 3*
Colour	Solid cream colour	Monochromatic, with a yellowish tint	Solid colour, creamy white
Shape	Thread-like, curved, do not stick together	Thread-like, curved, stick together	Thread-like, curved, do not stick together

Indicator	Research results		
	Control sample	*Sample 1*	*Sample 2 / Sample 3*
Consistency (after boiling)	Elastic, moderately dense (not overboiled)	Porridge-like appearance, stick together	Soft, moderately dense (not overboiled)
Taste and flavour	Inherent to this product, without foreign taste and smell		
Water for boiling	Slightly turbid	Slightly turbid, with a small amount of suspended solids	

According to organoleptic indicators, the obtained samples of pasta comply with the standards set by GOST.

Physical and chemical indicators of pasta are presented in table 5.

Table 5: *Physical and chemical indicators of pasta*

Indicator	Research results			
	Control sample	*Sample 1*	*Sample 2*	*Sample 3*
Humidity of products, %	12.4±0.3	13.8±0.2	12.7±0.4	12.6±0.2
Cooking time, min	10.1	9.5	9.7	9.4
Mass increase factor, g	1.90	2.10	2.19	2.28
Acidity of products, hail	3.9±0.01	4.2±0.01	4.5±0.02	4.8±0.01
Ash insoluble in 10% HCl solution, %	0.2±0.04	0.2±0.03	0.2±0.03	0.2±0.02
Shape retention of boiled products, %	100	100	100	100

Samples of pasta have a monochromatic colour with a creamy tint, are filiform, curved, and without foreign tastes and odours.

During the development of Sample No. 1, too much water was added during the dough kneading. This affected the appearance of the pasta. Unlike other samples, they have a yellowish tint and stick together.

The cooking time of samples with soy okara is practically the same as the cooking time of the control sample. The increase in weight gain is associated with the addition of soy okara due to its high fibre content.

The acidity of the pasta increases compared to the control sample. This indicator is associated with the use of additional raw materials (soy okara).

The acidity of pasta with soy enrichment should be no more than 5 degrees, which is normal.

Thus, based on the data obtained in tables 4 and 5, we can conclude that it is possible to use soy okara in the production of pasta.

The content of proteins in pasta was determined according to GOST 10846-91, based on the found amount of total nitrogen. In this case, when converted to protein, the conversion factor for nitrogen content to protein is used (k = 6.25).

The fibre content in pasta was determined according to GOST 31675-2012 using a semi-automatic system of the "Fibertec" type.

The results obtained are presented in table 6.

Table 6: Protein and fibre content of pasta

Name	*Protein content, %*	*Fibre content, %*
Control sample	11.00±0.8	3.20±0.09
Sample № 1	11.16±0.9	6.75±0.5
Sample ц № 2	13.08±0.7	9.50±0.6
Sample № 3	14.15±0.9	12.50±0.7

With an increase in soy okara content, the protein content in the obtained samples increases, due to the fact that dried soy okara flour contains a high protein content (31 g/100 g) compared to wheat flour (10 g/100 g). Soy okara protein is more complete, as evidenced by its amino acid composition. It has sixteen amino acids, including all the essential ones.

The received samples in comparison with the control lead in the content of fiber (2-4 times).

Thus, according to the content of protein and fibre, taking into account organoleptic, physico-chemical indicators, the recommended dosage of soy okara is 15% by weight of flour.

5. Conclusions

As a result of the research, it can be concluded that soy okara, which is a waste product of soy milk production, can be a useful enriching additive for pasta due to its high content of high-quality protein, dietary fibre, vitamins, and minerals.

In the work, a technological scheme for the preparation of soy okara was developed, a recipe was selected with the optimal dosage of 15%soy okara by weight of flour, which does not worsen organoleptic, physical, or chemical indicators, but only increases the nutritional value of the finished product.

In the developed samples of pasta with dried soy okara, the protein content is higher than in the control sample. This is due to the fact that okara contains a complete protein, as evidenced by its amino acid composition.

Soy okara contains a high amount of dietary fibre. The fibre content of the experimental samples is 2–4 times higher than in the control sample. In accordance with this, pasta with soy okara can be classified as a functional product, since the daily requirement for dietary fibre is satisfied by 40%.

The use of soy okara in the production of pasta not only contributes to the expansion of the product range, but also makes it possible to increase the content of complete vegetable protein in the human diet due to the mass consumption of this product.

6. Conflicts of interest

We declare that we have no financial and personal relationships with other people or organisations that can inappropriately influence our work; there is no professional or other personal interest of any nature or kind in any product, service, and/or company that could be construed as influencing the content of this paper.

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