Unconventional recipe component in the production of pasta

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Abstract. The use of secondary raw materials as new recipe ingredients in the production of food products is currently quite relevant. Soybean okara, which is a by-product of soy milk production, may be promising in this case. Special attention is paid to its technological properties and rich chemical formula which includes at least 5.5% of complete protein characterized by the content of all essential amino acids, dietary fiber, unsaturated fatty acids, macro-, microelements (potassium, calcium, magnesium, iron, iodine, etc.), vitamins (β-carotene, E, group B, choline, biotin, folic acid), isoflavones, which suggests the positive effect of the use of okara in food production in order to increase their consumer properties and nutritional value. It is important that soybean okara practically does not have any flavor, which allows to use it in the production of a great variety of food products and culinary. The article proves the possibility to use soybean okara in the production of pasta, gives some optimal drying parameters of soybean okara for its further use, investigates the influence of soybean okara on the properties of raw gluten of wheat flour, rheological characteristics of pasta dough and the quality, first of all, on cooking properties of pasta, determines its rational proportion taking into account the quality of the main raw material (11.5% to flour weight). The content of protein and fiber in the composition of soybean okara and finished pasta is determined.

1. Introduction

One of the main tasks of state economic policy in the field of ensuring food security in Russia is the search for new raw materials for the production of food products of high nutritional value, including secondary raw materials, which represent a significant reserve for saving plant materials [1].

The soybean or soya bean (lat. Glycine max) is an annual herbaceous plant of the legume family being one of the oldest cultivated plants. In Russia, they first learned about soybean after the expedition of V. Poyarkov to the Sea of Okhotsk in 1643-1646 during which he discovered the crops along the middle course of the Amur River. However, in Russia serious attention was paid to this leguminous oil crop only in 1873 after the World Exhibition in Vienna.

The main advantages of edible soy are its high productivity; a large amount (up to 50%) of complete protein that equals protein of meat products; a rich vitamin-mineral complex (including B vitamins, deficient iron and calcium, and potassium, and such essential polyunsaturated fatty acids as linoleic and linolenic). All this makes it possible to use soy for prophylactic purposes (to prevent
osteoporosis and cardiovascular diseases.) In addition, soybeans have a number of unique properties, which enables to produce from it a wide range of various products, including soy milk.

Soy milk production is a multi-stage process that ends with separation of soy milk from an insoluble solid mass of pale yellow color – okara that looks like a fluffy wet mass resembling millet gruel [2]. The chemical formula of soybean okara includes a lot of necessary and useful food substances that have important technological characteristics: up to 5.5% [3] of high-quality soy protein (according to other sources, the protein content can reach 24% [4]), 3% of the dietary fiber, 4% unsaturated fat, macro-, microelements, vitamins [2] and isoflavones [5]. Soybean okara protein is of especial value; it contains all essential amino acids and has a high degree of digestibility [6].

To date, soybean okara has found widespread use in food production. However, there is no data on its use in the industrial production of pasta, which makes the submitted scientific paper relevant and scientifically novel.

2. The purpose of the study
The purpose of the study was to find the possibility of using soy product (okara) in pasta technology, including the increase of pasta nutritional value.

3. The object of the study
The object of the study was soybean okara as a by-product of soy milk production by SP Samofalova L.A. according to STO 0103942807-002-2016, laboratory samples of pasta dough, semi-finished pasta and finished pasta.

4. Materials and methods
The soybean okara described in this paper was obtained from soybean Mezenka at the pilot factory of the Federal State Budgetary Scientific Institution «Federal Scientific Center of Legumes and Groat Crops» (settlement (of urban type) Streletskiy, Orel district, Orel region). The frozen okara was defrosted and dried using convection method in the electronic dryer (model VMD-2).

The properties of raw wheat gluten, pasta dough, and the cooking properties of pasta were studied according to generally accepted methods using the following technological instruments: Quartz-21M, SESH-3M, Structometer ST-1 (modes 2 and 3), Structometer ST-1M (mode 4, method 13).

The content of carotenoid pigment was determined according to GOST 8756.22-80. The content of protein nitrogen and crude fiber was determined together with «Innovative Research and Testing Center» at OrelGAU (Orel State Agrarian University named after N.V. Parakhin) (according to GOST 10846-91 and GOST 31675-2012, respectively).

5. Discussion of the results
The main raw material in the work was pasta flour of the highest grade (produced in Orenburg), the quality indicators of which corresponded to GOST 31463-2012, including mass fraction of moisture, % - 11.0 ± 0.1; acidity, number - 2.0; mass fraction of crude gluten, % - 28.61±0.2; mass fraction of dry gluten, % - 11.84±0.2; cohesive ability of crude gluten, N - 9.6; crude gluten quality, IDK (Gluten Deformation Meter) device units - 59.5; water absorption capacity of crude gluten, % - 142 ± 0.1; content of carotenoid pigments, mg - 0.037; granulometric composition, μm - 200-350.

The initial moisture content of soybean okara is 64% - 69%. For the purpose of its use in pasta production, okara was first dried to moisture content not exceeding that of wheat flour (no more than 15.5%). It was established that the optimal parameters of the drying process were: drying air temperature - 80 °C, drying time - no more than 3 hours (to moisture content of 11%). In this case, the protein content decreases by only 0.25% (from 7.22% to 6.97%). Dried okara was ground so that its particle size corresponded to the size of the particles of wheat flour, then such okara was sieved. Further, okara was used in the mixture with wheat flour in the following dosages: 8.5%; 10% and 11.5% to flour weight.
Table 1 shows the research results of the effect of soybean okara dried under optimal conditions on the properties of crude wheat gluten, the rheological characteristics of pasta dough and cooking properties of finished pasta.

Table 1. Effects of soybean okara on the properties of crude wheat gluten, wheat flour, rheological characteristics of pasta dough and cooking properties of finished pasta

| Indicator                                         | Soybean okara dosage, % to flour weight: | Reference sample |
|--------------------------------------------------|------------------------------------------|------------------|
| Amount of crude gluten, %                        | 8.5                                      | 11.5             | 10.0                                      | 28.61                                      |
| Amount of dry gluten, %                          | 26.64                                   | 26.84            | 27.12                                     | 11.44                                     |
| IDK, device units                                | 11.44                                   | 11.40            | 11.35                                     | 11.84                                     |
| Water absorption capacity of crude gluten, %     | 59.0                                    | 57.0             | 53.0                                      | 59.5                                      |
| Maximum shear stress of pasta dough, kPa         | 147                                     | 164              | 165                                       | 142                                       |
| Proportion of dry substances, transferred to cooking water during product cooking, % | 3.55                                    | 3.38             | 3.25                                      | 3.67                                      |

Since with the introduction of soybean okara the proportion of wheat flour in the mixture decreases, it is natural that the amount of crude and dry gluten in the mixture decreases as well. However, the actual values of these indicators are slightly higher than those estimated, which, in our opinion, is associated with the participation of proteins (mainly globulins and albumin, that is, low molecular weight proteins) and dietary fiber (pectin and fiber) of soybean okara in the formation of gluten structure [7]. And, in addition, high water absorption capacity of dietary fiber contributes to an increase in the amount of washed crude gluten.

IDK indicator decreased by 0.5-6.5 units shows that crude gluten strengthens as compared to the reference sample.

It is found that water absorption capacity (WAC) of crude gluten of wheat flour increases despite its strengthening by 5% - 21%, which can be explained by the interaction of gluten proteins with food fibers of soybean okara having high WAC [8].

Rheological behavior of pasta dough is closely connected with the properties of wheat gluten, therefore, increase in the values of maximum shear stress for test samples (by 0.84%; 14.3% and 21.43% depending on the dosage of okara) is natural.

In addition to organoleptic indicators, consumer advantages of pasta are characterized by their cooking properties and, above all, by the proportion of dry substances found in the cooking water. In this case, the value of this indicator for test samples is lower than that of the reference sample (by 0.12% - 0.42% depending on the dosage of soybean okara), although the reference sample fully complies with the requirements of the regulatory document (no more than 6%).

Thus, the research has resulted in a rational dosage of soybean okara. In this case, it is 11.5% to flour weight. However, when determining the rational dosages of any additional raw materials or
enriching additives, the quality of the main raw material for pasta production should be taken into account.

In the course of the preliminary studies it was found that in the sample dried at a temperature of 80 °C the protein content was 6.97%; fiber content in the okara not subjected to drying was 25.1% (with okara moisture of 64%).

The estimated data taking into account protein and fiber content in the composition of soybean okara are presented in Table 2.

| Table 2. Protein and fiber content in pasta |
|--------------------------------------------|
| Indicator                                  | Soybean okara dosage, % to flour weight: | Reference sample |
|                                            | 8.5   | 10.0  | 11.5  |       |
| Protein content, %                         | 11.56 | 11.49 | 11.41 | 12.0  |
| Fiber content, %                           | 8.27  | 9.01  | 9.71  | 3.70  |

Protein content in the test samples is slightly lower than in the reference sample, which is due to the fact that in okara itself the amount of protein is lower than in pasta flour. However, taking into account a more complete amino acid composition of soybean okara protein, one can say with certainty that the protein of the test samples is more complete than the protein of the reference sample.

6. Conclusion
In the course of pilot research the possibility of using soybean okara in the production of pasta has been established. Based on the study of the influence of soybean okara on the properties of crude gluten of wheat flour, the rheological behavior of pasta dough and quality indicators of pasta, okara rational dosage (11.5% to flour weight) has been determined taking into account the quality of the main raw material. A change in some indicators of pasta nutritional value has been shown when soybean okara is added to its recipe.

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