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INCREASING THE NUTRITIONAL VALUE OF PASTA BY USING LEGUMINOUS CROPS

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ABSTRACT

Ways to increase the nutritional value of pasta made from legume flour are discussed in the article. The technology of high nutritional value pasta in terms of protein, vitamins and minerals was developed. The developed technology allows to increase the biological value of the product and meets the goals in the field of healthy eating. All this confirms the relevance of the chosen topic, which is associated with the constant growth of consumer demand for pasta.

The aim of the work was to improve the technology of pasta by adding legumes, as well as determining the chemical composition of pasta and the amino acid composition of pasta.

Modern functional ingredients, such as chickpea and pea flour, were used to implement the tasks. The results of the research are presented in the form of research based on the advanced technology of high nutritional value pasta development.

The optimal amount for the replacement of flour was determined: 7.5% chickpea and 5% pea flour, as the means of pasta enrichment. Analysis of the chemical composition of pasta indicated an increase in protein content in the by 8.8%, in 3 by 8.35%, compared to the control in the first sample; fat content — by 2.8; 1.4% respectively, and the ash content — by 22.8; 17.1% compared to control (first sample). There was also an increase in iron and calcium, β-carotene, vitamin E content.

Analyzing the amino acid composition of pasta, an increase in the essential acids: lysine, methionine, tryptophan, threonine, valine, leucine, isoleucine compared to the control sample without legumes was observed. A similar trend was observed when examining substituted amino acids:

It was proved that the use of legumes in the technology of pasta helps to increase the nutritional and biological value in terms of protein, vitamins and minerals. The application of the results will be reflected in the development of the new type of high nutritional value pasta.

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ПІДВИЩЕННЯ ХАРЧОВОЇ ЦІННОСТІ МАКАРОННИХ ВИРОБІВ ПРИ ВИКОРИСТАННІ ЗЕРНОБОБОВИХ КУЛЬТУР

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У статті розглянуто шляхи підвищення харчової цінності макаронних виробів із борошном зернобобових культур. Розроблено технологію макаронних виробів підвищеної харчової цінності за вмістом білка, вітамінів та мінеральних речовин. Розроблена технологія дає змогу збільшити біологічну цінність продукту та відповідає меті здорового харчування. Все це підтверджує актуальність обраної теми, яка пов'язана з постійним, стабільним зростанням попиту споживачів на макаронну продукцію та забезпеченням населення повноцінними продуктами харчування.

Мета дослідження полягає в удосконаленні технології макаронних виробів шляхом збагачення їх зернобобовими культурами, а також визначенні хімічного складу макаронних виробів та амінокислотного складу макаронних виробів..

Для реалізації поставлених завдань застосовували сучасні функціональні інгредієнти, такі як борошно нуту та гороху. Визначено оптимальну кількість на заміну борошна: 7,5% нутового і 5% горохового борошна як збагачувачів макаронних виробів. Аналіз хімічного складу макаронних виробів вказує на збільшення вмісту білка в першому зразку на на 8,8%, у другому — на 8,35%, вмісту жиру, відповідно, на 2,8; 1,4%, вмісту золи — 22,8; 17,1% порівняно з контролем. Також спостерігається підвищення вмісту заліза та кальцію, β-каротину, вітаміну Е.

Аналізуючи амінокислотний склад макаронних виробів, спостерігаємо підвищення незамінимих кислот лізину, метіоніну, триптофану, треоніну, валіну, ізолейцину, лейцину порівняно з контролем. Доведено, що використання зернобобових культур у технології макаронних виробів сприяє підвищенню харчової та біологічної цінності за вмістом білка, вітамінів та мінералів. Результати досліджень буде впроваджено у розробці нового виду макаронних виробів підвищеної біологічної цінності.

Ключові слова: *макаронні вироби, функціональні інгредієнти, харчова цінність, зернобобові культури.*

Problem definition and its relationship with important practical tasks. In modern world the problem of providing the population with high-quality products is the most urgent. Food industry needs development of new products, the consumption of which will provide the population with vitamins, mineral substances and dietary fiber, which will promote public health. The most economically beneficial way is enrichment of mass consumption products which include flour confectionery.

In order to meet the demand, legumes and products of the flour processing industry — flour from chickpeas, peas, beans, wheat germ flakes and bran, are used, as they contain a significant amount of essential proteins, amino acids, polyunsaturated fatty acids, vitamins B, PP, E, minerals — calcium, magnesium, phosphorus, iron, food fibers, and have a low cost.

Analysis of recent studies and publications related to subject matter of the manuscript. Grain legumes are more beneficial than cereal grains in term of human health, being a rich source of nutrients. The risk of type-2 diabetes and cardiovascular diseases decreases with consumption of legumes (Jayathilake, 2018), while another positive effect include a reduction in the relative risk of developing myocardial infarction (Miller, 2017). The presence of fiber and phytochemicals in legumes lowers cholesterol and helps to regulate blood pressure (Bazzano, 2011). Moreover, the consumption of legumes improves health and assists in weight maintenance (McCrory, 2010). Legumes are also source of anti-cancer peptides which can potentially assist in the prevention of prostate and colorectal cancers (Luna-Vital & González de Mejía, 2018).

The feasibility of using pea fiber in the production of rye-wheat bread by accelerated technology was substantiated (Сильчук, Назар, Карпенко & Доценко, 2015). The influence of fiber on chemical processes in the dough, which characterize the balance of changes in sugars during dough preparation and gas-forming ability of the dough during fermentation, was studied. The content of sugars in finished products was analyzed. It was established that the introduction of pea fiber intensifies the technological process of bread production.

It is possible to make dietary and healthy pasta by introducing additives such pea meal and gram flour. The advantages of plant-based additives include their complex composition, the balance of individual components, and the presence of compounds in the most physiologically digestible forms (Матвеева, 2012).

Problem statement (statement of purpose of the manuscript). The objective of the research was studying the impact of leguminous crops' flour on the biological and nutrition values of pasta.

Comparative analysis on the composition of three types of flour, particularly, pea meal, gram flour and first-grade wheat flour, showed that there were significant differences in their protein, essential amino acids, vitamins, and macro and micro nutrients content.

The protein content of pea meal and gram flour was 1.87, which is 2.26 times higher than that of wheat flour. Flour from leguminous crops was not only richer in amino acids, but also in essential amino acids as lysine and methionine. The content of lysine in pea meal and gram flour was 5.7 and 6.36 times higher than in first-grade wheat flour, and the content of methionine was 2.09 and 1.77 times higher. These type of flour from leguminous crops are rich in minerals (calcium, iron) and vitamins (vitamin E, β — carotene) (Пащенко & Курчаева, 2004).

Materials and methods. Investigation of the chemical composition of leguminous flour and the effect of chickpea and pea flour on gluten and physical properties of the dough, on the quality and nutritional value of finished products in accordance with GOST.

In this regard, a research was conducted on the nutritional and biological value of pasta from first-grade wheat flour with the addition of 7.5% of gram flour (Sample 1)

and 5% of pea flour (Sample 2). Pasta without any additives was the control sample
Presentation of the main material. As the results of the study of the chemical composition of pea meal and gram flour meal, as well as their effect on the properties of gluten, on the physical properties of the dough, and on the quality of the finished products, the optimal dosages were suggested: to replace flour 7.5% of gram flour and 5% of pea meal as pasta fortifier.

In this regard, a research was conducted on the nutritional and biological value of pasta from first-grade wheat flour with the addition of 7.5% of gram flour (Sample 1) and 5% of pea flour (Sample 2). The chemical composition of pasta is shown in Table 1.

Table 1. **Chemical composition of pasta**

Indicators	Content per 100 grams of product		
	Control sample	Sample 1	Sample 2
Moisture content, %	13.0	13.0	13.0
Proteins, %	11.01	11.98	11.93
Fats, %	1.42	1.46	1.42
Carbohydrates, %	68.8	67.25	67.03
Fiber, %	0.20	1.20	1.13
Ash, %	0.70	0.86	0.82
Minerals, mg			
Ca	30 ± 6.4	39.0 ± 7.5	33 ± 6.4
Mg	42.0 ± 9.0	44 ± 9.1	40 ± 8.0
Fe	2.5 ± 0.5	2.62 ± 0.52	3.18 ± 0.60
Vitamins, β-carotene, mg	12.1	16.59	13.74
E	1.79	1.96	1.87
PP	2.23	2.24	2.15
Energy value, kcal	352	358	354

The results of the research analysis showed that the content of protein, vitamins and minerals in pasta products using legume flour increased. Thus, in comparison with control sample, the protein content in Sample 1 increased by 8.8%, while, in the Sample 2 — by 8.35%. The fat content increased by 2.8 and 1.4%, the ash content increased by 22.8 and 17.1% respectively.

Using flour from legumes in pasta dough the content of such elements as calcium and iron in ready-made pasta products increased. It was found that, in comparison with the control sample, the calcium content increased by 30% in Sample 1 and by 10% in Sample 2. The iron content increased by 4.8% and 27.2 % respectively.

It is seen from Table 1 that vitamin content of pasta products with gram flour and pea flour increased. In comparison with the control sample, the content of β-carotene (in Sample 1) increased by 37.1% and (in Sample 2) — by 13.5%. The content of vitamin E increased by 9.5% and 4.5%, respectively.

The composition of amino acids in flour, as well as in pasta made from this flour, determines the protein value of the final product. In this case, essential amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, tryptophan, threonine and valine) are of a particular value, as they cannot be synthesized in humans body. Lysine is one of the most important amino acids among other essential ones.

The results of the study of the content of amino acids in pasta from legumes' flour (Table 2) show that, in comparison with the control sample, the content of lysine in Sample 1 and Sample 2 increased 1.33 and 1.36 times. Compared to the control sample,

the content of methionine in pasta products with gram and pea flour was 1.05 times and 1.02 times higher. The content of following amino acids was higher in pasta products with gram and pea flour: threonine — 1.17 and 1.2 times; tryptophan — 1.17 and 1.13 times; valine — 1.1 and 1.1 times; isoleucine — 1.27 and 1.17 times; leucine — 1.05 and 1.06 times.

Similar data were obtained for nonessential amino acids. The content of alanine increased 1.08 times in the Sample 1and 1.13 times in Sample 2 in comparison with the control sample. The same change was observed for other nonessential amino acids: arginine content increased 1.35 and 1.3 times, respectively.

Table 2. **Amino Acid composition of pasta products**

Amino acids	Content per 100 grams of product		
	Control sample	Sample 1	Sample 2
Essential amino acids, mg			
Total amount	3488	3904	3949
Valine	550	582	589
Isoleucine	502	637	585
Leucine	941	982	996
Lysine	292	338	397
Methionine	179	187	183
Threonine	323	380	390
Phenylalanine	584	661	677
Tryptophan	117	137	132
Nonessential amino acids, mg			
Total amount	7730	8701	8004
Alanine	386	415	436
Arginine	467	631	609
Aspartic acid	397	564	584
Histidin	233	287	258
Glycine	409	439	454
Glutamic acid	3596	3383	3438
Prolin	1133	1847	1109
Serine	584	530	522
Tyrosine	292	342	341
Cystinum	233	263	253
Total amount of amino acids, mg	11218	12605	11953

The content of aspartic acid increased 1.42 and 1.47 times; histidine — 1.23 and 1.1 times; and glycine — 1.1 and 1.1, 11 times.

Conclusions

Thus, the analysis of the presented data showed that the use of flour from legumes is an appropriate way for enriching pasta such as proteins, essential amino acids, vitamins and minerals. The application of the results will be reflected in the development of the new type of pasta of high nutritional value.

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