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COMPARATIVE ANALYSIS OF THE CHEMICAL COMPOSITION OF RYE, WHEAT, AS WELL AS TRITICALE AND FLOUR FROM THEM GROWN IN THE REPUBLIC OF UZBEKISTAN

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The results of a comparative analysis of the chemical composition of rye, wheat and triticale grains grown in the Republic of Uzbekistan and their flour are presented. The main components of these grains are determined. Based on the results of the analysis, it was found that the amino acids of rye and wheat grains grown in the Republic of Uzbekistan differ from products grown in other regions.

Keywords: grain, variety, soft wheat, winter wheat, winter rye, protein, amino acids, biological value.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ХИМИЧЕСКОГО СОСТАВА ЗЕРНА РЖИ, ПШЕНИЦЫ, А ТАКЖЕ ТРИТИКАЛЕ И МУКИ ИЗ НИХ, ВЫРАЩИВАЕМЫХ В РЕСПУБЛИКЕ УЗБЕКИСТАН

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Представлены результаты сравнительного анализа химического состава зерна ржи, пшеницы и тритикале, выращенных в Республике Узбекистан, и их муки. Определены основные компоненты этих зерен. По результатам анализа установлено, что аминокислоты зерен ржи и пшеницы, выращенных в Республике Узбекистан, отличаются от продуктов, выращенных в других регионах.

Ключевые слова: зерно, сорт, мягкая пшеница, озимая пшеница, озимая рожь, белок, аминокислоты, биологическая ценность.

ӨЗБЕКСТАН РЕСПУБЛИКАСЫНДА ӨСІРІЛГЕН ҚАРА БИДАЙДЫҢ, БИДАЙДЫҢ, СОНДАЙ СОНДАЙ ТРИТИКАЛЫҚ ЖӘНЕ ОЛАРДАН ҰНЫНЫҢ ХИМИЯЛЫҚ ҚҰРАМЫНА САЛЫСТЫРМАЛЫ ТАЛДАУ

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Өзбекстан Республикасында өсірілетін қара бидай, бидай және тритикале дәндерінің және олардың ұнының химиялық құрамын салыстырмалы талдау нәтижелері берілген. Бұл дәндердің негізгі компоненттері анықталады. Жүргізілген талдау нәтижелері бойынша Өзбекстан Республикасында өсірілген қара бидай

және бидай дәндерінің аминқышқылдары басқа аймақтарда өсірілген өнімдерден ерекшеленетіні анықталды.

Түйінді сөздер: астық, сорт, кәдімгі бидай, күздік бидай, күздік қара бидай, ақуыз, аминқышқылдары, биологиялық.

Introduction. The health and longevity of the population directly depend on proper nutrition, so the problem of healthy nutrition remains relevant. One of the priority tasks of the food industry is to provide the population with food products. The functional composition of food products intended for rational nutrition should be formed in a wide range by scientists and manufacturing specialists, consisting of specialists from many fields [1].

Bread is the main food product. The big problem is that the mills of the Republic of Uzbekistan produce only flour from soft wheat, and as a result of the production of bread and flour confectionery products, the population lacks the nutrients that should be absorbed from flour products. The lack of research and reform in this direction further complicates the problem.

The compositional potential of various grains and legumes for baking flour is regularly studied throughout the world. This situation increases the relevance of studying the composition of various grains due to the fact that some countries have low climatic and agrotechnical capabilities for the production of grains, or the baking properties of a number of wheat and rye grains do not meet the requirements; the gluten it contains causes the development of some allergic diseases. At the same time, if we take into account the abundance of flour products in the diet of the population of our republic in comparison with grain products, a comparative analysis of the necessary components of local rye, triticale and other cereal grain products for everyday human needs allows us to identify tasks aimed at solving the problem.

The purpose of the research is to expand the range of baking flour, compare the chemical composition of rye and wheat grains grown in the Republic of Uzbekistan, as well as flour extracted from them.

Methods and materials. Flour products, especially bread, are a relatively inexpensive food product, consumed daily and accessible to all categories of the population. Recipes for bakery products with the following chemical composition useful for the human body: proteins 25-30%, carbohydrates - 30-40%, vitamins, minerals and dietary fiber - 20-25% satisfy the daily human need for these substances, increasing the amount of these substances increases nutritional and biological value of products [2].

The main raw material for the production of traditional bakery products is currently wheat flour. The grains from which most baking flours are made are rich in carbohydrates, the amount of their main components varies within different limits (Table 1) [3].

Table 1 - Amount of main components in spiked grains, %

Type of grain	Water	Proteins	Fats	Carbohydrates	Food fibers	Ash
Wheat	14,0	11,8	2,2	59,5	10,8	1,7
Rye	14,0	9,9	2,2	58,5	16,4	1,7
Triticale	14,0	12,8	1,5	58,6	11,1	2,0

The table shows that the amount of dietary fiber in rye grain is 5.6% more than in wheat grain, and 5.3% more than in triticale grain, and the amount of ash is the same as in wheat grain, but 0 .3%. less than triticale. It is concluded that, judging by the structural content, rye grains, compared to wheat grains and triticale, are more beneficial for the human body. Therefore, growing rye on the territory of the Republic of Uzbekistan and studying the technological properties of batches of rye grain are of great importance. The mass fraction of protein fractions in grains of wheat, rye and triticale was determined by many researchers (Table 2) [4].

Table 2 -Ratio to the total amount of protein fractions of different cereals, %

Type of grain	Albumen	Globulin	Glutelin	Prolamin	Insoluble residue
Wheat	5,2	12,6	28,2	35,6	8,7
Rye	35,7	20,2	11,9	11,3	20,8
Triticale	26,4	6,5	17,3	24,4	19,0

The table shows that, compared to wheat grains and triticale, the amount of protein fractions that are easily digestible by the human body in rye grains is different: there are more albumins by 30.5-9.3%, globulins by 7.6-13.7%. It can be concluded that flour and cereal products made from rye grain have a higher biological value compared to flour from other grains.

It is not only the amount of protein in food that is important, but also its amino acid composition. Therefore, research widely examines the amount of protein in various grains and their fractions and their amino acid composition. It has been established that the amino acid content of the grains indicated in the table. 3 is important [5-7].

Table 3 -Average aminoacid composition of spikelet grains, 100 *g/mg*

Indicators	Wheat	Rye	
Total Essential Amino Acids	3257	2770	3731
Valin	486	457	541
Isoleucine	411	360	460
Leucine	780	620	890
Lysine	360	370	410
Methionine	180	150	180
Threonine	390	300	390
Tryptophan	150	130	140
Phenylalanine	500	450	720
otal nonessential amino acids	7452	6791	8663
Alanin	380	459	470
Arginine	494	520	620
Aspartic acid	557	670	700
Histidine	244	200	290
Glycine	470	430	490
Glutamic acid	3106	2660	3670
Proline	1068	910	1320
Serin	530	420	520
Tyrosine	370	280	380
Cystine	230	242	203

Results and discussion. From the results presented in Table 3, it is clear that the amount of essential amino acids in triticale grain is higher than in rye and wheat grain.

Analysis of the chemical composition of rye and triticale grains grown in the Republic of Uzbekistan and their technological significance in processing have not been sufficiently studied. However, the technological, structural-mechanical, baking, hydrothermal properties and technological potential of local groups of wheat grain in flour milling have been widely studied [8-12].

The need to analyze the amino acid content when determining the biological value of food grains has been substantiated [12]. The amount of amino acids was studied: proline (0.94 and 0.79 g/100 g) and leucine (1.62 and 1.52 g/100 g) of winter rye. Studies conducted by many scientists show that resistance to drought and various other climatic factors is due to the content of proline in plant tissues, which is actively synthesized under various unfavorable conditions and acts as an osmoprotector [1, 2, 4, 5, 11].

In the limiting essential amino acids - threonine,

winter wheat is richer by 18 and 12%, methionine by 64.0 and 22.6%, lysine by 44 and 14%, respectively, compared to rye grain and triticale. In grain, the concentration of tryptophan is lower - 0.11-013 g/100 g.

The biological value of wheat and rye grains is 17 and 18%, respectively. The biological value of protein is limited to the lowest ranked essential amino acid. When studying all plants planted in autumn, i.e. overwintered, the amino acid content of the following varieties is lysine, and the amino acid level is below 100%. Winter wheat varieties Novosibirskaya 2 and Novosibirskaya 3 have a higher lysine content than other winter cereals - amino acid levels are 84 and 80%, respectively. Winter rye varieties, especially Petrovna 1, have a low amino acid content - only 32%. The results of determining amino acid scores in the studied grain samples of autumn crops showed that, in terms of biological value, the grain of varieties grown in the forest-steppe conditions of the southeast of Western Siberia has an average and low level of quality [12].

It has been established that the grain of the Zu Drive variety of foreign selection of winter rye has the lowest quality. Its biological value is 33%, which corresponds to a low level of quality grading. Low-quality grains are mainly used for feed. For example, regionalization of such varieties is not allowed in Canada, the USA and other countries [6, 14].

Despite the fact that rye grain contains less protein than wheat grain, due to the increased content of some important amino acids - lysine, threonine, phenylalanine - rye grain is more nutritious than wheat grain [8, 9, 10, 13, 17] .

The proteins of the aleurone layer and the embryo contain more lysine, tyrosine, histidine and serine. Table 4 shows the amino acid content of rye and wheat based on research. The biological value of the proteins of the aleurone layer and the embryo is higher than that of the endosperm proteins [7, 8, 9, 13, 16].

Despite the fact that 75% of the protein is in the endosperm, a decrease in the weight of 1000 grains increases the amount of protein in the grain and processed flour, therefore the highest concentration of protein is considered to be protein in the aleurone and husk layers of the grain, and the increase in small grains in grain batches is compared with the protein in endosperm layer and aleurone, proteins in the layer constitute a high percentage. In table Table 4 shows the composition of amino acids in rye and wheat [8, 9, 10, 13, 15, 17, 18].

Table 4 - Amino acid composition of rye and wheat grains

Amino acids	Average amount of amino acids, %		
	Rye	Wheat	”Ideal” protein
Lysine	3.9	2.5	3.00
Histidine	2.1	2.2	5.43
Arginine	6.0	5.1	5.45
Aspartic acid	7.3	4.3	7.30
Threonine	3.2	2.6	6.57
Serine	4.6	4.9	7.26
Glutamic acid	29.0	27.9	7.39
Proline	9.9	9.6	1.14
Glycine	4.4	5.8	3.89
Valine	5.2	4.1	2.91
Isoleucine	3.4	4.4	5.38
Leucine	6.7	7.7	7.44
Tyrosine	2.9	2.5	4.20
Phenylalanine	4.9	4.7	4.44

Experimental part. Isolation of free amino acids. Precipitation of proteins and peptides from the aqueous extract of the samples was carried out in centrifuge beakers. To do this, 1 ml (exact volume) of 20% TCA was added to 1 ml of the test sample. After 10 min, the precipitate was separated by centrifugation at 8000

rpm for 15 min. 0.1 ml of the supernatant was separated and freeze-dried. The hydrolyzate was evaporated, the dry residue was dissolved in a mixture of triethylamine-acetonitrile-water (1:7:1) and dried. This operation was repeated twice to neutralize the acid. By reaction with phenylthioisocyanate, phenylthiocarbamyl derivatives (PTC) of amino acids were obtained according to the method of Steven A., Cohen Daviel. Identification of amino acid derivatives was carried out by HPLC. HPLC conditions: Agilent Technologies 1200 chromatograph with DAD detector, 75x4.6 mm Discovery HS C18 column. Solution A: 0.14 M CH3COONa + 0.05% TEA pH 6.4, B: CH3CN. Flow rate 1.2 ml/min, absorbance 269 nm. Gradient %B/min: 1-6%/0-2.5 min; 6-30%/2.51-40 min; 30-60%/40.1-45 min; 60-60%/45.1-50 min; 60-0%/50.1-55 min [3].

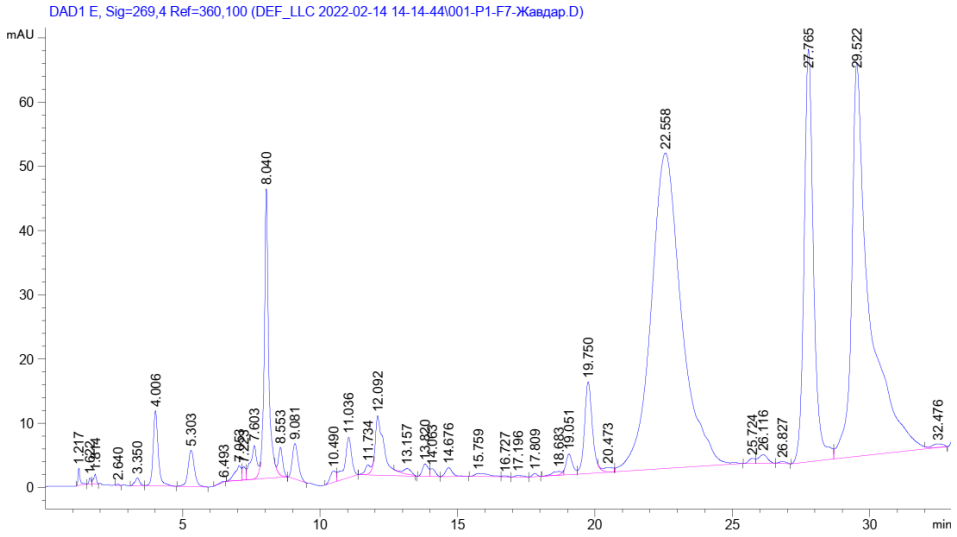

Fig. 1 - Diagram of the amino acid composition of rye grain protein according to experimental data

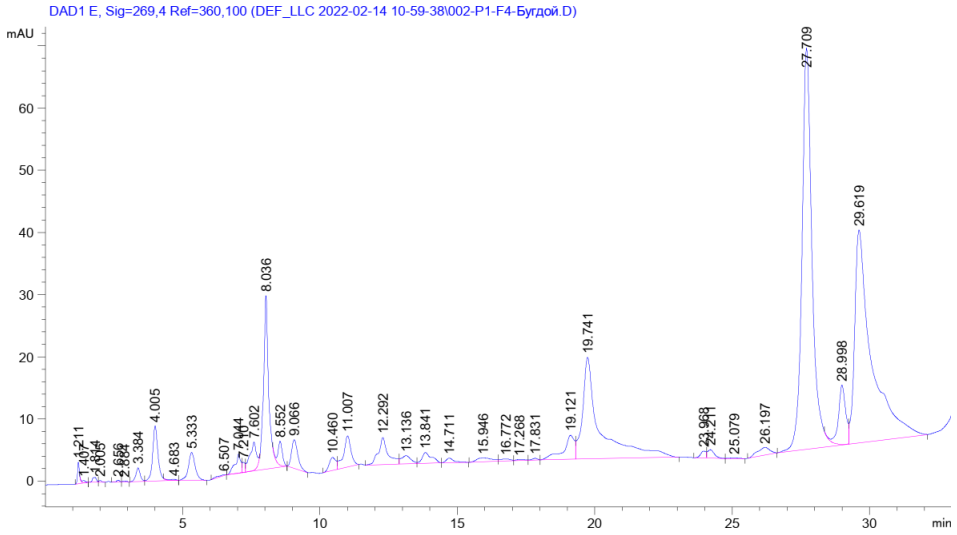

Fig. 2 - Diagram of the amino acid composition of wheat grain protein according to experimental data

Conclusions. Based on the results of the experiments, it was established that the amount of non-exchangeable amino acids in grain products is 2 times more than exchangeable amino acids in wheat and 1.5 times more in rye. The fact that nonessential amino acids cannot be synthesized in the human body demonstrates how important these products are. If there is a deficiency of proteins in the food products that we eat, these essential amino acids are used, then there is an imbalance of nitrogen in the body. This causes negative consequences for the human body: the person loses weight and stops growing. In addition, specific changes occur in the body [19-22].

Table 5 - Content of amino acids in the cereal protein of winter wheat grain “Davr” and winter rye grain “Vakhsh-116”

Name of amino acids	Wheat	Rye
	Concentration, мг/г	
Essential amino acids		
Aspartic	0,321769	0,397511
Glutamic	0,189061	0,229271
Serin	0,177442	0,194431
Glycine	0,445046	0,470672
Asparagine	0,435839	0,552007
Glutamine	0,182374	0,279165
Cysteine	0,533435	0,407295
Alanin	0,033806	0,017842
Proline	0,118658	0,081454
Tyrosine	0,406437	0,208458
Nonessential amino acids	2,843867	2,838106
Essential amino acids		
Threonine	0,276583	0,056363
Argenine	0,213912	0,443908
Valin	1,250259	0,495509
Methionine	0	0,041058
Isoleucine	0,044605	0,036468
Leucine	0,055477	0,073732
Histidine	0,016523	0,036638
Tryptophan	2,464393	0,892579
Phenylalanine	0,421936	0,968385
Lysine	1,426528	0,031426
Essential amino acids	6,170216	3,076066
Total	9,014083	5,914172

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