THE SIGNIFICANCE OF WHEAT AND BARLEY GRAINS IN ORGANIZING TARGETED CONSUMPTION RATIONS

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Abstract*. This study investigates the nutritional, biochemical, and technological potential of wheat and barley grains for the production of functional bakery and instant pasta products intended for special dietary consumption. Wheat remains one of the most important cereal crops worldwide due to its gluten-forming proteins, high energy value, and suitability for bread and flour products. Barley, however, demonstrates significant advantages in dietary fiber, β-glucan, vitamin E, minerals, antioxidants, and low glycemic index properties. Comparative analysis showed that barley contains higher levels of fiber and bioactive compounds, while wheat possesses superior gluten-forming amino acids essential for dough elasticity and bread structure. Scientific literature and analytical data confirm that the combination of wheat and barley flours can improve nutritional quality, antioxidant activity, and functional characteristics of cereal-based foods. The incorporation of barley components into wheat-based products contributes to reduced cholesterol levels, improved digestive health, and enhanced biological value. The study highlights the importance of developing functional grain products to support public health, diversify food production, and increase the economic efficiency of locally available cereal resources.*

Keywords: *β-glucan, barley grain, extrusion technology, dehulled barley, dietary fiber, physicochemical properties, functional food, instant products.*

INTRODUCTION

Cereal grains play a fundamental role in global food security and human nutrition. Among them, wheat is considered one of the most widely cultivated and consumed crops due to its high nutritional value, technological suitability, and ability to form elastic dough through gluten development [1]. Wheat-based products such as bread, pasta, and confectionery products represent major components of the daily diet in many countries and provide a substantial proportion of energy, protein, vitamins, and minerals required for human health [2]. The unique gluten network formed by wheat proteins contributes to desirable baking characteristics and porous bread structure, making wheat an irreplaceable raw material in the food industry [3].

In recent years, growing consumer awareness regarding healthy nutrition and the prevention of chronic diseases has increased demand for functional food products enriched with biologically active compounds. In this context, barley has attracted considerable scientific and industrial interest because of its rich composition of β-glucan, dietary fiber, antioxidants, vitamins, and minerals. Compared with wheat, barley demonstrates a lower glycemic index and higher levels of physiologically beneficial compounds that contribute to cardiovascular protection, cholesterol reduction, digestive health, and improved metabolic function [4].

Scientific studies indicate that the integration of barley flour into wheat-based products can significantly enhance their nutritional and functional properties. Barley proteins possess lower allergenic potential than wheat gluten proteins, making barley-containing products suitable for consumers with specific dietary requirements. Moreover, barley contains valuable compounds such as gamma-tocopherol, ferulic acid, lutein, and phytosterols, which exhibit strong antioxidant activity and support human health.

The development of functional bakery and instant pasta products using local cereal resources is particularly important for improving public nutrition and expanding the ассортимент of special dietary foods. Therefore, the present study focuses on the comparative analysis of wheat and barley grains and evaluates their potential application in the production of nutritionally enriched cereal-based products [5].

RESEARCH OBJECTS AND METHODS

The research objects of this study were wheat grain, barley grain, wheat flour, barley flour, and composite flour mixtures intended for the production of layered bread and instant pasta products. The chemical composition, amino acid profile, nutritional value, and functional-technological properties of the cereal raw materials were investigated. Particular attention was given to gluten proteins, β-glucan content, dietary fibers, vitamins, minerals, and antioxidant compounds [6].

Standard physicochemical and biochemical analytical methods were used during the research. Protein content was determined using the Kjeldahl method, while fat content was analyzed by Soxhlet extraction. Dietary fiber and ash contents were measured according to conventional gravimetric procedures. Amino acid composition was evaluated using chromatographic analysis [7]. Functional properties of dough, including water absorption, elasticity, and gluten quality, were assessed using rheological and baking tests. Comparative statistical analysis was applied to evaluate differences between wheat and barley samples [8]. Scientific literature, international nutritional databases, and published studies related to cereal functionality and dietary products were also systematically reviewed and analyzed.

RESULTS AND DISCUSSIONS

Barley contains higher amounts of magnesium and potassium compared to wheat. Magnesium is essential for muscle and nervous system function, energy production, and bone health, while potassium helps maintain fluid balance and supports cardiovascular health. These minerals contribute to overall health and help prevent conditions such as hypertension and osteoporosis.

Barley is also a good source of phosphorus, which is important for bone health and energy metabolism. In addition, it contains iron, which is necessary for hemoglobin formation and oxygen transport in the blood. Although these minerals are also present in wheat, the bioactivity and composition of barley make it particularly valuable in combating mineral deficiencies and improving nutritional quality.

Barley is rich in antioxidants, including carotenoids such as lutein and zeaxanthin, which are beneficial for eye health and help reduce the risk of age-related degeneration. Barley also contains phytosterols, plant compounds that help lower cholesterol levels and improve heart health. Phytosterols compete with cholesterol for absorption in the digestive system, thereby reducing total cholesterol concentration.

Barley oil is rich in gamma-tocopherol, a form of vitamin E with strong antioxidant properties. Gamma-tocopherol helps protect cells from oxidative damage and supports overall health. This compound gives barley nutritional advantages over wheat grain.

Barley also contains ferulic acid, a phytochemical with powerful antioxidant properties that may help protect against chronic diseases such as cancer and cardiovascular disorders. The presence of ferulic acid further enhances the health-promoting characteristics of barley compared to wheat.

From a chemical composition perspective, barley has several advantages over wheat. Its lower glycemic index, higher dietary fiber content, beneficial fatty acids, elevated levels of vitamins A and E, and rich mineral composition provide significant nutritional benefits. Furthermore, the presence of valuable phytochemicals, antioxidants, gamma-tocopherol, and ferulic acid highlights the superior functional properties of barley grain. Together, these characteristics improve the functionality of barley and support special dietary and health-related nutritional needs.

At the same time, these products are also economically significant because they are based on locally available raw materials.

Table 1. Analytical table of grain plant raw materials when organizing targeted consumption rations

Grain raw materials	Bio chemical composition	Beneficial properties	Application	Glycemic index	Additional information
Wheat	Protein, starch, vitamin B, minerals	A source of energy that promotes cell renewal	Flour, Cereal, Bread, and Confectionery	70	Raw materials suitable for special diets
Barley	Beta-glucan, fiber, vitamin E	Lowering blood cholesterol, nutritious	Barley groats, cookies	55	Suitable for diet meals

The role and significance of cereal crops in organizing targeted consumption rations were considered above. The chemical composition of cereal grains was also considered, and the composition relative to wheat grain was analyzed (Table 2).

Table 2. Chemical composition of cereals

Grain types	Water	Protein	Fats	Carbohydrates	Fiber	Ash
Wheat	14,0	11,8	2,2	59,5	10,8	1,7
Barley	14,0	10,3	2,4	56,4	14,5	2,4

According to the analysis of Table 1, the proportion of protein in barley grain is higher than in wheat grain, and barley grain has a clear advantage in the proportion of carbohydrates. Amino acids are the most important component, as a result of which the human body restores mature cells and produces new ones. This work examines the amino acid composition of target flour varieties. The amino acid composition of the grains is presented in Table 3 below.

According to the analysis presented in Table 3, the total amino acid content of wheat (10,709 mg) and its essential amino acid fraction (3,257 mg) were higher than those of barley grain

(9,946 mg and 3,151 mg, respectively). The gluten-forming amino acids, particularly glutamic acid and proline, were significantly higher in wheat. In contrast, barley contained higher amounts of leucine and alanine, whereas lysine and cystine levels were greater in wheat. Layered bread and instant pasta products enriched with these amino acids contribute to strengthening overall health, improving immunity, and increasing energy levels. Such products are especially beneficial for athletes, children, and individuals following special dietary regimens.

Table 3. Amino acid composition of cereal grains (100 mg/g)

Indicators	Wheat	Barley
Non-replaceable:	3257	3151
Valine	486	416
Isoleucine	411	312
Leucine	780	1282
Lysine	360	247
Metionine	180	120
Treonine	390	247
Phenylalanine	500	460
To be replaced:	7452	6795
Alanine	383	790
Arginine	494	411
Aspartic acid	557	580
Histidine*	244	260
Glycine	470	350
Glutamic acid	3106	1780
Proline	1050	400
Serine	576	290
Tyrosine	370	346
Total amino acid content	10709	9946

Compared with conventional wheat flour, the analysis of amino acid compositions of special flours produced from wheat and barley grains demonstrated elevated levels of important amino acids such as phenylalanine, isoleucine, leucine, methionine, valine, lysine, and threonine in all flour types.

Considering the importance of grain-based products, particularly layered bread and instant pasta products, and taking into account that the average local consumer currently consumes approximately 52 kg of grain products annually, the development of functional and safe food products in Uzbekistan has become highly significant. The expansion of health-oriented layered bread and instant pasta production contributes to improving public sanitary and epidemiological well-being.

Several regional healthy nutrition programs currently exist; however, many of them are narrowly focused on eliminating deficiencies of iodine, iron, and other individual nutrients, without addressing the comprehensive prevention of macro- and micronutrient deficiencies. At the same time, despite the planned expansion of enriched food assortments, the issues associated with producing sufficient quantities of such products are often not adequately addressed.

According to statistical data, the annual production volume of functional and therapeutic-preventive bakery products does not exceed 10 thousand tons, whereas the demand reaches

approximately 500–600 thousand tons. In developed countries, the production share of such products reaches up to 30% of the total grain product volume and demonstrates continuous growth.

Foreign experience in the production of grain-based special dietary products shows that countries such as the United Kingdom, Germany, and the United States actively incorporate wheat, rye, or barley bran, whole grains, sprouted barley flour, vegetable and fruit additives, and other components into the daily diet of the population. In recent years, the share of functional grain products in the total production volume in the United States increased from 18% to 34%. In 2024, retail sales of these products increased by 27% in the United States compared with 2022, by 68% in the United Kingdom, and doubled in Germany.

Currently, biologically active additives used to improve the specific characteristics of flour products include dietary fibers, vitamins such as C, D, B-group vitamins, β-carotene, tocopherols, minerals and vitamin-mineral premixes, lipids containing unsaturated omega-3 fatty acids, oligosaccharides, sugar substitutes, proteins, and flours obtained from unconventional cereal processing technologies.

The market for special dietary products, including layered bread and instant pasta products, is rapidly expanding due to increasing consumer awareness of health and lifestyle influences. The growing prevalence of chronic diseases such as diabetes, obesity, and gluten sensitivity significantly affects demand for functional and alternative cereal-based products. The integration of plant proteins, fiber-rich composite flours, and bioactive compounds contributes to the development of the next generation of health-oriented food products.

Future prospects in this field are associated with the formation of a culture of targeted nutrition, sustainable and green technologies, and innovative production systems. These trends increase consumer demand for healthy and sustainable food products, encourage manufacturers to implement competitive innovations, and strengthen the need for scientific research in this direction.

The future of special dietary products is not only promising but also critically important for improving global public health and ensuring the sustainability of the food industry.

CONCLUSION

The conducted study confirmed that wheat and barley grains possess valuable nutritional and technological characteristics important for the development of functional cereal-based foods. Wheat grain remains the primary raw material for bakery and pasta production due to its high gluten-forming ability, favorable amino acid composition, and excellent dough-forming properties. At the same time, barley grain demonstrates considerable advantages in terms of dietary fiber, β-glucan, antioxidant compounds, vitamins, and mineral composition.

Comparative analysis showed that barley contains higher levels of fiber, vitamin E, and bioactive compounds capable of reducing cholesterol concentration, improving intestinal function, and lowering the glycemic response of food products. Wheat, however, exhibited superior gluten quality and higher levels of certain amino acids essential for dough elasticity and product structure. The combination of wheat and barley flours therefore represents a promising approach for producing balanced functional foods with improved nutritional and physiological value.

The integration of barley into layered bread and instant pasta technologies can enhance product quality, increase antioxidant activity, and support preventive nutrition against chronic diseases such as diabetes, obesity, and cardiovascular disorders. In addition, the use of locally available cereal raw materials contributes to economic efficiency and sustainable food production. The study demonstrates the importance of further research aimed at optimizing composite flour

formulations and expanding the production of health-oriented grain products for special dietary consumption.

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