

Article

Amino Acid Content in Hulled and Hull-Less Barley Varieties

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Abstract: This article presents data on the amino acid content in hulled and hull-less barley varieties. The research objects included the hull-less barley variety "O'zbekiston-30" and the hulled barley variety "Bolg'ali". The amino acid content in grain composition was determined in the laboratory of the Research Institute of Agrobiotechnology and Biochemistry, Gulistan State University. The obtained results showed that the total amino acid content in hulled barley grain was 39.02 mg/g, while in hull-less barley it was 45.68 mg/g. It was noted that lysine is one of the limiting amino acids. Its content was determined to be 0.422 mg/g and 0.500 mg/g, respectively. It was also established that the proportion of essential amino acids in hull-less barley is 15–16% higher compared to hulled barley.

Keywords: Barley varieties, hulled barley, hull-less barley, amino acids, essential amino acids, limiting amino acid, biological value of protein.

Introduction

Barley (*Hordeum vulgare* L.) is a cereal crop belonging to the group of spike-bearing grains and is classified into multi-row (*H. vulgare* L. subsp. *vulgare*) and two-row (*H. vulgare* L. subsp. *distichon* (L.) Koern.) types. In addition, both hulled and hull-less forms of barley grain are widely distributed. Hulled barley is mainly used as animal feed, whereas hull-less barley is utilized in the food industry, for example, in the production of pearl barley and dietary flour [1].

It has been established that hull-less barley grain differs from hulled barley in terms of the content of essential amino acids, β -glucans, vitamins, macro- and microelements, as well as phenolic compounds and flavonoids [2].

The quality of protein is evaluated based on its amino acid composition. Due to the low content of amino acids such as lysine, tryptophan, and threonine in plant proteins, animal proteins are consumed to compensate for this deficiency. This, in turn, leads to an increase in fatty acids and cholesterol levels in the human body [3].

As noted above, the quality of protein depends on the amount and composition of amino acids it contains. The biological value of proteins is assessed using the amino acid score. This indicator determines how closely a given protein corresponds to a reference (standard) protein. According to the amino acid score, the amino acid present in the lowest amount is considered the limiting amino acid [4].

Using the score of essential amino acids, various plant products such as chestnut, pistachio, peanut, macadamia, Brazil nut, walnut, and hazelnut have been analyzed. The results demonstrated that among the studied products, chestnut, pistachio, and peanut are more effective for use in food. This is due to their relatively high biological values, which were found to be 69.4%, 65.0%, and 59.9%, respectively [5].

When analyzing the grains of crops such as sesame, sunflower, flax, rapeseed, wheat, chickpea, green pea, bean, and lentil, it was determined that methionine, cysteine, and lysine are limiting essential amino acids. Based on the coefficient of variation of the amino acid score (AASC, %), it was found that sunflower (66.7%), flax (6.43%), and rapeseed (64.01%) exhibited relatively higher values; therefore, their biological value was lower compared to other crops. In contrast, products derived from plants such as sesame (77.60%) and lentil (83.37%) were found to have higher biological value [6].

It has been recognized that amino acids are not only indicators of the biological value of protein but also serve as important criteria determining plant resistance to stress conditions. Amino acids such as lysine, glutamic acid, glycine, and histidine contribute to the absorption of nutrients in plants, while arginine, tyrosine, threonine, valine, serine, and alanine are involved in the regulation of metabolic processes. It has also been noted that serine plays a significant role in enhancing plant resistance to drought and salinity [7].

It has been reported that proline plays an important role in determining plant resistance to stress conditions. It has been established that the content of proline increases in genotypes tolerant to saline environments. This is associated with the high capacity of proline to maintain water retention and regulate ion balance in the cells of salt-tolerant genotypes. Therefore, proline content is considered an important physiological and biochemical indicator in evaluating plant tolerance to stress conditions [8].

It is well known that barley is mainly used as a forage crop. At the same time, it has been recognized that hull-less barley grain can also be utilized in food production. For example, it has been reported that high-quality bread can be produced by mixing hull-less barley flour (10.0%) with wheat flour (90.0%) [9].

However, in our republic, the possibilities of using hull-less barley in the food industry have not been fully explored. This is primarily due to the absence of locally adapted varieties of hull-less barley. As a result of long-term research, the hull-less barley variety "O'zbekiston-30" has been developed [10].

The main objective of this study was to determine and compare the amino acid content in hulled and hull-less barley varieties.

Materials and Methods

Research object. The research objects included the hull-less barley (*Hordeum vulgare* L.) variety "O'zbekiston-30" and the hulled barley variety "Bolg'ali". These varieties were studied under slightly saline experimental field conditions at the Research Institute of Agrobiotechnology and Biochemistry, Gulistan State University.

The amino acid composition of plant samples was determined qualitatively and quantitatively using standard samples supplied by Sigma-Aldrich (Germany). The analysis was carried out using a high-performance liquid chromatography (HPLC) system (Agilent 1260 II Infinity, Agilent Technologies, USA) equipped with a fluorescence (FLD) detector. A Poroshell 120 EC-C18 column (150 mm × 4.6 mm × 4 μm, USA) was used as the stationary phase.

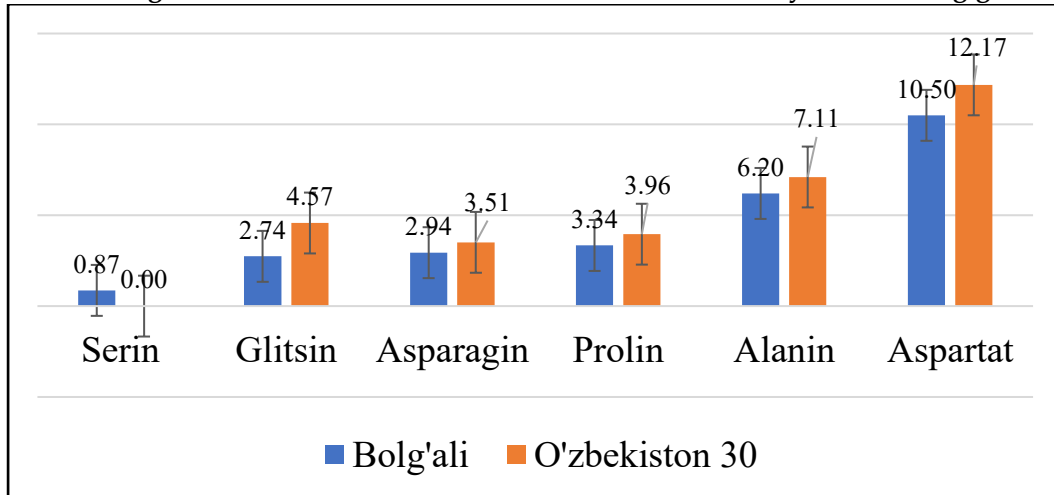
Statistical analysis of the primary data was performed using the SPSS-17 software package.

Results and Discussion

The obtained results revealed that amino acids such as glutamate, glutamine, threonine, and tryptophan were not detected in the grains of both hull-less and hulled barley varieties. The amino acid serine was found in the “Bolg’ali” variety at a level of 0.87 mg/g, whereas it was not detected in the “O’zbekiston-30” variety [11][12].

At the same time, among non-essential amino acids, the contents of glycine, asparagine, proline, alanine, and aspartate ranged from 2.74 to 10.50 mg/g in the “Bolg’ali” variety, while in the “O’zbekiston-30” variety they ranged from 4.51 to 12.17 mg/g (Figure 1).

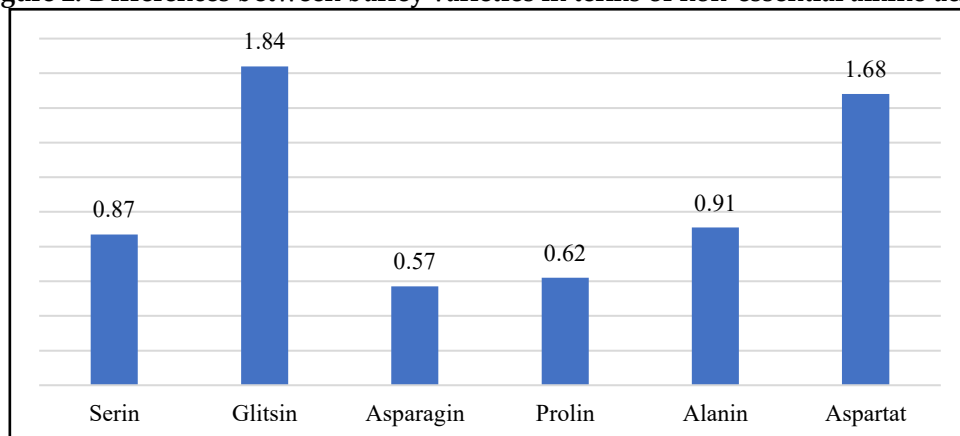
Figure 1. Content of non-essential amino acids in barley varieties (mg/g)



Based on these data, a comparative analysis of barley varieties showed that the “O’zbekiston-30” variety was superior in terms of the content of amino acids such as glycine, asparagine, proline, alanine, and aspartate (Figure 2).

According to the data presented in the figure, the glycine content in the “O’zbekiston-30” variety was 1.84 mg/g higher than in the “Bolg’ali” variety. A similar trend was observed for other amino acids, including asparagine (0.57 mg/g), proline (0.62 mg/g), alanine (0.91 mg/g), and aspartate (1.68 mg/g), where the “O’zbekiston-30” variety also showed higher values compared to the “Bolg’ali” variety[13].

Figure 2. Differences between barley varieties in terms of non-essential amino acids.



Note: “-” indicates that the content in the hull-less barley variety “O’zbekiston-30” is lower compared to the “Bolg’ali” variety, while “+” indicates a higher content.

In general, the non-essential amino acids in the grains of both hull-less and hulled barley varieties were arranged in the following ascending order: serine < glycine < asparagine < proline < alanine < aspartate[14].

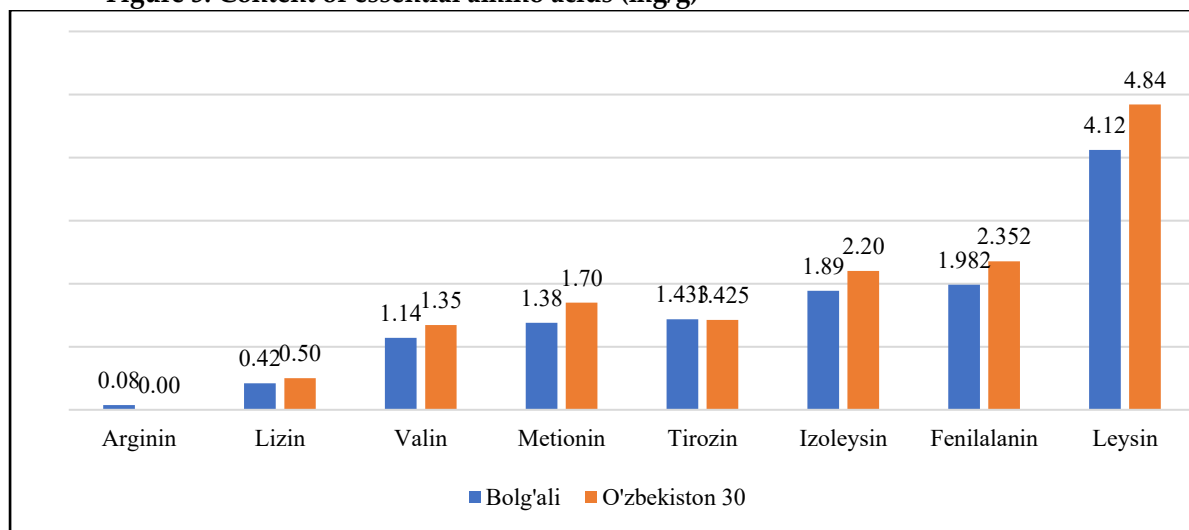
Based on these data, it was determined that among the non-essential amino acids, aspartate was present in the highest amount in the studied barley varieties.

It is well known that the biological value of protein is determined by its content of essential amino acids. The analysis results showed that the total amount of essential amino acids in the “Bolg’ali” barley variety was 12.44 mg/g, whereas in the “O’zbekiston-30” variety it was 14.36 mg/g. Differences between the barley varieties in terms of essential amino acid content were observed (Figures 3 and 4).

The content of arginine in the “Bolg’ali” variety was 0.08 mg/g, whereas this amino acid was not detected in the “O’zbekiston-30” variety. The valine content was 1.14 mg/g in the “Bolg’ali” variety and 1.35 mg/g in the “O’zbekiston-30” variety. The lysine content was 0.42 mg/g and 0.50 mg/g, respectively.

According to the data presented in the figures, among the essential amino acids, arginine and lysine were found in the lowest amounts, while leucine was present in the highest amount. The leucine content was 4.12 mg/g in the “Bolg’ali” variety and 4.84 mg/g in the “O’zbekiston-30” variety[15].

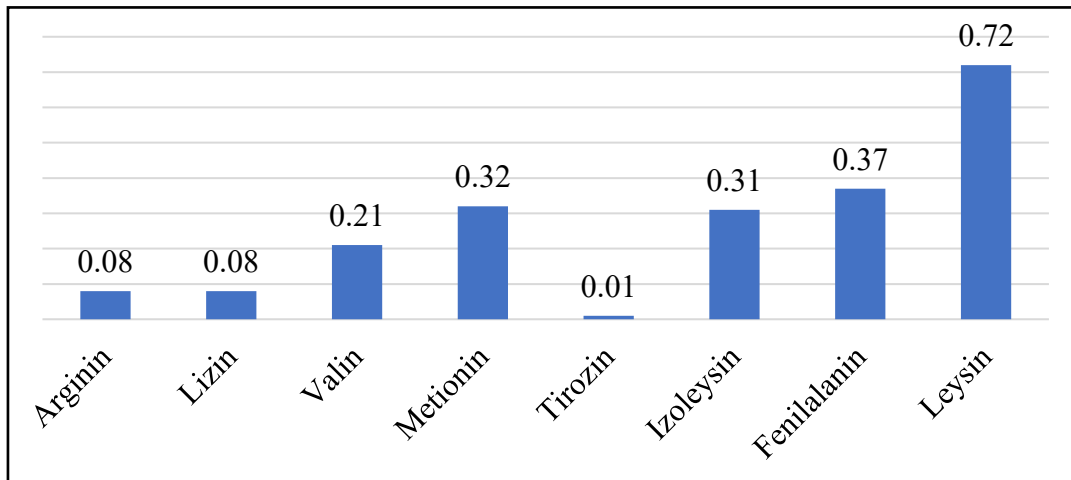
Figure 3. Content of essential amino acids (mg/g)



Based on the obtained results, a comparison of barley varieties showed that the “O’zbekiston-30” variety was superior to the hulled barley variety “Bolg’ali” in terms of all essential amino acids, except for arginine and tyrosine.

In particular, the leucine content in the “O’zbekiston-30” variety was found to be higher by 0.72 mg/g compared to the “Bolg’ali” variety (Figure 4).

Figure 4. Differences between barley varieties in terms of essential amino acids.
Note: “-” indicates that the content in the hull-less barley variety “O‘zbekiston-30” is lower compared to the “Bolg‘ali” variety, while “+” indicates a higher content.



In general, the results showed that amino acids such as glutamate, glutamine, threonine, and tryptophan were not detected in either of the studied barley varieties. The contents of glycine, asparagine, proline, alanine, and aspartate ranged from 2.74 to 10.50 mg/g in the “Bolg‘ali” variety and from 4.51 to 12.17 mg/g in the “O‘zbekiston-30” variety[16].

Among the analyzed amino acids, aspartate was found to be relatively abundant, accounting for 26.9% of the total amino acids. Among the essential amino acids, leucine constituted 10.6% of the total amino acids and 33.7% of the essential amino acids.

The higher content of leucine in barley varieties (in comparison with other amino acids) may contribute to increased cellular osmotic pressure under stress conditions, thereby enhancing resistance to drought and salinity.

Conclusion

1. Lysine was identified as a limiting amino acid in both hulled and hull-less barley varieties, with its content being 0.422 mg/g in hulled barley and 0.500 mg/g in hull-less barley.
2. The total amino acid content was 39.02 mg/g in hulled barley and 45.68 mg/g in hull-less barley.
3. It was determined that the content of essential amino acids in hull-less barley grain is 15–16% higher compared to hulled barley.

It was concluded that the resistance of barley to drought and saline conditions may be associated with the higher content of leucine.

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