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Influence of Ion-Ozone Cavitation Processing on the Amino Acid Structure of Wheat Grain

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Abstract

Reception of qualitative, environmentally friendly and balanced by the chemical composition of agricultural products, particularly food grains, recently become particularly relevant. Special attention is being given to the analysis of amino acid composition. The aim of the current research is to establish the influence Ion-Ozone cavitations treatment changes the amino acid composition of wheat grain. These results give reason to believe that we use Ion-Ozone processing in the cavitations zone have a positive impact on the quality of winter wheat—namely, increase in the content of lysine and threonine in the grain and improvement in the overall biochemical properties of grain processing.

Keywords

Ion-Ozone cavitations treatment; Amino acids; Amino acid score; wheat

Introduction

Wheat is one of the main sources of protein. Proteins play a particularly important role in the life processes of humans and animals. Proteins consist of amino acids [1]. Proteins that contain all the essential amino acids are called biologically complete; the rest are considered inferior. Essential amino acids cannot be synthesized in humans and animals and should be included in food [2]. The quality of protein is determined by the composition of amino acids contained in it: The more, the higher food and feed dignity culture. Most valuable are the following essential amino acids: valine, lysine, tryptophane, etc [3].

The amino acid composition is a biochemical criterion of the biological value of feed and food products (for the total content of essential amino acids) and the structural basis of protein molecules that perform specific functions in the cell [4]. Amino acid content in the grain, and in particular gluten cereal plants, is determined primarily by genetic factors and is different in composition for different proteins. It is noted that the feeding conditions have almost no effect on the amino acid composition of total proteins of vegetative organs. Amino acid composition of total proteins in wheat varies based on the variety of feeding conditions and characteristics but substantially less than the content of free amino acids [5].

Under the biological value of protein mean proportion of nitrogen retention in the body of the total nitrogen grown deep. Nitrogen retention in the body with adequate content of essential amino acids in dietary protein is sufficient to maintain the growth of the organism. According to the content of essential amino acids in the protein, amino acid score is calculated, which characterizes the biological value of protein. To calculate the score, the amino acid composition of the test protein is compared with the ideal protein composition as recommended by FAO/WHO. Amino acid, which has a fast lowest value, is called the first limiting acid. Importance of early this acid determines the biological tsenostey and digestibility of protein [6].

The aim of the current research is to establish the effect of Ion-Ozone cavitations on the amino acid composition of wheat grain. First was performed a full factorial scientific experiment taking into account the concentration of oxygen ions and ozone, cavitation parameters, and duration of grain processing in minutes. As a result, produced 16 runs and processed in different modes according to the plan drawn up for the experiment. The criteria for evaluation of the results of the study were the structural changes of thirteen amino acids: arginine, lysine, tyrosine, phenylalanine, histidine, isoleucine + leucine, methionine, valine, proline, threonine, serine, alanine, glycine [7].

The task of obtaining high-quality, environmentally friendly, and balanced chemical composition of agricultural products, particularly food grains, has recently become particularly relevant. The solution to this task is to study the chemical composition of the grain of wheat. With a special attention is given to the analysis of amino acid composition [8].

Methods

The objective of our research is the wheat cultivar "Bagornaya-56." Investigations were carried out in the laboratory of innovative technology and food processing at Almaty Technological University.

To test the effectiveness of Ion-Ozone grain processing in the field of cavitation, we carried out parallel experiments with and without using cavitation. The prepared samples were processed air Ion-Ozone grain mixture with a minimum mode ozone concentration of 2.0 g/m^3, the concentration of molecular ions of 9,000 U/cm^3, and the exposure processing time of 5 min at a maximum capacity ozone concentration of 6.0 g/m^3, the concentration of molecular ions of 64,000 units/cm^3, and the exposure processing time of 20 min [9].

Ion-Ozone grain processing zone with minimal cavitations regime produced an increase in pressure in the installation Ion-Ozone cavitations 0.2 MPa when the ozone concentration of 2.0 g/m^3, the concentration of molecular ions 9,000 U/cm^3 and exposure processing time of 5 min at maximum capacity with increasing the pressure in the installation Ion-Ozone cavitations 0.6 MPa, at a concentration of ozone of 6.0 g/m^3, the concentration of molecular ions 64,000 U/cm^3 and exposure processing time of 20 min [10].

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Analysis of the amino acid composition of wheat was conducted in the Food Security laboratory at Almaty Technological University. The amino acid composition was determined using a capillary electrophoresis system, Capel-105 [11] Method. Capillary zone electrophoresis. This method is efficient because practically it does not require the use of expensive high-purity solvents and involves low reagent consumption [12].

The analysis conditions are as follows:

- Buffer: working buffer (phosphate)
- Temperature Analysis: +30.0°C
- Length: 959 s
- Voltage: 25 kV
- Pressure: 0 mbar
- Wavelength: 254 nm
- Calculation method: Absolute graduation [11]

Results

To test the effectiveness of Ion-Ozone grain processing in the field of cavitation, we carried out five stages of comparative experiments. At the first stage of the study were determined to control the content of the samples studied amino acids. Results of the studied content of the amino acid composition of wheat grain in the control sample are shown in Figure 1 [13].

Figure 1 shows that the amino acid composition of the reference sample varieties of rained wheat 56 is characterized by a considerable content of proline, leucine, isoleucine, and serine+.

In the second phase of research carried out Ion-Ozone processing of wheat grain with minimal mode. The change in the content of the amino acid composition of wheat is shown in Figure 2 [14].

With minimal processing mode ionoozon protein wheat is characterized by a considerable content of proline, leucine + isoleucine, and glycine.

In the third phase of research carried out Ion-Ozone processing of wheat grain at maximum capacity. The change in the content of the amino acid composition of wheat is shown in Figure 3 [15].

At maximum capacity Ion-Ozone processing protein wheat greatest changes observed in leucine + isoleucine, proline, phenylalanine, and serine. In the fourth phase of research carried out Ion-Ozone cavitations processing of wheat grain with minimal mode. The change in the content of the amino acid composition of wheat is shown in Figure 4 [16].

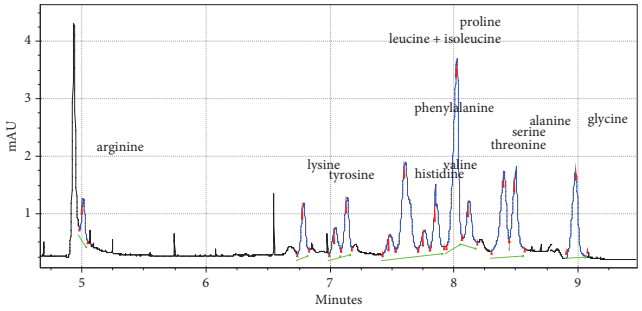

Figure 1: Electropherogram of the amino acid composition of the control sample varieties of rainfed wheat 56

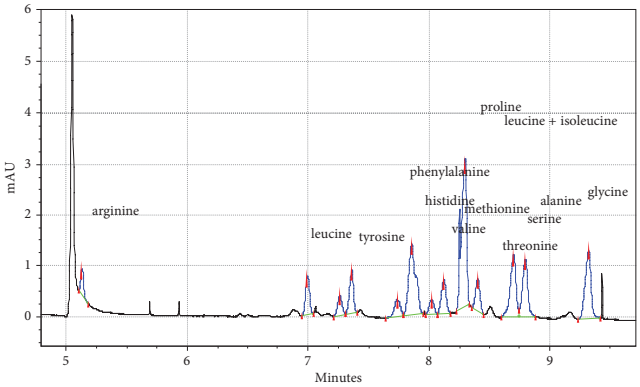

Figure 2: Electropherogram of amino acids with minimal regime ionoozonnoy processing of grain

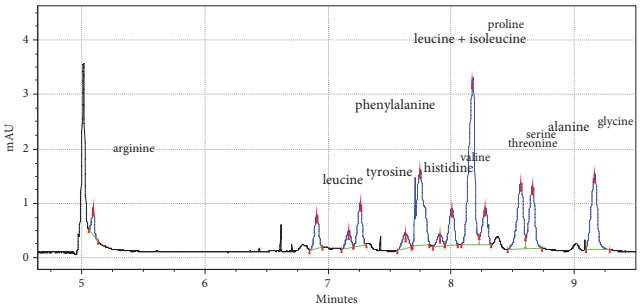

Figure 3: Electropherogram of amino acids at maximum capacity Ion-Ozone grain handling

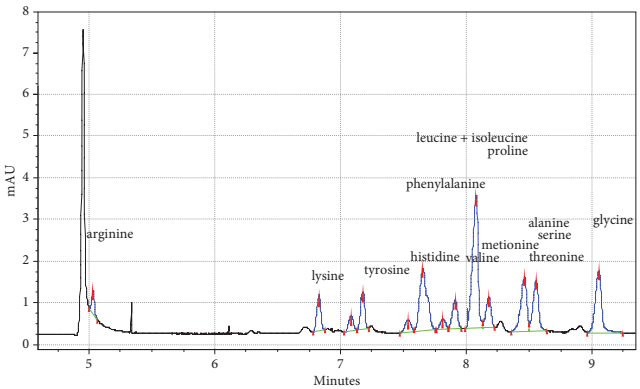

Figure 4: Electropherogram of amino acids with minimal mode Ion-Ozone cavitations grain handling

With minimal processing mode, in the protein of wheat, largest changes are observed for proline, leucine + isoleucine, and phenylalanine and the lowest in arginine and methionine.

At the fifth stage of research conducted, Ion-Ozone cavitations processing of wheat grain at maximum capacity. The change in the content of the amino acid composition of wheat is shown in Figure 5.

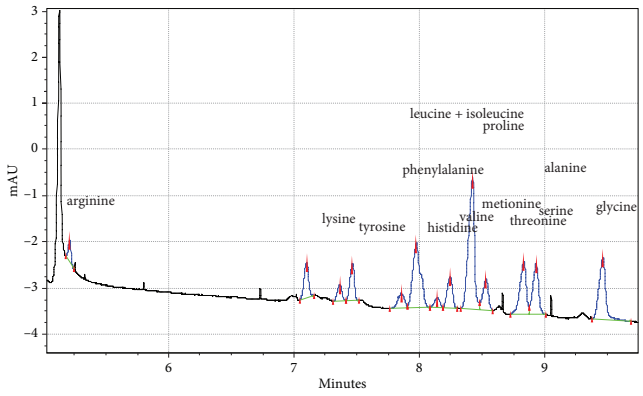

Figure 5: Electropherogram of amino acids at maximum capacity Ion-Ozone cavitations processing wheat

Discussion

With the maximum processing mode, in the protein of wheat, largest changes are observed in (except leucine + isoleucine) proline, serine, and phenylalanine and the lowest in tyrosine and methionine. Amino acid composition of proteins plays an important role because their amino acids are involved in the synthesis of important physiologically active compounds in the body and provide some of the properties of food and feed products. Table 1 shows the amino acid compositions of the treated wheat grain.

From Table 1 it can be seen that in all embodiments experience less contains methionine. From this table it also follows that the treatment of the grain increased the content of phenylalanine, histidine, valine, proline, and threonine compared with the control. When Ion-Ozone cavitations processing increases essential amino acids such as lysine, phenylalanine, isoleucine, and leucine + threonine compared with ionoozonnoy processing. This is due to the fact that in the process of cavitation treatment, conditions are favorable for the action of enzymes that are particularly active in 2-4 min cavitation. We can assume that in the course of mud pulse, cavitation treatment creates favorable conditions for the synthesis of proteins by enzymes [17].

Amino acid	Option experiments				
	Control	№ 1	№ 2	№ 3	№ 4
Arginine	3.7	3.2	2.9	3.3	2.8
Lysine*	3.0	2.9	2.5	3.2	3.2
Tyrosine	3.5	3.3	2.6	3.1	3.0
Phenylalanine*	6.1	6.3	6.1	6.4	6.4
Histidine	3.1	3.7	2.8	3.2	3.9
Leucine + isoleucine*	14.7	13.1	13.2	14.4	13.8
Methionine*	2.2	1.8	1.5	1.7	1.6
Valine*	4.3	3.7	3.9	3.9	4.1
Proline	16.2	16.4	18.4	18.8	17.7
Threonine*	3.6	3.5	4.4	4.6	4.6
Serine	7.6	7.4	7.1	7.9	6.8
Alanine	5.7	5.4	5.6	5.9	5.4
Glycine	5.2	4.9	5.2	5.9	5.9

*Essential amino acids, № 1—Ion-Ozone processing with minimal mode, № 2—Ion-Ozone treatment at maximum capacity, № 3—Ion-Ozone cavitations with minimal mode, № 4—Ion-Ozone cavitations at maximum capacity.

Table 1: Amino acid composition of wheat

In addition, it is necessary to take into account the fact that the uncontrolled use of agricultural herbicides, pesticides, growth of plants, animals and birds, which then fall to the food in the human body, a negative impact on his health.

Mass diseases medicines to treat only completely insufficient, it is necessary to carry out preventive health. One embodiment of the prophylactic treatment of a large number of patients is to use functional foods. This food, have the ability to not only nourish the human body, saturating it with the necessary amino acids, lipids, carbohydrates, vitamins and minerals, but also to neutralize the negative factors affecting human health through its food. As a result, many new forms of previously unknown diseases, the number of diseases of the cardiovascular system, cancer, etc.

Analysis of the status and trends of modern technologies for the production of functional foods shows that most of their production is based on the use of cereal grains. Raw material for the preparation of a large variety of foods are seeds of plants are dormant. Compared with the germinating seeds in these seeds decreased respiration rate and metabolism, is relatively small content of vitamins and trace elements, and replacement substances are in the form of complex molecules of proteins, fats, and carbohydrates. These seeds produce flour and cereals, they are the basis of many of bakery and confectionery products, including a variety of prepared cereals, flattened grains for cereals, popcorn, and more. It should be noted that sprouts are a natural product. All substances are useful in their natural, balanced amounts and combinations of these substances are incorporated into the organic system of living tissue. Their assimilation does not affect adversely on human health, and it can be observed in the use of some pharmaceutical agents. In addition, enzymes produced in germinating seeds cleaved complex replacement substances (proteins, fats, carbohydrates) into simpler ones (amino acids, fatty acids, simple sugars), and using in foods seedlings, humans spend much less effort on their digestion and absorption compared with other products obtained from the dry grain.

The development of theoretical foundations and chemical studies of functional new-generation products are now pressing tasks and of practical importance.

The aim of this work is to study the chemical composition and, on the basis of biological activity, study foods derived from germinated seeds.

Our studies have established that Ion-Ozone processing in the field of cavitations wheat causes quantitative changes in the amino acid composition.

For a more complete characterization of complete protein wheat used and the influence of factors on the figure we defined amino acid score for the protein content of essential amino acids [18].

Option experiments	Amino acids					
	Isoleucine	Leucine	Lysine	Methionine + Threonine	Valine	Phenylalanine + tyrosine
Control	133	54	62	90	86	160
№ 1	119	53	51	87	74	160
№ 2	120	46	42	110	78	145
№ 3	130	58	48	115	78	159
№ 4	125	58	45	115	82	157

*Essential amino acids, № 1—Ion-Ozone processing with minimal mode, № 2—Ion-Ozone treatment at maximum capacity, № 3—Ion-Ozone cavitations with minimal mode, № 4—Ion-Ozone cavitations at maximum capacity.

Table 2: Amino acid fast wheat, %

Calculation of amino acid score was carried out according to the following formula:

$$C = (A_j/H_j) \times 100\%$$

where C is the rate, %; A_j is the content of the jth amino acid in the protein of wheat, g/100 g of protein; and H_j is the content of the jth amino acid in an ideal protein, g/100 g protein.

Amino acid score of the wheat variety "Beauharnais 56" is shown in Table 2.

Conclusion

Calculation of amino acid shows that the first limiting acid for the control sample is lysine at Ion-Ozone and Ion-Ozone cavitations processing—methionine. According to the literature on indicators of the total amino acid score lower biological value of wheat have limiting amino acids which are lysine and threonine [19].

Thus, the results give reason to believe that the use of Ion-Ozone processing in the cavitations zone has a positive impact on the quality of winter wheat—namely, increase in the content of lysine and threonine in the grain and improvement in the overall biochemical properties of grain processing.

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