Technological parameters and chemical composition of soya beans

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Abstract. This article covers technological characteristics of localized soybeans, data on obtaining cereals and other types of products from them. Data based on analyzes obtained for soybean grain varieties are also provided. Physical-chemical properties of soybean varieties, proteins, fats and carbohydrates in the obtained products are widely analyzed. The macro-, micronutrients, and biologically active substances in soybeans are analyzed, and it is determined that they cause biological and physical-chemical changes in human health, and their deficiency leads to various immune-related diseases.

1. Introduction

Nowadays, meeting the demand of population for food products is becoming a big global problem, because one of the most difficult situations in the world today is the demographic growth. For example, in the last 50 years, the world's population has grown from 2.5 billion to 7.0 billion, or 2.4 times. This index, which is growing by the minute, indicates that the vital need for food security is growing. Currently, 1 billion people on the planet are eating well, 1 billion are hungry and the remaining 4.5 billion are malnourished. This means that if no remedial action is taken, then “the dangerous protein deficiency will take over the world.”

In accordance with the Resolution “On amendments and additions to the Resolution of the President of the Republic of Uzbekistan No. PR-3144 of July 24, 2017 “On measures to increase the sowing of soybeans and soybeans in the Republic in 2017-2021” No. PP-2832 of March 14. 2017. taking into account the soil and climatic conditions of each region, the possibility of increasing crop production is being identified. In solving this problem, special attention is paid to meeting the needs of the population in plant protein [1].

It is known that soya is one of the most nutritious, rich in amino acid in terms of its nutritional value and is quickly digestible product. In addition, soya protein is dominated by three factors in its composition.

- Amino acid composition.
- Digestion.
- Rich in minerals and vitamins.

Soya protein is 85-90% water-soluble protein, and its digestibility is very high. When soy protein is added to food, its nutritional value increases. For example, when 10% soy flour is added to wheat
flour, the protein content of bread increases by 1.11% and the energy value of bread increases by 3 times.

According to the Decree of Cabinet of Ministers of Republic of Uzbekistan PD-2832 in 2017, 20,000 hectares were allocated for the sowing of soybeans as the main crop, and 20,000 hectares for repeated sowing. This decision shows that the products of soybeans and other leguminous plants are used in all sectors of the economy in the country [2].

2. Results and discussion
Composition of soya is very rich in chemical compounds. For example, it contains 24-45% protein, 20-25% fat, 20-32% carbohydrates, micro- and macro-elements, as well as vitamins D, B, E and others. Soybeans can be used to produce oil, protein and other unique products. The chemical composition of grains of Uzbekskaya-2, Uzbekskaya-6 and Dustlik varieties zoned in Republic of Uzbekistan was studied. For this, three different soybean grains typed well-ripened soybean grains, poorly ripened soybean grains, insect-infested soybean grains, and broken soybean seeds were studied in 1,000 grain masses. However, the length and diameter of the grain were also measured in these grains [3]. Physical-technological characteristics of the grain of three different soybean varieties are given in table 1.

Table 1. Physical-technological characteristics of soybeans.

| No | Varieties of soya beans | Mass of the 1000 grains, g | Whole grain mass | Unripe grain mass | Defective grain mass | Broken grain mass | Dry grain size, mm | Grain size soaked in water for 24 hours, mm |
|----|-------------------------|-----------------------------|-------------------|-------------------|---------------------|-------------------|-------------------|---------------------------------------------|
| 1  | Dustlik                 | 210.7                       | 18.2              | 9.5               | 16.9                | 2.3               | 0.8               | 0.6                             | 1.3   | 0.8 |
| 2  | Uzbekskaya-2            | 189.2                       | 16.2              | 8.0               | 14                  | 2                 | 0.7               | 0.5                             | 1.2   | 0.7 |
| 3  | Uzbekskaya-6            | 189.9                       | 16.5              | 8.2               | 14.2                | 2.2               | 0.7               | 0.5                             | 1.2   | 0.7 |

As can be seen from table 1, the mass of 1000 grains, the value of whole grains, broken and defective grains shows a higher rate in the “Dustlik” variety than in other soya bean varieties. The results obtained on the dry size of the grains showed that the “Dustlik” variety is larger in length and diameter than the “Uzbekskaya-2” and “Uzbekskaya-6” grain varieties. When the seeds of three different soybean varieties were soaked in water for 24 hours, it became clear that the previous regularities were repeated in the “Dustlik” variety.

Soya bean grain was taken from the “Dustlik” variety, its mass was weighed, the initial size of the shape was measured using a caliper, and 150 ml of water was added to a 500 ml flask to determine how much water the soybean grain would contain (figure 1) [4].

Table 2. The water absorption properties of soybean varieties.

| Soya varieties | Grain length In 6 hours | Grain diameter In 6 hours | Grain length In 12 hours | Grain diameter In 12 hours | Grain length In 18 hours | Grain diameter In 18 hours | Grain length In 24 hours | Grain diameter In 24 hours |
|----------------|-------------------------|---------------------------|---------------------------|----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|
| Dustlik        | 1.0                     | 0.7                       | 1.1                       | 0.7                        | 1.2                      | 0.8                        | 1.3                      | 0.8                        |
| Uzbekskaya-2   | 0.7                     | 0.6                       | 1.0                       | 0.6                        | 1.1                      | 0.7                        | 1.2                      | 0.7                        |
| Uzbekskaya-6   | 0.7                     | 0.6                       | 1.0                       | 0.6                        | 1.1                      | 0.7                        | 1.2                      | 0.7                        |
The table shows that when soybean varieties are exposed to water, the water is evenly distributed throughout the entire shape during the first six hours. Over time, the waters may be in a different state according to the anatomical condition of the soya bean (figure 2). It was determined that the “Dustlik” variety retains moisture more than other varieties or absorbs more moisture than other varieties. This is due to the high concentration of proteins, amino acids, fats and other organic and inorganic substances in the soya bean grain of the “Dustlik” variety.

Proteins have a number of properties that have a certain effect on the conduct of technological processes during processing. These features must be taken into account, as they open up great opportunities for improving technology and expanding the product range. These properties of soy proteins include the process of hydration, which under normal conditions the proteins can retain two to three times the amount of water. The swelling ability of proteins plays an important role in food technology. However, proteins can also undergo denaturation. Denaturation is a change in the spatial orientation of a protein molecule under the influence of mechanical, chemical and other factors as the temperature rises. It plays an important role in the technological processes associated with the formation of half-finished products and structural systems of finished products [5].

The distinctive property of the soya that distinguishes it from other crops is that it contains a high amount of protein and fat at the same time. The protein content of soybeans varies from 27 to 68% [6].

International practice has recognized that soy protein is the highest quality, most common, and cheapest source of plant protein. If the protein-non-protein substances ratio in potatoes is 1:10 and the grain ratio is 1:6-7, in the soya bean this ratio is 1:2. Soya proteins, unlike many plant proteins, are considered completely valuable. It provides humans and animals with all the amino acids that act as building materials during cell development and metabolism in the body. In terms of quality, they are closer to meat, eggs and milk proteins. Thus, while the amount of lysine in the highest quality wheat flour, which is the most important part of the diet and the most deficient part of proteins, is 2.5 g per 1 kg, in soya flour this value is 27 g. A person’s daily need for lysine, which cannot be replaced by any other substance, is around 5 g. In this regard, in the absence of other sources of protein in the diet, soya in small amounts (150-260 g) can meet the daily requirement of a person for all amino acids. Table 3 shows the amount of essential amino acids in leguminous plants seeds [7].

Table 3 shows the amount of essential amino acids in the seeds of legume crops. Soya beans are found to have high levels of amino acids. In particular, the amount of lysine, which is several times higher than the remaining legumes, is a key factor determining the technological properties of the products. The chemical composition of cereals, legumes and oilseeds is given in table 4.

As can be seen from the table, the high protein content in legumes indicates that in some cases these proteins can be used for technological and chemical production purposes. The fact that soybean
protein is rich in amino acids has also attracted the attention of all scientists. The production of new products using soya protein using advanced technology has become the main goal of the article [8].

**Table 3.** Amount of essential amino acids in the seeds of leguminous plants, (g/kg relative to dry matter).

| Amino acid   | Soya  | Haricot | Lentil | Sowing pea | Yellow lupine | Feed leguminous plants | Lathyrus | Chick-pea |
|--------------|-------|---------|--------|------------|---------------|------------------------|----------|----------|
| Lysine       | 24.0  | 23.3    | 22.3   | 22.7       | 16.2          | 14.5                   | 18.4     | 20.7     |
| Methionine   | 5.0   | 1.5     | 4.0    | 1.0        | 4.1           | 3.3                    | 4.5      | 5.2      |
| Cystine      | 4.6   | 6.2     | 6.3    | 2.8        | 4.4           | 4.2                    | 3.0      | 4.8      |
| Arginine     | 25.6  | 16.5    | 21.6   | 19.7       | 28.3          | 17.0                   | 23.1     | 24.4     |
| Leitlin      | 41.6  | 44.0    | 38.8   | 31.8       | 37.5          | 24.8                   | 33.5     | 39.6     |
| Phenylalanine| 16.0  | 14.6    | 13.0   | 11.6       | 15.5          | 6.2                    | 10.0     | 11.3     |
| Treonin      | 13.0  | 11.0    | 10.9   | 11.7       | 14.0          | 9.8                    | 12.0     | 10.5     |
| Valin        | 16.5  | 16.0    | 15.8   | 11.0       | 11.2          | 9.6                    | 12.5     | 11.5     |
| Tryptophan   | 3.6   | 4.4     | 5.3    | 1.8        | 1.8           | 1.6                    | 2.9      | 30.0     |
| Gistidin     | 8.0   | 6.5     | 9.0    | 4.9        | 11.0          | 7.0                    | 6.1      | 6.0      |
| The sum of 10 essential amino acids | 158 | 144 | 147 | 120 | 144 | 98 | 126 | 128 |

**Table 4.** Comparative characteristics of chemical composition of field crops (% of dry matter).

| Crop type      | Protein | Oil  | BAM  | Cellulose | Ash  |
|----------------|---------|------|------|-----------|------|
| Soya           | 40.5    | 19.5 | 29   | 5         | 6    |
| Wheat          | 15      | 2    | 75   | 2.5       | 2    |
| Pea            | 28      | 1.5  | 60   | 6.5       | 3    |
| Lentil         | 30      | 1.2  | 60   | 3.5       | 3.1  |
| Chick-pea      | 25      | 5.6  | 58   | 7.3       | 3.7  |
| Haricot        | 23      | 1.8  | 55   | 3.8       | 3.9  |
| Peanut         | 29      | 49   | 15   | 3.1       | 3.1  |
| Sunflower      | 16.3    | 31   | 21.7 | 14.5      | 3.3  |
| Yellow lupine  | 38.3    | 4.6  | 25.4 | 14        | 3.8  |

All stages of the life activity of the cell and the organism as a whole go with the integral participation of proteins. The largest group of protein molecules performs highly specialized catalysis of all chemical reactions of matter and energy metabolism. Proteins as enzymes are involved in various chemical and photochemical internal and intercellular metabolic processes. It is not a single protein, but a complex self-regulating polyenzyme system.

Proteins are present in systems that convert light energy into chemical energy and vice versa. Thus, these molecules are the only class of compounds that have the ability to facilitate the interaction of almost all types of energies [9].

Soya absorbs solar energy more efficiently and quickly than other crops. This is determined by the high amount of protein it contains. Soya protein is slightly lower in nutritional value than beef protein and equal to milk protein. If we take the nutritional value of pure chicken egg protein as 100 units, then for boiled soybeans this value is 94.5 units, for soy flour is 91.7, and for soya milk is 95.3. The amount of protein in 100 grams of product is as follows: soya – 34, cheese – 30, meat – 14-20, fish – 12-16, and potatoes – 1.7 g [10].
It can be concluded that all products derived from soya beans can be considered as a product rich in natural micro and macronutrients, beneficial to the human body. Soya bean products are not only beneficial for the human body, but also maintain the balance of life as a living food for all living organisms. In particular, the problem of protein deficiency in food today, as well as meeting the demand for natural protein-containing products is one of the main requirements of our time. Besides, the more water the soybean grain absorbs, the stronger its physical condition will be. If the grain mass does not absorb water, then the grain cannot meet all the technological conditions in terms of chemical composition. Depending on the degree of water absorption of soybeans, the choice of technological lines is effective for the separation of oil, protein flour and other biologically active substances [11].

3. Conclusion
As can be seen from the results of the research conducted, soy varieties receive a good combination of water. Especially the friendliness of the shade from local varieties is reflected in the table above, where the norm of water absorption is higher than that of other varieties. This indicator indicates that in soy, amino acids, fats, proteins and other organic and inorganic substances are concentrated. This suggests that in the food industry, products made from soy and soy grains have a rich content. International practice has also recognized that soy protein is the highest quality, most common and affordable source of plant protein. Soy proteins, unlike many vegetable proteins, are considered to be fully valuable. Therefore, now a lot of work has been done and is being done on the addition of soy protein in the diet ration.

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