Biochemical composition of soybean foreign varieties and samples (under typical gray soil conditions of Uzbekistan)

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Abstract. Soybean stands out as a highly prized agricultural crop due to its exceptional nutritional attributes. The proteins found in soybean possess a distinctive profile, featuring essential non-exchangeable amino acids that closely resemble those present in animal proteins. This composition renders soybean proteins a valuable and comprehensive source of vital nutrients. This article offers insights into the biochemical characteristics of imported soybean varieties and samples grown under typical gray soil conditions in Uzbekistan. Specifically, it examines various parameters to assess the quality and composition of these leguminous crops. The study presents data on crucial components such as protein and oil content, both of which constitute the primary constituents of these crops. Additionally, the research delves into the moisture content of the seeds, which contributes to understanding their overall quality. Furthermore, the article provides information about the origin of the soybean varieties under investigation, shedding light on their respective countries of origin. By analyzing these biochemical indicators and considering the seeds' moisture content and source, the study contributes to a comprehensive evaluation of the suitability, adaptability, and potential economic value of these foreign soybean varieties within the specific agroecological context of typical gray soils in Uzbekistan.
Keywords. Soybean, country of origin, variety, sample, biochemical composition, protein, oil, moisture.

1 Introduction

Soybean is one of the most valuable agricultural crops, its proteins are characterized by the presence of essential non-exchangeable amino acids similar to animal proteins, and the oils contained in it are superior to olive oil (86-95% absorption rate by the body) [1, 2].

The daily protein requirement of the body is on average 110 grams [3, 4]. But now in many countries the problem of protein deficiency is increasing. Expanding the use of soybean and its processed products will almost solve this problem [5, 6].

The biochemical composition of soybean seeds depends on the biological characteristics of the species, the weather and the correct agrotechnical measures used in each phase of the

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plants. Obtaining a crop with high quality content is the main task of soybean cultivation [7, 8].

Soy protein constitutes a rich reservoir of essential components critical for human nutrition. This includes a robust presence of crucial amino acids, essential vitamins, vital macro-minerals, isoflavones, and phospholipids. The comprehensive nutritional composition of soy protein underscores its potential to contribute significantly to a balanced and healthful die [9, 10]t.

One of the remarkable aspects of soy protein is its affordability. When compared to animal protein sources, soy protein emerges as a cost-effective alternative, available at a fraction of the price. This cost-effectiveness makes it an attractive option for both consumers and food producers seeking to optimize their resources [11].

By planting varieties of soybeans with high-quality nutritional content and implementing appropriate agrotechnical practices in a timely manner, substantial yields can be attained. With the correct approach, it's feasible to obtain a range of 300 to 1200 kilograms of pure, top-tier protein per hectare of land sown with these high-quality soybean varieties [12]. This potential for high protein yield further underscores the significance of soybean cultivation as a viable solution to address nutritional needs and economic considerations alike.

Soybean oil meets the FAO/WHO standard in terms of biological value and quality, its composition is dominated by the most valuable unsaturated fatty acids (up to 87%) [9]. Soybean oil, in its natural and processed form, is used in food and medicine, as well as in the manufacture of a wide range of non-food products (soap, paints, plastics, biodiesel, etc.).

2 Materials and methods

Researches were carried out in the fields of the experimental farm of the Scientific Research Institute of Plant Genetic Resources. The research was carried out based on the following methodological manuals: "Methods for studying the world collection of legumes" [4], "Metodika polevogo opyta" and "Metodika gosudarstvennogo sortoispytaniya selskohozyaystvennyx kultur" by B.A. Dospehov were used [6]. The biochemical composition of the varieties and samples was determined in the German PFEUFFER-Granolyser apparatus.

Soya varieties Sparta, Arletta, Duar, Chara, Selekta-302, Selekta-201, Selena (Russia), Sava, Favorit (Serbia), Apollo (USA) and K-111, K-114, K-183 (China), K-113 (Ukraine), K-115, K-127 (Moldova), K-2, K-17, K-19, K-118, K-120, K-122, K-126, K-129, K-138, K-142 (USA), K-119 (Romania), K-124, K-152 (Russia), K-130 (France), K-141 (Germany), K-22 (Yugoslavia), Samples of varieties K-181 (Syria), K-182 (Korea), K-200, K-201 (Turkiye) and variety "orzu" (Uzbekistan) were studied.

3 Results and discussion

The experiments were conducted at the experimental field of the Scientific Research Institute of Plant Genetic Resources. The experimental farm of the scientific production department of the institute is located in the Qibrai district of the Tashkent region, 16 km from the city of Tashkent (at 41°2' north latitude and 69°2' east longitude). The natural climate of the Tashkent region is sharply continental and arid, rich in heat and sunlight throughout the year.

The climate of Tashkent region is characterized by a lot of light, rapid temperature changes during the day and seasons, dry and hot summers, and irregular winters. Duration of sunny days is 2800-2900 hours per year (360-400 hours in summer and 90-100 hours in winter). The average annual air temperature is +13...+14 ^{0}C [1].

The soil of the experimental field in Tashkent region is a typical gray soil that has been irrigated since ancient times. The parent rock of the soil is unevenly formed, and underground (seepage) water is located at a depth of 18-20 meters. According to M.A. Pankov, P.N. Besedin, P.Suchkov, one third of Central Asian soil consists of typical gray soils. Typical gray soils are characterized by low humus content and carbonation (but higher humus content than pale gray soils). Typical gray in soils rotted amount is 1.5-2.5%, nitrogen 0.08-0.1%, phosphorus 0.2-0.3 % is enough Phosphorous compounds solubility feature of soil high carbonation because of it is worth saying level no, that's why for of phosphorus quantity in the soil many p if not , him plant by appropriation level very is low [8] . Typical gray soils are heavy loamy and loamy in terms of mechanical composition. Also, the soil is characterized by low bulk density and high porosity. In these soils, biological processes are accelerated and the content of saturated cations is high. The process of mineralization of organic substances in the soil is fast, while the mobility of nitrogen is high, and the mobility of phosphorus is slow. The mobility of potassium is average compared to the mobility of nitrogen and phosphorus. Another agronomic property of this soil is that the amount of total nitrogen in the soil depends on the amount of humus in the soil. The amount of total nitrogen in the soil varies from 0.05% to 0.15%. Typical gray soils are very favorable for nitrification. The main part of nitrogen is found in the soil in the form of nitrates, and the nitrogen absorbed by the plant is in the same form. In most cases, the amount of total phosphorus is greater than the amount of total nitrogen. The amount of total phosphorus in the upper layers of the soil is 0.1%-0.2%. In general, the soil has a lot of remains of roots and other parts of the plant, soil compaction is low, and humus is present only in the plowed part of the soil.

One of the main directions of the selection process is to ensure that the quality of the varieties is high. The seeds with high quality content mean exactly the biochemical composition of the seeds.

The main biochemical component of soybeans is protein. Among all crops in the world, soybean is the plant with the highest protein index. According to various sources, the amount of protein in the seeds of this crop is on average 38-42% and can reach 50%. Soy proteins are diverse in structure and function. Soy is rich in essential amino acids, especially lysine (2.7%), which is found in small amounts in grain proteins. Most of the soy protein (about 70%) is 7S-globulins (β-conglycinins) and 11S-globulins (glycinins), which are absorbed by mammals . Since a significant portion of soy protein is water-soluble protein, obtaining plant protein from soy is the most efficient.

We can see in the table that the homeland of soybean varieties studied in the experiment is Russia, Serbia, USA. It is known that the protein content of the varieties is 33.5-47% in the specific climatic conditions of these countries, while this indicator was 33-40.7% in the typical gray soils of our country. If we give a separate explanation for each variety, Sparta of Russian origin increased from 42% to 40.7%, Arletta from 42% to 37%, Duar from 47% to 35.8%, Chara from 40% to 36.5%, Selekta-302 from 36.2 % to 36%, Selekta-201 from 33.5% to 33%, Selena from 36% to 36.1%, Apollo from the USA from 39% to 33.1%, varieties of Serbian selection Favorit from 40% to 38.1%, Sava from 35% we can see that it has changed from to 34.4 %.

The oil content of the studied varieties was 21.5-26.7% in the homeland of the variety, and 22.2-25.6% in the soil-climatic conditions of our republic. Sparta of Russian origin from 23% to 22.2%, Arletta from 23% to 23.7%, Duar from 26.7% to 24.7%, Chara from 22% to 23.7%, Selekta-302 from 25% to 24.7%, Selekta-201 from 22.4 We can see that from % to 25.6%, Selena from 23% to 23.4%, Apollo from the USA from 22% to 23.8%, Serbian selection varieties Favorit from 21.5% to 23.2%, Sava from 22% to 24.1%. The moisture content of the seeds was found to be on average from 6.7 to 8.5% (Table 1).

Table 1. Moisture content of the seeds.

#	Country of origin	Varietal name	Protein %	Oil %	In the typical gray soils of Uzbekistan		
					Protein %	Oil %	Moisture Content %
1	Russia	Sparta	42	23	40.7	22.2	7.9
2	Russia	Arlette	42	23	37	23.7	7.6
3	Russia	Duar	47	26.7	35.8	24.7	7.3
4	Russia	Remedy	40	22	36.5	23.7	7
5	USA	Apollo	39	22	33.1	23.8	7.4
6	Serbia	A favorite	40	21.5	38.1	23.2	8.1
7	Serbia	Sava	35	22	34.4	24.1	8.5
8	Russia	Selecta-302	36.2	25	36.0	24.7	8.4
9	Russia	Selection-201	33.5	22.4	33	25.6	8.2
10	Russia	Selena	36	23	36.1	23.4	6.7

Soy foreign samples were studied in comparison with the standard variety Orzu. The obtained results are given in Table 2. The protein content of Orzu standard variety seeds was 29.8%, while the oil content was 22.7%. The moisture content of the seeds was 7.5% in the Orzu variety. Taking into account that the protein content in the samples of the world collection of soy is between 27.4% and 38.2%, compared to the standard K-141; K-126; K-127; K-152; K-124; K-183; K-182; K-181; K-129; K-138; K-113; K-114; K-119; K-118; K-120; K-115; K-19; K-22; K-17; The protein content of K-201 samples showed a high result. K-126 by oil content; K-152; K-122; K-181; K-129; K-111; K-113; K-114; K-120; K-115; K-19; K-17; K-200; K-201 samples had a higher index compared to the standard variety (Table 2).

Table 2. Soy foreign samples in comparison with the standard variety Orzu.

#	Sample catalog	Country of origin	Protein content (%)	Oil content (%)	Moisture Content (%)
1	K-141	Germany	37.4	20.3	7.6
2	K-126	USA	36.9	23.6	7.9
3	K-127	Moldova	34.5	22.2	7.2
4	K-152	Russia	29.8	24.3	7.1
5	K-122	USA	29.7	23.2	8.8
6	K-124	Russia	30.0	22.5	7.7
7	K-183	China	38.2	19.6	6.7
8	K-182	Korea	37.7	19.2	7.0
9	K-181	Syria	35.4	24.0	7.6
10	K-129	USA	31.8	23.9	7.7

11	K-138	USA	29.9	22.2	7.8
12	K-111	China	28.0	26.2	8.8
13	K-113	Ukraine	29.7	23.8	7.0
14	K-114	China	32.8	23.9	8.2
15	K-2	USA	29.2	21.9	7.9
16	K-119	Romania	35.4	22.2	7.8
17	K-118	USA	34.4	21.2	8.2
18	K-120	USA	36.8	24.3	7.4
19	K-115	Moldova	33.2	24.2	8.2
20	K-19	USA	33.5	24.3	8.6
21	K-22	Yugoslavia	33.7	22.5	8.7
22	K-17	USA	30.6	25.2	8.8
23	K-200	Turkiye	27.4	26.5	7.9
24	K-201	Turkiye	34.4	23.9	8.6

Based on experience, we inform that:

- Soy is a plant with a high biochemical composition
- The studied foreign soybean varieties were found to have a very high protein content compared to the standard. In the conditions of the typical gray soils of our country, it was found that the protein content of the Sparta variety, native to Russia, is 40.7%.
- Among foreign varieties, Duar and Selekta-201, which are native to Russia, have the highest oil content, 24.7%, respectively; It was 25.6%.
- Among the soybean samples, the ones with higher protein index compared to the standard were: K-183 (China), K-182 (Korea).
- Among the samples, K-111 (China), K-17 (USA), K-200 (Turkiye) samples had a higher oil content than the standard variety.
- The average moisture content of soybean seeds was 6.7-9. The moisture content of the seeds corresponded to the standard.

4 Conclusions

Drawing from the comprehensive array of findings we have gathered, we have arrived at several overarching conclusions. To effectively address the protein deficit within our country, a prudent approach would involve the development of soybean varieties specifically engineered to possess elevated levels of both protein and oil content. This strategic enhancement could potentially serve as a valuable means to augment our national protein supply.

Furthermore, we recommend the careful selection of existing soybean varieties that exhibit exceptionally favorable biochemical compositions. These chosen samples can serve as the foundational building blocks for subsequent selective breeding processes. By starting with these superior genetic materials, we can expedite the development of new soybean strains that are not only optimized for elevated protein and oil content but also well-suited for the unique agroecological conditions present within our country.

Ultimately, these proposed strategies hold the potential to contribute significantly to our efforts in addressing protein scarcity and fostering more sustainable agricultural practices.

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