Study of physical and chemical parameters of soybean grain during storage

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Abstract. The need of the world's population for processed products from soybeans is increasing day by day. Due to the fact that soy Dogi contains a large amount of proteins and fats, it is widely used in various fields of the national economy. Soybeans are a very important crop globally, and the demand for soybean grains and processed products is growing day by day. This article examines the changes in physical and chemical parameters during the storage of various varieties of soybeans grown in Uzbekistan.

1. Introduction
At the beginning of the 21st Century, special attention was paid to the cultivation of non-traditional agricultural crops in the Republic of Uzbekistan. In order to further expand the soybean crop fields in the Republic, to create fertile and early soybean varieties, to organize primary seed production, to grow environmentally safe soybeans, to ensure the needs of the population for soybean oil, to supply soybean products to poultry enterprises, and to ensure the implementation of the decree of the president of the Republic of Uzbekistan «on №105 decision was adopted. According to this decision, in 2021 as the main crop – 1800 tons; as a repeated crop – in 2021-600 tons is planned to create a reserve of high-quality soybeans [1-3].

In our country, soy seeds are grown in small quantities. The main part of the products made from this raw material is mainly vegetable oil, which is brought from Russia and Kazakhstan. The production of soybean and sunflower oil also depends on the import of raw materials. In 2019, the production capacity allowed to process 800 thousand tons of soybeans and sunflower seeds. Despite the increasing number of non-traditional oil fields for Uzbekistan, its own raw material base is still insufficient for the installation of production capacities. In 2019, 269 thousand tons of sunflower seeds and 17 thousand tons of soy seeds were imported, which means that 35 percent of the processing capacity will be provided for the account of imported raw materials, and the share of imported raw materials in the volume of production will be high if the available capacity is not fully replenished [4-7].

Soy crop (glycine Max.) is a plant belonging to the family of legumes. Soy Dogi this is one of the most common crops on our planet, with more than 60 moderately developed countries with subtropical and tropical climates, the share of these legumes is 10-12%.

In recent years, the area of its cultivation in the Republic of Uzbekistan has also been steadily growing. Soy dog is very important to our daily life and pet ration. It contains high-quality protein 40-45% and 20-25% fatty acids, valuable fat, 25-30 % carbohydrate, up to 6% mineral substances such as Mn, Mo, Mg, B, Fe, and vitamins A1, V1, V2, V3, E, C, D, K, PP and others, all of which do not store
useful substances for humans like soy in its composition [8-10].

2. Materials and methods

The relative humidity of the air in this season is 40-60%, mainly due to ripening in August-September on the territory of the Republic of Uzbekistan, which in its place affects the physico-chemical indicators of soybean seeds, which are stored for a long time in the open air. Taking these into account, we investigated the processes of storage of soybean seeds grown in the conditions of Uzbekistan.

Our research work focused on the determination of moisture changes in soybean seeds by the amount of its oil content as well as other physico-chemical parameters.

Soybean seeds stored in accordance with the requirements of GOST should be checked for the exact periods specified in table 1 below [11-13]. It is desirable to carry out soybean seeds stored in a sprinkled state with bread pests, organoleptic indicators, depending on the temperature and humidity of the seeds, within the following periods (table 1).

Table 1. Control periods of stored soybean seeds.

| Moisture content of soybean seeds, % | Temperature of soybean seeds | Lower than +5°C | From +5 to +10°C | Lower than +10°C |
|-------------------------------------|-----------------------------|-----------------|------------------|------------------|
| Up to 15                            |                             | 20 times in 1 day | 20 times in 1 day | 20 times in 1 day |
| Higher than 15                      |                             | 15 times in 1 day | 15 times in 1 day | 15 times in 1 day |

For storage of soy seeds, it is necessary to ensure optimal conditions and observe the rules of storage. Seeds should be dried up to 10-12% moisture, it is allowed to contain up to 14% of moisture. Exactly such or low humidity ensures good storage of seeds. Seeds should be divided according to their size and grade before storage. Seeds are stored in bags in a dry, well-ventilated area. Before laying for storage, it is desirable to process seeds against ombor House pests. During the storage period, it is necessary to monitor the condition and condition of the seeds from time to time [5, 14-15].

For the use and processing of soybeans for food purposes, it is important to keep this crop on the basis of technological requirements. Green beans, collected in the technical ripening phase (60-th day after sprouting), can be stored in polyethylene bags for a short time (200-days) in a cool room at a temperature of +1-2°C. Soybean seeds are the most optimal conditions of long-term storage at a temperature of +20-22°C. Green soy beans packed in plastic bags-17-2-3 it can be stored in a regular refrigerator for a week. The optimum temperature for its storage is +10°C, while the shade remains fresh and retains its green color for a long time [16-17].

The temperature of storage significantly affects the acidity and the rate of increase in the number of fats. A decrease in storage temperature hinders the accumulation of free fatty acids [4, 6]. The intensity of the physico-chemical changes that occur in the process of storing soy seeds in different temperatures varies. Depending on the duration of storage of soybean seeds, the amount of oil in them and its quality are constantly changing [10].

The number of Perekis is the main indicator that manifests the oxidative changes of soy seed oil. In the presence of oxygen in the air, the fatty acids contained in the oil can form partially oxidized perecides and gidroperecises, which in turn leads to an increase in the number of perecides. During storage in low temperatures, the processes of oxidation of oils are slow [8].

In our research, the changes in the physical and chemical parameters of the storage process of «Nafis», «Dustlik» and «Parvoz» medium-sized varieties of soybeans grown in the conditions of Uzbekistan in the laboratory conditions of our institute and the plant were investigated. Based on the results of the obtained study, the changes in the physico-chemical indicators of the seeds of the above soy varieties are reflected in the diagrams below [16-20].

The main indicators of the samples of soybean seed varieties grown under the local conditions chosen for the study are presented in table 2.
Table 2. The main indicators of samples of soybean seed varieties grown under local conditions.

| Indicators                  | Varieties of soy seeds |
|-----------------------------|------------------------|
|                             | «Nafis»                | «Dustlik»             | «Parvoz»          |
| Weight of 1000 grains, g    | 137                    | 138                   | 143                |
| Volume weight, g/l          | 804                    | 818                   | 812                |
| Degree of pollution         | 4.25                   | 7.85                  | 1.2                |
| Coordinates, %              | 4.4                    | 4.1                   | 4.3                |
| Mass fraction of oil, %     | 18.35                  | 19.04                 | 19.43              |
| The quantity is reasonable, %| 33-36                  | 36-38                 | 38-40              |

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3. Results and discussion

In particular, changes in physico-chemical fertilizers in the process of storing soybean seeds of «Nafis» varieties grown in Romitan District of Bukhara region are presented in the diagrams in figure 1, 2, 3. In the process of storing soy seeds of this variety for 30 days, it was observed that the yield of soy seeds at a temperature of 5°C decreased from 18.35% to 17.96%, the temperature of 15°C increased from 18.35% to 18.92%, the temperature of 25°C increased from 18.35% to 19.36%, and the temperature of 35°C, soybean seed oil yield was observed to increase from 18.35% to 19.50%.

Figure 1. Variation of batter during storage of soybean seeds of «Nafis» varieties in different temperatures.

The indicator of the initial acid number of soybean seeds of this variety was 4.23%, during the storage process for 1 month it was determined that the acid number of soybean seeds increased slightly (4.92%) at a temperature of 5°C, at a temperature of 15°C up to 5.28%, at a temperature of 25°C up to 5.82% and
at a temperature of 35°C, it was found that the acid number of soybean seeds increased sharply from 4.23% to 6.34.

![Figure 2](image-url) Changes in the number of acids during storage of soybean seeds of «Nafis» varieties in different temperatures.

In the process of storing soybean seeds of «Nafis» varieties for 30 days, it was noted that the number of perekis of soybean seeds at a temperature of 5°C increased from 3.63% to 3.71%, at a temperature of 15°C from 3.63% to 3.91%, at a temperature of 25°C from 3.63% to 3.98%, and at a temperature of it was also noted that at a temperature of 35°C the number of perekis of soybean seeds increased from 3.63% to 4.16%.

![Figure 3](image-url) Changes in the number of perekis during storage of soybean seeds of «Nafis» varieties in different temperatures.

In the process of storing «Dustlik» varieties of soybean seeds grown in the Jondor District of Bukhara region in different temperatures for a month, the yield of soybean seeds at a temperature of 5°C increased less than 19.04% to 19.57%, at a temperature of 15°C from 19.04% to 19.93%, at a temperature of 25°C from 19.04% to 20.12%, and at a temperature of 35°C, the viscosity of soybean seeds increased from 19.04% to 20.25%, which was determined as a result of research (figure 4).
Figure 4. Changes in the batter during storage of soybean seeds of «Dustlik» varieties in different temperatures.

The indicator of the initial acid number of soybean seeds of this variety was 3.91%, during 30 days of storage at a temperature of 5°C, the acid number of soybean seeds increased significantly (4.41%), up to 4.63% at a temperature of 15°C, up to 4.97% at a temperature of 25°C, and at a temperature of 35°C, however, this figure recorded a sharp increase from 3.91% to 5.34% (figure 5).

Figure 5. Changes in the number of acids during storage of soybean seeds of «Dustlik» varieties in different temperatures.

The results of the study of changes in the number of pericis in the process of storage of soybean seeds of the «Dustlik» variety for 1 month were presented in figure 6. the number of soybean seeds at a temperature of 5°C increased from 3.38% to 3.49%, at a temperature of 15°C from 3.38% to 3.54%, at a temperature of 25°C, an increase was observed from 3.38% to 3.63%, and at a temperature of 35°C this figure was from 3.38% to 3.78%.
Figure 6. Changes in the number of perekis during storage of soybean seeds of «Dustlik» varieties in different temperatures.

In the process of storing soybean seeds of «Parvoz» varieties for 30 days, the viscosity of soybean seeds at a temperature of 5°C decreased from 19.43% to 19.13%, the temperature of 15°C increased significantly from 19.43% to 20.02%, the temperature of 25°C increased from 19.43% to 20.07%, and the temperature of 35°C increased soybean seed fat content is shown to increase from 19.43% to 20.11% (figure 7).

Figure 7. Variation of batter during storage of soybean seeds of «Parvoz» varieties in different temperatures.

It can be seen from the diagram shown in figure 8, the indicator of the initial acid number of soybean seeds of this variety was 3.95%. During 1 month of storage at a temperature of 5°C, the acid content of soybean seeds increased by 4.42%, at a temperature of 15°C up to 4.71%, at a temperature of 25°C up to 5.04% and at a temperature of 35°C a sharp increase was observed from 3.95% to 5.42%.
Figure 8. Changes in the number of acids during storage of soybean seeds of «Parvoz» varieties in different temperatures.

In the process of storing soybean seeds of «Parvoz» varieties for 30 days, the number of soybean seeds perekis at a temperature of 5°C increased from 3.75% to 3.91%, at a temperature of 15°C from 3.75% to 3.95%, at a temperature of 25°C from 3.75% to 4.02%. While at a temperature of 35°C, the number of perekis of soybean seeds increased from 3.75% to 4.05%, which was determined as a result of research (figure 9).

Figure 9. Changes in the number of perekis during storage of soybean seeds of «Parvoz» varieties in different temperatures.

4. Conclusions
Based on the results of the research carried out, the main factor is the influence of lipase and lipoxygenase enzymes, micro organism enzymes, as well as the amount of oxygen in the air on the changes in the physico-chemical parameters of soybean seed oil in the process of storage of soybean seeds grown in the conditions of Uzbekistan. Under the action of lipase fermenti, the oil decomposes into glycerin and free fatty acids, which in turn leads to an increase in the number of acids in them, when the storage period of soybean seeds is 1 month, and the temperature is 35°C. In particular, soybean seeds of «Nafis» varieties increased by 6.34%, soybean seeds of «Dustlik» varieties by 5.34%, soybean seeds
of «Parvoz» varieties by 5.42%. These indicators showed that the technological demand is 0.5-2.0% higher than the value.

In addition, the soybean seed oil content of «Nafis» varieties increased by 19.50%, the soybean oil content increased by 20.25% in the «Dustlik» varieties, and in the «Parvoz» varieties increased by 20.11%, these indicators were found to be 0.67-1.21% higher than the value of technological demand.

The number of peroxide of soybeans increased by 4.16%, up to 3.78% in the «Dustlik» variety, up to 4.05% in the «Parvoz» variety, these indicators were found to be 0.4-1.21% higher than the value of technological demand.

During storage at a temperature of 5°C under production conditions, a decrease in the viscosity of local soybean seeds leads to a decrease in the economic indicators of the enterprise. And in the process of storage in high temperatures, as a result of the increase in the values of the number of acids and the number of peroxide, bringing these indicators to the standard level increases the cost of the enterprise.

As can be seen from the results of the obtained research, in the process of storing seeds for the production of oil from soybean seeds, we recommend taking into account the duration and temperature of their storage in order to ensure the level of technological demand for their physico-chemical indicators.

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