Storage of potatoes with the help of biopreparations

Nasiba Ibragimova[1*], *Sayyora* Muradova[2] and *Mutabar* Khojanazarova[3]

[1]Urgench State University, Kh. Alimdjan str.,14, 220100, Khorezm, Uzbekistan
[2]Jizzakh branch of the National University of Uzbekistan, Sh. Rashidov avenue, 259, 130100, Jizzakh, Uzbekistan
[3]Tashkent State Agrarian University, University str., 2, 100140, Tashkent, Uzbekistan.

Abstract. The development and use of contemporary methods for preserving potatoes with the aid of biopreparations raises the caliber of the resulting food items. One of the important issues of today, requiring scientific investigation, is reducing losses during storage of potatoes and improving their nutritional and biological value. The development and implementation of contemporary technologies utilizing biopreparations for preserving potatoes enhance the quality of food products. It is essential to conduct research in this area of science to minimize potato losses during storage, improve their nutritional and biological worth, and address pressing challenges. The process of obtaining the inoculation material for the biopreparation was conducted in laboratory settings and involved two main steps. The first step was the activation of freeze-dried strains, which were then reproduced on the surface of solid nutrient media at a temperature of 28±20 °C for 72±2 hours. The second step involved the preparation of the inoculum, where the planting material was transplanted into a liquid nutrient medium and grown at a temperature of 28±20°C for 48±2 hours.

1 Introduction

Creation and introduction of modern technologies of preservation of potatoes with the help of biopreparations improves the quality of the produced food products. Reducing losses during storage of potatoes, increasing their nutritional and biological value is one of the urgent tasks of today, requiring research in the field of science [1-5].

Today, the use of biopreparations is a promising strategy to increase crop yields and reduce the use of chemical fertilizers, thereby creating sustainable agriculture that does not harm the environment [4-6].Various plant growth-promoting microbes are distinguished by their beneficial properties, they play an important role in improving the absorption of nutrients such as N, P, K, Zn and S, stimulating phytohormones, suppressing plant diseases and mitigating abiotic stresses [6-8]

* Corresponding author: nasiba_ibragimova@umail.uz

The biopreparation developed on the basis of the Bacillus subtilis strain helps to preserve potatoes, to increase the yield and to protect the tubers from diseases during the storage period [1]. The use of microbiological preparations and compost has approximately the same effect and increases productivity by 35-37% compared to control [2, 8-10]. The use of biologically active substances leads to a significant increase in yield, a slight decrease in nitrates and an increase in biochemical indicators of potato roots [5-8, 11].

When potatoes are stored optimally during long storage period, the tubers do not lose their properties and do not sprout until the new crop is ripe. Preservation of potatoes is related to a number of biological factors: structure, quick healing of mechanical damage, rest period, chemical composition, growing conditions [5-9, 11-13]. According to the sources, the factors determining the storage period of potatoes are the storage period and the amount of loss, and the rest period stage (physiological rest period) after harvesting the tubers is its biological characteristic. Its duration lasts up to 1-3 months, depending on the variety, growing conditions and storage conditions [11-14].

The main feature of biopreparations, compared to other means of plant protection, is to act on harmful organisms by stimulating their own defense mechanisms. The use of this feature helps to maintain ecologically stable agrosystems by utilizing the full potential of integrated protection of plants in plant science practice [4-7, 13-15]. A group of biologically active compounds that act as biostimulants on plants are also called growth regulators. Synthetic and natural organic compounds of an exogenous nature are included in them, affecting the vital processes of plants, in appropriate concentrations they do not have a harmful effect and are considered a source of nutrients for cells [7-9]. Some studies have shown that growth regulators are highly specific, active compounds that are highly sensitive even to plant species variation. Their physiological effect depends on many factors. At very low concentrations, these compounds act as growth regulators, while at high concentrations, they act as herbicides [5-9]

Data from long-term field trials and application of Albit biopreparation to potatoes are summarized. Albit increases the germination of tubers, accelerates germination and ripening, increases potato yield (average 3.4 t/ha), quality and marketability. When used together, it reduces the phytotoxicity of chemical pesticides. Immunization properties of plants against rhizoctoniosis, alternaria, scab and above-ground part and roots have been noted [9-13]. According to the researches of scientists of foreign countries, the regulators that actively affect agricultural crops, their representatives affect potato damage and quality indicators. That is why in many countries these substances are currently used as a biotechnological factor as an important tool in the cultivation of various agricultural crops in a system of complex measures. They are successfully used to increase the fertility of seeds, to catch the seedlings and cuttings of fruit and vegetable crops, to accelerate the germination of apples, tomatoes, legumes and other crops, and to increase the quantity and quality of the obtained harvest [6-9, 11-13].

Processing potatoes before planting and before storage prevents the loss of product and technological properties of potatoes, and the loss of starch in tubers decreases by 0.2-0.6% according to the storage period, and this situation also affects the dynamics of vitamin C changes [13-15]. Phytosporin M biofungicide, which is included in the group of instructions for conducting registration tests of agrochemicals and plant growth regulators, is also a microorganism belonging to the genus *Bacillus subtilis* , and it is reported that such biocomplex preparations promote the growth of potato plants and induce immunity against disease and stress factors [10-14].When the effect of using Planriz biological preparation before planting potatoes (1 l/t), spraying during growing season (0.5 l/ha in 300 l of water) and before storage was studied, the loss of tubers during winter storage was reduced by 2 times. The increase in productivity due to the use of Planriz was 3.3 t/ha. The obtained data show that biological products contribute to the increase of dry matter and

starch content in potato tubers. The taste of potatoes does not change and deteriorate against the background of the tendency to increase productivity [2-7, 9-11]. This research is aimed at obtaining a biopreparation production technology *based on the Bacillus subtilis SKB 309 strain, which* stimulates the growth of potato plants, the storage period, and allows obtaining environmentally friendly products.

The purpose of this research work was to develop a biopreparation production technology based on Bacillus subtilis SKB 309 strain .The object of the research was conducted at the Department of Biotechnology, Faculty of Bioengineering and Food Safety, Urganch State University, Khorezm region [13-15].

2 Materials and methods

The cultivation process of bacteria for inoculation involved utilizing a thermostatic device called UVMT-12-250, which was manufactured by NPO ELION in Russia. The microorganisms were grown through shaking Erlenmeyer flasks that contained GPB HIMEDIA medium [4-8]. The concentration of the material was kept between 5-10% equivalents, and the cultivation process took place at 28°C with an RPM for 72 hours.

In the second stage, 20-liter glass cylinders were employed, prepared according to GOST 10117.2-2001 standards [2-7]. The process included the addition of a 7-9% amount of 7-9% titer, not less than 5x10.9 bacteria/ml, to each flask, which was prepared in a single step while adhering to strict aseptic rules. The microorganisms were grown for 72 hours at 28°C until the presence of producer microorganisms was not less than 1x109 bacteria/ml [1-4, 9-11]. The subsequent stages were carried out at the "Mang'it-mineral" enterprise of the Amudarya district of the Republic of Karakalpakstan. The final biopreparation consisted of microorganism cultures and nutrient medium, which were then packed into 20-liter containers and shipped to a warehouse or farm for storage and use [11-13].

3 Results and discussion

The cultivation of microorganisms in liquid nutrient media involves a series of stages. These stages include the preparation of the food environment, sterilization, and cooling, followed by the preparation of the equivalent material. The producer microorganisms strains are then grown, and finally, the biopreparations are packed and saved. The research conducted revealed the optimal parameters for growing rhizobacteria that are suitable for three types of rhizobacteria, as presented in Table 1.

Table 1. Optimal parameters for growing rhizobacteria.

Parameters	Indicators
Duration of cultivation	72±3
Temperature, °C	28
pH indicator	7-8.0
Shaking intensity, rpm	150±5

It is worth noting that rhizobacteria are beneficial microorganisms found in the rhizosphere of plants, which promote plant growth by fixing atmospheric nitrogen and solubilizing soil nutrients. Understanding the optimal parameters for growing these

microorganisms is crucial in improving plant productivity and reducing the use of synthetic fertilizers.

Based on the outcomes of the experiments, a complex associative system was established for obtaining a biopreparation. This system was formed using a set of regulations that were derived from the experimental results. The purpose of the system was to create an optimal environment for the growth and development of microorganisms in order to produce a high-quality biopreparation. The formation of such a system is critical in the biopreparation industry as it ensures the consistency and reliability of the final product (Fig. 1). It is also worth noting that biopreparations are becoming increasingly important in modern agriculture due to their ability to improve plant health and productivity while reducing the use of synthetic chemicals.

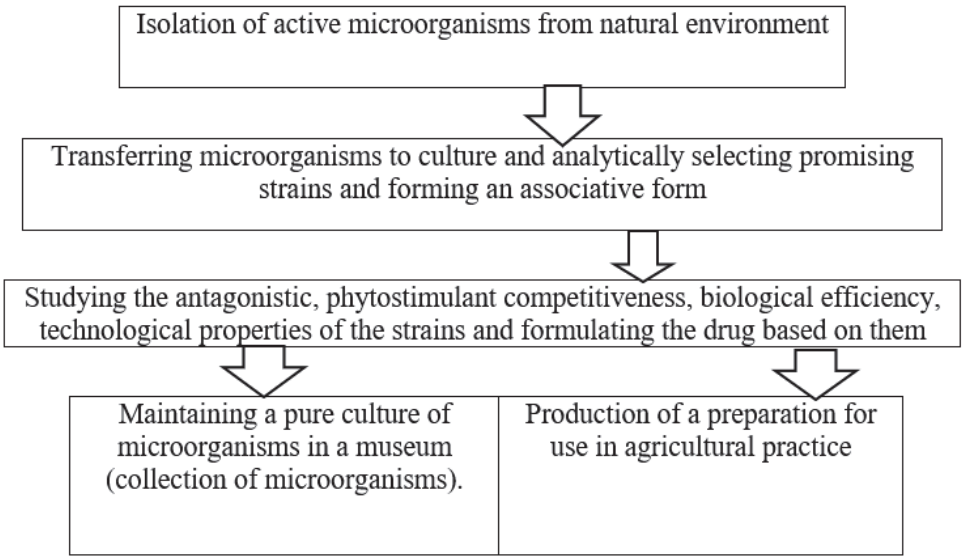

Fig. 1. Step of how to use of active microorganism in agricultural practice.

The process of obtaining the inoculation material for the biopreparation was conducted in laboratory settings and involved two main steps. The first step was the activation of freeze-dried strains, which were then reproduced on the surface of solid nutrient media at a temperature of 28±20 °C for 72±2 hours. The second step involved the preparation of the inoculum, where the planting material was transplanted into a liquid nutrient medium and grown at a temperature of 28±20°C for 48±2 hours. Through these steps, a technology for obtaining a multifunctional complex biopreparation from the local rhizobacterium strain Bacillus subtilis SKB 309 was established (Fig. 2). It is worth noting that the use of Bacillus subtilis SKB 309 has been found to promote plant growth by producing growth-promoting substances and by enhancing nutrient uptake. The technology for obtaining such biopreparations is crucial in the agricultural industry as it provides a sustainable and eco-friendly alternative to synthetic chemicals.

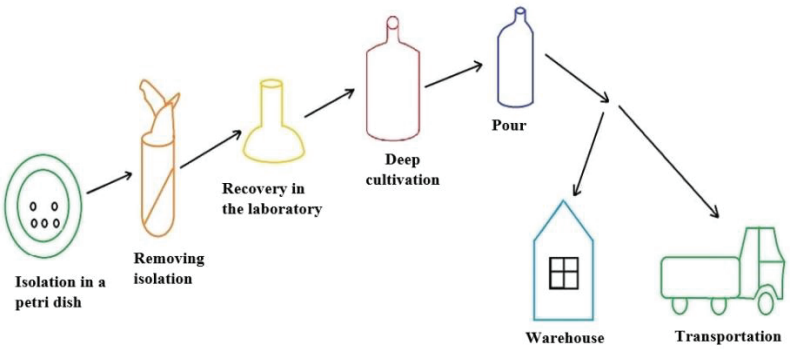

Fig. 2. Biopreparation scheme.

The study focused on the effect of a microbiological composition of a biopreparation based on Bacillus subtilis SKB 309 strain on the growth and development of potato plants. The results showed that the effectiveness of the biopreparation was influenced by various factors such as soil and climate conditions, the rate of the drug used, the method of seed material preparation, and the biological properties of the potato plant. The experimental variants treated with the biopreparation showed significantly higher growth and development indicators compared to the control options. Notably, there was a notable increase in the total productivity of the Gala potato variety by 1.2 tons per hectare, and the drug usage resulted in a 3.1-ton increase in productivity. These findings suggest the potential of biopreparations based on Bacillus subtilis SKB 309 strain in enhancing the growth and productivity of potato plants. Moreover, it highlights the importance of considering various factors when applying biopreparations in the agricultural industry.

4 Conclusions

Based on *Bacillus subtilis SKB 309 strain* The effect of the biopreparation in the vegetative phase of plant development is that the suspension of microorganisms and their metabolic products grow and fall on the surface of developing plants, helping them to manage vital functions and protective-adaptive reactions.

It was found that there are some significant differences in the parameters of the total yield of the Gala variety of potatoes in the experimental options with and without the drug, including the fact that the total yield increased by 3.1 tons in the Gala variety under the influence of the prepart.

Complex microbial preparations prepared on the basis of local rhizobacterial strains resistant to salinity stress easily adapt to saline soil-climate conditions, activate microbiochemical processes in the soil, and significantly increase plant productivity.

Microbiological preparations with complex effects are formulated on the basis of effective microorganisms with high metabolic activity.

The technology of obtaining a multifunctional complex biopreparation from the local rhizobacterium Bacillus subtilis SKB 309 strain was formed in a sequence of 4 stages in the cultivation of ecologically clean potato plants.

References

1. Soprunova, V. E., Tavtykova, A. A., & Soprunova, O. B. (2015). Preliminary data on the use of a new biological product to increase the yield and safety of potatoes. Agricultural Bulletin 5(21) 13-19.
2. Novikova, I., Minin, V., Titova, J., Zakharov, A., Krasnobaeva, I., Boikova, I., & Murzaev, E. (2022). New Polyfunctional Biorationals Use to Achieve Competitive Yield of Organic Potatoes in the North-West Russian Ecosystem *Plants* **11**(7) pp. 962. Doi: 10.3390/plants11070962.
3. Murodova, S. S., & Davranov, Q. (2017). Biotechnology of the production of multifunctional microbial composite Zamin-M. J*ournal of the Academy of Sciences of the Republic of Uzbekistan Lectures* **2** pp.33-37.
4. Basu, A., Prasad, P., Das, S. N., Kalam, S., Sayyed, R. Z., Reddy, M. S., & El Enshasy, H. (2021). Plant Growth Promoting Rhizobacteria (PGPR) as Green Bioinoculants: Recent Developments, Constraints, and Prospects *Sustainability* **13**(3) pp.1140. Doi:10.3390/su13031140.
5. Chakraborty, N., & Akhtar, M. (2021). Biofertilizers: Prospects and challenges for future. *In Biofertilizers* pp. 575-590. Doi:10.1002/9781119724995.ch20.
6. Mohanty, P., Singh, P. K., Chakraborty, D., Mishra, S., & Pattnaik, R. (2021). Insight into the role of PGPR in sustainable agriculture and environment *Frontiers in Sustainable Food Systems* **5** pp. 667150. Doi:10.3389/sufs.2021.667150.
7. Wasai, S., & Minamisawa, K. (2018). Plant-associated microbes: From rhizobia to plant microbiomes *Microbes and Environments* **33**(1) pp. 1-3.
8. Glick, B. R., & Gamalaro, R. (2021). Recent developments in the study of plant microbiomes. *Microorganisms* **9**(7) pp. 1533. Doi:10.3390/microorganisms9071533.
9. Shevelukha, B. C. (2016). True vegetative and ego regulation and ontogenesis, Agricultural Bulletin, pp.43-47.
10. Tursunov, S. T., & Sharifjonov, J. A. (2022). Features of storing potatoes. Agro-Ilm journal, 12(1) pp.17-23.
11. Uromova, I.P. (2009). Harvest and quality of potatoes when using biological products, Agronomy of Uzbekistan, **1** pp. 33.
12. Khojanazarova, M.K. (2021). Investigating the cultural-morphological features of rhizobacteria and allocating it from the cotton plant (Gossýpium hirsútum): in the example of irrigated meadow soils of Uzbekistan *IOP Conference Series: Earth and Environmental Science* **939**(1) pp.012045. Doi: 10.1088/1755-1315/939/1/012045.
13. Ibragimova, N. (2021). Studying the effect of potato products in extending the period of potato storage *E3S Web of Conferences* **258** pp. 04021. Doi: 10.1051/e3sconf/202125804021
14. Murodova, S.S., & Khujanazarova, M.K. (2020). Study of enzymatic activity of microbiological biopreparation in the cultivation of cotton plant (Gossypium hirsutum L.) under saline stress conditions *IOP Conference Series: Earth and Environmental Science* **614**(1) pp.012125. Doi: 10.1088/1755-1315/614/1/012125.
15. Jumanazarov, G., Zuparov, M., Mamiev, M., & Allayarov, A. (2021). Distribution and damage of powdery mildew disease in cassis and raspberry in Tashkent province, Uzbekistan *E3S Web of Conferences* **284** pp. 03017. Doi: 10.1051/e3sconf/202128403017.