

Program name: BR10765062 "Development of technology to ensure the safety of the quality of agricultural raw materials and processed products in order to reduce losses in various storage methods"

Relevance: Scientific directions for processing agricultural raw materials are quite well developed in the world, but many high-tech processing enterprises are developed in countries with high economic development. Despite the availability of a sufficient raw material base, processing of agricultural products is not sufficiently developed in Kazakhstan. Today, processing in Kazakhstan is characterized by the lack of an integrated, resource-saving approach.

Freeze drying technology (English freeze drying or lyophilization) is known internationally. If in other countries this technology is widespread and familiar in many areas (pharmaceuticals, food, applied biotechnology), then in Kazakhstan the technology of freeze-dried products for the needs of the food market is, for the time being, an innovation and refers to innovation.

Currently, there are about 70 certified farms producing organic raw materials in Kazakhstan, while there are no enterprises for processing and production of organic food products. In addition, a system of requirements (methods, technologies, technological regulations, etc.) for processing, transportation and storage of organic products has not been developed, taking into account the physico-chemical characteristics of local raw materials.

The program is aimed at solving the strategic objectives of the State Program for the Development of the agro-industrial complex of the Republic of Kazakhstan for 2017-2021" dated July 12, 2018 No. 423, Message of the President of the Republic of Kazakhstan N. Nazarbayev dated January 31, 2017 "The third modernization of Kazakhstan: global competitiveness", Message of the President of the Republic of Kazakhstan N. Nazarbayev dated January 10, 2018 "New development opportunities in the conditions of the Fourth Industrial Revolution", Message of the President of the Republic of Kazakhstan N. President of the Republic of Kazakhstan K. Tokayev dated October 5, 2018 "The growth of the well-being of Kazakhstanis: increasing incomes and quality of life", The Message of the President of the Republic of Kazakhstan K. Tokayev dated September 2, 2019 "Constructive public dialogue is the basis of stability and prosperity of Kazakhstan", the Message of the President of the Republic of Kazakhstan K. Tokayev dated September 1, 2020 "Kazakhstan in a new reality. Time for Action", Resolution of the Government of the Republic of Kazakhstan "On approval of the State Program "Digital Kazakhstan" dated December 12, 2017 No. 827, on improving the competitiveness of the industry, Kazakhstan's departure from the raw materials economy, the development of the export potential of domestic processed products.

Purpose: Development of innovative technologies for processing and storage of crop and livestock products

Expected results:

At the end of the program:

The technology of freeze-dried honey with a long shelf life will be developed.

Freeze-drying technologies of berries (strawberries, raspberries, currants, sea buckthorn, blueberries) with a long shelf life will be developed.

Technologies for storing fruits and grapes of domestic varieties will be developed in order to obtain organic products.

2 seminars and round tables will be held, at least 4 articles published in peer-reviewed foreign scientific publications with a non-zero impact factor, 3 articles in peer-reviewed foreign scientific publications indexed in the Science Citation Index Expanded database of Web of Science and (or) having a CiteScore percentile in the Scopus database of at least 30 (thirty) and at least 25 publications in foreign and domestic publications recommended by The Committee for Quality Assurance in the Sphere of Education and Science of the Ministry, 1 monograph in a Kazakh publishing house, 3 patent applications have been filed with the Kazakhstan patent office, of which at least 2 patents will be obtained.

3 pilot-industrial approbations will be carried out, calculations of the economic efficiency of new technologies will be carried out.

8 undergraduates and 2 PhD doctoral students will be involved, and it is also planned to improve the skills of young scientists in leading foreign scientific centers for at least 3 people per year.

The results obtained in 2021:

A comprehensive assessment of the thermodynamic and rheological characteristics of honey has shown that humidity and temperature affect the viscosity of honey. It was found that with increasing humidity for all varieties of honey, the viscosity decreases, when heated above 35⁰C, the viscosity of honey decreases, and also all varieties of honey in terms of water activity belong to products with low humidity, of the 3 varieties of honey, the low water activity index is in sunflower honey (0.4010), and the high one is in lime honey (0.5400 units).

It has been established that in order to achieve high quality of dry honey powder, 80-90% of the moisture contained should be removed during the sublimation process. At a temperature of minus 40⁰C, more than 90% of the moisture in honey crystallizes, and the maximum proportion of frozen moisture in the sublimation process is observed at temperatures from minus 300C to minus 40⁰C, depending on the types of honey. The drying temperature is one of the essential factors of drying. The drying process was carried out at a temperature of 40 ° C, since an increase in the drying temperature above 40 ° C can lead to a decrease in the quality of the product.

The optimal thickness of the layer of strawberries and raspberries during freezing, depending on the type and variety, is 2 cm thick, the freezing temperature of weakly binding and free water in the berry is -40 and - 500C. Raspberries of the Raspberry Ridge variety and strawberries of the Albion variety were selected for further research.

For sea buckthorn and blueberry currants, the optimal thickness of the berry layer is 0.5 cm, the freezing temperature is -40 and -50⁰C. For further experiments, varieties of blueberry "Darrow", currant "Altai early" and sea buckthorn "Jam"

were selected.

A stationary site has been selected in the Suzdaleva farm for conducting experiments. Stationary experiments to study the dynamics of the development of raspberry diseases are laid down in the farm "Zheksembieva", farm "Nurgeldi" in the village of Turgen on the raspberry variety Indian Summer and Polka. Experiments on studying the dynamics of grape diseases and sampling of pests and diseases of grapes were carried out in Amangeldy LLP in Turkestan region and Teyfur farm in Almaty region. Apple and grape varieties of domestic selection and raspberry berries were selected at stationary sites in order to obtain organic products.

During monitoring at the stationary site in the farm "Suzdaleva", 13 types of pests and 8 types of diseases were identified. The main types of pests and diseases of economic importance and affecting the development of diseases that manifest themselves during the storage period are: apple moth, several types of leaf-twigs, shield. Of the diseases that pose a danger, the following objects are noted: rot of various etiologies, scab, rust, along with the main causative agent of fruit rot (species of the genus *Monilia*) during the growing period, other types of fungi from the genera *Fusarium*, *Alternaria*, *Trichotecium*, *Penicillium*, *Botrytis* cause fruit damage.

The effect of 5 new immunostimulants on fruit preservation was studied. Biochemical, organoleptic, physico-chemical and microbiological characteristics of fresh berries, fruits and grapes with various storage methods were carried out. Biochemical analysis of fruits was carried out during the period of removable maturity of apples, grapes and raspberries. As an object, varieties of local selection of grapes of Taifi Pink (etalon), Muscat, Kyzyl Tan and apple trees of domestic varieties Maksat and Voskhod, as well as raspberries of zoned varieties Indian Summer and Polka autumn ripening dates were used.

The results obtained in 2022:

- The recipe and technology of preparation of soft cheese and semi-hard cheese from goat's and sheep's milk have been developed.
- established modes of tempering and steaming, taking into account the minimization of energy consumption for various grains and legumes, optimized regimes of extruding porridge.
- The recipe and technological regimes for drying combined fermented milk protein products with vegetable additives have been developed;
- The optimal regimes for the drying process of combined fermented milk protein products with vegetable additives using microwave energy have been obtained;
- 2 technologies for the manufacture of lactose-free products have been developed;
- 4 complexes of microelements (nanocarboxylates) were obtained; a technology for obtaining special additives (nutrients) and complex microelements using nanotechnology from local raw materials was developed, 1 experimental batch of a special additive was obtained; 4 recipes for enriched flour mixtures for bakery products have been developed;

- The effect of the use of preventive drinks enriched with probiotic ICD, vitamins and minerals and prebiotics on laboratory animals was evaluated;

- a recipe and a technological scheme for the production of whey drinks have been developed, which makes it possible to increase the biological value of the product by including biologically active components, such as shadberry and sea buckthorn juice, in the structure; a consortium of lactic acid bacteria has been developed; a technology for soft whey cheese has been developed. An experimental batch of soft cheese has been received;

- recipes for semi-smoked sausages with 10% oleogels based on sunflower oil and beeswax and with 7% oleogels content of a composite mixture based on sunflower oil, monoglyceride and wax have been developed; a technology and 1 recommendation for the production of a meat product with a low content of trans-isomers using raw materials of animal and vegetable origin have been developed;

- a technological scheme for obtaining a protein hydrolyzate from wool by-products has been developed and proposed; a recipe for prototypes of boiled sausage for gerodietic purposes was developed with the addition of a protein hydrolyzate and a vegetable component - purslane in an amount of 1%; Pilot testing of the production of meat gerodietary products enriched with biologically active ingredients from secondary meat raw materials was carried out at the meat processing complex of «MPK Rakhmet» LLP (Ekibastuz).

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List of publications and patents published within the framework of this project: (with links to them):

Published articles in foreign journals with a non-zero impact factor:

1. Kamanova S.G., Toymbaeva D.B., Ospankulova G.H. Freeze drying of berries //SSN 2308-4804. Science and world. International scientific journal. № 4 (104), 2022.Vol. II. С. 59-63. Impact factor 0.325.

2. Tultabayeva T.Ch., Zhumanova U.T., Tultabaev M.Ch., Safuani Zh.E. Physico-chemical indicators of honey of the East Kazakhstan region. ISSN 2308-4804. Science and world. International scientific journal, No.12 (100), 2021, Vol. II. pp.46-49. Impact factor 0.325.

3. Lisina M.M., Kopzhasarov B.K., Beknazarova Z.B., Koigeldina A.E. Changes in quality indicators of grapes during storage // International Scientific Journal Science and the World. – Volgograd, 2022. – pp.45-50.

Published articles in journals recommended by KOKSON::

1. Tultabayeva T.Ch., Zhumanova U.T., Tultabayev M.Ch., Tapalova A.B., Shoman A.K., Tultabayev B.Ch.. Determination of the parameters of freeze-drying honey. Вестник АТУ, №3, 2022. doi.org/10.48184/2304-568X-2022-3-185-191

2. Ospankulova G.H. *, Kamanova S.G., Murat L.A., Toymbaeva D.B., Temirova I.Zh., Ermekov E.E., Muratkhan M., Aldieva A.B.. Study of the chemical composition of various types of berries.Bulletin of ATU, No. 3, 2022. doi.org/10.48184/2304-568X-2022-3-45-51

3. Ospankulova G. H., Kamanova S. G., Toymbaeva D. B., Temirova I. Zh., Aldieva Muratkhan M., A. B. Murat, L.A., Ermekov E.E. Determination of vitamins and organic acids in berries of various types Bulletin of KazATU named after S.Seifullin, No. 4, 2022.

4. Tultabayeva T.Ch., Tultabaev M.Ch., Zhumanova U.T. et al. Creation of drinks based on honey. Izvestia of the Nizhnevolzhsky agrouniversitetskiy complex: science and education. No. 4.2022 (RSCI).

5. Tultabayeva T.Ch., Tultabaev M.Ch., Zhumanova U.T., etc. Drying of honey using sublimation methods. Izvestia of the Nizhnevolzhsky agrouniversitetskiy complex: science and education. No. 4.2022 (RSCI).

Information for potential users:

Additional information: