

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

Relevance: Scientific areas 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 presence of a sufficient raw material base, processing of agricultural products is underdeveloped in Kazakhstan. Today, processing in Kazakhstan is characterized by the lack of an integrated, resource-saving approach.

The technology of 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 for the production of freeze-dried products for the needs of the food market is still an innovation and belongs to innovation.

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

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. Nazarbayev dated October 5, 2018 “Growing the welfare of Kazakhstanis: increasing income and quality of life”, 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”, 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, to increase the competitiveness of the industry, move Kazakhstan away from a commodity-based economy, and develop the export potential of domestic processed products.

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

Expected results:

Upon completion of the program:

A technology for freeze-dried honey with a long shelf life will be developed.

Technologies for freeze-drying berries (strawberries, raspberries, currants, sea buckthorn, blueberries) with a long shelf life will be developed.

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

2 seminars and round tables will be held, at least 4 articles will be 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 the Web of Science and (or) having a percentile in CiteScore in the Scopus database at least 30 (thirty) and at least 25 publications in foreign and domestic publications recommended by KOKSON, 1 monograph in a Kazakh publishing house, 3 patent applications have been submitted to the Kazakh Patent Office, of which at least 2 patents will be obtained.

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

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

Results obtained in 2021:

A comprehensive assessment of the thermodynamic and rheological characteristics of honey showed that humidity and temperature affect the viscosity of honey. It has been established 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 are classified as products with low humidity; out of 3 varieties of honey, the low indicator of water activity in sunflower honey (0.4010), and high - in linden honey (0.5400 units).

It has been established that to achieve high quality dry honey powder, 80-90% of the moisture content 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 during 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 drying factors. The drying process was carried out at a temperature of 40°C, since increasing 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 determined to be 2 cm thick, the freezing temperature of weakly binding and free water in the berry is -40 and -500C. For further research, raspberries of the “Raspberry Ridge” variety and strawberries of the “Albion” variety were selected.

For sea buckthorn and blueberry currants, the optimal thickness of the berry layer is determined to be 0.5 cm, freezing temperature -40 and -500C. For further experiments, varieties of blueberry “Darrow”, currant “Altayskaya rannyaya” and sea buckthorn “Jamovaya” were selected.

A stationary site was selected at the Suzdaleva farm for conducting

experiments. Stationary experiments to study the dynamics of the development of raspberry diseases were carried out at the Zheksembieva farm, Nurgeldi farm in the village of Turgen on the raspberry varieties Babie Leto and Polka. Experiments on studying the dynamics of grape diseases and sampling of pests and diseases of grapes were carried out at Amangeldy LLP in the Turkestan region and the Teyfur farm in the Almaty region. In stationary plots, apple fruits and domestically selected grape varieties and raspberries were selected in order to obtain organic products.

During monitoring at a stationary site in the Suzdaleva farming enterprise, 13 types of pests and 8 types of diseases were identified. The main types of pests and diseases that are of economic importance and influence the development of diseases that appear during the storage period are: codling moth, several types of leaf rollers, and scale insects. Among the diseases that pose a danger, the following objects are noted: rots 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 spoilage.

The effect of 5 new immunostimulants on the preservation of fruits was studied. Biochemical, organoleptic, physicochemical and microbiological characteristics of fresh berries, fruits and grapes were carried out under various storage methods. Biochemical analysis of fruits was carried out during the period of harvesting ripeness of apples, grapes and raspberries. The object used was local selection of grape varieties Taifi Rozovy (standard), Muscat, Kyzyl Tan and apple trees of domestic varieties Maksat and Voskhod, as well as raspberries of the zoned varieties Babie Leto and Polka of autumn ripening.

Results obtained in 2022:

-1 technology for producing drinks with honey has been developed and installed their shelf life;

- optimal parameters for freeze drying of various types and varieties of berries have been established: It has been established that in freeze-dried berries, as the storage time increases, the vitamin C content decreases. The organoleptic characteristics of freeze-dried berries after storage indicate that after the storage time, the quality of the product changes slightly;

- 13 types of pests and 8 types of diseases were identified. The main types of pests and diseases that are of economic importance and influence the development of diseases that appear during the storage period are: codling moth, several types of leaf rollers, and scale insects. Among the diseases that pose a danger, the following objects are noted: rots of various etiologies, scab, drying diseases (cytosporosis and black cancer), 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* also cause fruit spoilage, *Trichotecium*, *Penicillium*, *Botrytis*.

- the effect of 4 selected immunostimulants on the preservation of fruits was studied. Biochemical, organoleptic, physicochemical and microbiological characteristics of fresh berries, fruits and grapes were carried out under various

storage methods. Biochemical analysis of fruits was carried out during the period of harvesting ripeness of apples, grapes and raspberries. The object used was local selection of grape varieties Taifi Rozoviy (standard), Karakoz, Kyzyl Tan and apple trees of domestic varieties Maksat and Voskhod, as well as raspberries of the Indian Leto variety of autumn ripening.

Results obtained in 2023:

-A study to determine the shelf life of honey drinks showed that the drinks retain their organoleptic characteristics and food safety for two months. In this regard, we have proposed the following storage conditions for honey drinks based on vegetable and berry raw materials: shelf life at a temperature of +4°C - 30 days, and at +25°C – 14 days;

- a technological process has been developed for freeze-drying bee honey at an initial sample temperature of -40°C, the drying time is from 7 to 9 hours. As a result, freeze drying reduced water activity by 28%, which made honey microbiologically more stable and eliminated the possibility of fermentation;

-technological instructions have been developed for the production of freeze-dried honey with a long shelf life, which is intended for direct consumption in food, for use in the food and pharmaceutical industries;

- as a result of sensory assessment, the optimal moisture content for black currant and sea buckthorn berries was determined, which was 16.27% and 17.2%, achieved at a shelf temperature of 50 ° C and a sublimation time of 20 hours;

- it was found that freeze-dried berries, with a drying process of 18 and 20 hours, lost an insignificant content of vitamins, organic acids and sugars. Increasing the sublimation time of black currant and sea buckthorn berries to 22 hours significantly reduces the level of both organic acids and sugars in the berries;

- it has been established that the optimal parameters for freeze-drying black currants and sea buckthorn are a shelf temperature of 50 ° C and a duration of the sublimation process of 20 hours;

- technology developed freeze-drying and production of high-quality berries with a long shelf life;

- recommendations for freeze-drying and production of high-quality berries have been developed;

- determined that the optimal storage temperature for most fruits and berries is about 0°C, and the relative air humidity is 90-95%. But there are individual characteristics in the storage mode of fruits of individual crops and even varieties. Depending on the shelf life of fruits and berries and on storage conditions, certain storage periods are established, under which the quality of the raw materials does not change significantly;

- the content of basic elements of mineral nutrition has a significant impact on the keeping quality and development of fruit diseases during storage. The longest shelf life is characterized by batches of fruits containing calcium and an optimal combination of sugars and dry substances. The best conditions for storing fruits are low temperatures from 0 to 40C;

- in our experiments, great success was achieved in preserving the quality of fruits; the longest shelf life is characterized by fruits with a set of indicators, including with an amount of ethylene of no more than 12.8 ppm;

-Monitoring and sampling of pests and diseases were carried out at fixed sites. When conducting monitoring at a stationary site in the Suzdaleva farming enterprise, 10 types of pests and 8 types of diseases were identified. The main types of pests and diseases that are of economic importance and influence the development of diseases that appear during storage are: apple codling moth, Californian scale insect, several types of mites, green aphids, etc. Among the diseases that pose a danger, the following objects are noted: rots of various etiologies, scab, drying diseases (cytosporosis and black cancer), along with the main causative agent of fruit rot (species of the genus *Monilia*), other types of fungi from the genera *Fusarium*, *Alternaria*, *Trichotecium*, *Penicillium*, *Botrytis* also cause fruit spoilage during the growing period;

-During storage, we will study the effect of 4 selected immunostimulants on the preservation of fruits. Biochemical, organoleptic, physicochemical and microbiological characteristics of fresh berries, fruits and grapes were carried out. Biochemical analysis of fruits was carried out during the period of harvesting ripeness of apples, grapes and raspberries. The object used was local selection of grape varieties Taifi Rozoviy (standard), Karakoz, Kyzyl Tan and apple trees of domestic varieties Maksat and Voskhod, as well as raspberries of the Indian Leto variety of autumn ripening.

- an assessment was given of the suitability of fruits, berries and grape varieties when treated with immunomodulators at various temperature conditions (+1) (+2) and air humidity of 75-80%. The assessment of varieties was carried out according to organoleptic indicators, biochemical composition (total dry matter content, moisture, amount of sugars, vitamin C), mineral substances, in particular calcium, before storing them in storage.

Research team members:

Full name	
Tultabaeva T.Ch.	S.C. 57190225030 , ID 0000-0003-2483-7406
Ospankulova G.Kh.	SC 57194595106, ID 0000-0002-6043-4658 , WOS - AAN-4822-2020
Aidarkhanova G.S.	SC 57205141237, ID 0000-0002-5108-8036 , WOS - AAF-1046-2022
Bulashev B.K.	SC 57218825492, ID 0000-0003-1831-3315
Kamanova S.G.	SC 57216961883, ID 0000-0001-9534-2721 , WOS - ABB-8697-2021
Toimbaeva D.B	ID 0000-0001-9595-0559
Temirova I.Zh.	SC 57205296556, ID0000-0002-9717-3236

Muratkhon M.	SC 57225141708 ID 0000-0002-7248-1531 WOS AAZ-2910-2021
Murat L.A.	ID 0000-0001-5684-0621
Aldieva A.B.	ID 0000-0003-1078-928X
Tultabaev B.Ch.	SC 57195502998

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

Based on the results of the research for 2021-2023, the following were published:

In 2021:

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

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

In 2022:

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

1.Kamanova S.G., Toimbaeva D.B., Ospankulova G.Kh. Freeze drying of berries // Science and world. International scientific journal. No. 4 (104), 2022.Vol. II. pp. 59-63. Impact factor 0.325.

2. Isina Zh.M., Kopzhasarov B.K., Koygeldina A.E., Beknazarova Z.B. Changes in quality indicators of grapes during storage //Science and world. International scientific journal, No. 11 (111), 2022, pp. 45-50. Impact factor 0.325.

-in foreign and domestic journals recommended by KOKSON:

1. Tultabayeva T.Ch., Zhumanova UT, Tultabayev M.Ch., Tapalova AB, Shoman AK, Tultabayev B.Ch.. Determination of the parameters of freeze-drying honey. Bulletin of ATU, No. 3, 2022. doi.org/10.48184/2304-568X-2022-3-185-191

2. Ospankulova G.Kh. *, Kamanova S.G., Murat L.A., Toimbaeva 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. Kh., Kamanova S. G., Toimbaeva D. B., Temirova I. Zh., Aldieva Muratkhan M., A. B. Murat, L. A., Ermekov E. E. Determination of vitamins and organic acids in various types of berries. Bulletin of KazATU named after. S. Seifullina, No. 4, 2022-Part-1-P.48-56.doi.org/10.51452/kazatu.2022.4.1198

4. Zhumanova U.T., Tultabaeva T.Ch., Tultabaev M.Ch., Shoman A. et al. Drying honey using vacuum-microwave drying methods. News of the Nizhnevolzhsky Agro-University Complex: science and education. No. 4.2022 - P.340-349DOI: 10.32786/2071-9485-2022-04-41.

5. Shoman A., Tultabaeva T.Ch., Tultabaev M.Ch., Zhumanova U.T. etc. Creation of drinks based on honey. News of the Nizhnevolzhsky Agro-University

Complex: science and education. No. 4. 2022 -P.369-377DOI: 10.32786/2071-9485-2022-04-45.

6. Kopzhasarov B.K., Beknazarova Z.B., Isina Zh.M., Dinasilov A.S., Kaldybekkyzy G. The influence of apple tree damage by the Californian scale insect (*Quadraspidiotus perniciosus*) on the quality of fruits and their safety // Bulletin of Kyzylorda University named after Korkyt Ata. No. 4 (63) 2022. P. 179-187. doi.org/10.52081/bkaku.2022.v63.i4.142

7. Klimov E.V., Asilov B.U. Selection and optimization of sales channels for small-scale fruit and vegetable producers // Problems of the agricultural market. – 2022.– No. 4.-P.94-103. DOI: 10.46666/2022-4.2708-9991.10

8. Isina M.M., Kopzhasarov B.K., Koygeldina A.E., Beknazarova Z.B. Changes in quality indicators of apple fruits during storage // Trends in the development of science and education.– Samara, 2022. – No. 92 (14). – pp. 68-74. doi: 10.18411/trnio-12-2022-647.

In 2023:

- *in foreign journals with a non-zero impact factor:*

1. Toimbaeva D.B., Muratkhan M., Murat L.A., Ermekov E.E., Ospankulova G.Kh. Comparative studies of the effect of freeze drying on the biochemical parameters of strawberries and raspberries ISSN 2308-4804. Science and world. 2023. No. 6 (118), pp. 24-28. Impact factor 0.325.

- *in foreign and domestic journals recommended by KOKSON:*

1. Klimov E.V., Kantarbaeva Sh.M., Kalymbekova Zh.K. Capacity of the organic food market of the Republic of Kazakhstan: possibilities of consumption by certain socio-demographic groups of the population. Problems of the agricultural market, No. 1, 2023. P. 161-171. DOI: 10.46666/2023-1.2708-9991.18

2. Koshmagambetova M.Zh., Beknazarova Z.B., Kopzhasarov B.K., Isina Zh.M., Kaldybekkyzy G. Almaty baldheaded zhagdayyndagy Californialyk kalkanshaly symyrdyn (*Diaspidiotus perniciosus*) bioecologies // Izdenister, natizheler 2023.– No. 3 (99) . <https://doi.org/10.37884/3-2023/10>

3. Kamanova S.G., Temirova I.Zh., Aldieva A.B., Ospankulova G.Kh. The influence of freeze drying on the organoleptic properties and chemical composition of blueberries. Food industry: science and technology, Minsk Vol.16, No. 3(61). 2023.P.36-41.

4. Aldieva A.B., Khamitova D.D. The influence of freeze-drying parameters on the content of polyphenols and anthocyanins in strawberries. ATU Bulletin. 2023. No. 3.-P.52-56. <https://doi.org/10.48184/2304-568X-2023-3-52-56>

5. Temirova I.Zh., Ospankulova G.Kh. Study of the effect of freeze drying on organoleptic characteristics and vitamin C content in raspberries. ATU Bulletin. 2023. No. 3.-P.57-62. <https://doi.org/10.48184/2304-568X-2023-3-57-62>

6. Tultabaeva T.Ch., Zhumanova U.T., Tultabaev M.Ch., Abubakirova L. Analysis of polymer materials for packaging freeze-dried honey. News of OshTU, 2023 No. 1. _S. 22-27.

7. Tultabaeva T.Ch., Zhumanova U.T., Tultabaev M.Ch., Shoman A., Abubakirova L. Honey drinks based on berry and vegetable raw materials. News of OshTU, 2023. No. 1-P.73-78.

8. Beknazarova Z.B., Koshmagambetova M.Zh., Kopzhasarov B.K., Isina Zh.M., Sarbasova A.M., Kaldybekkyzy G. Monitoring of the main garden pests in garden agrocenoses of the South and South-East of Kazakhstan. Bulletin of Kyzylorda University named after Korkyt Ata. 2023.– No. 3.P.193-203 <https://doi.org/10.52081/bkaku.2023.v66.i3.081>

9. Beknazarova Z.B., Kopzhasarov B.K., Isina Zh.M., Koshmagambetova M.Zh., Sarbasova A.M. Kazakhstan ontustik-shygys zhagdayynda alma baktaryndagy diaspidotus perniciosus population son pheromonitoring: Bulletin of science of the Kazakh Agrotechnical Research University named after. S. Seifullina (interdisciplinary). – Astana: 2023. -No. 3 (118). – B.331-339. [doi.org/10.51452/kazatu.2023.3\(118\).1514](https://doi.org/10.51452/kazatu.2023.3(118).1514)

10. Kaldybekkyzy G., Beknazarova Z.B., Kopzhasarov B.K., Isina Zh.M., Koshmagambetova M.Zh., Kaldybek D. Effect of apple tree damage by the codling moth (*Cydia pomonella* l.) on the quality of fruits and their safety. Bulletin of Science of the Kazakh Agrotechnical Research University named after. S. Seifullina (interdisciplinary). – Astana: 2023. -No. 3(118).- P.322-330. [doi.org/10.51452/kazatu.2023.3\(118\).1515](https://doi.org/10.51452/kazatu.2023.3(118).1515)

11. Isina Zh.M., Kopzhasarov B.K., Koygeldina A.E., Beknazarova Z.B., Kaldybekkyzy G. Zhuzimdi saktau kezindegi biokhimiya ozergerister. Bulletin of Science of the Kazakh Agrotechnical Research University named after. S. Seifullina (interdisciplinary). – Astana: 2023. -No. 3(118).- B.282-291. [doi.org/10.51452/kazatu.2023.3\(118\).1517](https://doi.org/10.51452/kazatu.2023.3(118).1517)

12. Kamanova SG, Yermekov YY, Wenhao Li, Ospankulova G.Kh.. Mathematical modeling and experimental studies of freezing drying of blackcurrant, blueberry, strawberry, raspberry and sea-buckthorn berries. "Bulletin of VKTU named after. D. Serikbaeva." 2023, No. 3.P.40-49. DOI 10.51885/1561-4212_2023_3_40

13. Koygeldina A.E., Isina Zh.M. The influence of apple storage conditions on product quality. News of OshTU, 2023.No.2, part 1.P.156-160.

14. Isina Zh.M., Koygeldina A.E. The influence of processing and storage methods on the content of the main biologically active compounds of raspberries. News of OshTU, 2023.No.2, part 1.P.104-114.

15. Aitbaeva A.T., Klimov E.V. The influence of the organic enzyme preparation agroflorin on the growth and development of watermelon and melon crops in the conditions of the South-East of Kazakhstan. News of OshTU, 2023.No.2, part 1.P.177-186.

16. Tultabaev M.Ch., Abubakirova L., Tultabaeva T.Ch., Zhumanova U.T. Studying the composition of different types of honey. News of OshTU, 2023.No.2, part 1.P.129-133.

17. Tultabaeva T.Ch., Zhumanova U.T., Tultabaev M.Ch., Abubakirova L. Possibilities of creating honey drinks Proceedings of OshTU, 2023.No.2, part 1.P.150-155.

in peer-reviewed scientific journals indexed in Web of Science and/or Scopus:

1. Tultabayev M.Ch., Tultabayeva T.Ch., Shoman A., Zhumanova UT, Tultabayev B.Ch.. Technology improvement obtaining powdered dried honey. Eastern-European Journal of Technologies. 4/11.2023. P. 59-64. <https://doi.org/10.15587/1729-4061.2023.285447>, percentile 47.

2. Kamanova S., Temirova I., Aldiyeva A., Yermekov Y., Toimbayeva D., Murat L., Muratkhan M., Khamitova D., Tultabayeva T., Bulashev B., Ospankulova G.Effects of Freeze-Drying on Sensory Characteristics and Nutrient Composition in Black Currant and Sea Buckthorn Berries//Applied Sciences. 2023; 13(23):12709. <https://doi.org/10.3390/app132312709>, percentile 65.

1. Tultabayeva T., Zhumanova U., Tultabayev M., Shoman A. An econometric analysis of price elasticity and demand factors in the global honey and honey-based beverage markets. Economic Annals- XXI Research Journal in 2023, volume 202, issue 3-4, p.40-51.[doi:https://doi.org/10.21003/ea.V202-04](https://doi.org/10.21003/ea.V202-04), percentile 58.

Patents:

1. Patent No. 7891 dated March 17, 23. Method of storing grapes. Authors: Isina Zh.M., Kopzhasarov B.K., Beknazarova Z.B., Boltaeva L.A., Khidirov K.R., Kaldybekkyzy G.

2. Application for utility model No. 2023/0802.2 dated July 30, 2023. "Composition of a dietary and prophylactic drink. Tultabaeva T.Ch., Zhumanova U.T., Tultabaev M.Ch., Shoman A.E., Tultabaev B.Ch.

3. Application for utility model No. 2023/0661.2 "Method for producing freeze-dried berries."Toimbaeva D.B., Muratkhan M., Murat L.A., Ermekov E.E., Ospankulova G.Kh.

4. Application for utility model No. 2023/1014.2 dated 10.10.2023 "Method of obtaining freeze-dried honey powder" Tultabaeva T.Ch., Zhumanova U.T., Tultabaev M.Ch.

5. Monograph: Tultabaeva T.Ch. Production of products from natural honey. ISBN 978-601-257-481-4. Astana, 2023, 126 p.

3 pilot industrial testing was carried out, calculations of the economic efficiency of new technologies were carried out.

8 master's students and 2 PhD doctoral students were involved; they completed advanced training courses for young scientists in leading foreign scientific centers.