

Brief information about the project

Name of the project	IRN AP26103429 A biotechnological method for producing a biodegradable functional cellulose film for innovative food packaging
Relevance	The relevance of the study is due to the need to reduce the negative impact of traditional packaging materials on the environment, as well as to prevent spoilage of products and increase their shelf life by improving the quality and functionality of packaging.
Purpose	Development of technological methods for obtaining biodegradable packaging nanocellulose film with antimicrobial, antioxidant properties and as colorimetric freshness indicator to prevent spoilage and increase the shelf life of food products.
Objectives	1. Optimization of a nutrient medium based on brewing industry waste for cultivating a bacterial cellulose producer; 2. Selection of the composition and method for producing an active and intelligent packaging film; 3. Assessment of the quality and safety of meat and fish products packaged in cellulose film.
Expected and achieved results	Achieved results: 2025: The optimal composition of the nutrient medium based on brewing waste for the BC producer, ensuring maximum productivity of the strain and reducing the cost of the biopolymer synthesized by it was selected. Expected results: 2026: The optimal composition of bio-packaging will be selected and the parameters of the technology for obtaining packaging material is being worked out. 2027: New packaging will be validated to extend shelf life, maintain and monitor the quality of meat and fish products. A process flow chart and regulations for obtaining active and smart cellulose packaging film will be developed.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	1. Project Manager, Shokatayeva Dina – PhD in 6D070100-Biotechnology, Senior Lecturer, Al-Farabi Kazakh National University. Scopus Author ID 57197794315; h-index 5; ORCID https://orcid.org/0000-0003-1131-7233; ResearcherIDT-1923-2017. 2. Savitskaya Irina Stanislavovna – Doctor of Biological Sciences, Professor, Al-Farabi Kazakh National University. h-index 12, CiteInd.-461, Scopus author ID 36705310600; https://orcid.org/0000-0003-2417-8463; Researcher ID F-5542-2013. 3. Kistaubaeva Aida Serikovna, PhD in Biology, Associate Professor, Al-Farabi Kazakh National University. h-index 12, CiteInd.-373, Scopus author ID 57197801138; http://orcid.org/0000-0002-9385-7155; ResearcherID F-5542-2013. 4. Voronova Nina Viktorovna, DSc in Biology, Associate Professor, Al-Farabi Kazakh National University.

	5. Zhantlessova Sirina - PhD in the educational program "8D05101-Biology", lecturer at the Faculty of Biology and Biotechnology of the Al-Farabi Kazakh National University. h-index 2, Scopus Author ID 57869399100, ORCID https://orcid.org/0000-0001-6604-8056, ResearcherID: ADA-3537-2022. 6. Talipova Aizhan - PhD on the educational problem "Nanomaterials and Nanotechnology", senior lecturer of the Faculty of Biology and Biotechnology of the Al-Farabi Kazakh National University. h-index 4, Scopus author ID 57211535311; ORCID https://orcid.org/0000-0001-6874-5760. 7. Khamitkyzy Zhazira – Master of Engineering Sciences, 3rd year PhD student in the educational program "Microbiology". Scopus author ID 58150821900; ORCID https://orcid.org/0000-0002-3364-6006. 8. Baltabay Akniet Saduakhaskyzy – Master of Engineering and Technology, PhD student in the specialty "Biotechnology". h-index 1, ORCID https://orcid.org/0000-0001-5903-9928, Scopus Author ID: 58547761700, Researcher ID: HKH-1193-2023. 9. Musabekov Zhurabek – Master of Engineering Sciences in Biotechnology. ORCID https://orcid.org/0009-0008-4895-8169.
Usage	For packaging meat and fish products to extend shelf life, control freshness, and reduce microbial spoilage; can be used in active and "smart" food packaging.
Priority compared to real-world alternatives	Biodegradability, the use of inexpensive raw materials (brewery waste), the presence of antimicrobial and antioxidant properties, as well as a built-in freshness indicator, which simultaneously provides protection and monitoring of product quality (unlike traditional inert packaging).
List of publications with links to them	1. Shokatayeva D., Savitskaya I., Kistaubaeva A., Talipova A., Asylbekova A., Abdulzhanova M., Mashzhan A. Bacterial cellulose and pullulan from simple and low cost production media // Eurasian Chemico-Technological Journal, 2019, 21(3), P. 247–258. DOI:10.18321/ectj866; (Scopus percentile-22, CiteInd.-11; WOS-Q4; CiteInd.-4). 2. Shokatayeva D.H., Talipova A., Savitskaya I., Pogrebnjak A., Kistaubayeva A., Ignatova L.V. (2020). Quality Parameters of Cellulose–Chitosan Based Edible Films for Probiotic Entrapment. In: Pogrebnjak, A., Pogorielov, M., Viter, R. (eds) Nanomaterials in Biomedical Application and Biosensors (NAP-2019). Springer Proceedings in Physics, vol 244. Springer, Singapore. https://doi.org/10.1007/978-981-15-3996-1_17 3. Savitskaya I., Zhantlessova S., Kistaubayeva A., Ignatova, L., Shokatayeva D., Sinyavskiy Y., Kushugulova A., Digel I. Prebiotic Cellulose–Pullulan Matrix as a “Vehicle” for Probiotic Biofilm Delivery to the

	Host Large Intestine // Polymers, 2024, 16, 30. https://doi.org/10.3390/polym16010030 (Scopus percentile-80, WOS-Q1). 4. Savitskaya I.S., Shokatayeva D.H., Kistaubayeva A.S., Ignatova, L.V. Digel, I.E. Antimicrobial and wound healing properties of a bacterial cellulose based material containing <i>B. subtilis</i> cells// Heliyon, Vol.5, Issue 10, 2019, №02592. DOI:10.1016/j.heliyon.2019.e02592; (Scopus percentile-82, CiteInd.-49; WOS-Q1; CiteInd.-41). 5 Turlybekuly, A., Pogrebnjak, A.D., Sukhodub, L.F., Sukhodub, L.B. Kistaubayeva, A.S., Savitskaya, I.S., Shokatayeva, D.H. et al. Synthesis, characterization, in vitro biocompatibility and antibacterial properties study of nanocomposite materials // Biomaterials Advances (Materials Science and Engineering C) Vol.104, 2019, №109965. DOI:10.1016/j.msec.2019.109965; (Scopus percentile-95, CiteInd.-95; WOS-Q1; CiteInd.-78). 6. Sukhodub L.F., Sukhodub L.B., Pogrebnjak A.D., Turlybekuly, Amanzhol, Kistaubayeva A., Savitskaya I., Shokatayeva D. Effect of magnetic particles adding into nanostructured hydroxyapatite–alginate composites for orthopedics // Journal of the Korean Ceramic Society, 2020, Vol. 57, Issue 5, P. 557 – 569. DOI: 10.1007/s43207-020-00061-w (Scopus percentile-61, CiteInd.-12; WOS-Q1; CiteInd.-10). 7. Savitskaya I., Kistaubaeva A., Shokataeva D., Abashidze I., Seishanlo F., & Amangeldi A. (2023). Creation of an immobilized probiotic based on bacterial cellulose for the correction of the intestinal microbiome. Vestnik kaznu. Biological series, 97(4), pp.72–86. https://doi.org/10.26577/eb.2023.v97.i4.07 (SHEQAC) 8. Savitskaya I.S., Kistaubayeva, A.S., Digel, I.E., Shokatayeva D.H. Physicochemical and antibacterial properties of composite films based on bacterial cellulose and chitosan for wound dressing materials // Eurasian Chemico-Technological Journal Vol.19, Issue 3, 2017, P. 255-264. DOI: http://doi.org/10.18321/ectj670 (Scopus percentile-22; CiteInd.-19; WOS-Q4; CiteInd.-13).
Patents	1. Patent for Utility Model No. 5756 dated 01/08/2021 Nutrient medium for cultivating <i>Komagataeibacter xylinus</i>, a producer of bacterial cellulose Authors: Kistaubaeva A.S., Savitskaya I.S., Shokataeva D.Kh., Abdulzhanova M.A. 2. Patent for Utility Model No. 35575 dated 03/18/2022 Bacterial strain <i>Komagataeibacter xylinus</i> C-3 - producer of bacterial cellulose. Authors: Savitskaya I.S., Kistaubaeva A.S., Shokataeva D.Kh., Abdulzhanova M.A. 3. Patent for Utility Model No. 7876 dated 10.03.2023 Method for producing yogurt with functional and probiotic properties. Authors: Abdulzhanova M.A., Kistaubaeva A.S., Savitskaya I.S., Sinyavsky Yu.A., Zhantlesova S.D.

	4. Patent for Utility Model No. 8172 dated 16.06.2023 Method for producing curd paste with functional and probiotic properties. Authors: Abdulzhanova M.A., Kistaubaeva A.S., Savitskaya I.S., Talipova A.B. 5. Utility model patent No. 9573 dated September 20, 2024. Method for producing cellulose fibers from plant raw materials. Authors: Smagulova G.T., Taurbekov A.T., Baltabay A.S., Imash A.A., Kaydar B.B., Keneshbekova A.M., Mansurov Z.A.
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