Brief information about the project

Name of the project	AP14870171 «Creation of new domestic biological products based on biologically active substances of phototrophic microorganisms».
Relevance	Microalgae and cyanobacteria are one branch of large groups of phototrophic microorganisms. Phototrophic microorganisms are of great interest for medicine, cosmetics and the food industry as new and safe sources of valuable biologically active drugs. They contain easily digestible proteins, lipids and polysaccharides characterized by a unique combination of biologically active compounds, polyunsaturated fatty acids with a high content of gamma-linolenic acid, carotenoids, chlorophyll, phycocyanin, as well as macro- and microelements. Cyanobacteria and microalgae are well known for their diverse biological actions, such as antibacterial, anticancer, antifungal, cytotoxic, immunosuppressive, antiallergic properties and antiviral activity. Experiments with cyanobacteria and microalgae have shown that substances in their cells have a unique ability to regulate immunity. To strengthen the immune system, it is important to receive dietary supplements and immunostimulating biological products. Within the framework of the project, it is aimed to develop a technology for obtaining a new type of biologically active additives based on phototrophic microorganisms to create new domestic biological products for food and medical purposes.
Purpose	The purpose of the project is obtaining biologically active additives based on phototrophic microorganisms for the creation of new domestic biological products for food and medical purposes.
Objectives	1. Isolation and screening of microalgae and cyanobacteria strains according to the productivity of their biomass and the accumulation of bioactive substances. 2. Identification of highly productive phototrophic microbe cultures with a high potential for bioactive chemical accumulation in cells. 3. Optimization of the conditions of cultivation of strains of phototrophic microorganisms, to increase the productivity of the accumulation of active substances, potential for the production of biologically active additives and immunomodulators. 4. Determination of biologically active substances in the cells of selected strains of microalgae and cyanobacteria for the production of biological products. 5. Assessment of the degree of pathogenicity and toxicity of new active complexes based on biomass of highly productive microalgae and cyanobacteria.

	6. Study of the effect of the obtained active complexes based on microalgae and cyanobacteria biomass on the body of experimental animals in laboratory conditions. 7. Development of formulations and commercial forms of new domestic biological products (biologically active additives) based on phototrophic microorganisms. 8. Development of regulations for the production of biologically active additives based on phototrophic microorganisms in the laboratory, using the experimental data.
Expected and achieved results	*Expected results* -New domestic biological products (biologically active additives) based on biologically active substances of phototrophic microorganisms for food and medical purposes will be obtained. Also, the formulation and commercial forms of biologically active additives with a therapeutic and preventive effect based on the biomass of microalgae and cyanobacteria will be developed. -All the obtained scientific results will be published in peer-reviewed foreign scientific journals of the Scopus and Thomson Reuters databases. -Planning the publication of monographs - 1; -1 (one) patent will be obtained in Kazakhstan; -Expected scientific and socio-economic effects -selected strains of phototrophic microorganisms will be included in the collection of phototrophic microorganisms of the Kazakh National University and the Association of European cultures of the ESSO collection, WDC (WorldDataCenter), as potential producers of biologically active substances with therapeutic and preventive properties; -Dissemination of the results of the work among potential users, the community of scientists and the general public - the introduction of research results into the educational process for PhD-doctoral and master students. *Achieved results* During the reporting period, 29 cultures of diatoms, green microalgae, and cyanobacteria from various taxonomic groups were screened for biomass productivity and bioactive substance accumulation. The selected cultures included from the *Nostoc* genus-4, *Oscillatoria-3*, *Synechococcus-7*, *Synechocystis-2*, *Spirulina-2*, *Chlamydomonas-2*, *Chlorella-2*, *Navicula*-1 and *Dunaliella*-2. The results indicate the productivity capabilities of these cultures. The taxonomic position, morphology, phylogenetic affiliation, cultivation features, productivity, physiological and biochemical characteristics were analysed. Key biochemical characteristics of microalgae and cyanobacteria biomass, such as total lipid and protein content, were determined. The productivity analysis

	revealed that *Oscillatoria* produced the highest biomass of 5.48 g/L on day 12 of cultivation. It is important to note that all evaluations are objective and free from bias. The lipid content of the isolated cyanobacterial strains ranged from 14.2% to 22.1% of cell dry weight. Among the studied cyanobacterial cultures, *Oscillatoria* accumulated the highest amount of lipids (22.1%). Analysis of pigment composition showed a high content of chlorophyll a. *Phormidium* extracts contained echinenone, zeaxanthin, and a small amount of myxoxanthophylls, while Trichormus contained echinenone, canthaxanthin, and zeaxanthin. Cyanobacterial strains were selected to evaluate their immunomodulatory effects on the MiaPaCa2 (pancreatic carcinoma), HepG2 (liver carcinoma), and K562 (human myeloleukemia) tumour cell lines. The study analysed the effect of cyanobacterial extracts on cell line growth and proliferation. Results showed that concentrations of extracts up to 100 µg/ml had no cytotoxic effect. The impact of cyanobacterial extracts on immunocompetent bone marrow cells of sexually mature male mice weighing 38-40 g was also assessed. The results indicate a positive effect of certain cyanobacterial products on the proliferation and growth of bone marrow immune cells.
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List of publications with links to them	One (1) review article was published in a peer-reviewed scientific publication, included in the 1st (first) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 65 (sixty-five):

	1. Sandugash K. Sandybayeva, Bekzhan D. Kossalbayev, Bolatkhan K. Zayadan, Asem K. Sadvakasova, Kenzhegul Bolatkhan, Elena V. Zadneprovskaya, Ardak B. Kakimov, Saleh Alwasel, Yoong Kit Leong, Suleyman I. Allakhverdiev, Jo-Shu Chang. Prospects of cyanobacterial pigment production: Biotechnological potential and optimization strategies // Biochemical Engineering Journal, 187 (108640), 2022. https://doi.org/10.1016/j.bej.2022.108640. 2 (two) articles were published in domestic publications recommended by KOKSON: 1. S.K. Sandybayeva, K. Bolatkhan, A.B. Kakimova, A.K. Toktybay, G.A. Akhmetova, D. Salauat, M.S. Amangeldin, B.K. Zayadan. Isolation and study of morphological and cultural properties of cyanobacteral community from hot springs in Almaty region // Eurasian Journal of Ecology, №2 (75), 2023. https://doi.org/10.26577/EJE.2023.v75.i2.010 2. M. M. Torekhanova, N. R. Akmukhanova, B. K. Zayadan, A. K. Sadvakasova, M. O. Bauenova, S.N. Seiilbek, A.Konisbai. A. Ermekova Study of the possibility of using agricultural wastewater for the accumulation of microalgae biomass // International Journal of Biology and Chemistry. – 2023. – Vol.16, №1. https://doi.org/10.26577/ijbch.2023.v16.i1.011
Patents	-