

## ANNOTATION

to the dissertation work of Sagymbek Fatima Gabitkyzy  
on the topic: «Development of biological product to improve the nutritional value  
and efficiency of feed» submitted for the degree of Doctor of Philosophy (PhD)  
in the educational program 8D05101 – «Biotechnology»

### **General characteristics of the dissertation work.**

This study is aimed at the isolation and selection of lactic acid bacterial strains with probiotic properties obtained from mare's milk and koumiss, as well as the development of a biological preparation based on these strains for use in aquaculture.

### **Relevance of the research work.**

In accordance with the directive of the President of the Republic of Kazakhstan, K.K. Tokayev, dated November 22, 2022, No. 22-01-38.41 (item 9), the country is implementing the Fisheries Development Program for 2021–2030. One of the key directions of this program is the intensive development of measures aimed at increasing the volume and ensuring the preservation of aquaculture products. In this context, the importance of biotechnologies, including the development of probiotic biological preparations, is significantly increasing.

Currently, in the fields of agriculture and aquaculture, key priorities include improving product quality, enhancing the health of aquatic animals, and ensuring the sustainable use of natural resources. One of the most effective approaches to addressing these challenges is the widespread application of probiotic biological preparations. Probiotics are biologically active substances developed from beneficial live microorganisms. They help normalize intestinal microflora, improve nutrient absorption, regulate metabolic processes, and enhance the overall immune status of the organism. Due to these properties, probiotics are effectively used to improve digestive health, boost productivity, and increase the resistance of animals and fish to various diseases.

One of the current priorities of domestic science is the selection of promising industrial strains of lactic acid bacteria with high antagonistic activity that are well adapted to natural environments. The development of next-generation probiotic preparations based on these strains using advanced biotechnological methods offers an environmentally and economically sound pathway to increasing fish productivity.

In this context, the present study is regarded as one of the strategically important directions aimed at strengthening the link between science and industry, as well as reducing dependence on imported products. The research outcomes will contribute to the advancement of the national biotechnology sector and the production of competitive and safe biological products.

**The purpose of the research:** Development of a biological preparation based on promising strains isolated from traditional fermented dairy products, aimed at enhancing the nutritional value and efficiency of animal feeds.

### **The main objectives of the study to achieve this goal:**

1. Isolation of pure cultures of lactic acid bacteria from traditional fermented dairy products (mare's milk and kumis) and investigation of their probiotic properties.

2. Identification of strains with probiotic activity using modern molecular biological methods.

3. Development of a biological preparation based on probiotic strains.

4. Determination of the quality parameters of the finished probiotic feed and its incorporation into the main diet of fish.

5. Study of the effects of the biological preparation on the intestinal microflora and biological condition of fish.

**The objects of research are:** mare's milk, koumiss, isolated lactic acid bacteria and yeast, tilapia fish (*Oreochromis niloticus*), biological preparation and feed.

**Scientific novelty of the research results.**

– 5 probiotic strains of lactic acid bacteria have been isolated from traditional Kazakh national fermented milk products (koumiss and mare's milk). Their safety, probiotic potential, and antimicrobial properties have been studied.

– 5 probiotic strains have been identified by modern molecular methods, among which one strain (100.00%) was registered and entered into the GENBANK database of the National Institute of Biotechnology Information of the USA (NSBI) <https://www.ncbi.nlm.nih.gov/nucleotide>

– Based on the analysis of microbiological properties and compatibility of strains that have demonstrated the greatest probiotic properties, a consortium of 2 strains has been created to develop a biological drug that stimulates fish growth.

– As part of the study, In vivo experiments were conducted on the use of the developed biological preparation in fish feed, aimed at increasing the nutritional value and effectiveness of feed.

The practical significance of the work.

A new strain of *Lactobacillus paracasei* was isolated from mare's milk and koumiss and identified by modern molecular methods. As a result of the research, a passport for the Strain was obtained and deposited in the Central Museum "Republican Collection of Microorganisms" under identification number No. 09112-71.

According to identification number No. 7343, a patent was obtained for a utility model "Strain of lactic acid bacteria *Lactobacillus paracasei*–010K, used to produce a probiotic drug intended for the prevention and treatment of gastrointestinal diseases of farm animals, birds and fish."

A patent for the invention "Probiotic preparation for growth stimulation, prevention and treatment of fish diseases" was obtained under identification number No. 36625.

The main provisions recommended for protection:

– The probiotic potential of lactic acid bacteria isolated from mare's milk and koumiss was investigated, and the strain *Lactobacillus paracasei* – 010K was identified.

– New strains of lactic acid bacteria with probiotic properties have been genetically identified and entered into the GENBANK USA database (No. PV5239071).

– A biological preparation based on active strains of *Lactobacillus paracasei* – 010K and *Torulopsis sphæerica* – 105k has been developed for effective use in fisheries.

– The effect of a probiotic drug on the intestinal microflora and biological parameters of fish has been studied.

#### **Main results and conclusions of the study:**

1. 24 strains of lactic acid bacteria have been isolated from traditional fermented milk products (koumiss and mare's milk), and their probiotic potential for resistance to acidic media (pH 2, pH 4), bile salts, antibiotics, and antagonistic activity against pathogenic strains of *Enterococcus faecalis*, *Aeromonas* spp., *Staphylococcus aureus*, and *Escherichia coli* has been determined. Only 11 strains had probiotic properties.

2. Of these, 5 strains were identified as *Lactobacillus fermentum* (3K, 7K, 9K) and *Lactobacillus paracasei* (010K, 11K), and strain 010K was registered in the GenBank database and the National Collection of Microorganisms of Kazakhstan.

3. Strains with high activity were lyophilized, and two compositions of probiotic drugs were developed: the first based on the *Lactobacillus paracasei* – 010K strain, the second based on the *Lactobacillus paracasei* – 010K and *Torulopsis sphæerica* 105k strains.

4. The optimal content of the probiotic drug in fish feed has been established – 5% of the total volume. Patents for utility models and inventions have been obtained.

5. The application of the developed probiotic preparation led to a significant increase in the population of beneficial intestinal microflora in fish: a 32.6% increase in the first experimental group and 72.59% in the second group compared to the control. The optimal dosage of the preparation was determined to be 5% of the daily feed ration. Inclusion of the preparation in the diet positively influenced the biological growth indicators of the fish: the absolute weight gain ranged from 32 to 41 g, the average daily gain was 1.0 to 1.3 g, with a survival rate reaching 98–100%.

#### **The personal contribution of the dissertation to the development of the results of scientific work submitted for defense**

The dissertation encompasses the formulation of all necessary scientific objectives, the planning and execution of experimental studies, statistical analysis of the obtained data, their interpretation and publication, as well as the industrial testing of the developed biological preparation and the preparation of patent documentation. All stages of the dissertation work were carried out with the direct involvement of the author.

#### **Approbation of the dissertation work.**

The main results of the dissertation work were discussed and published in the materials of the international scientific and practical conference of Almaty Technological University "Innovative development of food, light industry and hospitality industry" (Almaty 2020), XV International Scientific and practical conference "Global Science and Innovation 2021: Central Asia" (Astana, 2021).

**Scientific publications.** 8 scientific papers have been published on the topic of the dissertation, including: 1 article in the journal included in the Scopus database

Potravinarstvo Slovak Journal of Food Sciences (44th percentile); 3 articles in publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan; 2 articles are in publications recommended by the Committee for conference proceedings; 1 patent of the Republic of Kazakhstan for a utility model and 1 invention, was deposited in the Central Museum "Republican Collection of Microorganisms", a certificate of registration was obtained.

**The structure and scope of the thesis.** The dissertation work consists of the following sections: designations and abbreviations, normative references, introduction, literature review, research materials and methods, results and discussion, conclusion, practical recommendations for production, References and appendices. The dissertation consists of a computer text presented on 124 pages, 18 tables, 18 figures and 4 diagrams. The list of references contains 246 literary sources.