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on a dissertation for obtaining the scientific degree "Doctor of Sciences" in: field of higher education 5. Technical sciences, professional direction 5.13. General engineering, the scientific specialty "Technology of milk and dairy products"

Author of the dissertation: **CHULUUNBAT TSEN-AYUSH** doctoral student of independent training at the Department of Animal Husbandry Sciences at the Agricultural University, Plovdiv

Dissertation topic: THEORETICAL AND EXPERIMENTAL FUNDAMENTALS OF DAIRY PRODUCT TECHNOLOGIES OF FUNCTIONAL NUTRITION IN MONGOLIA CONDITIONS

Reviewer: Prof. Galin Yordanov Ivanov, DSc, UFT-Plovdiv, 5. Technical Sciences, 5.12. Food technology, Technology of milk and dairy products. Designated as a member of the scientific jury by order No. RD-16-824/18.07.2022 by the Rector of AU.

1. Brief introduction of the candidate.

Chuluunbat Tsend-Ayush was born on January 29, 1961 in Mongolia. In 1985, she graduated from Moscow State University with a Master's degree in Applied Biotechnology, majoring in engineering technology in the dairy industry. In 1997, she obtained a PhD in "Technology of milk and dairy products, biotechnology" from the East Siberian Technological University, Ulan-Ude, Russian Federation. The acquired knowledge and skills enable her to realize herself as a technologist in the production of dairy products in Mongolia and as a research scientist at the Mongolian University of Science and Technology. In the same university, she started her career as a teacher in 1990. In 2005, she held an academic position as an associate professor at the Faculty of Food Technology and Biotechnology, and from 2014 to the present, she worked as an associate professor at the Faculty of Industrial Technologies of the Mongolian University of Science and Technology.

2. Sate of the art

The increasing attention of consumers regarding the role of food for health and quality of life determine the need to develop new dairy products with improved characteristics that have a beneficial effect on human health. In this

regard, numerous studies have been conducted aiming at the incorporation of various functional ingredients to traditional dairy products. Lactic acid bacteria are an important part of the microflora of dairy products. Most of them have been proven to have probiotic properties that are important for human health. In his research work, Chuluunbat Tsend-Ayush uses the health potential of precisely this beneficial microflora, which is isolated from traditional Mongolian dairy products. For the application of the newly isolated probiotic strains of lactic acid bacteria, it is extremely important to develop appropriate technologies for their inclusion in starter cultures and their subsequent use in the technological process. The second half of the research work on the dissertation is dedicated to solving these problems. Everything stated so far gives me reason to define the research work on the dissertation as undeniably relevant. It provides a scientific platform for the development and implementation in the production of technologies for obtaining probiotic lactic acid products with functional properties that are adapted to the specific conditions of the R. Mongolia.

3. Aim, tasks, hypotheses and research methods.

The aim of the dissertation work was to develop a scientifically based platform for the development of technologies for obtaining functional dairy products using new types of starter cultures, including strains of lactic acid bacteria isolated from Mongolian national dairy products. I believe that the objective was well formulated, corresponds to the topic of the dissertation and reflects the essence of the research work conducted.

The main tasks of the research work on the dissertation are related to:

1. Study of the chemical composition of goat, sheep and cow milk from local Mongolian breeds.
2. Isolation of strains of microorganisms from traditional Mongolian dairy products.
3. Investigation of the properties of beneficial microorganisms isolated from traditional Mongolian dairy products.
4. Study of the probiotic characteristics of the isolated new strains of microorganisms.
5. Development of a science-based approach for the formation of starter cultures for the production of functional dairy products.
6. Development of technology for obtaining bacterial starter cultures for fermented dairy products

7. Determination of appropriate technological parameters for the production of lactic acid products from goat, sheep and cow's milk.

8. Development of technologies for probiotic and symbiotic lactic acid products from goat, sheep and cow's milk.

I believe that the assigned tasks are properly structured and derive from the purpose of the work.

4. Presentation of the results obtained.

The dissertation is structured according to the traditionally accepted scheme and consists of introduction – 1 page, literature review – 48 pages, aim and tasks – 2 pages, materials and methods – 19 pages, results and discussion – 157 pages, conclusion (conclusions and contributions) – 5 pages.

The material contains 77 tables and is illustrated with 28 figures. 257 literary sources were used in the development, of which 195 in Latin and 62 in Cyrillic. Of the literary sources used, more than 50% were published in the last 10 years.

In my opinion the results of the conducted experiments are adequately presented and interpreted in good scientific style.

5. Discussion of results and used literature.

The literature review shows the deep knowledge of the doctoral student on the problems investigated in the dissertation work. It summarizes all the main achievements related to the technological aspects for the development of new functional dairy products and the prospects for the use of goat and sheep milk in the dairy industry. I believe that the results of the research work are well compared with the achievements of world science in the field of milk processing.

A comprehensive study was conducted to characterize the properties of microorganisms isolated from Mongolian fermented milk products produced by traditional technologies. As a result of the research work, an innovative technology was developed for a number of fermented milk products with probiotic properties, which was implemented in practice in Mongolia and abroad.

6. Contributions of the dissertation.

The candidate's research work has a marked scientific and applied nature. A complex evaluation of the quality and technological properties of goat and sheep milk obtained from Mongolian breeds of animals was carried out using modern methods of analysis. A large-scale research work has been carried out related to obtaining, identifying and studying the probiotic properties of strains of lactic acid bacteria isolated from traditional Mongolian dairy products. As a result, strains of lactic acid bacteria of the species *Lactobacillus paracasei* subsp. *paracasei, Lactobacillus paracasei subsp. tolerans, Lactobacillus delbrueckii* subsp. *lactis, Lactobacillus fermentum, Streptococcus salivarius* subsp. *thermophilus, Lactobacillus helveticus and Lactobacillus fermentum* with valuable technological properties that are suitable for inclusion in starter cultures for dairy products. As a result of the research work, new starter cultures for dairy products were formulated and used in production.

The optimal conditions for the fermentation process with starter cultures composed of the newly isolated strains of lactic acid bacteria were determined. The parameters of the technological operations included in the technologies for obtaining lactic acid products from goat, sheep and cow's milk are defined.

As a result of clinical trials with the obtained lactic acid products, their anti-helicobacter and therapeutic effectiveness on the gastrointestinal tract has been proven. It was found that L. paracasei spp. paracasei 06TSD19b isolated from Mongolian fermented milk products has not only a probiotic effect, but has also shown anti-Helicobacter activity.

The significance of the contributions of the candidate's research work is also confirmed by the discovery of 112 citations in scientific publications referenced and indexed in world-renowned databases of scientific information.

7. Critical Notes and Questions.

The materials of the dissertation work are presented in their logical sequence and are well illustrated. There are small gaps in the presentation of some of the results, which are of a technical nature and do not decrease the scientific value of the work. E.g. in Table 7.4.4 – Changes in the physical and chemical indicators of goat's milk cheese during the feeding process, the units of measurement of the indicated indicators are missing.

8. Published articles and citations.

The dissertation materials include 10 scientific publications in publications that are referenced and indexed in world-renowned scientific information databases and 26 scientific publications in non-refereed peer-reviewed journals or in edited collective volumes, of which 14 in Mongolian and 12 in foreign editions. In 11 publications the doctoral student is the sole author, and in another 11 he is the first author. Attached are 5 pcs. patents and 2 copyright certificates. A list of participation in 8 projects (international and national), as well as 3 monographs (one independent and two collective) is presented. I believe that the presented publications meet the requirements of the RSARB and the rules of the AU for its application. The doctoral student participated in eight scientific projects with national and international funding, three monographs and seven patents and author's certificates.

A total of 112 citations of 7 of the publications presented with the dissertation materials are presented.

The presented abstract reflects objectively the structure and content of the dissertation work.

CONCLUSION:

Based on the various research methods learned and applied by the doctoral student, the correctly conducted experiments, the generalizations and conclusions made, I believe that the presented dissertation meets the requirements of the National legislation and the Regulations of the Agrarian University.

30.09.2022 г.
Plovdiv

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(prof. Galin Ivanov, DSc)