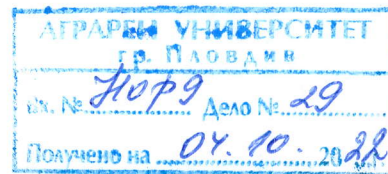


OPINION



on a dissertation work for obtaining the educational and scientific degree **Doctor of Technical Sciences** in the field of higher education: 5. *Technical Sciences*, professional area: 5.13. *General Engineering*, scientific specialty: **Technology of Milk and Dairy Products**.

Author of the dissertation work: associate prof. **Chuluunbat Tsend-Ayuush**, PhD
A doctor on a private study preparation in the Department of Animal Breeding Sciences at the Agricultural University – Plovdiv

Title of the dissertation work: *Theoretical and Experimental Validity of Dairy Product Technologies for Functional Nutrition in the Conditions of Mongolia*

Opinion worked out by: prof. **Dimitar Ferdinandov Grekov**, DSc – Agricultural University – Plovdiv, in the field of higher education: 6. Agrarian Sciences and Veterinary Medicine, professional area: 6.3. Animal Breeding, scientific specialty: 04.02.01. *Farm Animal Breeding, biology and biotechnology of reproduction*, assigned a member of the scientific panel with Rector's order № РД-16-824/13.07.2022.

1. Topicality of the problem.

In recent years in Mongolia, as well as around the world, there have been observed some topical issues related to dietology – more specifically the production of dairy products with functional application. One of the directions regarding the creation of dietary and medicinal dairy products is their enrichment in protective factors, such as microorganisms being part of the normal microflora of the human stomach.

In Mongolia there have not been provided enough research studies on goat and sheep milk being used as raw material in the industrial production, as well as on their derivative dairy products. There are no scientifically well-grounded technologies for the production of dietary products and products of medicinal purposes.

With this relation, the development of scientifically well-grounded technologies for the production of dairy products based on goat and sheep milk containing microorganisms for the healthy intestinal flora is an urging issue of great medicinal and economic significance. I, myself, consider that the present dissertation work has scientific and practical significance for the dairy industry, as well as for sheep breeding and goat breeding in Mongolia.

The examined milk bacteria strains being isolated from traditional Mongolian products are of great interest for Mongolia, as well as for the world science and practice. It is evidenced from the list of citations from prestigious research journals included in the dissertation work.

2. Aim, tasks, hypotheses and methods of research.

The present dissertation work aims at developing a technology for the use of functional dairy products, new types of ferments, ready strains of lactic acid bacteria isolated from the Mongolian national dairy products.

The aim completely corresponds to the topic of the dissertation work and has been scientifically proven in the thorough literature review. 12 particular and exact tasks have been laid out for achieving the above mentioned aim. They have been formulated in consequence, through the appropriate

methodology. The use of innovative methodology has helped the doctoral student to receive sufficient amount of information for modern analysis and in-depth interpretation.

3. Visualization and presentation of the received results.

The dissertation work is structured as an original scientific work with scientific-applied technological decisions for introduction, which has significantly contributed to the development of dairy industry. The main content of the dissertation is presented in 281 pages consisting of 9 chapters, including an introduction, analytical literature review, a methodological part, own results and studies visualized in 73 tables, 25 graphics and diagrams.

The dissertation work has been written in proper scientific style and language. It has been chosen the most appropriate way of visualization of the received results.

4. Discussion of the results and the used references.

It has been presented sufficient amount of material and results, which correspond to the laid aim and tasks. Their analysis in-depth give evidence for the doctoral student`s awareness and understanding with relation to the dissertation topic.

The literature review consists of sections with analysis of the information extracted from national and foreign references.

The medico-biological arguments for the creation of functional nutritive products have been defined.

Analysis on the dairy raw materials has been made: goat, sheep and cow milk being object for the production of children`s, probiotic and protein products. There have been presented the prospects for the development of biotechnologies of fermented dairy products and probiotic preparations. Their significance for the healthy nutrition has been defined. The composition of healthy microflora has been proven, which is used for the production of fermented dairy products and probiotic preparations. Data on the contemporary achievements in genetics and gene-engineering research methods have been described.

Other issues being reviewed in the dissertation work are those related to the reception of one-type and multi-type associations of microorganisms, as well as the tendency and perspectives for the production of probiotics.

The received results have been adequately and thoroughly analyzed within the context of the laid aim and tasks. The good knowledge of the doctoral student is outlined, as well as her skills in the work with literature references. There have been used 296 references, 22 of which are in Cyrillic, 274 – in Latin. This allows the doctoral student to make clear and exact conclusions and recommendations out of her work.

Taking into account 54 lactic acid bacteria, identified as *L. plantarum* or *L. paracasei* ssp., 10 have been isolated from the national product called *hormona* made of camel milk.

Thus, the isolated and identified strains of lactic acid bacteria with probiotic properties can be recommended to be included in a collection of Mongolian microorganisms, as well as for the creation of ferments used in the production of fermented dairy products.

Based on the received research results, new biotechnology for soft cheese made of goat milk has been developed.

5. Contributions of the dissertation work.

Scientific contributions

There have been presented original contributions of theoretical and scientific significance related to nutrition and the isolation of lactic acid bacteria strains possessing high probiotic activity.

As a result from the research studies related to the microflora of the national dairy products, there have been established 10 homo-fermentative probiotic strains of lactic acid bacteria. They are identified and classified as *L. Plantarum* and *L. paracasei* spp. *paracasei*.

There has been created a collection of Mongolian microorganisms and ferments used in the production of fermented dairy products.

Scientific-applied contributions

On the grounds of the received results the following innovations have been developed:

- Biotechnology of soft cheese made from goat milk;
- Technology of cheese in brine based on sheep milk;
- Technology of yoghurt with probiotic properties.

Innovative technology for the development of numerous fermented dairy products with probiotic properties has been introduced in practice in Mongolia and abroad.

6. Critical notes and questions.

I have no critical notes to the doctoral student.

7. Published research papers and citations.

The main content of the dissertation work was published in 36 publications, 3 of which – monographs; 10 – research papers in journals referenced and indexed in Scopus and Web of Science international databases (Journal of Food Science & Nutrition, Journal of Food Science and Technology Research, Journal of Functional Foods, Journal of International Immunopharmacology, Journal of Human Cell, Journal of Animal Science, Journal of Foods and Raw Materials, Journal of International Food Research, *Korean Journal Dairy Science and Technology*, Mongolian Journal of Chemistry). The rest of the publications were published in journals with scientific reviewing or in volumes with editorial board, including foreign volumes (Молочная промышленность, Пищевая промышленность, Хранение и переработка сельскохозяйственного сырья, Journal of Dairy Science and Biotechnology, Техника и технология пищевых производств, Mare Milk Industrialization Base Construction Project Symposium, China (2010); Book “Asia: Perspectives and Insights-Development through Collaborations (2012); The 8th International Forum on Strategic Technology (2013) International Symposium. Ulaanbaatar (2015)).

There have been submitted 7 patents and copyright certificates from Mongolia.

Citations:

The doctoral student has submitted 92 citations in journals, referenced and indexed in Scopus international databases, such as: Journal of dairy science, Food Microbiology, Bioscience of microbiota, food and health, Current Nutrition and Food Science, Anaerobe, J. Theor. Fimpology, Dairy Science and Technology, Health benefits of fermented foods and beverages, Journal of Functional Foods, Journal of Food Science and Technology, International journal of food science,

Iranian journal of pharmaceutical research, Research Journal of Pharmacy and Technology, Frontiers in Microbiology, Probiotics and antimicrobial proteins, Biochemistry and biophysics reports, etc. 20 citations have been found in other editions.

The submitted author's summary objectively reflects the structure and content of the dissertation work.


CONCLUSION:

The submitted dissertation work represents the results from long-term research studies, which have been purposefully planned and performed via innovative methods. Results have been presented, discussed and interpreted at high scientific level possessing considerable scientific and applied contributions. Results have also been protected with patents and copyright certificates and have been introduced in the production process.

The dissertation work corresponds to, and even exceeds, the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, as well as the Regulations of the Agricultural University – Plovdiv for its application. This gives me grounds to evaluate **POSITIVELY** the presented dissertation.

I allow myself to propose to the honourable scientific panel to vote positively and to award associate professor **CHULUUNBAT TSEND AYUUSH** the scientific degree **Doctor of Sciences** in the field of higher education: 5. Technical Sciences; professional area: 5.13 General Engineering; scientific specialty: *Technology of Milk and Dairy Products*.

20.09.2022
Plovdiv



OPINION WORKED OUT BY:
(**prof. Dimitar Ferdinandov Grekov, DSc**)