

**ABSTRACTS OF PUBLICATIONS**  
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**IN CONNECTION WITH THE DISSERTATION WORK FOR**  
**ACQUIRING THE DEGREE OF DOCTOR OF SCIENCE**

**1. Monographs (Books)**

**1.1. Jadambaa, Sh., Tsend-Ayuush, Ch. (2008). Balanced diet. Bambi Sun, Ulaanbaatar. 166 p., ISBN: 99929-77-57-4**

The monograph considers the role and importance of nutrients in food products in the human body, the functional effect of specific substances that are associated with health and longevity in the light of the modern paradigm is explained at the intersection of biochemistry, physiology and nutrition. The first chapter is devoted to the classification of foods and the concept of nutrients and their nutritional value. The second chapter includes the general principles of healthy nutrition, the determination of the value of food products and raw materials, including dairy products. Also discussed in this chapter are the biological value of dietary protein, amino acids, the need for essential amino acids, the role of minerals, fat, fatty acid and carbohydrate in metabolism. The third chapter describes in detail the process of digestion in the sections of the digestive tract: in the oral cavity, stomach and small intestine. The fourth chapter talks about functional foods, including their positive effect on the body. The classification of functional ingredients is also given and their value is determined. In addition, probiotics, prebiotics and synbiotics, which have recently deserved great interest in the world, are described in detail here. In the first part of the fourth chapter, synbiotics and their significance are considered, in the second part - prebiotics and their significance, in the third part - the features of probiotics and their classification, significance, and positive effect on the body. Also in this part, the authors attached particular importance to the description of the features of beneficial probiotic lactic acid bacteria. In addition, this part includes the results of our experimental studies, namely the types of strains of lactic acid bacteria isolated from traditional Mongolian fermented milk products, their characteristics. The fifth chapter talks in detail about the features and significance of food products that are beneficial to health. The monograph contains in tables the recommended norms of biologically active substances and additives used for therapeutic and prophylactic purposes for adults, the recommendation of the daily intake of food, the recommendation of the daily physiological norm of consumption of biologically active substances produced in the technological process, and not contained in food raw materials that are not contained in raw materials, but are formed as a result of the technological process. The tables describe the daily consumption of these products.

**1.2. Tsend-Ayuush, Ch., (2018). The chemical composition of the milk of farm animals, Ulaanbaatar,. – 93 p.**

The monograph considers the chemical composition, physicochemical and technological properties of raw milk of a local breed. The first chapter presents a comparative analysis of the biological value of cow, goat, sheep, mare and camel milk: milk characteristics of five types of farm animals. Goat's milk is close to cow's milk in terms of chemical composition and many properties, it has a higher amount of protein, fat and calcium, it contains little carotene, therefore it has a paler color. Fat globules of goat's milk are 1.5 times smaller than cow's milk, which contributes to its better absorption. The chemical composition of mare's milk is significantly different from the chemical composition of cow's milk and other farm animals. It contains 10-15% less solids than cow's milk. According to the content of milk sugar, it is 1.5 times richer than cow's. Casein in sheep's milk is 1.5 times more than in cow's milk, so it is thicker. Sheep's milk is noticeably different in texture, taste and color from cow's milk. It is thicker, white in color and has a specific taste and smell. In terms of dry matter content, especially in mineral content, camel milk is superior to cow's milk. The dry matter of mare's milk, in particular the content of fat and protein, is lower compared to the milk of other animals, and the content of carbohydrates is higher. The second chapter is devoted to the use of food as a raw material for production. The milk of farm animals for a specific production of products is proposed to be done on the basis of research on the technological properties of animal milk. Goat's and sheep's milk is more suitable for the production of byaslag /cheese/ and aaruul /curdled curd/. Goat milk has the ability to be easily digested. Based on this property, it is advisable to use goat's milk for baby and preventive nutrition.

The content of a large amount of milk sugar and small fat globules in mare's milk gives this product special therapeutic, prophylactic and dietary properties. For example, koumiss made from mare's milk. The protein in the milk of the Bactrian camel is close to the protein content of cow's milk. But camel milk is beneficial for the production of hoormog / like kefir /.

### **1.3. Tsend-Ayuush, Ch., Zhadambaa Sh. (2020) Biological active substances, Ulaanbaatar, 82 p.**

In this monograph, in the light of the decisions of the modern scientific paradigm and at the junction of biochemistry, physiology, issues related to the biological function in the metabolism of the cofactor, coenzyme that make up enzymes are considered. From an educational, methodological and didactic point of view, the content of the monograph is disclosed in detail in three chapters: enzyme, cofactor, mechanism of coenzyme activity. Briefly stated, the peculiarity of the monograph is that, in accordance with the law of living nature, the mechanism for turning food into "cell food" is shown here, which will become the key to happy longevity. The mechanism is described with the help of formulas, illustrations. This work is designed for specialists in the food industry, physicians and will become a textbook for teachers and students.

## **2. Scientific publication in publications that are referenced and indexed in world-renowned databases with scientific information:**

**2.1. Takeda, S., Yamasaki, K., Takeshita, M., Kikuchi, Y., Tsend-Ayush, Ch., Dashnyam, B., Ahhmed, A. M., Kawahara, S., & Muguruma, M. (2011). The investigation of**

**probiotic potential of lactic acid bacteria isolated from traditional Mongolian dairy products.** *Animal science journal = Nihon chikusan Gakkaiho*, 82 (4), 571–579. <https://doi.org/10.1111/j.1740-0929.2011.00874.x>. Scopus eISSN: 1740-0929 (Electronic), <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1740-0929.2011.00874.x>

The aims of this study were to investigate the diversity of lactic acid bacteria (LAB) isolated from traditional Mongolian dairy products, and to estimate the probiotic potential of the isolated strains. We collected 66 samples of the traditional Mongolian dairy products tarag, airag, aaruul, byasulag and eezgii, from which 543 LAB strains were isolated and identified based on 16S ribosomal DNA sequence. The predominant species of those products were *L. delbrueckii ssp. bulgaricus*, *L. helveticus*, *L. fermentum*, *L. delbrueckii ssp. lactis* and *Lactococcus lactis ssp. lactis*. However, we could not detect any LAB strains from eezgii. All LAB isolates were screened for tolerance to low pH and to bile acid, gas production from glucose, and adherence to Caco-2 cells. In vitro, we found 10 strains possess probiotic properties, and almost identified them as *L. plantarum* or *L. paracasei* subspecies, based on 16S ribosomal DNA and carbohydrate fermentation pattern. These strains were differentiated from each other individually by randomly amplified polymorphic DNA analysis. Additionally, it was notable that 6/10 strains were isolated from camel fermented milk from the Dornogovi province. Additionally, it was notable that 6/10 strains were isolated from camel fermented milk from the Dornogovi province.

**2.2. Takeda, S., Fujimoto, R., Takenoyama, S. I., Takeshita, M., Kikuchi, Y., Tsend-Ayush, C. Dashnyam, B., Muguruma, M., & Kawahara, S. (2013). Application of probiotics from Mongolian dairy products to fermented dairy products and its effects on human defecation.** *Food science and technology research*, 19 (2), 245-253. Scopus Online ISSN : 1881-3984

We screened suitable lactic acid bacteria (LAB) strains for use in fermented dairy products by analyzing milk fermented with 10 probiotic LAB strains from Mongolian dairy products. *Lactobacillus paracasei paracasei* strain 06TCa19 was selected because of its favorable effects on pH, lactic acid production, and viable bacterial numbers after fermentation of skim milk. Then, we prepared 06TCa19 and control fermented milks and conducted a randomized, double-blind crossover study with 46 healthy women to determine the effects of the strain on human defecation. The ingestion of 06TCa19 fermented milk improved the subjects' fecal characteristics, including shape and color. Analysis of stool samples from 8 subjects revealed that l-lactic acid levels and *Lactobacillus* and *Bifidobacterium* numbers increased. Moreover, strain 06TCa19 was suggested to reach and survive in the intestines, and is, therefore, suitable for fermented dairy products and can potentially improve human defecation

**2.3. Tsend-Ayush, Ch. & Yoon Y. Ch. (2013).Development of fermented goat milk using probiotic starter cultures.** *Journal of Foods and Raw Materials*. 1 (2),

The aim of this study was to develop probiotic fermented goat milk. Goat milk was inoculated with single (*Bifidobacterium longum* and *Lactobacillus acidophilus*) and mixed cultures

containing *Bifidobacterium longum* and *Lactobacillus acidophilus*. Goat milk was pasteurized at 95°C for 5 min, cooled to 37±1°C, and inoculated with the required culture before incubation. The combined culture *B. longum* : *L. acidophilus* (8 : 1) was used when it had attained a pH 4.5±2 and a titratable acidity 65–70. Goat milk for fermented milk was sterilized at 120°C for 10 min, cooled to 37°C, and inoculated with 8–10% of the bifidobacterium culture, and goat milk was pasteurized at 95°C for 20 min, cooled to 42°C, and inoculated with 3% of the *L. acidophilus* culture. The cultures were used when they attained pH 4.3 and 4.5 and titratable acidity between 56 and 800T. The developed technology of fermented milks and the characteristics of fermented goat milk were studied. According to the findings, we concluded that fermented goat milk was balanced by the amino acid content and products of high biological value. Fermented goat milk with the expected beneficial health effect is based on a high concentration of probiotic bacteria.

**2.4. Takeda, S., Hidaka, M., Yoshida, H., Takeshita, M., Kikuchi, Y., Tsend-Ayush, C., Dashnyam, B., Kawahara, S., Muguruma, M., Watanabe, W., & Kurokawa, M. (2014). Antiallergic activity of probiotics from Mongolian dairy products on type I allergy in mice and mode of antiallergic action. *Journal of Functional Foods*, 9, 60-69. Scopus, ISSN (Online): 2310-9599**

Antiallergic activities of 10 lactic acid bacteria strains prepared from Mongolian dairy products as orally administered probiotics were examined in three murine type I allergy models (compound 48/80 stimulation, passive cutaneous anaphylaxis reaction, and ovalbumin sensitization models). Among the 10, only *Lactobacillus plantarum* strain 06CC2 significantly alleviated allergic symptoms in all three models and reduced the levels of total IgE, ovalbumin-specific IgE, and histamine in the sera of ovalbumin-sensitized mice. In vitro study, interferon- $\gamma$  and interleukin-4 secretions from spleen cells of ovalbumin-sensitized mice administered the 06CC2 strain were significantly enhanced and suppressed, respectively, in the presence of ovalbumin. In Peyer's patches of ovalbumin-sensitized mice, strain 06CC2 significantly enhanced mRNA expressions of interferon- $\gamma$  and interleukin-12 receptor  $\beta$ 2, but suppressed that of the interleukin-4. Thus, strain 06CC2 probably promoted Th1 immunity through intestinal immunity and improved the Th1/Th2 balance in type I allergic mice, resulting in alleviation of allergic symptoms.

**2.5. Takeda, S., Takeshita, M., Matsusaki, T., Kikuchi, Y., Tsend-ayush, C., Oyunsuren, T., Miyata, M., Maeda, K., Yasuda, S., Aiba, Y., Koga, Y., & Igoshi, K. (2015). In vitro and in vivo anti-*Helicobacter pylori* activity of probiotics isolated from Mongolian dairy products. *Food Science and Technology Research*, 21(3), 399-406. Scopus Online ISSN : 1881-3984**

*Helicobacter* (*H.*) *pylori* is known to be a bacterial risk factor for gastric cancer. In this study, 16 strains of lactic acid bacteria (LAB) isolated from Mongolian dairy products were screened for potential probiotic activity against *H. pylori* strain no. 130 in vitro. *Lactobacillus* (*L.*) *paracasei*

06TCa19 and *L. plantarum* 07MR044 were identified as LAB strains with anti-*H. pylori* activities. Compared to strain 07MR044, strain 06TCa19 was more potent in reducing *H. pylori* counts in co-culture. The ability of strain 06TCa19 to inhibit the growth of *H. pylori* was attributable to its rapid and excessive generation of lactic acid. Moreover, oral administration of strain 06TCa19 was found to significantly reduce the number of colonizing *H. pylori* in the stomach of *H. pylori* strain no. 130-infected mice. Thus, strain 06TCa19 is potentially effective against *H. pylori* infection.

**2.6. Matsusaki, T., Takeda, S., Takeshita, M., Arima, Y., Tsend-Ayush, C., Oyunsuren, T., Sugita, C., Yoshida, H., Watanabe, W., & Kurokawa, M. (2016). Augmentation of T helper type 1 immune response through intestinal immunity in murine cutaneous herpes simplex virus type 1 infection by probiotic *Lactobacillus plantarum* strain 06CC2. *International immunopharmacology*, 39, 320–327. <https://doi.org/10.1016/j.intimp.2016.08.001> Scopus ISSN :1878-1705**

We previously found that *Lactobacillus plantarum* strain 06CC2 showed probiotic potential, and its oral administration effectively induced Th1 cytokine production and activated the Th1 immune response associated with intestinal immunity in mice. In this study, to evaluate its potential as a versatile oral adjuvant for treatment of viral infection, we assessed the immunomodulatory activity of 06CC2 on murine cutaneous herpes simplex virus type 1 (HSV-1) infection, in which a major immune defense system is a delayed-type hypersensitivity (DTH) reaction based on activation of the Th1 immune response, in relation to its oral efficacy for alleviation of herpetic symptoms. In the HSV-1 infection model, oral administration of 06CC2 (20 mg/mouse) twice daily for seven days starting two days before infection was significantly effective in delaying the development of skin lesions in the early phase of infection and reducing virus yields in the brain on day 4 after infection. In addition, 06CC2 significantly augmented the DTH reaction to inactivated HSV-1 antigen and elevated interferon (IFN)- $\gamma$  production by HSV-1 antigen from splenocytes. On day 2, natural killer (NK) cell activity was significantly elevated, and the elevation was still observed on day 4. Furthermore, gene expressions of interleukin-12 receptor  $\beta$ 2 and IFN- $\gamma$  in Peyer's patches were augmented on day 4 by 06CC2 administration. Thus, 06CC2 was suggested to alleviate herpetic symptoms in mice in correlation with augmentation of the Th1 immune responses associated with NK cell activity through intestinal immunity. Strain 06CC2 may be a versatile oral adjuvant to activate Th1 immune response.

**2.7. Cho, W. Y., Yeon, S. J., Hong, G. E., Kim, J. H., Tsend-Ayush, C., & Lee, C. H. (2017). Antioxidant Activity and Quality Characteristics of Yogurt Added Green Olive Powder during Storage. *Korean journal for food science of animal resources*, 37(6), 865–872. <https://doi.org/10.5851/kosfa.2017.37.6.865>. Scopus. eISSN 2234-246X**

The objective of this study was to determine the antioxidant and quality characteristics of yogurt added green olive powder stored at 4°C for 15 d. The following four groups were used in this study: Control group (GY0), Yogurt added with 1% green olive (GY1), with 3% green olive

(GY3), and with 5% green olive (GY5). The more time of titratable acidity went by, the more it increased. Except GY0, viscosity tended to decrease in other groups ( $p>0.05$ ), and the more time of syneresis went by, the more it increased, but GY3 of them showed the lowest syneresis. Lactic acid bacteria showed no significant with GY0 until 5 d, but after that, GY1, GY3 and GY5 showed lower than GY0. Yogurt added green olive showed darker color than GY0 (low  $L^*$  and high  $a^*$ ). The antioxidant activity of GY5 was found to be the highest among the four groups at day 1 of storage. Total phenolic content, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity, and reducing power of GY5 was found to be the highest among the four groups at day 1 of storage which were 6.96 mg GAE/kg, 47.53%, and 0.57, respectively. In the sensory evaluation sweet and overall, of GY3 indicated the highest score among the four groups. Results of this study demonstrated that green olive powder might be used to improve the antioxidant capacity and sensory characteristics of yogurt.

**2.8. Takeda, S., Igoshi, K., Tsend-Ayush, Ch., Oyunsuren, T., Sakata, R., Koga, Y., Arima, Y., & Takeshita, M. (2017). *Lactobacillus paracasei* strain 06TCa19 suppresses inflammatory chemokine induced by Helicobacter pylori in human gastric epithelial cells. *Human cell*, 30 (4), 258–266. <https://doi.org/10.1007/s13577-017-0172-z> Scopus ISSN: 1749-0774**

*Helicobacter* (*H.*) *pylori* infection is an important risk factor for gastric cancer that causes gastric inflammation. Inflammatory chemokines such as interleukin (IL)-8 and regulated on activation normal T cell expressed and secreted (RANTES) are elevated in the gastric mucosa by *H. pylori*. This study aimed to investigate the effects of *Lactobacillus paracasei* strain 06TCa19, a probiotic strain, on IL-8 and RANTES expression and production induced by *H. pylori* using human gastric epithelial cell lines. Strain 06TCa19 was shown to suppress *H. pylori*-mediated elevation of gene expression related to these chemokines in MKN45 cells. The strain also suppressed the increase in IL-8 and RANTES products induced by *H. pylori* in AGS cells as well as in MKN45 cells. In MKN45 cells inoculated with *H. pylori*, strain 06TCa19 was shown to downregulate the activation of NF $\kappa$ B and p38 MAPK signaling pathways. Additionally, the level of the CagA virulence protein of *H. pylori* in the MKN45 cells and the number of viable *H. pylori* adhering to MKN45 cells decreased with the addition of strain 06TCa19. Moreover, the strain 06TCa19 notably increased lactic acid in the supernatant of MKN45 cells. Thus, lactic acid released from strain 06TCa19 might have inhibited the adhesion of *H. pylori* to MKN45 cells and prevented the insertion of *H. pylori* CagA into the cells, and elevation of IL-8 and RANTES genes and proteins might be suppressed by downregulating the NF- $\kappa$ B and p38 MAPK pathways. Therefore, use of strain 06TCa19 may prevent *H. pylori* associated gastric inflammation.

**2.9. Yamasaki, M., Minesaki, M., Iwakiri, A., Miyamoto, Y., Ogawa, K., Nishiyama, K., Tsend-Ayush, C., Oyunsuren, T., Li, Y., Nakano, T., Takeshita, M., & Arima, Y. (2020). *Lactobacillus plantarum* 06CC2 reduces hepatic cholesterol levels and**

**modulates bile acid deconjugation in Balb/c mice fed a high-cholesterol diet. *Food science & nutrition*, 8(11), 6164–6173. <https://doi.org/10.1002/fsn3.1909> Scopus**

Previous study suggested that dietary intake of *Lactobacillus plantarum* 06CC2 (LP06CC2) isolated from Mongolian dairy products showed various health beneficial effects. Here, the effect of LP06CC2 on the cholesterol metabolism in mice fed a cholesterol-loaded diet was evaluated. Cholesterol and LP06CC2 were incorporated into the AIN93G-based diet to evaluate the effect on cholesterol metabolism in Balb/c mice. Serum and liver cholesterol levels were significantly increased in mice fed a cholesterol-loaded diet whereas the LP06CC2 ingestion suppressed the increase of liver cholesterol. LP06CC2 suppressed the increase of the hepatic damage indices. The increase of the cecal content and fecal butyrate were observed in mice fed LP06CC2. The analysis of bile acids clearly showed that LP06CC2 increased their deconjugation indicating the decrease of bile acid absorption. The protein expression of hepatic Cyp7A1 was also suppressed by LP06CC2 in mice fed cholesterol. Finally, in vitro studies showed that LP06CC2 had the most potent ability to deconjugate bile acids using glycocholate among the tested probiotic lactic acid bacteria isolated from Mongolian dairy products. Taken together, LP06CC2 is a promising microorganism for the reduction of the cholesterol pool via modulation of bile acid deconjugation.

**2.10. Sarengaole B., Tsend-Ayush Ch., Bayinjirigala. J., & Menghebilige, B. (2022). Development technology of starter cultures using lactic acid bacteria isolated from fermented. Camel milk with cholesterol lowering ability. *Mongolian Journal of Chemistry*, 23(49). <https://doi.org/10.5564/mjc.v23i49.1404>**

The aim of the study is to develop a technology of starter cultures for fermented milk using new strains of lactic acid bacteria isolated from Mongolian traditional fermented camel milk. “Khoormog” 12 samples are collected from Inner Mongolia, China. Totally 230 *Lactobacillus* strains are isolated and screened by acid-, bile- tolerance, lactose decomposition and acid production ability. The cholesterol lowering abilities and adhesiveness on Caco-2 are evaluated. The top 2 strains are 15 identified as *Lactobacillus plantarum*. These 2 strains are prepared as the starter cultures in milk fermentation. The development technology of starter cultures is studied

### **3. Scientific publication in non-refereed peer-reviewed journals or in edited collective volumes**

#### **Published in foreign publications:**

**3.1. Цэнд-Аюуш, Ч. & Ганина В.И. (2007). Жирнокислотный состав Монгольских молочных продуктов. *Молочная промышленность*, 2: 58-61. ISSN: 1019-8946, eLIBRARY ID: 9434364**

In order to study the chemical composition of dairy products prepared according to the traditional Mongolian technology, we carried out a number of scientific studies and analyzes: ▪

Some parameters of milk coagulation by the thermal acid method were determined ▪ Technologies for 3 types of dairy products were developed ▪ The content of fatty acids and cholesterol in the combined milk protein was determined both fresh and dried. The research results show that the fatty acid content in “eedem” is 2 times less than in fresh and dried “eezgii”. The content of polyunsaturated acids is approximately the same in fresh and condensed “eezgii”, and in “eedem” it is 15 times more. All samples contain C18:2 (linoleic acid), C18:4, C20:4 (arachidonic acid), C22:2, C22:4, C22:5, C22:6, hence it can be argued that “eedem”, fresh and dried “eezgii” have almost the same nutritional properties. The content of cholesterol in “eedem” is 2 times less than in “eezgii”

**3.2. Tsend-Ayuush, Ch. (2008). Features of the chemical and amino acid composition of the milk of Mongolian cattle. Food Industry, 3: 22-23 Web of Science (WoS) - Russian Science Citation Index, eLIBRARYID: 994221, ISSN 0235-2486 IF RSCI: 0.602**

The amino acid composition of proteins in combined milk samples of Mongolian cattle has been studied. It has been established that both goat's and sheep's and cow's milk are characterized by a higher content of amino acids such as glutamic acid, aspartic acid, leucine, lysine and proline. The proportion of essential amino acids in the total protein of goat, sheep, cow milk of Mongolian cattle is 43.64, respectively; 45.41 and 44.49%. According to these data, both goat's and sheep's and cow's milk have approximately the same nutritional value. According to the content of seroalbumin,  $\beta$ -globulin and  $\alpha$ -lactalbumin, goat's milk differs from cow's. In terms of the amount of  $\alpha$ -lactalbumin fraction, goat's milk protein significantly exceeds cow's milk protein. The conducted studies of the general chemical, amino acid and fractional composition of the milk of the Mongolian dairy cattle of pasture content confirm its enormous value.

**3.3. Tsend-Ayuush, Ch. & Ganina V.I. (2009). Micronutrient composition of milk of small pasture cattle in Mongolia. Storage and processing of agricultural raw materials, 9: 32-34, eLIBRARY ID: 12930043, eISSN: 2658-767X ISSN 0026-9026 ISSN 2072-9669 IF RSCI: 0.348**

The paper provides information confirming the feasibility of organizing measures for the industrial processing of goat and sheep milk in Mongolia and the production of dairy products from this raw material. To substantiate the possibility of using goat and sheep milk for the production of baby food, fermented milk products and cheese, the mineral composition of this raw material was studied. The obtained results on the composition of the mineral-vitamin composition of goat's and sheep's milk in comparison with cow's milk and the analysis of these data are presented.

**3.4 Tsend-Ayuush, C. & Ganina V. I (2010). Microflora of Mongolian traditional fermented milk products. Dairy industry, 2: 81, eLIBRARY ID: 13060100, ISSN: 1019-8946**

The publication proved the necessity of probiotic products manufactured for the Mongolian people. Also included are the results and data on the structure of microflora of analogical products as well as the varieties of traditional Mongolian fermented milk (sour-milk) and other dairy products produced in private enterprises. The Researcher's results collected in different



provinces of Mongolia showed the structure of microflora of sour-milk products (tarag, ).The analysis has shown that in Mongolian national sour-milk products contain the following microorganisms: *Streptococcus thermophilus*, *Lactobacillus fermentum*, *Lactobacillus (helveticus, crispatus, gallinarum)*, *Bacillus lechiformis*, *Brevibacillus invocatus*, *Leuconostoc (lactis, garlicum, argentinum)*, *Enterococcus (faecium, faecalis, durans)* and yeast.

**3.5. Batjargal, B., Tsend-Ayush, Ch., & Lkhagvadorj, B. (2010). Isolation of Lactic Acid Bacteria with High Biological Activity from Mongolian Airag. Mare Milk Industrialization Base Construction Project Symposium, China.- P. 9-20.**

The thirty-two strains of lactic acid bacteria were isolated from the Mongolian traditional mare's fermented milk, among them 25 strains show antibacterial activity against test microorganisms including *Escherichia coli*, *Staphylococcus aureus*, *Enterococcus faecalis* and *Pseudomonas aeruginosa*. Protease sensitivity assay demonstrated that the antibacterial substances produced by isolates A23, T2 are bacteriocins as their antibacterial activity were eliminated completely after treatment with protease. Identification of bacteria is being carried out. Among the isolates 22 strains show protease enzyme producing activity. The selected strains isolated from mare's fermented milk show the the specific protease activity from 7,9 U/mg to 11,9 U/mg. The strain A8 which is identified by biochemical and physiological characteristics and it exhibited the highest proteolytic activity.

**3.6. Tsend-Ayuush, Ch., & Ganina, V.I. (2011). Safety indicators of goat and sheep milk. Dairy Industry, 10:41-42. eLIBRARYID:17011559 ISSN: 1019-8946, IF RSCI: 0.927**

The purpose of the work is to assess the safety of goat and sheep milk by periods of the year. Milk samples taken in the private sector of different regions of the central zone of Mongolia were examined in the BIOTEST laboratory of the Moscow State University of Applied Biochemistry using the method of atomic adsorption spectrophotometry. The content of heavy metals (Pb, Cd, As, Hg) in all samples of milk from small pasture cattle did not exceed the maximum allowable concentrations. The content of lead, cadmium and mercury in goat's milk was slightly higher than in sheep's milk. The concentrations of pesticides and radionuclides in the studied samples did not exceed the standard values. Such milk can be recommended for the production of dairy products, including baby food. According to microbiological safety indicators, the samples did not belong to environmentally hazardous food products. The maximum permissible levels of potentially hazardous substances regulated in Russia can be recommended for Mongolian dairy raw materials.

**3.7. Tsend-Ayush Ch. (2012). Functional characteristics of lactic acid bacteria (LAB) isolated from the Mongolian traditional fermented milk- Book "Asia: Perspectives and Insights---Development through Collaborations, -P.637-651. ISBN:978-89-5930-307-6**

We have isolated 12 strains of lactic acid bacteria from camel's, goat's, mare's and cow's fermented milk. C60-3(fermented milk from camel's milk) strain was identified as *L.delbruekii*

*ssp. delbruekii*, (89,1% ID), S2 (fermented milk from mare's milk) strain identified as – *L. delbruekii ssp. delbruekii*, (92,4% ID). Other strains ( S3, TSI-1 TSI-2 TSI2-2 TSI-3, TSI-6, TSI-7 TSI-8 and TSI-10) were identified as *L. fermentum* S3(fermented milk from cow's milk) as *L. fermentum* (99,7%). The tolerance of artificial gastric juice and artificial bile acid and antimicrobial effect of LAB from Mongolian fermented milk was determined. Cultures were represented antimicrobial effect, but supernatant from each culture was not show antimicrobial effect. Therefore, this antimicrobial effect may be cause of production of organic acid.

**3.8. Tsend-Ayush Ch., Yoon, Y. C., & Kim, S. Y. (2013). Physico-Chemical Characteristics of Mongolian Goat, Sheep and Cow Milk. *Journal of Dairy Science and Biotechnology*, 31 (2), 93-98. <https://www.koreascience.or.kr/article/JAKO201309649928719.pdf> eISSN 2733-4562**

For purposes of substantiation of organizing measures on industrial processing of goat's and sheep's milk in Mongolia and the production of dairy products we have conducted the studied physico-chemical characteristics of the Mongolian goat's and sheep's milks specially to recognize amino acids, minerals and vitamins in the milk and compare with the n cow's milk. And also studied technological properties of goat, sheep and cow milk. Milk of the Mongolian animals high in total solids and rich in fat and protein. Sheep milk contains higher total solids and major nutrient contents than goat and cow milk. The average protein content in sheep milk (7.2%, w/w) is higher than in goat (5.0%, w/w) or cow milk (3.9%, w/w). Especially sheep milk contains higher levels of total solids and major nutrient than goat and cow milk. Sheep and goat milk proteins are also important sources of bioactive angiotensin converting enzyme (ACE) inhibitor peptides and antihypertensive peptides. Density lower of goat and sheep milk is comparable to that of cow milk. Viscosity of goat milk is slightly higher, while that of sheep milk is much higher than in cow milk.

**3.9 Tsend-Ayuush, Ch., & Ganina V.I. (2013). Probiotic properties of lactic acid bacteria isolated from national fermented milk products of Mongolia: Technique and technology of food production, 1:58A-64 eLIBRARY ID: 18855143 , ISSN 2070-9414b 2313-1748 (Online) IF RSCI: IF 0,**

Abstract: The purpose of this work is to identify and study the probiotic potential of lactic acid bacteria isolated from the national dairy products of Mongolia. 69 food samples were studied, including tarag, airag, aaruul, byaslag and eezgiy. As a result, strains of lactic acid bacteria were isolated, the identification of which was carried out on the basis of determining the sequence of their 16S rDNA. All isolated strains were tested for low pH and bile acid tolerance, gas formation and adhesion on Caco-2 cells. It was found that 10 of the studied strains can be used as probiotics, while 6 were isolated from khoormog made from camel milk. Based on 16S ribosomal rDNA analysis and carbohydrate profile, they were identified as *Lactobacillus (L.) plantarum* and *L. paracasei*.

**3.10 Tsend-Ayush Ch, Yoon Y.Ch. & Takeda, Sh. (2013). Development of Technology of Starter Cultures Using Strains of LAB Isolated from Mongolian Traditional Fermented Milk- The 8th International Forum on Strategic Technology. PROCEEDINGS. Volume I, 2013, 500-502 ISBN:1479909335**

The aim of the present study was to develop of technology of starter cultures for fermented milk using new strains of lactic acid bacteria isolated from Mongolian traditional fermented milk. Totally 587 Lactobacillus strains isolated from Mongolian traditional fermented milk and identified based on 16S ribosomal DNA sequence. We have evaluated the probiotic potential of these LAB. All LAB isolates were screened for tolerance to low pH and to bile acid, gas production from glucose and adherence to Caco-2 cells. To prepare of starter cultures of fermented milk have been strains isolated from Mongolian traditional fermented milk. The types of dry strains of LAB: *L. paracasei paracasei*, *L. paracasei tolerans*, *L. plantarum*, *L. delbrueckii lactis*, *Str. thermophilus*, *L. helveticus* and *L. fermentum* were selected to prepare starter cultures and were developed of technology of starter cultures as well as studied their characteristics. Viable cell counts prepared starter cultures using the *L. paracasei paracasei*, *L. paracasei tolerans* strains higher then viable cell counts prepared starter cultures using order strains. The findings of this study have wide-reaching application in the Mongolian dairy industry. Probiotic starter cultures can be used to produce functional dairy products for people with stomach and digestive problems. Also the starter cultures prepared from other strains is suitable for producing yoghurt for general population for wide consumption.

**3.11 Tsend-Ayush Ch. (2015) Probiotic potential of LAB isolated from Mongolian traditional fermented milk, Scientific Aspect for Use of Probiotics - International Symposium. Ulaanbaatar. Symposium BOOK, P.49-55.**

Probiotics are live microorganisms present in naturally fermented food products, and also added to other products as supplements to improve the hosts' health and microbial balance. Bacteria are considered as probiotics based on selection criteria that include the ability to survive the transition through the gastrointestinal tract conditions (pH and bile salt concentration), adhesion to the intestinal epithelium, auto-aggregation, and antibiotic resistance. The industrial properties of probiotic bacteria associated with their incorporation into food products are essential for the application of probiotic cultures in the development of functional foods. Probiotic bacteria must survive industrial applications, grow adequately in food products during their shelf life, and be technologically suitable for their incorporation into foods products so that they retain viability and efficacy. The antimicrobial activity of probiotic bacterial strains against foodborne pathogenic bacteria may also be a characteristic parameter for probiotics to be included in the composition of probiotic preparations and probiotic foods. Isolated strains of LAB tested on tolerance to low values of pH and bile acids, gas production and adhesion on Caco-2 cells.

**3.12 Tsend-Ayuush, Ch., Mashentseva N.G., Karpychev, S.V., Zyankin, M.V., & Ganina V.I. (2016). New starter cultures of Mongolia. Dairy Industry, 12:50-51. eLIBRARY ID: 27389993, ISSN 1019-8946**

The purpose of the work is the selection of starter cultures based on lactic acid bacteria isolated from the national products of Mongolia to create their own starter cultures, the study of technological parameters for the production of fermented milk products using new starter cultures. For the preparation of starter cultures and fermented milk products, *Streptococcus salivarius* subsp. *thermophilus* TSI/1216, *Lactobacillus helveticus* TSDI/11, *Lactobacillus fermentum* DTS/143, *Lactobacillus paracasei* subsp. *paracasei* 06TSD19b, *Lactobacillus delbrueckii* subsp. *lactis* 06DTS3b and *Lactobacillus paracasei* subsp. *tolerans* 06TSD39b isolated from Mongolian national dairy products. In the first series of experiments, the selection of microorganisms for the creation of starter cultures, which are most often used in the dairy industry, is scientifically substantiated. To prepare the starter, strains of *Streptococcus salivarius* subsp. *thermophilus* TSI/1216, *Lacto-bacillus helveticus* TSDI/11, *Lactobacillus fermentum* DTS/143. It has been established that, according to the duration of fermentation, *Lactobacillus helveticus* TSDI/11 has the highest milk fermentation activity. The organoleptic characteristics of the starter cultures met the established requirements. Further research was aimed at developing technologies for fermented milk products with new starters. For a fermented milk product with *Lactobacillus paracasei* subsp. *paracasei* 06TSD19b was clinically tested. In the feces of the group taking *Lactobacillus paracasei* subsp. *paracasei* 06TSD19b, the level of *Lactobacillus* significantly increased, and the level of *Bifido-bacterium* tended to increase depending on the duration of taking the probiotic in the composition of the fermented milk product. These results support the use of *Lactobacillus paracasei* subsp. *paracasei* 06TSD19b as a probiotic in fermented milk products.

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#### **3.13 Tsend-Ayuush, C., & Menkhzaya H. (2005) Fatty acid composition of Mongolian goat milk. Proceedings of the Mongolian State University of Science and Technology-MGUNT. No. 6/78 - S. 39-40. ISSN 1560-8794**

The study of the fatty acid composition of goat's milk was carried out using the gas chromatography method. The research results show that goat milk has a relatively higher content of long chain fatty acids (C 18:0, C18:1), white goat milk contains more linoleic and linolenic acids. Short and medium chain fatty acids, caproic (C6:0), caprylic (C8:0), capric (C10:0) and lauric acid (C12:0) are significantly higher in goat's milk than in cow's, respectively.

#### **3.14 Tsend-Ayuush, Ch., Enkhtul, Ts., Delgerma, S., (2005) The use of pure cultures of microorganisms for the preparation of starter cultures. Proceedings of the University of Science and Technology of Mongolia. No. 6/78 - S. 71-76. ISSN 1560-8794**

It has been proven that pure cultures of microorganisms give specific types of dairy products a taste, smell, nutritional value and contribute to the health of the body, inhibit the development of some putrefactive bacteria, and delay the process of sucking out toxic substances in the blood. To prepare the starter, collection cultures of lactic acid bacteria of the genus *Lactobacillus*

isolated from traditional dairy products were used: *L. bulgaricus* B1, *L. bulgaricus* B), str. thermophilus T1, str. thermophilus T2. The results of studies of the influence of temperature regimes of milk fermentation on lactic acid bacteria are presented. The optimal temperature for the fermentation of milk of pure cultures has been established. Starters that meet standard requirements have been obtained. With the use of sourdough, the output will improve, sanitary and hygienic requirements and production safety will be ensured. The resulting starter cultures allow them to be recommended for use in yogurt technology.

**3.15 Enkhtuul, C., Tsend-Ayuush, C., & Oyuun-Erdene, A. (2005) Results of microbiological testing of sourdough using pure cultures. Proceedings of the University of Science and Technology of Mongolia. No. 6/77 - pp. 140-144. ISSN 1560-8795**

Pure cultures of lactic acid bacteria are used in fermented milk production. The purpose of this work is the screening of active cultures for a new consortium of lactic acid bacteria and for the preparation of starter cultures, with high technological properties that meet standards and modern requirements. The objects of the study were collection cultures of lactic acid bacteria: streptococcus thermophilus 02, *Lactobacillus delbrueckii* subsp. *bulgaricus* 01. We have studied the properties and quality of the sourdough. As a result of the experiments, it was found that in terms of physicochemical, organoleptic and microbiological indicators, the studied starter meets the standard requirements. The study shows that, for example, the number of viable cells is not lower than the indicators recommended by the World Health Organization.

**3.16 Tsend-Ayush Ch. (2008). Fermented dairy product enriched lactulose. Proceepings of 3rd international symposium in chemistry. Proceepings of 3rd international symposium in chemistry „Chemistry and Food Safety“. C. 138-139.**

The main technological operations of the “Tugs” production are the following steps: the inspection and preparation of raw material; normalization; purification of the normalized composition; pasteurization; homogenization; cooling the composition to the fermentation temperature at 36-38 °C; inoculum by 5 % of *Lactococcus lactis*; mixing the fermented composition; incubation at 32-34 °C to the milk coagulate 80-85 °T; enriching the fermented composition with lactulose, solubilizing in the sterilized milk in the quantity, providing the minimal physiological dose of the lactose. The adding lactulose of the final step of the production gives the opportunity to keep it maximally in the product. Moreover, it's determined if we add this prebiotic before the process of fermentation it would be used by microflora for its vital activity. Before bottling the product, it mixes and after that packs. The duration of storage comprises not more than 24 h at the temperature not higher than 6°C.

Thus, the introduction of the food prebiotic additive before the process of fermentation influences on the dynamic of the microorganism's growth in the product. And acidity growth also influences on the intensities. Furthermore, the lactulose improves organoleptic parameters of the final product. As the fact, it has more pleasant taste and dense consistency.

**3.17 Tsend-Ayuush, Ch., (2009) Resource of small pasture cattle and its biological value. Livestock reforms, - No. 10. - S. 94-98. ISSN 99929-6-224-0**

Cow's milk is mainly processed industrially, and the milk of other animal species is used for the preparation of national dairy products in a small volume in individual farms. In Mongolia, according to statistics, there were about 43.3 million head of livestock, of which 19.9 million are goats and 18.4 million sheep, in connection with this, the resources of goat and sheep milk have increased. Based on the data on the increase in the number of broodstock, we calculated the total resource of milk for industrial processing. The biological value of goat and sheep milk was studied. Technological directions for the processing of goat and sheep milk have been established.

**3.18 Tsend-Ayush Ch. (2009) Specific features of Mongolian traditional fermented milk and lactic acid bacteria, isolated from the dairy products. Научно-технический журнал МГУИТ № 8/105- X. 186-187. ISSN 1560-8794**

The publication proved the necessity of probiotic products manufactured for Mongolians. Mongolian food culture, especially concerning dairy products, is different from Western cultures. Especially dairy products of Mongolian nomads have different names and different processing methods. Mongolian nomadic people have consumed large amounts of dairy products from five kinds of animals (cows, goats, camels, sheep and horses) traditionally are prepared by distinctive methods. Since the ancient time, they have been preparing milk and dairy products using traditional technology. Included are the results data on the structure of microflora of analogical products as well as the varieties of traditional fermented milk and order dairy products produced in private enterprises. The researches collected in different provinces of Mongolia showed structure of microflora of sour milk products (tarag, airag, hoormog and order dairy products). Investigated microflora of sour-milk products for the first time by applications of genetic methods. The analysis of the products showed that the Mongolian national sour-milk products following microorganisms are contained in the: *Streptococcus thermophilus*, *Lactobacillus delbrueckii ssp. bulgaricus*, *Lactobacillus fermentum*, *Lactobacillus helveticus*, *Bacillus lechiformis*, *Brevibacillus invocatus*, *Leuconostoc*, *Enterococcus (durans, faecium, argenitum)*, *Pediococcus* and *Lactobacillus (plantarum, paracasei)*. Новые штаммы микроорганизмов, выделенные из монгольских традиционных молочных продуктов, послужат основой создания национальной коллекции культур микроорганизмов в Монголии и создания заквасок, применяемых в производстве кисломолочных продуктов.

**3.19 Tsend-Ayuush, Ch., (2011) Possibilities of using goat's milk in children's and dietary nutrition. Proceedings of the University of Science and Technology of Mongolia, No. 1/117. - S. 81-84. ISSN 1560-8794**

In recent years, the demand and production of baby and dietary food products based on goat's milk has increased. Therefore, the problem of developing new technologies for the production of dairy products from goat's milk, increasing the variety of these products, and introducing them

into constant use is relevant, especially since the health-improving and therapeutic effect of such products is confirmed by researchers. In connection with the increase in the world market price for goat down, the number of goats in Mongolia has increased dramatically, thereby significantly increasing the resource of goat milk. The nutritional and biological values of goat milk have been studied. Studies have confirmed that, while the size of goat's milk fat globules is close to that of mother's milk, the fractional composition of whey proteins in goat's milk differs from that of cow's milk. New products from goat milk: a technology has been developed for the production of powdered milk enriched with lysozyme for children and yogurt. The nutritional and biological values of these products have been studied.

**3.20 Tsend-Ayuush, C., (2014), A New Direction of Research in the Dairy Industry, including the Development of Functional Nutrition Technology – “Probiotic Yogurt Technology Development”. Prefabricated scientific work of the IPT, S.186-189.**

Yogurt technology has been developed. For technological research on the development of technology for new types of yogurt with probiotic properties using cow's milk. For technological studies of the product, *L. paracasei paracasei* (LP 432), oligosaccharides and yeast extract were used. The investigated samples of yogurt were produced according to the traditional technology in a thermostatic way. The finished product was examined for organoleptic and microbiological parameters when stored in a refrigerator (6-8 °C) for 10 days to determine its shelf life. According to the results, the number of microorganism cells in the fermented milk product was found to be 10.9 CFU/ml on the first day of storage, and 10.9 CFU/ml on the 7th day. No change in organoleptic parameters was observed during 7 days of storage.

**3.21 Tsend-Ayuush, C., (2016) Lactic acid bacteria strains with probiotic properties - Science, Technology and Innovation in Food and Agriculture Sector. Product catalog, p.260.**

Characteristics of the product: This product is designed for functional nutrition prepared in the traditional way of production. Clinical trials have proven that the product has an action to support immunity, prevent various diseases of the gastrointestinal tract, as well as anti-allergic and anti-*Helicobacter pylori* activity.

A technology for the production of yogurt and sour-milk drink prepared on the basis of certain probiotic lactic acid bacteria has been developed and implemented.

Purpose, use of the product: This product is prescribed for preventive purposes and is recommended for food consumption of all population groups.

**3.22 Tsend-Ayuush, C., (2016) In vitro and in vivo study of anti-*Helicobacter* activity of probiotic lactic acid bacteria. Prefabricated scientific work MSUNT №1. 85-93. ISSN 1560-8794**

Infection with *Helicobacter pylori* causes chronic gastritis, ulcers and stomach cancer in humans. There are many remedies for the treatment of this disease, but recently there have been cases of

resistance of *Helicobacter pylori* to antibiotics and other chemical drugs. Therefore, preventing the risks of developing *Helicobacter pylori* is of paramount importance in the prevention of gastrointestinal diseases, in connection with which attention is paid to the development of functional foods and other natural products with anti-*Helicobacter pylori* activity. The aim of this study is to apply an established in vitro test to assess the probiotic potential of the probiotic properties of *Lactobacillus* strains isolated from dairy products and to select probiotic strains that meet the established criteria and therefore potentially be used as new probiotic strains in the dairy industry. We have isolated strains of lactic acid bacteria from traditional Mongolian fermented milk products, which showed high resistance to gastric juice and adhesion to human intestinal epithelium in experiments in vitro. *L. paracasei* has not only a probiotic effect, but has shown anti-*Helicobacter* activity. The search and use of lactic acid bacteria with anti-*Helicobacter* activity in the production of fermented milk products will contribute to the creation of new functional products with a therapeutic and preventive focus.

**3.23. Sarangol, B., Tsend-Ayush, Ch., Munkhbileg (2018) Application of cholesterol lowering yeast and lactic acid bacteria, isolated from Mongolian dairy products. Сборных научных труд ИПТ, - P.16-21.**

The main purpose of this study is to develop the processing technology of functional dairy products with cholesterol removal properties using probiotic lactic acid bacteria (LAB) and probiotic yeast which isolated from Mongolian traditional fermented camel milk “Khoormog” and mare milk “Airag”. Twenty “Khoormog” and three “Airag” samples were collected from both Mongolia and Inner Mongolia, China from 2017, July 28 to October 8. A total number of 920 LAB strains and yeast strains were isolated from the 23 collected samples. Colony observation, gram stain, catalase test and colony counts were carried out on all isolated strains. The LAB strains were screened by acid (pH 3.5) resistance and bile (0.5%, 1.0% of bile) resistance and lactose utilization (1.0% of lactose) and one step fermentation capacity. Yeast strains were screened by acid (pH 3.5) and bile (0.5%, 1.0% of bile) resistance and one step fermentation capacity. Finally, 60 LAB strains and 14 yeast strains were screened and frozen under -80 degree in Inner Mongolian Agricultural University in Hohhot, Inner Mongolia. Physicochemical properties, such as protein, fat, fatty acid, amino acid, vitamin and minerals of collected 23 samples will be determined after isolation. The cholesterol- and bile acid-lowering capacity of isolation will also be determined after the functional strain screening. New processing process of functional fermented dairy food will be carried out using the screened functional LAB and yeast strains. The determination of the optimum production process will be adjusted by fermentation time, temperature, starter selection and strain proportion. Enzymes will be used as the symbiotic factors in the production process. Symbiotic fermentation will be carried out after determination of functional yeast and LAB strains. And finally, the stability of probiotic properties and chemical compounds of the new products will be determined to ensure the product safety.



**3.24 Sarengaole, Ch. Tsend-Ayush, Munhebilige, (2021) Development Technology of Synbiotic Yogurt With Cholesterol Lowering Ability, Mongolian economy agriculture, - P. 44-51. (ISSN 2664-195X).**

The aim of the research is to study the development technology of functional food of cholesterol lowering yogurt. Two strains of lactobacillus plantarum with cholesterol lowering ability were used as the starter cultures. In single factor experiment, optimal rate, inoculum, optimal fermentation period and temperature was determined. Box-Behnken Design was performed. Chemical composition analysis, sensory evaluation and storage was determined.

**3.25 Tsend-Ayuush, C., (2022), Development of technology for soft cheese from goat milk using starter microflora with probiotic properties, Collected scientific papers MGUNT, No. 1.- C. 54-61**

The purpose of this work is to study the effect of the amount of a new probiotic bacterial starter culture and the dose of a milk-clotting enzyme on the duration of goat milk clotting at different temperatures. Rational biotechnological parameters for obtaining cheese from goat's milk using starter microflora with probiotic properties have been selected. A technology for the production of soft cheese from goat's milk has been developed. The physico-chemical parameters of the product in the process of maturation were studied.