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# Development of a recipe and technology for the production of drinking yogurt from camel milk for gerodietetic nutrition based on the enzyme, probiotics and nutrient additive

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**Abstract**
Despite extensive research and development of technology for fermented milk products from camel milk, until today its position in the form of a geroprotector has not been considered. This study is aimed at developing a technology for the production of fermented milk product from camel milk for gerodietetic nutrition and conducting a study of the developed samples, analysis of the results. As a result of research and development of technology for the production of fermented milk product, by enriching camel milk with various nutrient and other additives, it was possible to obtain drinking yogurt for gerodietetic nutrition with certain properties that meet the requirements of regulatory documents. The addition of enzyme (transglutaminase), prebiotic (fructooligosaccharide) and nutrient additive (apple pectin) to camel milk positively affected such properties as organoleptic, viscosity, and moisture-retention capacity of the product. And also, for the production of drinking yogurt in order to identify the most acceptable type of lactic acid starter cultures, a combination of different lactic acid starter cultures and its application in fermentation were carried out, as a result of which it was possible to obtain reasonable indicators of suitable lactic acid starter cultures for the production of drinking yogurt for gerodietetic nutrition.

**Keywords:** gerontology, camel milk, drinking yogurt, pectin, prebiotic, enzymes, healthy aging, prevention

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## INTRODUCTION

According to the World Population Review, the life expectancy of the population in different countries reaches a maximum of 81 years for men and 84 years for women. The first 5 countries with high life expectancy in the first half of 2019 are: Hong Kong (84 years), Macau (84 years), Japan (84 years), Switzerland (83.7 years), Spain (83.5 years). Kazakhstan takes 137$^{th}$ place in these statistics, after Iraq and Fiji with a life expectancy of 70.1 years.

Many scientific research sources can find many terms that characterize the overlapping concepts of defining and adhering to a healthy, long life. These terms mainly include words such as: successful aging, healthy aging, optimized aging, physical active aging, and good aging. Of all the terms, the most commonly used is successful aging, healthy aging (Carstensen et al. 2019).

Scientists in the field of aging Row and Kahn (1997, 1998) in their writings proposed the idea of successful aging as a variety from the traditional research approach to aging, in which efforts are aimed at understanding the pathological processes of aging (Rowe and Kahn 1997).

As mentioned above, for comparison there is no single definition of healthy aging. A recent review of scientific evidence on healthy aging offers a model in which healthy aging should be understood as a high level of physical and mental health, and the main determinants of healthy aging are physical activity, social interaction, healthy nutrition and perception control (Walker and Maltby 2012). But for many years, the widespread use of successful and healthy aging models has been accompanied by criticism for the fact

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that they primarily represent an academic view of what is important in later life and that models do not give priority to what older people themselves consider most important for their quality life in old age (Bowling 2007).

A related criticism is that the models introduced do not contain a subjective assessment (Pruchno et al. 2010), neglecting, therefore, scientific data demonstrating the effect of subjective well-being and self-esteem of health on objective health. Scientists Hicks and Conner (Hicks and Conner 2014) suggest that the model of good aging with a focus on the adverse factors that older people face when aging is better suited to the realities of later life than the model of healthy aging.

Several key theories of aging emphasize the importance of understanding later life in the context of the early stages of life. This is especially true of Ericsson's psycho-social development theory (Eriksson 1997), continuity theory (Atchley 1999, Atchley 1989) and Dannefer's life cycle theory (Dannefer 1984, Elder Jr 1975).

The well-known Ukrainian gerontologist Aleksandr Vayserman in his book "The Early Sources of Aging and Longevity" writes that aging is an important topic, and there are currently many studies showing that improving health, especially in old age, requires studying what happened from the moment of conception, and even what happened to the parents (Le Bourg 2019).

Currently, in medical scientific works, physical exercise or activity and healthy nutrition are recommended for the prevention and treatment of certain diseases that are often found in the elderly (Bodart et al. 2017). Aging has a profound harmful effect on almost all living organisms. Immune systems play a particularly important role in protection against external influences (pathogenic microorganisms) and internal lesions (cancer), but their protective abilities usually decrease with age (Weng et al. 2019).

The winner of the Nobel Prize in the field of physiology and medicine, I.I. Mechnikov, writes over the problem of combating old age: "Both man and every animal undergo significant changes with age. The strength is weakening, the body is hunched over, the hair turns gray, the teeth wear out ..."

The German physician K.V. Gufeland emphasized that "without a good stomach, you cannot reach a very old age."

The founder of Russian and Ukrainian gerontology A.A. Bogomolets claims that in the field of the study of the nutrition of body there is already a lot of data to build rational, anti-aging nutritional regimes.

An indispensable condition for longevity, maintaining health, working ability, vitality is healthy nutrition. According to Academician D.F. Chebotarev, "nutrition - the only practical tool that prolongs the species life span by 25-40%"

At the time of Kazakhstan's independence, life expectancy was 67 years, by 2000 it fell to 65,5 years, in 2005 it was 66 years old, in 2010 it was 68 years old, and in 2019 it reached its current levels. A person's life expectancy by 50% depends on the lifestyle that he leads (nutrition, activity and passivity), another 20% each have a share of a genetic predisposition to certain diseases, as well as environmental influences.

In the diet of the elderly and advanced age, it is most often recommended to include dairy products. The classification of assortments of dairy products for gerodietetic nutrition is growing in the last decade. The provision of "healthy aging" due to food is very high, since, here, the high quality of raw materials used is taken into account.

The joint work of scientists of the Bulgarian Research Center "LB Bulgaricum" and the Almaty Technological University today made it possible to research and develop a new fermented milk product from camel milk for herodietetic nutrition.

## MATERIALS AND METHODS OF RESEARCH

### Research Materials

Objects of research: camel milk, apple pectin, fructooligosaccharide, rice protein, transglutaminase, humaguar, sodium caseinate, oat flower powder.

Camel milk was taken from the camel farm of "Daulet-Beket" LLP located in the village of Akshi, Ilii district, Almaty region, the Republic of Kazakhstan. Lyophilized symbiotic bacterial cultures were used as starter culture for the production of fermented milk products - LBBY 5-54V and for the production of butter and sour cream - LBBB B5, produced by the laboratory of the company "LB Bulgaricum" LTD, Sofia city, Republic of Bulgaria.

Preliminary studies were conducted to find the concentration of drugs to be added (from 0,025 to 0,4% (w/h)) and the most effective ways to add them were determined.

### Research Methods

For research, milk of camels of the Kazakh Bactrian breed (two-humped) and Turkmen Avrana (one-humped) were taken (Tasturganova et al. 2018). The work was divided into 2 stages: stage 1 - development of the recipe and production technology of fermented milk product with LBBY 5-54V sourdough, analysis of samples, stage 2 - development of the recipe and technology of fermented milk product with starter culture LBBY B5, as well as the combination of starter cultures LBBY 5-54V and LBBB B5, analysis of the samples obtained.

### Preparation of Fermented Milk Product

29 samples were created from camel milk, of which 9 samples were taken for subsequent research, and three samples from cow's milk were added to it for further comparison of indicators (organoleptic, viscosity,

**Table 1.** The composition of samples from camel and cow's milk for the recipe development of fermented milk product

| Sample № | Sample composition | Used milk/purpose |
|---|---|---|
| 1 | Pure raw material without additives | Camel/control |
| 2 | Fructooligosaccharide | Camel |
| 3 | Apple pectin | |
| 4 | Apple pectin, rice protein | |
| 5 | Apple pectin, rice protein, oat flower powder | |
| 6 | Transglutaminase | |
| 7 | Transglutaminase, rice protein | |
| 8 | Apple pectin, fructooligosaccharide | |
| 9 | Transglutaminase, fructooligosaccharide | |
| 10 | Pure raw material without additives | Cow's/control |
| 11 | Transglutaminase | Cow's |
| 12 | Apple pectin | |

**Table 2.** Organoleptic indicators of yogurt according to SST RK 1732-2007

| Name of product | Name of indicators | | |
|---|---|---|---|
| | Appearance and consistency | Taste and smell | Color |
| Yogurt | Homogeneous, low viscosity. When stabilizer is added, jelly-like or creamy. Depending on the type of mixture when using food components. | Sweet milk. When adding sugar or sweeteners – of a little sweet taste. The food taste characteristic is determined by adding components | Milky white, homogeneous or due to the addition of components |

microbiological contamination, formation of organic compounds) of the product. Of the nine samples based on camel milk, the first sample was determined as a control. The remaining eight samples were used to prepare a fermented milk product with different nutrient additives and components, the data of which are shown in **Table 1**. Of the three samples of cow's milk, one sample was a control, and two other nutrient additives and components were added to the other two.

Fermentation of the mixture of samples was carried out at a temperature of 43$^0$C, while the pH concentration within 3-6 hours reached up to 4.6 – 4.7. The acidity of the samples was measured after 3, 4, 5 hours of ripening, as well as control the next morning. Samples were placed in a refrigerator for further cooling at 4±1°C for 15 days. During storage, the following sample analysis was also performed.

## Analysis of Samples

***Sensory analysis***

The organoleptic qualities of the product, in addition to the chemical composition and nutritional, biological value of the product, have a lot of weight, since it is this indicator that most affects the choice of consumers, which in turn makes up the demand for a certain type of product.

Therefore, when developing new fermented milk product, special attention was paid specifically to organoleptic characteristics, since camel milk has its own specific smell and taste, which may not appeal to all consumers, and it was important to take into account these characteristics, based on the fact that the product will be for people of elderly and advanced age.

Organoleptic evaluation was carried out on the basis of State standard of RK 1732-2007 "Milk and dairy products. Organoleptic method for determining quality indicators" (SST RK 1732-2007. "Milk and dairy products"). According to this standard, yogurt products according to organoleptic indicators must meet the requirements specified in **Table 2**.

***Viscosity of samples***

The viscosity of samples was determined using a rotational rheometer "Brookfield RST-CPC" from "Brookfield", USA. The principle of this equipment operation is simple. If the option "wait for temperature" was previously selected and a sensor "Pt100" is connected to the device, the system will wait until the measuring system and the sample reach the temperature. The test will start automatically. During the test, the screen displays the data for the most recent measurement point taken, including viscosity, shear rate, shear voltage and temperature on the left side and time, revolutions per minute, torque per mile and measurement point on the right side. Graphical and mathematical presentation formats are also available during and after active testing. The graph presentation format represents data, depicting time on the x-axis, viscosity on the y-1 axis, and temperature on the y-2 axis. In addition, the mathematical format shows the minimum viscosity value, the maximum viscosity value and the average value of all viscosity values in the upper half of the table. The lower half remains empty to start another program. All user input in offline mode is carried out using the touch screen. The touch screen serves as both an input and output device. The touch screen is resistive, which means that it responds to light pressure. After the test is completed, certain data is transmitted to the computer in the form of certain formats, from which it will be possible to analyze the results of the determination (Operating Instructions for the RST Rheometer).

***Microbiological contamination***

Microbiological research was carried out in accordance with SST ISO 7889-2015 "Yogurt. Counting characteristic microorganisms". The essence of the method is as follows: - tenfold dilution of the test sample is inoculated into acidified medium (MRS), then incubated under aerobic conditions at a temperature of 37°C ± 1°C for 72 hours, the number of *Lactobacillus delbrueckii subsp bulgaricus* is calculated; - the complete medium (M17) is then incubated under aerobic conditions at a temperature of 37°C ± 1°C for 48 hours, the number of *Streptococcus thermophillus* is counted; - colonies count and confirm the results obtained by conducting appropriate tests.

The number of characteristic microorganisms per gram of sample is calculated based on the number of

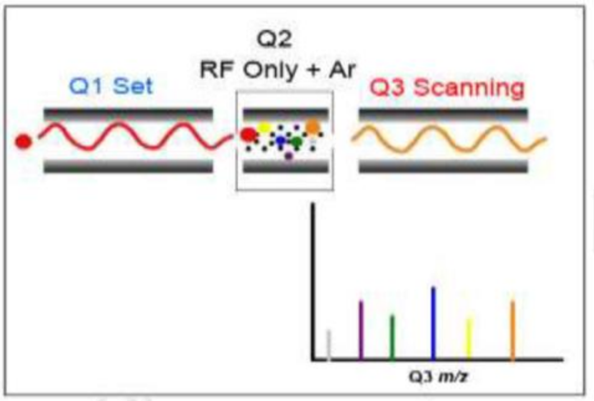


**Fig. 1.** Illustration of product scan mode

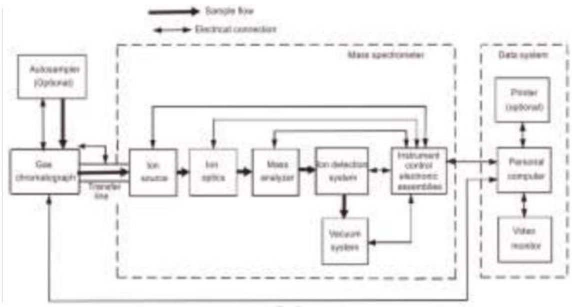

**Fig. 2.** Functional block diagram of systems TSQ Quantum XLS or TSQ Quantum GC

colonies obtained on plates at dilution levels that give a significant result (SST ISO 7889-2015 "Yogurt).

***Determination of aromatizing substances***

On the equipment of Thermo Scientific "TSQ Quantum XLS mass spectrometer", "Tri Plus autosampler", "TRACE GC Ultra gas chromatograph" the quantitative parameters of aroma substances in the samples were determined.

The mass spectrometers TSQ Quantum XLS and TSQ Quantum GC include an electron ionization/chemical ionization (EI/CI) ion source, ion optics, a three-stage mass analyzer and an ion detection system, all of which are enclosed in a vacuum collector. Ionization of the sample occurs in the ion source. The specific process used to ionize a sample is known as the ionization mode. Product scan mode performs two stages of analysis. At the first stage, the ions formed in the ion source enter Q1, which is configured to transfer ions with one mass to charge ratio. The ions selected in this first stage of the mass analysis are called parent ions. (As a result, Q1 is called the parent mass analyzer, and the mass-to-charge ratio of the ions transmitted by the parent mass analyzer is called the parent mass.) Parent ions selected by Q1 then enter Q2, which is surrounded by a collision cell. At the second stage of the analysis, ions in the collision cell can be fragmented further to obtain product ions. Two processes produce product ions: by unimolecular decomposition of metastable ions or by interaction with an argon collision

**Table 3.** Sample composition for the recipe development of fermented milk product

| Sample № | Sample composition | Type of starter culture |
|---|---|---|
| 1 /control/ | Fructooligosaccharide | |
| 2 | Fructooligosaccharide, apple pectin | symbiotic bacterial culture LBB B B5 |
| 3 | Fructooligosaccharide, transglutaminase | |
| 4 | Transglutaminase, apple pectin | |
| 5 | Fructooligosaccharide, humaguar | |
| 6 | Fructooligosaccharide, apple pectin | symbiotic bacterial culture LBBY 5-54V |
| 7 | Fructooligosaccharide, humaguar | |
| 8 | Fructooligosaccharide, transglutaminase, apple pectin | symbiotic bacterial culture LBB B B5 |
| 9 | Fructooligosaccharide, transglutaminase, apple pectin | symbiotic bacterial culture LBBY 5-54V |

gas present in the collision cell. This last step is called collision-induced dissociation (CID). Ions generated in the collision cell enter Q3 (product mass analyzer) for the second stage of mass analysis. B3 is scanned to obtain a mass spectrum that shows the ion product obtained from the fragmentation of the selected source Ion. The mass spectrum obtained in the product scanning mode (product mass spectrum) is the mass spectrum of the selected source Ion. The scan mode of the product is shown in **Fig. 1**, and the functional block diagram of the system is shown in **Fig. 2**.

After the analysis is completed, the data is stored in a personal computer. Analysis of the research results is carried out separately (TSQ Series 2010).

After obtaining the results of the above analyzes, it was decided to conduct the 2nd stage of the study, in order to compare the data obtained from the 1st stage of the study. Stage 2 of the study was begun with the preparation of samples with the addition of other species and combined lactic acid starter cultures.

*Stage 2. Preparation of fermented milk product for comparative analysis.*

In the second stage, in order to compare the final product obtained in parallel with the symbiotic bacterial culture, yogurt (LBBY 5-54V) was used to use starter culture (LBBB B5) for the production of butter and sour cream, as well as a combination of this starter culture with yogurt starter culture. A total of 15 samples from camel milk were prepared. 9 samples were selected in the process of determining suitability, of which 6 samples with starter culture B5, 3 samples with starter culture Y 5-54V. The composition of nutrient additives and components introduced into the samples (**Table 3**) were similar to the 1st stage. In the second stage, only camel milk was used exclusively.

Samples with the symbiotic bacterial culture LBB B 5 were sent for 16 hours to the thermostat to ripening at a temperature of +32°C. And samples with LBBY 5-54V were left at +43°C, up to 6 hours. After 3 hours of ripening, the pH of the samples with LBBY 5-54V was 4,7. After 16 hours of ripening, the pH of the samples

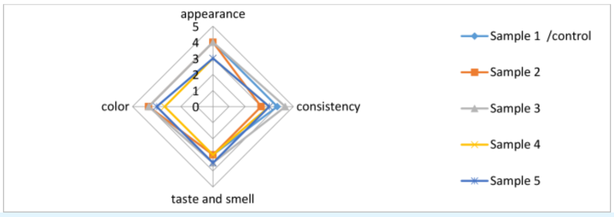


**Fig. 3.** Results of organoleptic evaluation of samples of drinking yogurt based on camel milk

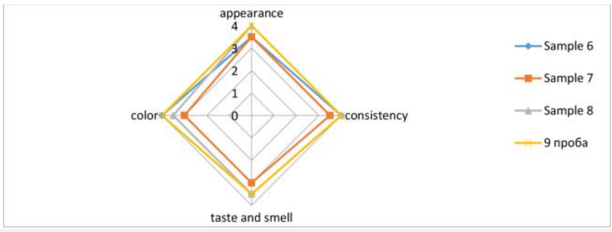


**Fig. 4.** Results of organoleptic evaluation of samples of drinking yogurt based on camel milk


**Fig. 5.** Results of organoleptic evaluation of samples of drinking yogurt based on cow's milk

with LBB B5 was 4,4-4,6. Samples were refrigerated for 15 days at a temperature of 4±1°C.

Analysis of samples at this stage, including organoleptic evaluation, determination of sample viscosity, microbiological examination and determination of aroma-forming substances were similar to the first stage of the study.

## RESULTS AND DISCUSSIONS

In the production of fermented milk products, such as yogurt or cottage cheese from camel milk, as compared to cow's milk, it cannot form a sufficient clot, the necessary consistency and texture, which reduces the organoleptic, the necessary viscosity and composition of the product as a whole. After obtaining the final indicators for the analysis of the studied samples, the following results were made.

### Sensory Analysis

The results of an organoleptic study of samples of the 1st stage from **Table 1** are presented in **Figs. 3**-**6** by type of milk used (on a 5-point scale).

It should be noted that when tasting the samples, rice protein samples were unacceptable in taste and were difficult to swallow. Samples 8, 9 were very soft in taste, but in some of them there was a specific smell of camel milk.

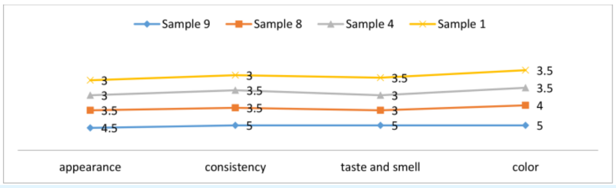


**Fig. 6.** Results of organoleptic evaluation of samples of drinking yogurt

In the second stage, in order to evaluate the samples, an organoleptic analysis of the samples was carried out (**Fig. 6**). During organoleptic evaluation, samples 1, 4, 8, and 9 were taken for a tasting analysis. The remaining samples had a precipitate. Samples 8 and 9 were selected from the above selected samples according to the tasting results. For 8 samples, the taste characteristics are acceptable, it has a sour taste, but there remains a specific smell of camel milk, and the consistency is liquid. The viscosity of sample 9, characteristic of drinking yogurt according to SST RK 1732-2007, has a pleasant mild taste, odorless, without sediment, uniform.

An organoleptic evaluation of the experimental samples showed that, in addition to fructooligosaccharide, apple pectin, the addition of transglutaminase to yogurt fermentation changed some consumer properties of the product, namely, taste, consistency and smell. The dosage of nutrient additives and probiotics, enzymes was from 0,2 – 0,4% of each of the mass of raw materials /100 ml/, significantly influenced the taste and smell of the samples, thereby giving it acceptable consumer properties: a soft, salty taste and a pleasant smell. And also, samples with humaguar, rice protein, caseinate chloride had a precipitate after 3 days of storage, which significantly reduced the taste and consistency of the sample.

### Viscosity of Samples

Rheological evaluation using measurements of controlled voltage and controlled rate allowed us to obtain comprehensive viscosity curves, profiles of viscosity and temperature. The effect of enrichment of camel milk with the above objects on the apparent viscosity of yogurt on the first day after production is shown in **Table 4**. The lowest viscosity at Shear rate (1/s) Y -104 was recorded for yogurt obtained from non-fortified milk. During viscosity estimation, information was collected from the work of Abdel Rahman et al. (2009), who noted that the viscosity of camel milk yogurt in his designs was very low and that its consistency was watery. An increase in the viscosity and total dry matter content of milk by the addition of transglutaminase, apple pectin and fructooligosaccharide led to a significant improvement in the viscosity of yogurt samples, while enriched samples alone with these additives gave lower viscosity samples. Compared to cow's milk, noticeable differences in camel's casein milk micelles, i.e. micelle size and relative distribution of

**Table 4.** Viscosity of the samples of drinking yogurt /at Shear rate (1/s) Y-104/ (First part)

| Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 | Sample 7 | Sample 8 | Sample 9 | Sample 10 | Sample 11 | Sample 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28861,5811 | 61864,1144 | 41479,522 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22945,672 | 56539,0305 | 36406,6658 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17806,738 | 39958,5275 | 23878,9441 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12830,3677 | 27075,5698 | 16583,4457 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10399,2492 | 16950,9621 | 10894,3023 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7609,8007 | 12077,3212 | 7667,246 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6109,6172 | 9149,4039 | 5301,5061 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5045,6562 | 6992,8475 | 4087,0923 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4323,8997 | 5446,8147 | 3228,4142 |
| 0 | 0 | 0 | 0 | 674,0203 | 0 | 0 | 0 | 0 | 4008,5879 | 4471,0534 | 2549,1509 |
| 0 | 0 | 0 | 0 | 385,1377 | 0 | 614,4182 | 0 | 0 | 3299,5919 | 3704,1985 | 2137,709 |
| 0 | 0 | 0 | 0 | 343,2586 | 0 | 436,021 | 0 | 0 | 2872,5779 | 3038,833 | 1771,3195 |
| 0 | 0 | 204,4434 | 0 | 321,9519 | 188,9188 | 0 | 0 | 169,0367 | 2496,2695 | 2483,799 | 1402,3201 |
| 0 | 142,4024 | 186,0336 | 0 | 281,7787 | 188,9249 | 0 | 0 | 172,5816 | 2069,3803 | 2097,9603 | 1054,8571 |
| 92,9246 | 142,5684 | 187,3046 | 107,1514 | 274,4603 | 190,789 | 79,641 | 99,2503 | 177,5944 | 1632,8755 | 1778,3494 | 799,5492 |
| 93,8709 | 142,6587 | 182,0232 | 102,7322 | 263,273 | 196,1037 | 72,7487 | 92,4421 | 182,8737 | 1322,6106 | 1508,6575 | 619,2038 |
| 105,9054 | 149,3023 | 179,7556 | 104,188 | 250,2839 | 203,7055 | 68,5615 | 88,4731 | 193,9824 | 1082,1599 | 1268,791 | 493,0924 |
| 114,3105 | 145,2337 | 182,899 | 102,3592 | 239,5672 | 193,0015 | 67,7377 | 85,2654 | 193,1888 | 885,073 | 1068,712 | 404,4959 |
| 115,4364 | 136,6492 | 173,3107 | 95,5436 | 221,796 | 175,6483 | 57,6817 | 76,6776 | 180,2849 | 714,2583 | 891,7942 | 336,3856 |
| 110,1791 | 124,04 | 157,0239 | 93,0043 | 202,2816 | 155,9794 | 51,0798 | 66,6909 | 162,7506 | 578,2734 | 750,2647 | 290,9037 |
| 99,2977 | 109,1154 | 133,9831 | 87,2967 | 177,4662 | 135,9035 | 44,573 | 57,6009 | 141,3074 | 463,5332 | 614,1287 | 255,3337 |
| 86,3252 | 92,7634 | 107,3982 | 76,5362 | 149,6111 | 116,0663 | 38,3777 | 48,5468 | 118,1979 | 364,7499 | 489,6653 | 224,4843 |
| 70,1794 | 74,4947 | 81,6055 | 62,8525 | 122,8184 | 95,4987 | 32,7256 | 38,7948 | 94,8649 | 277,0005 | 369,8625 | 194,9259 |
| 54,196 | 57,5117 | 60,6549 | 50,2277 | 100,0186 | 74,7538 | 27,8882 | 30,7291 | 72,6977 | 200,2041 | 265,7991 | 166,3673 |
| 41,2239 | 42,3888 | 45,3179 | 39,5976 | 82,3748 | 55,9848 | 24,1857 | 24,5999 | 52,9201 | 139,2784 | 174,8724 | 135,249 |

**Table 5.** Viscosity of the samples of drinking yogurt /at Shear rate (1/s) Y-104/ (Second part)

| Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 | Sample 7 | Sample 8 | Sample 9 |
|---|---|---|---|---|---|---|---|---|
| 0,0000 | 243,7196 | 0,0000 | 0,0000 | 249,7080 | 0,0000 | 0,0000 | 0,0000 | 531,5013 |
| 177,6037 | 185,3235 | 0,0000 | 0,0000 | 223,1282 | 0,0000 | 0,0000 | 0,0000 | 371,6475 |
| 166,3143 | 0,0000 | 147,0382 | 0,0000 | 0,0000 | 0,0000 | 120,3006 | 0,0000 | 241,0691 |
| 155,9820 | 83,6888 | 142,0032 | 89,9936 | 84,8335 | 139,2846 | 111,5834 | 0,0000 | 210,6357 |
| 148,5038 | 79,7270 | 129,5330 | 90,5396 | 79,8197 | 138,0510 | 114,9611 | 61,2953 | 187,5547 |
| 138,0970 | 73,0343 | 125,2367 | 93,2303 | 78,9643 | 149,7184 | 112,7253 | 63,1075 | 165,5894 |
| 126,2694 | 82,5756 | 114,0712 | 98,2517 | 83,5953 | 156,8046 | 117,2007 | 63,6593 | 142,9532 |
| 110,6202 | 79,0702 | 97,5260 | 96,5943 | 78,9798 | 155,7473 | 120,7082 | 58,0930 | 116,0608 |
| 96,0418 | 77,2547 | 84,4226 | 94,5961 | 76,8037 | 144,6876 | 122,5310 | 54,6085 | 92,7301 |
| 82,4432 | 71,5041 | 73,6970 | 87,8045 | 72,0936 | 127,4342 | 124,2271 | 50,4785 | 74,5237 |
| 69,2003 | 61,3538 | 64,8481 | 75,8411 | 62,7216 | 103,3822 | 114,3168 | 45,0900 | 59,6953 |
| 55,9899 | 49,7159 | 53,1019 | 61,1076 | 52,1086 | 73,5158 | 93,6066 | 39,7767 | 47,8554 |
| 43,2603 | 38,3886 | 40,7428 | 46,9104 | 41,3899 | 59,2349 | 69,6555 | 34,5575 | 39,6399 |
| 31,9266 | 29,2334 | 29,9333 | 35,3036 | 32,6373 | 44,1027 | 49,4735 | 29,4433 | 34,2432 |

individual caseins, especially for b- and j-caseins, also the different behavior of camel milk casein during acidification may be another reason for camel milk about which previously mentioned in the work (Abou-Soliman et al. 2017, Sagatgareev et al 2019).

Other samples with rice protein, humaguar, sodium caseinate, oat flower powder based on the appearance of yogurts and viscosity measurements had a watery texture and had a precipitate, which required additional mixing to determine the viscosity, but when determining the viscosity at Shear rate (1/s) Y -104, the viscosity of the samples was higher than 120. The highest viscosity numbers were determined for samples numbered 3, 5, 6, 9. The high viscosity of the samples 10, 11, 12 is explained by the fact that these samples were prepared from cow's milk, which is quite high amount of clot education compared to camel milk. Due to the low grades of tasting and viscosity, samples which had unacceptable characteristics for the participants in the discussion were excluded from a number of recommended samples.

From **Table 5**, it is seen that the last 3 samples have high viscosity of products. And also, samples 2, 3, 5, 6 at Shear rate (1/s) Y - 104, have a viscosity higher than 120, however, according to organoleptic characteristics, they are not recommended for use. Based on this, it can be comparatively analyzed that in the first stage, the sample with fructooligosaccharide and transglutaminase has an acceptable viscosity.

And also, in **Table 5** at Shear rate (1/s) Y -104, samples 3, 6, 9 have the highest viscosity of all samples. The highest viscosity number was determined in sample 9, where fructooligosaccharide, apple pectin, and transglutaminase were added. Based on these data, it should be noted that apple pectin in the food industry is more often used as a thickener, which explains the high viscosity of the sample. Given that this sample is fermented with yogurt starter culture LBBY 5-54V, it should be noted that the starter culture in turn also affected the viscosity of the sample.

### Microbiological Contamination

Samples of products for microbiological analyzes were taken prior to physico-chemical and organoleptic analyzes. The solid nutrient media MRS and M17 were used for seeding. The number of grown colonies on each

**Table 6.** Results of microbiological contamination in culture media

| Sample № with yogurt starter culture and additives | CFU/g | |
|---|---|---|
| | Culture medium - MRS | Culture medium - M17 |
| 1 | $1.03x10^8$ | $8x10^7$ |
| 2 | $3.8x10^8$ | $1.3x10^8$ |
| 3 | $6x10^7$ | $2.6x10^8$ |
| 4 | $2x10^7$ | $1x10^8$ |
| 5 | $7x10^7$ | $1.1x10^8$ |
| 6 | $2x10^8$ | $2.9x10^8$ |
| 7 | $1.2x10^8$ | $1.7x10^8$ |
| 8 | $8.4x10^7$ | $1.2x10^8$ |
| 9 | $2x10^8$ | $2.7x10^8$ |
| 10 | $3.4x10^8$ | $7.2x10^8$ |
| 11 | $1.9x10^8$ | $5.3x10^8$ |
| 12 | $1.7x10^8$ | $1.6x10^8$ |

plate was counted by counters, placing it upside down against a dark background, using a magnifying glass with an increase of 4-10 times. Each colony counted was marked in ink at the bottom of the cup. **Table 6** shows the results of microbiological studies.

And also, along with bacteriological contamination, microscopic photographs were taken from different samples to study live bacteria. During the study, the viability of the studied cultures was determined. The figures show that the bacterial cultures used *Streptococcus thermophilus*, *Lactobacillus bulgaricus* in combination with fructooligosaccharides, pectin and transglutaminase have an active life. According to microscopic analyzes, cocci of different shapes are found in the milk mixture, these are lactic streptococci, namely *Streptococcus salivarius ssp. thermophilus* (thermophilic streptococcus - *S. thermophilus*). Cells have an oval or spherical shape, a diameter of 0.7–1.0 μm, often connected in long chains. Active strains coagulate milk in 3.5–4 hours at an optimum temperature of 40–42$^0$C.

### Determination of Aroma-forming Substances

Aromatic compounds include a wide variety of substances. This includes hydrocarbons, alcohols, aldehydes, ketones, acids, and many others. Their number even exceeds the number of fatty compounds. Some of these compounds have a fragrant smell, which gave rise to call these compounds aromatic, despite the fact that many of them smell far unpleasant.

In the formation of taste and aroma, an important role is played by the carbonyl compounds diacetyl and aldehydes (acetaldehyde). Aldehydes have a low threshold for taste perception and they have few extraneous flavors. They are intermediate products in the formation of higher alcohols, and the conditions favorable to their formation also contribute to the formation of aldehydes. They can be secreted into the nutrient medium, and then, during the subsequent stages of fermentation, are again absorbed by the yeast cells and restored to the corresponding alcohols. Acetaldehydes are found in alcoholic fermentation products of sugary substances. Participate in the metabolism of the animal organism, but does not accumulate in it. The results of determining the quantitative indicators of aromatic substances (gas surface) in the samples are shown in **Tables 7** and **8**.

Analyzing the obtained data of the first stage of the study, it can be noted that 7 organic compounds were determined in the samples, such as acetaldehyde, acetone, butanone, ethanol, diacetyl, acetoin, and acetate. In samples 1, 9, the amount of acetaldehydes and acetoin is greater than in other samples, except for samples from cow's milk. The amount of acetone in the 2$^{nd}$ sample is found more than the rest of the samples. The highest amount of butanone, acetate was determined in sample 5. In sample 7, the amount of ethanol and diacetyl is higher than others.

According to the results of the second stage of the study, organic compounds similar to the first stage were determined. The amount of acetaldehyde and acetone is greater in sample 7, but butanone in this sample has a smaller amount. And also, the amount of ethanol in sample 4 is higher than the rest. Diacetyl, acetone in sample 8 is larger than other samples. In sample 8, acetate has the highest amount compared to other samples.

## CONCLUSION

Camel milk forms a watery texture when it is processed into yogurt. Strengthening camel milk with ingredients such as rice protein, humaguar, sodium caseinate, oat flower powder did not improve the yogurt texture. Based on the study of N.H. Abou - soliman et al,

**Table 7.** Determination of the amount of organic compounds in samples (mkl)

| Sample № | Organic compounds (aldehydes, ketones) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Acetaldehyde | Acetone | Butanone | Ethanol | Diacetyl | Acetoin | Acetate |
| 01 | 5.23 | 1.31 | 0.06 | 42.13 | 1.23 | 25.50 | 471.10 |
| 02 | 4.67 | 1.42 | 0.05 | 27.05 | 1.06 | 16.54 | 558.54 |
| 03 | 3.90 | 1.21 | 0.13 | 38.95 | 1.57 | 21.40 | 559.10 |
| 04 | 3.77 | 1.13 | 0.11 | 24.44 | 1.20 | 10.51 | 340.44 |
| 05 | 3.38 | 1.21 | 0.14 | 40.95 | 1.56 | 22.58 | 909.52 |
| 06 | 4.17 | 1.11 | 0.05 | 39.05 | 0.79 | 20.40 | 428.95 |
| 07 | 1.95 | 1.18 | 0.08 | 61.15 | 2.03 | 20.73 | 475.95 |
| 08 | 3.94 | 1.03 | 0.12 | 33.10 | 1.63 | 13.68 | 309.83 |
| 09 | 5.51 | 1.33 | 0.05 | 55.31 | 1.04 | 23.14 | 407.83 |
| 10 | 7.10 | 0.73 | 0.06 | 32.99 | 1.02 | 21.81 | 177.72 |
| 11 | 8.60 | 0.70 | 0.12 | 71.19 | 1.76 | 25.65 | 163.21 |
| 12 | 5.16 | 1.08 | 0.07 | 42.35 | 0.86 | 15.86 | 115.52 |

**Table 8.** Determination of the amount of organic compounds in samples (mkl)

| Sample № | Organic compounds (aldehydes, ketones) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Acetaldehyde | Acetone | Butanone | Ethanol | Diacetyl | Acetoin | Acetate |
| 01 | 1.12 | 0.62 | 0.07 | 57.82 | 1.84 | 50.42 | 643.07 |
| 02 | 1.14 | 0.42 | 0.11 | 50.80 | 2.12 | 19.24 | 636.45 |
| 03 | 1.27 | 0.83 | 0.10 | 68.40 | 2.36 | 35.18 | 851.04 |
| 04 | 1.21 | 0.28 | 0.14 | 80.94 | 0.74 | 12.48 | 646.00 |
| 05 | 1.16 | 0.71 | 0.08 | 43.62 | 2.92 | 62.54 | 1445.97 |
| 06 | 4.68 | 1.37 | 0.14 | 63.78 | 1.66 | 43.50 | 783.98 |
| 07 | 5.09 | 1.49 | 0.07 | 49.00 | 1.54 | 26.27 | 416.97 |
| 08 | 2.50 | 0.64 | 0.13 | 42.71 | 9.22 | 131.07 | 1309.75 |
| 09 | 1.99 | 0.91 | 0.11 | 33.77 | 6.72 | 33.10 | 397.60 |

2017, in addition to introducing transglutaminase into camel milk, we decided to add apple pectin and fructooligosaccharide, since the purpose of the product has functional significance (consistency, viscosity, customer satisfaction, preventive value), and these substances have a noticeable good effect on the human organism, especially in old age. Apple pectin and fructooligosaccharide positively affected the physical, textural properties and microstructure of yogurts. The total acceptability of the sensory evaluation showed that the addition of apple pectin, fructooligosaccharide, transglutaminase with yogurt fermentation LBBY 5-54V (manufactured by "LB Bulgaricum") to camel milk made it possible to develop a fermented milk product, namely drinking yogurt with the specified characteristics and requirements, corresponding to the standards. And also, it is necessary to note the fact that the processing of camel milk with these additives reduced the fermentation time. When determining the organic compounds, the sample that was chosen as the most acceptable, also had a low gas surface.

In the end of this study, we were able to develop a recipe and technology for the production of drinking yogurt from camel milk for gerodietetic nutrition. However, it should be noted that it is also necessary to conduct clinical or preclinical studies, the results of which would help determine the effect of the product on the body. However, this study is already of a different nature.

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