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The main biological properties of lactic acid bacteria promising in the production of fermented milk products for prophylactic purposes

Abstract. *The article provides information on the use of lactic acid bacteria in the production of fermented milk products (drinks) for prophylactic purposes. The important antimicrobial and biological properties of lactic acid bacteria are presented, according to which active strains of lactobacilli are selected and identified during screening, which are promising as ferments for obtaining bioproducts (drinks) of probiotic value. From literary sources, the article presents the high efficiency and safety of the use of probiotic lactic acid bacteria in use as ferments to produce fermented milk bioproducts with high antagonistic activity, high bacteriocin-producing activity, high adhesive activity, flavoring properties, and synthesis of vitamins. Thus, studies on the creation of fermented milk products with a specific composition and properties will give the product therapeutic and prophylactic properties due to the inclusion of probiotic strains in their composition. The development and creation of new domestic starter cultures in Kazakhstan is an urgent area based on strains of lactic acid bacteria isolated mainly from natural local national fermented milk products, as well as the development of combined therapeutic and prophylactic products (drinks) with the use of probiotics and vitamin-mineral substances.*
Keywords: *lactic acid bacteria, probiotics, antagonistic activity, bacteriocin-producing activity, aromatics, adhesion, starter culture.*

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Introduction

Lactic acid and probiotic microorganisms are of great importance for the food industry because they occupy a key position in the production of lactic acid products (yogurt, kefir, yogurt, acidophilus).

Lactic acid bacteria (LAB) are functional starter cultures in the food and dairy industry and are also considered a source of energy for biotechnology and fermentation. Due to its wide application in food and medicine, over the past several decades, intensive research and development has been carried out around the world to understand genomic and metabolic aspects [1].

The most important and popular probiotic crops that make up many drugs and dairy products are lactobacilli and bifidobacteria [2]. Species of bifidobacteria *Bifidobacterium adolescentis, B. animalis, B. bifidum, B. infantis, B. longum, B. breve, and B. thermaphilum* are widely used as probiotics [3]. And also, some strains of some species of *Streptococcus, Lactococcus, Enterococcus, Bacillus,* and *Sacharomyces* [4].

One of the important and promising directions in microbiology is the search for new strains of lactobacilli for the design of biological products [5].

The probiotic bacteria that makeup probiotics are living microorganisms that, when used in adequate amounts, benefit the health of the host [6]. The term "probiotic" is the opposite in meaning to "antibiotic". A side effect of antibiotics is the destruction of beneficial internal microflora. Probiotics restore the microbial balance in the human body [7-8].

In recent years, due to the difficult environmental and economic situation in the country, there has been a sharp jump in the incidence of diseases in adults, adolescents, children, covering such diseases of the century as diabetes, stomach ulcers, cardiovascular diseases, congenital anemia in newborns, etc. In this regard, to increase the body's resistance to the effects of adverse environmental factors and preserve the human gene pool, great attention should be paid to the organization of

preventive and therapeutic nutrition, the creation of a new generation of food products designed to slow the aging of the body, bind, neutralize and remove harmful substances from the body, preventing the development of diseases [9].

In Kazakhstan, according to doctors, from 75 to 90% of citizens are susceptible to dysbiosis - a violation of the normal intestinal microflora [10]. In this regard, the development of ferments based on probiotic strains for the preparation of fermented milk products (drinks) that can normalize the human intestinal microflora and have a regulatory effect on the body as a whole and its individual organs is becoming relevant.

Therefore, when screening probiotic microorganisms for a biological product, the most important properties of bacteria should be high antagonistic properties, high bacteriocin-producing activity, synthesis of aromatic substances, vitamin-forming ability, adhesive properties. The above biological properties of lactic acid bacteria are the foundation for the development and creation of fermented milk products (drinks) of probiotic value.

Discussion

Antimicrobial properties of lactic acid bacteria

Antibiotically active microorganisms that develop during the production of fermented milk products can suppress unwanted microflora and accumulate antibiotic substances in them [11].

The role of probiotics in human health improvement, as well as their effectiveness, has been shown in many studies, for example, in the treatment of intestinal disorders [12-13]. Some studies have shown their ability to inhibit gastric colonization and the activity of *Helicobacter pylori* bacteria, which cause gastritis, gastric ulcer, and cancer [14]. It has been proven that probiotics reduce the risk of developing certain types of cancer and hypertension, regulate the state of the genitourinary tract [15-17].

Lactic and acetic acids produced by probiotics enhance the effect on pathogenic bacteria due to the toxic effect and stimulation of intestinal motility. For example, it was shown that the strong antimicrobial activity of *L. rhamnosus* GG against *S. typhimurium* is due precisely to the accumulation of lactic acid [18]. The positive effect depends not only on the number of probiotic microorganisms in the product but also on the strain itself. The selection of strains according to their productive properties is an important aspect of the development of therapeutic and prophylactic products of probiotic value [19].

Lactic acid bacteria can inhibit the growth of pathogenic strains and improve human health [20], they are able to release various acids (formic, acetic, and propionic) [21-23].

The antimicrobial effect of lactobacilli is due to the complexity of their antagonistic properties and is determined by one of the important properties to produce lysozyme. Lysozyme-synthesizing strains acquire certain selective advantages in the intestine. Lysozyme used in medicine is a natural antibiotic [24].

Probiotic lactic acid bacteria strengthen the epithelial barrier by inducing mucin secretion [25], activating cytoprotective heat shock proteins [26-27], and preventing epithelial cell death [28].

B. adlescentis MC-42 strain was distinguished by high acid-forming activity. The strain has a complex of productive qualities (high resistance to phenol, bile, sodium chloride, acidic and alkaline reactions of the medium, high acid-forming activity, high antagonistic activity against pathogenic microorganisms) [29].

Lactobacilli produce lactic acid, hydrogen peroxide, volatile fatty acids, polysaccharides, acetaldehyde, diacetyl, carbon dioxide, some of which are used as antimicrobial drugs [30-31].

Propionic acid bacteria are used in the manufacture of cheeses. In the process of their vital activity, propionic acid and its salts are produced, which are mold antagonists [32].

Bacteriocins are a large family of peptides secreted by bacteria that have bactericidal activity and act against other strains of the same species or closely related species [33–34].

Lactic acid bacteria, which are part of fermented milk products, have a bactericidal effect against pathogenic and opportunistic microbes due to their ability to produce specific 15 antibiotic substances - bacteriocins [35]. Gueimonde M. and other authors note that they are immunomodulatory antibacterial complexes with thermal and acid resistance but differ from antibiotics by their sparing effect on normal microflora [36].

Lactic acid bacteria are producers of a huge number of antibiotic substances belonging to different classes of chemicals. The group of bacteriocins is the best-studied, since bacteriocins, due to their non-toxicity, are the most promising candidates for the development of a new generation of antibiotic drugs with probiotic properties [37]. Bacteriocins are in demand by the industry as safe and specific bio-preservatives [38-39]. Many bacteriocins of this group of bacteria have successfully proven themselves as bio-preservatives for fermented milk products [40–41]. The main directions of more effective use of bacteriocins in order to increase the shelf life of food products are in the use of their mixtures, the inclusion of bacteriocins in packaging materials, their combination with other preservatives. The effectiveness of bacteriocins is determined by the activity of their producers [42-43].

Bacteriocins from lactic acid bacteria are divided into two groups. Representatives of the first group are characterized by a narrow spectrum of antibacterial action - they cause the death of organisms close to the producer organism. This group includes lactocin B and F-27, amilovorin, pediocin N5P, thermophilin A, curvacin A, amilovorin 471, enterococcin. Bacteriocins belonging to the second group inhibit the growth of many types of gram-positive microorganisms, including *Listeria monocytogenes*, *Clostridium botulinum*, *Clostridium sporogenes*, *Staphylococcus aureus, Pediococcus acidilactici, Bacillus spp, Enterococcus faecalis* [44].

Producers of these bacteriocins are used as a starter culture in various food industries. The resulting bacteriocin ensures the dominance of the desired microflora and the suppression of extraneous microflora.

To obtain a starter culture in the manufacture of yogurt with new characteristics, *Streptococcus salivarius*, which forms bacteriocin, was used. The process of obtaining a starter culture based on the indicated bacteria in combination with *Lactobacillus delbrueckii* is described. It was noted that the product does not deteriorate during storage and transportation [45].

Nisin is licensed as a food preservative (E234) and is recognized to be safe by the Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Expert Committee on Food Additives [46].

Oral administration of *Lactobacillus acidophilus LB* to mice protected animals from *Helicobacter pylori* infection [47], the administration of *L. johnsonii LA1* supernatant to adult patients and schoolchildren with identified *H. pylori* carriers significantly improved their well-being and led to a significant value of urease production - a sign used to detect this pathogenic [48].

Lactic acid microorganisms such as lactobacilli, Lactis, and thermophilic streptococcus inhibit food spoilage and inhibit the activity of pathogenic bacteria while maintaining the nutritional properties of the product over a long shelf life [49-50].

Thus, antimicrobial compounds synthesized by lactic acid bacteria, which are used for the preparation of fermented milk products (drinks), are of scientific and practical value. When selecting promising strains for creating a fermented milk product based on them, the prophylactic value is the ability of lactobacilli to inhibit the growth and reproduction of pathogenic and opportunistic microorganisms.

Aroma-forming substances of lactic acid bacteria

Some lactic acid bacteria determine the aroma and taste of fermented milk products, such as aroma-forming streptococci (*Streptococcus diacetilactis*, *Streptococcus citrovorus*, and others), and form carbon dioxide, acids, and aromatic substances [32].

It was found that *Bifidobacterium lactis* achieves a high number of cells, which improve the taste of products and are resistant to an acidic reaction of the environment, as a result of which they have high

adhesive properties, i.e. survival in the gastrointestinal tract during microbial transformation [32].

Aroma-forming bacteria release in dairy products an increased number of volatiles, acids (acetic and propionic), and aromatic substances (esters, diacetyl). Mesophilic lactic acid streptococci provide active acid production and clot formation [51].

At present, lactobionic acid is of particular interest to scientists in the dairy industry. This is a new generation polyoxyacid, which is formed because of the oxidation of lactose disaccharide (milk sugar) and consists of galactose and gluconic acid molecules linked by an ester bond. Japanese scientists found that the acetic acid bacterium *Acetobacter Orientalis*, isolated from traditional Caucasian fermented milk, synthesizes lactobionic acid [52]. In the food industry, lactobionic acid is aimed at eliminating bitterness and improving the aroma, taste characteristics of starters, reducing the duration of fermentation of fermented milk products [53].

The exotic aroma and flavor of kefir, a refreshing feature, and slightly acidic taste are the result of the coexistence of yeast and LAB in a symbiotic association, and depend on the diversity of the microbiota of each kefir grain [54].

Aroma-forming bacteria are important in the formation of the taste, the pattern of the cheese due to the heteroenzymatic breakdown of milk lactose and citrates to form volatile organic compounds and CO2. Cheeses made with such starter cultures are distinguished by a more pronounced taste, aroma, and characteristic pattern with regular-shaped eyes.

These properties are especially inherent in microorganisms of the genus *Leuconostoc ssp*, which are capable of active production of carbon dioxide, diacetyl, acetic acid, and other flavoring and aromatic components. The use of leukonostoks in the composition of starter cultures for Dutch cheese is evidenced by the data on the relatively higher resistance of these microorganisms to bacteriophages, as well as on their transformation of acetaldehyde into ethanol, which prevents the formation of a sharp, tart aftertaste [55].

Consequently, from the above, it has been established that lactic acid bacteria contribute to the improvement of the organoleptic properties of a fermented milk product (drink).

Vitamin-forming ability of lactic acid bacteria

Bifidobacteria perform a vitamin-forming function, synthesize several essential amino acids, and improve the indicators of protein, lipid, and mineral metabolism [56].

Microorganisms *Streptococcus lactis 6* and *Streptococcus thermophiles K-2* synthesize two vitamins: pantothenic acid and biotin [57].

The presence in their cells of active components - glycoconjugates, which include various glycoproteins, polysaccharides, glycolipids, compounds with lipoteichoic acids and proteins, have immunostimulating and antitumor activity.

Sometimes probiotics are involved in processes that the human body cannot regulate. For example, replenishment of lactase deficiency indigestion [59].

Some species *(Propionibacterium shermanu)* are used to obtain vitamin B2 [32].

Many industrially important LAB such as *L. lactis* and *S. thermophilus* have the ability to synthesize folate [60].

A kefir product has been developed based on a combined starter culture of kefir fungi and propionic acid bacteria *Propionibacterium freudenreichii subsp. shermanii*. The invention makes it possible to increase the antibiotic and antimutagenic activity, increase the number of vitamins B1, B2, B6, and enrich the product with vitamin B12 [61-63].

From the analysis of literary sources, it was found that the revealed ability of certain strains of lactic acid bacteria to synthesize vitamins suggests the possibility of their use as starter cultures in the production of fermented milk probiotic products (drinks).

Adhesive properties of lactic acid bacteria

Among the important properties of probiotic microorganisms are adhesiveness or adhesive ability, which is a strain-specific trait. The ability of probiotic strains to attach to the intestinal epithelium depends on their ability to synthesize special substances - adhesins. These can be lectins or lectin-like compounds tightly bound to a bacterial cell, or protein-lipoteichoic complexes that are separated from the bacterial cell wall into the environment and protect epithelial cells from the fixation of pathogenic and opportunistic microbes on them [64-65].

Research by *Singh T.P. et al.* experimentally demonstrated that strains of the genus *Lactobacillus* exhibit adhesive properties that allow them to inhibit the adhesion of bacterial pathogens to host cells [66]. In a study by *Taverniti V.* and *Guglielmetti S.* it was shown that *L. helveticus* inhibits the adhesion of *E. coli* [67].

The presence of many adhesive factors allows bifidobacteria to dominate and compete with pathogenic microorganisms in intestinal microbiocenosis [68].

The adhesiveness of probiotic bacteria is one of their important properties, along with such properties as antagonistic activity against enteropathogens, immunomodulation, etc. [69].

The adhesiveness of bacterial cells is one of the mechanisms of protective action. Due to adhesion, lactic acid bacteria can successfully compete with enteropathogenic bacteria for binding receptors for epithelial cells of the mucous membranes [70].

It is known that spontaneously formed bacterial biofilms are characterized by high adhesive properties. Biofilms represent a natural immobilization of cells with colonization resistance [71-72].

Bacterial adhesion to epithelial cells is a complex multifactorial process that can include nonspecific physicochemical interactions or interactions between complementary molecules on cell surfaces. Complementary interactions, unlike physicochemical ones, form stronger bonds and provide irreversible binding of cells with epithelial cells [73]. These interactions are provided through adhesins, which in lactobacilli can be represented by teichoic and lipoteichoic acids of the cell wall [74], exopolysaccharides with an affinity for enterocyte receptors [75], or a whole complex of cell surface proteins [76].

Thus, highly adhesive bacteria that are part of fermented milk products (drinks), in comparison with bacteria with a low level of adhesion, are more efficiently fixed on the surface of colonocytes, reducing the likelihood of attachment of opportunistic microorganisms, stimulating the growth of intestinal normal flora, improving digestion and intestinal motility. Highly adhesive bacteria, in comparison with low-adhesive bacteria, are more effective in stimulating the phagocytic activity of immunocompetent cells that provide an immune response. All these factors have a positive effect on the growth and development of the whole organism, on its resistance to infectious agents, and provide a growth-stimulating effect.

The use of fermented milk products of prophylactic value enriched with lactic acid bacteria and vitamin and mineral substances

Analysis of the health status of the population in recent years shows a significant increase in diseases, which include obesity, diabetes, atherosclerosis, cardiovascular, oncological, and other diseases. The imbalance of macronutrients observed in the diet of most of the population, the deficiency of animal proteins, biologically active compounds, vitamins, and minerals complicates this problem and determines the relevance of the prevention and prevention of many diseases with the help of functional food products [77].

The main technology of functional food products is a modification of traditional products, providing an increase in the content of useful ingredients in their composition to a level corresponding to physiological consumption rates (10-15% of the average daily requirement) [78].

One of the most promising directions in the development of functional nutritional dairy products

is the use of probiotics and prebiotics in their composition, which have a positive effect on human health due to the formation and normalization of intestinal microbiocenosis. Of interest are products with synbiotic properties, enriched with the main representatives of normal intestinal microflora (bifidobacteria, lactobacilli, etc.) and containing prebiotic substances that selectively stimulate the growth and metabolism of probiotic microorganisms specific to the human body [79].

Fermented milk products contain extremely beneficial lactic acid bacteria. The most optimal are dairy products enriched with vitamins and microelements. They improve immunity, help fight colds and prolong life [80].

In many countries of the world, the effectiveness of fortification of food fortification with micronutrients has been proven. The joint work of scientists from the UK and Slovakia confirms that the regular use of a combination of probiotics (*Lactobacillus acidophilus* CUL21, *Lactobacillus acidophilus* CUL60, *Bifidobacterium bifidum* CUL20 at a concentration of 1.25x1010 CFU) and vitamin C can be used to prevent and treat upper respiratory tract infections in children 3 -6 years. Also, such a combination can lead to an improvement in the quality of life and a reduction in health care costs [81].

Scientists have developed formulations and technology for new types of drinks "Original" and "Pumpkin" with high probiotic properties and have carried out their experimental-industrial approbation in the conditions of Anmar Kft. NPF "SunLand" (Hungary) and UNIK "Technologist" of the Kuban State Agrarian University. And developed formulations and technologies for new types of desserts with bifidogenic properties based on fruit and vegetable purees, pectin, and sodium alginate; their experimental-industrial approbation was carried out in the conditions of LLC firm "Kaloria" (st. Staroderevyankovskaya, Kanevsky district) [82].

In Kazakhstan, because of experimental and analytical research, a technology to produce bio yogurt based on goat milk has been developed. The production process is carried out according to the traditional technology: preparation of raw materials, normalization, pasteurization, homogenization, cooling, fermentation, mixing, filling, filling, storage.

Mixed composition goat / cow milk (70/30) was warmed up to (35 ± 1) ° C, then normalized. The normalized mixture was pasteurized at (71 ± 2) ° C, cooled to the fermentation temperature of (40 ± 2) ° C, and the starter culture Bifidobacterium breve, *Bifidobacterium infantis, Bifidobacterium longum, Lactobacillus acidochillus, Lactobacillus bulgaricus, Lactobacillus paracasei, Streptococcus thermofillus*, pectin «GENU» type LM-106 AS-YA in the amount of 0.5%, the prebiotic lactitol in the amount of 1%. The mowing process was carried out within 6-8 hours. At the end of the fermentation process, flavoring fillers (pineapple, mango, kiwi) were added [83].

In the conditions of the laboratory "Microbiology and Biotechnology" InEU, a method to produce a fermented milk drink with prebiotics was developed (Patent RK No. 4271, class A23C 9/12, 04.09.2019). The objective of the present invention was to develop a method to produce a fermented milk synbiotic drink containing a prebiotic capable of stimulating the growth of beneficial microorganisms and ensuring their high survival rate in the human gastrointestinal tract. A fermented milk drink comprising pasteurized milk, a starter culture, a prebiotic, and a filler, according to the invention, contains Lactobacillus acidophilus and Streptococcus thermophilus as a starter culture, in a 1: 1 ratio, as a prebiotic - lactulose, a decoction of oats from whole grains, as a filler - natural jam from cherries [84].

Among the many lactic acid bacteria, the *L. acidophilus* 317/402 strain isolated by L.A. Yerzinkyan more than 50 years ago, based on which the fermented milk product "Narine" was further developed. "Narine" is used for medical nutrition, both for adults and children; the leaven is also useful for such diseases as tonsillitis, pneumonia, diabetes mellitus, infections after surgery [85].

The direction of development of dairy products with the use of whey and its constituents [86], fermented milk products with synbiotic properties, containing a complex of probiotics and prebiotics [87], with fructose [88], lactulose [89], oligofructose [90] and other functional additives.

Thus, the analysis of scientific literature on the development of combined therapeutic and prophylactic milk-based products (drinks) with the use of probiotics, vitamin-mineral premixes is an urgent area that is becoming increasingly popular on the market among consumers, being a source of many substances necessary for humans.

Conclusion

Summarizing the above, an actual approach for the search for new highly active strains of lactic acid microorganisms that are promising as ferments for obtaining fermented milk products (drinks) of probiotic value is the isolation of cultures of microorganisms from fermented milk products and the study of their antimicrobial and biological properties.

When selecting probiotic microorganisms to obtain a bioproduct, they must have the following properties: be non-pathogenic and non-toxic; maintain the stability of the composition and viability during the entire storage period; consist of living cells with a high adhesive and antagonistic ability to pathogenic and opportunistic microorganisms; do not suppress the normal intestinal microflora; have a pleasant smell and taste characteristic of lactic acid bacteria, and also enrich the product with vitamins.

The development and creation of new domestic starters in Kazakhstan based on strains of lactobacilli isolated mainly from local national dairy products are currently relevant and will qualitatively affect the general level of health of the local population.

Thus, the analysis of the literature data allows us to conclude that probiotic lactic acid bacteria have several positive qualities and are recognized as completely safe, which contributes to the overall health of the human body. This is due to a few antimicrobial properties (antagonistic and bacteriocin-producing activity), high adhesive activity, aroma-forming properties, and synthesis of vitamins. And, the development of combined fermented milk products (drinks) of prophylactic value using lactic acid bacteria enriched with vitamin and mineral substances is a promising direction for the development of the food production sector in Kazakhstan.

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Профилактикалық мақсаттағы ашытылған сүт өнімдерін өндіруде перспективалы сүт қышқылы бактерияларының негізгі биологиялық қасиеттері

Аңдатпа. Мақалада профилактикалық мақсатта ашытылған сүт өнімдерін (сусындар) өндіруде сүт қышқылы бактерияларын қолдану туралы ақпарат берілген. Пробиотикалық маңызы бар биоөнімдерді (сусындарды) алу үшін ашытқы ретінде перспективалы лактобактериялардың белсенді штаммдары іріктеліп, скрининг кезінде анықталатын сүт қышқылы бактерияларының маңызды микробқа қарсы және биологиялық қасиеттері ұсынылған. Әдеби көздерден жоғары антагонистік белсенділігі, жоғары бактериоцинді өндіру белсенділігі, жоғары адгезиялық белсенділігі, хош иісті қасиеттері және дәрумендер синтезі бар ашытылған сүт биопродукцияларын алу үшін ашытқы ретінде пайдалануда пробиотикалық сүт қышқылы бактерияларын қолданудың жоғары тиімділігі мен қауіпсіздігі атап өтілді. Осылайша, белгілі бір құрамы және қасиеттері бар ашытылған сүт өнімдерін жасау бойынша зерттеулер пробиотикалық штаммдарды қосу арқылы өнімге емдік және профилактикалық қасиеттер

береді. Негізінен, табиғи жергілікті ұлттық ашыған сүт өнімдерінен бөлінген сүт қышқылы бактерияларының штаммдары негізінде Қазақстанда жаңа отандық ұйытқыны әзірлеу және жасау, сондай-ақ, пробиотиктер мен витамин-минералды заттарды пайдалана отырып, аралас емдік-профилактикалық өнімдерді (сусындарды) әзірлеу Қазақстандағы өзекті бағыт болып табылады.

Түйін сөздер: сүт қышқылды бактериялар, пробиотиктер, антагонистік белсенділік, бактериоцин өндіру белсенділігі, хош иістендіргіш заттар, адгезия, ұйытқы.

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Основные биологические свойства молочнокислых бактерий, перспективных в производстве получения кисломолочных продуктов профилактического назначения

Аннотация. В данной статье представлена информация о применении молочнокислых бактерий в производстве получения кисломолочных продуктов (напитков) профилактического назначения. Представлены важные антимикробные и биологические свойства молочнокислых бактерий, по которым отбираются и выявляются при скрининге активные штаммы лактобактерий, перспективные в качестве заквасок для получения биопродуктов (напитков) пробиотического значения. В литературных источниках отмечена высокая эффективность и безопасность применения пробиотических молочнокислых бактерий при использовании в качестве заквасок для получения кисломолочных биопродуктов, обладающих высокой антагонистической активностью, высокой бактериоцинпродуцирующей активностью, высокой адгезивной активностью, вкусовыми ароматобразующими свойствами и синтезом витаминов. Таким образом, исследования по созданию кисломолочных продуктов с определенным составом и свойствами придадут продукту лечебно-профилактические свойства за счет включения в их состав пробиотических штаммов. Разработка и создание новых отечественных заквасок в Казахстане на основе штаммов молочнокислых бактерий, выделенных преимущественно из натуральных местных национальных кисломолочных продуктов, а также разработка комбинированных лечебно-профилактических продуктов (напитков) с использованием пробиотиков и витамино-минеральных веществ, являются актуальным направлением в Казахстане.

Ключевые слова: молочнокислые бактерии, пробиотики, антагонистическая активность, бактериоцинпродуцирующая активность, ароматобразующие вещества, адгезия, закваска.

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