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DEVELOPMENT OF A TECHNOLOGY FOR A NEW LACTIC ACID PRODUCT USING A MICROBIOLOGICAL CONSORTIUM

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This article examines the characteristics and methods of obtaining a new fermented dairy product derived from a microbiological consortium. In the agricultural sector, there is potential for using propionic acid bacteria and Lactobacillus acidophilus as probiotic microflora to enhance the productivity of fermented dairy products. In industrial production based on a microbiological concentrate, the study explores the interactions and methods for obtaining fermented dairy products such as Bifilife, acidophilic yeast, and their impact on growth and development. Improving the environmental conditions and economic potential of technological resources through microbiological consortia in the agricultural sector has led to an expansion of the range of specialized food products with a targeted, balanced composition and valuable nutrients in the food market. The study presents the structure and results of a new domestic fermented dairy product based on the use of a microbiological consortium (autoprobiotics, heteroprobiotics, and complex probiotics) in the zero-waste, integrated processing of dairy raw materials of animal origin. In modern conditions, there is a decline in public health due to an unfavorable environmental situation and the widespread use of antibiotics. The study of microbial consortia is considered one of the most relevant and promising issues for humanity.

Keywords: microbiological consortium, lactic acid, range, product, strain.

МИКРОБИОЛОГИЯЛЫҚ КОНСОРЦИУМДЫ ҚОЛДАНЫП, ЖАҢА СҮТҚЫШҚЫЛДЫ ӨНІМНІҢ ТЕХНОЛОГИЯСЫН ЖАСАУ

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Бұл мақалада микробиологиялық консорциумнан жаңа сүтқышқылды өнім алудың ерекшеліктері мен әдістері қарастырылады. Ауыл шаруашылығы саласында қолданылатын пропион қышқылы бактериялары мен lactobacillus acidophilus-ты пробиотикалық микрофлора ретінде ашытылған сүт өнімдерінің өнімділігін арттыру үшін қолдану мүмкіндігі қарастырылған. Микробиологиялық концорциум негізінде алынатын өнеркәсіптік өндірісте айран сияқты ашытылған сүт өнімдері, бифилайф, ацидофил ашытқыларының әрекеттесу ерекшеліктері мен алу әдістері және олардың өсуі мен дамуына әсері

зерттелді. Аграрлық сектордағы мақсаты микробиологиялық консорциум арқылы сүтқышқылының технологиялық ресурстарының экологиялық жағдайы мен экономикалық әлеуетін жақсарту болып табылады. Жануарлардан алынатын сүт шаруашылығы шикізатын қалдықсыз кешенді қайта өңдеуде микробиологиялық консорциумды (аутопробиотиктер, гетеропробиотиктер, кешенді пробиотиктер) пайдалану негізінде жаңа отандық сүтқышқылды өнімдерінің технологиясын әзірлеу сұлбасы мен нәтижелері көрсетілген. Азық-түлік нарығын зерттеу барысында мақсатты теңдестірілген құрамы мен құнды қоректік заттары бар арнайы тағамдардың ассортиментін кеңейтудің айқын тенденциясының өсу маңыздылығына ие. Қазіргі жағдайда экологиялық жағдайдың нашарлауына және антибиотиктерді кеңінен қолдануға байланысты халық денсаулығының нашарлауы байқалады. Адамның микробтық экологиясын зерттеу мәселесі ең өзекті және перспективалы болып саналады.

Негізгі сөздер: микробиологиялық консорциум, сүтқышқылы, ассортимент, өнім, штамм.

РАЗРАБОТКА ТЕХНОЛОГИИ НОВОГО КИСЛОМОЛОЧНОГО ПРОДУКТА С ИСПОЛЬЗОВАНИЕМ МИКРОБИОЛОГИЧЕСКОГО КОНСОРЦИУМА

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В этой статье рассматриваются особенности и методы получения нового кисломолочного продукта, полученного от микробиологического консорциума. В сельскохозяйственной отрасли предусмотрена возможность использования пропионокислых бактерий и Lactobacillus acidophilus в качестве пробиотической микрофлоры по повышению продуктивности кисломолочных продуктов. В промышленном производстве, полученном на основе микробиологического концентрата, изучены особенности взаимодействия и методы получения ферментированных молочных продуктов, таких как бифилаиф, ацидофильных дрожжей и их влияние на рост и развитие. Улучшение экологического состояния и экономического потенциала технологических ресурсов через микробиологический консорциум в сельскохозяйственном секторе в исследовании продовольственного рынка наблюдалась тенденция к расширению ассортимента специальных продуктов питания с целенаправленным сбалансированным составом и ценными питательными веществами. Показана схема и результаты иследования новой отечественной кисломолочной продукции на основе использования микробиологического консорциума (аутопробиотики, гетеропробио-тики, комплексные пробиотики) в безотходной комплексной переработке молочного сельскохозяйствен-ного сырья животного происхождения. В современных условиях наблюдается ухудшение здоровья населения в связи с опасной экологической обстановкой, и широким применением антибиотиков. Изучение микробного концорциума для человечества считается наиболее актуальной и перспективной проблемой.

Ключевые слова: микробиологический консорциум, молочная кислота, ассортимент, продукт, штамм.

Introduction

Currently one of the priority areas in the development of food technologies is the creation of products for functional purposes that can affect the human body. In addition, work coupled with the production of lactic acid products that combine compound components of the managed action of probiotics and prebiotics is becoming more and more pertinent.

In the last few decades, there has been a certain course in the food market to expand the range of supplemental food products that have a knowingly balanced composition and contain valuable nutrients. The total project covered the production of products that contribute to maintaining public health (actual nutrition) and reducing the progress of diseases (functional nutrition) [1]. Comparably with this direction, we are developing the technology of domestic lactic acid probiotic fermented milk drink.

In recent decades, domestic scientists U. Chomanov, M.K. Alimardanova, K.Zh. Zhangabylov, A.D. Serikbaeva, F.T. Dikhanbayeva, V.I. Ganina, N.B. Gavrilova, L.V. Golubeva S. Zobkova, G.D. Perfilev, G.M. Sviridenko have made a great contribution to

solving the problem of microbiological safety and quality of dairy products, as well as obtaining probiotics for functional nutrition.

Lactic acid bacteria are a key advantage of this taste, as fermented milk products contain essential nutrients in an easily digestible form, help normalize intestinal microflora, prevent dysbiosis, improve digestion, and strengthen the immune system. As a result, the creation of a group consortium of fermentation microorganisms, in which yeast prepared in pure cultures and living organisms from different taxonomic groups are combined, appears to be a promising method in lactic milk technology [2-6].

For the above reasons, we were prompted to explore a new innovative technology for obtaining propionic acid bacteria and Lactobacillus acidophilus for the microbiological consortium. To achieve this, we aim to harness the positive effects of yeast in the composite treatment of chronic hepatitis, coronary heart disease, hypertension, diabetes mellitus, and dysbiosis. Lactic acid fermentation is a key advantage of such a drink, as fermented milk products contain essential nutrients in an easily digestible form, help normalize intestinal microflora, prevent dysbiosis, improve digestion, and strengthen the immune system. As a result, the creation of a consortium of fermentation microorganisms, in which yeasts produced in pure cultures and beneficial bacteria from distinct taxonomic groups are combined, appears to be an emerging method in fermented milk technology.

In the production of probiotic fermented milk products based on complex yeasts, probiotic microorganisms should be adapted to technological conditions to ensure that, according to regulatory requirements, the content of probiotic microorganisms in the final food product is no less than 10° colony-forming units (CFU) per gram at the end of its shelf life [7-12].

The working theorem of our research covered the assumption that milk can serve as a further nutrient substrate for yeast microorganisms, which is shown in their increased activity. Since solitary microorganisms convey antagonistic and symbiotic properties relative to each other, it is mandatory to search for the ideal ratio and select unusual cultures that allow combining the positive properties of their application with modern and probiotic indicators.

Materials and research methods

Objects of research:

- lactic acid product
- thermophilic lactic acid culture (*Streptococcus thermophilus*);
- mesophilic lactic acid cultivations (combination of *Lactococcus Lactis* subspecies *cremoris, Lactococcus Lactis* subspecies *lactis, Leuconostoc mesenteroides cremoris, Lactococcus lactis* subspecies *lactis biovar diacetylactis*);
- genus Bacillus (*Lactobacillus acidophilus*);
- probiotic bacterium (*Bifidobacterium*);
- kefir grain yeasts.

As part of the research procedures, methods were used to characterize the nutritional and biological value as well as the safety of the studied materials.

As part of the study, we conducted research using the following methods to determine the physical and chemical indicators and the safety of low-fat cow's milk and lactic acid products:

Indicators such as purity group, bacterial composition, and milk acidity are assessed when determining the grade. According to GOST R 52054–2003, raw milk is classified into four categories: high, first, second, and non-grade.

The current areas of modern research include:

- ensuring the protection of dairy products;
- evolution of new types and strains of yeast with valuable and functional properties, primarily probiotic and symbiotic;
- development of directly introduced yeast biotechnology;
- optimization of bacteriophage control methods, especially in connection with the spread of polyphagia;
- development of methods and means of microbiological control, the need for which depends on the introduction of international systems for ensuring the quality of food products and the country's accession to the World Trade Organization.

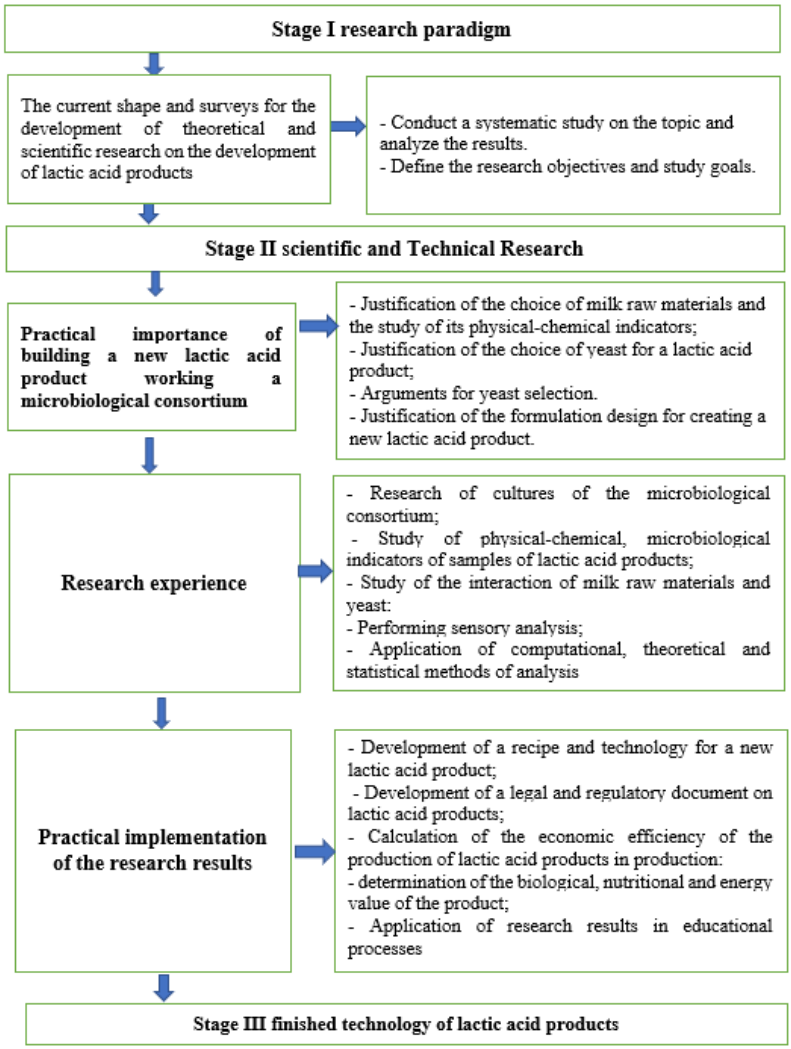

Figure 1. research scheme for creating a new lactic acid product using a microbiological consortium

The work of scientists shows that the first group includes microorganisms that are directly involved in the formation of the composition and properties and quality of dairy products. There, two subgroups are distinguished: industrial yeast microorganisms and microorganisms that cause defects in milk and dairy products.

This is due to the fact that there is very little useful information in the results of a published study on the mechanisms of gel formation due to the direct addition of acid to milk. Since the milk base for the production of fermented products is prepared differently and is subjected to homogenization and high-temperature processing, the properties of the gel formed as a result of fermentation can be different. Since a low heating rate was used in the study, the analysis concluded that due to the dependence of the results on factors such as pH and temperature, careful research is needed to determine the changes that are taking place.

In our testing, milk serves as a probiotic microflora through the use of propionic acid bacteria and *Lactobacillus acidophilus*.

The following interstate standards were used to determine physicochemical indicators:

1) GOST M-04-38-2009 to determine the amounts of amino acids;

2) GOST 3624-92 P. Titer acidity using the Turner method of 2 degrees;

3) Active acidity by GOST 3624-92 P.3;

4) The content of heavy metals was measured in accordance with GOST 30178-96;

5) GOST 5867-90. Milk and dairy products. Fat determination method;

6) GOST R 57079. Biotechnology. Classification of biotechnological products.

To obtain fermented milk drinks, whole and low-fat milk, cream, condensed and powdered

milk, sodium caseinate, kefir, and other dairy raw materials, as well as fruit and vegetable fillers, food flavors, dyes, sweeteners, structure stabilizers are commonly used.

There are two methods for producing fermented milk drinks: the tank method and the thermostat method. The technological process of beverage production using the tank method includes the following stages: preparation of raw materials, normalization, homogenization, and fermentation with bacterial bifid concentrate, with or without the use of stabilizers and lactic acid microorganisms. The product is produced with an oil content of 10%, 15%, 20%, 25%, and 30% by mass [13,14].

The biosynthesis of lactic acid drinks is carried out using both the tank and thermostat methods. For the production of sour cream, the following raw materials can be used: natural fresh milk, dried and plastic cream, kefir, and cow's butter. Normalized cream is prepared according to the product formulation and treated at a temperature of 86 ± 2°C for at least 10 minutes or 76 ± 2°C for 10 minutes when using powdered milk products, butter, or ductile cream. Decontamination is permitted at a temperature of 94 ± 2°C, after which the cream is homogenized (emulsified) at pasteurization temperature. Homogenization of the cream before pasteurization is also allowed.

For products with a fat content of 25% and 30%, partial homogenization of the cream is permitted [16-23]. Propionic acid bacteria or propionibacteria (lat. *Propionibacterium*) is a type of Gram-positive facultative anaerobic immobile bacteria that synthesize propionic acid in the metabolic process. *Propionibacterium* is usually found in the form of a sharp rod measuring 0.5-0.8 to 1.0-1.5 microns. Most often, depending on the conditions and cycle of development — coccoid, curved or club-shaped. *Propionibacterium* reproduces by dividing into two cells and does not form spores.

Propionic acid bacteria are agents of propionic acid fermentation, and in it the main products of carbohydrate agitation — propionic acid and its salts — propionates are formed. Propionic acid fermentation is similar to lactic acid fermentation when lactic acid bacteria (*Lactobacilli*, *Streptococci*, and other representatives of the command Lactobacillales) convert lactose, glucose, and other carbohydrates into lactic acid. In addition to propionic acid, propionic acid bacteria produce acetic acid, carbon dioxide, etc. [24-26].

Propionibacterium do not live in soil and water bodies, they are found in the gastrointestinal tract of ruminants, and often found in dairy products. The process of milk fermentation of *Propionibacteria* is very slow, it usually takes 5-7 days.

Most propionibacteria develop when the acidity values of the environment are below 5.0–4.5 PH. Propionibacterium tolerates only low partial oxygen pressure. The optimal temperature for their development is 30-35°C, at 60-70°c they die. In addition to sugar and lactic acid, Propionibacterium is able to ferment pyruvic acid, glycerin and other substances. They break down amino acids, breaking down fatty acids.

The World Gastroenterology Organization notes that there is evidence supporting the use of probiotics based on four strains: *Propionibacterium freudenreichii* ssp. shermanii, *Lactobacillus rhamnosus* GG, *Lactobacillus rhamnosus* LC705, and *Bifidobacterium breve* Bb99, in reducing certain symptoms of Irritable Bowel Syndrome (WGO, *Probiotics and Prebiotics*).

Propionibacterium Shermanii - 186 KM "Iodpropionix" and "Selenpropionix" are part of the domestic dietary supplements.

Results and discussion

The experiment was carried out at an optimal temperature (38 ± 1) °C, since at this temperature this microbial consortium has high biotechnological properties in a biological product. Studies have shown that in the bioproduct fermented by the consortium, phenol (0.4%), NaCl (6.5%), bile (40%) were constantly increasing, pH - 9.6. It was noted that the antagonistic activity of the microflora of the new product was preserved to a greater extent than in a bioproduct made by other yeasts than in pathogenic microorganisms**.**

Expected main results:

- conducting a literature review and patent research on the research topic;
- theoretical and scientific justification of the technology for the production of lactic acid products;
- selection of yeast cultures for making lactic acid products;
- selection of a recipe for making a lactic acid product;
- development of regulatory documents for the production of lactic acid products

In a scientific study, cow's low-fat milk was selected as a raw material for obtaining lactic acid products in a theoretical study. Naturally, skim milk was taken as the object of research.

Consequently, the shelf life of the new product "Control-1" was approved - 10 days. According to these studies, a new type of bioproduct has been developed. By introducing new products into production, the range of functional bioproducts increases, which increases the interest of the Kazakh population in probiotic products and meets their needs. In our research work, we found that propionic acid bacteria and *Lactobacillis acdophilus* are used as probiotic microflora. Studies show that propionic acid bacteria are used in Switzerland only in cheese production.

The peculiarities of interaction and methods of obtaining fermented milk products have been studied. The possibility of using propionic acid bacteria and *Lactobacillus acidophilus* as probiotic microflora to enhance the productivity of fermented dairy products in the agricultural sector has been investigated (Table 1).

Table 1. Results of the finished product sample

Quality indicators	Norm
Mass fraction of dry matter, %	14
Mass fraction of proteins, %	3,4
Adipose fraction of fats, %	1,7
Mass fraction of carbohydrates, %	3,5
Titratable acidity, ºT	65,85

The table shows the quality indicators of a sample of a lactic acid product. According to these parameters, the lactic acid product was prepared according to the standard. Samples of the new product meet the requirements of the standard, and other samples of the product are still being studied.

Conclusion

The challenge of studying microbial ecology in populations is considered highly relevant and promising. Given this, special attention has been paid to composite dairy yeasts and microbial consortia composed of diverse taxonomic groups, which are more resistant to adverse environmental factors and exhibit higher activity compared to yeasts cultivated from pure cultures. As a combination of distinct microorganisms, microbial consortia are less susceptible to the effects of phages, growth inhibitors, and other factors harmful to microorganisms. In the fields of bioengineering and industrial biotechnology, microbial consortia represent a key research focus that influences the pace of further development. In modern times, there is a degeneration in the health of the residents due to the deterioration of the environmental condition and the widespread use of antibiotics. The problem of analyzing microbial ecology is considered one of the most pertinent and promising. For this reason, microbial consortia composed of various taxonomic groups - resistant to adverse environmental conditions and exhibiting higher activity than yeasts obtained from pure cultures - deserve special attention. In bioengineering and industrial biotechnology, microbial consortia present a critical challenge that defines the trajectory of further advancements.

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DEVELOPMENT OF BEER TECHNOLOGY USING UNMALTED DOMESTIC RAW MATERIALS

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Currently, brewing is a leading industry in the beverage industry. The expansion of the product range, the use of new technologies, and modern equipment allows us to remain competitive in the market. For Kazakhstan, brewing is a new, modernized industry. The creation of new flavors and the use of non-traditional raw materials creates opportunities for obtaining beverages with enhanced biological properties. This study examines the possibility of using an unconventional grain crop of sorghum, in the form of non-malted raw materials of domestic breeding in beer production technology. The use of new types of grain crops makes it possible to obtain new beer profiles, as well as improve the functional properties due to individual components in the grain. The purpose of the study is to study the properties of sorghum grain of the domestic selection of the Kazakhstan- 16 variety and to develop beer technology based on it. A single-brewed mashing method has been selected, which is associated with the increased temperature of the sorghum grain gelatinization. The physicochemical properties, vitamin composition and antioxidant activity of the developed type of beer have been studied. The research was carried out at the NANO BREWERY TYPE 50 L4 microbrewery. The developed technology will make it possible to expand the range of products and produce beer with enhanced biological properties.

Keywords: brewing, beer, non-traditional raw materials, technology, sorghum, antioxidant activity.