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BIOTECHNOLOGICAL APPROACHES TO THE CREATION OF NEW FERMENTED DAIRY PRODUCTS

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ABSTRACT

The industrial production of balanced and healthy food has always been one of the most important tasks facing humanity. To solve this problem, research is relevant in the field of creating functional milk-based synbiotic products, which, along with traditional lactic acid microorganisms, include strains of probiotic bacteria with a proven specific positive effect on the macroorganism, and prebiotic substances that increase the selectivity of the benefits of the «useful» microflora of the gastrointestinal tract-intestinal tract and its biological activity.Along with lactic acid bacteria used as starters in fermented milk products, there is a population of predominantly adventitious heterofermentative lactobacilli that can have a positive effect on dairy products.This article describes the use of facultatively and obligately heterofermentative species such as *Lactobacillus bulgaricus*, *Streptococcus thermophilus* and *Lactobacillus fermentum 14*. The general characteristics of these species are described, as well as the desired properties (probiotic activity and taste formation) that affect the characteristics of dairy products.The general characteristics of these species are described along with the desired (probiotic activity and taste formation) properties affecting the characteristics of dairy products.Samples of yogurt based on probiotic starter cultures enriched with plant fillers were studied. The technological process of production was carried out in the traditional way. The dynamics of acid accumulation was studied, titratable and active acidity were determined. As a result of the study, it was revealed that the combination of fermented milk products with plant fillers slightly accelerates the fermentation process.

Keywords: goat milk; organoleptic indicators; taste formation; lactic acid bacteria; probiotics; plant fillers; dairy products.

INTRODUCTION

At present dairy goat farming in Kazakhstan is a slowly growing segment of the dairy market. Goat milk is more similar to woman's milk in structure, so there is a tendency to use goat milk instead of cow's milk for baby food production [1, 2].

One of the promising directions is the design of new types of starters and the development of technologies of dairy-based synbiotic products that include optimal compatibility of probiotic microorganisms consortiums.

Many strains of cultures used in the dairy industry refer to probiotics that have a stimulating and regulatory effect on the body, have antagonistic properties that affect pathogenic and conditionally pathogenic microorganisms of the gastrointestinal tract. These include lactobacilli (lat. *Lactobacillus*), a genus of gram-positive anaerobic non-sporulating lactic acid bacteria [3, 4].

It is advisable to use special types of lactic acid bacteria for making yogurt, which include *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. These bacteria stimulate each other and compensate for each other's metabolism. It is their combination that produces a finished product with the required organoleptic properties: the required viscosity, a sufficiently dense consistency, and a milky aroma and delicate taste [5-8].

Lactic acid bacteria (LAB) are characterized as gram-positive, bacilliform, acid-fast, facultative anaerobic or microaerophilic, and enzymatic. The efficacy of LAB as a probiotic agent is related to its ability to survive in stomach acid and bile salts (BS) and to attach to and colonize the intestinal mucosa [9]. Like many probiotic bacteria, lactic acid bacteria have either bactericidal or bacteriostatic properties. The direct antimicrobial activity of Lactobacillus species is due to the production of organic acids, bacteriocins, hydrogen peroxide, and low molecular weight compounds [10, 11].

Lactobacillus fermentum 14, isolated from goat milk and deposited in the Republican Collection of Microorganisms (Astana), was used as a probiotic culture, collection number of the strain is *B-RCM 1020*. Molecular genetic identification of the strain of the microorganism was carried out by sequencing the 16S rRNA gene according to Sanger. The search for homologous nucleotide sequences of the 16S rRNA genes were performed using the BLAST program (Basic Local Alignment Search Tool) in the International Gene Bank database of the US National Center for Biotechnology Information [12].

Lactobacillus fermentum, so named because it causes fermentation and is an obligate heterofermentative microorganism. It can be used as a probiotic culture and has been found in some types of cheese (Conte, Ragusano). *Lactobacillus fermentum* belongs to the *Lb. Reuteri*. *Lactobacillus fermentum* uses carbohydrates such as arabinose, galactose,cellobiose, maltose, mannose, melibiose, raffinose, ribose, sucrose, xylose and trehalose. The use of intestinal microbes as probiotics in food is aimed at preventing and treating various health problems. These health problems include allergies, tumor growth and inflammatory bowel disease [13].

Classic yogurt contains 11% sucrose. In this work, we replaced sucrose with syrups of plant origin, with the following objectives: enriching yogurt with biologically active substances of berry syrups and extract rich in resveratrol, as well as obtaining new products with probiotic properties of therapeutic and prophylactic purposes.

Of the berry syrups considered in the literature review, the choice is hawthorn, rowanberry, and rosehip syrups. The fourth plant filleris grape seed extract, which is rich in resveratrol. The choice of phytonaponifiers was determined on the basis of their chemical composition and biological value.

There is a growing demand worldwide for natural and sustainable environmentally compatible remedies for pathological conditions with health benefits that can supplement the daily diet or support or conventional pharmacological therapy. The main requirements for these products are: safety, minimum of unwanted side effects, better efficacy, greater bioavailability and lower cost compared to synthetic drugs available on the market. One such plant is hawthorn (*Crataegus* spp.).

Various parts of hawthorn, particularly the berries, flowers, and leaves, are rich in nutrients and have traditionally been associated with many therapeutic or nutraceutical health benefits [14], such as antimicrobial, anti-inflammatory, antioxidant, anticancer, and anticoagulant properties [15]. Because of the safety of this plant, the Committee on Herbal Medicinal Products (HMPC) ща the European Medicines Agency committee has classified hawthorn as a «traditional herbal medicine» [15, 16]

Hawthorn, also known as rowan, is mostly shrubs or trees and belongs to the genus *Sorbus* of the rose family, *Rosaceae.* Rowan has long been used as an anti-inflammatory, anti-diarrheal, diuretic and vasodilator. In folk medicine rowan berries are used to improve appetite, treat rheumatism and kidney diseases, as well as an excellent source of vitamins - ascorbic acid (vitamin C) [17-19].

Other basic phenolic acids (catechin, epicatechin, ferulic acid methyl ester, procyanidin B_1), flavonols (rutin, hyperoside, catechin, epicatechin, quercetin and isoquercetin), anthocyanins (mainly cyanidin glycosides) and proanthocyanidins were found in the water extract of mountain ash. Polyphenols found in rowan berries have strong antioxidant, antidiabetic, anticancer, antimicrobial and anti-inflammatory effects [20-23].

Resveratrol is a naturally occurring polyphenol (trans-3,4',5-trihydroxystilbene), has anti-inflammatory, antitumor and antioxidant properties that can be used in the fight against chronic diseases. The main sources of resveratrol are grapes (*Vitis vinifera L.*), various berries, peanuts, medicinal plants, and red wine [24].

It is known from the literature that due to their chemical composition, in particular the presence of dietary fiber, berries, in particular hawthorn and mountain ash, belong to prebiotics [14, 17]. Syrups of hawthorn and mountain ash fruits contain fiber, which, helps digestion by acting as a prebiotic. In addition, it can reduce the time of food passage through the digestive tract. Thus, it is relevant to create new synbiotic dairy products derived from probiotic strains with a wide range of antimicrobial activity and prebiotics of plant origin.

In order to solve this problem we carry out research on the development of functional dairy products with therapeutic and prophylactic properties. The purpose of this study is to select and justify the plant filler for obtaining fermented dairy products with pro- and prebiotic properties.

The obtained material was processed by the method of variation statistics using the Microsoft Excel 2000 software package. The results were considered significant at $p<0.01$, $p<0.05$.

MATERIALS AND METHODS.

Goat's milk of Zaanen breed of Almaty region was used for the study. A combination of strains *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus* (Danisco) and strain of lactic acid bacteria *Lactobacillus fermentum* 14, deposited in the Republican collection of microorganisms served as ferment.

Streptococcus thermophilus (Latin: *Streptococcus thermophilus*; also called *Streptococcus salivarius thermophilus* or *Streptococcus salivarius* subsp. *thermophilus*) is a species of gram-positive facultatively anaerobic bacteria. The cells of *Streptococcus thermophilus* are shaped like cocci (balls) arranged in long chains and belong to the α-haemolytic streptococci. *Streptococcus thermophilus* absorbs and processes lactose (milk sugar) and therefore is used in lactase deficiency, has an acidifying effect, providing a bactericidal effect against pathogenic microorganisms, and is also able to synthesize and release polysaccharides, which makes baby formula more dense and promotes the prevention and treatment of regurgitation.

Cultural and morphological features and physiological and biochemical properties of *Lactobacillus fermentum 14*: Gram-positive bacteria are medium-sized, bacilliform with rounded ends, arranged singly or in short chains (2-3 bacteria each), immobile; no capsule, membrane or flagella are formed; cell size is 0.5-1.5 µm. MRS forms medium-sized, white, round, convex colonies with a smooth edge on dense nutrient medium.

To improve the organoleptic and probiotic properties of the product, we used a combination of strains of *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subspecies *bulgaricus* and *Lactobacillus fermentum 14*, isolated from goat milk and deposited in the Republican Collection of Microorganisms (Astana). These microorganisms are characterized by symbiotic relationships. Str. thermophilus forms formic acid, which is required for the growth of *Lbc. Bulgaricum*, and this, in turn, releases amino acids necessary for the growth of *Str. thermophilus* and *Lactobacillus fermentum.*

To determine the number of lactic acid bacteria, dense MRS medium (deMan, Rogosa and Sharpe) was used and incubated at 37°C and 43°C for 48 hours. Cultures were taken from individual colonies about 1 mm in diameter.

Total bacterial infestation (reductase test, Number of mesophilic aerobic and facultative anaerobic microorganisms determination) was performed according to GOST 9225-84 «Milk and dairy products. Methods of microbiological analysis». The number of lactic acid bacteria in the samples of dairy products were determined according to GOST 10444.15-94. The method of limiting dilutions with subsequent calculation of the most probable number of lactic acid microorganisms was used.

Determination of belonging of isolated bacteria to lactic acid bacteria was carried out according to GOST 10444.11-89 «Food products. Methods for detection of lactic acid microorganisms» in relation to Gram staining, motility. Bacteria of the genus *Lactobacillus* included microaerophilic, gram-positive, bacilliform, immobile, non-sporulating microorganisms [25].

Sieving was performed from each dilution. The cultures were incubated for 2-3 days at 37°C under anaerobic conditions using anaerostats and Merck KGaA (Germany) gas-generating bags. Microscopy of bacterial culture preparations was performed using a Rathenow microscope.

RESULTS

At the initial stage, the total bacterial contamination of raw goat milk was investigated. The class of bacterial contamination of milk is presented in Table 1.

In our work we determined the effect of added plant filler (syrups of rosehip, hawthorn, rowanberry, and grape skin extract (resveratrol)) on organoleptic parameters of experimental samples. The control and experimental samples were prepared on goat milk with *Lactobacillus bulgaricus* and *Streptococcus thermophilus* starters. *Lactobacillus fermentum 14* isolated from goat milk was used as a probiotic.

The control was a classical yogurt with a concentration without a plant filler. Fillers (syrups) were added to the mixture of experimental samples in an amount from 1% to 9%, and grape skin extract in an amount from 0.5 to 2.5 g, which satisfies the daily requirement for resveratrol when consuming the product.

Syrups were added to the mixture of experimental samples from 1% to 9 % in steps of 2 %. Experimental data on the influence of plant fillers on organoleptic parameters of yoghurt are presented in Table 2, the data of organoleptic evaluation in points according to the tables in Figures 1 and 2.

As can be seen from Table 2, clear, dairy product flavor with a characteristic added plant filler, a pleasant smell, had samples with filler concentration from 1% to 5 %. However, an increase in the dose of plant filler over 5% led to a slight deterioration in the smell of the filler, while an increase in concentration over 6% led to a specific sugary taste with the smell of the filler. Thus, according to organoleptic indicators (taste and smel) the sample with the concentration of plant filler 5% was chosen. The effect of the concentration of rowan syrup on organoleptic indicators of dairy product is presented in Table 3.

The effect of rosehip syrup concentration on organoleptic characteristics of dairy product is presented in Table 4.

The effect of grape skin extract (resveratrol) concentration on organoleptic characteristics of dairy product is presented in Table 5.

As can be seen from the data in Tables 2-5, dairy product flavor with a pleasant berry smell had samples with filler (syrup) concentration from 1% to 5 %. However, an increase in the dose of plant filler over 5% resulted in a slight deterio-

Table 1- Class of bacterial contamination of milk

Name of samples	Method of testing	Duration of testing, h	Goat milk
Milk class			Ist class
Number of bacteria in 1ml (million)	Standard	Over 5.5	Up to 0.5

Table 2 - Effect of hawthorn syrup concentration on organoleptic parameters of dairy product.

Concentration of filler, %	Quality indicators	
	Taste and odor	Consistency
Control	Clear, dairy product	Homogeneous, viscous
1	Clear, dairy product	Homogeneous, viscous, light caramel color
3	Clear, sour, light odor of added syrup	Homogeneous, viscous, soft caramel color
5	Clear, sour, light odor of added syrup	Homogeneous, viscous, has a caramel hue
7	Clear, sour, you can smell the plant filler	Homogeneous, viscous, slightly brownish tinge
9	Acidic, with a faint taste and odor of added filler	Homogeneous, viscous, with a brown tint

Table 3 - Influence of ash syrup concentration on organoleptic indices of dairy product.

Concentration of filler, %	Quality indicators	
	Taste and odor	Consistency
Control	Clear, dairy product	Однородная,вязкая
1	Clear, dairy product	Homogeneous, viscous, creamy shade
3	Clear, sour, light odor of added syrup	Homogeneous, viscous, creamy color
5	Clear, dairy product, light odor of added syrup	Homogeneous, viscous, has a soft creamy hue
7	Clear, sour with a flavor of plant filler	Homogeneous, viscous, has a saffron hue
9	Dairy product, with a faint taste and smell of added filler	Homogeneous, viscous, with a dark orange hue

Table 4 - Effect of rosehip syrup concentration on organoleptic characteristics of dairy product.

Concentration of filler, %	Quality indicators	
	Taste and odor	Consistency
Control	Clear, dairy product	Homogeneous, viscous
1	Clear, dairy product	Homogeneous, viscous, orange tinge
3	Clear, sour, light odor of added syrup	Homogeneous, viscous, bright creamy hue
5	Clear, sour, light odor of added syrup	Homogeneous, viscous with a slight pink tint
7	Clear, sour with a flavor of plant filler	Homogeneous, viscous, dark pink hue
9	Dairy product, with a faint taste and smell of added filler	Homogeneous, viscous with a brownish-red tint

Table 5 - Effect of grape skin extract (resveratrol) concentration on organoleptic parameters of dairy product.

Concentration of filler, %	Quality indicators	
	Taste and odor	Consistency
Control	Clear, dairy product	Homogeneous, viscous
0.25	Clear, dairy product	Homogeneous, viscous, light caramel color
0.5	Clear, sour, light odor of added syrup	Homogeneous, viscous, light brown hue
0.75	Clear, sour with a flavor of plant filler	Homogxeneous, viscous, with a brown tint
1	Clear, sour, light berry smell	Homogeneous, viscous with a golden brown hue
1.25	Sour, slightly tart, with a subtle berry flavor	Homogeneous, viscous, with a richer brown hue

ration of the filler odor, and an increase in concentration over 6% resulted in a specific sugary flavor with a filler odor. For a fermented dairy product with grape skin extract (resveratrol), adding a 1% of plant filler was the best solution. Figure 1 shows the effect of the concentration of plant fillers (syrups) on the organoleptic characteristics of the dairy products. Figure 2 shows the effect of the concentration of plant filler (grape skins extract) on the organoleptic characteristics of the dairy product.

Also as a result of the studies it was found that the concentration of the filler does not have a significant effect on the consistency of the finished product. The samples were pasteurized and fermented under standard conditions.

Further two moments of introduction of plant fillers were investigated: before pasteurization in the normalized milk; after pasteurization before milk fermentation. Pasteurization of goat milk was carried out at 85-87 °C with a holding time of 15-20 seconds.

To determine the moment of addition of plant fillers (syrups and extract powder), the samples were prepared in two stages. At the first stage, the fillers were added to the normalized mixture before pasteurization, and at the second stage, after pasteurization, together with the starter. The control sample was produced without fillers. The technological production process was carried out in the traditional way. The dynamics of acid accumulation was studied, titratable and active acidity were determined. Data on titratable acidity of the control and experimental samples are presented in tables 6-9.

As can be seen from the data in tables 6-9, significant differences in the dynamics of acidity titration between the experimental samples with plant fillers introduced before and after pasteurization compared with the control sample were not observed. The dynamics of acidity accumulation in the control and experimental samples was similar. During 6 hours of churning the titratable acidity reached 78±3 °Th, active pH was 4.57±0.05.

The number of starter microorganisms was determined every hour during the process of fermentation. The researches were carried out in comparison with the control. The control

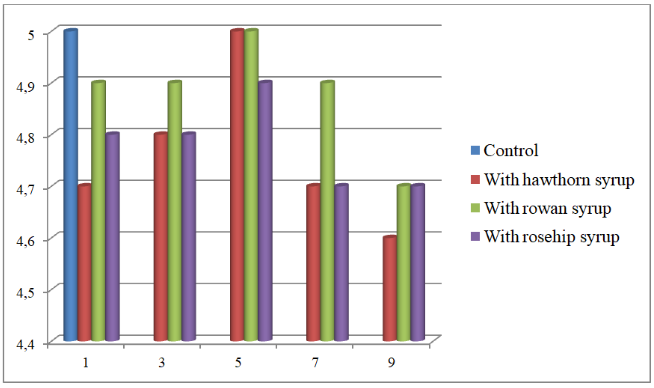


Figure 1 - Effect of the concentration of plant fillers (syrups) on the organoleptic characteristics of dairy product.

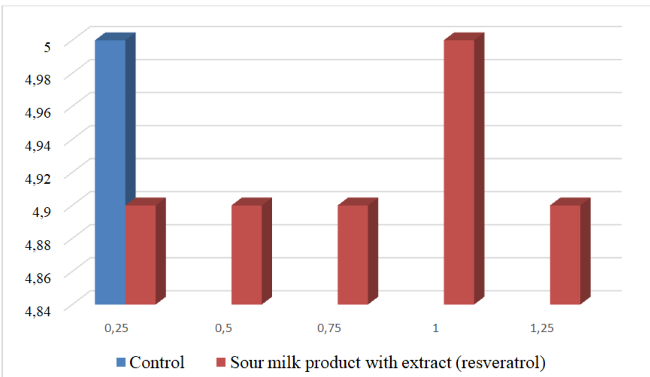


Figure 2 - The effect of the concentration of plant filler (grape skin extract) on the organoleptic characteristics of dairy product.

Table 6 - Dynamics of acidity accumulation with plant filler (hawthorn syrup) introduced before and after pasteurization.

Duration of the fermen-tation process	Control, °Th	Experimental sample with plant fillers added before pasteurization	Experimental sample with fillers added after pasteurization and plant fillers together with sturter culture, °Th
Before fermentation	20±0,46	20±0,34	20±0,42
After 1 hour	23±0,43	21±0,14	24±0,18
After 2 hours	27±0,18	25±0,16	29±0,21
After 3 hours	41±0,27	39±0,23	43±0,52
After 4 hours	62±0,11	60±0,41	64±0,34
After 5 hours	73±0,17	71±0,32	74±0,45
In 6 hours	75±0,25	73±0,12	76±0,47

Table 7 - Dynamics of acid accumulation with plant filler (rowan syrup) introduced before and after pasteurization.

Duration of the fermen-tation process	Control, °Th	Experimental sample with plant fillers added before pasteurization, °Th	Experimental sample with fillers added after pasteurization and plant fillers together with sturter culture, °Th
Before fermentation	20±0,46	20±0,24	20±0,32
After 1 hour	23±0,43	22±0,11	26±0,18
After 2 hours	27±0,18	26±0,18	31±0,27
After 3 hours	41±0,27	40±0,31	44±0,21
After 4 hours	62±0,11	61±0,56	65±0,32
After 5 hours	73±0,17	72±0,62	78±0,47
In 6 hours	75±0,25	74±0,36	80±0,53

Table 8-Dynamics of acid accumulation with plant filler (rosehip syrup) introduced before and after pasteurization.

Duration of the fermen-tation process	Control, °Th	Experimental sample with plant fillers added before pasteurization, °Th	Experimental sample with fillers added after pasteurization and plant fillers together with sturter culture, °Th
Before fermentation	20±0,46	20±0,18	20±0,24
After 1 hour	23±0,43	21±0,28	25±0,12
After 2 hours	27±0,18	26±0,23	32±0,27
After 3 hours	41±0,27	38±0,26	43±0,17
After 4 hours	62±0,11	60±0,38	66±0,4
After 5 hours	73±0,17	71±0,46	76±0,38
In 6 hours	75±0,25	73±0,57	81±0,52

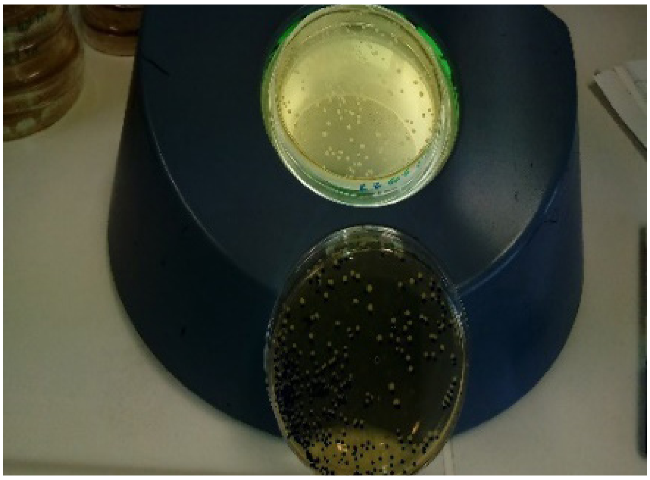
Table 9 - Dynamics of acid accumulation with a plant filler (grape skin extract) introduced before and after pasteurization.

Duration of the fermen-tation process	Control, °Th	Experimental sample with plant fillers added before pasteurization, °Th	Experimental sample with fillers added after pasteurization and plant fillers together with sturter culture, °Th
Before fermentation	20±0,46	20±0,23	20±0,12
After 1 hour	23±0,43	21±0,14	24±0,11
After 2 hours	27±0,18	25±0,32	30±0,24
After 3 hours	41±0,27	38±0,28	42±0,35
After 4 hours	62±0,11	60±0,23	64±0,54
After 5 hours	73±0,17	71±0,45	75±0,61
In 6 hours	75±0,25	73±0,56	78±0,57

Table 10 - Changes in the number of lactic acid microorganisms during fermentation.

Duration of fermentation	Control sample	Experimental sample with hawthorn syrup	Experimental sample with rowanberry syrup	Experimental sample with rosehip syrup	Experimental sample with grape peel extract
0	$1{\bullet}10^4$	$1{\bullet}10^4$	$1{\bullet}10^4$	$1{\bullet}10^4$	$1{\bullet}10^4$
1	$1{\bullet}10^5$	$1{\bullet}10^5$	$1{\bullet}10^5$	$5{\bullet}10^5$	$5{\bullet}10^4$
2	$1{\bullet}10^6$	$1{\bullet}10^6$	$5{\bullet}10^7$	$1{\bullet}10^5$	$1{\bullet}10^5$
3	$1{\bullet}10^6$	$1{\bullet}10^7$	$5{\bullet}10^8$	$1{\bullet}10^6$	$1{\bullet}10^6$
4	$1{\bullet}10^7$	$1{\bullet}10^7$	$5{\bullet}10^8$	$5{\bullet}10^7$	$5{\bullet}10^7$
5	$1{\bullet}10^8$	$1{\bullet}10^8$	$5{\bullet}10^9$	$5{\bullet}10^7$	$5{\bullet}10^8$
6	$1{\bullet}10^9$	$1{\bullet}10^9$	$5{\bullet}10^9$	$5{\bullet}10^9$	$5{\bullet}10^9$

sample was yogurt without the addition of a plant filler. The process of fermentation was carried out for 6 hours. Picture 1 shows colony counts on Petri dishes. The results are presented in Table 10.



Picture 1 - Counting colonies on Petri dishes.

DISCUSSION

The development of a combined dairy-vegetable yogurt is a promising direction and is of practical importance for the dairy industry. The results of the study show that the use of vegetable fillers has a positive effect on titratable acidity and on the organoleptic characteristics of finished products. The resulting fermented milk products will be used to expand the range of domestically produced fermented milk products enriched with biologically active substances of fillers.

Experimental studies have shown that the components introduced with vegetable fillers have practically no effect on the fermentation process. Since an increase in the dose of vegetable filler above 5% led to a slight deterioration in the smell of fermented milk products, and an increase in the concentration of fillers above 6% led to the appearance of a specific aftertaste with the smell of the filler, a dose of fillers of 5% was chosen.

CONCLUSIONS

The dynamics of acid accumulation and cell growth rate of lactic acid microorganisms in the control and experimental samples with plant fillers were similar, in 6 hours of fermentation the titratable acidity reached 78 ± 3 °Th, the number of microbial cells of starter by the end of fermentation reached $1\text{-}10^9$ cells/g. It was found that syrups and grape skin extract rich in resveratrol slightly accelerate the fermentation process. It is known that thermophilic streptococcus requires essential amino acids during the whole period of development. Apparently, due to the biologically active substances - iron, potassium, magnesium, vitamins A, E, C, B_1, B_2, PP and K, flavonoids introduced together with plant fillers, thermophilic streptococcus more actively synthesizes exopolysaccharides that have the ability to form viscous clots resistant to syneresis [11].

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ЖАҢА АШЫТЫЛҒАН СҮТ ӨНІМДЕРІН ЖАСАУДАҒЫ БИОТЕХНОЛОГИЯЛЫҚ ТӘСІЛДЕР

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АННОТАЦИЯ

Өнеркәсіпте теңгерімді және пайдалы тағамды өндіру адамзат алдында тұрған маңызды мәселелердің бірі болып саналады. Бұл мәселені шешу үшін дәстүрлі сүтқышқылды микроорганизмдермен қатар спецификалық оң әсері дәлелденген пробиотикалық бактериялардың штамдарын және селективтілігін арттыратын пребиотикалық заттарды қамтитын функционалды сүт негізіндегі синбиотикалық өнімдерді жасау саласындағы зерттеулер өзекті болып табылады. Пайдалы микрофлораның артықшылығы ас қорыту жолдары және оның биологиялық белсенділігі болып есептеледі. Ашыған сүт өнімдерінде ашытқы ретінде қолданылатын сүтқышқылды бактериялармен қатар сүт өнімдеріне оң әсер ететін гетероферментативті лактобактериялардың басым көпшілігі бар. Бұл мақалада *Lactobacillus bulgaricus, Streptococcus thermophilus* және *Lactobacillus fermentum* сияқты факультативті және міндетті гетероферментативті түрлерді пайдаланылуы сипатталған. Бұл түрлердің жалпы сипаттамалары сүт өнімдерінің сипаттамаларына әсер ететін қажетті (пробиотикалық белсенділік және дәмнің қалыптасуы) қасиеттерімен бірге анықталған. Өсімдік толтырғыштарымен байытылған пробиотикалық ашытқы негізіндегі йогурт үлгілері зерттелді. Өндірістің технологиялық процесі дәстүрлі түрде жүргізілді. Қышқылдың жиналу динамикасы зерттелді, титрленетін және белсенді қышқылдық зерттелді. Зерттеу нәтижесінде ашытылған сүт өнімдерін өсімдік толтырғыштарымен біріктіру ашыту процесін аздап тездететіні анықталды.

Түйінді сөздер: ешкісүті; органолептикалық көрсеткіштер; дәмнің қалыптасуы; сүтқышқылды бактериялары; пробиотиктер; өсімдік толтырғыштар; сүт өнімдері.

БИОТЕХНОЛОГИЧЕСКИЕ ПОДХОДЫ К СОЗДАНИЮ НОВЫХ КИСЛОМОЛОЧНЫХ ПРОДУКТОВ

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АННОТАЦИЯ

Промышленное производство сбалансированных и здоровых продуктов питания всегда было одной из самых важных проблем, стоящих перед человечеством. Для решения этой задачи актуальными являются исследования в области создания функциональных синбиотических продуктов на молочной основе, в состав которых, наряду с традиционными молочнокислыми микроорганизмами, входят штаммы пробиотических бактерий с доказанными специфическими позитивными эффектами на макроорганизм, и пребиотические субстанции, повышающие селективные преимущества «полезной» микрофлоры пищеварительного тракта и ее биологическую активность. Наряду с молочнокислыми бактериями, используемыми в качестве заквасок в кисломолочных продуктах, существует популяция преимущественно адвентивных гетероферментативных лактобацилл, которые могут оказывать положительное влияние на молочные продукты. В этой статье описано использование факультативно и облигатно гетероферментативных видов, таких как *Lactobacillus bulgaricus, Streptococcus thermophilus* и *Lactobacillus fermentum 14*. Общие характеристики этих видов описаны вместе с желательными (пробиотической активностью и образованием вкуса) свойствами, влияющими на характеристики молочных продуктов. Исследованы образцы йогурта на основе пробиотической закваски, обогащенные растительными наполнителями. Технологический процесс производства осуществляли традиционным способом. Исследовали динамику кислотонакопления, определяли титруемую и активную кислотность. В результате исследования выявлено, что комбинирование кисломолочных продуктов растительными наполнителями незначительно ускоряют процесс ферментации кисломолочных продуктов.

Ключевые слова: козье молоко; органолептические показатели; формирование вкуса; молочнокислые бактерии; пробиотики; растительные наполнители; кисломолочные продукты.