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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
АО «Институт топлива, катализа и
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Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Химия және технология сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Химия және технология сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді химиялық ғылымдар бойынша контентке адалдығымызды білдіреді.

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FRUIT-BERRY FILLERS IN THE PRODUCTION OF KAZAKH NATIONAL FERMENTED MILK DRINKS

Abstract. This paper offers investigation of fruit and berry fillers on the rheological properties of fermented milk drinks. The research was conducted as part of a scientific research effort. Local wild plants were used as fillers. This type of research allowed expanding the range of products at the enterprise and improving the organoleptic and nutritional properties of products. The purpose of this article is to find additional local vegetable raw materials as filler for fermented milk products. The importance of the results is that the data obtained can be used by specialists of dairy farms. During the period of coronavirus infection, when there were interruptions in the supply of raw materials, such directions it sets for future research as the development and improvement new food products by using local plant raw materials were revealed. The experimental samples of fermented milk drink from goat's milk with various fillers (tayberry, shadberry, black chokeberry and blackcurrant). The pH of the samples were measured with a pH meter (Exspert-pH, Russia). Total solids, protein, fat, ash, and titratable acidity were determined according to the methods described by the standard method. Goat's milk is subjected to ozonization for 10 minutes at an ozone concentration of 80 mg/m^3 before entering the container. The pasteurized goat milk (at 37 °C) was inoculated with freeze-dried culture bacterial starter culture (thermophilic lactic acid bacteria and bifidobacteria (*Breve B 10*, *Bifidobacterium adolescentis B 14*, *Bifidobacterium adolescentis B 37*) in the ratio 2:1 at 5 % inoculation level. The sensory aspects were undertaken using 10 panellists. The degree of influence of the introduced bacterial starter culture on the duration of fermentation of fermented milk beverages was studied by taking into account the rheological characteristics and structural and technological parameters. A mathematical model of the dependence of the strength and acidity of a fermented milk clot on the dose of fruit and berry fillers is constructed.

Key words: ayran, fermented milk drink, fruit and berry filler, goat's milk, mathematical model, ozonisation.

Introduction. Recently, there has been growing interest of knowledge on the technology of national dairy products and ways to improve them has strategic importance for the Kazakh people. Since ancient times, the Kazakhs-nomadic people cherished recipes of fermented milk products, for example, ayran and kurt saved from thirst and hunger, and also saturated the body with necessary micro and macroelements. Various types of milk from farm animals were used as raw materials: sheep, goats, cows, camels, and horses. However, the modern market of Kazakhstan is filled mainly with dairy products from cow's milk, most of them of foreign origin. The task of modern Kazakh scientists and dairy technologists is to preserve and improve the traditional and industrial methods of national dairy products production.

In Kazakhstan, goat breeding is the least developed livestock industry. The range of products produced from goat's milk is not significant, and goat's milk as a raw material is only partially developed. In Kazakhstan, there are only a few relatively large goat farms located in the Atyrau, Almaty, and Akmola regions. However, the prospects for the production and processing of goat's milk are vast due to the increase in consumer demand (Shunekeyeva, A. et al., 2019).

In recent years a growing number of publications focusing on fruit and vegetable additives. They are used in the form of syrups, concentrates or dry mixes to give fermented milk drinks a pronounced taste and smell of fruits, berries, and vegetables, as well as to provide them with an attractive appearance. Due

to these fillers, the content of vitamins, carbohydrates, and minerals in fermented milk products is regulated (Belokrinickaja et al., 2006) [1]. Fruits, berries, and vegetables are widespread in Kazakhstan. Of particular concern is reducing the cost of dairy raw materials.

Research in this area has shown that due to the presence of a wide range of bioactive nutritive components, berries are among the best-known dietary sources. Bioactive components in berries include phenolic compounds, flavonoids, and tannins apart from vitamins, minerals, sugars, and fibers. It has previously been observed that in addition to valuable phenolic compounds, berries contain natural compounds, including carbohydrates, essential vitamins, dietary fibers, and minerals. There are a large number of published studies (Bincy et al., 2017) that describe berries like rich in sugars with fructose being the main sugar form but are low in calories and lipids [2]. Fruits, especially berries, are excellent sources of natural antioxidants and represent an essential component of a healthy diet. Several studies have found consumption of fruits in an adequate amount reduces the risk of major chronic diseases like cancer, type 2 diabetes mellitus, obesity, and cardiovascular disorders (Skrovankova et al., 2015, Bincy et al., 2017) [2,3].

Tayberry is a cultivated shrub in the genus Rubus of the family *Rosaceae*, as a cross between a blackberry (*Rubus fruticosus L.*) and a red raspberry (*Rubus idaeus L.*). The fruits have high nutritional value and are a valuable source of vitamin C, flavonoids, folate, and fiber, with applications from food to the wine industry. These effects have been shown in research scientists (Zayova et al., 2016) [4].

Blackcurrant (*Ribes nigrum L.*) is a valuable berry in the human diet due to its high concentration of bioactive compounds and antioxidants that can be found mostly in berries. Blackcurrants possess a high antioxidant activity for which the phenolic compounds and ascorbic acid (AsA) make the major. AsA concentrations in blackcurrants surpass many other fruit and berry cultures, and its stability has been described to be more consistent due to the presence of anthocyanins and other flavonoids. Blackcurrant fruit use as dessert fruits and sweet berries are valuable ingredients for other tasty products with no need for additional sugars (Kikas et al., 2017) [5]. Black currant occupies one of the leading positions among berry plants in terms of the content of nutrients and bioactive substances that are necessary for a balanced human diet. Data from several studies suggest that black currant berries contain from 518.1 to 813.6 mg/100 g of bioflavonoids, including 20.6 mg/100 g of flavonols, 75.4 mg/100 g of phenol carboxylic acids, 233.8 mg/100 g of catechins and 335.1 mg/100 g of anthocyanins (Tikhonova et al., 2019) [6].

Shadberry (*Amelanchier*) fruits have excellent flavour attributes when consumed as fresh fruit or processed foods and have the potential to be an economically important fruit crop. The major classes of flavonoids in the fruit are flavonols (quercetin and rutin), flavones and, finally, anthocyanins. It has been established that the high content of the flavonoids antioxidants in the fruit is responsible for the observed anti-inflammatory, antidiabetic and chemo-protective effects. Consequently, shadberry has perspective potential in anticancer therapy and as an important antidiabetic agent (Jurikova. T et al., 2013) [7].

Black chokeberry fruits (*Aronia melnocarpa*) are used in the food industry for the production of juices, preserves, tinctures, fruit teas, and dietary supplements. Fresh, unprocessed black chokeberry fruits, however, are rarely consumed due to their bitter taste, resulting from the presence of a significant amount of polyphenols. It has been noted that black chokeberry fruit and products have a great health-promoting potential as they reduce the risk factors of the metabolic syndrome. Many studies showed the beneficial effects of black chokeberries in frequent co-morbidities such as dyslipidaemia, hypertension, obesity, glucose metabolism disorders, proinflammatory conditions and thrombosis risk. Black chokeberry has the probable potential to inhibit the development of various types of cancers; including leukaemia, breast, and intestinal cancer as well as cancer stem cells. Recent evidence suggests that black chokeberry can be considered as a promising component of novel food with increased biological potential (Sidor. A et al., 2019) [8]. According to the literature data, the berries contained more β-carotene (770.6 μg/100 g), dietary fibre (5.62 g/100g) than other fruits and berries. The content of β-cryptoxanthin (463.0 μg/100g) and polyphenol (748.4 μg/100g) in these was also high (Tanaka et al., 2001) [9].

Thus, from a technological point of view, fermented milk drinks are the most convenient for creating new products, including using natural vegetable raw materials. In conclusion, these studies show that fermented milk drinks with fruit and berry fillers are a source of vitamins, trace elements, amino acids, dietary fibre, pectin, and other substances that are useful for the human body.

Material and methods. The research was conducted based on LLP "Breeding farm "Zerenda" (Akmola region, Kazhymukan village). The goat milk was obtained from the goats of the Saanen. Breed with an average body weight of 52 - 54 kg. The animals were aged 3–4 years (second and third lactation). Milking was carried out mechanically. Each day's total milk yield was obtained by combining the same quantity of milk from morning and evening milking's.

Ayran manufacture. Experimental samples of fermented milk drink from goat's milk with various fillers:

- goat milk;
- bacterial starter culture (thermophilic lactic acid bacteria and bifidobacteria (*Breve B 10, Bifidobacterium adolescentis B 14, Bifidobacterium adolescentis B 37*)) in the ratio 2:1;
- plant fillers: 1 - tayberry (*Rubus fruticosus x Rubus idaeus*) 5% of the total weight; 2- shadberry (*Irga, Amelanchier*) 10% of the total weight; 3 - black chokeberry (*Aronia melanocarpa*); blackcurrant (*Ribes nigrum*), shadberry in the ratio 1:1:1(5% of the total weight).

Goat's milk is subjected to ozonization for 10 minutes at an ozone concentration of 80 mg/m^3 before entering the container. Fresh goat milk was pasteurized at 75 °C for 20 min using a plate heat exchanger (Sordi, Italy). The pasteurized goat milk at 37 °C was inoculated with freeze-dried culture bacterial starter culture (thermophilic lactic acid bacteria and bifidobacteria *(Breve B 10, Bifidobacterium adolescentis B 14, Bifidobacterium adolescentis B 37))* in the ratio 2:1 at 5 % inoculation level. The inoculated milk was immediately transferred to fermented milk containers and incubated at 37-39 °C until the pH decreased to 4.6 (about 6-8 h required).

Insertion of fruit-berry fillers: the mixture of fruit fillers was first cleaned, then chopped with a blender for 60 s, filtered from small seeds, and ozonated for 10 minutes before being added to the drink at an ozone concentration of 15 to 140 mg/m^3. Fermentation of these mixtures is carried out at a temperature of 37 ° C for 8-10 hours, ripening – for 6-8 hours, packaged, storage fermented milk drinks at the temperature 4±2 °C. The fermented milk from goat milk with added fruit-berry was transferred to a sterile plastic bottle with lids and stored at 6 °C for 15 days.

Physicochemical analysis. The pH of the samples was measured with a pH meter (Exspert-pH, Russia). Total solids, protein, fat, ash, and titratable acidity were determined according to the methods described by the standard method by GOST 32892-2014 Milk and dairy products. Method of pH determination [10].

The acidity of the samples was measured in accordance with the requirements of state standard GOST 3624-92 Milk and milk products. Titrimetric methods of acidity [11].

The samples of fermented milk drinks were measured in accordance with the requirements of GOST 9225-84 - Milk and milk products. Methods of microbiological analysis [12].

A number of 10 trained panellists selected from University staff members who consume fermented milk with fruit had previous taste panel experience rated the sensory properties of the fermented milk samples. Fermented milk samples were organoleptically examined according to the state standard method ST RK 1732-2007 Milk and milk products. Methods of sensory analysis [13]. Samples of fermented milk drinks in 100-mL cups were coded with numbers and presented to the panellists. The working conditions for all tasters were the same. The amount of product taken per definition is 5-10 g. The duration of holding the sample in the mouth is no more than 1.5...2.0 minutes. After evaluating each sample, the mouth was rinsed with warm drinking water to clean and refresh the taste and smell organs. Before the results were announced, each taster wrote down their rating and its justification in the tasting list, and then the average rating of the tasting commission was set.

Contingent viscosity measurements were taken at 20 °C with a simple method: by-product leaking time from a pipette (100 ml) with outlet diameter (5 mm). The time of the clot leaking (at the end of fermentation) should be at least 20 seconds. The average value of 5 measurements was taken.

Structural and mechanical properties. The method is based on measuring the maximum force at the moment of pushing the clot (ultimate strength) by an indenter moving at a constant speed. The device was invented by Siberian Scientific Research Institute (Russia).

The determination of the strength limit of a fermented milk clot reflects the structural and mechanical properties of the clot. The principle of operation of the device is based on the measurement of the strength

limit of the sour milk clot when the indenter is immersed in the sample. The measurement results (converted to grams) are displayed on the monitor screen, as well as recorded in the computer memory. Thus, this method of studying the process of fermentation of fermented milk drink is based on measuring the resistance that the indenter experiences when immersed in a sour-milk clot. A measuring device with a mechanical system and a control unit is connected by cable to a computer for data logging.

Necessary materials and equipment:

- samples of fermented milk drinks from goat's milk;
- indenter with a round working surface (40 mm);
- the program "Arduino";
- data logger;
- personal computer (Shunekeyeva et al., 2020) [14].

Statistical analysis. Mathematical processing of the experiment results was performed using a statistical method based on the software package "STATISTIKA" and Excel.

Results and discussion. ***Compositional analysis.*** Fat-normalized goat's milk for the fermented milk drinks production had pH =6.58, 20 °T titratable acidity, 1030 kg / m^3 density, 11.15 % total solids, 2.87-3.2 % protein, 1.0-3.0 % fat, 4.52 carbohydrates and 0.75 % ash.

The tayberry pulp mixed with the fermented milk drinks had pH=3.48, 1.2-1.5 % protein, 0.5-0.65 % fat, 4.4 – 11.94 % carbohydrates, and 0.46 % ash. The shadberry pulp mixed with the fermented milk drinks had pH=3.52, 24-28 % total solids, 0.3-1.0 % protein, 0.1-0.15 % fat, 11.0 – 12.9 % carbohydrates, and 0.53 % ash. The black chokeberry, shadberry, and black currant pulp mixed with the fermented milk drinks had pH=3.54, 20-28 % total solids, 0.3-1.0 % protein, 0.6-0.7 % fat, 8.0 – 12.7 % carbohydrates and 0.69 % ash.

The mean mass fraction of total solids in our study was 8.64. Fruit and berry fillers addition insignificantly increased the mass fraction of total solids in the fermented milk drinks from goat's milk.

Table 1 shows the chemical properties of fermented milk drinks from goat milk. Fruit–berry addition did not significantly affect the mass fraction of total solids in the fermented milk drinks. Increasing the mass fraction of plant fillers significantly reduced the mass fraction of fat in the fermented milk drinks reported in the literature.

Table 1 – Effect of fruit-berry fillers mass fraction on the chemical properties of fermented milk drinks from goat milk

Indicator	Tayberry (5%)	Shadberry (10%)	Black chokeberry, blackcurrant, shadberry (5%)
total solids	8.64±0.05	8.64±0.07	8.64±0.11
fat	1.0±0.02	2.5±0.01	2.5±0.04
protein	3.2±0.02	3.2±0.04	3.2±0.03
ash	0.85±0.01	0.95±0.02	0.87±0.02
carbohydrates	5.8±0.05	5.8±0.09	5.8±0.07

According to the results of microbiological studies (table 2), it can be concluded that the fermented milk drinks from goat's milk meet the requirements and the addition of fruit and berry components to the milk in an amount of up to 20% does not worsen the bacterial contamination of the finished product due to ozonisation.

Table 2 – Microbiological indicators of the fermented milk drinks from goat's milk

Indicator	Sample 1	Sample 2	Sample 3
KMAFANM,CFU/1.0g	$1*10^4$	$5*10^3$	$1*10^3$

To determine the fully sensorial profile the following attributes have been used: appearance, odour, taste, colour and consistency. Experiments have shown that it is economically feasible to use the amount of added fruit and berry fillers from 2 to 20 %.

Table 3 – Organoleptic indicators of control and experimental samples of fermented milk drink from goat's milk

Sample	Taste and odour	Consistency and appearance	Colour	By 10 point rating scale
Control	clean sour milk taste and smell	homogeneous, thick, viscous	white	7
№ 1	sweet taste of filler	viscous homogeneous, contains inclusions of the introduced filler	light pink	8
№ 2	sweet taste of filler	light grits, contains inclusions of the introduced filler	light purple	9
№ 3	sweet taste of filler	homogeneous, moderately viscous, contains homogeneous inclusions of the introduced filler	light purple	10

Table 3 shows the highest rating for organoleptic indicators of sample 3 that contains a mixture of berries (black chokeberry, shadberry and black currant).

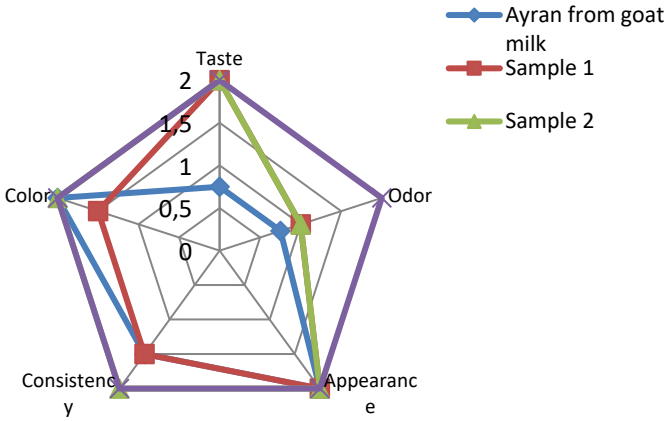

Figure 1 – Graphical representation of scores obtained for textural characteristic of ayran and fermented milk drinks from goat milk. Note – compiled by the author

The main advantage of using the ozonisation process is that ozone has high indicators in the fight against pathogenic micro flora. Thus, to suppress or prevent the occurrence of mould micro flora in fermented milk products, it is necessary to use ozonisation before using goat's milk and a mixture of fruit - berry fillers when adding to fermented milk drinks.

As a result of the experiments, the technology for the production of fermented milk drinks from goat's milk with fruit and berry fillers was compiled and tested in industrial conditions. Copyright is protected by a patent «Method of production of fermented milk drink analog of ayran from goat's milk».

Structural and mechanical properties. The change in titrated acidity during fermentation of fermented milk beverages distinguishes two main stages of the fermentation process (table 4, figure 2):

1) uniform accumulation of titrated acidity;

2) stabilization of the process.

At the initial stage of the fermentation process, there are favourable conditions for increasing the growth of lactic acid bacteria in fermented beverages. Further reduction of bacterial activity is associated with stabilization and alignment of the process.

Table 4 – Regression analysis of changes in titrated acidity during fermentation of control and experimental samples of fermented milk beverages

Samples	Linear regression equation		The coefficient of approximation	
	Titratable acidity	Active acidity	Titratable acidity	Active acidity
Control	y=20,4x – 9,4	y = -0,3506x + 6,4053	R^2=0,9106	R^2= 0,9584
№ 1	y=21,286x – 11,333	y = -0,272x + 6,5487	R^2=0,9123	R^2= 0,8815
№ 2	y=17,457x – 8,9333	y = -0,3531x + 6,3993	R^2=0,8494	R^2 = 0,939
№ 3	y=20,514x – 9,4667	y = -0,302x + 6,3853	R^2=0,9111	R^2 = 0,912

The linear regression analysis of changes in titrated acidity during fermentation (Table 4) allows us to draw the following conclusions:

- an increase in the duration of fermentation leads to an increase in titrated acidity, as evidenced by the sign (+) for these factors;
- an increase in the duration of fermentation leads to a decrease in active acidity as indicated by the sign (−) for these factors;
- the introduction of vegetable fillers does not reduce the speed of fermentation of fermented milk drinks;
- the approximation confidence value (R^2) is close to one, which allows an adequate search for optimal values of the factors of the studied processes (Kulazhanov et al., 2010) [15].

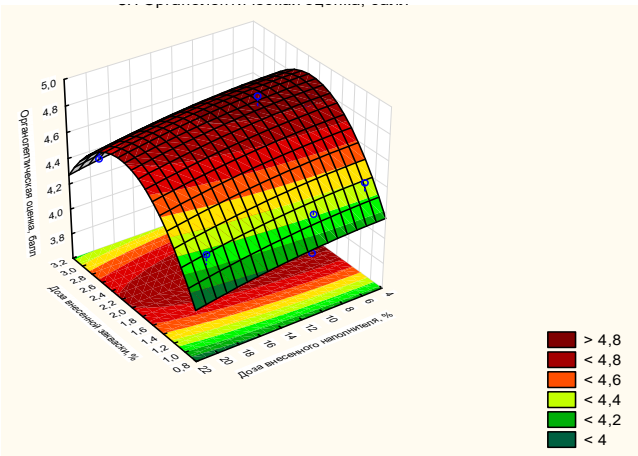

Figure 2 – Response surfaces of the dependence of the organoleptic evaluation of fermented milk drinks of the fillers and starter culture. Note – compiled by the author

Conclusion. The most obvious finding to emerge from this study is that the adding's of fruit-berry fillers to condensed goat milk promotes the expansion of the range; increase biological value of products for vitamins and minerals; to savings of raw milk by 20%. Correctly done processes of ozonisation of goat's milk and fruit-berry fillers provide an increase in the antibacterial properties of the finished product.

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ҚАЗАҚТЫҢ ҰЛТТЫҚ АШЫМАЛ СҮТ СУСЫНЫ ӨНДІРІСІНДЕГІ ЖЕМІС-ЖИДЕК ТОЛТЫРҒЫШТАРЫ

Аннотация. Жұмыста жеміс-жидек толтырғыштарының ашымал сүт сусынының реологиялық қасиеттеріне әсерін зерттеу ұсынылады. Зерттеу ғылыми зерттеу жұмысы аясында жүргізілді. Толтырғыш ретінде жергілікті жабайы шикізат пайдаланылды. Зерттеудің мақсаты – кәсіпорындағы өнімдердің түрлерін кеңейтуге және өнімнің органолептикалық және тағамдық қасиеттерін жақсартуға мүмкіндік беру. Мақаланың мақсаты – ашытылған сүт өнімдеріне толтырғыш ретінде қосымша жергілікті өсімдік шикізатын іздеу. Алынған нәтижелердің маңыздылығы қол жеткізген деректерді сүт өндірісінде мамандардың қолдануы айқындалады. Коронавирустық инфекция кезеңінде, шикізатпен қамтамасыз етуде үзіліс болған кезде, әрі қарайғы зерттеулердің бағыттары жергілікті өсімдік материалдарын қолдана отырып, жаңа тамақ өнімдерін әзірлеу және жетілдіру бойынша зерттеу бағыттары анықталды.

Әртүрлі толтырғыштары бар (ежемалина, ирга, қара жемісті шетен және қара қарақат) pH үлгілерінің ешкі сүтінен дайындалған ашытылған сусынның тәжірибелік үлгілері pH-өлшегішінің көмегімен өлшенді (Exspert-pH, Ресей). Қатты зат, ақуыз, май, күл және титрленетін қышқылдың жалпы мөлшері стандартты әдістермен анықталды.

Ешкі сүті ыдысқа құйылардан бұрын 80 мг/м^3 озон концентрациясы кезінде 10 минут бойы озонға ұшырады. Пастерленген ешкі сүті (37 °С кезінде) кептірілген бактериялық ұйытқының (термофильді сүт қышқылды бактериялар және бифидобактериялар (*Breve B 10, Bifidobacterium adolescentis B 14, Bifidobacterium adolescentis B 37*) 2:1 қатынасында 5% мөлшерде ферменттелген. Сенсорлық сипаттар пікірталас тобындағы 10 қатысушы арқылы жүзеге асырылды.

Енгізілген бактериялық ашытқының қышқыл сүт сусынының ашыту ұзақтығына әсер ету дәрежесі реологиялық сипаттамалар мен құрылымдық және технологиялық параметрлері негізінде зерттелді. Қышқыл сүт ұйытқысының күштілігі мен қышқылдығына жеміс-жидек толтырғыштары дозасына тәуелділігінің математикалық моделі жасалды.

Түйін сөздер: айран, ашымал сүт сусыны, жеміс-жидек толықтырғышы, ешкі сүті, математикалық модель, озонирлеу

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ПЛОДОВО-ЯГОДНЫЕ НАПОЛНИТЕЛИ В ПРОИЗВОДСТВЕ КАЗАХСКИХ НАЦИОНАЛЬНЫХ КИСЛОМОЛОЧНЫХ НАПИТКОВ

Аннотация. В данной работе предлагается исследование влияния фруктово-ягодных наполнителей на реологические свойства кисломолочных напитков. Исследование проводилось в рамках научно-исследовательской работы. В качестве наполнителей использовались местное дикорастущее сырье. Этот вид исследований позволил расширить ассортимент выпускаемой продукции на предприятии и улучшить органолептические и пищевые свойства выпускаемой продукции. Целью данной статьи является поиск дополнительного местного растительного сырья в качестве наполнителя для кисломолочных продуктов. Важность полученных результатов заключается в том, что полученные данные могут быть использованы специалистами молочного производства. В период коронавирусной инфекции, когда были перебои в поставках сырья, были выявлены такие направления дальнейших исследований, как разработка и совершенствование новых пищевых продуктов с использованием местного растительного сырья.

Экспериментальные образцы кисломолочного напитка из козьего молока с различными наполнителями (ежемалина, ирга, черноплодная рябина и черная смородина) pH образцов измеряли с помощью pH-метра (Exspert-pH, Россия). Общее содержание сухих веществ, белка, жира, золы и титруемую кислотность определяли по методикам, описанным стандартными методами.

Козье молоко перед поступлением в емкость подвергали озонированию в течение 10 минут при концентрации озона 80 мг/м3. Пастеризованное козье молоко (при 37 °С) ферментировали высушенной культурой бактериальной закваски (термофильные молочнокислые бактерии и бифидобактерии (*Breve B 10, Bifidobacterium adolescentis B 14, Bifidobacterium adolescentis B 37*) в соотношении 2:1 при 5% уровне внесения. Сенсорные свойства были проведены с использованием 10 участников дискуссионной группы.

Степень влияния введенной бактериальной закваски на продолжительность брожения кисломолочных напитков изучали с учетом реологических характеристик и структурно-технологических параметров. Построена математическая модель зависимости прочности и кислотности кисломолочного сгустка от дозы внесения фруктово-ягодных наполнителей.

Ключевые слова: айран, кисломолочный напиток, плодово-ягодный наполнитель, козье молоко, математическая модель, озонирование.

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