ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
С. Ж. Асфендияров атындағы Қазақ ұлттық медицина университеті

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Казахский национальный медицинский университет им. С. Д. Асфендиярова

N E W S

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
**Asfendiyarov
Kazakh National Medical University**

SERIES
OF BIOLOGICAL AND MEDICAL

1 (343)

JANUARY – FEBUARY 2021

PUBLISHED SINCE JANUARY 1963

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

«ҚР ҰҒА Хабарлары. Биология және медициналық сериясы».
ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)
Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).
Қазақстан Республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5546-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Мерзімділігі: жылына 6 **рет.**
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28; 219, 220 бөл.; тел.: 272-13-19
http://biological-medical.kz/index.php/en/

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

«Известия НАН РК. Серия биологическая и медицинская».
ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)
Собственник: РОО «Национальная академия наук Республики Казахстан» (г. Алматы).
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5546-Ж,** выданное 01.06.2006 г.

Периодичность: 6 раз в год.
Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28; ком. 219, 220; тел. 272-13-19
www:nauka-nanrk.kz / biological-medical.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of biology and medicine.
ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty).
The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan **N 5546-Ж**, is sued 01.06.2006.

Periodicity: 6 times a year.
Circulation: 300 copies.

Editorial address: 28, Shevchenko str. of. 219, 220, Almaty, 050010; tel. 272-13-19
http://nauka-nanrk.kz / biological-medical.kz

Address of printing house: «Aruna» ST, 75, Muratbayev str, Almaty.

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF BIOLOGICAL AND MEDICAL
ISSN 2224-5308
Volume 1, Number 343 (2021), 83 – 91 **https://doi.org/10.32014/2021.2519-1629.63**

UDC 637.07
IRSTI 65.63.03

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IMPROVING SENSORY AND QUALITY PROPERTIES OF YOGURTS FROM GOAT'S MILK

Abstract. Fermented milks, which are highly-consumed foods in the world and more nutritious compared to milk, have high contents of proteins, minerals and vitamins. In general, the overall properties of yogurt, such as acidity level, the production of aroma compounds as well as the sensory profile (appearance, color and texture), are important traits which have a decisive role in consumer acceptance of products.

Goat milk yogurts were manufactured with the supplementation of 5% cherries, 5% blackthorn fruits, and 5% mixture of two. Yogurts were characterized based on compositional, microbiological and safety properties of the added fruit pulp and sensory analyses during storage (15 d at 5°C). Compared with control samples yogurt made by using fruits and berries had higher protein content and sensory properties, but also higher acidity values. Goat milk yogurts without additions, in particular, had better physical characteristics. Using supplements caused the changing structure of yogurt, leading to higher syneresis values. Yogurt with mixed of two fillers was the best accepted among the yogurts. For the parameters used, a mix of cherries and blackthorn has promising features as suitable ingredients for goat milk yogurt manufacture.

The overall acceptability decreases when adding the non-roasted amaranth flour in a product. The main weakness of this study was the paucity of size of our panel (10 people). With a small sample size, caution must be applied, as the findings might not be transferable to show objective data.

Key words: blackthorn fruits; cherry; goat milk; nutritional value; sensory properties; yogurt

Introduction

Nowadays, goat products and milk are popular because of growing interest in healthy food consumption. Goat milk has hypoallergenic properties (Huang et al., 2020) [1]. However, goat milk flavor can stand an obstacle to development production of goat milk products. Characteristic goaty flavor give the lipase and lipolytic enzymes in goat milk. Goaty flavor is caused by caprylic, capric, and caproic acids. This is considerable to certain consumers who prefer cow milk to goat milk (Yang et al., 2015) [2]. Thus, in order to overcome the defects of goat milk product in terms of sensory characteristics, researchers proposed the addition of different fillers (Wang et al., 2019) by using different starter cultures (Mituniewicz–Małek et al., 2019) and technological methods (Costa et al., 2014) for reducing goaty flavour [3,4,5].

Prior studies have establish that fruits and vegetables contains essential vitamins, minerals, carotenoids and dietary fiber, polyphenols and can decrease risk for several chronic disease (Dauchet et al., 2006; Cooper et al., 2012) [6,7].

Cherries has two major types, the sweet (Prunus avium L.) and tart (Prunus cerasus L.) cherries (Ferretti et al., 2010), and contents significant amounts of important nutrients and bioactive food components including fiber, polyphenols, carotenoids, vitamin C, and potassium (McCune et al., 2011) [8,9]. Both types of cherries are good source of tryptophan, serotonin, melatonin and polyphenols (McCune et al., 2011; Commisso et al., 2017). According to the researches, consumptions of cherries may reduce of oxidative stress, inflammation, exercise-related muscle damage, arthritis, diabetes disease, sleep disorders [9, 10].

Blackthorn (*Prunus spinosa* L.) is a plant with phytotherapy and pharmaceutical properties, contains tannins, anthocyanins and is potential antioxidant, antibacterial and anti-inflammatory activity (Sabatini et al., 2020) [11].

According to some studies (Fraternale et al., 2009) blackthorn fruits considered as a potential food beneficial and supplementary source for food industries [12].

In the present study, the effects of addition cherries and blackthorn fruits on the safety indicators, rheology and sensory properties of goat yogurts were investigated.

Materials and methods

Microorganism and Materials

Goat milk was obtained from a goat farm in the Akmola Region, Kazakhstan. Freeze-dried DVS cultures (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* spp. *bulgaricus*) were used (YO-MIX 495, Danisco, France). The manufacturer's instruction was followed when using the culture. For each batch of yogurt base mixture (10 L), 0.2 g of starter culture was used.

Fruits and berries (1 kilogram each) were purchased from local market (Kokshetau, Kazakhstan). Safety indicators were determined, and then cherries and blackthorn fruits were classified, washed and dried. After separating seed from fruit manually were blended using by device Vitek VT 8525 (China). The 60% ratio fruit pulp ± 38% ratio sugar; with 2% corn starch was mixed and pasteurized at 90±5°C for 5 min, and filled into cleaned glass jars. The fruit pulp was stored at room temperature until used in yogurt production.

Goat Yogurt Manufacture

Yogurt samples were produced in a goat farm ("Zeren" Ltd, Akmola Region, Kazakhstan). Homogenization was applied to each different batch of mixture at 12±3 MPa at 67±3°C. Mixes were heated to 85°C for 5 min, rapidly cooled to 40°C, inoculated with yogurt culture at 37°C, with the addition of 5% fruits dispensed into 200 g of plastic containers and incubated for 6 h until the pH reached 4.7. Then yogurts were placed in cold storage at 6°C. Analysis of yogurt samples was performed at d 0, 5, 10, and 15 of cold storage (6°C).

pH and titratable acidity of yogurt

The pH values of the yoghurt samples from goat milk (10 g) were measured at 23±2°C using a pH meter (Expert, Russia) after calibrating with fresh pH 4.0 and 8.0 standard buffers. The titratable acidity was determined after mixing a yoghurt sample with 20 mL of distilled water and titrating with 0.1N NaOH. The measurement of the pH and titratable acidity of yogurts was determined according to GOST 31976-2012 [13].

Microbiological analyses

Lactic acid bacteria were counted according to standard method in triplicate on *medium sucrose* agar *(*GOST 10444.11-2013, 2015*). Subsequent serial dilutions were prepared and viable numbers enumerated using Petri dishes.* Coliform bacteria and E. coli were determined using Kessler's *medium* according to the state standard GOST 31747-2012 Food products. Methods for detection and quantity determination of coliforms (GOST 31747-2012, 2013). Petri dishes were incubated aerobically at +37 °C for 48 h [14, 15].

Syneresis

The level of spontaneous whey separation in yogurt samples (syneresis) was determined using visual and instrumental method. Approximately 100 ml of the yogurts samples was separated and the coagulum was weighed during storage at 6°C. The whey was weighed and the syneresis was expressed as the percent weight of the whey separated from the yogurt over the initial weight of the coagulum. Syneresis was determined by the amount of whey released when filtering 100 ml of the destroyed clot through a paper filter for a time at room temperature. Double determinations were carried out.

Safety indicators

The determination of the safety indicators was carried out according to the GOST 33823-2016 Frozen fruits. General specifications. Mass fraction of toxic elements was determined by GOST 26927-86. Berries are washed with running water, removed inedible parts of products. To determine the mass of the measured sample, the cuvette is weighed before and after it is filled. Colorimetric determination of mercury is performed by visually comparing the color of the sediment in the test tubes with the color of the sediment in the tubes of the calibration scale. To do this, the tubes are positioned at an angle of 25-30° so that the sediment remains at the bottom of the tube, and the supernatant moves to the plug. The preparation of fruits samples for analysis of toxic elements and radionuclides was carried out according to standard methods: GOST 31976-2012, 2014; GOST 33823-2016, 2018; GOST 26927-86, 1990; GOST 32161-2013, 2014; GOST 32163-2013, 2014; GOST 26933-86, 1986; GOST 26932-86, 1986; GOST 31628-2012, 2013 [16-22].

Sensory analyses

The panellists were chosen up of 10 members of the Polytechnical faculty (Department of Engineering and Transportation, at the Sh. Ualikhanov University Kokshetau, Kazakhstan). Sensory evaluation of the 3 samples of cherry, blackthorn and mix of them (cherry+blackthorn) yogurts (S1, S2, S3 respectively) was conducted by 10 untrained taste panelists between the age of 27 to 55. Each panelist received 3 samples at each serving. The samples were placed in uniform disposable plastic cups that did not impart any flavor or odor to the products. The panelists were asked to indicate their frequency of yogurt consumption and evaluate appearance, flavor, texture, and overall quality of the samples using a hedonic scale of 1 to 9. The hedonic scale had 9 categories, and each point on the hedonic scale was assigned a value ranging from 9 (like extremely) to 1 (dislike extremely). All panelists gave written informed consent to participate in the study (Hekmat et al., 2006) [23].

Statistical Analysis

For statistical analysis, one-way analysis of variance (ANOVA) Statistica (Statsoft, Russia) was performed on the 4 batches and the corresponding replicates. All tests were performed at $p = 0.05$.

Results

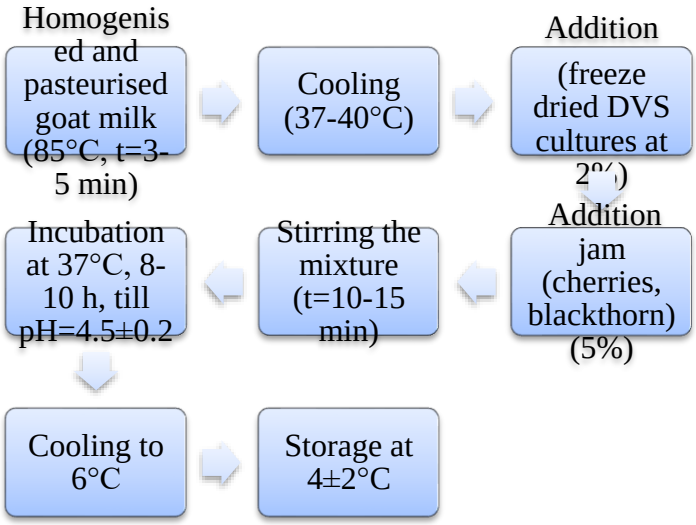

Figure 1 - Flow diagram for the preparation of yoghurt with berries from goat milk

Changes in titratable acidity and pH

The changes in titratable acidity (TA) and pH in yoghurt are illustrated in Figure 2. The initial TA (titratable acidity) of goat milk (20°T) increased to 97° - 100° T in yoghurts made from fruits and berries S1, S2 and S3, and to 75°T for control C at 0 d. After 5 d at 4°C the TA increased to 0.96-0.97% for yoghurts made with fruits and berries S1, S2 and S3, and to 0.97% for control yoghurt (C). This increase might be attributed to the residual fermentation changes and actions of acids and substances found in fruits and berries. The increase in TA was maximal for samples S1, S2 and S3, (0.6-0.7%) for these yogurts as compared with control C (0.97%). However, the final TA remained lower in the yoghurt made without addition. The overall increase in TA after 5 d storage at 4°C was similar to that of storage for up to 15 d for all the yogurts studied.

The initial pH of milk (6.5-6.6 at 0 h) decreased to 4.6-4.7 for samples S1, S2 and S3, and to 4.6 for C at 0 d. The initial pH of milk (6.50-6.60 at 0 h) decreased to 4.60-4.70 for samples S1, S2 and S3, and to 4.60 for C at 0 d. The decrease in pH was obviously due to continued fermentation during overnight cooling till the temperature of the product reached 4°C. The gradual decrease in the pH was observed throughout the storage period of 15 d. The trend was identical for all the starter cultures, similar to that observed for TA (Figure 2). After 15 d storage, the pH dropped to 4.16-4.22 for yogurts S1, S2, S3, and 4.4 for control C and to 4.30 for S3. The drop in the pH was almost the same for all yogurt samples. There was slight difference in pH values at 4°C. These results are consistent with data obtained in some published studies (Wang et al., 2019; Huang et al., 2020).

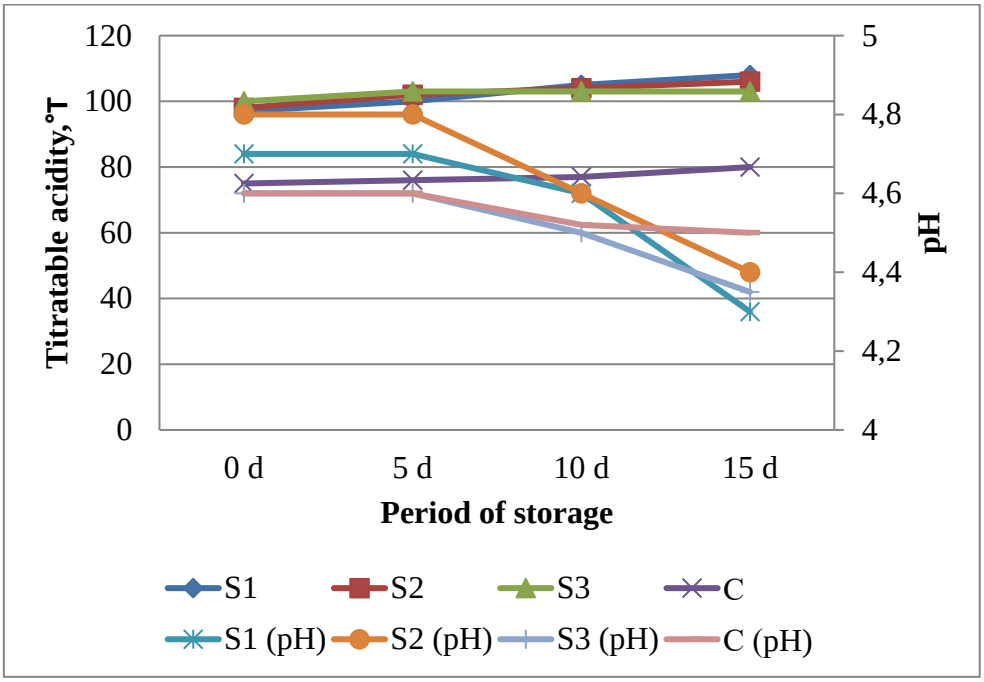

Figure 2 - Changes in titratable acidity and pH in yoghurt samples from goat milk
S1, S2, S3 – samples of yogurts with berries, C – control sample

Microbiological analyses

All strains were more than 1×10^6 cfu/g. Determining counts of strains that were evaluated in this study is given in table 1. Observations taken during 15 d storage of the product at 5°C.

Table 1 - Viable counts of *Streptococcus thermophilus* and *Lactobacillus delbrueckii ssp. bulgaricus* strains after 15 day-storage (cfu/g)

Sample	Streptococcus thermophilus	Lactobacillus delbrueckii ssp. bulgaricus
S1 (5% cherries)	29×10^7	19×10^7
S2 (5% blackthorn berries)	91×10^7	14×10^7
S3 (5% mixture of cherries and blackthorn)	126×10^7	25×10^7
C	44×10^6	10×10^6

Safety indicators

The concentrations of toxic elements (Pb, Cd, As, Hg) were very low. Table 2 shows the summary results of safety indicators the level of which not exceed the legal limiting mass fraction value.

Table 2 - Safety indicators of fruits and berries

Indicators	**Test method**	**Results**
Pb	GOST 26932-86	0.01
Cd	GOST 26933-86	0.01
As	GOST 31628-2012	less than 0.002
Hg	GOST 26927-86	less than 0.002
Cesium -137	GOST 32161-2013	0.33
Strontium -90	GOST 32163-2013	0.05

Sensory analyses

Organoleptic parameters of prepared with fruits samples of yogurt from goat milk are given in Figure 3.

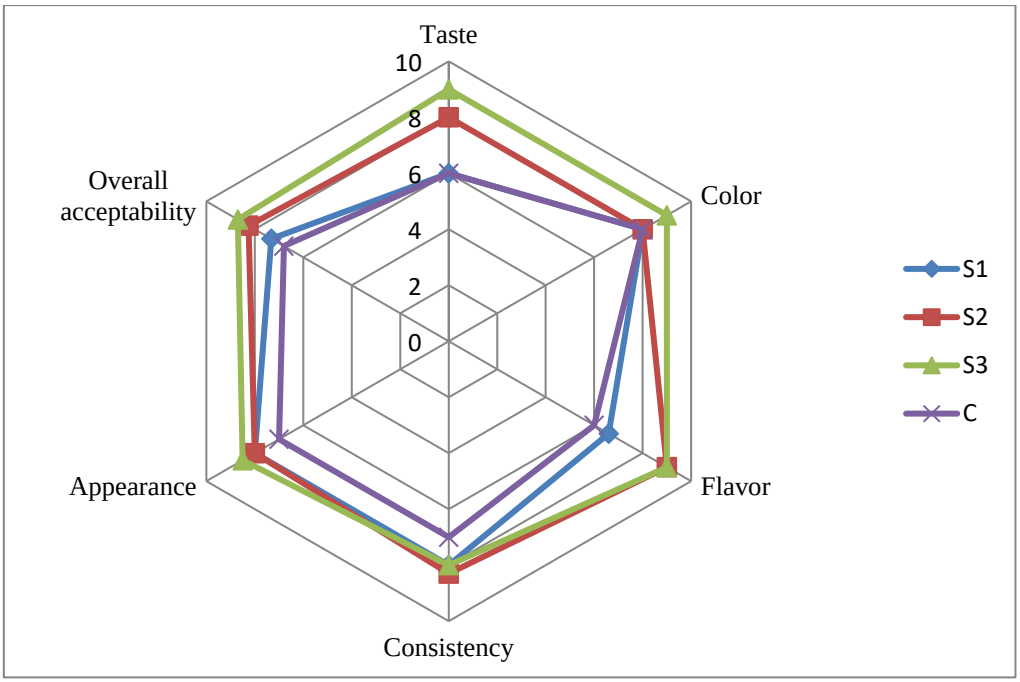

Figure 3 - Sensory profiles of the yogurt samples from goat milk

The preferred formulation was 12% (by weight) yogurt sample S3. The mean appearance scores for all samples were 7.0 or higher (Figure 3).

Discussion

The hedonic score of majority corresponds were much liking of the samples and moderate liking of the control sample. The addition of these berries did significantly alter the mean appearance score of samples S1, S3 compared with control C. The mean appearance score of S3 was significantly higher ($P < 0.05$) than S1 and S2.

The higher preference of S3 could be due to relationship of mixed berries of this sample, which may have produced a better sensory characteristic. There were no significant appearance differences ($P < 0.05$) among S1, S2, and S3 (Figure 3). These results indicate that the addition of chosen fruits did not affect the appearance of the yogurt. However panelists liked S3 samples more than the other 2 samples, the mean scores were very similar, and control yogurt had a less scores.

Conclusion

The results showed that various fruits can be used for manufacturing yogurt from goat milk with improved sensorial quality. Yogurts fortified with mix of cherries and blackthorn fruits had more viscous structure and lower syneresis than that yogurt supplemented with fruit pulp of cherries. Adding of fruits in general did not improve the textural characteristics of the final product.

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ЕШКІ СҮТІНЕН ЖАСАЛҒАН ЙОГУРТТАРДЫҢ СЕНСОРЛЫҚ ЖӘНЕ САПАЛЫ ҚАСИЕТТЕРІН ЖАҚСАРТУ

Аннотация. Әлемдегі ең көп тұтынылатын өнімдерінің бірі қышқыл сүт сусындары және де сүтпен салыстырғанда қоректік заттары, ақуыздары, минералдары мен дәрумендері бай. Йогурттың қышқылдық деңгейі, хош иісті қосылыстар, сондай-ақ сенсорлық көрсеткіштері (сыртқы түрі, түсі және құрылымы) сияқты жалпы қасиеттері тұтынушының өнімді қабылдауында ерекше рөл атқарады және маңызды белгілер болып табылады.

Ешкі сүтінен жасалған йогурттар 5% шие, 5% тікенді қараөрік және 5% екеуінің қоспасы қосылған. Йогурттар қосылған жеміс целлюлозасының композициялық, микробиологиялық және қауіпсіз қасиеттері және сақтау кезінде сенсорлық талдау негізінде сипатталды (15 күн 5°С температурада). Бақылау үлгілерімен салыстырғанда, жемістер мен жидектерді қолдану арқылы дайындалған йогурт ақуызға және сенсорлық қасиеттерге ие болды, сонымен қатар қышқылдық деңгейі жоғары болды. Ешкі сүтінен жасалған йогурттар, атап айтқанда, физикалық сипаттамалары жақсы болды. Қоспаларды қолдану йогурт құрылымының өзгеруіне әкеліп соқты, бұл синерездің жоғары мәндеріне әкелді. Йогурттар арасында екі толтырғыш қоспасы бар йогурт жақсы қабылданды. Қолданылатын параметрлерге сәйкес, шие мен тікенді қараөрік қоспасы ешкі сүтінен йогурт өндіруге қолайлы ингредиенттер ретінде перспективті қасиеттерге ие.

Зерттеудің басты әлсіздігі - біздің топтың аз болуы (10 адам). Іріктеменің көлемі шағын болған кезде сақ болу керек, өйткені алынған нәтижелер объективті деректерді ұсыну үшін қолайсыз болуы мүмкін.

Түйін сөздер: тікенді қараөрік; шие; ешкі сүті; тағамдық құндылығы; сенсорлық қасиеттері; йогурт.

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УЛУЧШЕНИЕ ОРГАНОЛЕПТИЧЕСКИХ И КАЧЕСТВЕННЫХ ХАРАКТЕРИСТИК ЙОГУРТОВ ИЗ КОЗЬЕГО МОЛОКА

Аннотация. Кисломолочные напитки являются наиболее потребляемыми продуктами в мире и более питательными по сравнению с молоком, имеют высокое содержание белков, минералов и витаминов. В целом, общие свойства йогурта, такие как уровень кислотности, ароматические соединения, а также сенсорный профиль (внешний вид, цвет и текстура), являются важными признаками, которые решающе влияют на восприятие потребителем продуктов.

Йогурты из козьего молока изготавливались с добавлением 5% вишни, 5% плодов терна и 5% смеси из двух плодов. Йогурты характеризовались на основе композиционных, микробиологических и безопасных свойств добавленной фруктовой мякоти и сенсорных анализов при хранении (15 дней при 5°C). По сравнению с контрольными образцами йогурт, приготовленный с использованием фруктов и ягод, обладал более высоким содержанием белка и сенсорными свойствами, но и более высокими значениями кислотности. Йогурты из козьего молока без добавок, в частности, имели лучшие физические характеристики. Использование добавок вызывало изменение структуры йогурта, что приводило к более высоким значениям синерезиса. Йогурт со смесью двух наполнителей был лучше всего принят среди йогуртов. По используемым параметрам смесь вишни и терновника имеет перспективные свойства в качестве подходящих ингредиентов для производства йогурта из козьего молока.

Главной слабостью этого исследования была малочисленность нашей группы (10 человек). При небольшом объеме выборки следует проявлять осторожность, поскольку полученные результаты могут быть неприемлемы для представления объективных данных.

Ключевые слова: плоды терна; вишня; козье молоко; пищевая ценность; сенсорные свойства; йогурт.

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ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)

http://biological-medical.kz/index.php/en/

Редакторы: *М.С. Ахметова, Д. С. Аленов, А. Ботанқызы*
Верстка на компьютере *Зикирбаева В.С.*

Подписано в печать 15.02.2021.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
4,6 п.л. Тираж 300. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19