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Technology of receiving of high-quality shubat from camel milk with a long period of storage

The article describes experiments into optimal modes of sterilization for obtaining high-quality shubat from camel milk, taking into account time and different temperature conditions, with maximum preservation of physical, chemical, nutritional properties and energy value of vitamins, microelements with a long shelf life in the laboratory in order to create a therapeutic and prophylactic fermented milk product on its basis. According to the research results, the optimum mode of sterilization of fresh milk at a temperature of 100–101°C for 3–5 seconds followed by cooling to +25 °C and adding 15 % shubat leaven of the mass of milk was determined. Tested technology of quick-freezing allowed to obtain bioproduct preservation in its native properties and with the ability for long-term storage.

Keywords: camel milk, shubat, sterilization, leaven, technology, freezing, therapeutic and prophylactic fermented milk product.

Introduction

Camel milk, being an important source of animal proteins and adiposes, includes a lot of vitally indispensable mineral elements and nutrients: calcium, zinc, cobalt, iron, potassium, phosphorus, and vitamins A, C, and B, which are involved in the activity of many cellular enzymes in the body.

It is shown that in comparison with cow's milk, the content of vitamin C in camel milk exceeds it 5 times, vitamin PP 3 times, vitamin E 2 times, iron 10 times, calcium 1,5 times, lactoferrin 30 times, and the content of lactose and casein, on the contrary, is less [1–6].

More than 30 types of dairy products are produced from camel milk, which is in demand both on the domestic and international market [7]. Most often, all possible cheeses, ice cream, and traditional fermented milk drinks are produced from camel milk [8]. Shubat is especially popular.

At the same time, camel milk is a natural immunomodulator, in particular, the protein spectrum of this milk is dominated by immunoglobulins, lactoferrin, which has antioxidant, anti-carcinogenic, and immunostimulating properties [9–11].

Camel shubat is a perishable product, because due to its high acidity and carbonation it turns sour after 4–7 days and becomes unusable, which makes it almost impossible to transport it over long distances.

Camel milk is also a quickly spoiling product, as it is highly acidic, which contributes to rapid acidification and unsuitability for reception, which complicated its delivery to remote areas. The specific method of preparation of shubat is also an obstacle to its distribution, as it is prepared in a natural environment. From this follows that it is possible to extend it shelf-life only under conditions of placing it in a temperature not higher than +6°C which requires refrigeration equipment.

It is also known that freezing as a method of preserving raw materials of animal origin is not only more cost-effective than heat treatment but also better preserves the consumer qualities of the product. The process of freezing dairy products is accompanied by phenomena caused by the complex physical state of milk as a solution containing substances of different degrees of dispersion.

According to the research [12], the properties of milk during freezing do not change much if the freezing is carried out to a temperature below -22^0C by rapid sequential freezing in thin layers. Milk frozen this way remains unchanged for more than 6 months (at a temperature below -20^0C) and does not precipitate after thawing.

Therefore, the prospects for long-term storage of fermented milk products of a medicinal nature dictate the need for research aimed at improving sterilization regimes, as well as developing a low-temperature storage technology with the condition of ensuring the initial quality characteristics.

Based on the above, the purpose of the research was to study various sterilization regimes and test the technology of low-temperature storage of shubat — fermented milk product from camel milk.

Materials and research methods

The objects of the study are fresh camel's milk, starter cultures for camel milk and shubat.

At the first stage, experiments were carried out in the laboratory to sterilize camel milk, taking into account the time and temperature conditions.

According to the set goal, a selection of high-quality leaven was carried out to obtain shubat, for which strains of cultures of lactic acid bacteria of bacterial leaven for the fermented milk product (*Lactobacillus lactis, Lactobacillus acidophilus, Torulopsis spherica*) were studied in an amount of at least $1{,}5\times10^9$ colony-forming units (CFU).

Complex studies of qualitative and quantitative parameters of the tested product were carried out on shubat prototypes: organoleptic, physical and chemical properties (a mass fraction of moisture, fat, protein, solids and titratable acidity), a microbiological assessment (total of mesophyll-aerobic and facultative-anaerobic microorganisms, coliform bacteria, pathogenic microorganisms, including salmonellas) and vitamin contents in testing laboratories of LP «Nutritest» and «Expert Test» at the Kazakh Academy of Nutrition of Ministry of health.

Conclusion and dispute

Nutritious properties of shubat, to a large extent, depend on the quality of the leaven. Fresh camel milk, after filtration, was sterilized according to the technological process by boiling at various temperatures and time intervals: at a temperature of 100–101^{0}C lasting for 3–5 seconds; 102–103^{0}C for 2–3 seconds; 104–105^{0}C for 1–2 seconds. Sterilized milk was cooled to the temperature of + 25 °C, + 30 °C, then a bacterial starter containing pure bacterical cultures (*Lactobacillus lactis, Lactobacillus acidophilus, Torulopsis spherical*) was added and resuspended.

Further, the resulting raw material was incubated in a thermostat for 18–24 hours at a temperature of +25 °C for maturation. The resulting finished biostimulating shubat was cooled in a refrigerator to +4 °C-+6 °C. Subsequently, the product was packed into sealable plastic bottles.

Analyzing the obtained data, the technology of preparation of shubat with a long period of storage was developed. Also, we conducted experimental studies on the selection of high-quality leaven of shubat with a ratio of 25 %, 20 %, 15 %, with the sterilization of camel milk at a temperature of 100–101 °C lasting for 3–5 seconds; 102–103 °C for 2–3 seconds; 104–105 °C for 1–2 seconds and cooling to the temperature of +25 °C, with carrying out a tasting assessment of organoleptic indicators of prototypes of shubat with a long period of storage. The technological process of receiving bio-stimulating shubat is presented in Figure 1.

Experimental tests are made in 3 options:

1 — option: 750 ml of sterilized milk + 250 ml of leaven ;

2 — option: 800 ml of sterilized milk + 200 ml of leaven ;

3 — option: 850 ml of sterilized milk + 150 ml of leaven .

Leaven with a ratio of 25 %, 20 %, 15 % and traditional ferment (for the control experiment) were added to the sterilized camel milk (samples of 1 liter). After carefully mixing for 10 minutes, they were incubated in maturation at a temperature of +25 °C for 18–24 hours. After that the studied material was placed in the refrigerator at a temperature of +4 °C-+6 °C.

In 15 days a tasting assessment of organoleptic indicators of prototypes of shubat was carried out.

At a tasting assessment of the prepared shubat in various ratios of leaven, it was revealed that shubat of the 3rd sample is preferable.

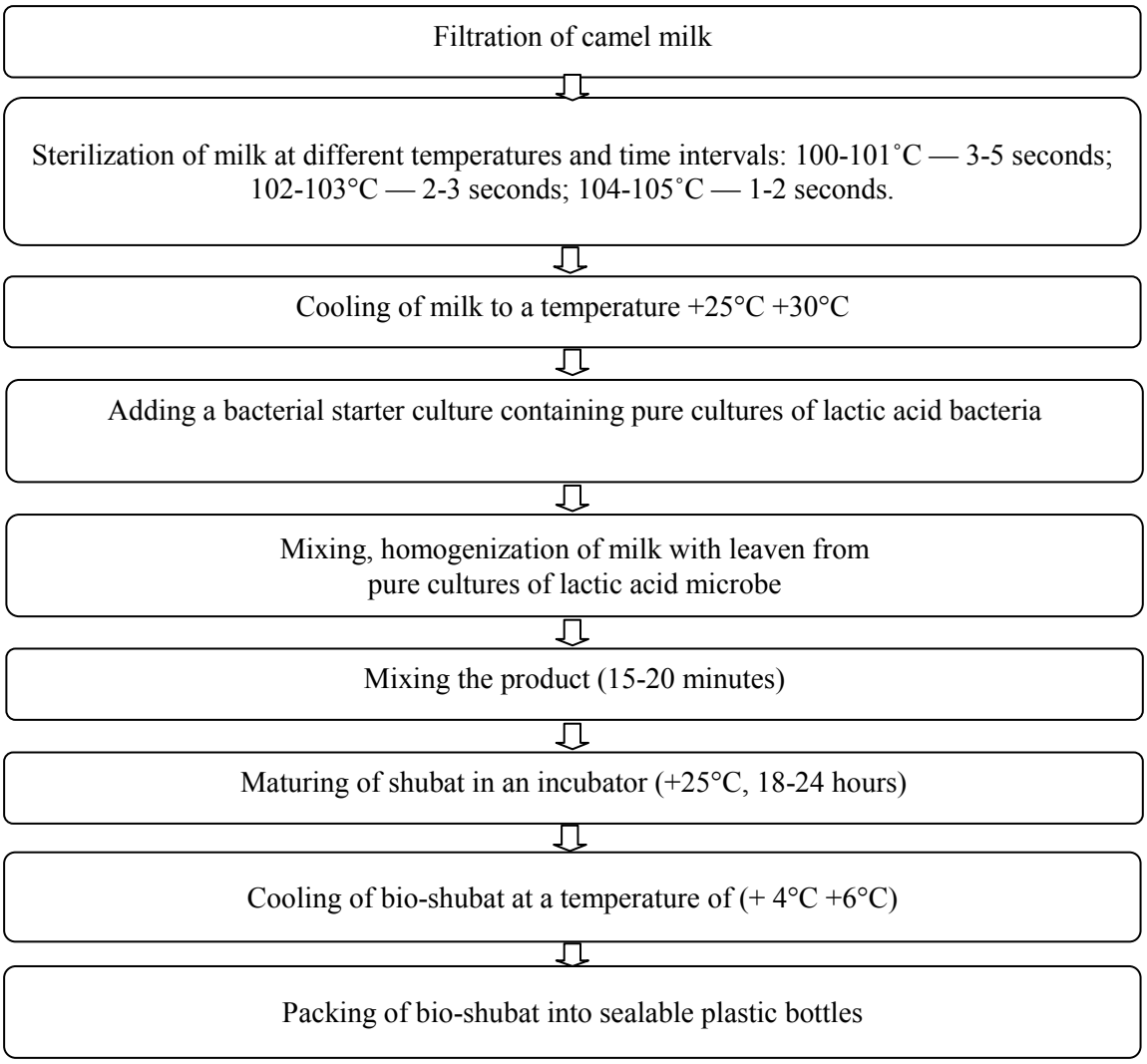

Figure 1. The technological process of obtaining bio-stimulating shubat

The results of research show that the sterilization of camel milk in 3–5 seconds at a temperature of 100–101 °C with further addition of sourdough of shubat of 15 % of the mass of sterilized milk results in shubat of a uniform consistency, with pleasant flavoring and without foreign smells. The received results are given in Table 1.

Table 1

Comparative characteristic of organoleptic indicators of shubat with various ratios of sourdough of shubat

№	The name of indicators	The sourdough of shubat with various ratios		
		250 ml (25 %)	200 ml (20 %)	150 ml (15 %)
1	Appearance and consistency	Uniform lightly carbonated liquid, foams at transfusion	Uniform lightly carbonated liquid, foams at transfusion	Uniform liquid, without flakes, foams at transfusion lightly
2	Taste and smell	With the pleasant smell and taste, no odor and aftertaste, with the sour taste	With the pleasant smell and taste, no odor and aftertaste, with lightly sour taste	With the pleasant smell and taste, no odor and aftertaste
3	Color	Milky-white	Milky-white	Milky-white

In order to improve the qualitative characteristics and to increase the duration of the period of storage of shubat experimental tests on the improvement of low-temperature storage of shubat were couducted. Shubat with a ratio of leaven of 15 %, which preserves in the refrigerator at a temperature of +4 °C, +6 °C for 15

days, was frozen in the freezer at a temperature of -18 °C for 12–16 hours. After that the produced shubat is put in the cooling chamber at a temperature of +4 °C, +6 °C.

Then comprehensive qualitative researche on the prototypes of shubat in testing laboratories of LP «Nutritest» and «Expert Test» at the Kazakh Academy of Nutrition of Ministry of health of the Republic of Kazakhstan was conducted: organoleptic, physical and chemical properties (a mass fraction of moisture, fat, protein, solids and titratable acidity), a microbiological assessment (total of mesophyll-aerobic and facultative-anaerobic microorganisms, coliform bacteria, pathogenic microorganisms, including salmonellas) and vitamin contents. With a ratio of leaven of 15 % and stored with a long period of storage of 15, 45 and 72 days the following results were received [13] (Tables 2).

Table 2

Microbiological indicators of shubat with a long period of storage received from the sterilized camel milk in the course of storage in the conditions of the refrigerator from +4 to +6 °C (TORMENTS (MCI) 4,2–1847–04)

№	The name of indicators, units of measurement	Permissible limits of ND	The periodicity of control			ND designation for test methods
			15 days	45 days	72 days	
1	Lactic acid bacteria CFU/g/cm^3, no less	$1x10^7$	$1x10^8$	$1x10^7$	$1x10^7$	GOST 10444.11–89
2	*E. coli* group bacteria (coliforms), in 1g.	not permitted	absent	absent	absent	GOST 31747–2012
3	*St.aureus*, in 1g (cm^3)	not permitted	absent	absent	absent	GOST 31747–2012
4	Pathogens, including salmonellasin 25g/ cm^3	not permitted	absent	absent	absent	GOST 31659–2012
5	Mildew, CFU/g/ cm^3, no more	50	absent	absent	absent	GOST 10444.12–88
6	Yeast, CFU, g/cm^3, no more	50	absent	absent	absent	GOST 10444.12–88

*ND — normative documents

Result of the microbiological research of shubat with a long period of storage of 15, 45 and 72 days showed that the existence of pathogenic microorganisms, including salmonellas, *E. coli* group bacteria (coliforms) isn't found.

The results of tests of a nutrition value and physical and chemical properties (mass fraction of moisture, fat, protein, solids and titratable acidity) of shubat with a long period of storage of 15, 45 and 72 days showed that the mass fraction of fat of no more than 4,87 %, the mass fraction of protein of no less than 3,73 %, the mass fraction of carbohydrates of no more than 3,22 %, the titratable acidity of 93–160°T (Tab. 3).

Table 3

Complex assessment of quality indicators of shubat with a long period of storage received from the sterilized camel milk in the course of storage in the conditions of the cooling chamber (from +4 to +6 °C) (TORMENTS 4,2–1847–04)

№	The name of indicators, units of measurement	Permissible limits of ND	The periodicity of control			ND designation for test methods
			15 days	45 days	72 days	
1	2	3	4	5	6	7
The nutritional value, g/100 g of product						
1	Protein	-	3.73±0.37	4.12±041	4.10±0.41	GOST 23327–98 GOST 5867–90
	Fat	-	4.87±0.49	4.5±0.45	4.35±0.43	
	Carbohydrates	-	3.22±0.32	3.21±0.32	2.8±0.28	ND 4.1.1672–2003, part III, point 4 GOST 3626–73
	Moisture	-	87.48±8.75	87.40±8.74	88.0±8.8	GOST 15113.8–77
	Ash	-	0.70±0.07	0.77±0.08	0.75±0.075	
2	Energy value, kilo Cal/kilo J/100g	—	71.63/300	69.8/292	66.75/279	I.M. Skurikhin, 1987

1	2	3	4	5	6	7
Physical and chemical indicators						
3	The mass fraction of moisture, %	-	87.5±8.75	87.4±8.74	88.0±8.8	GOST 3626–73
	The mass fraction of dry tings, %	-	12.5±1.25	12.6±1.26	12.0±1.20	GOST 3626–73
	The mass fraction of the titr. acidit, ^{0}T	-	93	121	160	GOST 3624–92
	Density, g/cm^3	-	1.023	1.026	1.023	GOST 3625–84
	Organoleptic: the description					
4	Organoleptic: the description	-	Opaque, milky liquid with a pleasant smell and taste, no odor and aftertaste	Opaque, lightly carbonated milky liquid with a pleasant smell and taste, no odor and aftertaste	Opaque, milky liquid with a pleasant smell and taste	GOST 28283–89
Vitamin content, in 100 ml						
5	B_3, mg	-	0.123±0.012	0.131±0.013	0.120±0.012	GOST 30627.4–98
	C, mg	-	7.873±0.784	8.435±0.844	7.1±0.71	GOST 30627.2–98
6	E, mg	-	0.144±0.014	0.0399	0.138±0.013	GOST 30627.3–98
	β-carotene, mg	-	0.032±0.003	0.0033	0.03±0.003	GOST 7047–55, point 2

*ND — normative documents

The results of the study showed that the physical and chemical parameters such as the mass fraction of moisture and dry substances remained unchanged, and the mass fraction of titrated acidity ^{0}T increased by 30–72 % depending on the storage period. The energy value of shubat decreased by 0,6 % for long storage periods of up to 72 days.

When studying the content of vitamins, it was found that the main mass is vitamin C (96,3 %), then vitamin E (1,8 %), vitamin B_3 (1,5 %), β-carotene (0.4 %).

Safety indicators of shubat with a long period of storage after 15, 45 and 72 days of storage: ions of heavy metals, radionuclides showed that lead and cesium are lower than allowable rate, other heavy metals aren't found. The received results are given in Table 4.

Table 4

The maintenance of ions of heavy metals and radionuclides in shubat prepared from the sterilized camel milk during storage in the conditions of the cooling chamber (from +4 to +6 ºC) (TORMENTS 4,2–1847–04)

№	The name of indicators, units of measurement	Permissible limits of ND	The periodicity of control			ND designation for test methods
			15 days	45 days	72 days	
1	Toxic elements, mg/kg, no more:					
	Lead (Pb)	0.1	0.0007	0.010	0.023	GOST P 51301–99
	Cadmium (Cd)	0.03	absent	0.0005	0.00072	GOST P 51301–99
	Arsenic (As)	0.05	absent	0.0002	absent	GOST 26930–86
	Mercury (Hg)	0.005	absent	absent	absent	GOST 26927–86
2	Radionuclides, BC/kg, no more:					
	Cesium (Cs) — 137	100	1.08	1.29	1.27	GOST P 54016–2010
	Strontium (Sr) — 90	25	absent	absent	absent	GOST P 54017–2010

*ND — normative documents

Conclusion

Based on the above, it can be postulated that the shubat obtained by sterilizing fresh camel milk at a temperature of 100–101 °C and then refrigerating to +25,+30 °C, rapid chilling to a temperature of -18 °C for 12–16 hours, preserves its native properties and allows to expand the shelf life of the product to 72 or

more days at +4 °C,+6 °C in the refrigerator, which indicates an improvement in quality characteristics and prolongation of storage terms without any stabilizers and preservatives.

Therefore, it is possible to provide the population with the prepared high quality natural shubat with the established long periods of storage, and also on its basis it is possible to receive treatment and prophylactic dairy products, bio yoghurts and biological products in combination with extracts of medicinal plants that posses antioxidant, immunostimulating and hypoglycemic properties [14–17], which do not have analogs in the world dairy and pharmaceutical industry.

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Түйе сүтінен сапалы шұбатты ұзақ сақтау мерзімімен алу технологиясы

Мақалада түйе сүтінің негізінде ұзақ сақтау мерзімі бар емдік-профилактикалық қышқылды сүт өнімдерін алу мақсатында, түйе сүтінің құрамындағы дәрумендер мен микроэлементтерін, физика-химиялық қасиеттерін және энергетикалық құндылығын барынша сақтай отырып, зертхана

жағдайында ұзақ сақтау мерзімі бар шұбатты алудағы түйе сүтін зарарсыздандырудың тиімді уақыты мен температурасын таңдауға және ашытқысын дайындауда жүргізілген тәжірибелік сынамалар сипатталған. Зерттеу нәтижелері бойынша, ұзақ сақтау мерзімді сапалы шұбатты алудағы зарарсыздандырылып алынған түйе сүтінің құрамын +25 °С-қа дейін салқындата отырып, 15 % ашытқысын қосу арқылы, зарарсыздандырудың оңтайлы тиімді 100–101°С температурасы мен 3–5 секунд уақыт аралығы таңдалып алынды. Сонымен қатар сынақтан өткен жылдам мұздату технологиясы өзінің нативтік қасиеттерін сақтап, ұзақ сақтауға қабілетті биоөнімді алуға мүмкіндік беретінін көрсетті.

Кілт сөздер: түйе сүті, шұбат, зарарсыздандыру, ашытқы, технология, мұздату, емдік-профилактикалық қышқылды сүт өнімі.

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Технология получения качественного шубата из верблюжьего молока с длительным сроком хранения

В статье описаны экспериментальные опыты стерилизации оптимальных режимов для получения качественного шубата из верблюжьего молока с учетом времени и различных температурных режимов, с максимальным сохранением физико-химических, пищевых свойств и энергетической ценности витаминов, микроэлементов с длительным сроком хранения в лабораторных условиях с целью создания на его основе лечебно-профилактического кисломолочного продукта. По результатам исследования установлен наиболее оптимальный режим стерилизации свежевыдоенного молока при температуре 100–101°С в течение 3–5 с с последующим охлаждением до +25 °С и добавлением 15-процентной шубатной закваски от массы молока. Апробированная далее технология скоротечного замораживания позволила получить биопродукт, сохранивший свои нативные свойства и обладающий способностью к длительному хранению.

Ключевые слова: верблюжье молоко, шубат, стерилизация, закваска, технология, замораживание, лечебно-профилактический кисломолочный продукт.

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