



EXAMINATION OF THE QUALITY OF FROZEN MILK DURING STORAGE

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Article history:	Abstract:
Received: 7 th March 2024 Accepted: 3 rd April 2024	The paper presents the results of studies of the quality of pasteurized frozen milk obtained under patent FAP 02272 during storage. It has been shown that the stated deep freezing regime at a temperature of -25°C to -31°C for 2 hours is the most optimal, as it ensures rapid complete freezing and better preservation of the quality of cow's milk for up to 1.5 months.
Keywords: Milk, Technological Properties, Safety Indicators, Heat Resistance, Freezing, Storage.	

INTRODUCTION. The problem of milk preservation is widely known, the methods of its solution include both numerous developed and mastered technologies of xeropreservation, and cryopreservation technologies that have not yet found widespread industrial application - freezing of milk and dairy products. By the way, the use of technology for their refrigeration, freezing and refrigeration storage could significantly contribute to smoothing out the seasonality of consumption of such products and guaranteeing their high quality.

The expansion of the production of quick-frozen food products is considered by the International Institute of Refrigeration to be a promising direction in the technology of food preservation in the XXI century. However, the most effective methods of freezing cow's milk have not yet been developed.

At present, cow's milk is preserved by drying with high temperature, as well as cold, which consists in freezing pre-separated and condensed milk in plastic bags in the form of thin rectangular blocks at temperatures from -28 to -300C in tunnel coolers [1]. However, the proposed methods of canning cow's milk with cold have a high cost, so they are not widespread.

Methods of freezing sheep and mare's milk are proposed. The method of freezing sheep's milk involves freezing raw whole sheep's milk at a temperature of -270C and storing it at these temperatures for a year while maintaining the stability of the samples [2]. The essence of the patent "Method of preserving mare's milk with cold" of the Yaroslavl Research Institute of Agriculture is to freeze mare's milk in bags made of polymer and combined materials with a volume of 1000 ± 50 ml in low-temperature chambers with a temperature regime from -220C to -320C for 1.5-2 hours, after which mare's milk could be stored for up to 6 months in freezers with a temperature regime of -150C [3]. A similar method of industrial canning of mare's milk by shock freezing was developed at the Kazakh Research Institute. According to the developed technology, frozen packaged milk is carried out at a temperature not higher than -250C , then the milk is stored in refrigerated chambers or glaciers with a temperature not higher than -150C . Milk is recommended to be stored for up to 6 months to obtain kumys of decent quality [4].

The issues of the effect of low temperatures on the components of milk and its technological properties, which determine the possibility of processing, have been studied by many researchers both from the point of view of the interaction of milk fractions with each other, and from the point of view of the use of various temperature regimes and technological methods of subsequent industrial processing. Currently, the Department of Service of the Samarkand Institute of Economics and Service is conducting research on the development of pasteurized frozen milk. We have obtained a patent of the Republic of Uzbekistan for a utility model No FAP 02272 "Method of freezing pasteurized cow's milk" [5]. This utility model relates to the field of the food industry, and more specifically to the preservation of milk and dairy products, and concerns the method of preparing packaged frozen cow's milk. The task of this technical solution was to ensure safety, preservation of the nutritional and biological value of frozen packaged pasteurized cow's milk during storage and subsequent direct consumption.

The purpose of this study is to study the quality of pasteurized frozen milk obtained under patent FAP 02272 during storage.

MATERIALS AND METHODS. The following research methods were used in the work: relative density according to GOST 3625-84; titratable acidity according to GOST 3624-92; mass fraction of fat according to GOST 5867-90; organoleptic characteristics according to GOST 29245-91; mass fraction of moisture and dry matter according to GOST 30305.1-95; mass fraction of total nitrogen according to GOST 23327-98. The quality of frozen packaged pasteurized cow's milk was checked in defrosted form. The repetition of analyzes is 5 times.

RESULTS AND DISCUSSION. According to the method proposed by us, cow's milk is allowed for freezing, prepared in accordance with GOST 13264-88 "Cow's milk. Requirements for procurement" and GOST 31449-2013 "Raw cow's

milk", with a density of at least 1027 kg/m³, acidity from 16.0 to 21.0 °T, with a protein content of at least 2.8%, fat content of at least 2.8%, QMAFAnM (number of mesophilic aerobic and facultative-anaerobic microorganisms) not more than 1•10⁵ CFU (colony-forming units)/cm³, the content of somatic cells is not more than 1•10⁵ cells per 1cm³. In the proposed method of freezing preservation, purified cow's milk, normalized in terms of fat mass fraction, is homogenized at a pressure of 10 – 15 MPa and a temperature of 45 – 70 °C and heat treatment at 74 – 78 °C with a holding time of 20 seconds, cooling, packaging in bags made of polymeric materials with a volume of 500±50 ml and quick freezing at temperatures from -25 °C to -31 °C for 2 hours and stored in freezers with a temperature of -18 °C for no more than 4 - 6 weeks.

The results of studies of technological indicators of frozen milk during storage are shown in Table 1.

Table 1

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Показатели	Пастеризован-ное коровье молоко	Замороженное молоко по срокам хранения		
		в первую неделю хранения	в третью неделю хранения	в шестую неделю хранения
Плотность, г/см ³	1,0280±0,0003	1,0285±0,0003	1,0281±0,002	1,0282±0,001
Кислотность, °T	20,01±0,01	20,50±0,01	20,71±0,04	21,00±0,20
Сухой обезжиренный молочный остаток, %	8,20±0,02	8,40±0,05	8,55±0,30	8,65±0,40
Indicators	Pasteurized cow's milk	Frozen milk by shelf life	2,99±0,07	2,98±0,06
in the first week of storage	in the third week of storage	in the sixth week of storage	Density, g/	1,0280±0,0003
1,0285±0,0003 °C	1.0281±0.002	1.0282±0.001	Acidity, °T	20.01±0.01

As can be seen from the data of Table 1, freezing of pasteurized cow's milk under the adopted freezing regimes generally does not have a significant effect on the values of the studied parameters. During storage, there is a slight increase in the values of titratable acidity, dry skimmed milk residue and a slight decrease in the protein content. The results of the assessment of organoleptic parameters of pasteurized frozen cow's milk are shown in Table 2.

Table 2
White, with a slightly yellowish tint

20.50±0.01	20.71±0.04
21.00±0.20	Dry skimmed milk residue, %
8.20±0.02	8.40±0.05
8.55±0.30	8.65±0.40

The results of organoleptic assessment show that during the storage of pasteurized frozen milk, no special changes in organoleptic characteristics occur and preserve the organoleptic characteristics of pasteurized milk until freezing.

FINDINGS. Thus, as the results of the studies show, the declared deep freezing mode at a temperature of -25 °C to -31 °C for 2 hours is the most optimal, as it provides a quick complete freezing and better preservation of the quality of cow's milk for up to 1.5 months.

It should be noted that in the conditions of constant and rapid improvement of industrial technologies and hardware solutions, properly performed milk freezing, which does not allow negative changes in its structure, while allowing to preserve most of its native components, remains a modern alternative method of preservation.

According to most researchers, frozen milk can be stored at minus 200C for 3-4 months or up to 10 months if it is further processed, including into cheese. However, it should be noted that in accordance with the technical regulation "On the safety of milk and dairy products", adopted by Resolution No 474 of the Cabinet of Ministers of the Republic of Uzbekistan dated July 7, 2017, the use of frozen milk in the production of dairy products is not allowed [6]. Therefore, the issue of legislative regulation of the possibility of using frozen milk in the modern domestic dairy industry remains relevant.

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