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## Technological Indicators of Frozen Pasteurized Cow's Milk

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**Annotation:** The work conducted a review of scientific and methodological literature on the influence of freezing on the technological properties of milk. It is shown that the declared deep freezing mode at a temperature of  $-25\text{ }^{\circ}\text{C}$  to  $-31\text{ }^{\circ}\text{C}$  for 2 hours is the most optimal, as it provides quick complete freezing and the best preservation of the quality of cow's milk up to 1.5 months.

**Key words:** milk, technological properties, safety indicators, heat resistance, freezing, storage.

**Introduction.** The problem of preserving milk is widely known; methods for solving it include both numerous developed and mastered xeroconservation technologies, and cryopreservation technologies that have not yet found wide industrial application - freezing milk and dairy products. By the way, the use of technology for their cooling, freezing and refrigerated storage could significantly help smooth out the seasonality of consumption of such products and guarantee 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 food preservation technology in the 21st century. However, the most effective methods for freezing cow's milk have not yet been developed.

Currently, cow's milk is preserved by drying at high temperatures, as well as cold, which consists of freezing pre-separated and condensed milk in plastic bags in the form of thin rectangular blocks at temperatures from  $-28$  to  $-300\text{ }^{\circ}\text{C}$  in tunnel coolers [1]. However, the proposed methods for preserving cow's milk by cold have a high cost and therefore are not widely used.

Methods for freezing sheep and mare's milk have been proposed. The method of freezing sheep milk involves freezing raw whole sheep milk at a temperature of  $-270\text{ }^{\circ}\text{C}$  and storing 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 by cold" YANIISKH is to freeze mare's milk in bags made of polymer and combined materials with a volume of  $1000\pm 50$  ml in low-temperature chambers with a temperature range from  $-220\text{ }^{\circ}\text{C}$  to  $-320\text{ }^{\circ}\text{C}$  for 1.5-2 hours, after which mare's milk could be stored for up to 6 months in freezers with a temperature of  $-150\text{ }^{\circ}\text{C}$  [3]. At the Kazakh Research Institute, a similar method of industrial canning of mare's milk using the shock freezing method was developed. According to the developed technology, packaged milk is frozen at a temperature no higher than  $-250\text{ }^{\circ}\text{C}$ , then the milk is stored in refrigeration chambers or glaciers with a temperature no higher than  $-150\text{ }^{\circ}\text{C}$ . It is recommended to store milk for up to 6 months to obtain kumiss of decent quality [4].

Currently, research is underway at the Service Department of the Samarkand Institute of Economics and Service to develop technology for pasteurized frozen milk. We have received a patent of the Republic of Uzbekistan for utility model No. FAP 02272 "Method of freezing pasteurized cow's milk" [5]. This utility model relates to the food industry, and more specifically to the canning of milk and dairy products and concerns a method for preparing packaged frozen cow's milk. The objective of this technical solution was to ensure safety, preserve 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 investigate the effect of freezing on the technological performance of pasteurized cow's milk.

**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 indicators 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. Repeat the analyzes 5 times.

**Results and discussion.** According to the method we proposed, cow's milk, 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/m<sup>3</sup>, acidity from 16.0 to 21.0 °T, with a protein content of at least 2.8%, fat content of at least 2.8%, KMAFAnM (the number of mesophilic aerobic and facultative anaerobic microorganisms) no more than 1•10<sup>5</sup> CFU (colony-forming units)/cm<sup>3</sup>, the content of somatic cells no more than 1•10<sup>5</sup> cells per 1cm<sup>3</sup>.

In the proposed method of freezing preservation, purified cow's milk, normalized by the mass fraction of fat, is subjected to homogenization at a pressure of 10 - 15 MPa and a temperature of 45 - 70 °C and heat treatment at 74 - 78 °C with holding time for 20 seconds, cooling, packaging in bags made of polymeric materials with 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 and organoleptic indicators of frozen milk are shown in Tables 1 and 2, respectively.

**Table 1 The effect of freezing on the quality of pasteurized cow's milk 2.5% fat**

Indicators	Pasteurized cow's milk	Frozen milk by shelf life		
		in the first week of storage	in the third week of storage	in the sixth week of storage
Density, g/cm <sup>3</sup>	1,0280±0,0003	1,0285±0,0003	1,0281±0,0002	1,0282±0,0001
Acidity, °T	20,01±0,01	20,50±0,01	20,71±0,04	21,00±0,20
Skimmed milk powder, %	8,20±0,02	8,40±0,05	8,55±0,30	8,65±0,40
Protein, %	3,01±0,20	3,00±0,10	2,99±0,07	2,98±0,06
Fat, %	2,50	2,50±0,80	2,50±0,80	2,50±0,80
Temperature, °C	-18	-18	-18	-18

**Table 2 Requirements for organoleptic characteristics of frozen packaged pasteurized cow's milk 2.5% fat**

Indicator name	Characteristic
Consistency	Slightly viscous, homogeneous, with the presence of minor ice crystals. Without protein flakes and fat lumps.
Taste and smell	Characteristic of milk, without foreign tastes and odors, with a slight aftertaste of boiling
Color	White, with a slightly yellowish tint

As the results of the studies show, the stated deep freezing regime at a temperature of -25 0 C to -31 0 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.

**Conclusions.** Thus, in the context of a constant and rapid pace of improvement of industrial technologies and hardware solutions, properly performed freezing of milk, which does not allow negative changes in its structure, while allowing the preservation of most of its native components, remains a modern alternative method of preservation. The issues of the influence 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 conditions and technological methods for subsequent industrial processing.

According to most researchers, frozen milk can be stored at minus 200C for 3-4 months or up to 10 months if it is subsequently processed, including into cheese. However, it should be noted that in accordance with the technical regulations “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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