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DEVELOPMENT OF A NEW TYPE OF ALCOHOLIC ICE CREAM

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***Abstract:** The modern range of milk-based ice cream with an alcohol component was analyzed. The choice of alcoholic tincture in the composition of milk ice cream was substantiated. The cryoscopic temperature of the mixtures was determined using a measuring complex, the dynamic viscosity was determined by a Hepler viscometer, the melting resistance was determined by the melting time of the hardened ice cream samples, and the ice cream was whipped by the weight method. The possibility of using tinctures with an alcohol content of 20% as a part of milk ice cream has been scientifically confirmed. The selection of the structure stabilizer and rational modes of maturation of milk-alcohol mixtures were substantiated by the values of the coefficient of dynamic viscosity. According to the cryoscopic temperature of ice cream mixtures, it was found that the production of ice cream with a mass fraction of alcohol up to 3% determines the possibility of using conventional freezing modes to obtain a product of guaranteed quality. A new type of milk ice cream with the use of tinctures can be recommended for the introduction of the classical technological scheme of production with the clarification of maturation modes.*

***Keywords:** tinctures, ice cream, cryoscopic temperature, maturation.*

INTRODUCTION

The ice cream market is one of the developed segments of the food industry of Ukraine, as ice cream is one of the most popular types of dessert (Floka, L.V., Birta, G.O. & Zalagina, S.O., 2021).

Alcoholic ice cream is a product that has recently become increasingly popular. It is widespread in the United States, Canada, European countries, and Japan (<https://www.prnewswire.com/news-releases/global-alcoholic-ice-cream-market-2018-2022---market-to-register-a-revenue-of-usd-1242-2-million-300718505.html>).

All types of alcohol are widely used in the production of alcoholic ice cream - from beer to strong vodka. The leading leader in the production of alcoholic ice cream is the American company Häagen-Dazs, which produces its alcohol line under the brand name "Spirits". The alcohol content in ice cream is only 0.5% (<https://www.transparencymarketresearch.com/alcoholic-ice-cream-market.html>).

Drunken Dairy is the king among alcoholic ice creams in the UK. Every consumer will definitely appreciate the many flavors of frozen dessert - and tequila, orange and Amaretto, white chocolate and Malibu/ The alcohol content in the frozen dessert is 5% (<https://www.transparencymarketresearch.com/alcoholic-ice-cream-market.html>).

In Switzerland, the production of ice cream "winecream" with pear and apricot brandy, as well as with wine (<https://www.prnewswire.com/news-releases/global-alcoholic-ice-cream-market-2018-2022---market-to-register-a-revenue-of-usd-1242-2-million-300718505.html>); <https://www.transparencymarketresearch.com/alcoholic-ice-cream-market.html>).

The first and only frozen alcoholic dessert in Ukraine based on milk "SCANDAL" is a unique combination of natural cream ice cream with world-famous flavors of alcoholic cocktails that contains up to 5% alcohol (<https://www.0532.ua/news/2883062/u-poltavi-stvoruut-scandal-edine-v-ukraini-alkogolne-morozivo-foto-video>).

The use of an alcoholic component in ice cream determines the justification of the prescription composition and clarification of the technological parameters of the production of alcoholic ice cream.

EXPOSITION

Study of the process of maturation of alcoholic ice cream

As an alcohol component new in composition original tinctures were used based on lemon and cranberry (strength 20°, mass fraction of dry matter 7%), that were developed at the Department of Biotechnology of Fermentation and Winemaking Products of NUFT.

Stabilizer plays a significant role at all stages of the technological process and significantly contributes to both the formation and stabilization of the structure of ice cream during storage (Syed, Q. A., Anwar, S., Shukat, R. & Zahoor, T., 2018).

Studies on the selection of structure stabilizers for the production of alcoholic ice cream were conducted. Given the technological features of the production of alcoholic ice cream, the tincture was supposed to be made immediately before freezing the mixture at a temperature of 0-6 °C.

As stabilizers of the structure were used:

- stabilization mixture Kremodan - sample 1;
- stabilizing mixture STAB (carob gum E410, sodium alginate E401, carrageenan E407, mono and diglycerides E471) - sample 2;
- guar gum stabilizer - sample 3;
- gelatin - sample 4.

The coefficient of dynamic viscosity depends on the temperature, composition, selected raw materials, including stabilizers. To determine the coefficient of dynamic viscosity, a Hepler viscometer with a set of 6 glass and metal beads of different diameters was used (Hlavac, P., & Bozikova, M, 2016).

The results of the study are shown in Fig. 1, 2.

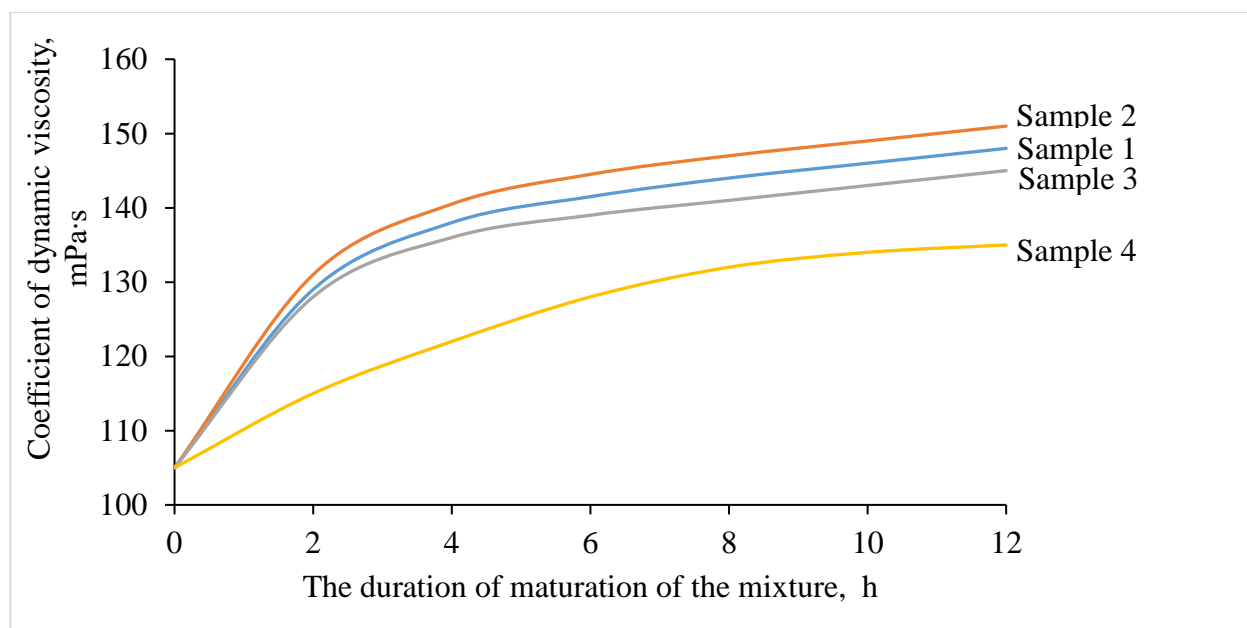


Fig. 1. Study of the maturation process of milk-chocolate ice cream with lemon tincture

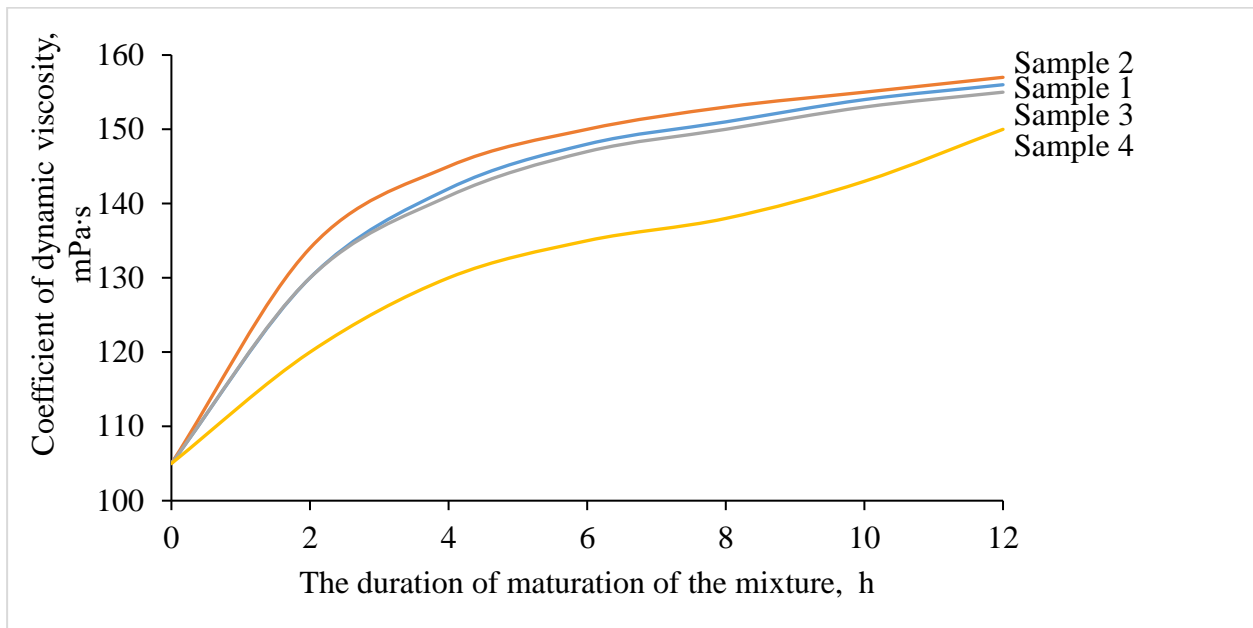


Fig. 2. Study of the maturation process of milk ice cream with cranberry tincture

As can be seen from Fig. 1-2, the achievement of the minimum appropriate value of the coefficient of dynamic viscosity (140 MPa s) is observed for the stabilizing mixture STAB (sample 2) after 3 h.

Determination of cryoscopic temperature of alcoholic ice cream mixtures

To substantiate the rational content of the alcohol component in the composition of milk ice cream in the next stage of the study it was determined the cryoscopic temperature of mixtures containing from 2 to 6% alcohol. Cryoscopic temperature in ice cream production is significant because it affects the proportion of bound water, which causes the formation of a creamy consistency of the finished product in the technological cycle of ice cream production (Polishhuk, G.C., & Semko, T.V., 2012).

The cryoscopic freezing point of these mixtures after maturation for 3 hours was determined according to the formulations of alcoholic ice cream. Cryoscopic temperature was determined by a measuring complex developed at the Department of Thermal Power and Refrigeration Engineering of NUFT.

The complex includes a device for temperature control with a set of copper-constantan thermoelectric converters (thermocouples) type T with a measurement error of not more than 0.05 °C, two measuring units ICP i7018 and a signal conversion unit standard RS-485 - RS-232 brand ICP i7520 (Potapov, S.G., & Maslikov, M.M., 2009).

Data registration is carried out through a personal computer using special programs: DCON Utility, which is designed to configure I / O modules ICP DAS using DCON or Modbus and EZ Data Logger, which allows you to register data from data loggers and remote input modules / output based on configured time intervals.

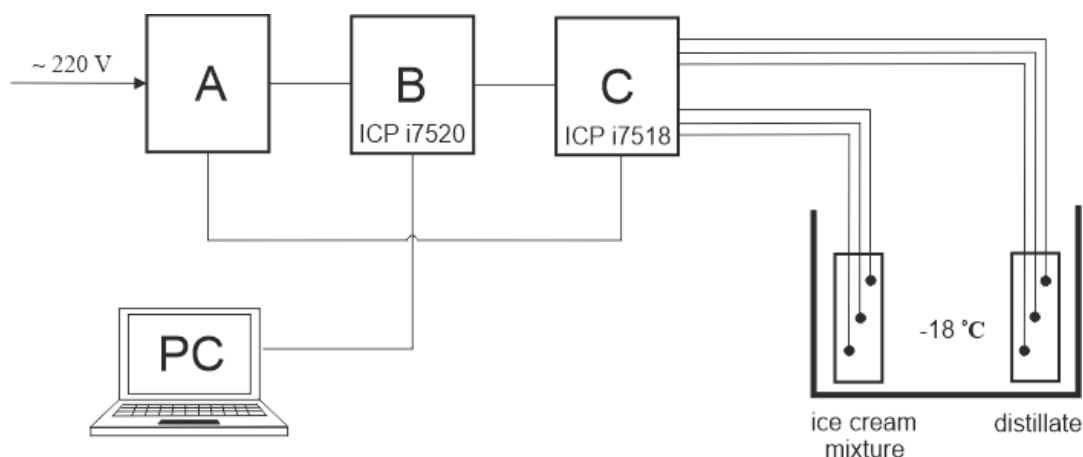


Fig. 3. Scheme of the measuring complex:

A - power supply (from the network); B - conversion unit standard RS-485 - RS-232; C - measuring unit with 8 thermocouples; PC - data registration (connection via RS-232 - USB); mixtures in metal boxes or PET cups placed in a freezer.

A feature of the method is the ability to simultaneously measure temperatures of up to 16 samples, provided that all thermocouples are working. To increase accuracy, the measurement for each sample is performed using three thermocouples, the results of which are averaged. To compensate for possible fluctuations of the controller readings simultaneously with the mixtures, three control thermocouples, the temperature is measured in a box with freezing distilled water having a temperature of 0 °C throughout the freezing time. The readings of thermocouples measuring the temperature of the mixtures are corrected by the average value of the readings of the control thermocouples (correction to the zero junction Δt_{0sp}), which increases the accuracy of measurements.

The values of cryoscopic temperature of the mixtures confirmed the possibility of production of ice cream with an alcohol content of 2 to 4%, which leads to a homogeneous, plastic and creamy structure, according to the generally accepted modes of technological processing. Increasing the alcohol content to 5% leads to a decrease in the mass fraction of frozen moisture, which leads to too soft a structure of the finished product (Cook, K.L.K., & Hartel, R.W., 2010).

The obtained research results are shown in table 1.

Table 1 The value of cryoscopic temperature

Samples	№ thermo-vapor	The value of the thermocouple t_{tc} , °C	Thermocouple correction, Δt_{tc}	Correction for zero junction Δt_{tc}	Actual temperature t_a , °C	Average cryoscopic temperature t_{cr} , °C
Sample 1 (alcohol content 2%)						
Distillate	2-2	+2,5	2,8	-	-0,3	-
Sample	2-0	0,0	1,8	-0,3	-1,5	-1,6
Sample 2 (alcohol content 3%)						
Distillate	2-2	+2,8	2,8	-	0,0	-
Sample	2-5	+1,8	4,7	0,0	-2,9	-2,7
	2-6	+1,9	4,4		-2,5	
	2-7	+1,8	4,4		-2,6	
Sample 3 (alcohol content 4%)						
Distillate	2-2	+4,8	2,8	-	0,0	-
Sample	2-0	+1,2	1,8	+2,0	-2,6	-2,8
	2-1	+1,2	1,9		-2,7	
	2-3	+1,2	2,3		-3,1	

Sample 4 (alcohol content 5%)						
Distillate	1-0	+2,2	2,7	-	-0,5	-
	1-2	+1,2	1,7			
Distillate	1-3	-2,2	1,5	-0,5	-3,2	-3,4
	1-5	-1,2	2,8		-3,5	
	1-6	-1,4	2,6		-3,5	
Sample 5 (alcohol content 6%)						
Distillate	2-2	+4,9	2,8	-	0,0	-
Sample	2-5	+2,0	4,7	+2,1	-4,8	-4,7
	2-6	+1,8	4,4		-4,7	
	2-7	+1,7	4,4		-4,8	

To test the effect of cryoscopic temperature and viscosity of ice cream mixes with tinctures on the quality characteristics of ice cream of different types, it is advisable to study their physicochemical and organoleptic characteristics, which is the next stage of scientific research.

CONCLUSION

Given the cryoscopic temperature of the mixtures, new original formulations of alcoholic ice cream with an alcohol content of 2-4% have been developed, which provides ice cream of homogeneous, plastic and creamy structure, according to the generally accepted modes of technological processing. According to the values of the coefficient of dynamic viscosity, with the use of modern stabilization systems, the rational regime of maturation of milk-alcohol mixtures - up to 3 hours is substantiated.

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