STUDY OF THE WATER STATE AND PHASE TRANSITIONS OF LIQUID IN MILK-PROTEIN SEMI-FINISHED PRODUCTS BELOW 0 ^{0}C

Gregoriy Deynichenko[1], Inna Zolotukhina[1*], Dmytro Dmytrevskyi[1], Vitalii Chervonyi[1], Dmytro Horielkov[1], Vasyl Guzenko[1], Kateryna Sefikhanova[2]

[1]Faculty of Equipment and Technical Service, Kharkiv State University of Food Technology and Trade, Klochkovska 333, 61051 Kharkiv, Ukraine
[2]Autonomous subdivision "Dnipro Faculty of Management and Business of Kyiv University of Culture", M. Gruhevskogo 9, 49007 Dnepr, Ukraine

[*]e-mail:zolotce5@gmail.com

Abstract

It is known that milk proteins the degree of assimilation of which is 96 - 98% are of high value. Whey proteins of buttermilk are rich in essential amino acids, due to which soluble high- and low-calcium co-precipitates with different water-binding and emulsifying properties are products of high biological value. Due to the widespread need for the use of milk-protein semi-finished products in the food industry, it becomes necessary to have sufficiently large stocks of them. However, during storage their consumer qualities may decline. In recent decades, the technologies of foods preparation based on frozen semi-finished products have been widely developed in order to preserve their technological and taste qualities. Thus, in order to improve the technologies of various frozen food semi-finished products production, it is relevant to conduct research aimed at studying the phase transitions of the liquid and the water state in semi-finished products at temperatures below 0 ^{0}C.

In this work, the study of the crystallization, glass transition, and melting in milk-protein semi-finished products of buttermilk with the addition of 30% of carrot or pumpkin purees was conducted, as well as research of the Astri Gel stabilizer effect on the phase behavior of semi-finished products at temperatures below 0 ^{0}C. The researches held using a low-temperature differential scanning calorimeter, the actions of which are based on a change in heat absorption or heat release of a substance when the temperature changes at a controlled speed.

The research showed that metastable solid amorphous glassy inclusions were formed in the frozen milk-protein semi-finished products along with the crystalline phase. Temperature ranges of reverse glass transition, the temperature of crystallization completion and melting were determined. Final solidification of the studied systems occurred after glass transition, therefore, the effective storage of the studied semi-finished products can be ensured at temperatures below the glass transition temperature.

It was shown that the Astri Gel stabilizer promoted water binding, the formation of fine ice and an increase of glassy phase in the studied semi-finished products. In the case of semi-finished milk protein with the addition of vegetable puree, this temperature is -57.6 ^{0}C, and with the addition of the Astri gel food mixture to -63.5 ^{0}C.

***Key words**: Crystallization, Glass transition, Melting, Differential scanning calorimetry, Milk-protein semi-finished products, Storage.*