Abstract

Differential scanning calorimetry (DSC) is one of thermoanalytical techniques that is increasingly used to analyze foods, including milk and dairy products. The results of such analyses are used to generate DSC curves and determine the characteristic parameters of phase transition peaks.

The research conducted as part of the doctoral dissertation focused on the applicability of DSC for evaluating selected types of milk and dairy products. The course of DSC curves and peak parameters were determined, with particular emphasis on the phase transitions of milk fat, and the differences between the thermal properties of the analyzed products were described. The results were linked to the fatty acid profile. The effects of the water and fat content of the sample, and the thermal history of the sample on the results of DSC analysis were determined. Bovine and ovine milk, sweet cream, sweet buttermilk, butter made from sweet cream, butter made from whey cream and their fats were used in the study.

The thermal characteristics of milk fat from the examined milk and dairy products were thoroughly analyzed in the study, and the results can be used in future research. It was found that all parameters of phase transition peaks can be used to evaluate thermal characteristics, but peak width at half height ($\Delta T_{1/2}$) was most useful for analyzing exothermic peaks associated with milk fat crystallization, whereas $\Delta T_{1/2}$, enthalpy and peak height were most useful for analyzing endothermic peaks associated with milk fat melting. The course of DSC curves and the parameters of milk fat phase transition peaks are more diverse in the case of endothermic than exothermic peaks, and they are affected by the fatty acid profile, the water and fat content of the sample, and the thermal history of the sample. The fat content and the fatty acid profile of the sample determine the number and values of the parameters of milk fat phase transition peaks on DSC curves. Changes in the values of peak parameters result from the proportions of most fatty acids and fatty acid groups, and particularly strong relationships were noted between SFAs and C12:0, C14:0 and C16:0 vs. MUFAs, PUFAs, LCFAs and C18:1. Decreased water content of the sample prevents the overlapping of water phase transition peaks with milk fat phase transition peaks in DSC curves, and shaping the thermal history allows to obtain stable forms of fat crystals, thus reducing the variability of results.

Differential scanning calorimetry is an objective and highly sensitive technique for evaluating phase transitions. The research results can be used in laboratory analyses of milk and dairy products, quality control, and technological process planning in the dairy industry.

Key words: differential scanning calorimetry; phase transitions; milk and dairy products; milk fat

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