Application note No.11-001 2019-02-18

Differential Scanning Calorimeter

Thermal analysis of butter and margarine

Chip-DSC 10

Introduction

In food production and food investigation due to health studies, the thermal analysis becomes more and more important. Especially carbon and fat content of various products is very often target of analytical interests. Butter and margarines are typical examples where the type of contained fats is not always easy to investigate. Therefore the DSC method can be used as a tool for quality control in production and research.

Methods

Using a DSC for analyzing foods and organics is a more or less common technique. In this application, the new Chip DSC was used for measurements of different fat containing samples.

The DSC signal in general is generated by heating a sample containing pan and an empty reference pan with the same heat source and subtracting the heat flow signals of the two pans from each other, resulting in endothermic or exothermic peaks if the sample temperature changes due to thermal effects.

The Chip-DSC integrates all essential parts of DSC: furnace, sensor and electronics in a miniaturized housing. The chip-arrangement comprises the heater and temperature sensor in a chemically inert ceramic arrangement with metallic heater and temperature sensor.

Therefore the Chip DSC allows a very fast heating and cooling speed combined with high resolution and accuracy as well as reproducibility.

The result of a DSC measurement can be used as a fingerprint model for substance identification in quality control but can also be used to determine enthalpies of effects like phase transitions.

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Experimental

All samples were obtained from a local food supplier. Samples were used as provided and measured directly using a Chip-DSC with quench-cooler. All samples were cooled with liquid nitrogen to -60°C before they were measured. The experimental setup is given in table 1.

Table 1. Experimental Conditions

Instrument	Chip-DSC
Heating rate	05 K/min
Sample Mass	15 mg
Sample Pan	Aluminum pan
Purge Gas	Air

Results

Figure 1 shows DSC profiles of three different kinds of margarines and butter. Each sample was precooled with liquid nitrogen to -60°C and then measured using the same conditions and sample mass.

The first effect that can be observed in all four samples is the endothermic melting enthalpy of the contained water at around 0°C. The plant margarine and sunflower oil margarine with a fat content of 80% show significantly less water than the low fat margarine that contains only 37% fat. Butter however has similar water content like the 80% fat margarines.

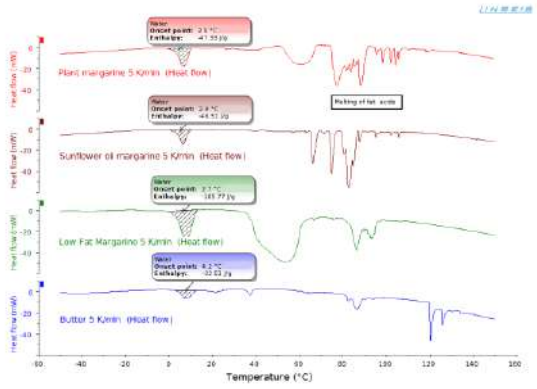

Fig.1 DSC Heat Flow curves of plant margarines, low fat margarine and butter. Heating rate 5 K/min

At 50°C the fatty acids of the plant and sunflower oil margarine start to melt, showing several endothermic melting peaks. The sunflower oil margarine shows fewer peaks than the plant margarine that obviously contains more different unsaturated and saturated fatty acids. The low fat margarine melts earlier at around 40°C, resulting in a broad melting peak that indicates that this product contains more short-chain fatty acids than the two plant margarines.

The butter however starts to melt slightly above room temperature, resulting in a considerable small melting peak at 35°C. At higher temperatures there are additional melting effects of fatty acids that remain solid as white flakes in the molten butter until their melting point is reached.

Summary

The composition of butter and margarines can be analyzed and compared very easily using the Chip DSC. Water content and different fatty acids can be compared and used for QC and research purpose.

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