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DSC AS PROBLEM-SOLVING TOOL: CHARACTERIZATION OF THE FAT CONTENT IN MARGARINE

Problem

A thermal analyst, working for a food company, has a need to characterize the fat content in margarine specimens for quality assurance applications. The scientist desires a sensitive testing approach for this application.

Solution

Differential scanning calorimetry (DSC) offers a sensitive means of analyzing margarine or butter samples with respect to fat content and type. The Seiko Instruments DSC220C offers the performance characteristics needed to best study the fat content of these materials which include:

- high sensitivity
- excellent resolution
- good baseline stability
- ability to rapidly achieve equilibrium conditions during heating and cooling.

Margarine and other food samples containing vegetable and/or animal fats are very sensitive to the thermal history of the material. This is because the fats found in food products crystallize during cooling and the resulting crystallization is a time dependent or rate dependent effect. Therefore, it is important to apply an appropriate and uniform thermal program to these fat-containing foods when studying them by DSC.

Three different margarine samples were studied using the Seiko Instruments DSC220C: Promise Regular, Promise Light and Promise Ultra. The Regular contains 10 g fat per serving, while the Light has 6 g and the Ultra contains 4 g fat per serving.

The margarine samples were subjected to the following thermal program which provides a uniform thermal history to the foods:

- Place sample in DSC cell at 24°C
- Hold sample until heat flow signal stabilizes
- Cool from 30° to 1°C at a rate of 2.5°C/min
- Hold at 1°C for 30 minutes
- Heat from 1° to 85°C at a rate of 2.5°C/min.

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Approximately 22 mg of margarine were loaded into sealed aluminum containers. The sealed containers permit the analysis of samples which yield volatiles during heating. The reference pan contained 31.8 mg of aluminum in order to effectively counterbalance the heat capacity of the sample. This provides more rapid equilibration when the DSC cell is dynamically heated or cooled from isothermal conditions.

Shown in Figure 1 are the DSC results, obtained during the heating portion of the thermal program, for the Promise Regular margarine. The data shows the occurrence of two endotherms (at 17.5 and 32.4°C) due to the melting of the fats found in the margarine.

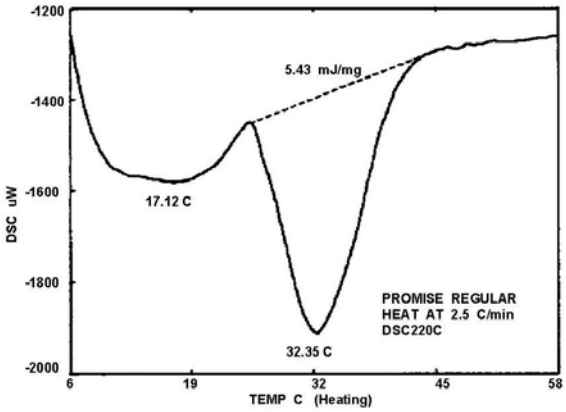

Figure 1

The DSC220C has the necessary sensitivity and resolution to detect these thermal events.

The Promise Light and Ultra margarine samples were analyzed using the same program and an overlay of the results for Regular, Light and Ultra are displayed in Figure 2. All of the data has been normalized to a constant mass of 20.00 mg. It may be seen that the intensities of the melting endotherms decrease as a function of the total fat content found in the three margarines. Even though the Ultra margarine contains very little fat content, the DSC220C has the required sensitivity to be able to observe the low energy melting endotherms.

The following are the heats of fusion for the melting of the margarine vegetable fat component at 32°C:

Type	ΔH (J/g)
Regular	5.43
Light	2.84

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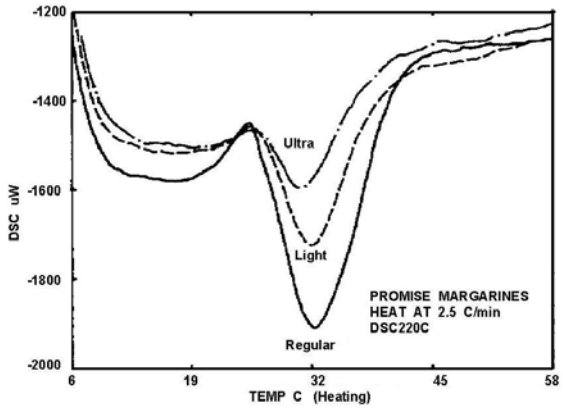

Figure 2

Summary

It is important to apply an appropriate and uniform thermal history when analyzing food samples containing fats. The DSC220C offers the necessary high performance characteristics to properly study the melting behavior of the fats found in margarines

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