Spreadability of Cream Cheese - Influence of Temperature and Fat Content

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Rheology, Yield Stress, Dairy Products, Cream Cheese

Introduction

Soft, spreadable foods such as cream cheese are viscoplastic materials. Consumer acceptance of these foods depends on their textural characteristics such as spreadability – a measure of how easily and uniformly they can be deformed and spread at end-use temperatures. It also determines if a given substrate like soft white bread will be able to withstand the spreading force.

The rheological properties correlating with spreadability of food products have been studied by a variety of methods. Breidinger and Steffe [1] for instance used yield stress and yield strain data from vane measurements to construct texture maps of spreadable foods. As semi-liquid and soft foods like spreadable foods are often difficult to work with when using conventional plate/plate or concentric cylinder geometries on rotational rheometers because of the possible wall slip and excessive sample disruption during loading into narrow gaps vane geometries are recommended here.

When the vane rotor is fully immersed in the sample, the yield stress itself can then be calculated according to Boger [2]:

$$\sigma = \frac{T}{K} \qquad [a]$$

With T being the Torque and K the vane parameter that depends on the height (H) and the diameter (D) of the paddle according to:

$$K = \frac{\pi \cdot D^3}{2}\left[\frac{H}{D} + \frac{1}{3}\right] \qquad [b]$$

Experimental Results and Discussion

As described earlier it is recommendable to test dairy products with vane rotors. Figure 1 shows the new Thermo Scientific™ HAAKE™ Viscotester™ iQ with vane configuration.

Two cream cheese products with varying fat content (10% versus 50%) have been studied at room temperature (25 °C) as well as at refrigerator temperature (8 °C). After the vane rotor has been fully immersed into the sample a constant rotational speed Ω = 0.05 rpm was commanded. Then the shear stress is monitored as a function of measuring time. After an initial purely elastic response in the sample the structure collapses and the shear stress is decreasing again. The maximum value in shear stress then corresponds with the yield stress. Figure 2 shows the results for both products at RT.

Fig. 1: Thermo Scientific HAAKE Viscotester iQ

As can be seen in Figure 2 the yield stress for the high fat content product is 1000 Pa versus 200 Pa for the low fat product. In comparison to that, Figure 3 shows the test results for the same products at 8 °C, simulating that the cream cheese was just taken out of the refrigerator.

As can be seen in Figure 3 the yield stresses for the cream cheese products rise considerably at 8 °C to 1500 Pa for the high fat product and 370 Pa respectively for the low fat product. Let us now consider that we want to spread these products on soft white bread. Specific soft white breads can have a shear Modulus G of as low as 1200 Pa.

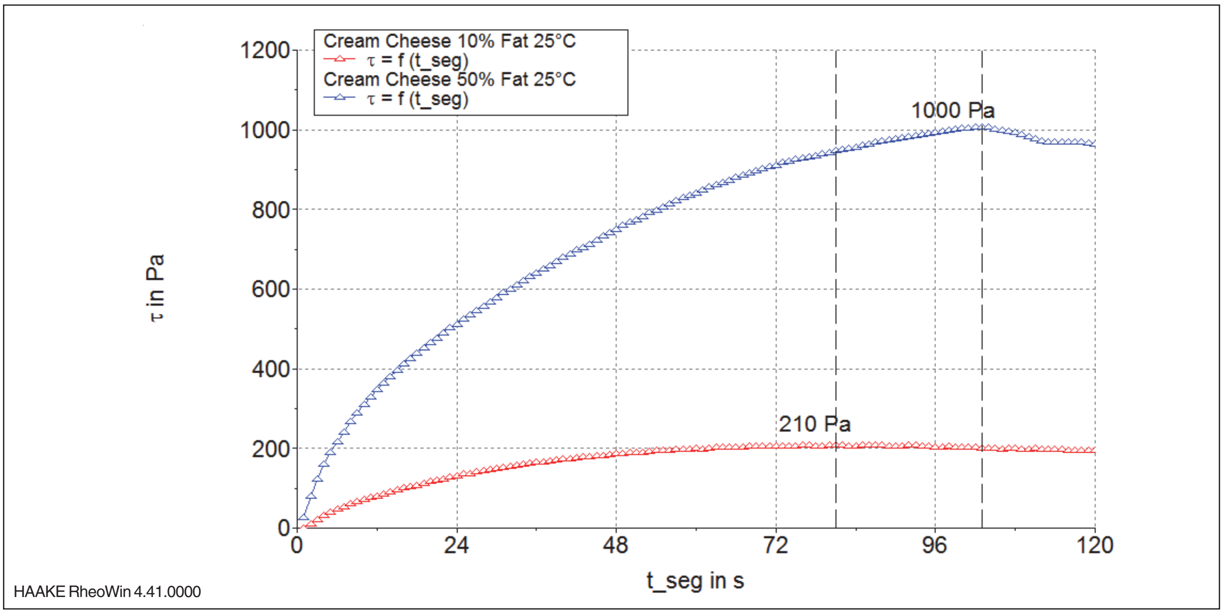

Fig. 2: Shear Stress versus Time for the two different cream cheese products at 25 °C

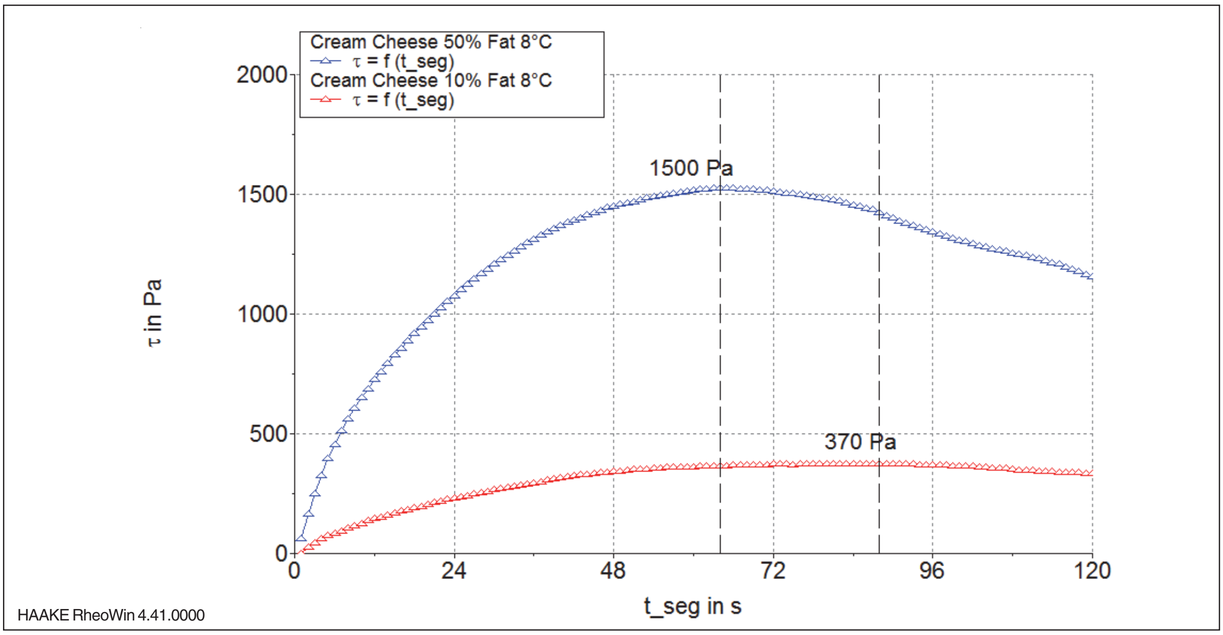

Fig. 3: Shear Stress versus Time for the two different cream cheese products at 8 °C

From the results above we can thus see that problems will arise when trying to spread the refrigerated high fat content product on soft white bread as yield stress of cream cheese > Shear Modulus of bread.

Conclusion

The vane method on the Thermo Scientific HAAKE Viscotester iQ is a quick, simple and accurate approach to understand spreadability and customer acceptance of spreadable foods like cream cheese.

Literature

[1] Breidinger, S. L. and Steffe, J. F. 2001. Texture map of cream cheese. J. Food Sci. 66, 453-456

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