Production: CHEESE SPREAD

Objective: Spreadability/Softness of cheese spread

Type of action: Penetration test

Test mode settings:

Speed	Test mode	Trigger	Target	Hold
3 mm/s	Distance (c)	0 gf	23 mm	0 sec

Accessory:
Butter spreadability rig, Platform

Introduction:
Many people are interested in measuring the spreadability of food products such as butter, spreads, peanut butter, margarines, cheese, and cream cheese as well as non-food items such as lotions, creams, gel shaving creams, joint compound, greases, etc. These products are often very shear sensitive and are difficult to consistently prepare for testing. Penetration and compression style tests are simple methods that give results of sample hardness. Hardness measurements however, even with cone probes, are not always good discriminators of spreadability although the apparent yield value calculated from cone penetration with constant load has been used in the past and has correlated with sensory estimates of spreadability.

Firmness (or hardness - the two are synonymous) as a discrete sensory property of a table spread is implicit in the determination of its spreadability. The first impression of a table spread texture will be that of its firmness, obtained as the consumer forces a spreading instrument into the product. Spreadability, in pragmatic terms, is the ease with which a spread can be applied in a thin, even layer to bread. Firmness or hardness may be measured by the force required to obtain a given deformation or by the amount of deformation under a given force. Although spreadability is also a deformation under an external load, it is a more dynamic property. Measurements of firmness and spreadability are usually highly correlated, however the relationship is rarely perfect, and this is partly a function of worksoftening. Margarine, for instance, work softens (when spread on bread) more easily than butter, which allows it to be more spreadable even when hardness values are initially equal.

The Butter spreadability rig is a set of precisely matched male and female Perspex 90 cones. The material is allowed to set up in the lower cone or is filled into the lower cone with a spatula. The material is pressed down only so much as is needed to eliminate air pockets which are visible through the Perspex cones, and then the surface is levelled with a flat knife. Excessive work is not introduced into the product. The fixture comes with five replaceable female cone sample holders which can be filled in advance of testing and then easily locked into the base holder precisely centred under the matching upper male cone probe. The sample holders can be stored in refrigerated or frozen environments, or they can be used at room temperature.

As long as the material has not been excessively worked or whipped, different styles of filling the material only affect the early part of the test.

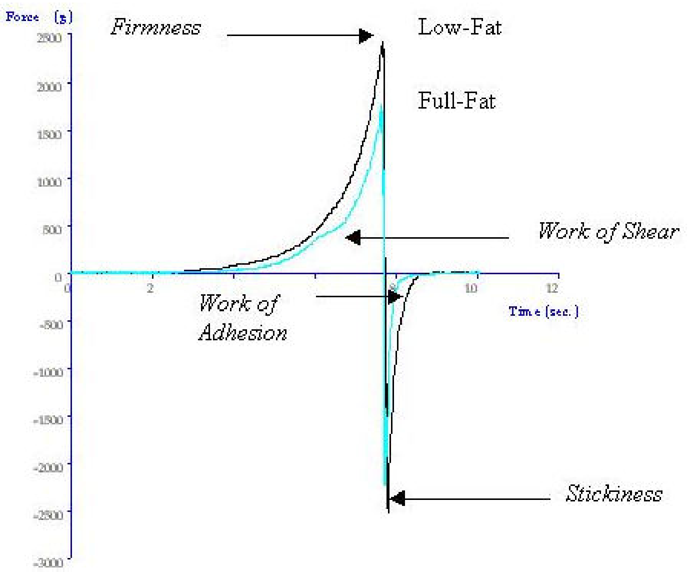
The important action that the test is designed to measure, spreadability, occurs only in the later stages of the test. During these stages the product is squeezed out from between the male and female cones. The cone-shaped holder offers no locations into which the product can be packed or compressed, so the product flows outward between the male and female cone surfaces. The probe withdrawal may offer some insights into adhesive behaviours.

Sample Preparation:
Place sample into the female cone and press it down to eliminate air pockets. Scrape off any excess sample with a knife, to leave a flat test area. Excessive work should not be introduced into the product. Allow the samples to equilibrate to the specified temperature e.g. 20C before testing.

Test Set-Up:
Place the Heavy Duty Platform on the base of the machine but do not secure the position at this stage. Position the base holder on the Heavy Duty Platform and lock into place by tightening the screws. Insert an empty female cone sample holder into the base holder. Move the male cone probe down so that it fits almost all of the way into the female cone sample holder. When the male and female cones are practically touching, moved the Heavy Duty Platform so that the cones are precisely aligned. At this point tighten the screws of the Heavy Duty Platform so that it is secured into position. Before testing, the male cone probe must be calibrated against the female cone so that the starting point is at the same height for each test e.g 25.0mm above the female cone. To do this, raise the male cone up so that it is just above the female cone and select: **Calibrate Height**

When prompted, type in 25.0mm for the return distance, then click on OK. The probe will come down, just touch the female cone, and then return to a position precisely 25.0mm over the female cone. The **Control Probe** facility allows this test position to be reset rapidly and accurately after replacing the female cone with a new sample and cleaning the male cone. Each test must be commenced from this 25mm start position.

Typical plots:



The above curves were produced from low and full-fat cheese spreads, tested at 20C.

Observations:
Once the test is commenced the male cone probe proceeds to approach and then penetrate into the cheese spread sample and continues to a depth of 2mm above the sample holder surfaces, i.e. the probe moves a distance of 23mm from its start point. During penetration the force is seen to increase up until the point of maximum penetration depth. This force value can be taken as the firmness at this specified depth. A firmer sample also shows a correspondingly larger area that represents the total amount of force required to perform the shearing process. Both of these values have been shown to rank samples in the same order of spreadability (and firmness), but for some samples one may prove to be more suitable than the other. The probe then proceeds to withdraw from the sample. The maximum negative peak indicates the stickiness of the sample and the maximum negative area is taken as the work of adhesion. A stickier sample will require a greater force to remove the probe, yielding a larger negative area. The results of this test reveal the low-fat sample to be firmer and stickier than its full-fat counterpart, and so would be more difficult to spread.

Data Analysis:

☒Max Force

☒Area (+)

☒Min Force

Results

Sample	Mean Max. +ve Force 'Firmness' (+/- S.D.) (g)	Mean +ve Area 'Work of Shear' (+/- S.D.) (g·s)	Mean Max. -ve Force 'Stickiness' (+/- S.D.) (g)	Mean -ve Area 'Work of Adhesion' (+/- S.D.) (g·s)
Low-Fat	2306.6 +/- 124.8	2274.5 +/- 73.0	-2424.1 +/- 135.2	-524.5 +/- 65.8
Full-Fat	1852.8 +/- 86.1	1528.7 +/- 23.9	-2352.8 +/- 117.4	-343.2 +/- 12.3

Notes:

- To avoid the Texture Analyzer from overloading/underloading, the cones must be precisely aligned and the chosen penetration distance should always be at least two millimeters less than the calibrated probe height.
- In between tests, only remove the female cone from the base holder; do not remove the base holder from the Heavy Duty Platform otherwise the male and female cones will require realignment.
- During penetration, a large blip in the otherwise smooth curve may be observed. This is due to the compression of an air pocket within the product, so it is important to minimize the presence of air pockets when filling the female cone.
- When reporting results the test temperature and calibrated height (start point) should always be specified for the purpose of comparison.
- When attempting to optimize test settings it is suggested that the first tests are performed on the hardest samples to anticipate the maximum testing range required and ensure that the force capacity allows testing of all future samples.

References:

Methods to Assess Quality and Stability of Oils and Fat-Containing Foods (Eds. K. Warner & N.A. M. Eskin), AOCS Press (1994).

Food Texture - Instrumental and Sensory Measurement (Ed. H.R. Moskowitz), Marcel Dekker (1987).