LFRA TA APPLICATION NOTE
UTILISING COMPUTER INTERFACE PACKAGE

COMPARISON OF PRODUCT SOFTNESS OF FULL, MEDIUM AND LOW FAT SOFT CHEESE

PRODUCT: Philadelphia type soft cheese:

1. Full Fat = 30% Fat
   Per 100g ◊ 19.8g saturated;7.3g Mono; 1g poly (8% protein)
2. Light = 15% Fat
   Per 100g ◊ 9.9g saturated;3.6g Mono; 0.5g poly (12% protein)
3. Extra Light = 6% Fat
   Per 100g ◊ 4g saturated; 1.5g Mono; 0.3g poly (15% Protein)

OBJECTIVE: To compare and contrast the force:deformation curves generated from cream cheese samples of varying fat content and composition.

BACKGROUND: Soft cheeses are classified as cheeses with moisture contents between 48% and 80%. They are sub-divided further into either:

- *Surface ripened, ripening mould added*
  e.g. Brie, Camembert
- *Unripened*
  e.g. Cottage, Lactic, Ricotta

Based on recommendations 1970 Cheese Regulations, full fat soft cheeses should not contain more than 60% moisture with a fat content greater than 20%.

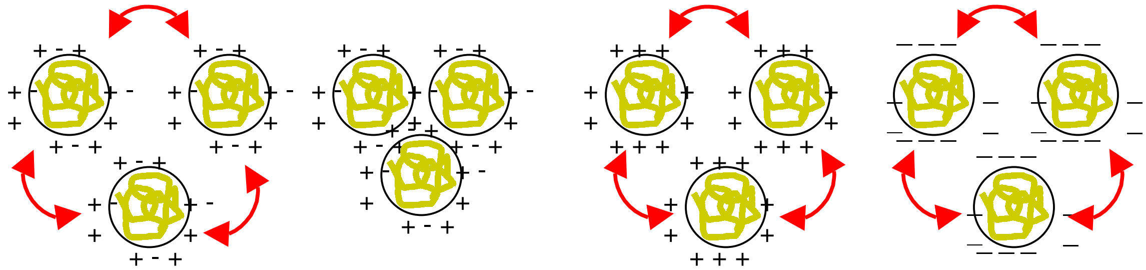
The soft cheese evaluated in this exercise were acid set, being technologically simple to produce. Lactic cheeses are generally manufactured from skimmed milk (although milk with a fat content as high as 25% can be used). Mesophilic starter cultures, usually containing *L. lactis spp. lactis* or *ssp. cremoris* are used to form an acid coagulum. Whey is drained from the curd until when sufficiently dry the resulting cheese is salted and packaged. Texture analysis plays a vital role in the quantification of curd characteristics where it acts as a rheological predictor of finished product quality, as well as a potential indicator of moisture content.

Lactose naturally present in milk is fermented by the starter culture into lactic acid. The production of acid causes a decrease in product pH, which results in destabilisation of the milk protein casein. The milk begins to curdle at around pH 5.2 and the casein is precipitated in the form of flocculent curds entrapping the whey phase in a 3-dimensional network, forming a soft gel. This precipitation is illustrated in Figure 1 where the protein-protein bonds are symbolised at pH 4.7.

The elevated protein content (solids-not-fat) of the light and extra light soft cheese samples evaluated in this exercise, form strong casein-casein bonds uncharacteristic in a full fat soft cheese, where homogenised fat globules are partially covered with casein, facilitating protein-protein interactions. Fat trapped within this protein network imparts the smooth creamy mouthfeel and viscosity characteristic of full fat soft cheese. Fat is therefore considered a critical component in defining food texture and mouthfeel and consequently eating quality.

Fig. 1. The Effect of pH on Milk Protein Stability

The side chains of some amino acids in milk proteins carry an electric charge that is determined by the pH of the milk…



A protein molecule vat pH 6.6 has a net negative charge and molecules remain separate because identical charges repel molecules.

A protein molecule at pH 4.7 is at its isoelectric point, where the hydrogen ions are absorbed by the protein molecules. At pH 4.7 the positive charge of the protein molecule is equal to the negative charge. The protein molecules no longer repel each other, with the positive charge of one molecule linking to the negative charge of neighbouring molecule causing clusters of protein (curd).

A protein molecule at pH 1 absorbs too many hydrogen ions and develops a net positive charge. This results in the molecules repelling each other once more a solution persists.

A protein molecule at pH 14 will acquire a net negative charge and dissolve.

Stabiliser systems are utilised to build solids, increase viscoisity and enhance product mouthfeel (creamy texture) and flavour release. Texture analysysis thus plays an essential role in the development of low fat foods where the product developer wishes to mimic the texture profile of full fat counter parts.

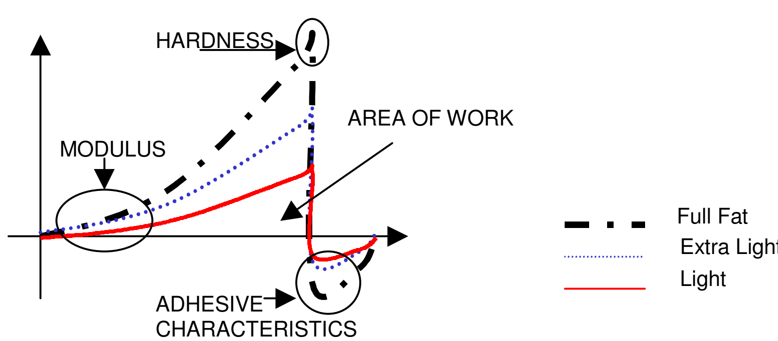
LFRA SETTINGS:	MODE:	Measure force in compression
	PLOT:	Peak
	SPEED:	1mm/s
	DISTANCE:	20mm
	OPTION:	Normal
	TRIGGER:	Auto 4g

PROBE REF: Ref: TA15 – 45^0 Perspex Cone

TEST CONFIGURATION: Samples were removed from refrigerator at 6.8^0c, located beneath the test probe and evaluated within original container. 3 replicate test were made within the same sample.

A time elapse of 3mins persisted between first and last test.

TYPICAL RESULT:



OBSERVATIONS: The test procedure followed generated an insight into both product firmness and spreadability, based the interactions and close correlation between these two results. In addition adhesiveness characteristics were also observed, relating to product mouth coating properties on mastication.

The force deformation curves of the three products show dramatic variation of textural characteristics. The full fat product is the most firmly set possessing the greatest values for all characteristics. This characterises the lowest moisture content and highest proportion of saturated fat in this product. The increase in fat and particularly saturates has resulted in a firm structure with little visible whey, whilst the reduced moisture resulted in surface cracks on penetration.

The half fat product had the lowest hardness and other textural parameter values of the three soft cheeses. This sample had a great deal of visible moisture to its surface indicating that slip may have occurred between the probe:sample interface. It also highlights that this product had weaker structure where the protein network failed to support all milk constituents.

The increased protein of the extra light sample indicates that this sample contained increased solids to compensate for a reduced fat content. The presence of increased solids-not-fat has resulted in a tighter stronger bound network within which the milk constituents are trapped. This corresponds to visual observations where the low fat sample appeared more bound and firm than the light product. This sample was also more grainy, exhibiting surface cracking but to a lesser extent than the full fat product.

DATA ANALYSIS: Ensure that cursor B is positioned at the start of profile curve and that cursor A is at peak load.

All parameters can then simply be calculated through *Analyse a test with tables*" screen.

PARAMETERS:

HARDNESS (g)	Peak positive load attained in full cycle Force required to attain a given deformation
ADHESIVE FORCE (g)	Peak negative load attained in full cycle Force required to pull probe from sample
TOTAL POSITIVE AREA (gs)	Work required to attain deformation indicative of internal strength of bonds within product
TOTAL NEGATIVE AREA (gs)	Work necessary to overcome attractive forces between food surface and materials with which it comes into contact
MODULUS (g/s)	Ratio of sample stress divided by strain during the first compression cycle e.g. the slope of force:deformation curve within linear region. It is representative of sample rigidity

RESULTS:

	FULL FAT	LIGHT	EX. LIGHT
HARDNESS (g)	897	180	356
ADHESIVE FORCE (g)	-140	-33	-60
TOTAL POSITIVE AREA (gs)	6502.8	1171.7	2279.4
TOTAL NEGATIVE AREA (gs)	196.8	-63.5	-83.9
MODULUS (g/s)	34.6	5.7	11.1

CONCLUSIONS:

Texture evaluation has highlighted that the three products evaluated have very different textural characteristics. The full fat product has the firmest texture with a very structured and bound consistency. The light product is very soft in comparison with a high degree of free moisture. The extra light product falls between both the full fat and light samples, with a structured consistency resultant of stabilisation with increased milk protein and additives. The inclusion of these compounds failed to mimic the overall profile of the full fat sample where adhesion parameters of both the light samples fall a long way short of the full fat attribute.

The average values recorded highlight the hardness and modulus parameters to show greatest differentiation between samples. The modulus data gives optimum indication of sample rigidity as the test probe penetrates the sample, as if a spreading implement is penetrating the product. This is therefore a very good imitative measure within either the quality or research environment.

Finally the stabilising system included within the reduced fat products has failed to mimic the textural characteristics of the full fat product.

AFFECTING FACTORS:

Test Conditions which will effect results generated:

1. Sample size
2. Sample age
3. Sample temperature
4. Base and edge effects caused by probe contact with product packaging
5. Proximity of previous test sites

Sample conditions which will effect results generated:

1. Fat content
2. Type of fat present
3. Synerisis and surface characteristics
4. Protein content
5. Composition and formulation e.g. presence of stabilisers and other additives.

RELATED TESTS

Penetration with cylinder probe
Stress relaxation with either conical or cylinder probe (simply utilise hold function in programme settings.