



Some simple guidelines for texture testing . . .

Dairy

What does Texture Analysis mean to the Dairy Industry?

Dairy products are unique in that they primarily originate from the same base ingredient. Raw milk is condensed, fermented, agitated and acidified to create a whole range of products each with unique textures and flavour profiles. Physical properties and sensory texture play a critical role within the processing behaviour, performance and ultimately consumer perception.

Instrumental texture analyses combined with sensory expertise are essential *objective* tools for the identification and measurement of *subjective* textural characteristics.

- From a **manufacturer's** perspective, this could be structural changes during additional unit operations such as grating, slicing, pumping, mixing and depositing, or through formulation changes.
- From a **customer's** perspective, this could be an anticipated or expected sensory profile, where a low fat cheddar cheese should still feel like its traditional full fat counterpart or behave in a pre-specified manner, e.g. a production level.

Some Texture Analysis Experiences Within The Total Quality Loop

RESEARCH & DEVELOPMENT

"...texture analysis helped us establish how cheese gel hardness affected aroma release"

"...we used it to identify which strains of functional bacteria gave us the best texture in yogurts"

QUALITY DEPARTMENT

"...critical texture qualities identified during research and development were used to monitor our production process"

"...random sampling allowed us to measure the effect of seasonal changes in the setting properties of our yogurts"

PRODUCT DEVELOPMENT

"...texture analysis helped us to measure the effect of using ingredients from different suppliers in our dips"

"...we used it to see how our cheese texture changed during maturation"

**TOTAL
APPROACH TO
QUALITY**

PROCESS DEVELOPMENT

"...texture testing helped us to commission our new fermentation plant so we could maintain the same properties of our Stilton"

"...it increased automation in our dairy to measure shear thinning in our cream cheese"

How do I know that I need to measure the texture of my dairy product?

Food texture analysis is primarily concerned with how a food material feels, behaves and performs. There are two principle approaches that can be taken to measure food texture:



Sensory based

Texture treated as a perception or human experience, which is correlated to what we feel.

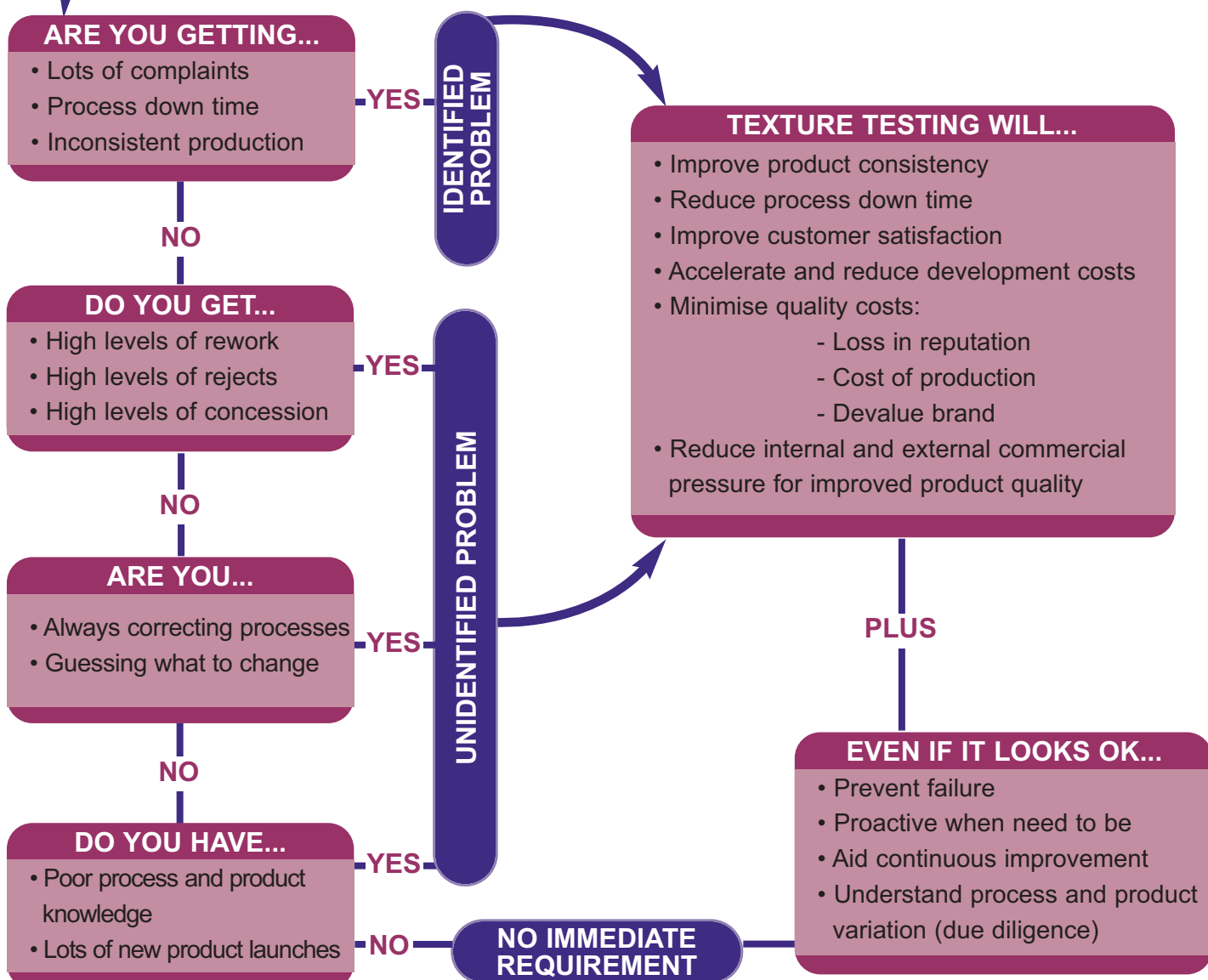


Engineering based

Texture treated as a condition, which can be monitored and manipulated during manufacture.

Whatever approach is taken, the methods followed should be simple, practical and, most importantly, generate information of “real” value on the product being tested.

Do I have a texture related problem?



PRODUCT

DESCRIPTION

PASTES & VISCOUS LIQUIDS

DIPS
MAYONNAISE
SOURD CREAM
FROMAGE FRAIS
CRÈME FRAICHE
YOGURTS
WHIPPED CREAMS
MOUSSE
CLOTTED CREAM



Thick semi-solid products with weak gelled structures. Supplied in containers due to unsupported structure. May contain particulates such as fruit, onions and confectionery pieces.

PARTICULATES

FRUIT PREPARATIONS
FRUIT & VEGETABLE INCLUSIONS
RICE PUDDINGS
COTTAGE CHEESE
CURDS

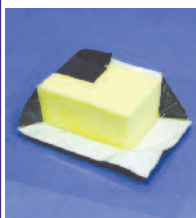


Small, irregular and non-uniform particulate pieces with viscous solid structure. Consumed or handled in bulk. Multiple blades are used to maximise contact area between instrument and establish averaging effect on measurement.

Range from individual grains in cooked and dried state to fruit pieces, dried berries and precipitated milks.

PLASTIC & VISCOUS SOLIDS

MARGARINE
SPREADS
BUTTER
CREAM CHEESE
QUARK
RICOTTA
PROCESSED CHEESE



Smooth viscous pastes with uniform structure. Self-supporting at low temperatures, becoming fluid as the temperature rises.

Often supplied in container due to temperature-related softening. Butter and some cooking margarines are the exception where fat constituents contained in multiphase emulsion are solid at higher temperatures.

SOFT CHEESE - CREAMY & ELASTIC

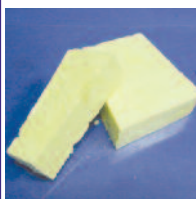
BRIE
CAMEMBERT
GOATS CHEESE
PORT SALUT



Soft creamy ripened cheese that soften over life, almost becoming liquified. Often have a rind on the outside, which holds very soft creamy interior. Ripeness can be measured by squeezing to the rind or by measuring the interior resistance.

HARD CHEESE - WAXY & ELASTIC

MOZZARELLA
FETA
PANEER
HALLUMI
EDAM
STILTON
CHEDDAR
PARMESAN



Predominantly waxy solid materials with low moisture content. Formed from pressed curds, they are generally matured to develop specific textures and flavours.

Elastic when lightly compressed and viscous (like plasticine) when squashed to high levels.



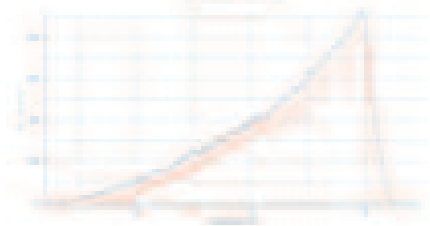
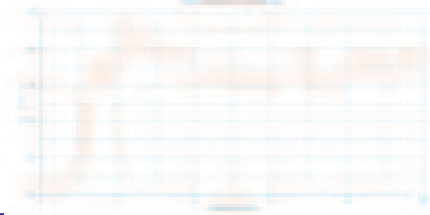
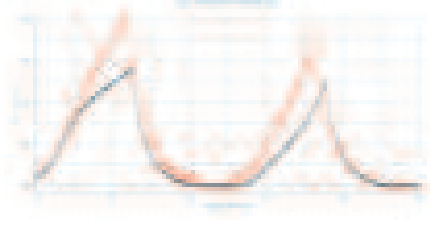
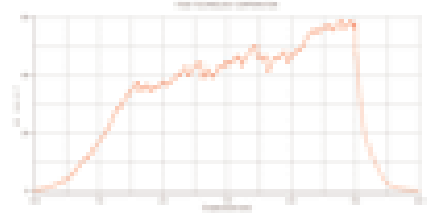

MULTILAYERED & VARIABLE

FRUITED CHEESES
DUAL-LAYERED CHEESE
ICE-CREAM




Products with non-homogenous textures. Can support particulates of dried fruits, vegetables and nuts or consist of different layers to provide more interest to the consumer.



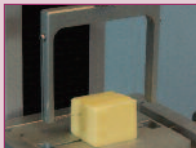
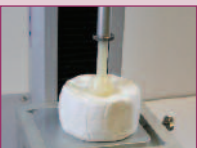

CORE CHARACTERISTICS

<ul style="list-style-type: none"> • Consistency and body of gelled structure • Flow characteristics • Shear thinning in pumps • Structure recovery • Mouth coating • Spoonability 	<p style="text-align: center;">SEMI-SOLID</p> <p style="text-align: center;">FLOWS IF UNSUPPORTED. POURED, PUMPED, EXTRUDED OR SPREAD DURING HANDLING OR CONSUMPTION</p> 	<p>Extrusion comparison between low fat and full fat yogurts</p> 	
<ul style="list-style-type: none"> • Firmness of curd set • Water holding capacity • Brittleness of curd • Fermentation characteristics • Whey drainage • Press efficiency • Cook quality (rice) • Vegetable freshness 		<p>Bulk shearing to assess cottage cheese curd at different PH</p> 	
<ul style="list-style-type: none"> • Firmness and spreadability • Work softening • Melting point and temperature related changes • Flow yield point • Process hardness • Adhesiveness • Effect of fat type and content variation • Aerated texture 		<p>ISO-16305 wire shearing firmness testing on tempered butter</p> 	
<ul style="list-style-type: none"> • Ripening • Rind toughness • Elasticity and springiness • Softness and maturity • Shelf-life changes • Sensory comparisons • Melting properties 		<p>TPA testing of ripening brie with ball probe</p> 	
<ul style="list-style-type: none"> • Sensory comparisons • Grating/slicing hardness • Surface adhesion • Maturity • Pressed properties • Bacterial degradation • Crumbliness • Shelf-life changes • Moisture migration and surface changes 		<p style="text-align: center;">SOLID</p> <p style="text-align: center;">SELF-SUPPORTING STRUCTURE. DEFORMED, SQUASHED, SHEARED OR SNAPPED DURING HANDLING OR CONSUMPTION</p>	<p>Fracture wedge testing of cheddar cheese</p> 
<ul style="list-style-type: none"> • Inclusion softening • Bulk hardening • Ripening • Shelf-life changes • Breakdown • Moisture migration • Melting properties 			<p>Multiple needle penetration of fruited cheese</p> 



CHOOSING THE RIGHT FIXTURE

	EXTRUSION	BULK ANALYSIS
	Make a thick liquid flow just like pumping a yogurt or depositing a mayonnaise	Measure individual pieces in bulk like eating a spoonful of cottage cheese or squashing curd together to make cheddar
PASTES & VISCOUS LIQUIDS DIPS MAYONNAISE SOURED CREAM FROMAGE FRAIS CRÈME FRAICHE YOGURTS WHIPPED CREAM MOUSSE CLOTTED CREAM	TMS EXTRUSION CELL (432-026) TMS-EXTRUSION CONE (432-027) TMS EXTRUSION PLATEN SET (432-029) TMS AERATED SAMPLE PROBE (432-030)	Test samples in pots they are deposited in using extrusion cones or platens 
PARTICULATES FRUIT PREPARATIONS FRUIT & VEGETABLE INCLUSIONS RICE PUDDINGS COTTAGE CHEESE CURDS	TMS EXTRUSION CELL (432-026)	FTC STANDARD SHEAR COMPRESSION CELL (432-240) FTC THIN BLADE SHEAR COMPRESSION CELL (432-231) TMS MINI KRAMER SHEAR/ OTTAWA CELL (432-033)
PLASTIC & VISCOUS SOLIDS MARGARINE SPREADS BUTTER CREAM CHEESE QUARK RICOTTA PROCESSED CHEESE	TMS BUTTER AND MARGARINE SPREADABILITY JIG (432-309)	
SOFT CHEESE - ELASTIC BRIE CAMEMBERT GOATS CHEESE PORT SALUT	Hold containers in place when carrying out extrusion tests with the TMS Container Grips (432-038) 	
HARD CHEESE - WAXY & ELASTIC MOZZARELLA FETA PANEER HALLUMI EDAM STILTON CHEDDAR PARMESAN		Use multiple probes to measure firmness and allow for particles in fruited cheese 
MULTILAYERED & VARIABLE FRUITED CHEESES DUAL-LAYERED CHEESE ICE-CREAM		

MULTIPLE POINT ANALYSIS	PENETRATION	SHEARING	COMPRESSION
<p>Multiple site tests are used to measure products with variable textures like pushing a fork into a fruited cheese</p>	<p>Use small cylinders, balls, needles and cones to push into a sample like pushing your finger into a piece of ripe Brie</p>	<p>Cut across a section of the sample just like cutting through a block of butter</p>	<p>Squash a small sample with a flat or rounded probe like squeezing a piece of cheese in your hand</p>
<p>Measure curd firmness with the Kramer Shear Cell to assess bulk properties</p> 	<p>1" PERSPEX HEMISPHERICAL (432-096) 1" BALL PROBES (432-088)</p>	<p>Ball and hemispherical probes can act like pushing your thumb in to a thick liquid like dips</p> 	
	<p>2MM Ø CYLINDER (432-076)</p>		<p>Use wire shear probe to measure cross-section of sample and follow ISO 16305 (Butter Firmness Standard)</p> 
	<p>4.5MM Ø CYLINDER (432-072) 45° PERSPEX CONE (432-081)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS WIRE SHEAR PROBE AND PLATE (432-242)</p>	
<p>Use ball probes to press on sample surface and measure ripeness</p> 	<p>1" PERSPEX HEMISPHERICAL (432-096) 1" BALL PROBES (432-088)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS WIRE SHEAR PROBE AND PLATE (432-242)</p>	<p>TMS 50MM Ø COMPRESSION PLATEN (432-009)</p>
	<p>10MM Ø AND SMALLER S.S. CYLINDERS (432-066 TO 432-074)</p>	<p>TMS LIGHTWEIGHT BLADE SET (432-245) TMS WIRE SHEAR PROBE AND PLATE (432-242) TMS LARGE KNIFE EDGE (432-017)</p>	<p>TMS 50MM Ø COMPRESSION PLATEN (432-009)</p>
<p>TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)</p>	<p>Use large knife wedge to create a fracture and split hard cheese</p> 	<p>TMS LARGE CRAFT KNIFE (432-295) TMS WIRE SHEAR PROBE AND PLATE (432-242)</p>	<p>Please Note: Accessories listed in each category are examples of those most suited to the application. Only one accessory is normally required per application to perform the majority of tests.</p>

APPLICATION SHEETS

- Yogurt structure and consistency measurement through penetrometry
- Comparison of viscosity and gel strength of low fat derivatives of mayonnaise
- Measure the effect of process or formulation changes
- Shear thinning in stabilised dairy creams
- Hardness changes with milk fat constituents
- Aerated mousse stability and breakdown
- Cheese curd texture as a precursor to improved finished product quality
- Water holding capacity of curds when using different formulations and over different stages of shelf-life
- Compression behaviour of Cheddar cheese
- Work softening properties of butters and spreads used in commercial bakeries
- Measure spreadability and setting characteristics in margarine
- Quantify changes when using different blends of oils and fats
- Crumbliness of Latin American style cheese
- Mayonnaise flow yield point
- Use as standard quality measure of butter firmness testing following ISO 16305 test protocol
- Processing properties of hard cheese in relation to slicing
- Stress relaxation to measure visco-elasticity in elastic products such as Mozzarella
- Texture Profile Analysis correlations with sensory measurements in Cheddar cheese
- Stringiness of melted cheese
- Ripening and processing conditions on the effect of cheese texture

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