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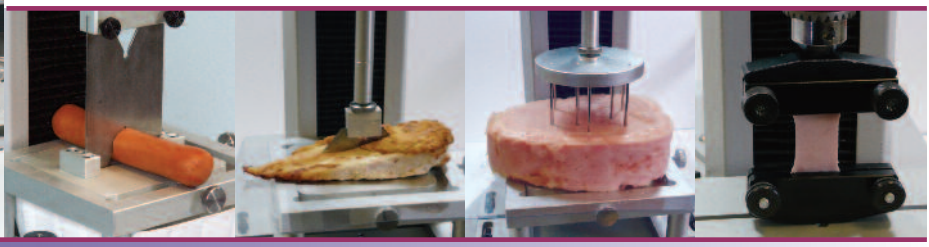

Some simple guidelines for texture testing . . .

Meats

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What does Texture Analysis mean to the Meat Industry?

Texture is a primary consideration in determining the eating quality of fish, meat and their processed derivatives. Sensory studies have shown that the consumers consider meat tenderness or perceived textural quality to be the most important characteristic upon which satisfaction is based; for example, we do not want a processed meat product to appear rubbery or a steak to be tough!

Texture analysis is an objective and reproducible way of measuring the critical quality attributes of tenderness and eating quality. These instrumental measurements put a number to what would otherwise be a subjective characteristic.

- From a ***manufacturer's*** perspective, this could be the effect of an ingredient e.g. a processed ham producer adding water to his product and wanting to quantify the maximum level of added H_2O acceptable to the consumer.
- From a ***customer's*** perspective, this could be the integrity of our reformed ham when used in a convenience food or its performance in a commercial slicer.

Some Texture Analysis Experiences Within The Total Quality Loop

RESEARCH & DEVELOPMENT

"...texture analysis allowed us to objectively measure the effect of ageing on meat tenderness"

"...we used it to design a hydrocolloid blend to maximise water holding in reduced fat paté"

QUALITY DEPARTMENT

"...critical texture qualities gave us an objective way to check quality inconsistencies in our hotdog plant"

"...texture testing gave us a reproducible way of standardising our beef burger suppliers"

PRODUCT DEVELOPMENT

"...texture analysis helped us identify core sensory attributes when we developed a vegetarian hotdog"

"...we used it to develop a reformed ham product for an own label low-cost brand"

PROCESS DEVELOPMENT

"...texture testing helped us to commission our new forming press for making burgers"

"...we used shear testing to measure the slicing properties of our chorizo sausage"

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

ARE YOU GETTING...
- Lots of complaints
- Process down time
- Inconsistent production

YES → IDENTIFIED PROBLEM

NO ↓

DO YOU GET...
- High levels of rework
- High levels of rejects
- High levels of concession

YES → UNIDENTIFIED PROBLEM

NO ↓

ARE YOU...
- Always correcting processes
- Guessing what to change

YES → UNIDENTIFIED PROBLEM

NO ↓

DO YOU HAVE...
- Poor process and product knowledge
- Lots of new product launches

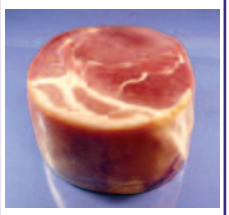
YES → UNIDENTIFIED PROBLEM

NO → NO IMMEDIATE REQUIREMENT

TEXTURE TESTING WILL...
- Improve product consistency
- Reduce process down time
- Improve customer satisfaction
- Accelerate and reduce development costs
- Minimise quality costs:
  - Loss in reputation
  - Cost of production
  - Devalue brand
- Reduce internal and external commercial pressure for improved product quality

PLUS

EVEN IF IT LOOKS OK...
- Prevent failure
- Proactive when need to be
- Aid continuous improvement
- Understand process and product variation (due diligence)

PRODUCT		DESCRIPTION
PASTES & VISCOUS LIQUIDS MEAT SLURRIES PASTES POTTED MEATS MECHANICALLY REMOVED MEAT CRAB MEAT STOCKS & CONCENTRATES		Thick semi-solid products with weak gelled structures. Supplied in containers due to unsupported structure. May contain particulates such as onions, course muscle fibres and nuts. Food system can be emulsified to support particulates.
PARTICULATES MINCED MEATS GROUND BEEF DICED MEATS (STEAK, CHICKEN, FISH ETC) PIE FILLINGS PRAWNS, SQUID AND OTHER SEAFOOD RECONSTITUTED MEAT PIECES AND HAMS		Small, irregular and non-uniform particulate pieces with fibrous solid structure. Predominantly consumed or handled in bulk encompassing all texture characteristics including those of carriers such as sauces and gels. Bulk test measurements will quantify toughest component providing an indication of bulk firmness from shearing or puncture.
HOMOGENEOUS SOLIDS PATE MOUSSES BOLONGA LIVER SAUSAGE PROTEIN BASED GELS E.G. SURIMI, MEAT & SURIMI HOTDOGS & FRANKFURTERS		Smooth viscous pastes or homogeneous gelled products with uniform structure. Self-supporting, can be cut or spread when under sufficient stress. Highly elastic when lightly squeezed, but fail once maximum resistance is reached. Generally fracture, split or begin to flow once yield force or conditions are reached.
INHOMOGENEOUS SOLIDS BURGERS EMULSIFIED MEATS (BREADED PRODUCTS) SAUSAGES RECONSTITUTED COOKED HAMS SALAMI TERRINES		Inhomogeneous solid products made up from suspended particulates of varying size and shape. Often incorporate gelling or binding components to create self-supporting and emulsified structure. Presence of gelling agents create elastic structure at small deformations. Products will fail or collapse when squashed to higher levels, reverting to particulate or component structure.
FIBROUS SOLIDS WHOLE MUSCLE • STEAKS • FISH FILLETS • WHOLE FISH	 	Bundles of muscle fibres tightly grouped together. Multiple groups of fibre bundles are often found within a single sample, which can result in combinations of fibre orientation. Result producibility is improved when single orientation of fibres is used in traditional shear tests. If muscle tissue is in variable form, multiple point analysis using Kramer shear cell is advised to measure toughest component. **Special Note: For improved testing accuracy** Samples are generally taken from iced carcasses using mechanical borers. Samples must be taken from the same location of different carcasses to compare results. Orientation of fibres within the cored muscle sample must be presented to the test blade in the same direction between samples as this will directly affect the force reading recorded e.g. if the blade passes down through the fibre bundles the forces will be much lower than if the blade cuts through the bundles themselves. If carcasses are tested whole as with fish, the test site must be in the same position on each sample, e.g. when testing whole salmon for firmness, a site just behind the dorsal fin is used.

CORE CHARACTERISTICS

- Consistency and body of gelled structure
- Flow characteristics on spreading and pumping
- Structure recovery after pumping
- Cohesiveness and/or mouth coating properties

SEMI-SOLID

FLOWS IF UNSUPPORTED. POURED, PUMPED, EXTRUDED OR SPREAD DURING HANDLING OR CONSUMPTION

Penetration of potted crab paste with ball probe

- Resistance to chewing of particles
- Grizzle content
- Firmness of reconstituted ground meats
- Toughness of muscle fibres

Kramer shear test on different grades of minced beef

- Firmness and spreadability
- Yield point and flow
- Gel strength and break point
- Gel relaxation and resilience
- Elasticity and springiness

Warner-Bratzler shear test on tofu and meat hotdogs

- Slicing resilience
- Hardness to bite (shearing)
- Hardness to touch (compression)
- Elasticity and consistency comparisons
- Bond strength of emulsion
- Sensory comparisons and objective measures
- Skin peel strength

Multiple penetration of burger patties

- Muscle fibre toughness
- Bonding strength between fibres
- Shear toughness of muscle
- Firmness of muscle
- Elasticity and resistance to chewing
- Maximum bite resistance
- Tensile strength an bonding

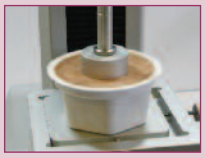
SOLID

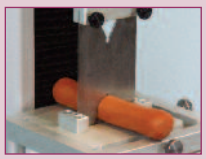
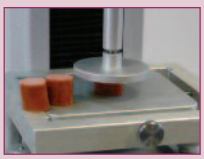
SELF-SUPPORTING STRUCTURE. DEFORMED, SQUASHED, SHEARED OR SNAPPED DURING HANDLING OR CONSUMPTION

Razor blade shear testing of cooked chicken breast to measure toughness

Ball probe compression testing of fish fillet firmness

CHOOSING THE RIGHT FIXTURE

	EXTRUSION	BULK ANALYSIS	MULTIPLE POINT ANALYSIS
	Make thick liquids flow just like pumping a meat slurry or depositing an unset terrine or paté mix	Measure individual pieces in bulk as if biting through a mouthful of ground beef or squashing minced meat together to make burger patties	Multiple site tests are used to measure products with variable textures as if biting into burger patties or reformed ham
PASTES & VISCOUS LIQUIDS MEAT SLURRIES PASTES POTTED MEATS TERRINES	TMS EXTRUSION CELL (432-026) TMS-EXTRUSION CONE (432-027) TMS EXTRUSION PLATEN SET (432-029)	Back extrusion of thick pastes to measure consistency and body 	
PARTICULATES MINCED MEATS DICED MEATS (STEAK, CHICKEN, FISH ETC) PIE FILLINGS PRAWNS, SQUID AND OTHER SEAFOOD RECONSTITUTED MEAT PIECES AND HAMS		FTC STANDARD SHEAR COMPRESSION CELL (432-240) TMS MINI KRAMER SHEAR/ OTTAWA CELL (432-033) TMS CRISPNESS CELL (432-296)	TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)
HOMOGENEOUS SOLIDS PATÉ MOUSSES LIVER SAUSAGE PROTEIN BASED GELS E.G. SURIMI, MEAT & FISH JELLIES HOTDOGS & FRANKFURTERS	Kramer shear blades assess quality and grizzle content in ground beef 		TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)
INHOMOGENEOUS SOLIDS BURGERS EMULSIFIED MEATS (BREADED PRODUCTS) SAUSAGES RECONSTITUTED COOKED HAMS SALAMI		Multiple points testing used to evaluate entire cross-section of patties firmness 	TMS MULTIPLE NEEDLE PROBE (432-249) TMS JUNIOR MULTIPLE PROBE FIXTURE (432-252)
FIBROUS SOLIDS WHOLE MUSCLE E.G. STEAKS, FISH FILLETS & WHOLE FISH		FTC STANDARD SHEAR COMPRESSION CELL (432-240)	

PENETRATION	SHEARING	COMPRESSION	TENSION
Use small cylinders, balls, needles and cones to push into a sample like pushing your finger on to the surface of reformed meat to measure gel firmness	**Cut across a section of the sample just like biting through a piece of steak or cutting through a chicken breast**	**Squash small or cored samples with flat or rounded probe as if squeezing with the tongue or in the hand e.g. evaluate hardness to touch of hotdogs**	**Stretch or pull a sample to see how it extends and resists like pulling sliced meats away from your front teeth as you bite into a sandwich**
1" PERSPEX HEMISPHERICAL (432-096) **1" BALL PROBES (432-088)** **TMS FMBRA DOUGH POTS (432-034)**			Tension tests allow break strength analysis of liver sausage to identify failure point 
2MM Ø NEEDLE PROBE (432-087) **1" BALL PROBES (432-088)**	Ball probe is used to test firmness and elasticity of processed meats 		
1" PERSPEX HEMISPHERICAL (432-096) **1" BALL PROBES (432-088)** **10MM Ø AND SMALLER S.S. CYLINDERS (432-066 TO 432-074)** **TMS CONICAL PROBES (432-079 TO 432-085)**	**TMS LIGHTWEIGHT BLADE SET (432-245)** **TMS LARGE CRAFT KNIFE (432-295)** **TMS WIRE SHEAR PROBE AND PLATE (432-242)**	**TMS 75MM Ø COMPRESSION PLATEN (432-010)**	**TMS EXTENSIBILITY FIXTURE (432-046)** **TMS LARGE WEDGE GRIP KIT (432-297)**
Shearing of hotdogs etc to assess hardness to bite for product comparisons 	**TMS LIGHTWEIGHT BLADE SET (432-245)** **TMS LARGE CRAFT KNIFE (432-295)**	**TMS 75MM Ø COMPRESSION PLATEN (432-010)** **1" PERSPEX HEMISPHERICAL (432-096)** **1" BALL PROBES (432-088)**	Compression of sliced sample to evaluate hardness to touch in hot dogs 
Razor blades cut across muscle fibres to assess shear toughness and grade meat 	**FTC HEAVY DUTY BLADE SET (432-014)** **TMS LIGHTWEIGHT BLADE SET (432-245)** **TMS LARGE CRAFT KNIFE (432-295)** **TMS VOLODKOVITCH BITE JAWS (432-016)**	**TMS 75MM Ø COMPRESSION PLATEN (432-010)** **1" PERSPEX HEMISPHERICAL (432-096)** **1" BALL PROBES (432-088)**	Whole fish tested behind dorsal fin to assess muscle firmness and structure 

APPLICATION SHEETS

- Firmness and viscosity comparisons between low fat and full fat paté
- Yield and spreading properties of meat paste
- Toughness testing of minced meat before and after cooking
- Assess grizzle content and effect of size reduction (mincing) on structure
- Optimise cooking process to maximise perceived tenderness in pork steak
- Compression testing to measure physical consistency for slicing performance
- Assess functional properties of gelling and binding agents on reconstituted ground meats
- Measure burger tenderness from different suppliers
- Optimise product formulation and functionality in vegetarian hotdog
- Measure toughness (hardness to bite) by shearing through chicken fillet
- Firmness testing of fish cake to assess performance in former or moulding machine
- Correlate with perceived sensory textures on shearing and understand breed, sex and age variations
- Use stress relaxation to measure visco-elasticity in elastic products such as surimi gels and hotdog slices
- Muscle firmness testing if wild and farmed salmon using ball probe
- Water holding capacity and texture of reformed hams using TPA
- Prediction of poultry meat tenderness using razor blade shear test
- Instrumental texture analysis of restructured beef steaks
- Influence of gums on low fat meat system

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