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THE WORLD OF FOOD TEXTURE: Defining Characteristics and Areas of Overlap

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Texture – From Universal Concepts To Universal Food Texture Scales

Texture – Universal concepts based on rheology

Texture is the sensory manifestation of the structure or inner makeup of materials perceived through receptors in the skin (tactile / somesthesis) or muscles (force / kinesthesis)

Texture concepts can be broadly subdivided into three main categories

- Mechanical properties (e.g., hard, dense, cohesive)
- Geometrical properties (e.g., roughness of mass, size and shape of particles)
- Moisture characteristics (e.g., surface moistness, moisture release or absorption, moistness of mass)

These concepts can be leveraged universally in the world of consumer products.

The concept of hardness, for example, defined as the force required to attain a given deformation, applies to categories as disparate as:

Foods
- Force to compress / firmness (tongue to palate)
- Force to chew (molars)
- Force to bite (incisors)

Personal Care
- Force to compress
- Force to spread
- Force to squeeze bottle

Packaging
- Force to compress
- Force to trigger

Fabric/Paper
- Force to stretch/rip
- Force to compress
- Force to depress

Pen Barrel Elastomer
- Firmness – force to squeeze
- Depression firmness – force to depress the sample ¼ inch

Furniture
- E.g., mattress firmness

More specifically in the world of foods, similar texture properties can be applied to categories seemingly as disparate as yogurt and chips.

Applying universal texture concepts to the world of foods

The Spectrum Food Texture Scales were developed specifically to be used across food products and categories and facilitate direct comparison of texture 'fingerprints' both within a category (apples to apples) and across categories (apples to oranges).

The method includes a universal rating scale, which covers the full range of food products. The scale:

- Ranges from 0.0-15.0, with 0.0 = none and 15.0 = very strong
- Incorporates the ability to use tenths of a point (potential of 151 scale differentiations)
- Uses an absolute zero intensity
- Was developed empirically to exhibit ratio properties (e.g., a rating of 4.0 is twice as intense as a 2.0)

Using this rating scale, each Food Texture Scale incorporates:

- A clear definition of the property under evaluation
- The technique used to determine that property
- A list of anchors or references to aid in determining the intensity of the property.

Example: Hardness

Definition: The force to attain a given deformation, such as force to compress between molars, force to compress between tongue and palate, or force to bite through with incisors.

Technique: Place food between molars and bite down evenly, evaluating the force required to compress the food.

References:

Scale Value	Reference*	Brand/ Type/ Manufacturer	Sample Size
1.0	Cream cheese	Kraft Foods/ Philadelphia block cream cheese	½ in. cube
4.5	Cheese	Yellow American pasteurized process – deli/Land O'Lakes	½ in. cube
7.0	Frankfurter	Large, cooked 5 min, Hebrew National Beef	½ in. slice
9.0	Peanuts	Cocktail type in tin, Planters	1 nut, whole
11.0	Almonds	Shelled, Planters or Blue Diamond	1 nut
14.5	Hard candy	Life Savers	3 pieces, one color

**Note: references for a single texture scale span many different categories, enhancing the universality of the scale.*

The Question

While the idea of a universal texture measurement tool based on universal rheological concepts is intuitive, many questions remain, specific to the granularity of the information that can be gathered through the use of universal scales.

Can each scale within the instrument both demonstrate large differences (for example, between two disparate categories) and offer enough sensitivity to show minute differences among two samples that are quite similar overall?

Methodology

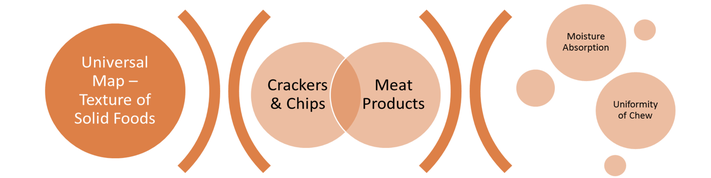
Food Categories

In order to better understand the defining texture spaces among food products, three general categories were chosen:

The Sensory Spectrum expert food panel, trained in the Spectrum Descriptive Analysis method, evaluated 12-18 products from each category.

The panel evaluated texture only, and considered first bite/ compression, chewdown/manipulation, and residual attributes.

Data Mining Approach



Category Differentiation
- Texture profiles of solid foods (meats, chips, crackers) are mapped together to show category-specific attributes as well as areas of overlap.

Expanding the View
- Sub-maps of crackers & chips and meat products 'zoom-in' on attributes that clearly define each category and where differentiation occurs within products in a category.

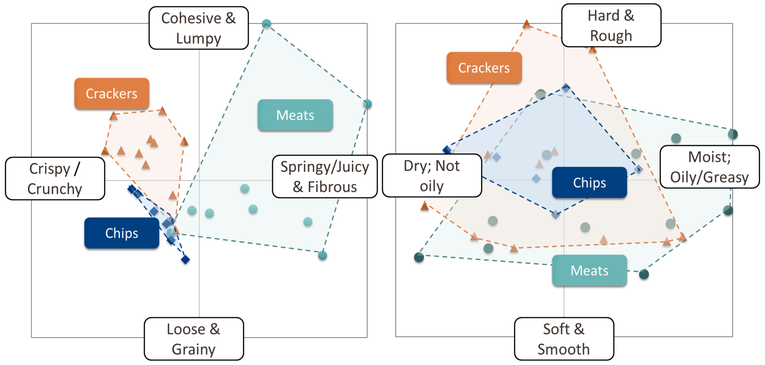
Attribute-Level Comparison
- Zooming in to the attribute level allows for examination of attributes that clearly differentiate between categories and where products in both categories exhibit similar ranges of attribute intensities.

Key Results

WORLD OF SOLID FOODS

The instrument allows identifying areas of differentiation & overlap among very diverse categories.

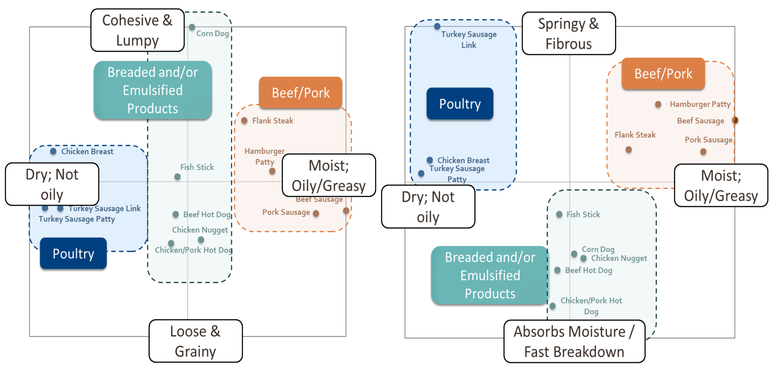
While texture concepts are universal, evaluation techniques may differ for different categories, limiting the ability to consolidate information from disparate categories such as solid, semi-solid and liquid foods.



WORLD OF MEAT

The instrument allows identifying areas of differentiation & overlap within a smaller category.

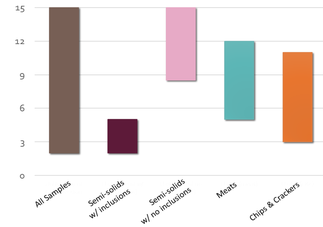
As one explores smaller categories (e.g., moving from the world of meat to the world of chicken nuggets, or even smaller within the context of a smaller DOE to establish quality standards), the instrument continues to highlight similarities and differences among samples.



At the attribute level, some individual texture scales clearly define a product category, while others exhibit large within category variability.

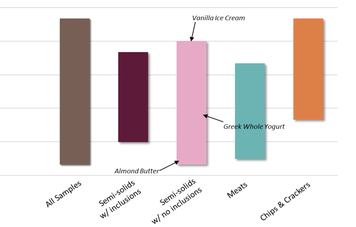
At the attribute level, the instrument shows enough sensitivity to highlight large differences among individual products as in the case of chicken / pork hot dog vs. beef sausage as well as much smaller differences as in the case of chicken / pork hot dog vs. beef hot dog.

Uniformity of Compression/Chew is a category differentiator



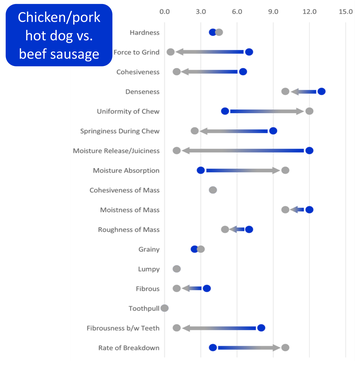
The evenness of force required to bite or chew completely through sample using the molars; the degree to which the mass feels uniform during compression against the palate.

Moisture Absorption demonstrates category overlap at the attribute level



The amount of moisture the product absorbs during chewdown; the degree to which the mass mixes with saliva.

Chicken/pork hot dog vs. beef sausage



Chicken/pork hot dog vs. beef hot dog