

Food Texture: Pleasure and Pain

Gail Vance Civile

Sensory Spectrum, Inc., New Providence, New Jersey 07974, United States

ABSTRACT: Food texture provides sensory signals to consumers. Most of these signals stimulate responses from consumers, both good and bad, because of the expected pleasure – from creamy puddings and ice cream to crispy crackers and snacks. One critical role that texture plays in the success of products is its indication of the freshness and stability of the food product. The mechanical properties of food texture, such as hardness, cohesiveness, crispness, crunchiness, and denseness, are easy indicators of a product's freshness and wholesomeness. Although texture is often considered to be secondary to flavor in evaluating a product's success and acceptability, texture will tip the scales for the consumer, if the texture does not meet the consumer's expectation. Two case studies demonstrate the different texture properties of foods, how they function to generate consumer likes and dislikes, and how texture is key in determining food staleness versus freshness.

KEYWORDS: Food texture, sensory signals, freshness

INTRODUCTION

Product developers and marketers generally focus on the appearance and flavor of foods. The assumption is that consumers do not pay that much attention to the texture. Such thinking can be risky. Consumers do mention the texture of a food or beverage in one of two instances: when the flavor is mild and the texture is pronounced (puddings, chips, cereals) or when the texture is "off" (stale or uncharacteristic). In addition, the texture, although not always articulated, contributes to the total sensory experience and is critical to consumer acceptance and delight.

Early development of texture terminology related to instrumental rheological measures^{1–3} propelled the study of texture as an important consideration in the development and preservation of food quality. Development of panel training techniques,⁴ application to several food types,⁵ and correlation with consumer methods⁶ supported product development focused on the texture properties of foods and beverages. Further development of the descriptive process that expanded the attributes⁷ and refined the Spectrum Descriptive Method to provide even more attributes, references, and clarified scales⁸ brought the tools of study even further. The case studies below demonstrate further application and development.

Texture is the sensory measurement of the structure or inner makeup of foods and ingredients and is "felt" through two distinct pathways: The skin's *tactile sense*, also called somesthesia, perceives fat and moisture and geometrical particles as it moves across the surface of a food. The muscles' *sense of forces*, also called kinesthesia, measures a food's mechanical properties and reactions to applied forces in chewing and manipulation.

Texture combines these physical measures of tactile and mechanical perceptions.

On the other hand, flavor is a combination of chemical senses: taste (salty, sweet, sour, bitter, and umami); olfaction/smell, (fruity, vanilla, meaty, green herb, brown spice, etc.); and chemical feeling factors (heat, metallic, astringent, cool, burn, etc.).

Cohesive – the freshness indicator

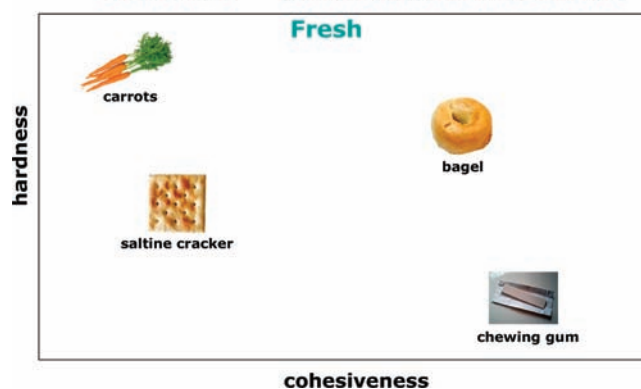


Figure 1

Both flavor and texture are sensory properties and cannot be measured with instruments. Instruments can only simulate what might be perceived in the mouth and, for texture, should imitate the forces that humans use to manipulate those foods in the hand or in the mouth in terms of the type, rate, and direction of application of the force. The compression of a hot dog between two plates is not likely to correlate with human perception of hardness because the hot dog is sheared with the incisors, not compressed. Efforts to understand the attributes that humans perceive and when and how they perceive them can only help the rheologist develop the right instrumental methods to correlate with consumer observations and preferences.

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Some obvious textural pluses and minuses for consumers are as follows: Positives in texture include creamy semisolids such as puddings and ice creams that have thick, smooth, and fatty texture that consumers call “creamy”; snacks, crackers, and vegetables that have crispy and/or crunchy texture that provides tactile, mechanical, and sound “entertainment” in the eating; candy bars, desserts, and main meals with texture contrasts. (Note: children do not like texture contrasts and textural variety

until they get older.) Negatives in texture include cherry tomatoes, oysters, and thick sandwiches that are hard to control and potentially messy; gritty spinach or clams or lettuce with unwanted and unexpected sand; high-fiber cereal products that leave loose fibers in the mouth; and ice creams and chocolates that fail to melt as expected. Also, because texture is a key indicator of freshness and wholesomeness, changes in the texture that indicate staling are easily rejected by consumers.

Most scientists measure hardness as an indicator of stability or design changes in texture. Although hardness is a key textural property of foods, cohesiveness is a better freshness indicator. Cohesiveness is the amount that a product deforms rather than ruptures when forces are applied. Some products, such as stick gum, white bread, and caramels, are initially chewy and deforming, bending to avoid the chew or bite. As these products stale, they become harder and more rigid: they crisp or crumble. On the other hand, products that start out crispy, crunchy, and/or rigid, such as carrots, crackers, and snacks, stale by becoming more bending and deforming (wilting) as they stale. See Figure 1 for the original fresh position. See Figure 2 for cohesiveness with staling.

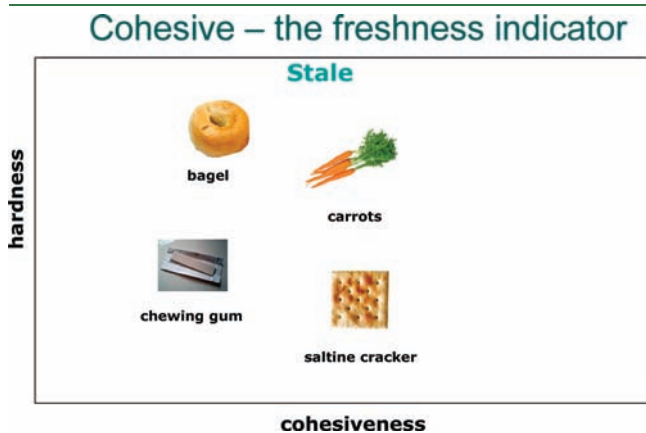


Figure 2

CREATIVE CONSUMERS – SCAN

Sensory Spectrum’s SCAN panel (Spectrum Community Narrative) uses 10–12 highly articulate and creative individuals to discuss and theorize about sensory and product experiences. These innovative consumers provide early guidance to marketing

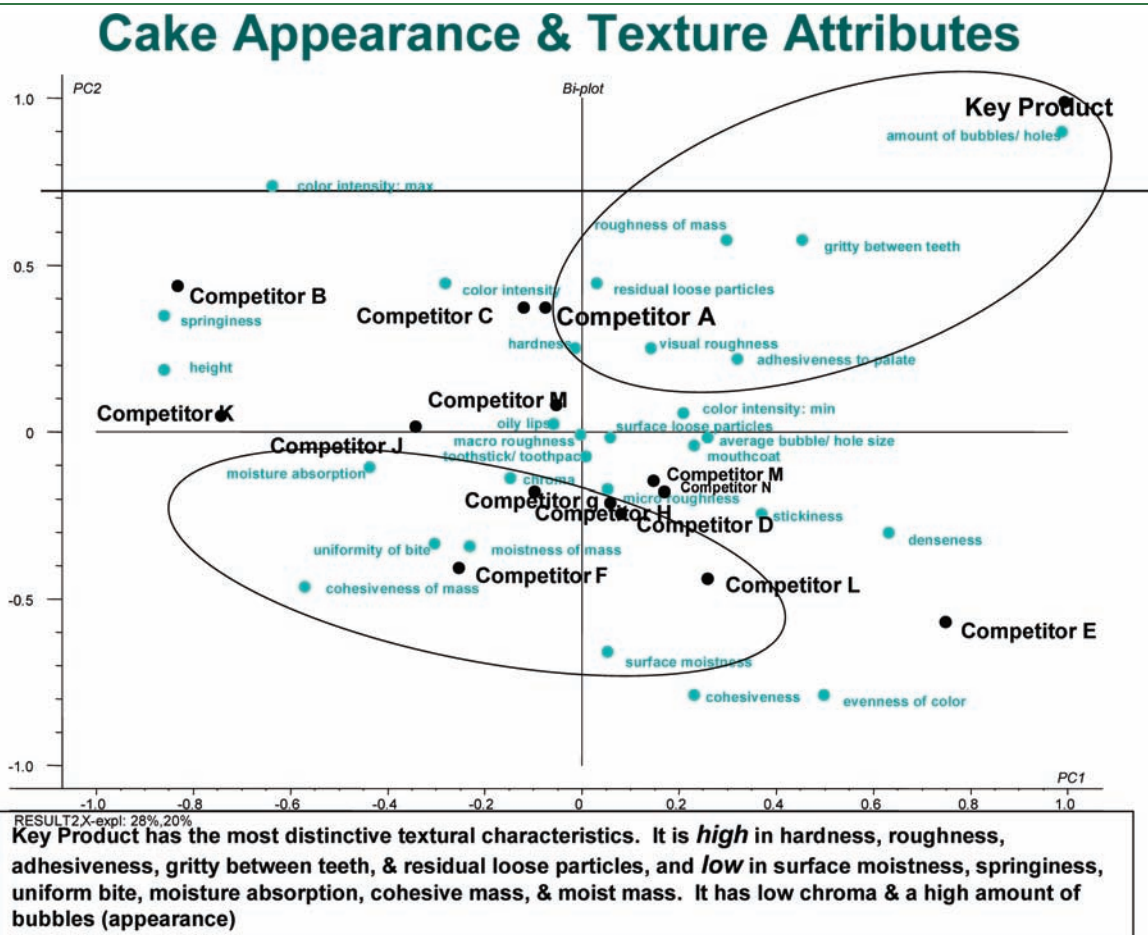


Figure 3

A successful cracker product – 2 Targets:

- the crunchiness/crispiness of Target 1
- dissolvability of Target 2

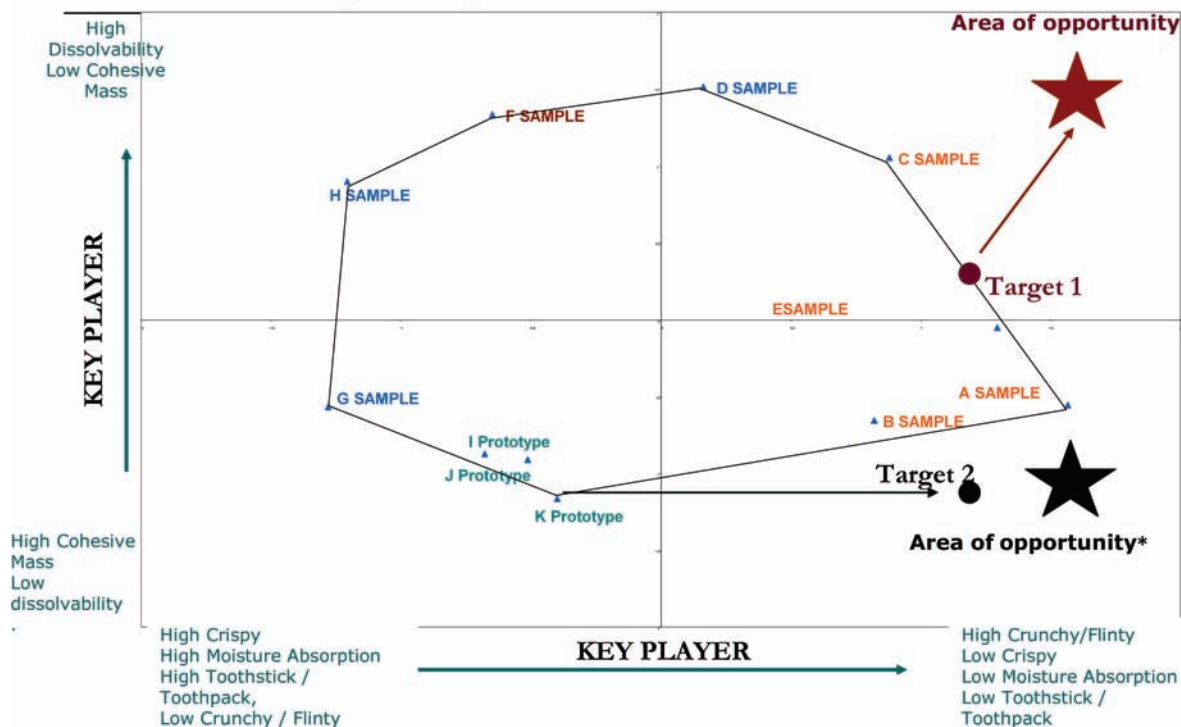


Figure 4

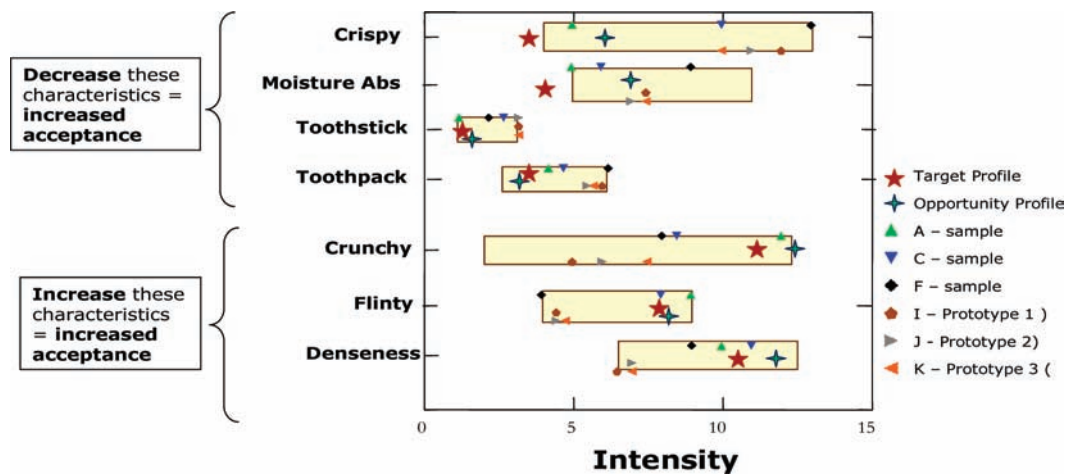


Figure 5

and product development about what consumers see and how they talk about their experiences. On general textural issues SCAN observed the following:

“If flavor stays the same, a textural difference can ruin the meal. Al dente, crisp, moist green beans taste wonderful; floppy, wet green beans still taste like green beans but are ruined by the texture.”
 “Many young children have textural issues. Children will eat French fries, baked or boiled potatoes and simply gag trying to get mashed potatoes down, purely due to the texture.”

Textural properties are detected not only by feel (tactile and mechanical) but also by sound, which really resonated with the SCAN:

“Fresh celery, carrot, and pickle have a loud crunch.”
 “Fresh potato chips have a high-pitched crisp.”
 “Fresh peanuts have a dull crunch.”
 “Flaky Ritz crackers have a delicate crush.”
 “Stale cookies and crackers make a dull, lower pitched sound than crisp, fresh products.”

“Undercooked chicken can squeak!”

“Dry peaches have a crunch, juicy ones don’t.”

These are quite sophisticated observations for untrained observers!

On the painful side of the texture continuum are food textures that result from cooking errors and aging:

The three main causes of painful texture were identified as “not fresh”, “overcooked”, and “undercooked” foods.

Examples of textural changes due to freshness were as follows: slimy cold cuts; soft crackers, cookies, and nuts; dry, hard bread; limp lettuce, celery, and carrots; soft, slimy, mushy bananas; hard, dry cheese; and over-ripe, wet, soft fruit.

■ CASE STUDIES

The importance of a product’s textural properties can be ascertained by linking the texture attributes to consumer liking and delight or by comparing the product’s texture to that of the market leaders. Each of the following studies demonstrates how the texture played an important role in dictating the direction that research and development needed to drive the product development process.

Case 1 (See Figure 3). The appearance and texture of 15 different cakes were evaluated by a highly trained descriptive panel; the resulting profiles were simplified with a principal component analysis map that permits the researchers to see all of the data at once. The key product cake has the most distinctive textural characteristics. It is *high* in hardness, roughness, adhesiveness, gritty between teeth, and residual loose particles and *low* in surface moistness, springiness, uniform bite, moisture absorption, cohesive mass, and moist mass. It has low chroma and a high amount of bubbles (appearance). From the map we can see it is an outlier and has high levels of some negative characteristics (gritty, hard, sticky), and it lacks positive attributes (moist across the experience and springy). Given the competitive set, the product development team has a clear direction for fixing the texture.

Case 2. Studying an array of snack products that include current market products and prototypes provides a good sense of the playing field. The overall map of both the descriptive panel data and the consumer input demonstrates areas of opportunity (Figure 4). Two textural dimensions are uncovered that explain the textural differences. Dimension 1 addresses dissolvability and cohesiveness of the mass; the term “melt away” is how consumers might describe it. Dimension 2 addresses crispy, crunchy, moisture absorption, and tooth stick: products that are heartier, more robust, and require more effort to eat.

When the descriptive data are related to overall liking by consumers, two different areas of development emerge. Targets 1 and 2 represent product opportunities for creating products that fall within the space tested. The areas of opportunities are product suggestions that fall outside the testing space.

Two distinct directions are possible improvements. Direction 1 develops a product that has high dissolvability but is crunchy. Direction 2 is a product that has low dissolvability and high crunch. What does that mean to product development (Figure 5)? The focus should be on the attributes of crispy, crunchy, and dissolvability. The range graph shown in this example demonstrates how the existing samples J and K provide the best representation of opportunity 1 for delivering crispy. On

the other hand, product development direction for a crunchy product needs to focus on the crispiness of sample A.

■ PLEASURE AND PAIN IN TEXTURE

Texture stands to offer consumers delight in a product. As with flavor, the integration of the different elements provides a smooth and complete sensory experience. Characteristics such as creaminess (smooth surface, some fat lubricity, and some thickness) are integral to the enjoyment of products from puddings to toppings to soups. A product such as a Snickers bar provides a classic example of a fully integrated texture. All components (caramel, nougat, peanuts, and chocolate) are perceived during the chew, and all elements disappear at the same time, with the caramel and nougat carrying the nuts away. This process seems so obvious, but there are many products in which some of the components remain as residue in the mouth and may be annoying to consumers.

In texture, the pain perspective usually stems from lack of control of the product (reflected in the texture properties) or lack of freshness (reflected in the changes in cohesiveness). Products with sharp, abrasive, or hard particles are likely to be rejected. Cereals with lots of fiber usually contain raisins or dates that act like vacuum cleaners to grab the loose fibers so they do not end up floating in the mouth or sticking between the teeth and gums.

Acceptable texture requires control; without control of the chewing or swallowing, consumers become annoyed with or turned off by the texture, thus the pain. Cherry tomatoes are less popular than grape tomatoes because consumers do not want to risk having the center of the tomato squirt out of the mouth; oysters are perceived to be risky texture adventures because they may be hard to control in consumption; particulates that are not integrated into the carrying matrix will annoy most consumers.

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