The Texture of Taste

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The taste of a favorite food is as familiar as a pair of old, comfy gym shoes. But when those shoes don't feel right, every stride is off.

So it is with the "feel" of foods. Whether it's a snap, a crunch or a rich, creamy thickness, mouthfeel can be as important as any flavoring ingredient in affecting what is perceived as "taste."

Feel the flavor

The taste of a food is described in terms of its flavor and aroma. A product's texture, the way a product feels in the mouth, takes into account a product's viscosity, rigidity, softness, smoothness, grittiness and a myriad of other tactile stimuli. And while taste and texture are distinct facets of a given product, each definable and measurable in its own right, the texture of the product dramatically affects the perception of taste.

Texture can indicate a product's storage condition, the results of which are often referred to in terms of taste. "Texture, and particularly the relationship between cohesiveness and crispness, is a primary indicator of wholesomeness," notes Gail Civille, president, Sensory Spectrum, Inc., Chatham, NJ. "If the texture is off, the product may be considered 'bad,' — limp carrots or celery; stiff, hard bread; crispy stick of chewing gum." How often do we suggest that something "tastes" stale, when the flavor hasn't really changed at all?

In practice, however, consumer acceptance or preference can hinge on product texture without the consumer realizing it. Terri Summers, sensory panel expert and trainer for 21st Sensory, Inc., Bartlesville, OK, offers tomatoes as an example: "Some may like the flavor of raw tomatoes but not eat them because of the texture. But if you blend them, they will eat them."

Sometimes, overall preference for an item can hinge on what the consumer perceives as a flavor change. Summers offers another example: "Some may interpret raw apples, sliced and cooked in a skillet with sugar to a caramelized stage, as being dehydrated apple flavor when in reality, the apples' texture have changed from wet crisp to tough and chewy; it was not a dehydrated flavor at all. The texture had changed with the cooking giving a flavor perception. As an untrained consumer, the perception is everything because they don't know better. In other words, the consumers often do not identify the difference between flavor and texture."

This is because of the close association between taste and texture, or "mouthfeel," and the various ways in which a product's textural characteristics will affect the way consumers perceive its taste. "Food matrices are inherently complex," notes Jim Carr, Ph.D., president, Excelon Specialty Products, Inc., Lake Bluff, IL, "and can play a significant role in taste perception."

Not just a physical relationship

Scientists have been investigating the relationship between taste and texture since the mid 1940s. They believed differences in taste perception resulted simply from differences in the way a food matrix released flavor and aroma compounds during consumption. Several schools of thought place flavor and

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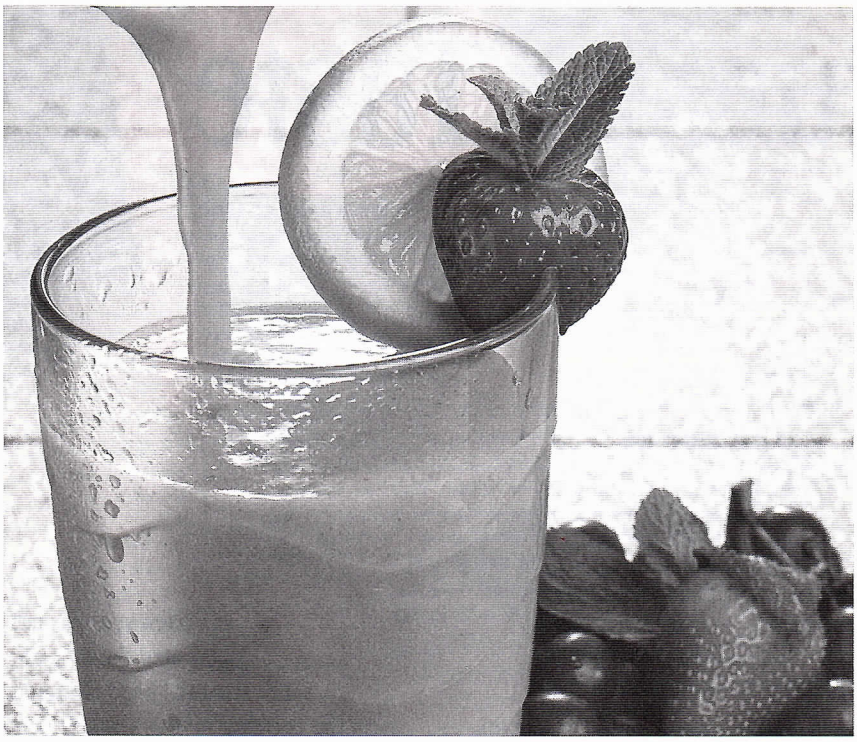

Photo: TIC Gums

Use a thickening or gelling agent to improve viscosity when preparing beverages. Gels with increased strength provide longer flavor-perception time and affect the flavor intensity of a product.

nonflavor interactions in one of three categories. "Binding" refers to numerous types of physiochemical interactions that tie flavoring compounds to another substrate. "Partitioning," describes a physical distribution of flavoring compounds among the various phases of a given food matrix. The way a flavor becomes available for perception by the consumer is referred to as "release."

Textural characteristics affecting flavor release are the most straightforward of these interactions. Numerous studies show that increasing viscosity reduces flavor perception. The ability to perceive flavors relies upon the flavoring compounds' ability to diffuse from the food onto the tongue, and the diffusion rate affects the amount of the flavoring in question, as well as the condition of its matrix.

The level of a thickening or gelling agent increases product viscosity, thereby slowing flavor components' release from the food to taste and aroma receptors. A study comparing various gelling agents, textural attributes and flavor types shows that increasing gel strength decreases the perceived flavor intensity. Flavor intensity also varies with the type of gelling agent used. Gelatin's low melting point temperature facilitates the release of flavoring compounds at mouth temperatures (30°C to 35°C), which explains the associated high perceived-flavor levels.

Carrageenans create the same textural attributes as gelatin and yield lower-perceived flavor levels due to melt temperatures higher than gelatin. When considering a given gel's texture, elasticity and rigidity, the gelatin gel will melt at lower temperatures than a carrageenan gel with the same textural attributes. Gelatin melts when it hits a warm plate, but the carrageenan gel (designed to mimic the texture of the gelatin gel it replaces) will not melt at the same warm temperature.

Research shows increasing certain flavor compounds alters the way viscosity is perceived. Adding sucrose increases the measured viscosity, sodium chloride decreases the perceived viscosity while citric acid affects both perceived and measured viscosity in thickened solutions.

Another study shows that gels with increased strength provide longer flavor-perception time. In theory, stronger gels take longer to chew than softer gels, increasing the time needed to expose the surface area from which flavors are released.

Within the realm of fat reduction, developers find dramatic differences in product texture that result in differences in the rate and amount of fat-soluble and water-soluble flavoring components released. Carr points out similarities in the development of low-fat and, more recently, low-carb foods. "In each case, the flavor perception of the product was skewed as important formulation components were removed or as others were added in disproportionate amounts. In many

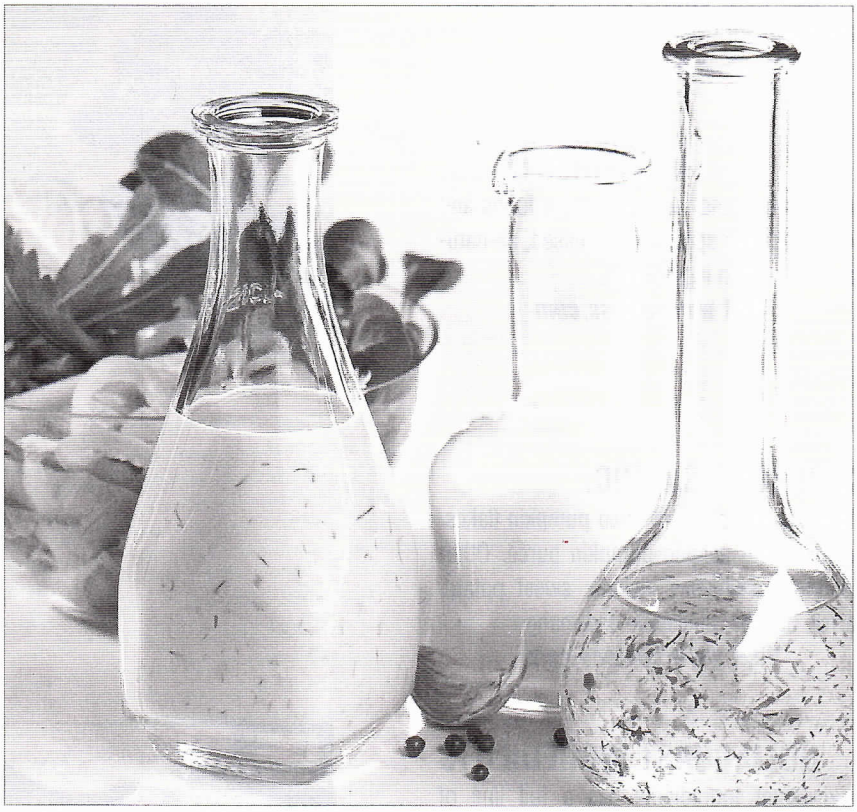

Photo: Degussa

Texturizing agents, such as carrageenans, emulsifiers, guar gum, locust bean gum and xanthan gum and blends of these, create the proper stabilization for sauces and dressings, without affecting the taste profile.

instances, significant modifications in product texture were associated with changes in taste perception for the products," he notes.

Direct interaction between flavoring and nonflavoring compounds relies on the properties of both constituents. Flavors might become tied to various substrates via covalent bonding, hydrogen bonding, hydrophobic bonding or by formation of inclusion complexes that entrap flavor within the structure of another material.

The most often studied and reported of these interactions is the binding of volatile substances with proteins, especially soy proteins. These interactions are very complex, varying with the degree of denaturation, temperature and pH of the proteins in question. Generally speaking, aldehydes form irreversible chemical bonds, while ketone, hydrocarbon and alcohol compounds form reversible hydrogen or hydrophobic bonds.

Flavors can interact with starches by becoming "caught" in hydrophobic regions of their helical structures or by direct binding. Starches with lower amylose content, tapioca for example, exhibit weak binding with flavors. High-amylose starches, such as potato or corn, have more binding capacity.

Problem or solution?

From one perspective, both physical and chemical interactions can mask flavor, necessitating additional flavoring ingredients for a given flavor level. Formulators can also use this "time-delayed-flavoring" effect, though, when trying to mimic the flavor release of a traditional product in a revised version (low-fat, -carb, -sugar, etc.), or to enhance the overall character of a new creation.

Carrageenan in chocolate milk prevents cocoa particles from settling by suspending them within a soft-gel network. This network also gives the rich mouthfeel and slow flavor release of a high-fat product, despite using a low-fat base. This dual effect ensures consistent delivery of creamy chocolate goodness in every sip.

Transforming a typical beverage to a "sugar-free" version might require replacing 15% sugar with a tiny amount of a nonnutritive sweetener and water. The resulting product "tastes" as thin as water. The original texture, and corresponding taste effects, can be replaced with levels around 0.10% of a high-methoxyl (HM) pectin. A similar approach can regain a fruit juice's mouthfeel that is lost with the removal of pulp.

Formulators can use flavor masking to advantage when dealing with undesirable flavor notes. "In a dressing or mayonnaise, acid added to keep the product shelf stable can be quite strong to the senses," says Erin Chavez Surratt, senior application specialist, Degussa Texturant Systems, Atlanta. "Carrageenan, propylene glycol alginate or blends, such as xanthan and locust bean gum, give the finished product a smoother, creamier mouthfeel that smoothes out the sharp, acidic notes."

Identity crises

Many products are defined as much by their texture as their flavor. "One good example is found in confectionery products," suggests Carr. "An acidified, fruit-flavored, high-solids formulation can be produced with different texture ingredients and yield dramatically different finished products. The traditional gummy-bear formulation based on high-bloom gelatin yields a very firm, elastic product while a fruit-jelly confection based on pectin or agar yields a tender, short-textured product, and a gumdrop produced with thin-boiling starch yields a chewy and adhesive or sticky product. Combinations of these products can, however, provide the tools to create a spectrum of textural profiles all within the same universe of acidified, fruit-flavored confectionery products. In each case, one can argue that the product's acceptability is first and foremost defined by its textural properties."

Adding the same flavoring system to each of these results in a variety of finished product tastes. Traditionally, prepared starch gels' sticky character provides a slow flavor release. Pectin-based gels' short texture yields a more-immediate impact. Combinations of these stabilizing systems can create a host of unique texture and flavor characteristics.

Another product group that relies on the right mouthfeel is frozen desserts. Nobody screams for ice cream if it exhibits any one of many potential defects that make the finished product "not quite right." Terms like "sandy," "fluffy," "soggy" or "gummy" all refer to textural defects that arise from improper handling or incorrect choice and/or usage of stabilizing systems. The way the ice cream feels on the tongue, the perceived coldness, the way it melts or doesn't melt, the amount of air entrapped in the matrix all affect flavor release. Carr suggests, "Specific hydrocolloid blends are used to directly influence each of these texture and stabilization parameters and, in this manner, have a dramatic influence on flavor or taste perception."

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Aerated products are yet another formulation area in which mouthfeel defines the product. Mousses and whipped toppings utilize delicate flavor profiles in equally delicate vehicles. "The development of proper texture and stabilization for these foams is often necessary to deliver the taste profile being sought," Carr continues. "A foam with a more-viscous character, or one that is destabilized and suffering gas-cell coalescence, can dramatically fall short in flavor performance as the product is consumed."

Sticky business

The simple marshmallow presents an excellent illustration of texture over taste, perception over reality. These campfire delights rely upon gelatin to create the distinctive texture, and the resulting twist on a seemingly simple flavor system; sugar, corn syrup and vanilla flavor. Carr describes a "gelatin-free marshmallow" formulation his company developed utilizing a carrageenan and galactomannan texturizing system instead of animal-derived gelatin. "Once we created the familiar gelatin-type texture, there were minor adjustments to be made to the flavoring system to create the right overall effect," he adds. The resulting product can be enjoyed by those for whom dietary guidelines prohibited gelatin-containing foods.

Texture is an absolutely crucial characteristic in food systems. In practice, product developers can use texture to fool the tongue, turning perception into reality. Regardless of the application, one rule applies: The flavorings might be perfect, but if it doesn't squish perfectly between those layers of chocolate and graham, consumers won't be asking for s'more. ■

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