Understanding Senses in Sensory Evaluation

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Sensory Evaluation is the scientific discipline used to evoke, measure, analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing. (1975 Institute Food Technologist definition)

To understand the power of sensory evaluation, you must first develop an understanding of the basic psychology and physiology of the senses. This understanding of the senses will assist in understanding products you work with, as well as appreciate the controls for implementing successful sensory tests.

The senses that will be discussed include aroma and flavor, taste, tactile, sight and sound.

Aroma and Flavor
The sense of smell is very complex. Aroma and flavor are chemical senses stimulated by the chemical properties of odor molecules which must reach the olfactory bulb to interact with olfactory cells in the olfactory mucosa. Smells are detected by breathing air that carries odor molecules. Therefore, to smell, molecules must be airborne (i.e., volatile). The air comes in contact with the tiny smell receptors high in the nasal passages. These receptors send information to smell nerves, then the brain. The specific reaction with the odor molecule is unknown.

The sensory term which we term “flavor” is a mingled experience with includes sensations of vision, smell, temperature, pain, pressure and other tactile sensations (i.e. texture). By definition, flavor is based on human judgment. Thus, the study of volatile compounds by GC, HPLC and other physical and chemical means is not “flavor” research.

Factors affecting odor sensitivity include interactions with other senses such as taste and vision/color. In particular, color can lead to the perception of smell when it isn’t present, increased perceptions or distorted perceptions. Odor is subject to adaption in which one odor generally has little effect on perception or dissimilar odors, but interferes with the perception of similar odors. Other factors affecting odor include age, gender, smoking and olfactory disorders (anosmia, hyposmia, hypersomnia and dysosmia.)

Taste
The sense of taste is a chemical sense due to taste stimuli falling on taste receptors located on the tongue called taste buds. It is generally accepted that humans can distinguish among five to six basic taste qualities – sweet, sour, salty, bitter, umami and fatty. Between 20 and 30 levels of intensity can be distinguished for each taste.

Factors affecting taste sensitivity include age, smoking, viscosity of products, taste disorders (ageusia, non-tasters, hypogeusia, hypergeusia, dysgeusia) and temperature.

Sight
Color is the visual perception resulting from the stimulation of the retina by light (wavelengths between 380 and 760 nm). Light or electromagnetic radiation can be described in terms of its wavelength, purity and amplitude.

In foods, color and appearance are often the first attributes by which quality is assessed. The importance of color is also demonstrated in such foods as Jell-O, Kool-Aid, candy and sherbet, in which color affects perception of other attributes such as flavor due to the association with a color. For instance, a yellow beverage is expected to have a lemon flavor.

Factors affecting sight perception include intensity of the light source, distribution of wavelength in the light source, absorption or transmission characteristics, surface characteristics of object, shape of object, reflectance, texture or surface of object. Physiological factors include state of adaptation, angle, sensitivity of eye specific wave lengths and color vision deficiencies.

To consistently evaluate color, judges should be checked for color vision deficiencies. Standards for visual assessment should be determined (memory, physical color chips or model products). The “acceptable” range must be predetermined, preferably under the same light source the samples will be judged in the future, otherwise metameric matching may occur. Metameric matching is the phenomena that a pair of samples may appear to be a match under one light condition, but mismatched under most other conditions.

Sound
Vibrations squeezing together or spreading apart molecules in the air produce sound waves. Sound can be described in terms of frequency and amplitude.

The measurement of sound is measured in frequency (Hz) which is the number of cycles that a sound wave can complete in one second and corresponds to the pitch of a sound. Amplitude is the maximum pressure created by sound waves, often measured in decibels and corresponds to the perception of loudness.
Sound waves strike the eardrum causing it to vibrate. The vibration is passed through the middle ear to the fluid-filled cochlea in the inner ear, where sensory cells pick up the vibration and send it along the auditory nerve to the brain.

Factors affecting sound perception include hearing impairments, conduction deafness, nerve deafness and interaction with other senses such as vision which increases localization accuracy.

**Tactile**
This is the feel of sensations on the skin (includes tongue). Our skin is our largest sensory system, containing numerous receptors, which have free nerve endings which sense touch, pressure, hot, cold and pain. Most of what we feel is a combination of sensations, and not all parts of the skin are equally sensitive to touch, pressure, pain or temperature. Sense of touch assists in decision making and helps us avoid pain. While often overlooked, touch is an important component to the foods we eat. Think hot chocolate, ice cold lemonade and carbonated sodas, to name a few.

**Texture**
Texture is defined as “the sum total of kinesthetic (muscle sense) and cutaneous sensations derived from manual and oral manipulation. It encompasses mouthfeel, masticatory properties, residual properties and even visual and auditory properties of a food.”

The first bite or initial phase encompasses the mechanical characteristics of hardness, fracturability, and viscosity and any geometrical characteristics which are observed initially. The second or masticatory phase encompasses the mechanical characteristics of gumminess, chewiness, and adhesiveness and any geometrical characteristics observed during chewing. The third or residual phase encompasses changes induced in the mechanical and geometrical characteristics through mastication.

The feel of food is closely interrelated with other sensations which occur simultaneously during “normal” eating. For example – crunchiness of raw carrots is not independent of sound or limpness of lettuce is not independent of its appearance.

In conclusion, all the senses play a key role in product/flavor development — the color, aroma, feel in hand or mouth, sound to the ears and ultimately the taste.