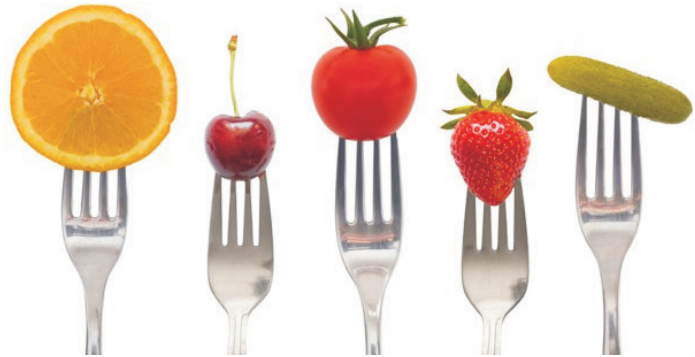


Sensory Perception

SENSORY PERCEPTION is an understanding gained through the use of one or more of the senses: taste, smell, sight, sound, and touch. Your sense of taste has five categories: bitter, salty, sour, sweet, and savory. Which taste category would you assign to each of the foods shown on these forks? You have been using sensory perception to evaluate food since you were an infant.



Objective:



Analyze the ways sensory perception impacts food creation and preparation.

Key Terms:



astringent
cilia
flavor
glutamates
gustation
hedonic

mouthfeel
palate
papilla
pungent
saccharide
savory food

sensory evaluation
sensory perception
sensory science
umami
volatile

Understanding Sensory Perception and Food Preparation

Sensory perception is an understanding gained through the use of one or more of the senses. The senses of taste, smell, touch, sound, and sight impact and solidify your perception of food and beverages. Naming a fruit after tasting it (while blindfolded) and knowing which song is playing are examples of sensory perception.

Sensory science is the study of the reactions of the five senses to the characteristics of physical matter, which includes foods and beverages. A related and specialized field—psychophysics—measures, analyzes, and interprets psychological stimuli. The goal of

sensory science is to determine which characteristics and qualities in a food product matter most to the end-consumer.

Sensory evaluation is a scientific method used to analyze and measure human responses to the composition of food and beverages—appearance, taste, odor, touch, texture, and temperature. It is a structured way to collect and evaluate feedback on products and dishes; researchers follow a strict tasting panel protocol. Tasting panels are an example of a scientific sensory evaluation process.

TASTE CATEGORIES

Taste categories (e.g., bitterness, saltiness, sourness, sweetness, and savoriness) are recognized on different areas of the tongue.

Bitterness

Bitterness is an unpleasant or sharp taste and is the least desirable; it is the part of the tongue that detects bases.

Saltiness

Saltiness is a flavor from sodium ions, such as sodium chloride (table salt) and potassium chloride (a salt substitute).

Sourness

Sourness is the detection of acidity in foods.

Sweetness

Sweetness is the most desired taste and is produced by sugars, some proteins, and a few other substances. A **saccharide** is any sugar or other carbohydrate. Sweet does not necessarily mean “sugary.” For instance, beets, tarragon, and onions are all sweet in flavor but are not sugary.

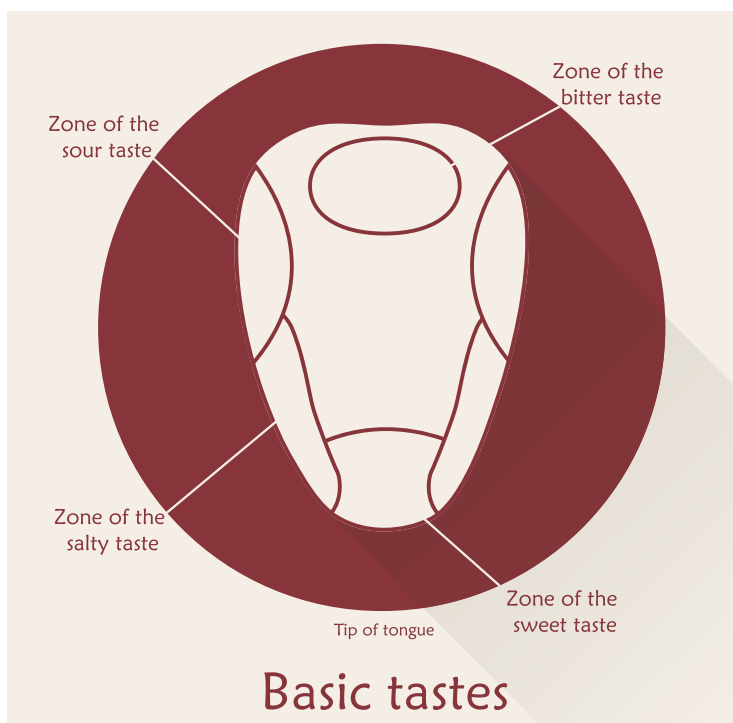


FIGURE 1. The bitterness, saltiness, sourness, and sweetness of foods and beverages are sensed in specific locations on the tongue.

Savoriness

Savory literally means “full of flavor” and is a taste commonly found in fermented and aged foods and in most meats and appetizers. **Savory food** is “meaty” tasting and is the opposite of sweet. This savory, meaty taste indicates the presence of glutamates found in meats, cheeses, and other protein-heavy foods. For example, Parmesan and Roquefort cheeses are fermented foods that contain free glutamates that cause a savory flavor. However, glutamates also are present in unfermented foods (e.g., walnuts, broccoli, grapes, and some meat).

- ♦ **Glutamates** are the carboxylate anions and salts of the amino acid glutamic acid. Glutamate detection is a relatively recent discovery. For instance, a Japanese scientist isolated monosodium glutamate (MSG)—a food additive often associated with Asian cooking—while conducting research on seaweed broth.
- ♦ **Umami** is the Japanese term for “delicious” and is an indication of a savory taste from glutamates. Examples of food containing glutamates are MSG, ripe tomatoes, mushrooms, cured meats, fish, soy sauce, and cheese. It was discovered in 1908 and was added as a scientific term in 1985.
- ♦ Other flavors scientists describe are astringent and pungent.
 - Saffron, tannins in teas, and other tart foods are called astringent. Saffron is collected from crocus stigma. Astringent foods—lemons, pomegranates, and persimmons—cause the mouth to pucker. In addition, these foods absorb water, tighten tissues, and dry fats. The mouth may feel “dry” when eating astringent foods. An **astringent** is any substance that causes tissue to contract, bind, or shrink.
 - Chilies are pungent. The heat and pungency is from the capsaicin (the chemical in chili peppers that makes them spicy) contained in the seeds. Pungent foods stimulate diges-



UNDER INVESTIGATION...

LAB CONNECTION: Identifying Umami

You do not have to have the Japanese dish made from soy sauce, sardines, and dried mushrooms to experience umami. You can experience the savory taste of umami with common foods such as ripe tomatoes, mushrooms, cured meats, and cheese. Sampling two or more will help you identify the umami savory taste.



Umami is the Japanese term for “delicious” and is an indication of the savory taste from glutamates. Shown here are the ingredients for dashi—a Japanese soup stock. Dashi is a combination of kombu (kelp) and katsuobushi (dried bonito flakes). Sometimes, as pictured here, niboshi (small dried fish) and shitake mushrooms are included.



UNDER INVESTIGATION...

LAB CONNECTION: Supertaster

Learn more about two supertaster tests at <https://www.inkling.com/read/cooking-for-geeks-jeff-potter-1st/chapter-3/differences-in-taste-and>. Find out how gender and ethnic background affect your chances of being a supertaster. The first test requires the purchase of PTC testing strips to identify a supertaster. The PTC testing strip tastes very bitter to a supertaster and just like paper to a non-supertaster. The second test uses blue food coloring, a cotton swab, and a piece of binder paper. Place the hole-punched area of the paper on your tongue. Inside the $\frac{5}{16}$ -inch hole, dab the blue food coloring. Count the papillae. If you count 30 or more, you are a supertaster.

tion and metabolism. Some of the hottest chilies are Habanero, Scotch Bonnet, South American chinenses, African birdseye, and Indian Tezpur. **Pungent** is having a strong taste or smell.

ANATOMY OF SENSORY PERCEPTIONS

Various senses can impact how you respond to certain foods. For instance, you may not like how something looks, how it smells, or its texture.

Taste

Gustation is the act of tasting; tasting is detected by taste buds on the tongue. **Papillae** are the bumps found on the tongue that enclose hundreds of taste buds each. **Taste blindness** is a reduced ability to detect bitter tastes as a result of having fewer taste buds or a lack of gustatory stimuli. Phenylthiocarbamide (PTC paper) can be used to test this genetically recessive trait. People with a cold may experience temporary taste blindness, and a person of advanced age may experience taste blindness.

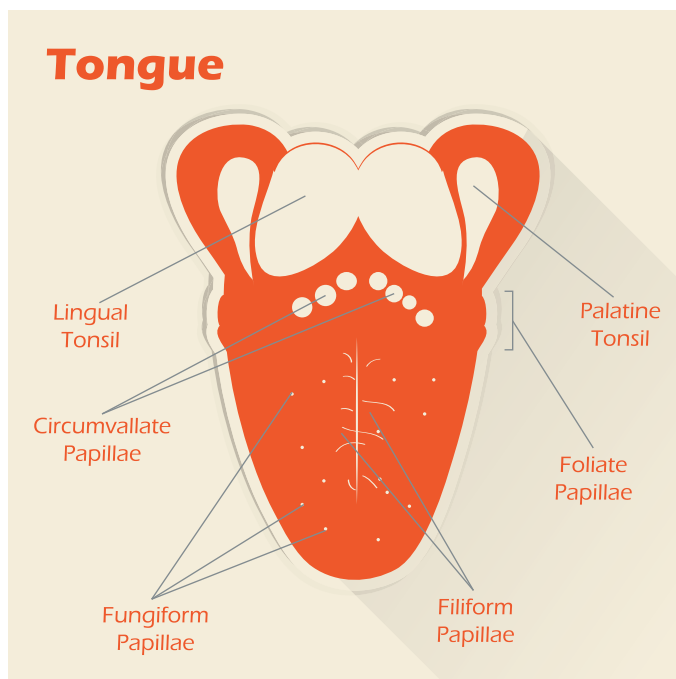


FIGURE 2. Papillae are the bumps found on the tongue that enclose hundreds of taste buds each.

Smell

Odor or smell uses the olfactory organs that connect olfactory cells to the brain. The body responds to odors in the form of a gas. Odors are **volatile** (unstable), and volatile odors quickly evaporate at low temperatures. Odors are collected by the **cilia**—hairs found in the nasal cavity that collect odors and sweep away foreign objects.

Sight

Vision is the brain's ability to detect electromagnetic waves. The eye lens focuses the rays onto the retina in an upside down manner, and the brain reverses the image.

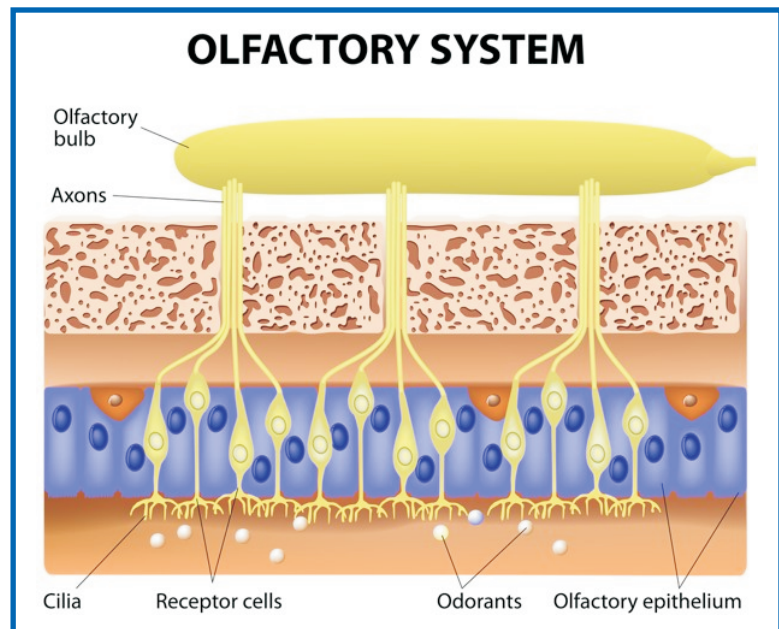


FIGURE 3. In this illustration of a nose, the olfactory bulb at the top connects to scent cells at the bottom to identify odors. Notice the fine cilia hairs that collect odors for processing. Smell is the most powerful tool humans have when tasting food.

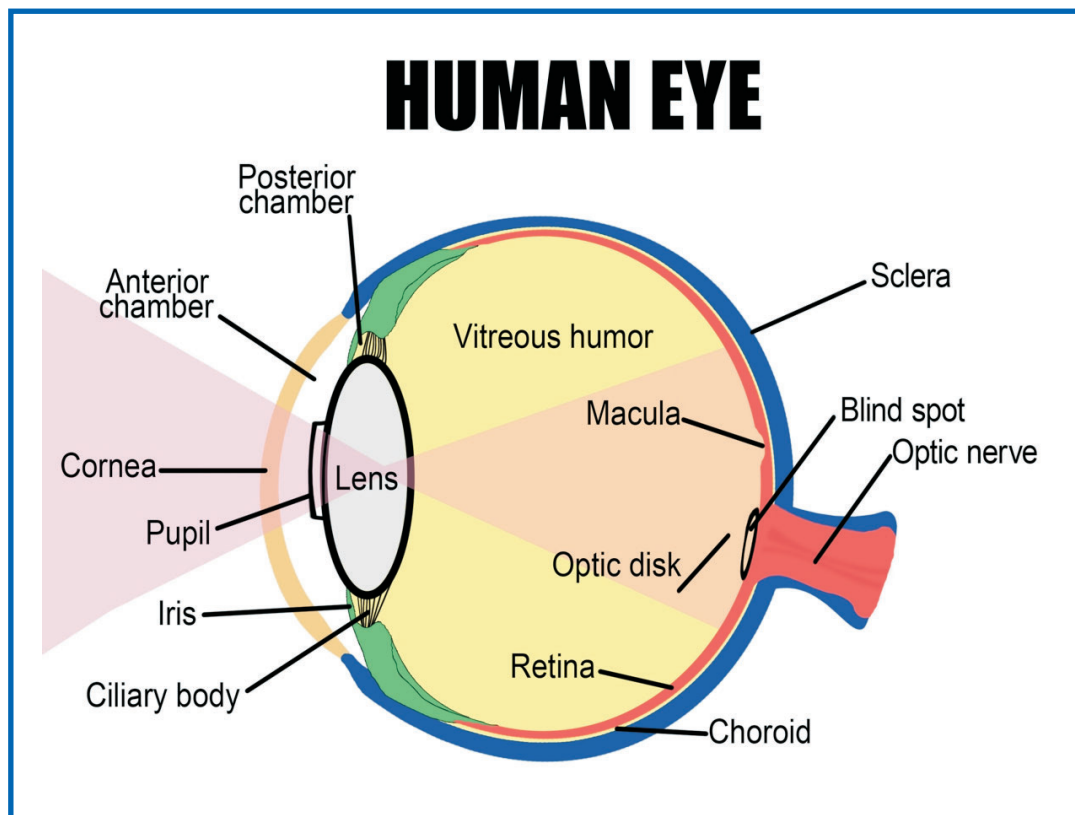


FIGURE 4. Visual images—contrasting colors, textures, and shapes—are a powerful tool in selecting and tasting foods and beverages. This is an illustration of a human eye.

Sound

Sound occurs from vibratory changes in air pressure on the eardrums. Foods that make sounds include apples, chips, and crackers. Soft foods have little sound.

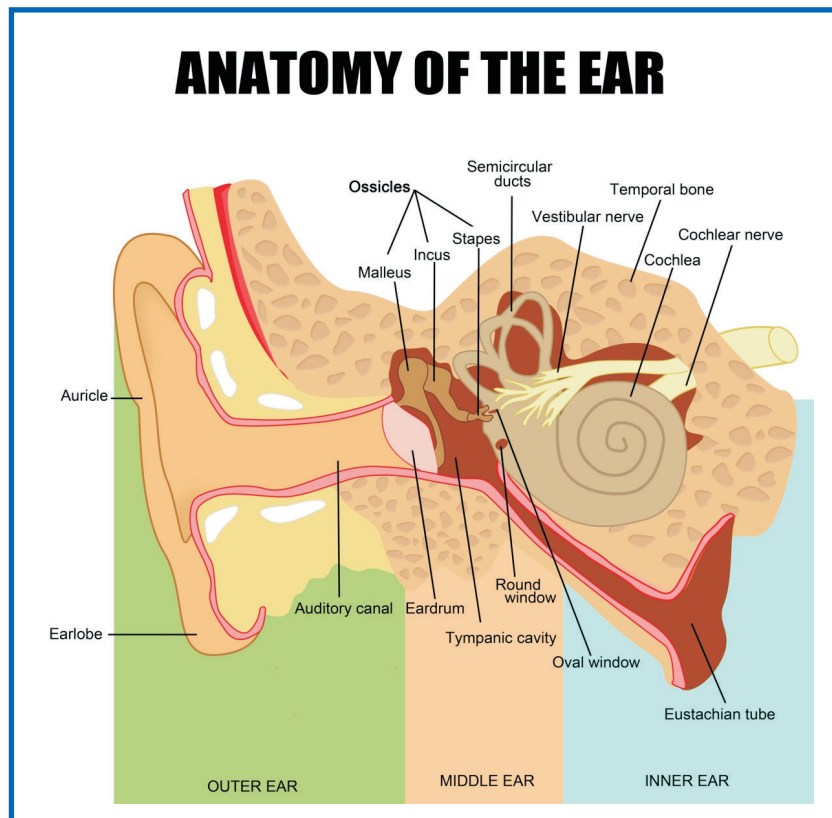


FIGURE 5. Foods that make sounds include apples, chips, and crackers. This is an illustration of a human ear.

Touch

Touch is the perception of pressure on the skin or mouth.

Mouthfeel is the physical sensation made by a food or beverage in the mouth or how the food “feels” in the mouth. Mouthfeel is affected by food and beverage temperature and texture. Food texture descriptors include chewy, grainy, crunchy, brittle, and tender.

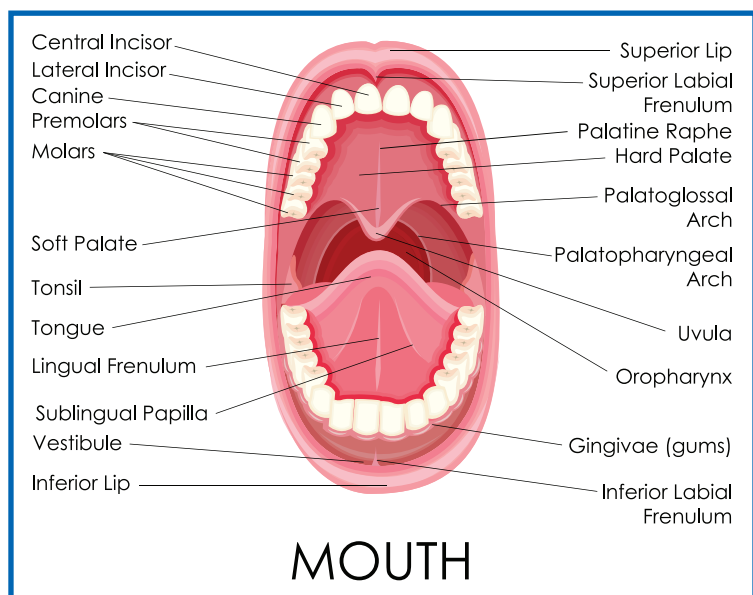


FIGURE 6. Mouthfeel is the physical sensation made by a food or beverage in your mouth. This is an illustration of the anatomy of the human mouth.

SENSORY EVALUATION PANELS

Sensory evaluation is a scientific method used to analyze and measure human responses to the composition of food and beverages—appearance, taste, odor, touch, texture, and temperature. It is a structured way to collect and evaluate feedback on products and dishes. Researchers follow a strict tasting panel protocol. Tasting panels are an example of a scientific sensory evaluation process.

A **blind taste test** is a method to gather information about the taste of a food or beverage without revealing the brand name. In a blind taste test, the testers do not know what they are tasting. For example, different types of orange juice are presented to the panelists in identical cups (the same plastic cup for all samples), and panelists are asked to taste and profile each sample. In a double blind taste test, the administrator of the products does not know the brands.

Tasters are typically asked to wear no scent (perfume or cologne as well as lotion); their clothing should be laundered in a neutral detergent; and each tester is isolated in a cubicle. These protocols (procedures) minimize any interference with product testing. Tasters determine the formulation of the final product.

Sensory Evaluation Panel Types

Highly trained experts are used to judge the quality of foods (e.g., coffee and wine). They use scientific standards established by the food company for the evaluation.

Laboratory panels are small groups that work at a company. *Cook's Country* food magazine is an example of a company that conducts panel testing of consumer products. Examples of food testing can be found at http://www.cookscountry.com/taste_tests/browse/tv.

Consumer panels are often set up at a grocery store or shopping mall to interview and receive feedback from a large number of people. This is a less scientific process and often asks which sample(s) people like or dislike (e.g., yes or no feedback versus descriptors).



DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Cook's Country

Cook's Country, a division of America's Test Kitchen, is an example of a company that conducts panel testing of consumer products. In fact, the studio audience participates in some product testing. The hosts often report the difference in ratings between the laboratory panels and the consumer panels. Find food testing examples at http://www.cookscountry.com/taste_tests/browse/tv.

Panel Selection

Panel selection is important to the scientific process. Panelists to avoid include those who:

- ◆ Have taste or odor disorders
- ◆ Are colorblind
- ◆ Have denture defects
- ◆ Have senses affected by allergies, medications, or infections
- ◆ Have lost the sense of taste or smell (sometimes due to advanced age or illness)
- ◆ Are unable to concentrate on the differences in food

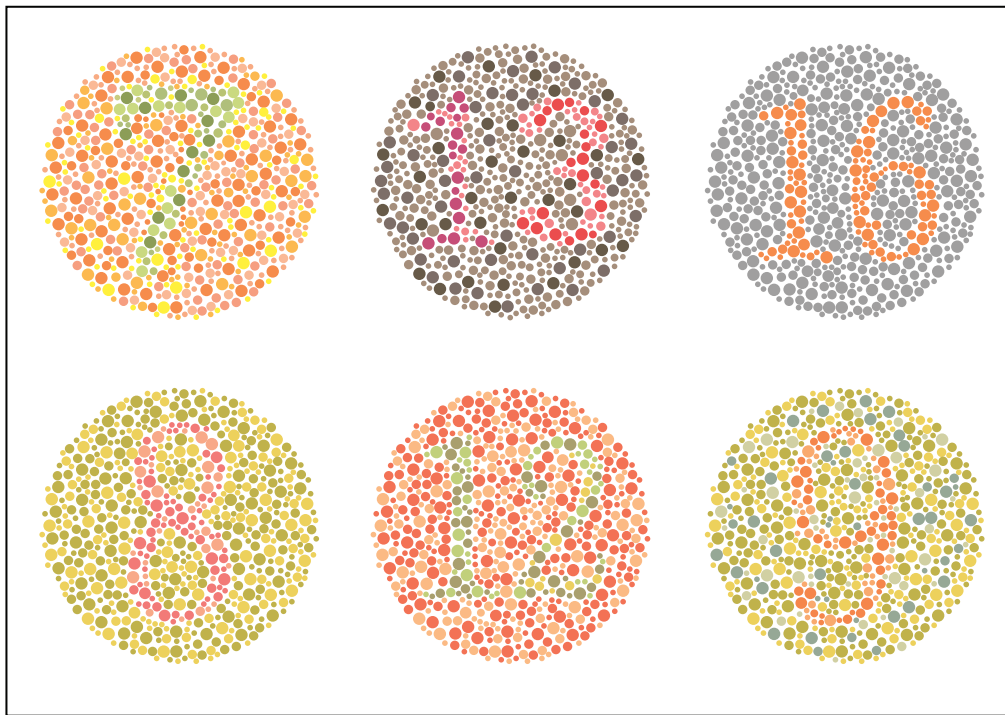


FIGURE 7. Would you be a good sensory evaluation panel member? What numbers do you “see?” This is an Ishihara color perception test.

Sensory Test Types

Various test types are used to acquire sensory information on products. Preference, discrimination, and descriptive tests are a few of the tests given.

Preference Tests

Preference tests use descriptors, such as “like and dislike.”

- ◆ **Hedonic** (concerned with pleasure) preference tests are used to determine which samples are liked or disliked. A “smiley face” ranking often is used to do sensory testing with children who are not old enough to read.

- ◆ Paired preference comparison tests use two samples, and panelists decide which they “like.”
- ◆ Scoring may be captured in a 1 to 5 range:
 - 1—Dislike very much
 - 2—Dislike
 - 3—Neither dislike nor like
 - 4—Like
 - 5—Like very much

Discrimination Tests

Discrimination tests are used to evaluate attributes (e.g., sweetness, sourness, crunchiness, and others). Discrimination tests include triangle tests, duo trio tests, and ranking tests.

- ◆ Triangle tests use three samples. Two samples are the same food product or have the same attributes. A panelist is asked to determine which sample is different. For example, three types of tea are brewed for the same time and at the same strength and temperature. All three samples are of the same size. Two samples contain four teaspoons of sugar, and one sample contains one teaspoon of sugar.
- ◆ Duo trio tests use three samples with one as the control (a comparative standard in an experiment). One of the two is alike or similar to the control. The tester identifies which sample is the same or similar to the control sample.
- ◆ Ranking tests are used to compare one attribute, such as sweetness. To rank sweetness, three samples with varied amounts of sugar are prepared. The samples are ranked first, second, and third. This test can be conducted with five food samples.

Descriptive Tests

Descriptive tests ask panelists to write descriptions of the food products using vivid and colorful words. For example, star charts/diagrams analyze one food sample by looking at eight attributes. The star shape has eight lines that intersect in the center. Each attribute line is divided into 10 increments. Examples of attributes are crunchy, smooth, spicy, and sweet. The food is ranked for each attribute by placing a dot on the line’s increment number.

Obtain Valid Panel Results

To eliminate bias (prejudice):

- ◆ Use colored lights to disguise the differences in the color of food items.
- ◆ Vary the order of the samples. A contrast effect (giving higher or lower scores) happens when a higher quality sample is offered just before a lower quality sample.
- ◆ Use three-digit numbers to identify samples. The use of 1, 2, 3 or A, B, C to identify samples has a psychological bias.

- ◆ Between samples, cleanse the palate to remove food residue from the mouth and to neutralize the taste buds. Often warm water is served between fatty samples or a bland food (e.g., an oyster cracker) is served between samples. The **palate** is the roof of the mouth; when you touch the top of your mouth with your tongue, you are touching your palate.
- ◆ Serve all samples in the same size and at the same temperature.
- ◆ Limit the number of samples to three. Larger numbers of samples make it difficult for testers to make comparisons.
- ◆ Conduct sensory evaluations in late mornings or mid-afternoon when panelists tend to be more alert.
- ◆ Evaluate one food that comes in a variety of types. For instance, compare baked, fried, and reduced fat chips or cooked fresh, frozen, and canned corn.

Sensory Evaluation: Product Development and Marketing

The food industry uses sensory evaluation to conduct Research and Development (R&D). They may be looking for the following reactions:

- ◆ Consumer preferences
- ◆ Relationship to competitors
- ◆ Gaps in existing market
- ◆ Consumer reaction

New Coke vs. Coke Classic is a classic example of a time when sensory evaluation did not work. After two years of taste tests and research, the New Coke formula was placed on the market on April 23, 1985. In all the taste tests, the New Coke product was preferred over original Coke. The company planned to use the new formula in Coke production.

However, the company did not take into consideration the emotional attachment people had to the original Coke. People began to hoard original Coke. The public's reaction caused a change in plans. Original Coke was renamed "Coke Classic" and remains in stores today. In 2009, the term "Classic" was removed from that label. In 1992, the "New Coke" name was changed to "Coca-Cola II." In 2009, the product was removed from market shelves in the United States.

SENSORY FOOD COMBINATIONS

Chefs must carefully consider the combinations they are offering. Some foods and flavors are complementary, and others simply are not.

Flavor

Flavor is the sensory impression of a food or beverage; it is primarily determined by the senses of taste and smell. Smell is the determining factor of a food's flavor. Taste is limited to bitter, salty, sour, sweet, and savory. Food smell, however, is almost unlimited.

The power of artificial flavors must be considered. For example, most jams and jellies are made of nearly the same type of base ingredients—water, pectin, and sugar. Then flavors—genuine or artificial—are added. Consumer noses detect the aroma. Flavors and flavorings are edible chemicals—fragrances—that alter the flavor of foods and beverages through the sense of smell.

Garnishes

Garnishes are used to enhance the plated food. Contrasting colors adds appeal. For instance:

- ◆ Green parsley sprigs on a plate of steak and potatoes
- ◆ Red paprika sprinkled on a meat or vegetable
- ◆ Whipped cream topping on a dessert
- ◆ Chocolate shavings on a dessert
- ◆ Raspberry coulis sauce around chocolate cake
- ◆ A lemon wedge in cola

Sensory Food Combinations

Examples of sensory food combinations are:

- ◆ • Sweet/sour combinations:
 - Sweet and sour pork
 - Orange chicken
- ◆ Sweet/salty combinations:
 - Caramels with sea salt
 - Salted watermelon
 - Chocolate-covered bacon
- ◆ Sweet/savory combinations:
 - Tomato soup served with grilled cheese
 - Watermelon and feta cheese salad
- ◆ Cold/hot combinations:
 - Hot taco meat salad
 - Hot fudge sundae



FIGURE 8. Watermelon salad with feta cheese and greens is a sweet/savory combination.



DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: The Science of Taste

Chefs use the science of taste in development and the presentation of recipes. View the YouTube video “The Science of Taste” at <http://www.youtube.com/watch?v=0HxAB54wlig>. The chef indicates that your senses are the most important tool in the kitchen. What new information did you learn about sensory perception presentation? How did the chefs include sensory perception in the food presentations? What does science have to do with the taste of food?

◆ Savory/bitter combination:

- Indian chicken curry dishes
- Beef chili with hot peppers

◆ Other combinations:

- Fat/lean combination in spare ribs
- Bitter/salty combination in mustard greens and bacon
- Bitter/sour combination in cranberries and grapefruit

Summary:



The five senses—taste, smell, sight, sound, and touch—are used to evaluate the foods you eat. Sensory evaluation panels are used by R&D organizations to predict the success of a new food product. Sensory evaluation panels use a variety of tests and procedures to evaluate food samples. Efforts are made to eliminate bias in a sensory evaluation. Sensory food combinations help chefs create exciting new food combinations. Remember, the most important tool in the kitchen is the chef's senses.

Checking Your Knowledge:



1. What are the five senses?
2. What are the five taste categories?
3. What is a supertaster?
4. How is bias eliminated in a sensory evaluation?
5. What are sensory food combinations? Give three examples.

Expanding Your Knowledge:



Check out the YouTube videos by Dr. Stuart Firestein, a biologist at Columbia University, on the science of sensory perception. His presentations are 3 to 5 minutes each and are shown in the Web Links. The videos offer a scientific discussion about how the brain utilizes sensory perception.

Web Links:



From Nose to Brain: The Neurology of Smell

http://www.youtube.com/watch?v=uQ_qiqeD1Uo

From Tongue to Brain: The Neurology of Taste

<http://www.youtube.com/watch?v=gTIdl8acmxY>

The Mysterious Connection Between Taste, Smell, and Memory

<http://www.youtube.com/watch?v=R-TTHK40u4w>