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Sensory evaluation

Sensory evaluation is defined as the scientific discipline which encompasses all methods to evoke, measure, analyze and interpret human responses to the properties of foods, as perceived by the five senses: taste, smell, touch, sight and hearing. Specific senses of heightened interest are taste and smell, particularly in their relationship with ingestive behavior.

Reasons for sensory evaluation

There are essentially five types of problems in which sensory evaluation is a necessary technique:

a. New product development
b. Cost reduction exercises
c. Quality improvement
d. Evaluation of product acceptance
e. Quality control and assurance

When presented with a sample for sensory evaluation, the test controller may have several well-defined aims to view:

a. Establish and characterize changes which may be either natural to or induced in the product
b. Distinguish between different samples
c. Ascertain whether some defined quality attributes can be expressed in terms of a simple numerical scale or index
d. Whether the total quality of the sample can be expressed in a simple or multidimensional manner so as to rank different samples
e. Establish standards and specifications
f. Grade samples with or without reference to a standard sample
g. Establish a relationship between objective and subjective test data or
h. Establish the hedonic values of the product

In all cases, the assessor is asked to apply a human judgement on the sample, based on his senses, which are capable of providing a wide variety of response depending on the questions asked. This response falls broadly into two categories:

a. Analytical – applied to the establishing of differences
b. Hedonic - applied to preference and acceptability decisions

For example, as one individual ingests a sucrose solution, the sucrose molecules bind with the gustatory cells in the taste buds, which generate an influx of information sent to the brain. The brain then processes the information: it organizes, analyzes and interprets the sensations into perceptions. Once the stimulus is recognized, the brain formulates a response. The response might be one of objective identification of the perception: “this is sweet”, or one of subjective affective reaction to the stimuli: acceptance or rejection: “I like it/I don't like it”, and/or emotional response: “it gives me comfort”, “it brings back happy memories of my childhood”.

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Sensory evaluation focuses both on the objective measurement of the sensory properties of products (also referred to as "product understanding") and the subjective responses of individuals to physical products (often referred to as "consumer understanding"), as well interpretation of consumer response through understanding the response to product ("linking product and consumer understanding").

Based on these two types of judgement there are three main categories of sensory assessment:

a. Difference testing - usually carried out by a small panel of assessors (judges)not necessarily having a great experience
b. Rating into categories – usually carried out by a panel of well trained and experienced assessors
c. Acceptability appraisal – may be carried out by panels ranging from small local groups to very large consumer panels. These, preferably, should not include trained technical staff whose judgements may be unduly biased and unrepresentative of the majority

Product understanding

The techniques that measure the product sensation, or product understanding, are considered objective measurements and are either **discriminative** or **descriptive**.

Discrimination tests answer the question "Are two or more products perceptibly similar or different?". For example, if the objective is to reduce sodium and maintain sensory properties, discrimination is a good method. The types of discrimination tests are:

Paired comparison test: Panel members receive one or more pairs of coded samples, which may be the same or different in one or more stated attributes. Samples are presented in pairs positioned at random.
Judgment: Determine whether the individual samples in each pair are the same or different, or select the sample which is stronger in a stated attribute.
Chance probability: ½.
Panel size: 20 or more selected assessors.

Triangular difference test: Best known and most used test method particularly valuable where the number of assessors is limited. Panel members are presented with three samples at one time. Among these samples two are alike and one is different. Samples are presented an equal numbers of times in each of two sets of permutations (e.g. AAB, ABA, BBA, ABB, etc.).
Judgment: Select the odd sample. If there is a stronger flavor attribute this should be given as the odd sample as this reduces fatigue during the test.
Chance probability: ½.
Panel size: 15 or more selected assessors.

Duo-trio difference test: Panel members receive a designated reference sample with which they become familiar. This is followed by one or several pair of samples, each containing one reference and one unknown. The samples are presented in random positions.
Judgment: Select the different sample in each pair. It is often easier to pick out the sample which is identical with the reference sample rather than the one which is different. The standard reference sample remains available throughout the test.
Chance probability: ½.
Panel size: 20 or more assessors.

Two alternative forced choice test: Panel members are presented with five coded samples, two of which are of one type and three are of the other. The order of presentation is selected at random.
Judgment: Group the two sets of samples.
Chance probability: ½.
Panel size: 10 or more assessors.

'A'/ not 'A' test (single sample test): A test method applicable for determining differences in products having a marked after-taste. Panel members are familiarized with the standard reference sample. Samples are then presented one at a time, in random order, either of the reference material or the unknown. The time interval is important and should not be less than 5 min between samples. The number of samples may have to be limited.
Judgment: Is this sample 'A' OR 'not A'?.
Chance probability: ½.
Panel size: 20 or more selected assessors.

In industry these tests are commonly used to test for ingredient substitutions, when the objective is to maintain product similarity. The same basic procedure is used in order to arrange samples in order of intensity or degree of some specified attribute by means of:

Ranking classification
Rating and scoring
Grading

Descriptive analysis is another objective sensory technique, and requires a highly trained panel. Descriptive methods document the qualitative and quantitative sensory aspects of a product. The qualitative aspects of products include specific appearance, aroma, flavor or texture characteristics, called attributes. The quantitative aspect is the intensity of each of the attributes. Different descriptive analysis methods differ primarily on their scale usage. The Spectrum™ method uses a 15 point scale with ratio properties, where 0 is no detectable amount of attribute and 15 is a high amount. Descriptive analysis is often used, when the objective is to determine how samples differ. The following test methods are used:

Simple descriptive
Descriptive with rating
Flavour profile
Dilution profile technique

Consumer understanding

These techniques measure the subjective personal reaction of consumers, such as acceptance (liking) or preference. In addition the consumer perception of product performance benefits can be measured such as “comfort”, “therapeutic” or “healthy”, which may be important to brand identity, product quality or setting up consumers' expectations. Consumer Understanding focuses on measuring the perception of product attributes as filtered through the consumers' screen of expectations. For example, if a brown liquid was served to consumers as “cola”, but is actually a fine coffee, it would be perceived quite negatively based on the consumer's expectations of cola.

There are two types of consumer testing; **quantitative** and **qualitative**.

Testing with consumers for **quantitative** results requires high numbers of participants (at least 75) due to the person-to person variability in preferences and physiological sensitivity. During quantitative testing respondents are asked specific closed-ended questions and given a scale in which to rate liking or hedonics.

Qualitative consumer testing, such as **focus groups or triads**, is more discussion-based and generates data that is verbal. Participants are asked open-ended questions and a moderator verbally probes for more depth in response. **Qualitative** testing often focuses on language to describe products, emotions around products and usage behaviors.

Often quantitative testing is used towards the end of the development phase or in product benchmarking within a category. Qualitative testing is used towards the earlier phases in product development and can uncover potential reasons why a product is liked or disliked as well as the emotional links to product sensory characteristics.

Organoleptic guide lines - Flavour evaluation

Visible characteristics, such as colour, clarity, or viscosity of a liquid and of the texture of a solid are observed.

Smelling and tasting are necessary in judging food flavors and flavorings. Smelling is always done first. The most important requirement for effective sensing is complete concentration on the subject. Distractions compete with sensing. The taster should be at easy, completely comfortable and in a quiet place. Loud noises interfere with smelling or tasting observations.

Organoleptic guide lines - Smelling procedure

Smelling is done by inhaling through the nose for a period of 2-3 seconds with both nostrils open. An aroma of unknown material is to be propelled little by little toward the nose and then sniffed cautiously. This prevents injury to the sense of smell. The smelling is done with the same nostril or both for direct comparisons. The air stream to the smelling area is rarely equal for the two nostrils.

Smelling should be done as far away from the hands as possible to avoid interference of ever-present skin odors. It is best sitting at a desk with the samples arranged in front and the body bent forward until the nose is about an inch from the sample product. Never compare two specimens, one held in the left hand and one in the right, but smell one with the left nostril and the other with the right. When smelling, the air should be still, even if it odouriferous. For adequate comparisons of odor, two specimens of the same temperature should be presented to the nose.

Blotter technique

Blotters usually are pieces of odorless and absorptive paper ½ inch wide and about 6 inches long. They are used for convenient and accurate odor comparisons of essential oils and aromatic chemicals. Blotters are dipped into the respective liquids to the depth of 1 inch. The wetted areas are compared for odor. Odor impressions from the smelling of blotters are subject to constant change. Flavor varies continuously as the more volatile ingredients evaporate. The blotter test is followed to dryness, thus enabling a complete study from the most volatile to the least volatile ingredients of the samples under test.

Francis Kurkdjian, creator of best-selling fragrances

Bottle technique

Smelling from bottles are dominated by top notes which are produced by the lowest boiling ingredients of the sample. Smelling from bottle caps and stoppers give results intermediate to the test from blotters and from bottles.

Tasting procedure

Tasting should be done after smelling. The tempo should be slow, 1 or 2 tastes with 1 min for each and up to 5 min intervals for strong tastes or for thick flowing materials. Tasting is most valuable when it is made against a definite standard. In the strict sense, tasting is mostly done for sweet, sour, salty and bitter.

Professional tasters distinguish between what the nose tells them and what the tongue alone can tell them, such as pepperiness, coolness, astringency, and the four tastes: sweetness, saltiness, sourness and bitterness.

Sample presentation

Uniformity of sample presentation is all-important in achieving meaningful results from sensory testing. Samples should, wherever possible, be homogeneous and of uniform appearance, texture and temperature. They should be presented in equal quantities and in similar containers. All these potential variables may lead to a biased judgment of the odor and flavor of the sample. The order of presentation of multiple samples should be randomized.

Nibbling and mouth rinsing

Tasters often nibble on bread, crackers, or fruit, or rinse out the mouth with water or with charcoal and then water. The best techniques is to keep the saliva and the taste buds in their natural state and thereby to prepare them for the next tasting. Smokers should not smoke for an hour or more before each sensing. A great deal of thought and attention is needed to develop acute flavor-consciousness and an accessible as well as a well-stocked flavor memory. Smelly teaspoons, which may have been used for taste tests, may be restored to usefulness by being baked for about an hour in a low oven (150^{o}C)

Chewing procedures

In the judgment of bread flavor and other baked goods or of chewing gum, the soluble substances are introduced into the saliva by chewing a standard-sized piece. By regular chewing procedure it is possible to assay the texture and the aromatic elements early in the chewing operation, then sweetness, sourness, saltiness and bitterness with associated feeling of warmth, coolness, pain and touch , including astringency and texture. The chewed material is discarded by removal from the mouth insteasd of swallowing it.

Slurping and sucking

Hot beverages and soups are tested by slurping the material and by sucking it through pursed lips to spray it over the palate. Undissolved material, such as tea leaves or coffee grounds, should be lifted with a spoon for smelling. Hot beverages such as coffee and tea involve both smelling and tasting. The aroma is judged first while hot and odoriferous; tasting is done after the beverages have cooled and the aroma is gone.

Essential oils are judged by the blotter test, the syrup test, the alcohol and water test.

Conclusion

One of the difficulties in sensory evaluation is managing the many sources of variability. When designing a sensory test, the 5 S's should always be considered; Subjects, Site, Samples, Statistical Analysis and Sensory Method.

Tests should be designed in such a way, as to balance controlled testing environments with the high variability that is the reality of normal product consumption. It is important to remember the reality of everyday life, and that the product of interest likely has emotional ties to the end user (consumer).

As discussed, there are sensory tools to avoid cognitive dissonance in products such as qualitative techniques, descriptive analysis paired with consumer quantitative testing, and multivariate data analysis, among others. These sensory tools can ensure that the results of the studies are applicable to the end user and that the product achieves sensory congruence with the underlying consumer expectations.

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