Sensory and Consumer Science: understanding perception and preferences

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Abstract: *Consumers can detect whether a food or beverage is excellent or poor, they have always utilised their senses to assess the safety and quality of food. Sensory assessment is field of measurements directly related to accuracy, precision, and sensitivity that helps avoid drawing incorrect judgments. Sensory assessment incorporates methods from various biological sciences as well as psychology, statistics, food science, physics, engineering, ergonomics, sociology, mathematics and humanities. A scientific approach to elicit, quantify, analyse and interpret responses to items as experienced through sight, smell, touch, taste, and hearing is known as sensory evaluation. In terms of product marketing and quality assurance, sensory evaluation is crucial. In the food industry, it is widely utilized for product recipe modification and new product creation. The purpose of the investigation is to determine the types of differences between the items and whether or not those differences should lead to the acceptance or rejection of those products.*

Keywords: Sensory assessment, product development, Accuracy, Recipe modification, Aroma, Flavour

1. INTRODUCTION

Consumers can detect whether a food or beverage is excellent or poor, they have always utilised their senses to assess the safety and quality of food. Standardised methods for rating the quality of food and beverage goods were created as civilization and common trade advanced. They served as the basis for contemporary sensory analysis and the antecedents of food sensory testing (Drake *et al.,* 2023). Over the past century, sensory science—the study of how people react to stimuli—has developed into a broad range of research fields and effective tools for real-world applications, from food science and textiles to psychology and neuroscience (Meilgaard *et al.,* 2016, Schiano *et al.,* 2017). This integrated perception of the sensory character of foods, which connects their energy and macronutrient content to their sensory signature, is the basis for meal choice and intake behaviour. Perceiving food is a dynamic process that involves temporally divergent sensory contacts, which the senses are uniquely able to integrate into a continuous perceptual output (Ciarán G. Forde, 2016).

Sensory assessment is a field of measurements directly related to accuracy, precision, and sensitivity that helps avoid drawing incorrect judgments. Sensory assessment incorporates methods from various biological sciences as well as psychology, statistics, food science, physics, engineering, ergonomics, sociology, mathematics and humanities. To produce food products that have the highest degree of consumer acceptability, sensory attributes must be connected to physical, chemical, formulation, and process variables. In the food industry, this makes successful sensory evaluation possible (Sharif *et al.*, 2017). A scientific approach to elicit, quantify, analyse, and interpret responses to items as experienced through sight, smell, touch, taste, and hearing is known as sensory evaluation. In order to reduce biasing variables, guidelines for the preparation and serving of samples under controlled settings are provided via sensory evaluation. In the quantitative science of sensory evaluation, numerical data are gathered to establish specific and legal correlations between human perception and product attributes. The tools used in behavioural research to measure and observe human reactions are largely borrowed by sensory approaches. Sensory evaluation is crucial to the process of developing new products as well as to the enhancement and optimization of existing ones. The food sector needs information on consumer preferences in order to produce new goods and to adjust existing products based on these preferences (Mónica Montouto- Graña *et al.,* 2012). Using the panellist's senses of sight, smell, taste, touch, and hearing, sensory analysis investigates the qualities (texture, flavor, taste, look, fragrance, etc.) of a food product.

According to Drake *et al.,* (2023), there are two main types of sensory tests: emotional sensory tests, which concentrate on consumer reactions such as liking, preference, and emotions, and objective sensory tests, which use humans as detection instruments. Aside from safety, developing products that best meet consumer expectations is one of the many issues that food firms confront. Purchase behaviour is thought to be influenced by a number of variables, including habit, impulsivity, brand loyalty, imagery, preferences, nutritional advantages, price/value ratio, perceived quality, and the actual eating experience (Stone *et al.,* 2009). Newer, faster, more thorough sensory techniques have emerged in addition to an important and sufficient statistical analysis. Examples of these techniques include preference and hedonic tests, check-all-that-apply (CATA), napping (N), flash profile (FP), temporal dominance of sensations (TDS), and flash profile (FP). These techniques are still in widespread use today. All of these approaches have advantages and disadvantages, but they are all very useful for developing new cuisines. However, other elements also influence whether or not a new product succeeds and is accepted. Numerous other elements are also important, such as social issues, the environment, awareness of nutrition, specific diets, emotions, health, the nature of the products, packaging, etc. When creating new food products, producers should take their

target market's views and needs into account. Consumers describe a product's benefits based on its perceived internal and external attributes. Currently, researchers and industry believe that one of the most useful tools for improving product quality and ensuring that innovations are successfully adopted by consumers at different stages of new product development, from design to commercialization, is sensory analysis combined with consumer research (Ruiz- Capillas C. *et al.,* 2021). In a sensory evaluation, there exist numerous uncontrollable reasons of variation in human reactions. An exercise in sensory evaluation is by definition an experiment. Data and statistical information from experiments are only helpful when analyzed in light of existing knowledge, assumptions, and the consequences of findings for choices and course of action. It is necessary to reach well-reasoned conclusions that are based on information, analysis, and outcomes. According to Lawless *et al.,* (2010), sensory evaluation specialists are required to provide interpretations and recommend suitable courses of action based on the data, going beyond simply acting as conduits for experimental results.

2. NEED FOR SENSORY EVALUATION

- To identify the commonalities and differences among a collection of food items
- Assessing an existing food product by comparing it to a benchmark sample.
- Examine food samples to identify areas for improvement based on input from the market.
- To elicit specific response to a food sample: whether acceptable or not by consumers.
- To study a specific characteristic in an ingredient or a food product.
- To determine whether a ready-to-eat product satisfies the original requirements or standard sample.
- To obtain feedback data in order to make decisions and carry out suitable modification in a food product. (Sahu, 2020)

3. USES OF SENSORY EVALUATION

- New Product development
- Analyse the impact of formulation modifications, particularly in situations where natural ingredient availability is limited.
- Study the impact of processing changes.
- Ensure batch consistency.
- Monitor shelf-life changes.
- Determine consumer acceptance
- Expert versus consumer sensory report
- Sensory quality control and consumer loyalty

- Sensory evaluation in Food Science courses (Sahu, 2020)

4. PRINCIPLES OF GOOD SENSORY TESTING

Different types of controls are necessary for sensory assessment, and these controls affect how sensitive the tests are: Elimination of psychological distraction, irrelevant odour and light stimulation are the main environmental controls. The provision of a favourable atmosphere is the ultimate objective. Testing must ideally be conducted in specifically constructed facilities for sensory purposes. In the event that such facilities are unavailable, researchers should nevertheless establish a comfortable environment as near to it as feasible (Sharif *et al.*, 2017).

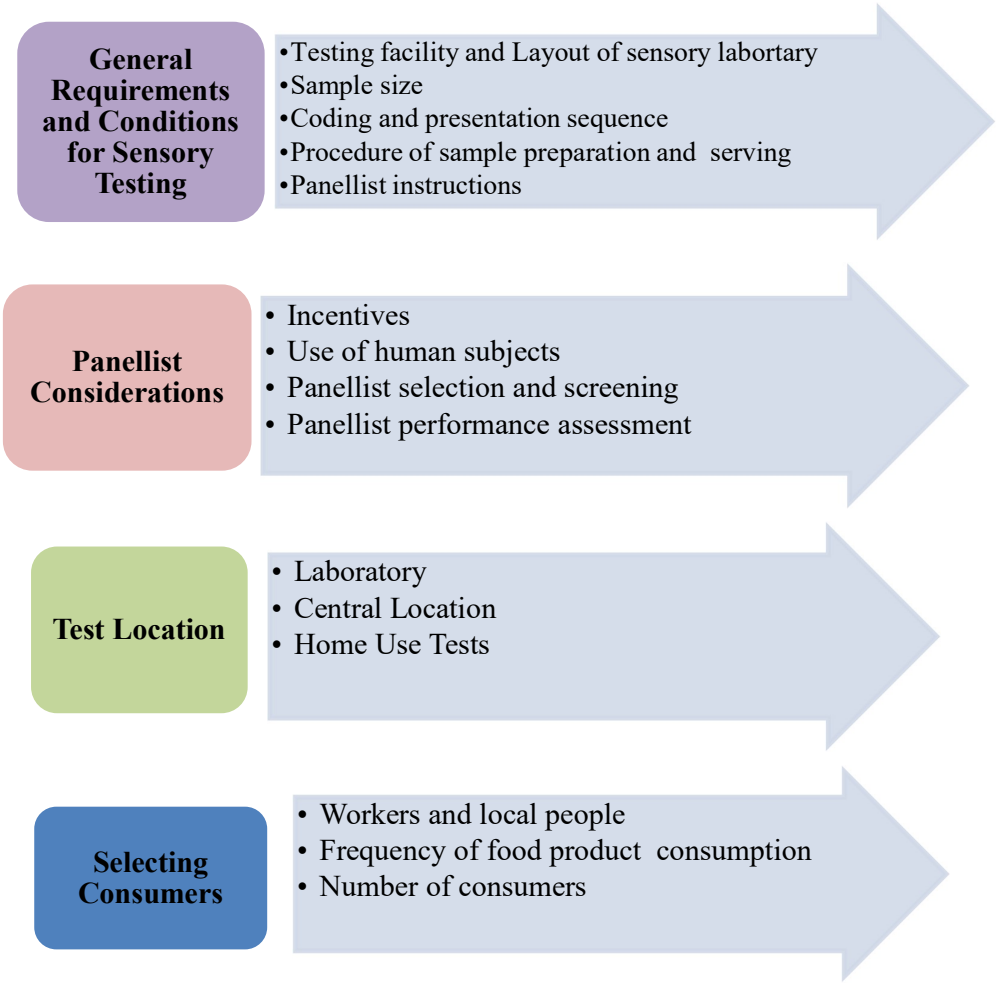

Figure 1 Principles of Sensory Analysis

4.1 General Requirements and Conditions for Sensory Testing (Sharif *et al.,* 2017)

- **Testing Facility and Layout of the Sensory Laboratory:** The sensory facility should be located in a noise- and odour-free environment, close to possible panellists. The assessors should be able to easily access the area with little disruption to their daily schedules. Convenient testing facilities have a negative impact on judge's performance and motivation. Confusion and noise should be avoided by keeping the laboratory far from busy roads. This facility should not normally be located close to a cafeteria or lobby in the food sector because it could interfere with the evaluation process. It can seem that this need contradicts accessibility, though. For accessibility reasons, sensory laboratories may be located close to those locations without sacrificing testing settings if appropriate measures, including soundproofing and waiting rooms, are taken to reduce noise and confusion. The assessors must have easy access to the sensory booth area. Ground floors are the best locations for sensory laboratories. Additionally, the assessors' traffic pattern should be taken into account, and the facilities administrative and food preparation areas should not be obstructed. One goal of laboratory design is to set up the testing environment to ensure effective physical operations. The architecture of the facility aims to prevent testers from being distracted by outsiders or by the functioning of laboratory equipment and workers. Reducing the amount that respondents are distracted from one another is the third goal. There should be a minimum of three sections to the testing area: one for the preparation and storage of the samples, one for briefing and discussion, and one for the actual testing. The following sections should be present in a sensory laboratory that has been thoughtfully and fully equipped:
    i. Waiting room area
    ii. Briefing area
    iii. Sample preparation area
    iv. Evaluation area
    v. Discussion area.
- **Sample Size:** This will vary depending on the test's goals, but for the purpose of evaluating the product as a whole, a sample large enough (about 30g or enough for 2-3 sips) is required. Typically, this quantity is doubled in consumer tests. The sensory specialist determines the sample size by taking into account the study's goal, the product's typical portion size and mouthfeel, and the quantity of attributes that need to be assessed. There may occasionally be a minimum amount that must be consumed. This is particularly important for consumer tests because some assessors can be reluctant to taste new products. In general, considerations such as the product's

preparation, storage, and cost are taken into account while determining the sample size.

- **Coding and Presentation sequence:** To prevent bias, samples are typically coded using randomly chosen 3- digit numbers and presented in a random sequence to prevent presentation-related distortions. Depending on the test, the presentation order may be random or balanced. Consumer tests often have a balanced presentation order; in contrast, descriptive tests should have a randomized presentation order, and discrimination tests, like paired comparison or triangle tests, should have a balanced presentation order.
- **Procedure for Sample Preparation and Serving:** Efforts should be made to standardize serving protocols and sample preparation methods, with the exception of the variables being assessed. When two separate specialists cut samples into cubes, the size may vary significantly, and this could eventually contribute to bias in appearance. The timing of this process needs to remain constant when using carriers or product combinations. The type of container, sample size and shape, visual appearance, serving temperature, carrier use and quantity of samples in a session and mouth washing in between should all be considered by the sensory specialist.
- **Panellist Instructions:** It is frequently required to provide the assessors with written instructions on the score sheet and verbal instructions prior to entering the assessment area on how to conduct the sensory evaluation. Panellist instructions should be brief and extremely clear. Before attempting to follow these rules, the project should first undergo a pre-test. To further prevent confusion between the technician and sensory specialist, the support staff should also get extremely explicit instructions, preferably in writing. Creating standard operating procedures that are accessible in the lab is a smart idea.

4.2 Panellist Considerations (Sharif *et al.,* 2017)

- **Incentives:** The goal of this is to encourage individuals to volunteer. Experts in sensory analysis should be prepared to respond when asked, "What is in it for me?" by a panellist. Certain cultures will use a sense of social duty and a desire to encourage teamwork as incentive. In the same way, serving on a sensory panel in business should only be done by volunteers. The incentive should be sufficient to encourage involvement in the activity, but not so strong that it becomes the sole justification. Overpaid people typically lack motivation throughout the session and are only involved for the financial gain. The payment is the main source of concern in consumer testing, where there is little to no fidelity, long-term concern, and commitment. Snacks may be provided to employees during a social break. This is

where the opportunity for social interaction could become a driving force. Sometimes the management's gratitude for the panellist's contributions to research and development is also beneficial. All tiers of management, from supervisors to upper management, must endorse sensory evaluation.

- **Use of Human Subjects:** When employing human subjects, sensory experts should adhere to the following standards and prioritize the panellist's health and safety: Obtaining the assessors' voluntary consent is essential in order for them to take part in the project.
  a. The researcher is responsible for guaranteeing that the study will not pose any health risks.
  b. If there is a risk involved in the study, the assessor should be trusted.
  c. In the evaluation, the individuals are entitled to use their free will.
  d. The study's conclusions ought to be beneficial to society. Most sensory experiments do not present any dangers that are not already present in daily life, accepted safety status. In this case, the panellists should be made aware of any potential risks associated

Physical dangers, however, can occasionally exist in certain situations. During product development, different substances and food additives are tested before gaining generally with the product being considered, and their involvement in the activity should be entirely voluntary. The study's protocol covering the ethical use of human subjects in research and development is approved by the Human Subjects Institutional Review Board in a developed nation.

- **Panellist Selection and Screening:** Assessors must be selected based on their sensory perception by a sensory specialist. In order to achieve this, the panellists assign the sensory specialist a number of general tasks and a range of tests pertaining to the products under consideration. Nonetheless, it is advised that simple screening tests not overburden judges with work before conducting accurate product evaluations. An excessive number of screening tests may cause the assessors' enthusiasm and drive to wain during the real examination. In certain cases, a medical screening is necessary prior to research participation.
- **Panellist Performance Assessment:** Reporting and panellist assessment systems are in place in the majority of the food industry. When panellists with training are used for extended periods of time, there is a decrease in their motivation and engagement throughout evaluations. When trained assessors take long stretches of time off from

sensory evaluation because of leaves, transfers, or vacations, their performance may suffer and they may need to be retrained.

4.3 Test Location (Sharif *et al.,* 2017)

- **Laboratory:** In this instance, the primary participants in a firm or institution's sensory evaluation are either employees or local residents. The primary benefits of a sensory laboratory are that they are easily accessible, have a tightly regulated environment, analyse results quickly, and evaluate a sizable number of samples in one session. When conducting shelf life research, this kind of setup is useful because it allows consumers to taste six or seven items that have been stored at different intervals. This process can be completed in a lab setting with ease. A customer can sample half of the samples, take a fifteen-minute break to clear their palate, and then sample the remaining samples. The primary drawback of the laboratory's location is that it presents the items as belonging to the corporation, which may skew the results. Standardized preparation techniques and product handling guidelines may also not accurately reflect customer behavior and experience at home.
- **Central Location:** At a central location, sensory evaluation is typically conducted in a rented space that is most likely an underutilized area of a restaurant. While en route to retail centres or sidewalks, assessors are apprehended. Those who pass the preliminary screening by answering a few questions are asked to participate in a consumer test. After passing the tests, they are often given presents as incentives. The primary benefit of using central location testing is that the participants are accurate representations of the intended audience. Owing to respondents' time constraints, the quantity of questions and goods should be restricted for an efficient evaluation. Most people are not prepared to dedicate more than fifteen to twenty minutes to completing these examinations. These kinds of tests are very helpful for shelf life studies (SSL), where it is typically necessary to examine six to seven samples, taking fifteen to twenty minutes on average. It is important to make an attempt to keep the questionnaire as short as possible. The only response we require from a customer in the majority of SSL tests is whether or not they accept the sample. A central location test would be appropriate in this case. The primary drawback of a central location is that it creates artificial conditions when contrasted to actual product usage in settings like homes, restaurants, or at a party.
- **Home Use Tests:** Typically conducted towards the conclusion of the food product development stage, these tests assess how the product is really used at home. The primary benefits of home use testing are that more detailed information on the product's general use may be obtained because the items are produced and used in

real-world settings. Similarly, data can be gathered through repeated use of the product instead of just the initial impression. The disadvantages of home usage tests are that they take longer, have less hygienic control, test fewer samples—typically no more than two or three—and offer little control over sample preparation and use. Sanitary control is equally crucial.

4.4 Selecting Consumers (Sharif *et al.,* 2017)

- **Workers and Local people:** Because product creation is time- and money-sensitive, the food industry frequently uses workers or local people. Due to available knowledge about the sensory qualities of the goods, this kind of sensory evaluation may be skewed, potentially leading to the product's rejection even with slight modifications to its sensory characteristics. Such minute modifications are invisible to the average or target consumer. Furthermore, because they are loyal to their employer, factory workers typically deem all samples satisfactory. Therefore, care should be used when using staff members and locals in sensory assessments.
- **Frequency of Product Consumption:** When determining the frequency of product consumption, researchers prefer heavy users in the majority of sensory assessments. If the product is a certain brand of snack bars, heavy users are those who eat this brand on a daily basis. It is advised to conduct a study with 40–60 corporate employees or locals living in the institution's neighbourhood to find out how frequently they consume that particular type of snack bar. Due to the high expense and time required, the concept of heavy users is abandoned, and instead, moderate or light users are typically questioned when choosing assessors in order to identify noteworthy variations amongst the samples.
- **Number of Customers:** Whether or not the panellists are trained has an impact on how many customers there are. In consumer acceptability tests, at least 100 panellists are needed for a given set of parameters, taking into account the average standard error and a difference between sample averages of 10% of the sensory scale.

5. SENSORY PERCEPTION

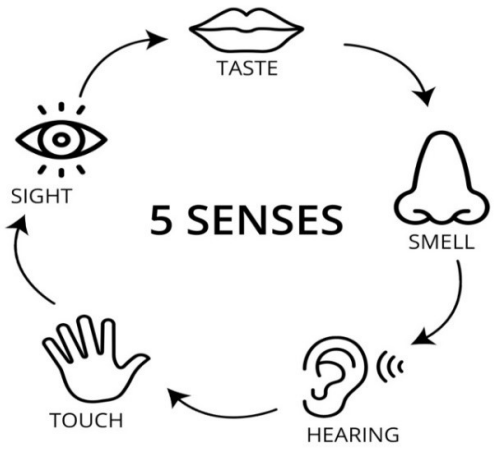

Figure 2 Human senses used for Sensory Analysis

A product is examined using its senses—sight, smell, taste, touch, and hearing—to determine its look, flavour, aroma, texture and sound, among other qualitative features. This process is known as sensory analysis. The following is a quick description of several food product attributes: (Sharif *et al*., 2017)

i. The human senses identify and ultimately choose food based in large part on appearance, which is the first quality that is perceived. This is the way that color, shape, size, gloss, dullness, and transparency are perceived visually in food. Meal presentation has been demonstrated to affect hunger stimulation or depression, which can lead to either complete sadness or pleasure. Even before a meal or drink reaches the consumer's mouth, its appearance affects its acceptability and craveability. This is so because, before we ever smell or taste, we eat with our eyes.

ii. The terms taste, mouthfeel, and odour are all used to describe the sensory phenomenon known as flavor. Aromatic chemicals known as flavouring substances are created by combining taste and smell, and are detected by the nose and mouth. The perfume of most baked goods and freshly cooked rice, for example, enhances the pleasure of eating. Taste facilitates the recognition, acceptance, and enjoyment of food. It is sensed by the tongue's taste buds. Taste perception can be divided into four categories: sweet, salty, sour, and bitter. Bitter and sour are frequently mistaken. When it comes to mouthfeel, the mouth's nerves are stimulated by chemical or temperature reactions, such as the sensation of different food items.

iii. Taste's first cousin is aroma. These are volatile substances that are detected by the nasal cavity's olfactory tissues' smell receptors. The mastication process releases aromatic chemicals. Smell evaluates a food's aroma, which is significant for

appreciating flavor. Food tastes better when it smells good. In order for something to smell, it needs to be in a gassy state. Additionally, scent plays a crucial role in identifying food that is fresh, rotten, or occasionally toxic.

iv. A mix of senses, including touch, taste, sight, and hearing, are used to perceive texture. It is among the most important characteristics of a food. It is unlikely that a client will return if they bite into a soggy biscuit or eat ice cream that has a sandy feel. Many items must have a certain texture in order to be accepted, such as bread and meat that is soft and tender. In addition, it covers the food's consistency, thickness, fragility, chewiness, and particle size and form. Texture analysers are useful for ensuring that the desired texture is maintained from the lab to the user's kitchen.

v. Sounds Hearing considers the noises produced by food during cooking and consumption, such as the crackling of hard biscuits, the fizz of liquids, and the crackle of fried food. Thus, organoleptic, or sensory, qualities of food are measured, analyzed, and interpreted through the use of the senses in sensory analysis.

6. FACTORS AFFECTING CONSUMER SCIENCE

Extrinsic and intrinsic product cues are the sources from which customers often derive expectations and perceptions of a food product. They both have an impact on eating decisions, although they happen at different times. Although they are not physically present in what is tasted or consumed, extrinsic product qualities are nonetheless tied to the product. As a result, buyers decide what to buy while being uncertain about the quality of the goods. As a result of their lack of sensory awareness, customers rely their decisions on extrinsic characteristics associated to the product (such as brand, packaging, price, labels, and claims) (Akdeniz *et al.,* 2013). The physical attributes and nutritional makeup of a product are examples of intrinsic cues, which also influence the food's look, flavor, texture, and mouthfeel. Based on these innate clues, sensory perception shapes how consumers perceive and interact with the food. Consumers respond differently to extrinsic and intrinsic product cues, which together influence their buying decisions (Symmank C., 2019).

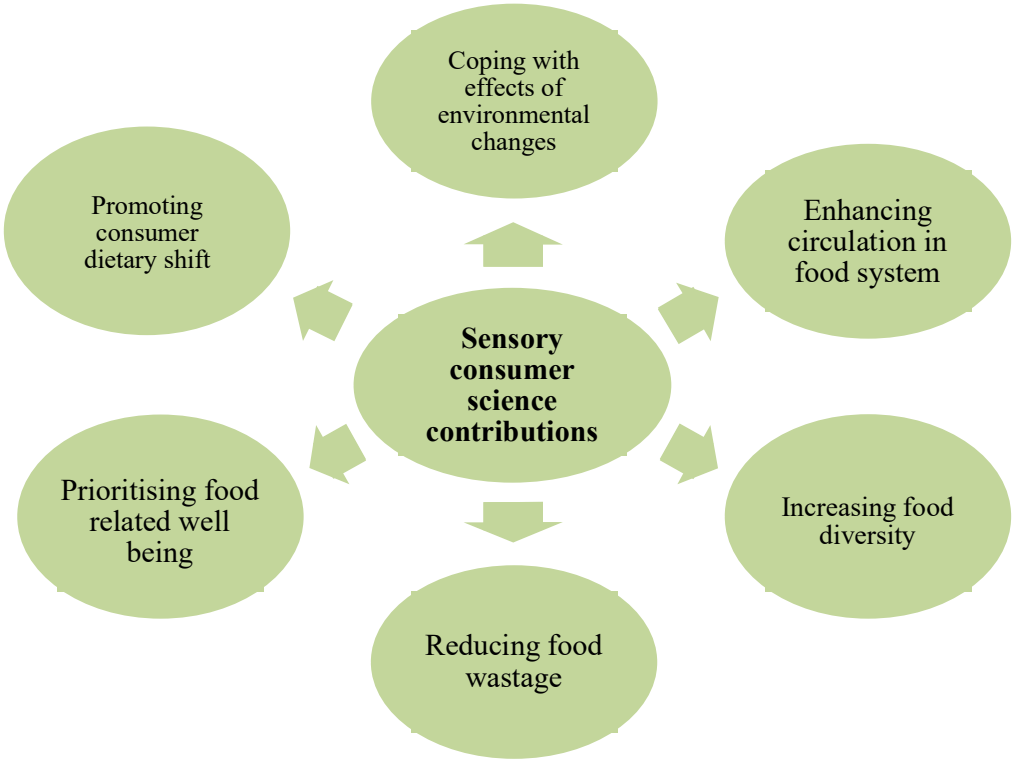

Figure 3 Sensory and Consumer Science contributions (Aschemann- Witzel J. *et al*., 2019)

7. SENSORY EVALUATION METHODS

In terms of product marketing and quality assurance, sensory evaluation is crucial. In the food industry, it is widely utilized for product recipe modification and new product creation. The purpose of the investigation is to determine the types of differences between the items and whether or not those differences should lead to the acceptance or rejection of those products. Using discriminating, difference, descriptive, and emotional methodologies, food products' sensory qualities can be evaluated (Lawless, 2013). Different types of sensory tests can be performed within each category. In practice, two types of sensory testing are typically used. The trained panellists typically conduct objective tests, which yield objective information on the sensory qualities of items. These are separated even further into two classes: tests of discrimination and tests of description. While descriptive tests go into more detail about the type or extent of sensory abnormalities, discrimination tests are helpful in evaluating the differences in perception between the samples. Subjective testing also yields information about the products' acceptance, liking and preference. Usually, these are handled by judges with little experience. They are also well-known as consumer or affective tests. Below is a brief explanation of each kind of test:

a. Objective tests (Sharif *et al*., 2017)

- Triangle test: This test is useful in quality control for identifying strange products from different manufacturing lots and results of ingredient substitution. Panellists who possess the ability to distinguish differences can also be chosen using the triangle test. Usually, this test does not indicate the degree or quantity of difference. The assessor should be asked to postulate a dissimilar attribute for this purpose. Each assessor receives three coded samples for the triangle testing; two of the samples are the same and one is unique. Selecting the odd sample is the task at hand. It is possible to examine the responses to questions two and three if the judge successfully isolates the odd sample. They are ignored if not.

b. Descriptive testing: (Sharif *et al*., 2017) the food business uses descriptive testing to elucidate the perceived sensory qualities of food products. These are important for evaluating sample differences, sample perceptions of sensory attributes, and the effects of processing, packing, and storage conditions on the sensory qualities of the individual product. It is useful for investigating the basis of product acceptability, assessing crucial parameters important to quality control or shelf-life studies, investigating the impact of recipe or process modifications on sensory attributes, and managing food product research and development. When conducting descriptive testing, the following techniques are typically used:

- Scaling Methods: These assessments, also known as scoring methods, are used to determine the degree to which certain attributes are present. The assessor expresses his or her choice using a structured or unstructured scale. Scaling techniques are useful in determining the extent, direction, and magnitude of variations for a given attribute; hence, professionals with the necessary training or experience should administer these tests. Typically, a single quality is given a numerical rating on a structured scale, along with descriptive labels such as "extremely sweet", "sweet", and "not sweet". After that, the scale's particular intervals are converted to figures for analysis. On the other hand, linguistic anchors are present at both ends and the middle of an unstructured scale. The sensory specialist typically measures distance on the line to translate each sample's position on the scale, which the assessor has marked, into a numerical value. In the food industry, scoring or scaling techniques are mostly employed for quantitative descriptive analysis.

c. Affective testing: This type of testing is mostly used to determine whether or not a particular product is preferred or accepted by consumers based on their likes and dislikes. In the food business, affective testing is used to ascertain consumer preferences for some products over others, as well as their intention to use a product. In general, fresh products are preferred over items nearing the end of their shelf life. It

is normal for a rusk to become little less crisp and to taste slightly different. Customers are frequently asked if, despite changes in sensory characteristics after storage, they still find these rusks satisfactory. The most popular affective techniques are the nine-point hedonic scale, ranking for preference, and paired preferences. The assessor is asked to identify the sample from the two that he prefers in paired preference. Even if the judge decides on one of the samples, they may not think either is ideal. This test is rather straightforward and easy to run, particularly if you know which sample is the most desirable. The assessor is asked to select two or more samples as favourites when rating for preference. The degree of liking for a particular product is measured using the hedonic scale. The 7-point and 9-point hedonic scales, which range from severely disliked to exceedingly liked, are the most widely used hedonic scales. The evaluator can compare the acceptability of multiple products by utilizing the hedonic scale. The majority of the world uses the 9-point hedonic scale in English-speaking nations as well as in Pakistan.

d. **Tests at the Threshold:** The basic definition of a threshold is the concentration at which the typical individual notices a signal. There are four different kinds of thresholds: terminal, absolute, difference, and recognition. The lowest concentration at which a stimulus can be recognized is called recognition. The concentration shift necessary to produce a discernible difference is known as the difference threshold. The lowest stimulus that can elicit a response is known as the detection or absolute threshold. According to Meilgaard *et al.,* (2016), a terminal threshold is the concentration at which there is no discernible change in reaction. While there are uses for each of these particular thresholds, the detection threshold is the one that is most frequently employed in studies on food science. Thresholds can be difficult in real life. Conducting threshold testing requires a lot of work. Even among trained panellists, thresholds might differ significantly, and the parameters used to create thresholds can also affect the outcome (Drake *et al.,* 2023).

e. **Temporal Examinations:** Sensory assessments known as temporal tests make an effort to record the dynamic nature of the sensory encounter. A simple example is texture-trained panel profiling. Measurements of biting stiffness come first, then characteristics of chewing down, and finally mouthfeel following expectoration. Due to the dynamic nature of food, measuring its changing features is relatively simple for trained panel profiling; however, measuring the temporal elements of flavour, or the combination of flavor and texture, might be more difficult. The intensity of one or more attributes can be tracked continuously, a technique known as time intensity profiling, or panellists can be asked to record the intensities of one or more attributes at predetermined time points (also known as fixed time-point methods) (Morais *et al.,*

2014, Palazzo & Bolini, 2013). Some of the earliest temporal methods to be created were the discrete/fixed time point and time intensity approaches, which are still in use today (Lawless & Heymann, 2010). Frequency-based methods, which do not require scaling, have been developed more recently, primarily with the introduction of computer technology. These methods include temporal order of sensations, temporal dominance of sensation, temporal check-all-that-apply, and temporal ranking of attributes (Keefer *et al.,* 2022, Reyes *et al.,* 2017, Wu *et al.,* 2019). These temporal approaches can yield complementing results to typical trained panel descriptive profiles, and they have specific applications as well. In the past, temporal methods were employed with trained panellists; however, more recently, consumers have also been subjected to temporal methods in order to measure changes in attributes over time, as well as emotion or likeness (Drake *et al.,* 2023).

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It's not applicable.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

ETHICAL APPROVAL

It's not applicable.

REFERENCES

1. *Akdeniz B., Calantone R.J., Voorhees C.M. (2013). Effectiveness of marketing cues on consumer perceptions of quality: the moderating roles of brand reputation and third-party information. Psychology and Marketing. 30, 76–89.*
2. *Aschemann-Witzel J., Ares G., Thøgersen J., Monteleone E. (2019). A sense of sustainability? – How sensory consumer science can contribute to sustainable development of the food sector. Trends in Food Science & Technology. 90, 180–186.*
3. *Forde C.G. (2016). Sensory Science: From measuring perception to understanding Ingestive behavior. Reference Module in Food Science, Elsevier. http://dx.doi.org/10.1016/B978-0-08-100596-5.03396-5.*
4. *Drake M.A., Watson M.E., Liu Y. (2023). Sensory analysis and consumer preference: best practices. Annual Review of Food Science and Technology. 14(1), 427–448.*

5. *Hobbs D.A., Ashouri A., George T.W., Lovegrove J.A., Methven L. (2014). The consumer acceptance of novel vegetable-enriched bread products as a potential vehicle to increase vegetable consumption. Food Research International. 58, 15–22.*
6. *Food Research Lab. (2024). Sensory evaluation of food. https://www.foodresearchlab.com/blog/rte-rtc/sensory-evaluation-of-food/ (Assessed on 11 April 2024).*
7. *Inspirit VR. (2024). Senses study guide. https://www.inspiritvr.com/senses-study-guide/ (Assessed on 11 April 2024).*
8. *Keefer H.R.M., Harwood W.S., Castura J.C., Drake M.A. (2022). Temporal ranking for characterization and improved discrimination of protein beverages. Journal of Sensory Studies. 37(4), e12751. https://doi.org/10.1111/joss.12751.*
9. *Lawless H.T., Heymann H. (2010). Sensory Evaluation of Food: Principles and Practices. 2nd edn. Food Science Text Series, Springer Science+Business Media. DOI: 10.1007/978-1-4419-6488-5.*
10. *Lawless H.T. (2013). Laboratory Exercises for Sensory Evaluation. Springer, New York. https://doi.org/10.1007/978-1-4614-5713-8.*
11. *Meilgaard M.M., Civille G.V., Carr B.T. (2016). Sensory Evaluation Techniques. CRC Press, Boca Raton, FL. 5th edn. https://doi.org/10.1201/b19493.*
12. *Montouto-Graña M., Cabanas-Arias S., Porto-Fojo S., Vázquez-Odériz M.L., Romero-Rodríguez M.A. (2012). Sensory characteristics and consumer acceptance and purchase intention toward fresh-cut potatoes. Journal of Food Science. 71(1), S40–S46.*
13. *Morais E.C., Pinheiro A.C.M., Nunes C.A., Bolini H.M.A. (2014). Multiple time-intensity analysis and temporal dominance of sensations of chocolate dairy dessert using prebiotic and different high-intensity sweeteners. Journal of Sensory Studies. 29, 339–350.*
14. *Palazzo A.B., Bolini H.M.A. (2013). Multiple time intensity analysis: sweetness, bitterness and chocolate flavor and melting rate of chocolate with sucralose, rebaudioside and neotame. Journal of Sensory Studies. 29, 21–32.*
15. *Reyes M.M., Castura J.C., Hayes J.E. (2017). Characterizing dynamic sensory properties of nutritive and non-nutritive sweeteners with temporal check all that apply. Journal of Sensory Studies. 32(3), e12270. https://doi.org/10.1111/joss.12270.*
16. *Ruiz-Capillas C., Herrero A., Pintado T., Delgado-Pando G. (2021). Sensory analysis and consumer research in new meat products development. Foods. 10(2), 429.*
17. *Sahu P. (2020). Sensory evaluation: Basics of sensory evaluation, tools, techniques, methods and interpretation. DOI: 10.13140/RG.2.2.28805.58082.*
18. *Schiano A.N., Harwood W.S., Drake M.A. (2017). A 100-year review: sensory analysis of milk. Journal of Dairy Science. 100(12), 9966–9986.*
19. *Sharif M.K., Butt M.S., Sharif H.R., Nasir M. (2017). Sensory evaluation and consumer acceptability. In: Handbook of Food Science and Technology. pp. 362–386.*
20. *Stone H., Sidal J. (2009). Sensory science and consumer behavior. In: Global Issues in Food Science and Technology (World Congress Book). pp. 67–77.*
21. *Symmank C. (2019). Extrinsic and intrinsic food product attributes in consumer and sensory research: literature review and quantification of the findings. Management Review Quarterly. 69, 39–74.*
22. *Wu A.Z., Lee R.W., Calve B., Cayeux I. (2019). Temporal profiling of simplified lemonade using temporal dominance of sensations and temporal check all that apply. Journal of Sensory Studies. 34(6), e12531. http://dx.doi.org/10.1111/joss.12531.*