

Food Product Development: From the Consumers Aspect

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Abstract. Product development involves the design activities of “new” products as well as the functionalization of the valid ones. This concept is highly associated with the demand of the consumers towards the product such as health promotion or sensory attraction. Moreover, consumers are the decider of product survival in the market. Therefore, with the sensory testing, we assess the consumers’ response which indicates the market success of the developed food. Hence, a food developer who comes up with a new product idea (including new and functionalization of the current one) needs to make sure of the consumer acceptance via sensory evaluation tasks. Sensory evaluation practices are usually the final and the determinant step of product success and acceptance. A comprehensive sensory practice should be well structured in terms of technical assessment as well as correct panelist group selection to be representative enough to give consumer’s response. Even though this aim sound to be a straight forward concept, the eating activity is quite complex and dynamic to mimic on the selected panelists as a consumer. So far, investigators collected enough data to understand only some of the senses however, sensory understanding of the several sense involving parameters like texture and aroma is still uncovered. This talk is established to understand the importance of the sensory approach which is done in practice to decide on the new/functionalized product to be placed in the market or not for business success.

1 Introduction

Human beings need the energy to maintain the daily survival activities. For obtaining that vital energy we need to eat and drink calorie-containing foods. This statement has found a partner aside from the modern ages and the industrialization of the food sector. Therefore, the new statement is that eating and drinking activities are essential for two reasons: energy fulfillment (vital) and pleasure and socialization. Noteworthy, recent ages are dealing with many eating disorders and that’s also proof that eating and drinking are also done for non-vital reasons.

As an industry food processors target the consumers’ non-vital perception mainly. Since the economies are constantly developing, thankfully nowadays starvation has been overcome by most of the countries. Consumers are customers of the industry, hence the sector needs to understand the expectation, behavior, and perception of the consumer for the product and brand success. Therefore, we can say that the consumer perception towards the product is the driving force for the industry and this work aims to illustrate the consumers’ sensory perception for the food products that affect the food product development.

2 Sensory analysis

Sensory analysis and sensory evaluation deal with the understanding of the consumers’ sensation towards

tested sensory modality. Until the 1940s the sensory evaluations and analysis were considered to be purely subjective. However, today we design and practice a method that is reliable, robust, and low in the individuals’ variabilities. This early statement was not correct but there was not enough evidence that we could design a sensory test that could be perceived as “objective”. Luckily, today we have sensory test methods and statistical analysis to support the reliability of the tests.

Sensory properties are, therefore, critical for the food developers to estimate the consumer behavior towards the product. Sensory observations are complicated due to their inter-nature between different sensory modalities and individual variance even though we can decrease it to a minimum. So far we are still incapable of mimicking the real oral conditions to measure the sensory in an instrumental approach due to catastrophic and dynamic processes during eating. Therefore, the best and only way of understanding consumer preference is still to run a sensory test on either trained or untrained panelists which are highly time and cost-consuming.

Looking at the history behind the sensory tests we observe that the initial sensory tests were focused on the intensity measurement of the senses as hearing or vision. Later on most probably around industrial revolutions, people started to question the food product preferences which triggered the food sensory studies for the aim of higher sales of a product/brand. The principles of the basic sensory evaluations incorporate; human sense,

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basic sensory analysis requirements, physiology, and psychological effects, data interpretation.

3 Human sensation

Basic human senses are divided into five as; vision, gustation, olfaction, touch, and hearing. Each sense corresponds to different perceptions which are illustrated in Table 1.

Table 1. Human senses, corresponding organs, and perceived sensations [1].

Sense	Organ	Perception
Vision	Eye	Appearance
Gustation	Mouth	Taste
Olfaction	Nose	Odor/aroma
Touch	Skin	Texture
Hearing	Ear	Sound

These listed senses are all somewhat responsible for the food sensory perception. Moreover, the order of food sensation sense is; appearance, odor/aroma, consistency, texture, and lastly flavor [2]. This sequence is not surprising at all and could be valid for any sensation mechanism not only food.

The human as an instrument usually makes a visual check before anything. This is an evolutionary fact to protect ourselves from predators also to avoid eating toxic (usually) colorful foods. The initial look usually gives us a hint about the following sensations and forms a cue about the product. From the sensory point of view, we can say that the packaging material and the general look of the product attract or detract the consumer to give the decision to buy or reject in the supermarket. Noteworthy visual cues involve color, shape, size, visual consistency for a consumer to test [3]. For the sensory testing conditions, if the visual properties are not the primary question, we usually blindfold the consumers to obtain less violated answers regarding the testing modality such as flavor or texture.

The second sensation is the odor/aroma. This modality is very complex but involves volatile compounds to be detected by the olfactory epithelium of the nasal cavity which can get easily saturated. We also know that aroma sensation includes taste buds and gustation sense to be defined in the human cortex for the corresponding reference [1]. For the gustation perception, we know that it is triggered by the mouth (tongue and inner skin of the mouth) and taste buds. The soluble and non-volatile (so odor-free) food compounds are mainly given 5 taste sensations which are; salty, sweet, sour, bitter, and umami. Despite the historic belief that taste buds are grouped according to their responsible taste on the tongue, recent studies illustrate that taste buds are evenly distributed on the tongue [4–7].

For the consistency and texture sensation, we know that the tactile receptors on the skin are responsible for the sensation that works either direct or indirect methods for touch and cutlery contact, respectively [8–10]. Additionally, the literature has enough evidence to support that consistency and texture cues initiate through

the first look (visual cue) which is evaluated with the contact through the skin (or cutler or a tool) then lastly evaluated by the oral contact through the mouth. The texture and consistency sensation also involves the auditorial senses especially with crunchy foods [11]. Good examples for the texture and consistency evaluations are; crisps, nuts, creamy foods such as butter, sour cream, etc.

4 Inter-relationship between the sensation mechanisms

Inter-relationships between various senses are illustrated in Table 2. In this table, the highlighted boxes represent the active sensation. Therefore, during a sensory test design, we need to select the correct minute of testing for either before eating and after eating (oral processing phase).

Table 2. Sensory modalities inter-relationships during oral processing [1].

Sense	Visual	Oral Processing	Perceived modality
Vision			Appearance
Gustation	Nasal		Flavor Taste
Olfaction			
Trigemina l			
Touch			Texture
Hearing			

These senses are usually in charge of any modality as a part of the system which makes understanding the sensation mechanisms more complex. Not only the sensation modalities integrating but also the food that is being orally processed experiences a series of changes due to mechanical breakdown (chewing with teeth and shearing with tongue and palate) as well as saliva integration (dilution and enzymatic reaction with the amylase). Therefore, these catastrophic food structure change and the sensed modality interactions with the skin, mouth and auditorial sensors creates complex nature to understand. The literature illustrates that during oral processing the temperature, saliva content, and pH continuously change. Hence, the food sensation mechanism needs to involve all these variables to obtain a realistic (instrument-like) understanding, which is unfortunately still not possible.

A sensory test involves a main step for the designing and analyzing of the tested modality. An investigation done previously by Cardello (1996), illustrates a model for the five main senses and their roles influencing food preference and acceptance [12]. According to that model, a researcher can select the modality, the time, and test question (quantitative or qualitative). Despite this, a sensory test design needs to be selected carefully around the objective with the environmental conditions, subjects, and target group selection, test method and finalize the design with the correct validation methods. Sensory procedures are divided into two main classes as analytical and hedonic tests. The analytical approach involves discrimination and descriptive tests where

hedonic usually test the preference, acceptability questions. Each approach determines the careful selection of the test hypothesis and requires the correct subject selection and validation method. Moreover, due to their natural differences and statistical validation methods we need to assess a minimum number of panelists (trained or untrained) to confirm the findings as valid. These minimum numbers are illustrated in Table 3.

Table 3. Required minimum number of assessments for various sensory methods [13].

Test	Minimum number of subjects	
	Trained	Untrained
Paired comparison	20	30
Triangle test	15	25
2 out of 5	10	-

5 Conclusion and future remarks

Consumers aspect towards the product development is therefore, a determinant factor for the critic decisions. According to that approach understanding of these main sensory properties concerning the food oral processing conditions (physiological), individual perception mechanisms (psychological), scientific testing (sensory tests), and interpreting of the data obtained through these scientific tests are the list of variables for the decision criteria. Noteworthy, there are vast amount of parameters to be interpreted with these complicated senses that integrate into the sensation modality. However, thanks to the advanced technics of sensory and statistics we are capable of obtaining realistic sensory feedback on the product which illustrates the product's success in long-term effect.

Future studies of sensory science are expected to be focusing more on the automated systems that interpret the physical measurements as the panellists (affective approach). These assessments will be either a model of a simulation (from a practiced sensory testing) or algorithms of the expected sensations (physiological measurements) where both approach requires extremely high numbers of sensory testing for reasonable sensory feedback.

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