

FOOD TEXTURE: SENSORY EVALUATION

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Summary

Texture is a primary attribute that, together with visual appearance, taste, and aroma, comprises the sensory quality of foods. The only way to evaluate sensory quality or some of its attributes (i.e., the result of sensations experienced by humans when consuming foods) is to ask the opinion of the consumer, since sensory quality is not an intrinsic food characteristic, but the result of interactions between humankind and food. Defining food texture, as it is understood today, is not an easy task, mainly because this attribute is the result of perceived stimuli of a very different nature and because its evaluation is not an instantaneous process. This process comprises a) perception of the stimulus, b) elaboration of the sensation, and c) oral communication of the sensation. Perceived texture in the mouth may be the response to different physical stimuli, as a function of the flow characteristics of a particular liquid food or the resistance to mastication of solid foods. The physical stimuli are transformed into psychological sensations that are integrated into a final sensation or perception. Sensory analysis techniques (discriminatory, descriptive, and affective tests) are used to study food texture. Of special interest is the Texture Profile method. Of a descriptive nature, this is designed to standardize the sensory description of food texture in terms of previously fixed attributes. An interesting alternative to describing food texture is the application of a technique known as the Free Choice Profile, in which there is no need to elaborate on a consensus list of descriptors because each assessor uses his/her own terms for the attributes perceived. Finally, the use of affective tests to evaluate acceptance or

preference of foods for texture is discussed. Hedonistic scales are useful for obtaining data from consumers. Interpretation of the results presents the problems derived from the various individual responses. Segmenting the whole population into subgroups that show similar tendencies in preference is a great help in drawing valid conclusions. This type of information is especially useful in new product development, and in defining the textural quality specifications of certain food products.

1. Introduction

Texture is a primary attribute that, together with visual appearance, taste, and aroma, comprises the sensory quality of foods. The only way to evaluate sensory quality or some of its attributes (i.e., the result of sensations experienced by humans when consuming foods) is to ask their opinion, since sensory quality is not an intrinsic food characteristic, but the result of interactions between humankind and food. The analysis of the chemical composition and the physical properties of a certain food product affords information about the nature of stimuli perceived by the consumer, but not about the sensation experienced in its consumption.

Defining food texture, as it is understood today, is not an easy task, mainly because this attribute is the result of perceived stimuli of a very different nature, and because its evaluation is not an instantaneous process. Evaluation of texture is a complex, dynamic process that comprises visual perception of the product surface, product behavior in response to previous handling, and integration of in-mouth sensations experienced during mastication and further swallowing. The human brain compiles all of these, and a unique sensation is built up.

It was not until the 1960s that texture began to be considered important in evaluating food quality. Since then, a number of definitions have been proposed that are synthesized in the corresponding ISO Standard 5492 (1992). In this standard texture is defined as, “*All the mechanical, geometrical and surface attributes of a product perceptible by means of mechanical, tactile and, where appropriate, visual and auditory receptors*”. Consideration is given in this definition to the rheological and mechanical properties of foods, the contemporary development of studies on food rheology and food texture, and the assumed connections between both groups of properties, suggests that said connections are more important than can actually be established. In the first place, it should be taken into account that during mastication, foods are broken down into small pieces, this process being then outside the scope of food rheology. Size, shape, and surface roughness of the resultant particles, as well as their capacity to absorb water from saliva, are not rheological properties. Less direct connections can be established between rheology and the textural perceptions linked to both visual and auditory receptors. Depending on the nature of the food considered, human perception of different attributes by different senses (Table 1) may lend more or less importance to the integrated texture sensation perceived. In general, attributes perceived in the mouth are the most important. Even when considering only those aspects of food texture directly related to the perception of rheological or mechanical properties, the entire sensation could be modified by interactions with other sensory attributes, such as flavor or color, and by certain hedonic connotations that are hard to eliminate. Therefore, even if a rheological or mechanical method is available to explain a high proportion of the

variability observed in some of the textural characteristics, it will never afford sufficient information to evaluate texture as a whole.

In summary, texture is clearly defined as a sensory attribute, and is thus only measurable directly by sensory means. According to Szczesniak (1987), “*It is only the human being that can perceive, describe and quantify texture*”. To analyze texture more completely one should use Sensory Analysis methodology.

NATURE OF THE ATTRIBUTE	EXAMPLES
Visual	Color (fruits and vegetables) Dropping rate (liquids)
Auditory	Sound intensity during mastication (crunchy, crispy foods)
Tactile, Non Oral	Resistance to deformation (fruits and bread) Resistance to cut with a knife (meats) Resistance to cut with a spoon (dairy deserts)
Tactile, Oral	Resistance to mastication (solid foods) Resistance to displacement in mouth (liquid foods) Structural characteristics (Fibrousness, granularity, flouriness, etc.) In mouth movements (liquids and solids)

Table 1. Examples of attributes of a different nature, related to perception of texture in some foods.

As defined by ISO Standard 5492 (1992), sensory analysis is the “*examination of organoleptic attributes of a product by the sense organs*”. One of the biggest problems inherent to sensory analysis of foods is in obtaining a precise and reproducible human response. The development and improvement of sensory methods destined for the study of eating sensations experienced by humans requires knowledge of the sensory quality evaluation process. This process comprises a) perception of stimulus, b) elaboration of sensation, and c) communication of sensation (Figure 1).

Since the second half of the twentieth century, along with the development of sensory methods to evaluate texture, there has been a notable increase in the number of studies aimed at elucidating the perception mechanisms involved in assessing the textures of liquid, solid, and semi-solid foods. Factors influencing the human sensation, as well as the identification, definition, and classification of specific textural terms, have also been the object of recent studies. Advances in these matters, together with the improvement of sensory analysis methodology and statistical data treatment have led to the present

position, in which sufficient tools are available to study the sensory evaluation of food textures successfully.

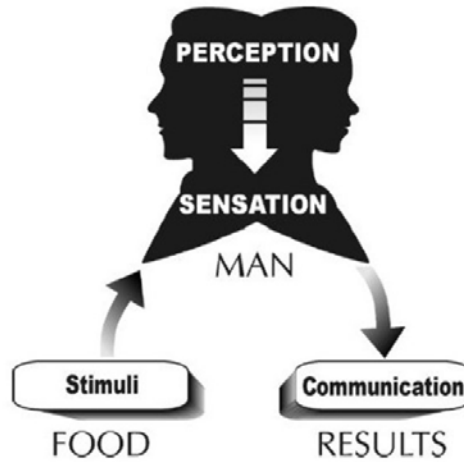


Figure 1. Process of sensory evaluation.

2. Physiological Perception

Ascertaining the mechanism of physiological perception for a certain stimulus is difficult. It must be based on knowledge of the process involved in determining the human perception of a food's physical characteristics, both from a physiological and a psychological point of view. In the case of texture, most research has addressed the analysis of perceptions of food that occur in the mouth prior to swallowing. As stated by Pierson and Le Magnen (1970), *"The oral spatio-temporal pattern as a source of the perception involves stimulation of at least two different sensory systems. Food in the mouth is a tactile stimulus for the lingual, palatal, and pharyngeal regions. From the beginning of mastication to the final deglutition, it elicits a spatial distribution of stimulations of touch mucosal receptors"*.

Several techniques developed by researchers that have yielded interesting information on the different aspects of physiological perception follow:

- Monitoring of fluid movement in the mouth.
- Direct measurement of the physiological response (e.g., acoustic methods), registering the sounds produced during swallowing.
- Direct measurement of the sounds produced when the product structure is destroyed through breaking or chewing crisp or crunchy foods.
- Electromyographic methods, in which the electrical potentials of facial muscles during the oral manipulation of liquid, semisolid, or solid foods are measured.
- Kokini *et al.* (1977) used another approach to elucidate the mechanism of the physiological perception of texture.

These researchers developed a physical theory modeled on the physical structure of the mouth and solved constitutive equations relating certain sensory attributes to specific forces.

Analysis of the results reported in the above-mentioned research provides interesting and valuable information on the different aspects of the sensory perception of texture. Perhaps the first conclusion to be drawn from these studies is that perceived texture in the mouth may be a response to different physical stimuli (e.g., the flow characteristics of a particular liquid food or the resistance of a solid food to mastication). More research is needed to unveil the process by which humans perceive texture in different foods; only then will the real nature of those stimuli, wholly or primarily responsible for sensation, be ascertained in each particular case. This type of study is difficult to conduct, mainly because geometry in the mouth changes constantly during chewing and swallowing, and different forces, depending on the subject and food, are developed during biting and chewing processes.

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Biographical Sketches

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