

Editorial

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## MEASUREMENT OF SENSORY ATTRIBUTES IN FOOD QUALITY CONTROL

Food quality can be defined in several ways. One of the more appropriate to be applied to industrial quality control activities is that enunciated by Professor Kramer: *the composite of food characteristics that differentiate individual units of a product, and have significance in determining the degree of acceptability of that unit by the buyer*. These characteristics are of very different nature and have to be discussed separately or, at least, in homogeneous groups. Classification of quality characteristics, also referred to as factors or parameters, can also be made differently. A widely accepted classification implies the definition of the following groups of factors: Purity or authenticity, Safety, Nutrition, and Sensory attributes. Other factors, mainly of commercial nature, such as product presentation, labelling, convenience of use, or even price, will not be discussed here.

Purity factors refer to the food product composition as ingredients and additives and are, of course, defined by the legal standards in each country or geographical area. In some places a so-called identity standard will specify which ingredients and additives can be used for the particular foodstuff to be considered pure or authentic. It was said in a very schematic manner that pure food is the one that contains all that it should and does not contain anything that it should not. The industrial control of this group of factors relies on the chemical analysis of the specified ingredients. Safety factors, being of great concern to consumers, include all possible contaminations by undesirable microorganisms and toxins and/or by harmful chemical products, which can be present either by casual or, in some cases, by bad manufacturing practices. Their control, either in industry or along the commercial chain, must be carried out by established microbiological and chemical methods. Nutrition factors evidently involve the presence of the desired nutritional components and the absence of the undesired ones. In this case, their control along the food chain will rely on both chemical and biological tests. Sensory quality factors include the food characteristics perceived by the human senses, the main ones being flavour, colour and texture. In the first place, it must be clearly stated that these factors, parameters or attributes, as they are commonly named, are not strictly food characteristics or properties. They are, in fact, human sensations produced by the perception of physical or chemical stimuli. In other words, they are the result of the man-food interaction. The foods themselves have no flavour, no colour and no texture. What foods, as any other existing materials, have are volatile and non-volatile chemical components, capable of producing sensations in people tasting and/or smelling them. They also have more or less specific optical properties, such that when light strikes them and reaches the human eye, visual sensation occurs. Similarly, the physical

structure and/or the mechanical properties of a particular piece of food will result in a certain food texture only when the consumer touches, presses, masticates or swallows it. These considerations, widely accepted and confirmed, lead to the unquestionable conclusion that sensory attributes can only be correctly measured by sensory analysis, carried out by humans.

The instruments used in sensory evaluation are evidently the human senses. These are of a very complex nature. The mechanisms of the perception process are only partially known. Some water-soluble chemical substances act as stimuli for taste sensations: when they approach the receptor cells in an aqueous medium (saliva), perception takes place and an electrochemical signal is transmitted through the neurons to the brain, where the taste sensation originates. Something similar happens when certain volatile substances get in touch with the sensitive cells, present in the cilia, located in the nostrils, producing the corresponding odour or aroma sensation. Both these so-called chemical senses build up the complex sensation known as flavour (sometimes considered to include also tactile perceptions). Colour, together with other optical properties such as gloss and transparency, is perceived in the human retina, where the cones detect the relative quantities of the three basic hues, red, green and blue, present in the light ray entering the eye. Signals are then sent to the brain as three different pairs of sensations: white-black, red-green and yellow-blue. The final colour sensation is formed in the brain, jointly with other sensations, originated from visual perceptions of variable importance, such as geometric proportions, surface characteristics, abnormalities, defects, etc. Texture, a much diversified concept, is perceived by touch and by the kinaesthetic sense. Using these senses humans can detect and evaluate the magnitude of some mechanical properties of the food, such as resistance to deformation or to rupture, degree of recovery after compression or extension of the material tested, rugosity of the surface, viscosity or consistency of a liquid or semisolid food, etc. The receptors are located in the skin and in the muscles and their reactions to contacting or handling foods are transmitted to the brain. The most important of all these reactions are those of the masseter muscles in the jaws, where the resistance of solid foods to mastication are perceived. These can be visualised and quantified by electrophysiological registration of the forces generated during mastication in an electromyograph (EMG).

By definition, sensory evaluation of food quality can only be performed by people, using their senses. Obviously, quality control cannot rely on sensory evaluations carried out by anybody in any situation. Rules must be set to convert human sensations into reproducible measurements of scientific value. This is precisely the aim of Sensory Analysis.

The recentness and slow development of the discipline of Sensory Analysis is perhaps the cause of the present scarcity of methods to measure and control sensory quality, both in industry and in control organisations. Consequently, more or less correct methods, with variable scientific basis, have been proposed for sensory quality control. The main ones used at present for control purposes are: Difference from a standard (control sample, mental or written) and Descriptive methods.

The simplest method would be the evaluation of the overall degree of difference between the food sample in question and a control sample (standard), used as a reference. A scale with the extremes labelled “no difference” and “extreme difference” will do and a group of not necessarily trained judges can perform it. This method is frequently used in public or government organisations, where the objective is to separate samples of low quality. A more informative method consists of selecting the most important sensory attributes for a particular product and evaluating the differences from the standard for each attribute. When there are difficulties in having an adequate control sample, a mental standard can be used, as is common with fresh foods. Of course, the use of a mental standard by one or several experts to define the quality of a food product presents two serious problems, derived from the possible difference between the mental standards used by the experts, if more than one, and from the fact that their opinions are not representative of consumers’ opinion. When the experts doing this test have a good knowledge of the product and of its manufacturing process, and a recognised ability to evaluate differences, this method may render adequate results for control purposes. A third alternative is the use of written standards. The method known as Quality Grading is one of the most popular sensory tests used in quality control. It consists of developing a scorecard, including a scoring system with points assigned for each grade and a description of the selected sensory characteristics needed to define quality. The scorecard is composed of ordinal scales using discrete numbers and contains the description of the characteristics. A group of very well-trained judges give scores to each attribute and when a product is assigned a score in the lower third of the scale, it should be rejected, according to the ISO Standard no. 4121 (1987). This test allows for a rapid qualification of the product and for the detection of the possible causes of rejection.

Descriptive methods do not require the use of a standard. They rely on the formation of a well-trained sensory panel, capable of providing data on a set of the product’s sensory attributes. Food quality can be measured with this type of methods by the evaluation of the intensity of each previously selected attribute, thus obtaining what is known as a descriptive profile (conventional profile, Qualitative Data Analysis, Spectrum). The person responsible for quality control evaluates the results of the statistical analysis of experimental data and makes the final decision, based on the sensory specification previously established, where the range of intensities tolerated for each attribute has been defined. The two main advantages of this approach are the absence of any subjectivity in the evaluation and the quality of the data obtained. The main disadvantages are the time and cost necessary to train and calibrate the panel, and the time necessary to perform the test and analyse the data. Fortunately, the design of this type of test and the corresponding data analysis can be simplified by using the different software programmes available today.

A short final comment on a frequently posed question in this matter: Can sensory attributes be measured by physical or chemical methods? Based on the above-mentioned statement that they are not intrinsic food properties, the answer is no. But everybody knows that there are objective methods used to measure some of them,

which are incorporated in quality control. There are colorimeters, texturometers, or even electronic noses or tongues in the market with clear and useful applications in industry and in commercial enterprises. The very important thing to have always in mind is that these convenient, easy to operate, and generally precise instruments do measure physicochemical food properties. The success in effectively controlling sensory attributes strongly depends on the validity of the previously established relationships between the particular objective measurement and the nature and intensity of the human sensation, which is to be measured.

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