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Sensory analysis — Methodology — Texture profile

Analyse sensorielle — Méthodologie — Profil de la texture

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 12, *Sensory analysis*.

This second edition cancels and replaces the first edition (ISO 11036:1994), which has been technically revised. The main changes compared with the previous edition are as follows:

— definitions have been added for consistency with ISO 5492;

— changes have been made to avoid repetition.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Sensory profiling methods are formal procedures used for assessing in a reproducible manner the separate attributes of a sample and then rating their intensities on a suitable scale. The methods can be used for evaluating odour, flavour, appearance and texture, separately or in combination.

As a consequence of the unique nature of texture, methods have been developed specifically for texture profiling.

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Sensory analysis — Methodology — Texture profile

1 Scope

This document specifies a method for developing a texture profile of food products (solids, semi-solids, liquids) or non-food products (e.g. cosmetics).

This method is one approach to sensory texture profile analysis and other methods exist. This method describes various steps in the process of establishing a complete description of the textural attributes of a product.

This method is applicable to:

— screening and training assessors;

— orientating assessors through the development of definitions and evaluation techniques for textural characteristics;

— characterizing the textural attributes of a product in order to establish its standard profile and to discern any later changes;

— improving old products and developing new products;

— studying various factors that can affect the textural attributes of a product, e.g. changes in process, time, temperature, ingredients, packaging or shelf-life, and storage conditions;

— comparing a product with another similar product to determine the nature and intensity of textural differences;

— correlating sensory and instrumental and/or physical measurements.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5492, *Sensory analysis — Vocabulary*

ISO 8586, *Sensory analysis — General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors*

ISO 8589, *Sensory analysis — General guidance for the design of test rooms*

3 Terms and definitions

For the purposes of this document, the definitions given in ISO 5492 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

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3.1
texture, noun
all the mechanical, geometrical and surface attributes of a product perceptible by means of mechanical, tactile and, where appropriate, visual and auditory receptors

Note 1 to entry: The "mechanical attributes" are those related to the reaction of the product to stress. They are divided in five primary characteristics, i.e. hardness, cohesiveness, viscosity, springiness and adhesiveness. The "geometrical attributes" are those related to the size, shape and arrangement of particles within a product. The "surface attributes" are those related to the sensations produced by moisture and/or fat content. In the mouth, they are also related to lubrication and the way in which these constituents are released.

4 Principle

The development of a texture profile by means of a systematic classification that describes all of the textural attributes (mechanical, geometrical and surface).

5 General test requirements

5.1 General conditions of test

Evaluations shall be carried out in a test room that is in accordance with ISO 8589.

5.2 Equipment and premises

Utensils, containers and other needed materials shall be selected by the sensory analyst or panel leader, according to the nature of the product, the number of samples, etc. These shall in no way affect the test results.

If standardized apparatus corresponds to the needs of the test, it shall be used.

Sampling should be done following best practices. A standardized sample preparation that represents the texture of the whole batch should be selected.

6 Methodology

6.1 Components of a texture profile

The concept of texture profiling is based on the same elements as in flavour profiling. Therefore, a texture profile may include the following elements, depending on the type of product (food or non-food):

a) perceptible textural attributes, i.e. mechanical, geometrical and other;

b) intensity, i.e. the degree to which the attribute is perceptible;

c) the order of appearance of the attributes, which can be outlined as follows:

   1) prior to touch (visual);

   2) first touch (which may be with hands or another part of the body);

   3) first application (for food, this may be to the lips or tongue; for other products, it may be to skin surfaces on other parts of the body);

   4) manipulation (e.g. chewing for food, rubbing for creams/lotions/textiles);

   5) residual (changes occurring during mastication and/or absorption, such as the rate and type of breakdown);

   6) follow up, if any (e.g. swallowing, absorption, wipe off, rinsing).

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6.2 Classification of textural attributes

6.2.1 General

Texture is composed of different properties since the sensory evaluation of texture is a dynamic process.

Textural attributes can be grouped into three main classes (see 6.2.1 to 6.2.3) according to the degree to which each is present, and the order in which they appear.

Textural attributes are manifested by the reaction of a food or non-food product to a constraint or product manipulation. They are measured either:

a) by kinaesthesis, which includes the sensations of position, movement and tension of parts of the body, perceived through nerves and muscles, tendons and joints;

b) by somesthesis, which includes the sensations of pressure (touch) and pain perceived by receptors located in the skin and lips, including the oral mucosa, tongue and periodontal membrane.

6.2.2 Mechanical attributes

To obtain the maximum benefit from the use of scales in a sensory programme, each attribute shall be defined. A sensory technique should always accompany the definition of a textural attribute. Examples of mechanical attributes, definitions, techniques and common alternatives for liquid, semi-solid and solid food and non-food products are listed in Table 1.

Table 1 — Examples of definitions and methods of evaluation for mechanical textural attributes

Characteristic	Sensory definition	Technique	Common synonyms	Common antonyms
Hardness	Mechanical textural attribute relating to the force required to achieve a given deformation or penetration of a product. In the mouth, it is perceived by compressing the product between the teeth (solids) or between the tongue and palate (semi-solids). With hands, it is perceived by compressing the product between the hand (solids) and a plain surface or between two fingers (semi-solids).	Place the sample between the molar teeth or between the tongue and palate and chew evenly, evaluating the force required to compress the food. Evaluate sample hardness by pressing down on the sample on a plain surface or evaluate it between two fingers.	Firm, hard	Soft
Viscosity	Mechanical textural attribute relating to resistance to flow. It corresponds to the force required to draw a liquid from a spoon over the tongue, or to spread it over a substrate.	Place a spoon containing the sample directly in front of the mouth and draw the liquid from the spoon over the tongue by slurping, evaluating the force required to draw the liquid over the tongue at a steady rate. The degree of resistance of a liquid flow when administered on a surface or substrate may be evaluated visually or via kinaesthesis.	Viscous	Fluid, thin, runny

[a] Applies to non-food products. See also Annex B.

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Table 1 *(continued)*

Characteristic	Sensory definition	Technique	Common synonyms	Common antonyms
Springiness	Mechanical textural attribute relating to the rapidity of recovery from a deforming force and the degree to which a deformed material returns to its undeformed condition after the deforming force is removed.	Place the sample either between the tongue and palate (semi-solids) or molar teeth (solids) and compress it partially. Remove the force and evaluate the degree and rapidity of recovery. Place the sample either between a hand and a plain surface or another part of the body, or between two fingers and compress it partially. Remove the force and evaluate the degree and rapidity of recovery.	Plastic, malleable, elastic, springy	
Adhesiveness	Mechanical textural surface attribute relating to the force required to remove material that adheres to the mouth or to a substrate (such as the skin surface).	Place the sample on the tongue, press it against the palate, and evaluate the force required to remove it with the tongue. Evaluate the degree to which fingers stick to each other or to the sample after coming in contact with the sample.	Sticky, tacky, gooey, gluey	
Fracturable	Mechanical textural attribute related to cohesiveness and to the force necessary to break a product into crumbs or pieces.	Place the sample between the molar teeth and bite down evenly until the sample crumbles, cracks or shatters, evaluating the force with which the food moves away from the teeth. Place the sample between both hands, scrub one hand to the other pressing evenly until the sample crumbles, cracks or shatters, evaluating the force with which the sample moves away from the hands.	Brittle	
Cohesiveness of mass	Mechanical texture attribute related to the degree to which the mass holds together while chewing or during manual manipulation.	Chew sample with molar teeth until phase change. Knead or squeeze the sample manually until there is a phase change.	Springy and gummy	
Drag[a]	The amount of pressure required for the application of the product on a substrate, such as the skin or nails.	Place the sample on the substrate and evaluate while moving the sample on the substrate at a predetermined rate and form.		
Spreadable[a]	The ease to which the product can be manipulated on the surface of a substrate, such as the forearm or nails.	Place the sample on the substrate and evaluate the force needed to reposition the sample.		

[a] Applies to non-food products. See also Annex B.

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6.2.3 Geometrical attributes

6.2.3.1 General

Geometrical attributes are perceived by tactile receptors located in the skin. In the case of food products, these are located mainly in the tongue, mouth and throat. In the case of non-food products, these are mainly located in the skin (e.g. the hand or another location on the body). These attributes are also discernible through the appearance of the products, whether or not they are food.

6.2.3.2 Granularity

Granularity is a geometrical textural attribute relating to the perception of the size and shape of particles in a product.

Attributes relating to particle size and shape can be demonstrated by reference products in the same manner as the mechanical attributes. For example, terms such as smooth, chalky, grainy, gritty, sandy and coarse comprise a scale of increasing particle size.

6.2.3.3 Conformation

Conformation is a geometrical textural attribute relating to the perception of the shape and the orientation of particles in a product. Attributes relating to the orientation of particles represent highly organized structures. Geometrical attributes are not suitable for clear-cut scaling. Evaluation is qualitative and quantitative as to the type and amount of particles present in the mass or on the surface of the product.

Different terms correspond to a certain number of conformations. For example:

— “fibrous” refers to long particles oriented in the same direction (e.g. celery sticks, yarn);

— “cellular” refers to a highly organized structure composed of spherical ovoid particles, or composed of cell walls filled with a gas (e.g. egg white foam, stone cells in pears);

— “crystalline” refers to angular particles (e.g. granulated sugar);

— “puffy” refers to hard or firm outer shells filled with large, often uneven, air pockets (e.g. cream puffs, puffed rice);

— “aerated” refers to relatively small, even cells filled with air and surrounded (usually but not always) by soft cell walls (e.g. marshmallows, meringues, polyurethane foam).

Examples of the different geometrical attributes are presented and the amount of each characteristic present described. When a greater discrimination is required, a scale can be established for a specific characteristic.

6.2.4 Other attributes (moisture and fat content)

6.2.4.1 General

These attributes refer to mouthfeel qualities related to the perception of moisture and/or fat content of a product by the tactile receptors in the mouth cavity or on the skin, and may also be concerned with the lubricating properties of the product.

The dynamic attribute of melting in the presence of heat should be noted (contact with the skin or in the mouth) where the idea of time/intensity is related to the time necessary for a change in state and to the perception in the mouth or on the skin surface of different textures (e.g. a piece of cold butter or an ice-cube put into the mouth and simply allowed to melt without chewing, dissolution of pulp in non-Asian pears, melting of body butter when it comes into contact with the skin).

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6.2.4.2 Moisture content

Moisture is a surface textural attribute that describes the perception of water absorbed by or released from a product.

The popular terms used to describe the moisture content of a product reflect not only the total amount of moisture perceived but also the type, rate and manner of release or absorption. Popular terms include:

— dry (e.g. dry biscuit, baby powder);

— moist (e.g. apple, lotion);

— wet (e.g. water chestnut, mussels, tonic water);

— juicy (e.g. orange).

6.2.4.3 Fat content

Fatness is a surface textural attribute relating to the perception of the quantity or the quality of fat in a product. With fat content, the total amount of fat and its melting point, as related to mouth-coating attributes and geometrical attributes, are also important.

Secondary parameters, i.e. oily, greasy and fatty, have been established to distinguish between these attributes:

— oily reflects the perception of soaking and runny fat (e.g. salad with French dressing, oily skin lotion);

— greasy reflects the perception of exuding fat (e.g. bacon, chips);

— fatty reflects the perception of high fat proportion in a product, without exudation (e.g. lard, tallow, body butter).

6.3 Development of terminology

Terms shall be established to describe the texture of any product. Traditionally, this is done by having the panel evaluate several samples representing the full range of textural variations for the particular product type of interest. It is helpful to give assessors a broad range of terms with clear concise definitions at the beginning of the session to ensure that as many one-dimensional attributes as possible are utilized.

The assessors then list all the terms that are applicable to one or all of the samples.

These are then discussed under the direction of a panel leader and a mutually acceptable list of terms and definitions is compiled. The following points should be considered:

— whether the terms include all the characteristics relevant to the product;

— whether any of the terms have the same meaning and can be combined or deleted;

— whether each panel member agrees to the use of each term and its definition.

NOTE See also ISO 11035.

6.4 Reference products

6.4.1 Scales of reference products

Based on the classification of textural attributes, standard rating scales have been developed in order to provide a defined quantitative method of evaluation of the mechanical attributes of texture (see

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Annex A). These scales are only illustrative of the basic concept of using familiar reference products to quantify the intensity of each sensory texture attribute. These scales reflect the range of intensities of the mechanical attributes normally encountered in foods and non-foods intended to be profiled. They may be adopted without modification, or other reference products may be selected to allow for local availability, habits, etc.

These scales, as given, are suitable for training. However, they cannot be used to evaluate profiles of all products without some adaptation. For example, when evaluating products that are all soft (e.g. varying formulations of cream cheese or body lotions), the lower end of the hardness scale will have to be expanded and other portions disregarded. Therefore, any portion of the scales could be expanded to allow for more precise ratings of similar products.

The described scales offer a basis for quantitative texture evaluation and the resulting values give a texture profile. Examples of scales are given in Annex A.

6.4.2 Criteria for selection of reference products

The reason to establish reference products scales is to show that it is feasible to construct intensity scales for sensory textural attributes and that it is possible to select well-known foods and non-food products as examples of specific intensities of these attributes. It is a method used to train assessors to use the same scale and evaluate the same sensory concept, and also to speak the same language.

Reference products shall be standardized as to the size, shape, temperature and form (i.e. peeled, sliced, ground).

The textural attributes of many foods and non-foods are dependent on the humidity of the environment in which they are stored (e.g. biscuits, potato chips, lip sticks, concealers, baby powder). In these cases, it may be necessary to control the humidity of the atmosphere under which such foods are tested and to condition the samples prior to testing so that they are in equilibrium with the test atmosphere. The implements or containers used by assessors shall also be standardized.

6.5 Order of occurrence

Texture attributes follow a definite pattern of perception (see Annex B). The panel shall evaluate the same characteristics in the same order. Usually each attribute shall be evaluated at the time at which it is most obvious and, therefore, most easily discerned.

After the panel has developed a method and a list of appropriate descriptors in the proper sequence, an answer form shall be drawn up. This form is a guide for each panel member for reporting the data. It shall describe the procedure to be followed at each stage of the evaluation, the descriptors to be evaluated and their proper sequence and the corresponding intensity scales.

6.6 Evaluation technique

When establishing a standard technique for evaluation, the manner in which the product is normally consumed or used is considered. In the case of a non-food product, this may include preparation, application, manipulation and evaluation of the product in a controlled manner. For example, in the case of a skin lotion, the technique should consider skin attributes (appropriate preparation and area for both application site and applicator; in the simplest form, this can include panellists' fingers and forearm skin) and sensory texture attributes over product application and manipulation phases. These may include sample visual and tactile attributes such as viscosity, stringiness, stickiness, amount of particles, denseness, etc. over pick-up, rub-out and final evaluation after a period of time has passed. In the case of a food product, this may include:

— the way the food is introduced into the mouth (e.g. bitten with front teeth, removed from a spoon by lips, placed whole in the mouth);

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— the way in which the food is broken down (e.g. it is chewed with the teeth only, it is manipulated between the tongue and palate, it is partially broken down by the teeth and then manipulated by the tongue to complete the breakdown);

— the condition of the food prior to swallowing (e.g. whether the food is usually swallowed as a liquid, semisolid or as particles suspended in saliva).

The adopted technique should duplicate as closely as possible the eating conditions to which the food is normally subjected.

See Figure 1.

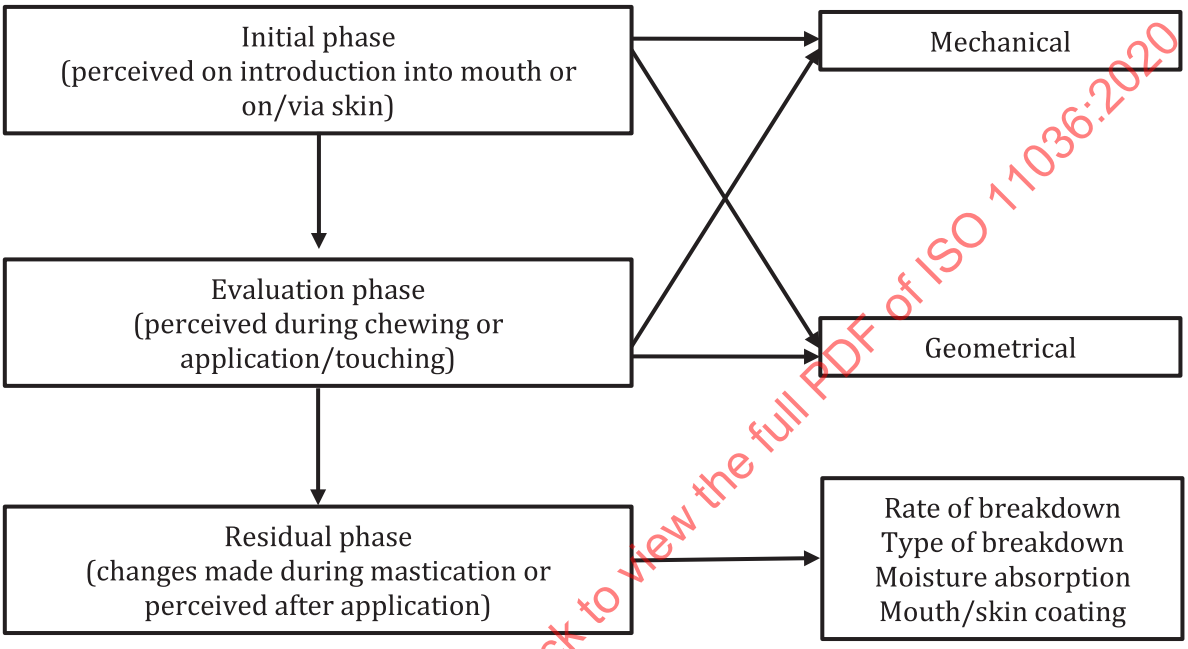

Figure 1 — Example of a procedure for evaluating texture (modified based on ISO 6658)

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6.7 Use of intensity scales

Category and line scales are commonly used for texture profiling (see ISO 4121).

7 Panel screening and selection

7.1 General

Panel screening and selection shall be conducted in accordance with ISO 8586.

7.2 Panel screening

7.2.1 General

A group of potential panelists shall be screened prior to the selection of the panel.

7.2.2 Mouth or skin environment

Since dental or buccal prostheses, salivation anomalies or any procedures to the skin can restrict or remove the perception of many textural attributes, resulting in lower sensitivity, people with these conditions should be chosen only when it has been proved that they are capable of carrying out the tests.

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Some individuals with normal dentition and skin can have a poor discrimination ability during mastication or skin contact.

7.2.3 Behaviour criteria

Consideration should be given to the availability, interest, personality, ability to function well in a group and verbal skills of a candidate. This may be achieved by means of individual interviews.

7.3 Panel selection

A rapid method for the detection of physiological capabilities is to present each candidate with a minimum of four examples of samples that they need to rank in order based on an attribute of interest (such as hardness). The candidates shall be able to place all the items in the proper ranking order.

Following the initial screening for physiological criteria and motivation interviews, 10 to 15 individuals from the original group shall be selected for training. See ISO 13299 for additional guidance.

8 Panel training

8.1 First stage: Mechanical attributes

Panel training begins with the introduction of the classification of textural attributes. Present the panel with the sensory definitions of the mechanical attributes. The assessors study each of the attributes through repetitive evaluations of selected reference products representing points on the reference scales. This provides the assessors with an understanding of the scales. The use of the scale selected for the eventual evaluation of the products is introduced.

The assessors then evaluate a wide selection of products other than those that represent points on the reference scales. They are asked to classify the given samples according to the scale.

This allows the panel to practise their perception and discrimination. It also builds confidence since the intervals on each scale are wide and unknown samples can be rated with relative ease.

The whole evaluation procedure shall be covered during this stage. This will allow a homogeneous group to be obtained who will use common terminology. Any disagreements among panel members should be discussed at length.

8.2 Second stage: Geometric attributes and fat and moisture content

The geometrical attributes and fat and moisture characteristics are studied. Present the panel with a list of these attributes and examples of products exhibiting these characteristics. The panel evaluates one or more products containing these attributes.

8.3 Third stage: Develop scales

The panel then develops scales for a specific product including varieties of that product.

During this stage, the assessors shall complete their training using these specific scales. See ISO 8586 for additional guidance.

9 Preparation and presentation of samples for training and for evaluation

Procedures for sample preparation shall be standardized. Particular attention shall be paid to:

a) standardizing the preparation of samples so that the resulting textures are representative of the products to be tested and reproducible from day to day and batch to batch;

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b) standardizing the sample size and shape so that the object to be masticated or manipulated is consistent as well as representative of the product as it is usually introduced into the mouth or put in contact with the skin or other materials;

c) defining and controlling, whenever appropriate, sample temperature, moisture content, time elapsed after preparation, etc.

The appropriate reference samples shall be presented for each attribute, either in a sensory booth at the same time as the experimental samples or at a training session beforehand.

10 Evaluation by the panel

This clause discusses the evaluation of the products under study using the scales devised and the techniques established.

Each assessor evaluates the test samples individually and independently based on a test design and in replicate if deemed necessary. Sensory booths should be used for the individual evaluations. The data are analysed according to appropriate practices.

11 Data analysis

For data analysis, independent assessments may be analysed using data analysis appropriate to the type of data collected (e.g. ANOVA, non-parametric methods).

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Annex A
(informative)

Examples of scales of reference products for evaluating the mechanical texture attributes of food products

Table A.1 — Example of a hardness scale

Popular term	Scale value	Reference product	Type	Sample size	Temperature
Soft	1	Cream cheese or tofu[a]		1,25 cm cube	7 °C to 13 °C
	2	Egg white	Hard-boiled, 5 min	1,25 cm tip	Room
	3	Frankfurter sausages or fish sausages	Large, uncooked, skinless	1,25 thick slice	10 °C to 18 °C
	4				
Hard	5	Olives, green or canned chestnuts	Giant-size, stoned (olives)	1 piece	10 °C to 18 °C
	6	Peanuts	Cocktail type, under vacuum	1 whole nut	Room
	7	Carrots or almonds	Uncooked	1,25 cm thick slice/ 1 piece	Room
	8				
	9	Hard candy		1,25 cm piece	Room

[a] Products are variable whether commercial in nature or agricultural. The scales depend on the products selected.

Table A.2 — Example of a cohesiveness scale

Popular term	Scale value	Reference product	Type	Sample size	Temperature
Low-intensity cohesiveness	Low	Corn bread		1,25 cm cub	Room
	Medium low	White sandwich bread	Sliced, enriched	1,25 cm square	Room
High-intensity cohesiveness	Medium high	Dried fruit	Raisin, seedless	1 piece	Room
	High	Chewing gum	After 40 chews	1 piece	Room

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Table A.3 — Example of a viscosity scale

Popular term	Scale value	Reference product	Sample size	Temperature
Low viscosity	1	Water	30 ml	7 °C to 13 °C
	2	Light cream (18 % fat)	30 ml	7 °C to 13 °C
	3	Heavy cream (35 % fat)	30 ml	7 °C to 13 °C
	4	Evaporated milk	30 ml	7 °C to 13 °C
High viscosity	5	Maple syrup	30 ml	7 °C to 13 °C
	6	Chocolate syrup	30 ml	7 °C to 13 °C
	7	Mixture: 125 ml mayonnaise + 60 ml heavy cream	30 ml	7 °C to 13 °C
	8	Condensed milk, sweetened	30 ml	7 °C to 13 °C

Table A.4 — Example of a springiness scale

Popular term	Scale value	Reference product	Type	Sample size	Temperature
Low-intensity springiness	0	Cream cheese		1,25 cm cube	5 °C to 7°C
	5	Frankfurter sausages[a]	Cooked 5 min in boiling water	1,25 cm thick slice	Room
High-intensity springiness	9	Marshmallows	Miniature	1 piece	Room
	15	Gelatin dessert[b]		1,25 cm cube	5 °C to 7°C

[a] Area compressed between tongue and palate is parallel to cut.

[b] Dissolve one package of jelly and one package of gelatin in 375 ml of hot water. Cover and refrigerate (5 °C to 7°C) for 24 h.

Table A.5 — Example of an adhesiveness scale

Popular term	Scale value	Reference product	Sample size	Temperature
Low adhesiveness	1	Hydrogenated vegetable oil	30 ml	7 °C to 13 °C
	2			
High adhesiveness	3	Cream cheese	30 ml	7 °C to 13 °C
	4			
	5	Peanut butter	30 ml	7 °C to 13 °C

Table A.6 — Example of a cohesiveness of mass scale

Popular term	Scale value	Reference product	Sample size	Temperature
Low cohesiveness of mass	0,0	Shoestring liquorice	1,25 cm slice	Room
	2,0	Fresh baby carrots	1,25 cm slice	Room
High cohesiveness of mass/compact	4,0	Fresh white button mushrooms	1,25 cm slice	Room
	7,5	Frankfurter sausages	1,25 cm thick slice	7 °C to 13 °C
	10,0	Processed cheese	1,25 cm square	7 °C to 13 °C

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Table A.7 — Example of a gumminess scale

Popular term	Scale value	Reference product	Sample size	Temperature
Low-intensity gumminess	1	40 % flour paste	1 tablespoon	Room
	2	45 % flour paste		
	3	50 % flour paste		
	4	55 % flour paste		
	5	60 % flour paste		

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