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Sensory analysis — Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach

Analyse sensorielle — Recherche et sélection de descripteurs pour l'élaboration d'un profil sensoriel, par approche multidimensionnelle

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11035 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*, Subcommittee SC 12, *Sensory analysis*.

Annexes A, B and C of this International Standard are for information only.

Introduction

An overall sensory profile describes the sensory attributes of a product.

A "product" is characterized by several parameters. Some of these have a single dimension (e.g. the diameter of a ball, the weight of a sachet, etc.) and others have several dimensions (e.g. the shape of a product, the texture of meat, etc.); a sensory profile requires monodimensional quantities to lead to a measurement of intensity.

Consequently, the evaluation of a complex sensory quantity needs methodology which is founded on identification of appropriate descriptors. This work is given to a trained panel who describe their perceptions both qualitatively (nature of the stimulus) and quantitatively (intensity of each stimulus).

If the aim is to appreciate all the attributes, an "overall sensory profile" is built; if it concerns the evaluation of only flavour, odour, texture or appearance, a "partial sensory profile" is then elaborated.

In both cases, the choice of descriptors is the preliminary phase which determines the quality of the sensory profile.

There are several ways to establish a list of descriptors, for example:

a) leave each assessor to choose and use, for the final profile, his/her own descriptors (free-choice profile);

b) use descriptors common to all the members of the panel, either

   1) by suggesting existing descriptors, on condition that the relevance of the descriptors for the product has been checked and that the assessors have been trained on these descriptors (generally with the help of reference products), or

   2) by the creation of descriptors by all the members of the panel after individual or collective work.

This can be done by a consensus method (see, for example, ISO 6564) or by the method described in this International Standard, which is characterized by the elaboration of a list of descriptors convenient for the product studied and which guarantees, as far as possible, the exhaustivity of this list, and allows verification of the relevance and independence of each descriptor, and if they are monodimensional.

NOTES

1   Drawing up a sensory profile of a product is a complex procedure and the user of this International Standard needs to know that although this method gives satisfactory results, it requires a large investment in preparation time, calculation and number of training sessions.

2   This International Standard requires a basic knowledge of multidimensional analysis [in particular, a minimal knowledge of Principal Components Analysis (PCA) and Hierarchic Ascending Classification (HAC)].

Sensory analysis — Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach

1 Scope

This International Standard describes a method for identifying and selecting descriptors which can then be used for drawing up the sensory profile of a product.

It describes the different stages in the process for setting up tests through which a complete description of the sensory attributes of a product can be obtained:

— from a qualitative point of view, by defining by means of descriptors all the perceptions for distinguishing one product from others of the same type;

— from a quantitative point of view, by evaluating the intensity of each descriptor (stronger or weaker impression analysed by an assessor on one element of the overall perception).

The so-called "sensory profile" method can be used:

— to define a production standard; identification of the nature of the differences makes it easier to grasp the issue;

— to improve or develop products;

— to study the influence of the ageing of products and also of the conditions of storage and preservation; it is thus possible to determine those characteristics which vary and to what extent;

— to compare a product with those of the same type already on the market; it is therefore possible to tell the nature of the differences in terms of sensory perception.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4121:1987, *Sensory analysis — Methodology — Evaluation of food products by methods using scales.*

ISO 5492:1992, *Sensory analysis — Vocabulary.*

ISO 6564:1985, *Sensory analysis — Methodology — Flavour profile methods.*

ISO 6658:1985, *Sensory analysis — Methodology — General guidance.*

ISO 8586-1:1993, *Sensory analysis — General guidance for the selection, training and monitoring of assessors — Part 1: Selected assessors.*

ISO 8586-2:1994, *Sensory analysis — General guidance for the selection, training and monitoring of assessors — Part 2: Experts.*

ISO 8589:1988, *Sensory analysis — General guidance for the design of test rooms.*

3 Definitions

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

3.1 descriptor: A term referring the assessor to an element of the perception of the product. The properties of the descriptor (relevance of the product, monodimensional) shall be such that it can be used to produce an evaluation on a scale of intensity (sweet flavour of sucrose, for example).

3.2 overall sensory profile: The use of descriptive terms in evaluating the sensory attributes of a sample and the intensity of each attribute.

3.3 partial sensory profile: The use of descriptive terms in evaluating the sensory attributes of a sample and the intensity of each attribute by one or by several sensory inputs.

Examples: flavour profile, texture profile, appearance profile and odour profile.

4 Principle

Identification and selection of a set of relevant descriptors giving maximum information on the sensory attributes of the product under analysis, in order to establish a sensory profile.

The various stages in the methodology are given below (see figure 1):

— training of the panel,

— preparation of a list of descriptive terms,

— reduction of the list of terms,

— choice of reference products,
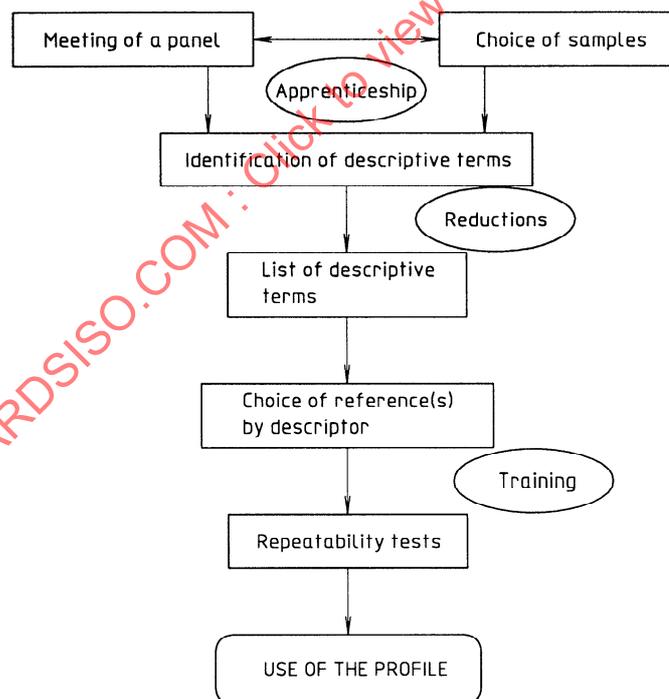
— training,

— use of the profile.

Figure 1 — Stages in the identification and selection of descriptors for establishing a sensory profile

2

5 General test requirements

The general directives concerning the methodology of sensory analysis described in ISO 6658 shall be followed.

5.1 Test room

See ISO 8589 for the characteristics of the room in which the tests are to be performed.

5.2 Apparatus

The apparatus should be selected by the panel leader according to the nature of the product or products to be analysed, the number of samples, etc., and shall have no influence on the results.

If standard apparatus meets the requirements of the test, it shall be used.

6 Methodoloy

6.1 Number of assessors

A minimum number of six assessors is required in order to allow for individual differences.

In order to have a group of six to ten assessors permanently available, it is recommended that two or three times this number be trained and coached.

6.2 Training of the panel

The quality of the sensory profile depends on the quality of the panel. It is important that the assessors be correctly trained and coached before selection according to their ability to recognize and evaluate the stimuli pertaining to the types of products for which a sensory profile is to be established.

When selecting the assessors, their creativity and their ability to express themselves are the first criteria to be taken into account. In fact, it is important for the assessors to have an extensive vocabulary and to be at ease in the use of this vocabulary in order to produce a simple and easily understood description of the product to facilitate communication between the various parties concerned.

Training is carried out on the types of products for which the profile is to be established or on their component parts (identification of the components and evaluation of the perceived intensities). All these preliminary sessions contribute to the training of the assessors. When this training period is over, the ca-

pacity of each assessor to repeat the evaluation shall be verified.

For conventional methods of selection, training and testing, consult ISO 8586-1 for assessors and ISO 8586-2 for experts. However, these methods shall be adapted to the profile concerned (overall profile, flavour profile, texture profile, etc.).

It is important that the assessors regularly attend sensory analysis training sessions. Regular attendance at the classes also gives an indication of the motivation of the assessors.

6.3 Role of panel leader

The role of the panel leader is of utmost importance in the selection of the panel, its training and maintaining the motivation of the assessors.

The panel leader should also be able to conduct and coordinate a work group, taking into account the opinions of each participant and harmonizing them.

6.4 Identification of the largest possible number of descriptive terms

The aim of this stage in the identification of descriptors is not to neglect any aspect of the product and to avoid bias due to the influence of an individual on the group. It also serves as an apprenticeship for identifying and evaluating the nature of the differences.

6.4.1 Selection of products

A series of similar products should be selected (three or four per session) which, when tasted, will enable the assessors to distinguish all the possible qualitative differences which can be detected in the product for which the profile is to be drawn up.

To obtain these differences between products, factors such as ageing, proportions of ingredients during manufacture, or the duration of certain stages in manufacture can be varied. Another possibility would be to examine similar rival products.

6.4.2 Generation of descriptors in tasting booths

In order for the assessors to achieve the necessary concentration for individual identification of the descriptive terms, without trying to make do with the terms given by others, the assessors should each be in tasting booths (see ISO 8589) under the usual conditions for sensory evaluation of products.

In the initial sessions (at least four), the assessors are presented with the product for which the profile is to be made as well as the series of selected samples. The assessors are asked to generate the maximum number of terms (descriptors) to describe all the sensations produced by these products, whether visual, tactile, olfactory or gustatory (in the case of an overall profile) and to note down on the form provided all the terms which occur to them. (See annex A for a specimen form.)

6.4.3 Group discussion

The assessors then discuss in a group and compare their perceptions under the guidance of the panel leader who should encourage each of them to analyse the different components of the perception of the products.

These components shall be expressed by an appropriate descriptor (e.g. bitterness, acidity, smoky flavour, etc.).

The identification of terms ceases once the assessors have exhausted their vocabulary on the product. The group usually manages, in several sessions, to generate without difficulty more than a hundred different descriptive terms.

All the descriptive terms are then collected together at this stage, including synonyms.

See an example of an application to sandwich bread in annex B.

6.5 Preliminary sorting of descriptors

This sorting is performed during the initial sessions by the panel leader during group discussions and in the presence of the samples.

The following are gradually eliminated from the discussion:

— hedonistic terms, such as pleasant, fine, appetizing, good, etc.;

— quantitative terms, such as too much, too little, strong, weak, etc.;

— terms describing the product in its own terms, such as "bready taste" for bread (except for certain cases of prepared or converted products where the odour or the aroma of a constituent remains, for example the aroma of vanillin or vanilla in vanilla ice cream);

— irrelevant terms such as "acid" when describing an odour.

The panel leader explains to the assessors why these terms are considered to be unsuitable for the intended purpose, which is to identify and describe the nature of the perception and the combinations of differences between products.

6.6 First reduction of the number of descriptors

The descriptors resulting from the preliminary sorting are generally too great in number; in further tasting sessions, terms are eliminated which do not appear suitable for describing or differentiating products from a sensory point of view.

In order to make this reduction, it is necessary to make sure that the assessors have well understood the meaning of each descriptor.

The assessors are presented with different variants of the product and are asked, for each of the descriptors used, to judge the perceived intensity by allocating it a mark on a scale from 0 to 5, specifying that zero (0) is equivalent to an absence of perception for the property considered.

NOTE 3   It is possible to check if there are differences or not in the perception of the products by using triangular tests.

Figure 2 presents the type of scale which is usuable for each descriptor in the first reduction.

Consult ISO 4121 for methods using scales and categories.

	Not perceived	Weak	Rather weak	Average	Rather strong	Strong
Descriptor	0	1	2	3	4	5
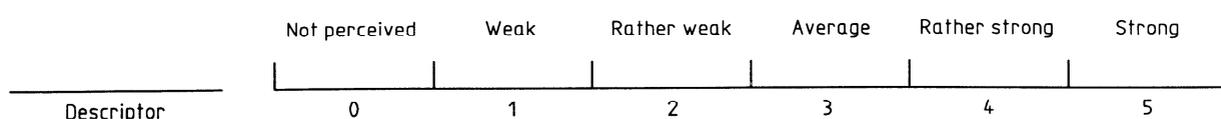
Figure 2 — Scale of intensity for the first reduction of descriptors

In order to reduce at this stage the number of descriptors, they are initially classified by the geometric mean M, which is the square root of the product of the frequency, F, and the relative intensity, I, of each descriptor:

$$M = \sqrt{F \cdot I}$$

where

  F is the number of times the descriptor is mentioned over the total number of times it is possible to mention that descriptor, expressed as a percentage; and

  I is the sum of the intensities given by the whole panel for a descriptor over the maximum possible intensity for this descriptor, expressed as a percentage.

This method of calculation makes it possible to take into account, in the same way, descriptors which are rarely mentioned but which are very important in terms of the perceived intensity and descriptors with a low perceived intensity but which are mentioned often (see ref.[1] in annex C).

The classification of descriptors according to the size of this mean makes it possible to eliminate a number of descriptors whose geometrical means are relatively low.

EXAMPLE

Tables 1 and 2 give the sequence of calculations in the case of 5 products tested with 9 descriptors by 18 assessors.

The total number of times each descriptor is mentioned is, in this case, 90 (5 products by 18 assessors).

The total possible intensity per descriptor is 450 (maximum of 5 on the scale of intensity for 5 products with 18 assessors = 5 × 5 × 18).

In this example, the calculations (table 3) show that the descriptors classed in the lowest two positions (D3 and D8) could be eliminated.

Table 1 — Calculation of the frequency, F, of mentioning each descriptor

Product	Descriptors								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
P1	12	8	0	9	8	17	17	1	12
P2	17	17	0	15	16	9	4	1	16
P3	2	12	0	4	8	0	1	1	3
P4	7	1	3	5	8	14	14	1	4
P5	1	9	0	6	14	2	3	2	3
Number of mentions	39	47	3	39	54	42	39	6	38
F = Number/total number (%)	43,3	52,2	3,3	43,3	60,0	46,7	43,3	6,7	42,2

Table 2 — Calculation of the relative intensity, I, of each descriptor

Product	Descriptors								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
P1	69	43	0	16	27	64	31	5	19
P2	43	33	0	30	52	44	9	3	33
P3	3	25	0	13	42	2	2	1	11
P4	36	8	10	6	8	37	50	5	5
P5	4	19	0	30	78	5	11	11	7
Perceived intensity per descriptor	155	128	10	95	207	152	103	25	75
I = intensity/total intensity (%)	34,4	28,4	2,2	21,1	46,0	33,8	22,9	5,6	16,7

Table 3 — Classification of descriptors by importance (by geometric mean)

Parameter	Descriptors								
	D1	D2	D3	D4	D5	D6	D7	D8	D9
I	0,344	0,284	0,022	0,211	0,460	0,338	0,229	0,056	0,167
F	0,433	0,522	0,033	0,433	0,600	0,467	0,433	0,067	0,422
M	0,386	0,385	0,027	0,302	0,525	0,397	0,315	0,061	0,265
As a percentage	38,6	38,5	2,7	30,2	52,5	39,7	31,5	6,1	26,5
Classification of descriptors	3	4	9	6	1	2	5	8	7

See also an example of the application to sandwich bread in annex B (tables B.2 to B.4).

6.7 Second reduction in the number of descriptors by multidimensional analysis and variance analysis

The second reduction makes it possible to group together synonyms (correlated positively) or antonyms (correlated negatively) and eliminate descriptors which make very little contribution to showing differences between the products tested in a sensory profile.

6.7.1 General principles

Multidimensional analysis allows evaluation of the relative importance and the contribution of descriptors in differentiating products since it allows all the products to be visualized at the same time as well as the correlations between the descriptors. By identifying the closeness of the descriptors and the weight attached to each descriptor for distinguishing between products, it is possible to eliminate some of them or to group them together.

The interpretation of a Principal Components Analysis (PCA) thus permits the following to be noted:

a) the relative importance of each axis (linear combination of the descriptors) in relation to the total cloud (% inertia);

b) the contribution of each descriptor in relation to the main axes (relative contribution);

c) the "quality" of the representation of each element on the chosen plane (cosine square), which indicates whether or not the element is close to the plane of projection of the product/descriptor space.

Certain products can make too great a contribution to the inertia by overpowering the others in the chosen representation space and by masking the differences. These should be eliminated from the search for descriptors.

Care should be taken that there is a good distribution of the products in the four quadrants of the projection planes.

6.7.2 Rules for reducing the number of descriptors

Three rules have to be applied in order to reduce the number of terms.

a) Delete terms which do not best characterize the product space and/or the differences between products. If a descriptor maintains a constant value for all of the products evaluated, it may be kept provided that it is always desirable to find again that characteristic at a given intensity (e.g. in quality control).

In a multidimensional analysis, a weak contribution of the descriptors in relation to the relevant axes is interpreted as a term which is only slightly appropriate or a descriptor which maintains a constant value.

It is best to examine the contribution of each descriptor on all the axes so as not to eliminate a descriptor which is independent of the others and which would constitute by itself an axis which is relevant but of weak inertia.

b) Delete synonymous terms, since they will appear close together in the PCA and in the associated Ascending Hierarchical Classification (AHC) (see refs. [2]-[6]).

c) Replace by a single descriptor, to be defined with the assessors, two terms which are sensory opposites (correlation close to −1 and descriptors opposite in relation to the centre of gravity of the descriptor space).

Before eliminating a strongly correlated term or a term anti-correlated to another, it is necessary to ensure that it really does belong to the same sensory continuum. For example, "sweet" and "acid" in the case of ripening of a fruit do not belong to the same sensory continuum, even if a diminution of acidity may be related to an increase in sweetness.

In practice, the corresponding scores of synonymous descriptors are added up if a second processing of the data table is desired. Consequently, a single term will be kept which has to be redefined with all the assessors. The advantage of the second processing is that it can check that no information has been lost. A "product" space or a "descriptor" space largely identical to that resulting from the first processing should be obtained.

The final number of descriptors shall be at most 15 in order to obtain an operational profile, i.e. one enabling an assessor to evaluate several samples of products in less than one hour. If the number of descriptors is too high, what one hopes to gain in finesse is lost in the accuracy of the measurement.

EXAMPLE

A simplified example given in table 4 [1] helps to illustrate two important points in the reduction of terms from the data table by grouping the intensities given by the panel for each product and each descriptor.

In this example it can be seen that descriptor D1 does not discriminate between products since the mean of the perceived intensities is similar (assuming that all the scales are identical).

NOTE 4   The power of discrimination of each descriptor should be verified for the different products by a ranking test and/or a variance analysis. The ranking test permits verification of the discrimination of the products no matter

how the assessors use the scale. The variance analysis ensures the similarity of the mean of the values of each product for one descriptor. The equality of the means given by assessor and by product can be tested by applying a two-factor variance analysis ("product" factor and "assessor" factor).

If only differences between products are of interest, descriptor D1 can be eliminated (provided that samples have been taken of all the products within the range in order to make sure that this descriptor will not play any part in the differences).

In the case of quality control, for example, it would be important to keep D1 in order to be sure of finding again this characteristic with the same intensity in all of the products.

Descriptors D2 and D3 are always in the same ratio of intensity; they are therefore closely correlated.

6.8   Choice of reference products or substances

If the number of descriptors is reduced, a definition of each descriptor shall be given, understood by all the assessors, which shall be kept for easy reference. A suitable stable reference product shall also be assigned to each of these descriptors.

A pure chemical is not necessarily a relevant reference substance for defining a descriptor. For example, the assessor must be able to extract from a complex sensation the stimulus which echoes the descriptor (e.g. bitterness of a coffee, astringency of a fruit, etc.).

It is important to use reference products which are stable or reproducible in time. The choice of these reference products can be difficult, as it is a question of reconciling appropriateness and ease of use.

Table 4 — Example of a table of results for the whole panel

Product	Descriptors					
	D1	D2	D3	D_i	. . .	D_n
P1	11	60	20	. . .	. . .	. . .
P2	13	45	15	. . .	. . .	. . .
P3	12	75	25	. . .	. . .	. . .
P4	12	30	10	. . .	. . .	. . .
P5	11	6	2	. . .	. . .	. . .
P6	13	15	5	. . .	. . .	. . .

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1)   This example is not connected to tables 1 to 3.

Reference position

| Not perceived | Weak | Rather weak | Average | Rather strong | Strong |

Descriptor   0   1   2   3   4   5
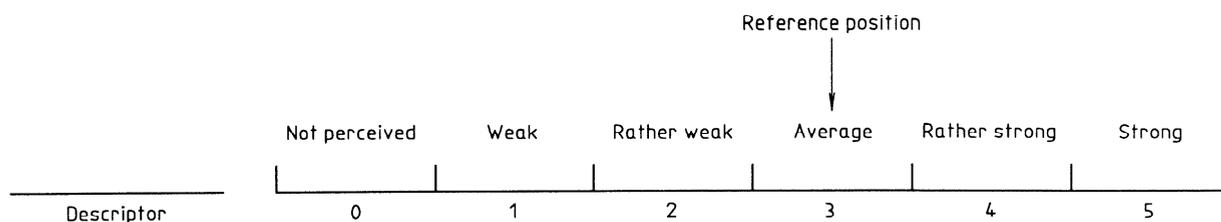
Figure 3 — Position of the reference product on the intensity scale

6.9 Training the panel in the use of the reduced list

In order to train a panel correctly, at least one reference product shall be used per descriptor at a concentration corresponding to the mean position on the intensity scale, as shown in figure 3.

A method which is surer but longer to set up is to offer also references for *all* the steps on the scale or at least for those representing the extremes. In this way it can be guaranteed that the assessors will be homogeneous with respect to one another and that they will analyse the intensity of the perception corresponding to this descriptor in the same way.

For descriptors of flavour, such as "salty" and "sweet", for which the reference products can be simple (solution of sodium chloride and of sucrose), it is easy to make a range of references of increasing intensity.

Training is satisfactory if each assessor repeats him/herself appropriately (i.e. if the standard deviation is slight for repetitions with the same samples).

It may be that assessors have different perceptions for certain descriptors. In this case, it is important to check that the same assessor evaluates the product in the same way from one session to the next. This stage can be very lengthy and can require a large number of sessions. It is essential for the reliability of the method to prolong training until the assessor gives the same evaluations for the same stimuli from one session to the next (taking into account a dispersion around a mean to be fixed). In fact, only repetitions (at least three) allow determination of the reliability of the assessors and of the results.

7 Establishing profiles

Once the panel is well trained, i.e. when it has assimilated all the perceptions associated with the descriptors and is capable of quantifying the perceptions in relation to reference products, it can serve as a measuring instrument and establish a profile. (See also ISO 6564.)

The graphical representation of a sensory profile can be used to visualize the characteristics of the product. A bar graph or histogram or any other form can be used which is easy to read and provides a comparison between the various products.

Figures 4 to 6 give two examples for presenting the results of profiles
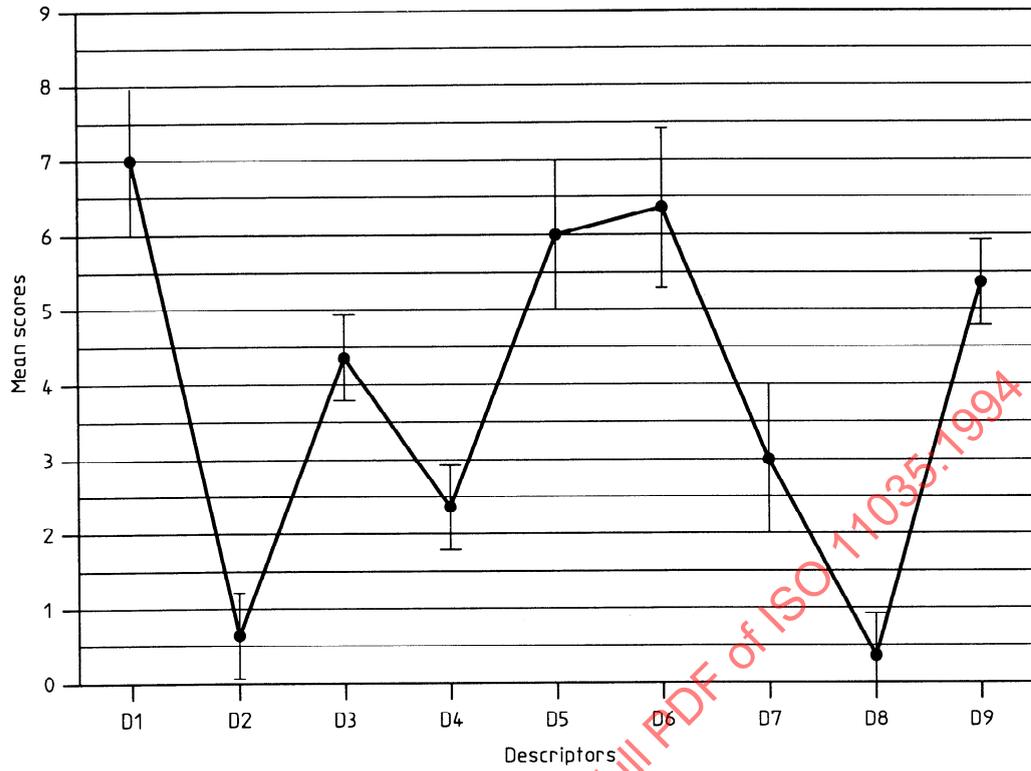
Figure 4 — Example of a sensory profile
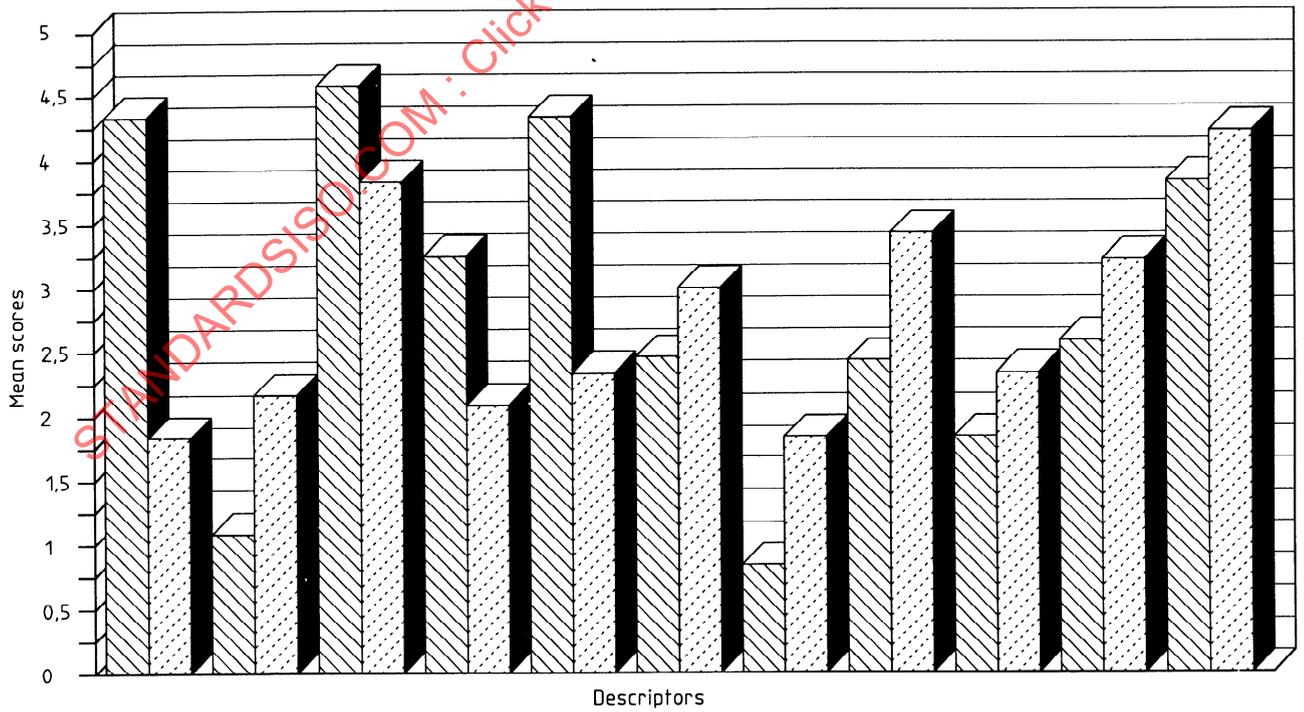
Figure 5 — Comparative profile of two products
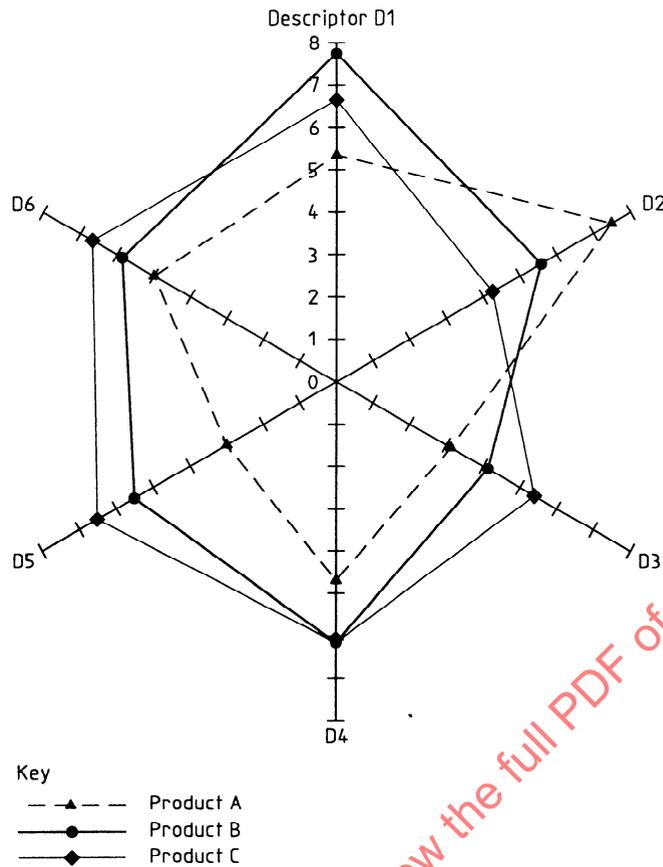
Figure 6 — Comparative profile of three products

The graphs shown can provide the following information:

— standard deviations or confidence intervals for each descriptor;

— result by assessor;

— comparative position of all the products evaluated;

— deviations with respect to a standard product profile used as a reference.

The useful information will be selected according to the requirements of the departments using the sensory profile obtained (Production, Quality Control, R & D laboratory, Marketing).

The processing of all the collected data can be done using data-processing tools and software available in multidimensional analysis.[2]

2) The following are examples of appropriate software commercially available:

STATGRAPHICS; STATI/ITCF; SPSS/PC+; SYSTAT; SAS; ADDAD (Association pour la Diffusion et le Développement de l'Analyse des Données); MODULAD.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the products named. Equivalent products may be used if they can be shown to lead to the same results.

Annex A
(informative)

Example of a (condensed) questionnaire for the elaboration of an exhaustive list of descriptors

SURNAME:..................................... PRODUCT No. ....

NAME   :.....................................

DATE   :.....................................

Describe the sensations given by the (these) product(s) following the properties indicated below, using your own vocabulary.

	Before tasting	During tasting	After tasting
Appearance			
Odour			
Flavour (taste + aroma)			
Texture (in mouth)			
Texture (by finger and possibly with a spoon)			

Annex B

(informative)

Example of application of the method to sandwich loaves

Table B.1 — List of descriptors given collectively for sandwich loaves (Application of 6.4)

Appearance	Texture	Odour	Flavour
General appearance	**Texture by finger pressure**		
Regularity of shape	Elasticity (behaviour to stretching: if it breaks immediately it is not elastic)	Yeast	Bland
Pinched	Compressibility (resistance to pressure by the finger: if a great effort is necessary, it is not compressible)	Leaven	Neutral
Narrowness		Alcohol	Milk
Appearance of crust		Ethanol	Lactic acid
Mat	Deformability (behaviour after deformation: if it returns to initial state, it is not deformable)	Sour odour	Flour
Shiny	**Texture in mouth** [1)	Pungency	Starch
Pale	Moistness	Flour	Gluten
Brown	Freshness	Wet flour	Uncooked pastry
Blond	Flexibility	Starch paste	Brioche
Burnt	Firmness	Bran	Butter
Uniform colour	Tendency to crumble	Butter	Acid
Thickness	Doughy	Brioche	Pungency
Cohesion of the loaf	Sticky	Gingerbread	Sour flavour
Peeling	Ability to cause salivation	Dried fruit	Salty
Crumbling	Chewiness	Rancid	Sweet
Crustiness	Granularity	Musty	Bitter
Flakiness	Roughness	Dusty	Astringent
Importance of scratches on the side	Thickness of grains	Ferrous odour	Ethanol
		Curdled milk	Alcohol

Appearance	Texture	Odour	Flavour
Appearance of loaf			
General regularity	Melting	Fermented milk	Fermented
Rolling up	Ability to liquefy	Smoked	Yeast
Homogeneity of colour		Tobacco	Musty
Yellow			Nutty
White			Dusty
Regularity of the alveoli (cells)			Earthy
Size of the largest alveoli			Plastic
Size of the smallest alveoli			Tobacco
Flakiness			
Crumbling			
Moistness			
Freshness			
Density			
Sponginess			
Doughiness			
Lumpiness			
1) **Chronology of tasting** a) First impression in the mouth: more or less moist phase. b) Beginning of chewing: crumbling. c) End of chewing: sticky or liquefaction. d) Residual impression: granularity, adhesiveness.			

Table B.2 — Form given to subjects to reduce the list of descriptors (Application of 6.6)

Sample No. — Appearance	Sample No. — Texture	Sample No. — Odour	Sample No. — Flavour
General appearance	**Texture by finger pressure**	Yeast	Bland
Regularity of shape	Elasticity (behaviour to stretching: if it breaks immediately it is not elastic)	Leaven	Neutral
Pinched	Compressibility (resistance to pressure by the finger: if a great effort is necessary, it is not compressible)	Alcohol	Milk
Narrowness	Deformability (behaviour after deformation: if it returns to initial state, it is not deformable)	Ethanol	Lactic acid
Appearance of crust	**Texture in mouth** [1]	Sour odour	Flour
Mat	Moistness	Pungency	Starch
Shiny	Freshness	Flour	Gluten
Pale	Flexibility	Wet flour	Uncooked pastry
Brown	Firmness	Starch paste	Brioche
Blond	Tendency to crumble	Bran	Butter
Burnt	Doughy	Butter	Acid
Uniform colour	Sticky	Brioche	Pungency
Thickness	Ability to cause salivation	Gingerbread	Sour flavour
Cohesion of the loaf	Chewiness	Dried fruit	Salty
Peeling	Granularity	Rancid	Sweet
Crumbling	Roughness	Musty	Bitter
Crustiness	Thickness of grains	Dusty	Astringent
Flakiness		Ferrous odour	Ethanol
Importance of scratches on the side		Curdled milk	Alcohol

Sample No.		Sample No.		Sample No.		Sample No.	
Appearance of loaf							
General regularity	Melting				Fermented milk		Fermented
Rolling up	Ability to liquefy				Smoked		Yeast
Homogeneity of colour					Tobacco		Musty
Yellow							Nutty
White							Dusty
Regularity of the alveoli (cells)							Earthy
Size of the largest alveoli							Plastic
Size of the smallest alveoli							Tobacco
Flakiness							
Crumbling							
Moistness							
Freshness							
Density							
Sponginess							
Doughiness							
Lumpiness							

1) **Chronology of tasting**

a) First impression in the mouth; more or less moist phase.

b) Beginning of chewing; crumbling.

c) End of chewing: sticky or liquefaction.

d) Residual impression: granularity, adhesiveness.

Table B.3 — Raw data: Sum of the notes of intensity given by the panel for each descriptor
(Application of 6.6)

Sum of the intensities given by all the assessors

Parameter	Products studied																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Appearance																		
Regularity of shape	27	13	32	25	33	18	31	39	27	33	25	15	21	30	30	30	32	33
Pinched	1	16	12	13	0	25	1	4	12	3	16	28	25	15	14	7	6	17
Narrowness	29	6	16	15	15	26	30	8	20	18	16	27	21	16	18	31	28	35
Appearance of crust																		
Mat	22	21	14	35	30	21	32	15	35	32	33	17	25	35	35	33	14	31
Shiny	5	2	5	0	0	6	0	12	0	0	0	0	5	0	0	4	1	5
Pale	5	21	7	12	6	7	2	8	4	5	6	3	7	8	3	0	0	4
Brown	26	8	12	18	10	12	34	7	22	25	25	20	19	15	31	40	25	14
Blond	4	8	2	10	16	10	1	19	14	4	2	6	9	7	5	4	7	17
Burnt	2	6	0	10	0	4	12	0	6	23	5	26	19	10	6	15	4	2
Uniform colour	30	7	34	14	32	14	15	19	18	23	20	14	22	15	23	21	38	36
Thickness	15	16	16	19	17	16	17	15	13	26	18	25	20	17	25	24	21	27
Cohesion of the loaf	31	20	34	31	30	19	16	36	33	29	24	26	25	25	43	26	26	27
Peeling	12	8	5	12	7	13	26	10	6	12	17	11	25	17	11	8	11	16
Crumbling	4	14	18	15	18	4	1	3	9	4	16	4	7	19	8	5	12	5
Crustiness	4	8	13	11	11	3	1	14	10	10	5	1	2	11	6	5	6	0
Flakiness	8	5	5	6	1	14	4	4	4	4	6	14	13	5	5	8	7	8
Importance of scratches on the crust	5	1	0	10	0	0	7	10	8	4	3	0	1	2	5	13	1	0
Appearance of loaf																		
General regularity	18	13	25	35	26	16	29	35	32	23	36	22	37	23	27	23	35	35
Rolling up	11	21	22	4	13	21	12	6	7	17	23	28	21	17	12	10	10	6
Homogeneity of colour	17	26	19	30	32	32	32	35	32	31	33	27	33	25	26	23	30	31
Yellow	22	6	31	15	25	19	30	6	16	12	28	26	30	9	15	29	6	22
White	1	9	0	11	0	6	3	22	8	15	1	8	0	18	19	3	25	7
Regularity of alveoli	11	12	19	34	22	18	20	28	24	29	26	21	30	13	30	25	28	30
Size of largest alveoli	25	25	16	17	20	17	30	19	17	24	20	25	18	34	19	33	27	24
Size of smallest alveoli	14	17	12	7	14	13	15	10	13	14	16	14	10	14	11	14	13	12
Flakiness	7	12	1	7	0	1	7	9	11	1	2	7	4	1	4	7	7	6
Crumbling	4	15	16	18	20	12	12	4	10	10	21	23	15	23	6	15	19	15
Moistness	32	18	10	16	5	9	27	30	31	22	9	12	24	19	34	27	28	37
Freshness	28	9	11	12	5	9	20	29	26	21	11	7	26	11	33	31	35	28
Density	16	13	15	13	8	6	17	22	11	8	8	5	12	8	14	11	20	13
Sponginess	18	12	7	7	9	10	23	16	12	15	14	11	19	12	27	17	17	29
Doughiness	0	12	2	7	0	3	0	9	8	7	3	4	3	4	4	2	6	0
Lumpiness	1	2	2	0	4	0	0	0	3	0	0	0	0	6	0	0	0	0

Sum of the intensities given by all the assessors

| Parameter | Products studied | | | | | | | | | | | | | | | | | |
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Texture																		
Elasticity	34	14	11	9	8	4	15	25	31	23	3	5	13	8	35	23	13	24
Compressibility	36	27	21	23	13	21	32	36	36	35	15	19	37	21	43	37	41	36
Deformability	13	22	15	13	14	20	17	14	14	19	18	6	17	13	18	16	12	21
Moistness	34	8	5	16	8	7	23	32	31	31	11	10	29	14	36	27	28	28
Feshness	25	5	5	12	8	7	24	28	30	24	11	8	23	18	31	26	30	25
Flexibility	30	5	4	10	6	6	9	18	21	21	12	6	28	11	29	21	20	17
Firmness	3	3	12	6	18	27	11	8	12	9	25	11	16	19	11	9	10	16
Tendency to crumble	2	20	27	23	23	17	8	1	4	21	8	25	21	28	5	9	11	6
Doughy	19	5	1	10	7	9	18	26	27	24	4	2	14	4	32	21	19	20
Sticky	10	19	2	15	8	6	18	31	29	29	31	5	13	11	18	7	21	18
Causes salivation	5	24	16	10	19	16	18	3	10	9	6	28	16	26	15	15	16	20
Chewiness	12	7	7	3	9	9	16	13	10	14	11	9	7	6	13	16	14	18
Granularity	4	7	13	17	30	25	18	3	4	3	11	18	13	25	6	7	4	6
Roughness	4	15	21	5	18	24	7	3	1	0	16	31	2	17	0	5	3	3
Thickness of grains	2	13	16	11	25	19	14	17	2	2	15	22	9	11	7	15	5	5
Melting	14	12	5	10	6	6	9	17	21	13	10	2	28	15	28	8	17	19
Ability to liquefy	25	8	17	20	11	8	8	18	18	15	8	8	13	14	19	10	13	14
Odour																		
Yeast	0	0	0	0	0	0	8	3	11	6	0	3	11	7	7	0	7	3
Leaven	26	8	15	26	21	13	15	22	10	22	14	11	15	17	24	19	12	19
Alcohol	5	0	3	6	3	7	7	1	6	4	2	6	4	1	3	6	2	3
Ethanol	5	4	5	7	7	1	9	4	14	10	7	1	2	7	7	12	11	7
Sour odour	8	3	2	7	16	6	24	0	15	6	3	5	11	16	6	11	5	7
Pungency	4	5	11	0	7	6	7	5	8	7	4	4	9	14	1	17	13	6
Flour	0	6	2	0	3	10	4	2	4	0	3	0	3	5	2	0	2	2
Wet flour	17	9	7	14	6	16	13	12	6	21	13	4	13	11	15	14	18	23
Starch paste	2	7	0	2	2	2	0	1	0	0	0	0	1	2	0	2	2	1
Bran	5	4	4	0	6	0	0	0	2	0	2	8	0	1	0	0	0	0
Butter	6	0	2	0	2	4	2	1	4	1	2	1	1	0	3	4	7	3
Brioche	7	0	0	0	2	3	1	5	2	2	4	3	0	1	4	5	4	5
Gingerbread	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dried fruit	2	4	0	0	0	3	0	0	0	2	0	4	0	0	3	0	3	0
Rancid	2	4	5	6	3	3	3	1	3	4	3	8	4	3	4	5	4	4
Musty	1	4	4	7	3	3	3	2	0	4	4	3	2	9	4	7	1	2
Dusty	1	11	7	6	6	4	3	2	1	1	4	14	6	9	0	9	2	7
Ferrous odour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curdled milk	1	4	1	1	1	4	5	1	3	3	0	2	3	1	0	0	6	1
Fermented milk	0	2	2	0	2	0	2	4	9	0	2	0	2	4	3	0	0	1
Smoke	0	0	0	3	3	0	2	0	3	2	0	0	1	0	3	0	0	0
Tobacco	0	0	0	0	0	1	3	0	0	0	0	1	0	0	0	0	0	0

Parameter		Sum of the intensities given by all the assessors — Products studied																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Flavour																		
Bland		11	13	14	6	8	18	13	12	18	12	3	0	9	9	13	13	8	6
Neutral		14	5	10	12	13	25	13	9	11	14	8	10	16	9	7	15	14	11
Milk		3	0	3	0	2	0	0	3	2	1	1	0	0	0	2	0	3	12
Lactic acid		0	0	0	0	3	3	0	0	3	0	0	0	3	0	0	1	0	3
Flour		9	18	11	10	7	8	9	11	6	8	3	0	3	2	6	2	9	7
Starch		2	5	1	2	0	4	0	3	0	3	0	0	0	0	0	0	3	0
Gluten		4	0	0	0	0	0	0	0	4	0	0	0	0	0	3	0	3	0
Uncooked pastry		15	12	1	3	0	0	8	7	9	18	4	0	7	6	22	8	13	13
Brioche		2	0	0	0	0	0	0	0	0	3	6	0	2	1	1	2	6	10
Butter		1	0	2	0	0	0	0	0	2	0	3	2	1	1	2	2	0	2
Acid		5	4	1	23	9	3	17	10	5	5	0	10	6	5	2	16	17	5
Pungency		5	9	9	14	6	12	7	3	6	6	2	9	8	15	9	15	5	5
Sour flavour		4	5	5	4	11	3	9	4	3	3	0	8	6	5	3	5	2	0
Salty		4	12	8	20	12	2	9	11	12	9	3	3	10	19	4	7	11	2
Sweet		9	4	4	4	0	4	3	7	2	6	28	3	3	6	13	3	9	29
Bitter		0	2	0	3	2	0	6	2	8	2	0	0	4	7	3	0	0	2
Astringent		4	6	3	8	4	7	9	6	0	0	0	4	2	1	2	5	5	3
Ethanol		1	1	2	2	0	0	0	0	0	0	0	0	4	0	0	0	0	1
Alcohol		1	1	2	2	1	0	1	0	0	0	0	0	1	0	3	0	1	0
Fermented		3	2	3	0	0	0	0	2	3	0	2	0	4	6	2	3	0	0
Yeast		0	0	0	3	0	2	0	0	2	3	0	5	7	0	4	0	1	3
Musty		0	3	4	0	1	0	2	0	0	1	0	5	3	9	2	6	3	2
Nutty		0	0	9	6	0	5	3	2	0	0	0	11	0	0	0	4	0	0
Dusty		0	4	2	0	10	6	0	0	0	1	0	2	3	10	0	0	1	1
Earthy		0	3	3	0	4	3	2	0	0	0	0	3	4	1	0	2	0	0
Plastic		0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0
Tobacco		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B.4 — Corrected data: Geometric means of the descriptors for the whole panel (Application of 6.6)

Parameter	Geometric mean for all the assessors — Products studied																		Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Appearance																			
Regularity of shape	76,9	57,0	89,4	74,5	85,6	59,6	83,0	93,1	73,0	85,6	74,5	57,7	64,8	73,5	77,5	77,5	80,0	81,2	76,44
Pinched	13,7	63,2	51,2	50,7	0,0	74,5	11,1	26,3	51,6	24,3	59,6	74,4	67,1	54,8	52,9	37,4	34,6	58,3	48,35
Narrowness	85,1	36,2	54,8	50,9	50,9	67,0	81,6	42,2	66,7	63,2	59,6	73,0	54,2	50,6	60,0	78,7	71,0	83,7	54,07
Appearance of crust																			
Mat	64,2	67,8	46,8	88,2	77,0	60,2	79,5	43,0	99,2	79,5	85,6	18,6	63,2	83,7	83,7	77,1	82,5	74,7	70,74
Shiny	12,5	11,2	21,7	0,0	0,0	21,1	0,0	38,5	0,0	0,0	0,0	54,2	20,0	0,0	0,0	12,6	6,3	14,1	12,80
Pale	21,7	57,3	25,6	29,8	17,2	18,6	7,0	19,9	9,9	15,9	17,2	8,6	20,5	21,9	13,4	0,0	0,0	8,9	17,13
Brown	75,4	22,4	47,4	47,1	31,4	38,5	86,9	22,8	61,7	60,9	70,3	54,4	47,7	42,4	74,7	89,4	63,2	37,4	54,65
Blond	11,2	22,4	7,9	31,4	39,8	31,4	5,0	48,4	37,2	44,1	7,0	17,2	26,8	16,7	14,1	12,6	16,7	36,9	22,38
Burnt	15,8	27,4	0,0	31,4	0,0	19,9	38,5	0,0	24,3	67,4	22,2	71,7	47,7	31,6	21,9	38,7	17,9	12,6	29,88
Uniform colour	86,6	39,1	92,2	52,6	79,5	52,6	50,9	65,0	63,7	71,5	62,9	52,6	66,3	52,0	67,8	64,8	87,2	84,9	67,28
Thickness	53,0	54,8	54,8	57,3	50,2	48,7	50,2	47,1	40,1	67,0	55,8	65,7	49,0	45,2	59,2	58,0	54,2	61,5	54,14
Cohesion of the loaf	88,0	61,2	92,2	83,0	77,0	61,3	52,6	89,4	80,7	75,7	73,0	76,0	70,7	70,7	92,7	64,5	68,4	69,7	75,04
Peeling	38,7	27,4	17,7	34,4	22,8	35,8	62,1	27,2	24,3	34,4	50,2	33,0	63,2	45,2	33,2	25,3	33,2	50,6	37,20
Crumbling	22,4	46,8	58,1	43,0	51,6	17,2	8,6	12,2	29,8	19,9	48,7	19,9	23,7	47,7	28,3	17,3	31,0	20,0	30,84
Crustiness	19,4	27,4	45,1	28,5	33,0	12,2	8,6	41,6	35,1	31,4	19,2	8,6	6,3	25,7	19,0	14,1	19,0	0,0	22,51
Flakiness	27,4	17,7	12,5	21,1	7,0	37,2	14,1	14,1	17,2	9,9	17,2	37,2	27,9	14,1	17,3	17,9	16,7	21,9	19,78
Importance of scratches on the crust	28,0	9,7	0,0	31,4	0,0	0,0	29,4	35,1	28,1	22,2	17,2	0,0	8,9	12,6	20,0	39,5	10,0	0,0	19,37
Appearance of loaf																			
General regularity	62,7	57,0	79,1	88,2	76,0	52,6	80,3	88,2	84,3	63,1	89,4	69,9	86,0	67,8	65,7	64,3	83,7	83,7	75,18
Rolling up	41,5	67,8	69,4	26,3	43,8	60,2	45,5	34,4	37,2	61,5	71,5	78,9	61,5	55,3	43,8	40,0	40,0	31,0	51,62
Homogeneity of colour	61,0	80,6	54,5	81,6	74,5	84,3	84,3	88,2	84,3	83,0	85,6	77,5	77,1	63,2	68,4	64,3	77,5	70,4	76,01
Yellow	64,2	27,4	88,0	47,1	65,7	53,1	77,0	24,3	52,6	38,5	78,9	71,7	73,5	30,0	38,7	72,2	21,9	59,3	54,84
White	7,9	33,5	0,0	28,5	0,0	17,2	8,6	57,1	19,9	43,0	5,0	29,1	0,0	42,4	47,7	11,0	59,2	20,5	24,88
Regularity of alveoli	45,4	51,2	64,5	86,9	55,9	63,2	62,9	74,4	68,9	80,3	71,7	64,4	73,5	45,6	77,5	70,7	71,0	77,5	68,26
Size of largest alveoli	74,0	68,5	50,0	33,0	54,4	45,8	72,0	57,3	54,2	64,4	58,8	70,3	46,5	73,8	51,6	77,1	69,7	62,0	60,42
Size of smallest alveoli	51,2	56,5	43,3	26,3	45,5	40,1	50,9	41,6	47,4	49,2	52,6	45,5	34,6	47,3	39,2	50,2	45,6	43,8	45,15
Flakiness	20,9	38,7	7,9	22,8	0,0	7,0	26,3	29,8	28,5	8,6	9,9	26,3	12,6	4,5	21,9	16,7	16,7	15,5	18,58
Crumbling	25,0	48,4	56,0	47,1	54,4	35,5	42,2	24,3	38,5	38,5	60,2	58,4	38,7	52,5	26,8	45,8	51,6	49,0	45,03
Moistness	83,7	67,1	43,3	56,2	27,2	42,2	73,0	77,0	78,3	61,7	42,2	48,7	65,7	58,5	78,2	69,7	66,9	86,0	64,23
Freshness	72,5	54,8	45,4	38,5	24,8	29,8	58,8	70,8	62,1	55,8	43,6	29,4	64,5	36,3	72,7	74,7	79,4	66,9	55,79
Density	50,0	23,9	48,4	35,8	28,1	21,1	41,0	57,1	28,5	24,3	19,9	15,7	31,0	21,9	33,5	29,7	44,7	32,2	32,85
Sponginess	47,4	9,7	20,9	18,6	25,8	27,2	58,4	39,8	34,4	43,0	37,2	28,5	43,6	31,0	61,5	41,2	41,2	68,1	39,28
Doughiness	0,0	33,5	7,9	18,6	0,0	8,6	0,0	21,1	19,9	18,6	8,6	9,9	7,7	8,9	8,9	6,3	15,5	0,0	10,68
Lumpiness	5,6	7,9	7,9	0,0	9,9	0,0	0,0	0,0	8,6	0,0	0,0	0,0	0,0	15,5	0,0	0,0	0,0	0,0	3,04

Geometric mean for all the assessors

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Mean
Texture																			
Elasticity	92,2	59,2	49,1	44,7	42,2	29,8	57,7	74,5	83,0	71,5	21,1	33,3	50,0	40,0	83,7	67,8	51,0	69,3	59,82
Compressibility	94,9	82,2	72,5	71,5	53,7	68,3	84,3	89,4	89,4	88,2	57,7	65,0	86,0	61,5	92,7	86,0	90,6	84,9	79,85
Deformability	57,0	74,2	57,3	53,7	55,8	66,7	61,5	55,8	55,8	65,0	63,2	36,5	58,3	51,0	60,0	56,6	49,0	64,8	58,29
Moistness	92,2	38,7	37,8	59,6	42,2	37,2	67,4	84,3	78,3	78,3	51,6	47,0	76,2	50,2	80,5	69,7	71,0	74,8	65,88
Freshness	69,5	25,0	28,6	42,2	44,4	34,8	68,9	69,6	72,0	59,6	40,4	34,4	60,7	56,9	65,9	64,5	73,5	63,2	55,54
Flexibility	81,0	21,7	22,1	31,4	21,1	21,1	36,5	47,1	50,9	50,0	28,1	21,1	66,9	33,2	63,7	54,2	52,9	45,2	42,74
Firmness	16,8	9,7	38,3	17,2	47,1	68,3	28,5	24,3	38,5	24,3	29,8	28,5	47,3	47,7	36,3	26,8	24,5	40,0	33,76
Tendency to crumble	13,7	61,2	87,8	63,1	67,4	50,2	24,3	12,2	17,2	17,2	65,7	65,7	54,2	66,9	26,5	30,0	39,2	21,9	44,75
Doughy	54,5	21,7	6,4	38,5	22,8	29,8	47,1	62,1	68,3	70,8	24,3	9,9	37,4	15,5	71,6	54,2	43,6	49,0	41,63
Sticky	35,4	64,5	18,1	47,1	24,3	21,1	51,6	73,2	75,7	75,7	17,2	22,2	39,5	33,2	50,2	26,5	54,2	46,5	44,08
Causes salivation	21,7	67,1	57,1	27,2	53,1	39,8	51,6	24,3	31,4	29,8	78,3	69,6	40,0	60,3	38,7	42,4	40,0	49,0	45,45
Chewiness	33,5	20,9	23,9	8,6	21,1	21,1	39,8	19,9	31,4	37,2	17,2	25,8	20,5	15,5	32,2	40,0	37,4	42,4	27,43
Granularity	19,4	29,6	46,1	50,2	77,0	65,7	47,1	19,2	17,2	14,9	28,5	47,1	39,5	59,2	24,5	23,7	12,6	19,0	36,07
Roughness	22,4	43,3	71,7	11,1	51,6	64,4	22,8	12,2	5,0	0,0	44,4	78,3	8,9	41,2	0,0	17,3	13,4	13,4	29,31
Thickness of grains	13,7	40,3	57,1	33,0	70,3	53,1	37,2	9,9	7,0	9,9	43,0	61,7	30,0	29,7	26,5	38,7	14,1	17,3	32,92
Melting	41,8	38,7	20,2	31,4	17,2	17,2	29,8	50,2	55,8	35,8	31,4	9,9	66,9	42,4	62,6	25,3	45,2	51,6	38,25
Ability to liquefy	74,0	27,4	64,5	54,4	28,5	24,3	24,3	55,8	51,6	47,1	24,3	28,1	36,1	41,0	43,6	31,6	36,1	41,0	40,43
Odour																			
Yeast	0,0	0,0	0,0	0,0	0,0	0,0	19,9	8,6	28,5	17,2	0,0	8,6	29,7	16,7	20,5	0,0	16,7	7,7	10,39
Leaven	75,4	31,6	55,3	71,7	50,9	35,8	43,0	57,1	22,2	57,1	41,6	28,5	38,7	45,2	58,0	51,6	31,0	47,7	46,72
Alcohol	17,7	0,0	11,1	21,1	7,0	22,8	22,8	5,0	17,2	14,1	9,9	21,1	12,6	4,5	11,0	15,5	6,3	11,0	13,11
Ethanol	17,7	19,4	20,2	18,6	7,0	5,0	21,1	14,1	37,2	27,2	22,8	5,0	8,9	20,5	11,0	31,0	29,7	20,5	19,06
Sour odour	31,6	13,7	9,0	22,8	48,7	21,1	64,4	0,0	43,0	17,2	8,6	19,2	33,2	43,8	21,9	29,7	14,1	23,7	26,38
Pungency	19,4	21,7	42,4	36,9	18,6	21,1	22,8	11,1	28,1	22,8	14,1	9,9	30,0	37,4	6,3	41,2	39,5	15,5	24,69
Flour	0,0	19,4	9,0	5,0	8,6	27,2	9,9	7,0	9,9	0,0	8,6	14,1	7,7	14,1	6,3	0,0	6,3	6,3	1,10
Wet flour	51,5	33,5	29,3	37,2	17,2	44,4	35,8	34,4	17,2	55,8	40,1	14,1	32,2	29,7	38,7	37,4	46,5	52,5	36,21
Starch paste	7,9	20,9	0,0	7,0	7,0	7,0	0,0	5,0	0,0	0,0	0,0	0,0	4,5	6,3	0,0	6,3	6,3	4,5	4,63
Bran	17,7	11,2	12,8	0,0	17,2	0,0	9,9	0,0	7,0	5,0	7,0	19,9	0,0	4,5	11,0	0,0	0,0	0,0	5,12
Butter	23,7	0,0	12,8	5,0	7,0	14,1	5,0	5,0	14,1	7,0	7,0	5,0	4,5	0,0	12,6	12,6	20,5	7,7	9,12
Brioche	25,6	0,0	0,0	0,0	0,0	8,6	0,0	15,7	7,0	0,0	14,1	8,6	0,0	4,5	0,0	17,3	15,5	14,1	9,63
Gingerbread	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,0	0,0	0,0	0,0	12,6	0,0	0,0	0,0	0,55
Dried fruit	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	14,1	0,0	0,0	7,7	0,0	7,7	0,0	1,72
Rancid	11,2	15,8	2,2	24,3	12,2	12,2	8,6	5,0	8,6	14,1	0,0	24,3	12,6	11,0	12,6	17,3	12,6	15,5	13,29
Musty	11,2	15,8	18,1	22,8	12,2	12,2	8,6	7,0	0,0	17,2	12,2	8,6	8,9	23,2	12,6	20,5	4,5	6,3	12,43
Dusty	5,6	32,1	23,9	17,2	21,1	14,1	8,6	0,0	5,0	5,0	14,1	41,6	15,5	26,8	0,0	23,2	6,3	20,5	16,00
Ferrous odour	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Curdled milk	5,6	15,8	6,4	5,0	5,0	14,1	15,7	5,0	25,8	8,6	7,0	7,0	11,0	4,5	15,5	0,0	15,5	4,5	7,42
Fermented milk	0,0	7,9	9,0	0,0	7,0	0,0	7,0	14,1	12,2	0,0	0,0	0,0	6,3	8,9	7,7	0,0	0,0	4,5	6,34
Smoke	0,0	0,0	0,0	0,0	8,6	0,0	7,0	0,0	0,0	7,0	7,0	0,0	4,5	0,0	0,0	0,0	0,0	0,0	2,70
Tobacco	0,0	0,0	0,0	0,0	0,0	5,0	8,6	0,0	0,0	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0	1,06

Products studied

Parameter	Geometric mean for all the assessors — Products studied																		Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Flavour																			
Bland	32,1	40,3	47,8	21,1	24,3	47,1	31,0	34,4	47,1	29,8	8,6	0,0	23,2	26,8	32,2	34,6	17,9	19,0	28,48
Neutral	41,8	17,7	35,0	29,8	35,8	60,9	35,8	25,8	28,5	37,2	24,3	27,2	40,0	23,2	20,5	34,6	33,5	29,7	32,31
Milk	13,7	0,0	11,1	0,0	7,0	0,0	0,0	8,6	7,0	5,0	5,0	0,0	0,0	0,0	6,3	0,0	11,0	31,0	5,97
Lactic acid	0,0	0,0	0,0	0,0	8,6	8,6	25,8	0,0	8,6	0,0	8,6	0,0	11,0	6,3	15,5	4,5	0,0	7,7	2,89
Flour	29,0	58,1	36,7	27,2	22,8	24,3	0,0	33,0	0,0	24,3	0,0	0,0	7,7	8,9	0,0	6,3	23,2	16,7	20,54
Starch	7,9	17,7	6,4	7,0	0,0	14,1	0,0	8,6	7,2	8,6	0,0	0,0	7,7	0,0	7,7	0,0	7,7	0,0	5,59
Gluten	11,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	9,9	0,0	0,0	0,0	0,0	0,0	7,7	0,0	7,7	0,0	2,04
Uncooked pastry	43,3	38,7	6,4	12,2	0,0	0,0	19,9	4,8	25,8	51,6	14,1	0,0	16,7	15,5	51,4	21,9	32,2	27,9	23,84
Brioche	7,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	12,2	21,1	0,0	6,3	4,5	4,5	8,9	19,0	31,6	7,01
Butter	5,6	0,0	12,8	0,0	0,0	0,0	0,0	0,0	9,9	0,0	12,2	7,0	4,5	4,5	6,3	6,3	0,0	6,3	4,17
Acid	17,7	15,8	9,0	63,1	25,8	12,2	50,2	27,2	15,7	15,7	0,0	27,2	19,0	20,0	6,3	35,8	45,2	14,1	23,96
Pungency	21,7	33,5	33,2	41,6	17,2	34,4	22,8	14,9	21,1	21,1	7,0	21,1	28,3	42,4	26,8	38,7	17,3	17,3	25,86
Sour flavour	15,8	21,7	20,2	9,9	28,5	8,6	25,8	9,9	12,2	8,6	14,9	19,9	21,9	14,1	13,4	14,1	8,9	0,0	14,22
Salty	15,8	38,7	31,3	54,4	34,4	7,0	25,8	33,0	38,5	25,8	14,9	12,2	28,3	51,6	12,6	20,5	29,7	6,3	26,77
Sweet	29,0	15,8	18,1	17,2	0,0	0,0	8,6	18,6	7,0	21,1	78,9	8,6	7,7	19,0	36,1	11,0	23,2	72,2	22,79
Bitter	0,0	7,9	0,0	8,6	7,0	18,6	17,2	7,0	24,3	7,0	0,0	0,0	8,9	16,7	7,7	0,0	0,0	6,3	6,76
Astringent	15,8	19,4	15,6	19,9	14,1	0,0	25,8	17,2	0,0	7,0	0,0	14,1	6,3	4,5	6,3	14,1	14,1	7,7	12,16
Ethanol	5,6	5,6	9,0	0,0	0,0	0,0	0,0	0,0	0,0	7,0	0,0	0,0	4,5	0,0	0,0	0,0	0,0	4,5	1,49
Alcohol	5,6	5,6	9,0	9,9	0,0	0,0	5,0	0,0	0,0	0,0	0,0	0,0	12,6	0,0	11,0	0,0	4,5	0,0	4,45
Fermented	9,7	7,9	11,1	0,0	0,0	0,0	0,0	0,0	8,6	0,0	7,0	0,0	12,6	15,5	6,3	7,7	4,5	0,0	5,09
Yeast	0,0	0,0	0,0	0,0	0,0	0,0	0,0	7,0	9,9	8,6	0,0	0,0	16,7	0,0	12,6	0,0	0,0	7,7	3,75
Musty	0,0	13,7	18,1	12,2	5,0	7,0	0,0	0,0	0,0	5,0	0,0	15,7	7,7	23,2	8,9	19,0	11,0	6,3	8,67
Nutty	0,0	0,0	0,0	0,0	0,0	0,0	7,0	0,0	0,0	0,0	0,0	15,7	0,0	0,0	0,0	0,0	0,0	0,0	1,25
Dusty	0,0	11,2	27,7	17,2	27,2	15,7	8,6	7,0	0,0	0,0	0,0	28,5	7,7	24,5	0,0	12,6	4,5	4,5	9,99
Earthy	0,0	9,7	11,1	0,0	9,9	17,2	0,0	7,0	0,0	0,0	0,0	7,0	8,9	4,5	0,0	0,0	0,0	0,0	4,56
Plastic	0,0	0,0	0,0	0,0	0,0	8,6	7,0	0,0	0,0	0,0	0,0	8,6	6,3	0,0	0,0	6,3	0,0	0,0	3,57
Tobacco	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,00

NOTE — Calculations are carried out using the formula $\sqrt{F \cdot I}$. The frequency (F) is not given in the table but it is possible to calculate it.