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Senzorična analiza - Metodologija - Preskus "A" ali "ne A"

Sensory analysis -- Methodology -- "A" - "not A" test

Analyse sensorielle -- Méthodologie -- Essai "A" - "non A"

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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Sensory analysis — Methodology — "A" - "not A" test

Analyse sensorielle — Méthodologie — Essai «A» - «non A»

Reference number
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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8588 was prepared by Technical Committee ISO/TC 34, *Agricultural food products.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Sensory analysis — Methodology — "A" - "not A" test

1 Scope and field of application

This International Standard describes the "A" - "not A" test for use in sensory analysis :

a) as a difference test, particularly for evaluating samples having variations in appearance (making it difficult to obtain strictly identical repeat samples) or in after-taste (making direct comparison difficult);

b) as a recognition test, particularly for determining whether an assessor or group of assessors identifies a new stimulus in relation to a known stimulus (for example recognition of the quality of the sweet taste of a new sweetener);

c) as a perception test, to determine the sensitivity of an assessor to a particular stimulus.

Examples of its application are given in annex A.

2 References

ISO 3534, *Statistics — Vocabulary and symbols.*

ISO 5492 (Parts 1 to 6), *Sensory analysis — Vocabulary.*

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

ISO 8589, *Sensory analysis — General guidance for the design of test rooms.* [1)]

3 Definitions

For the purpose of this International Standard, the definitions given in the various parts of ISO 5492, for terms concerning sensory analysis, and in ISO 3534, for statistical terms, apply.

4 Principle

Presentation to an assessor of a series of samples, some of which are composed of sample "A" while others are different from sample "A"; for each sample, the assessor has to determine whether or not it is identical to "A".

This test requires the assessor to have evaluated a known sample "A" prior to the exposure to test samples.

5 Apparatus

The apparatus shall be selected by the test supervisor, according to the nature of the product to be analysed, the number of samples, etc., and shall in no way affect the test results.

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

6 Sampling

Refer to sampling standards for the sensory analysis of the product or products for testing.

In the absence of such standards, agreement shall be sought between the parties concerned.

7 General test conditions

7.1 Test room

The characteristics of the room in which the tests are to be carried out form the subject of ISO 8589. See also ISO 6658.

7.2 Assessors

7.2.1 Qualification, selection, arrangement

The conditions with which the assessors shall comply will form the subject of a future International Standard.

All the assessors shall have the same level of qualification. This qualification shall be chosen in accordance with the object of the test.

7.2.2 Number of assessors

The number of assessors to be used depends on the object of the test, and on the required significance level.

1) At present at the stage of draft.

8 Procedure

8.1 Preparation of the test samples

(distribution, dilution, cooking, etc.)

Provide a sufficient quantity of test sample of "A" and "not A" products so that the desired number of samples may be prepared.

The assessors shall not be able to draw conclusions as to the nature of the samples from the way in which they are presented to them. The samples shall be prepared in an identical fashion (same containers, same quantities of products).

The temperature of the samples shall be checked and constant.

The containers holding the test samples shall be coded, preferably using three-digit numbers chosen at random. The coding shall be different for each test.

8.2 Test method

The "A" - "not A" test presupposes an explicit initial experience of the sample "A". After this experience, and as soon as the assessment has started, the assessor no longer has access to an explicit "A" sample; in addition, in the series presented to the assessor, all the "not A" samples are similar, and the respective number of "A" and "not A" samples is unknown to the assessor.

The order of presentation of the "A" and "not A" samples shall be random and the order shall be different for each assessor. Each assessor shall be presented with an identical number of "A" samples and with an identical number of "not A" samples (these two numbers not necessarily being the same).

According to the nature of the sample, and in order to avoid certain interfering effects of sensory adaptation, the same time intervall shall be observed between the presentation of two successive samples.

Specimen answer forms are reproduced in annex C.

Depending on the aims of the test, possible variations include :

a) the initial experience, which may cover not only the "A" sample but also the "not A" sample;[1)]

b) free availability of an explicit "A" sample throughout the assessment;

c) the presentation of "not A" samples which are themselves different.

9 Expression of results

At the end of the test the analyst obtains, in the simplest form of the test, a table of two columns and two rows (see table 1).

Table 1 — Observed numbers

		Sample presented is "A"	Sample presented is "not A"	Total
The assessor identifies	"A"	n_{11}	n_{12}	$n_{1.}$
	"not A"	n_{21}	n_{22}	$n_{2.}$
Total		$n_{.1}$	$n_{.2}$	$n_{..}$

where

n_{11} and n_{22} are the numbers of correct "A" and "not A" responses, respectively;

n_{21} and n_{12} are the numbers of incorrect "A" and "not A" responses, respectively;

$n_{1.}$ and $n_{2.}$ are the sums of responses of rows 1 and 2, respectively;

$n_{.1}$ and $n_{.2}$ are the sums of responses of columns 1 and 2, respectively;

$n_{..}$ is the total number of responses.

The interpretation consists of comparing the two distributions

$(n_{11} - n_{21})$ and $(n_{12} - n_{22})$

to determine whether the ratio n_{11}/n_{21} is significantly different from the ratio n_{12}/n_{22}.

It may be carried out by means of a χ^2 test. Examples are given in annex A. Some values of χ^2 are given in annex B.

Other interpretation methods are possible, notably

— when the number of responses is small, the exact Fisher[2)] test can be used;

— when the "A" - "not A" test is used to determine a perception threshold, signal detection theory[3)] can be used.

The signal detection theory allows for payoffs to be assigned for each decision possibility in order to effect bias and performance.

1) Position of the American Society for Testing and Materials (ASTM).

2) See FISHER, R.A., *Statistical methods for research workers.* Edinburgh, Oliver & Boyd, 1941.

3) See for example GREEN, D.M. and SWETS, J.A., *Signal detection theory and psychophysics.* New York, John Wiley & Sons, 1966; SWETS, J.A., *Signal detection and recognition by human observers.* New York, John Wiley & Sons, 1964; BAIRD, J.C. and NOMA, E., *Fundamentals of scaling and psychophysics.* New York, John Wiley & Sons, 1978.

Annex A

Examples of application of the "A" - "not A" test

A.1 Example 1

Recognition of the sweet taste of sucrose (stimulus "A") from that provoked by a sweetener ("not A" stimulus)

The two substances are presented in aqueous solution in concentrations resulting in an intensity of sweetness equivalent to that given by a 40 g/l sucrose solution.

Number of assessors : 20

Number of samples per assessor : 5 "A" and 5 "not A"

Results (all assessors together) : see table 2.

Table 2 — Observed values for example 1

		Sample presented is "A"	Sample presented is "not A"	Total
Number of responses identifying the sample as	"A"	60	35	95
	"not A"	40	65	105
Total		100	100	200

The χ^2 index is calculated :

$$\chi^2 = \sum_{i,j} \frac{(E_o - E_t)^2}{E_t}$$

where

E_o is the observed number in box i,j (in which i is the number of the row and j is the number of the column);

E_t is the theoretical number in the same box given by the ratio of the product of the number from the row and the number from the column to the total number, i.e. using the symbols of clause 9 :

$$\frac{n_{i.} \times n_{.j}}{n_{..}}$$

For example for box "A" "A" (or $_{11}$) :

$$E_t = \frac{95 \times 100}{200} = 47,5$$

i.e.

$$\chi^2 = \frac{(60 - 47,5)^2}{47,5} + \frac{(35 - 47,5)^2}{47,5} + \frac{(40 - 52,5)^2}{52,5} + \frac{(65 - 52,5)^2}{52,5}$$

$$= 12,53$$

This observed index is compared with a critical value given in table 7 for a number of degrees of freedom equal to 1.

If this index is greater than the critical value, it will be decided that, for the chosen risk, there is a significant difference in the recognition of the two sweet tastes [as is the case in this example, as 12,53 > 3,84 (5 % risk), the hypothesis being two sided : see note 3].

If this index is less than the theoretical value, it will be decided that there is no significant difference in the recognition of the two sweet tastes, as is the case in table 3.

Table 3 — No significant difference in recognition

60	50
40	50

In this case, χ^2 is equal to 2,02, a value less than 3,84.

NOTES

1 Strictly speaking, given that the χ^2 distribution (continuous) is used as an approximation to a discontinuous distribution, the preceding equation should be corrected as follows (Yates's correction) :

$$\chi^2 = \sum_{i,j} \frac{(|E_o - E_t| - 0,5)^2}{E_t}$$

where $|E_o - E_t|$ is the modulus of the difference.

The correction 0,5 is negligible when there is a high number of responses; it is generally considered to be essential if one of the numbers in a box is less than 5, and desirable if the total number of responses in the table is less than 40.

2 In the case of a 2 × 2 table, the preceding equation may be of the form

$$\chi^2 = \frac{[|n_{11} \times n_{22} - n_{12} \times n_{21}| - (n_{..}/2)]^2 \times n_{..}}{(n_{11} + n_{12})(n_{21} + n_{22})(n_{11} + n_{21})(n_{22} + n_{12})}$$

$$= \frac{[|n_{11} \times n_{22} - n_{12} \times n_{21}| - (n_{..}/2)]^2 \times n_{..}}{n_{.1} \times n_{.2} \times n_{1.} \times n_{2.}}$$

3 The hypothesis in this example is a two-side one : the "sucrose" — "not sucrose" responses are independent of the sample. The analyst may wish to make a decision within the context of the one-sided hypothesis : the "sucrose" response is more frequent when the sample is sucrose than when the sample is not sucrose. In this case, the critical value for 5 % risk is 2,71.

A.2 Example 2

Identical to example 1, but each assessor assesses "A" 4 times and "not A" 6 times. See table 4.

Table 4 — Observed values for example 2

		Sample presented is "A"	Sample presented is "not A"	Total
Number of responses identifying : the sample as	"A"	50	55	105
	"not A"	30	65	95
Total		80	120	200

$\chi^2 = 5{,}34$ Significant value at the 5 % threshold.

A.3 Example 3

Identical to example 1, with the difference that each assessor assesses 32 samples : 13 "A" and 19 "not A", and that attention is given to each assessor and not to the responses from all the assessors as a whole, for example assessor 1. See table 5.

Table 5 — Observed values for example 3 (for one assessor)

		Sample presented is "A"	Sample presented is "not A"	Total
Number of responses identifying the sample as	"A"	8	6	14
	"not A"	5	13	18
Total		13	19	32

$\chi_c^2 = 1{,}73$ Non-significant value at the 5 % threshold in a one-sided hypothesis.

The continuity correction is essential here, in view of the low numbers in table 5. Note that the non-corrected value of χ^2 (equal to 2,81) would have been significant at the 5 % threshold.

A.4 Example 4

Identical to example 1, but the "not A" sample is composed of two different sweeteners, "(not A)$_1$" and "(not A)$_2$". For example the analyst obtains the values of table 6.

The analyst may have carried out the experiment in order to decide

a) whether "A" is recognized in a different way from the group "(not A)$_1$ + (not A)$_2$" : in this case, the problem is dealt with exactly as shown in examples 1 and 2, with subgroups "(not A)$_1$" and "(not A)$_2$" being combined in a group "not A";

b) whether the three samples "A", "(not A)$_1$" and "(not A)$_2$" are recognized in a significantly different way : in this case, the problem is dealt with in a similar way to example 1, except that the total has to be extended to all the boxes (in this case 6), and the number of degrees of freedom (df) is equal to the number of samples less one (in this case 3 − 1 = 2) and that Yates's correction is not necessary :

$\chi^2 = 4{,}65$ Value less than the critical value 5,99 for a 5 % threshold and 2 degrees of freedom (two-sided hypothesis);

c) whether the two samples "(not A)$_1$" and "(not A)$_2$" are recognized in a significantly different way : in this case, the problem is dealt with as described in example 1 (column "A" being removed) provided that the preliminary test carried out on the three samples has resulted in a significant difference; if not, the question is a pointless one, since the previous test has concluded that the three samples "A", "(not A)$_1$" and "(not A)$_2$" are not perceived as different. The same comment applies if the analyst wished to compare, for example, "A" and "(not A)$_1$" or "A" and "(not A)$_2$".

For the example proposed, the overall test [$\chi^2 = 4{,}65$ (2 df)] results in non-significant differences; therefore, the other comparisons

"A" with ["(not A)$_1$" + "(not A)$_2$"]

"A" with "(not A)$_1$"

"A" with "(not A)$_2$"

"(not A)$_1$" with "(not A)$_2$"

do not have to be tested.

Table 6 — Observed values for example 4

		Sample presented is "A"	Sample presented is "not A"		Total "not A"	Total "A" + "not A"
			"(not A)$_1$"	"(not A)$_2$"		
Number of responses identifying the sample as	"A"	60	45	40	85	145
	"not A"	40	55	40	95	135
Total		100	100	80	180	280

Annex B

Extract from a χ^2 table

Table 7 gives the critical values of χ^2 to determine whether, in the case of a two-sided hypothesis, there are significant differences if the value of χ^2 observed is greater than the critical value.

In the case of a one-sided hypothesis, the risk is divided by two.

Table 7 — Critical values of χ^2

Two-sided hypothesis One-sided hypothesis		Value of χ^2 for a risk of 0,10 (10 %) 0,05 (5 %)	0,05 (5 %) 0,025 (2,5 %)	0,025 (2,5 %) 0,012 5 (1,25 %)	0,01 (1 %) 0,005 (0,5 %)	0,005 (0,5 %) 0,002 5 (0,25 %)
Degrees of freedom :	1	2,71	3,84	5,02	6,63	7,88
	2	4,61	5,99	7,38	9,21	10,6
	3	6,25	7,81	9,35	11,3	12,8
	4	7,78	9,49	11,1	13,3	14,9
	5	9,24	11,1	12,8	15,1	16,7
	6	10,6	12,6	14,4	16,8	18,5
	7	12,0	14,1	16,0	18,5	20,3
	8	13,4	15,5	17,5	20,1	22,0
	9	14,7	16,9	19,0	21,7	23,6
	10	16,0	18,3	20,5	23,2	25,2