International Standard 5495

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Sensory analysis — Methodology — Paired comparison test

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

International Standard ISO 5495 was developed by Technical Committee ISO/TC 34, *Agricultural food products*.

This second edition was submitted directly to the ISO Council, in accordance with clause 6.11.2 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 5495-1981), which had been approved by the member bodies of the following countries:

Australia	Hungary	Romania
Bulgaria	India	South Africa, Rep. of
Canada	Israel	Thailand
Cyprus	Kenya	Turkey
Czechoslovakia	Korea, Rep. of	United Kingdom
Egypt, Arab Rep. of	Mexico	USA
Ethiopia	Netherlands	Yugoslavia
France	New Zealand	
Germany, F.R.	Poland	

No member body had expressed disapproval of the document.

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Sensory analysis — Methodology — Paired comparison test

1 Scope

This International Standard specifies a technique for detecting differences in the organoleptic attributes of two products.

It is necessary to know, from the start, whether the test is a **one-sided test** (one direction is of particular interest) or a **two-sided test** (both directions are of equal interest).[1)]

2 Field of application

The paired comparison test may be used for the following purposes :

a) directional differences : in order to determine the direction of the differences between two test samples for a specified attribute (for example more or less sweet);

b) preference : in order to establish whether there is a preference between two test samples (for example in consumer tests);

c) training assessors : in order to select, train and check the performance of assessors.

3 References

ISO 3534, *Statistics — Vocabulary and symbols.*

ISO 5492, *Sensory analysis — Vocabulary.*

4 Definitions

For definitions of terms relating to sensory analysis, see ISO 5492, and for those referring to statistics, see ISO 3534.

5 Principle

Presentation of a pair of samples to assessors; one sample may be a control.

Following testing, written response by the assessors, and interpretation of the replies obtained.

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

7 Sampling

Refer to the International Standards relating to sampling, for sensory analysis, of the product or products to be examined.

8 General test conditions

8.1 Room

The conditions in the room in which tests are to be conducted will form the subject of a future International Standard.

8.2 Assessors

8.2.1 Qualification, selection, aptitude

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

8.2.2 Number of assessors

In general, for the statistical validity of the test, the minimum number of assessors is :

a) for directional tests : 7 experts or 20 qualified assessors;

b) for tests of preference : 30 untrained assessors, and, if possible, one or several hundred;

c) for training assessors : a variable number of assessors according to the test.

1) General guidance on the methodology of sensory analysis and definitions of these terms will form the subject of ISO 6658.

8.3 Preliminary discussion and test

It may be desirable to hold a preliminary discussion between the assessors and the test supervisor, on the problem concerned and the nature of the samples, provided that this discussion cannot influence future judgements.

A few samples, typical of the series to be analysed, may be presented and discussed. They shall be limited in number (two or three), but shall be representative of the stimulus to be examined. This technique should not be used for preference testing.

If the test in question concerns the detection of foreign flavours, this preliminary test shall include the examination of a sample free from any foreign flavour, or, on the contrary, when possible, examination of the foreign flavour to be detected.

In general, it may be advisible to introduce controls (reference substances).

9 Procedure

9.1 Preparation of test samples (distribution, dilution, cooking, etc.)

9.1.1 Make provision for a sufficient quantity of bulk sample and for the necessary number of individual samples.

9.1.2 The assessors shall not be able to draw conclusions as to the nature of the samples from the way in which they are presented.

The various pairs of the series shall be prepared in an identical fashion (same apparatus, same vessels, and same quantities of products).

9.1.3 The temperature of the samples in any given pair shall be the same and, if possible, the same as that of all other samples in a given test series.

9.1.4 The vessels containing the test samples shall be coded, preferably using three figure numbers chosen at random. The coding shall be different for each test.

9.2 Test technique

9.2.1 Presentation of samples

The paired samples shall be presented simultaneously or successively for evaluation. The order of presentation shall be balanced so that the combinations AB and BA appear an equal number of times and are distributed at random among the assessors. Several pairs may be offered in succession (series of pairs), provided that sensory fatigue is minimized or avoided.

9.2.2 Questions to be asked

NOTE — The manner in which the questions are asked is very important as it can lead to bias in the replies of the assessors.

Depending on the aim of the test, the following questions may be asked :

a) Test for directional differences : Of these two samples, which is the more .....? (sweet, salty, etc.)

b) Test for preferences : Of these two samples, which do you prefer?

c) Training of assessors : Of these two samples, which is the more .....?

9.2.3 Choice of technique :

The person supervising the test shall opt for one of the following possibilities :

a) according to the "forced choice" technique, oblige the assessors to indicate which sample they consider more intense or prefer to the other, even if the assessors claim not to perceive a difference;

b) allow the answer "no difference" or "no preference".

Specimen answer forms for the "forced choice" technique are reproduced in annex A.

Whichever technique is chosen, the answer forms shall not pose more than one question, but necessary space shall be provided for series of pairs. If it is necessary to ask more than one question, the samples shall be coded anew and submitted for each separate question.

The "forced choice" technique is the only one based on statistical principles.

10 Expression and interpretation of results

Replies shall be collated and interpreted by the test supervisor as follows.

NOTE — Practical examples of application are given in annex B.

10.1 "Forced choice" technique

If the "forced choice" technique has been chosen :

a) for a one-sided test, total the number of responses in the direction anticipated by the test supervisor and refer to table 1;

b) for a two-sided test, total the number of responses (taking the larger of the two figures) and refer to table 2 in order to determine whether there is a significant difference between the samples or a significant preference for one of them.

10.2 "No difference" or "no preference" replies

If "no difference" or "no preference" replies have been permitted, treat these replies according to one of the following two techniques :

a) ignore them, i.e. subtract them from the total number of replies from the panel;

b) allocate half of the "no difference" or "no preference" replies to each of the two categories of replies.

A large proportion of "no difference" or "no preference" answers provides an interesting piece of information and may be useful during subsequent tests. It could indicate, in particular, that the difference between the samples is below the detection threshold of the assessors. This may equally reveal an imperfect experimental technique, reflect the existence of an important physiological variation in the assessors making up the panel, or even a lack of motivation of certain assessors for the tests in which they are participating.

11 Test report

The test report shall make reference to this International Standard and shall give the following information :

a) the problem posed;

b) all information necessary for the complete identification of the sample (or samples);

c) the test parameters adopted;

d) whether reference substances were used;

e) any other recommendations given during the test (for example recommendations relating to certain special food products);

f) the number of tests and the number of experts or of trained or untrained qualified assessors;

g) all the test conditions, in particular whether the "forced choice" technique was used, and whether the test was one-sided or two-sided;

h) the results obtained, at the level of significance chosen;

j) the date, hour and material conditions of the tests;

k) the name of the person supervising the tests.

Table 1 — One-sided test

Number of replies	Minimum number of positive replies for a significance of		
	$\alpha \leqslant 0,05$	$\alpha \leqslant 0,01$	$\alpha \leqslant 0,001$
7	7	7	—
8	7	8	—
9	8	9	—
10	9	10	10
11	9	10	11
12	10	11	12
13	10	12	13
14	11	12	13
15	12	13	14
16	12	14	15
17	13	14	16
18	13	15	16
19	14	15	17
20	15	16	18
21	15	17	18
22	16	17	19
23	16	18	20
24	17	19	20
25	18	19	21
26	18	20	22
27	19	20	22
28	19	21	23
29	20	22	24
30	20	22	24
31	21	23	25
32	22	24	26
33	22	24	26
34	23	25	27
35	23	25	27
36	24	26	28
37	24	27	29
38	25	27	29
39	26	28	30
40	26	28	31
41	27	29	31
42	27	29	32
43	28	30	32
44	28	31	33
45	29	31	34
46	30	32	34
47	30	32	35
48	31	33	36
49	31	34	36
50	32	34	37
60	37	40	43
70	43	46	49
80	48	51	55
90	54	57	61
100	59	63	66

Table 2 — Two-sided test

Number of replies	Minimum number of replies citing one sample for a significance of		
	$\alpha \leqslant 0,05$	$\alpha \leqslant 0,01$	$\alpha \leqslant 0,001$
7	7	—	—
8	8	8	—
9	8	9	—
10	9	10	—
11	10	11	11
12	10	11	12
13	11	12	13
14	12	13	14
15	12	13	14
16	13	14	15
17	13	15	16
18	14	15	17
19	15	16	17
20	15	17	18
21	16	17	19
22	17	18	19
23	17	19	20
24	18	19	21
25	18	20	21
26	19	20	22
27	20	21	23
28	20	22	23
29	21	22	24
30	21	23	25
31	22	24	25
32	23	24	26
33	23	25	27
34	24	25	27
35	24	26	28
36	25	27	29
37	25	27	29
38	26	28	30
39	27	28	31
40	27	29	31
41	28	30	32
42	28	30	32
43	29	31	33
44	29	31	34
45	30	32	34
46	31	33	35
47	31	33	36
48	32	34	36
49	32	34	37
50	33	35	37
60	39	41	44
70	44	47	50
80	50	52	56
90	55	58	61
100	61	64	67

NOTES

1 The values given in the tables were calculated from the exact formula : binomial law for parameter $p = 0,50$ with n repetitions (replies).

2 When the number of replies is higher than 100 ($n > 100$), it is necessary to use the following formula based on the approximation of the binomial law by the normal law and which gives the actual minimum number of expressed assessments to be obtained, with a maximum error equal at most to 1 unit.

Minimum number of replies : Nearest whole value to $\frac{n + 1}{2} + k\sqrt{n}$

One-sided test

$\alpha \leqslant 0,05$ $k = 0,82$
$\alpha \leqslant 0,01$ $k = 1,16$
$\alpha \leqslant 0,001$ $k = 1,55$

Two-sided test

$\alpha \leqslant 0,05$ $k = 0,98$
$\alpha \leqslant 0,01$ $k = 1,29$
$\alpha \leqslant 0,001$ $k = 1,65$

Annex A

Specimen answer forms

Detection of directional differences

Object of test :	Date :
Test criterion :	Name :
Problem : Of the two samples, which is the more .....?	
Pair under test	Sample the more .....
Sample number / Sample number	
..... /	.....
..... /	.....
Comments :	

Test for preference

Object of test :	Date :
Test criterion :	Name :
Problem : Of these two samples, which do you prefer?	
Pair under test	Preferred sample
Sample number / Sample number	
..... /	.....
..... /	.....
Comments :	

Annex B

Practical examples of application

The test supervisor accepts a 5 % risk of error (i.e. $\alpha \leqslant 0,05$).

Two-sided test

Two drinks are coded "789" and "379". Although one of the drinks may be formulated to be sweeter, either of them may be perceived as sweeter (or preferred) by the assessor.

One-sided test

Two drinks are coded "527" and "806". Sample "527" is formulated to be the sweeter. The assessor will be asked which of the coded samples is sweeter.

Directional difference test

The two drinks are served in a balanced random order to 30 qualified assessors.

Question : Which sample is sweeter?

Replies : 18 opt for sample "789"
12 opt for sample "379"

From table 2, it can be concluded that there is no significant difference in the sweetness of the two drinks.

Question : Which sample is sweeter?

Replies : 22 opt for sample "527"
8 opt for sample "806"

From table 1, it can be concluded that drink "527" is perceptibly sweeter than drink "806".

Preference test

The two drinks are re-coded and are served in a balanced random order to 30 untrained assessors.

Question : Which sample do you prefer?

Replies : 22 prefer sample "832"
8 prefer sample "417"

From table 2, it can be concluded that drink "832" is preferred to drink "417".

Question : Which sample do you prefer?

Replies : 23 prefer sample "613"
7 prefer sample "298"

From table 1, it can be concluded that there is a preference for drink "613" over drink "298".

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