ORGANOLEPTIC ASSESSMENT
OF VIRGIN OLIVE OIL

1. SCOPE

The purpose of this method is to determine the criteria needed to assess the flavour characteristics of virgin olive oil and to develop the methodology required to do so.

2. FIELD OF APPLICATION

The method described is only applicable to the organoleptic assessment and classification of virgin olive oil. It confines itself to grading the virgin oil on a numerical scale related to the perception of its flavour stimuli, according to the judgement of a group of selected tasters working as a panel.

3. GENERAL BASIC VOCABULARY FOR SENSORY ANALYSIS

Refer to the standard COI/T.20/Doc. no. 4 "Sensory Analysis: General Basic Vocabulary".

4. SPECIFIC VOCABULARY FOR OLIVE OIL

Almond. This flavour may appear in two forms: that typical of the fresh almond; or that peculiar to dried, sound almonds which can be confused with incipient rancidity. A distinctive taste is perceived as an aftertaste when the oil remains in contact with the tongue and the palate. Associated with sweet oils which have a flat odour.

Apple. Flavour of olive oil which is reminiscent of this fruit.

Bitter. Characteristic taste of oils obtained from green olives or olives turning colour. It can be more or less pleasant depending on its intensity.

Brine. Flavour of oil extracted from olives which have been preserved in saline solutions.

Cucumber. Flavour produced when an oil is hermetically packed for too long, particularly in tin containers, and which is attributed to the formation of 2.6 nonadienal.

Earthy. Characteristic flavour of oil obtained from olives which have been collected with earth or mud on them and not washed. This flavour may sometimes be accompanied by a musty-humid flavour.

Esparto. Characteristic flavour of oil obtained from olives pressed in new esparto mats. The flavour may differ depending on whether the mats are made of green esparto or dried esparto.

Flat or Smooth. Flavour of olive oil whose organoleptic characteristics are very weak owing to the loss of their aromatic components.

Fruity. Flavour which is reminiscent of both the odour and taste of sound, fresh fruit picked at its optimum stage of ripeness.

Fusty. Characteristic flavour of oil obtained from olives stored in piles which have undergone an advanced stage of fermentation.

Grass. Characteristic flavour of certain oils reminiscent of recently-mown grass.

Greasey. Odour of olive oil extracted in a plant where residues of petroleum, grease or mineral oil have not been properly removed from the machinery.

Green leaves (bitter). Flavour of oil obtained from excessively green olives or olives that have been crushed with leaves and twigs.

Grubby. Characteristic flavour of oil obtained from olives which have been heavily attacked by the grubs of the olive fly (Dacus oleae).

Harsh. Characteristic sensation of certain oils which, when tasted, produce a mouthfeel reaction of astringency.

Hay. Characteristic flavour of certain oils reminiscent of more or less dried grass.

Heated or Burnt. Characteristic flavour of oils caused by excessive and/or prolonged heating during processing, particularly when the paste is thermally mixed, if this is done under unsuitable conditions.

Metallic. Flavour that is reminiscent of metal. Characteristic of oils which have been in prolonged contact, under unsuitable conditions, with foodstuffs or metallic surfaces during crushing, mixing, pressing or storage.

Muddy sediment. Characteristic flavour of oil recovered from the decanted sediment in vats and underground tanks.

Mustiness-Humidity. Characteristic flavour of oils obtained from fruit in which large numbers of fungi and yeasts have developed, as a result of its being stored in piles, in humid conditions, for several days.

Old. Characteristic flavour of oil that has been kept too long in storage containers. May also appear in oils which have been packed for an excessively long period.

Pomace. Characteristic flavour that is reminiscent of the flavour of olive pomace.

Pressing mat. Characteristic flavour of oil obtained from olives that have been pressed in dirty pressing mats in which fermented residues have been left.

Rancid. Characteristic flavour common to all oils and fats that have undergone a process of auto-oxidation caused by prolonged contact with the air. This flavour is unpleasant and cannot be corrected.

Ripely fruity. Flavour of olive oil obtained from ripe fruit, generally having a somewhat flat odour and a sweet taste.

Rough. Characteristic perception in certain oils which, when tasted, produce a thick, pasty mouthfeel sensation.

Soapy. Flavour producing an olfactory-gustatory sensation reminiscent of that produced by green soap.

Sweet. Pleasant taste, not exactly sugary, but found in oil in which the bitter, astringent and pungent attributes do not predominate.

Vegetable water. Characteristic flavour acquired by the oil as a result of poor decantation and prolonged contact with vegetable water.

Winey-Vinegary. Characteristic flavour of certain oils reminiscent of wine or vinegar. Due mainly to the formation of acetic acid, ethyl acetate and ethanol in larger amounts than is usual in the aroma of olive oil.

5. GLASS FOR OIL TASTING

Refer to the standard COI/T.20/Doc. no. 5, "Glass for Oil Tasting".

6. **TEST ROOM**

Refer to the standard COI/T.20/Doc. no. 6, "Guide for the Installation of a Test Room".

7. **APPARATUS**

The following apparatus, which is required by the taster to perform his task properly, shall be supplied in each booth and shall be within easy reach:

- Glasses (standardised) containing the samples marked with a legend consisting of two randomly-picked figures or of two figures and letters. The marks shall be made with an indelible, odourless pencil.

- Watch-glasses with identical marks, to cover the glasses.

- Rating sheet (see fig. 2) containing the instructions for its use.

- Pencil or pen.

- Small trays of sliced apple.

- Glass of water at ambient temperature.

8. **METHODOLOGY**

This section stipulates the prior knowledge required to perform the sensory analysis of virgin olive oils and attempts to standardise the conduct and procedure of the tasters participating in such tests who must be aware of both the general and specific recommendations for olive oil tasting.

8.1. Duties of the Panel Organiser or Supervisor (or Panel)

The panel organiser shall be a suitably trained, knowledgeable person who is an expert on the kinds of oils which he will come across in the course of his work. He is the key figure in the panel and is responsible for its organisation and running. He shall summon the tasters sufficiently in advance and shall clarify any doubts they may have as regards the performance of the tests, but shall refrain from suggesting any opinion to them on the sample.

He shall be responsible for inventorying the apparatus, and for ensuring that it is properly cleaned, for preparing and coding the samples, and presenting them to the tasters in accordance with the appropriate experimental design, as well as for assembling and statistically processing the data obtained, so that the best results are obtained with the minimum of effort.

The work of the panel supervisor calls for sensory skill, meticulousness in the preparation of the tests and their rigorous arrangement, as well as for skill and patience in the planning and execution of the tests. It is the duty of the panel supervisor to stimulate the morale of the panel members by encouraging interest, curiosity and a competitive spirit among them. He shall ensure that his opinion is not known and shall prevent possible leaders from asserting their criteria over the other tasters. He shall also be responsible for training, selecting and monitoring the tasters in order to ascertain whether they are keeping up to an adequate level of aptitude.

8.2. Test Conditions

8.2.1. Sample Size

Each glass shall contain 15 ml of oil.

8.2.2. Test Temperature

The oil samples to be tested shall be kept in the glasses at 28°C ± 2°C. This temperature has been chosen because it is the best for easily observing organoleptic differences, at normal temperature, when oils are used as a condiment. Another factor that tends to weigh in favour of this value is that at higher or lower temperatures either the aromatic components scarcely volatilise or volatile components are produced that are peculiar to heated oils.

8.2.3. Test Times

The morning is the best time for testing oils. It has been proved that there are optimum perception periods as regards taste and smell during the day.

Meals are preceded by a period in which olfactory-gustatory sensitivity increases, whereas afterwards this perception decreases.

However, this criterion should not be taken to the extreme where hunger may distract the tasters, thus decreasing their discriminatory capacity and, in particular, their preference and acceptance criteria.

9. TASTERS

The people acting as tasters in the organoleptic tests carried out on edible olive oils shall be trained and selected in accordance with their skills in distinguishing between similar samples; it should be borne in mind that their accuracy will improve with training (see appropriate section).

8-12 tasters are required for the test, although it is wise to keep some extra tasters in reserve to cover possible absences.

9.1. General Recommendations for Candidates and Tasters

These recommendations apply to the conduct of the candidates and tasters during their work.

When called by the panel supervisor to participate in an organoleptic test, the taster should be able to attend at the time set beforehand and shall observe the following:

9.1.1. He shall not smoke at least 30 minutes before the time set for the test.

9.1.2. He shall not use any perfume, cosmetic or soap whose smell could linger until the time of the test. He shall use an unperfumed or slightly perfumed soap to wash his hands which he shall then rinse and dry as often as necessary to eliminate any smell.

9.1.3. He shall fast at least one hour before the tasting is carried out.

9.1.4. Should he feel physically unwell, and in particular if his sense of smell or taste is affected, or if he is under any psychological effect that prevents him from concentrating on his work, the taster shall inform the panel supervisor accordingly with a view to being withdrawn from the test or to the appropriate decisions being taken, bearing in mind the possible deviation in the mean values for the rest of the panel.

9.1.5. When he has complied with the above, the taster shall take up his place in the booth allotted to him in as orderly and quiet a manner as possible.

9.1.6. When seated, he shall check that he has the correct apparatus and that it is properly arranged, and shall ensure that the legend on the glass matches the legend on the watch-glass.

9.1.7. He shall carefully read the instructions given on the rating sheet and shall not begin to examine the sample until absolutely sure about the task he has to perform. If any doubts should arise, he shall discuss the difficulties encountered privately with the panel supervisor.

9.1.8. The taster shall pick up the glass, keeping it covered with the watch-glass, and shall bend it gently; he shall then rotate the glass fully in this position so as to wet the inside as much as possible. Once this stage is completed, he shall remove the watch-glass and smell the sample, taking even slow deep breaths until he has formed a criterion on the oil under assessment. Smelling shall not exceed 30 s. If no conclusion has been reached during this time, he shall take a short rest before trying again. When the olfactory test has been performed, the taster shall then judge the flavour (overall olfactory-gustatory-tactile sensation). To do so, he shall take a small sip of approximately 3 ml of oil. It is very important to distribute the oil throughout the whole of the mouth cavity, from the front part of the mouth and tongue along the sides to the back part and to the palate support, since it is a known fact that the perception of the four primary tastes, sweet, salty, acid and bitter varies in intensity depending on the area of the tongue and palate.

It should be stressed that it is essential for a sufficient amount of the oil to be spread very slowly over the back of the tongue towards the throat while the taster concentrates on the order in which the bitter and pungent stimuli appear; if this is not done, both of these stimuli may escape notice in some oils or else the bitter stimulus may be obscured by the pungent stimulus.

Taking short, successive breaths, drawing in air through the mouth, enables the taster not only to spread the sample extensively over the whole of the mouth but also to perceive the volatile aromatic components via the back of the nose.

Tactile sensation shall also be taken into consideration. Consequently, fluidity, stickiness and sharpness or sting shall be noted down when detected, and if so required for the test, their intensity shall be quantified.

9.1.9. When organoleptically assessing a virgin oil, ONLY ONE SAMPLE shall be evaluated in each session to avoid the contrast effect that could be produced by immediately tasting other samples.

As successive tastings produce fatigue or loss of sensitivity, it is important to use a product that can eliminate the remains of the oil from the preceding tasting from the mouth.

The use of a small slice of apple (about 15 g) is recommended which, after being chewed, can be spat out into the spittoon. Then rinse out the mouth with a little water at ambient temperature. At least 15 minutes shall lapse between the end of one tasting and the start of the next.

9.2. Screening of Candidates

This stage shall be completed by the panel organiser who shall personally interview the candidates to familiarise himself with their personality and surrounding environment. The physio-psychological conditions that have to be met are not very rigorous since, theoretically, any normal person should be able to participate. Factors such as sex, age, specific habits (smoking), etc. have been superseded nowadays by others such as health, personal interest and having time available for the work.

During the interview, the panel organiser shall explain the characteristics of his task to the candidate and approximately how much time it will take up. He shall then glean information from the candidate allowing him to assess his interest and motivation and how much real time he has available. The following questionnaire could help as a reference.

QUESTIONNAIRE

Please answer the following questions:

		YES	NO
1.	Would you like to be involved in the work on this topic?	☐	☐
2.	Do you think this work could contribute to the quality improvement of foodstuffs on the domestic and international fronts?	☐	☐

3.   If so, why? 1/ ....
     ....
     ....

4.   You should be aware of the fact
     that you will have to taste   YES   NO
     oils when called upon to do so.   ☐   ☐
     Would you be prepared to do this? .....

5.   Would you like to compare your   YES   NO
     olfactory-gustatory skill with   ☐   ☐
     that of your colleagues? ....

6.   Are you available time-wise?
     Are you independent enough   YES   NO
     to organise your daily work   ☐   ☐
     as you wish? ....

7.   If you are dependent upon a
     superior, do you think that
     if you had to absent yourself
     from your usual job for anything
     up to half an hour, on several
     occasions over a successive   YES   NO
     number of days, you would be   ☐   ☐
     allowed to do so? ....

8.   Would you be able to make up
     for any time lost in your job   YES   NO
     due to your participation in   ☐   ☐
     the sensory analyses? ....

9.   Do you think you should be   YES   NO
     remunerated for this work? .... ☐   ☐

10. In what way? ....

     The organiser shall use this information to screen the
candidates and shall reject those who show little interest in
this kind of work, are not readily available or who are incapable
of expressing themselves clearly.

_____

1/   Describe what could be gained from the organoleptic
     assessment of any foodstuff, or, if you wish, of olive oil.

9.3. Determination of the "Mean Threshold" of the Group for "Characteristic Attributes"

Carefully choose four oils, each one of which is considered representative of one of the following attributes: fusty, winey, rancid and bitter, and has as great and clear an intensity as possible.

Take an aliquot part of each oil and prepare samples, each of whose concentrations differs by a ratio of 2, comprising successive dilutions with the appropriate support until no difference can be detected between the glass containing the support only and the last two or three dilutions. The last pair shall be two glasses of the support.

Complete the series with glasses containing higher concentrations, until a total of 8 is reached.

Prepare sufficient amounts of the samples prepared at different concentrations so that complete series of each attribute can be given to each candidate.

To establish the "mean threshold" of the candidates for each attribute, give each of them one glass containing 15 ml of any one of the prepared concentrations, and another glass containing 15 ml of the support solely. After performing the test, the candidate shall indicate whether they are the same or different.

Repeat the same test for the remaining concentrations of the attribute under consideration.

Note down the number of correct answers obtained for each concentration by all the tasters and give this figure as a percentage of the number of tests performed.

Then plot as abscissae, in ascending order, the concentrations tested and as ordinates the % of correct identifications for each concentration.

Figure 1 is a practical example of these instructions. The detection threshold is determined by extrapolating the ordinate point representing 75% correct appraisals from the curve onto the abscissae.

This "threshold concentration", which may be different for each initial oil because it depends on the intensity of the attribute present, should be similar for the different groups of candidates to various panels; it is not linked to any habit or tendentious preference. Consequently, it is a point of reference common to any normal human group and may be used to homogenise the various panels by their olfactory-gustatory sensitivity alone.

On the basis of the threshold concentration obtained for the group, proceed as follows:

Prepare a series of increasing and decreasing concentrations in such a way that the "threshold concentration" holds the 10th place in this scale. Naturally, the 11th and 12th concentrations will be more diluted, as a result of which it will be more difficult to detect the presence of the oil possessing the selected attribute.

Taking the C_{10} concentration as the basis, remaining samples can be prepared in accordance with the following formula:

$C_{10} \times a^n$, where "a" is a constant, the dilution factor, which is equal to 1.5, and "n" is the exponent which varies between 9 and -2.

Example: assuming that the threshold obtained for rancid oil is 0.32; C_{10} = 0.32, on the basis of which, since "a" = 1.5, the series of samples would have the following concentrations:

Sample	1	2	3	4	5	6	7	8	9	10	11	12
Conc.	12.30	8.20	5.47	3.65	2.43	1.62	1.08	0.72	0.48	0.32	0.21	0.14

If the above procedure is repeated for the three remaining attributes on the basis of their respective thresholds which are also calculated as indicated above, scales with similar aromatic intensities for each stimulus will be obtained for all the laboratories, even though the defects of the initial oils may be perceptible at different intensities.

9.4. Selection of Tasters by the Intensity Rating Method

In the selection procedure, there should be two to three times more candidates than those required for the panel so that the people with the best sensitivity or powers of discrimination can be picked out. It is always advisable to use the same product as the one that is to be subsequently analysed (consequently, olive oil will always be used).
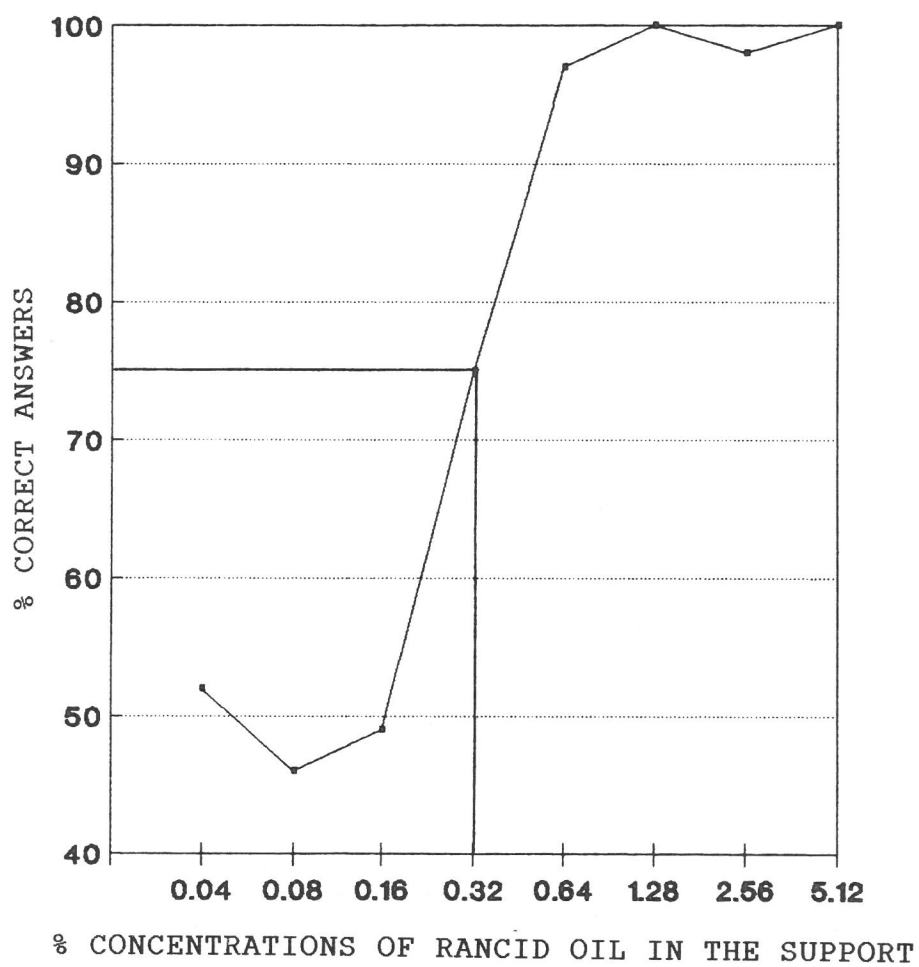
Fig. 1

When selecting the method, it should not be overlooked that, apart from being effective, the procedure adopted should be as economical as possible as regards the quantity of oil, the number of samples to be sent and the time spent on selection. The effectiveness of a selection procedure lies in the choice of the optimum levels of the following three dependent variables: a) "cost" determined by the number of tests, b) "proportion" of potentially suitable candidates who by chance have been unfortunately eliminated during screening and c) "proportion" of candidates who by chance have got through the selection process although unsuitable material.

Four points of the selection procedure chosen, the intensity rating test, which is described in the A.S.T.M.*, S.T.P.* no. 440, page 53, have been modified by: 1) decreasing the number of samples in the series, 2) broadening the range of stimuli with a view to increasing the number of olfactory-gustatory notes on which selection is based, so as to adapt them to the most common defects perceived in olive oil, 3) varying the concentration ratios in the series and 4) statistically processing the results.

Apparatus Required

- 1,500 ml bottles or glass flasks.

- Dark-coloured tasting glasses.

- Graduated 10, 15, 1,000 and 1,500 ml test tubes.

Products Required

- Merck paraffin (reference 7.160, DAB 8, USP XX) or oily support without taste or odour (recently refined olive oil or another similar oil).

- Oils: fusty, winey, rancid and bitter.

9.4.1. Procedure

After preparing the dilutions, go on to the selection stage beginning with 25 candidates, in accordance with the methodology described hereafter for each stimulus:

1) Prepare series of 12 tasting glasses marked with a code (one series per candidate). Pour 15 ml of each of the various concentrations prepared according to the formula $C_{10} \times a^n$, into each respective tasting glass.

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*   American Society for Testing and Materials (A.S.T.M.),
        Special Technical Publication (S.T.P.).

2) When the tasting glasses have been filled up, they should be left covered with a watch-glass in the tasting room at a temperature of 20-22°C for at least an hour before starting the tests so as to homogenise their temperature with the ambient temperature.

3) The organiser shall then arrange the 12 tasting glasses of each series in a row in descending order of concentration.

The next step is to ask each candidate to perform the test on his own, in accordance with the following instructions:

9.4.2. Instructions for Candidates

The 12 tasting glasses lined up in front of the candidates contain dilutions of any one of the fusty, winey, rancid or bitter stimuli. The distinguishing factor between the contents of the tasting glasses is the intensity of the odour. The glass with the most intense odour is on the far left-hand side and the rest of the glasses are placed in descending order of intensity towards the right. The last tasting glass on the right may have such a weak odour that it will perhaps be impossible to detect.

Proceed as follows: Become familiar with the odour of each of the tasting glasses in the series. To do so, begin at the right-hand side (no. 12) and try to retain the intensity of all the odours, without becoming overtired.

When you feel that you have got used to the scale of concentrations of the odours, leave the room.

Meanwhile, the organiser shall remove one of the tasting glasses from the series and shall place it on a level with the last one on the right-hand side, moving all the others together so as to fill in the space left. Then return to the room and carry on with the test.

The test involves the following:

The tasting glass withdrawn from the series has to be put back in its exact place. To do so, smell it and compare it with the others as often as wished, bearing in mind that if it is to be replaced correctly it must smell stronger than the sample on its immediate right and weaker than that on its left. This test will be repeated with three other glasses.

Each candidate shall be issued a form, in addition to the instructions just described, so as to make the test and the collection of the replies easier.

SELECTION OF CANDIDATES

Test no. .... Attribute ....

The glass taken out belongs to position no. ....

Date .... Name ....

9.4.3. Obtaining the Results

The panel organiser shall record the data for each of the candidates in the following manner to facilitate their arrangement:

Name of Candidate	Attribute studied	No. of order given (K')	Exact no. of order (K)	Grading $(K'- K)^2$
....	....	....	....	....
....	....	....	....	....

9.4.4. Statistical Grading Procedure

In this particular selection case, the tasting glasses that have to be replaced in their exact position shall be the same for all the candidates. According to the statistical calculations done for this purpose, they shall correspond to the following positions in the order of the series as regards each attribute:

Fusty (Fy)	Winey (W)	Rancid (Rd)	Bitter (Bt)
Glass no.	Glass no.	Glass no.	Glass no.
(10, 5, 7, 2)	(11, 3, 8, 6)	(7, 4, 10, 2)	(6, 3, 11, 9)

The number corresponding to the position of the glasses in the order of the series may not vary since the statistical calculations for this test have been done with an eye to the probability of the glasses being randomly put back into their exact position.

In order to make it extremely difficult for any information to be passed on from one candidate to another, the panel organiser shall ensure that:

1) THERE IS NO POSSIBLE MEANS OF CONTACT BETWEEN THE CANDIDATES. DIFFERENT LEGENDS SHALL BE USED FOR EACH CANDIDATE.

2) THERE IS NO WAY IN WHICH THE CANDIDATES CAN FIND OUT THE POSITION OF THE GLASSES WHICH HAVE BEEN WITHDRAWN.

3) EVEN THOUGH ALL THE CANDIDATES SHALL BE PRESENTED WITH THE SAME GLASSES INDICATED EARLIER ON, THE ORDER IN WHICH THEY ARE HANDED OVER TO EACH CANDIDATE SHALL VARY.

Each candidate shall then be given a grading, depending on his performance in the following manner:

Let e^i_1, e^i_2, ...e^i_{12}, be the 12 glasses with the 12 corresponding concentrations of attribute "i" (i may be any one of the 4 attributes: fusty, winey, rancid and bitter) arranged in descending order of intensity.

Let e^i_k be one of the glasses picked and K' the position it is allocated by the candidate when replaced in the series. Therefore, the values of K and K' are whole numbers between 1 and 12 inclusive, corresponding to the real place number of the glass chosen and that allocated by the candidate respectively.

Let T (maximum permitted deviation) be a value set beforehand, which in our case is equal to 3, so that if $|K'- K| > T$, the candidate is automatically rejected [1].

If, on the contrary, $|K'- K| \leq T$, theoretically the candidate is accepted and may go on with the test since he or she is able to put the stimulus back into its exact position or at least very near it.

In this case, the grading awarded a candidate who has assessed a set stimulus (concentration), for instance in the fusty series (Fy), shall be equal to the square of the difference between the exact number of the glass in the order of the series and the position in which the candidate has replaced it. That is to say

$$P_h(Fy) = (K' - K)^2$$

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[1] The panel organiser should press the candidate to proceed reasonably, that is to say without losing any sensitivity through olfactory fatigue.

Since this operation will be conducted by each candidate on four stimuli (concentrations), of each attribute, the partial grading for the attribute (e.g. Fy) would be:

$$Z^{Fy} = P^{Fy}_h + P^{Fy}_j + P^{Fy}_l + P^{Fy}_m$$

Some examples are given below to facilitate comprehension of this operation.

Example 1: Let us assume that the answers given by candidate A for the four stimuli withdrawn from the series for attribute (i) are as follows:

Exact position of the glass in the series (K)	Position in which it was replaced by the candidate (K')	Deviation from the exact position (K' - K)
7	7	7 - 7 = 0
4	5	4 - 5 = -1
10	6	10 - 6 = 4 (*)
2	4	2 - 4 = -2

(*) This candidate is rejected because he has obtained T>3 in the test.

Example 2: Let us assume that a candidate rearranges the glasses for an attribute as follows:

Exact position of the glass in the series (K)	Position in which it was replaced by the candidate (K')	Deviation from the exact position (K' - K)
7	7	7 - 7 = 0
4	4	4 - 4 = 0
10	7	10 - 7 = 3
2	3	2 - 3 = -1

This candidate is not rejected. He has obtained a grading of:

$$Z^i = 0^2 + 0^2 + 3^2 + (-1)^2 = 10$$

The candidate's final grading, sealing his acceptance or rejection for selection as a taster, depending on his responses to the four attributes under consideration, would be as follows:

$$p^{Fy}_h + p^{Fy}_j + p^{Fy}_l + p^{Fy}_m = Z^{Fy}$$

$$p^{W}_h + p^{W}_j + p^{W}_l + p^{W}_m = Z^{W}$$

$$p^{Rd}_h + p^{Rd}_j + p^{Rd}_l + p^{Rd}_m = Z^{Rd}$$

$$p^{Bt}_h + p^{Bt}_j + p^{Bt}_l + p^{Bt}_m = Z^{Bt}$$

$$\text{Final } Z = Z^{Fy} \dots Z^{Bt}$$

Where: Fy = Fusty
      W = Winey
      Rd = Rancid
      Bt = Bitter

It is now a question of determining up to what maximum value for Z the candidate can be considered to have good levels of perception, olfactory retention and intellectual organisation to give the correct answer for the four stimuli considered. Obviously, Z always has a non negative value and Z = 0 means that the candidate has recognised and correctly quantified the whole of the 16 intensities presented (four for each attribute). Values of Z other than zero indicate that the candidate has recognised the scale areas from which the selected intensities have been picked, but within these areas he has been unable to locate the exact position because his ability to discriminate the scale of intensity presented to him for one or more of the stimuli is not satisfactory.

Therefore, a critical value (Z_c) will have to be determined such that should the candidate randomly replace all the glasses inside the areas he had recognised beforehand, the probability of a final grading Z, less than Z_c, is a sufficiently small quantity α which can be set beforehand. In other words, it must be ensured that the probability, using this procedure, of selecting a taster for the panel who does not show sufficient discriminatory power for the intensities of the stimuli used in the selection process is less than α.

When the value for α is set (in our case at 0.05), Z_c is obtained from the probability distribution of the variable Z, which in turn depends on the probability distributions of the P variable (K').

Following the relevant statistical calculation, the value for Z_c comes to 34.

When the Z grading for all the candidates has been obtained, any candidates whose grading lies above 34 shall be eliminated.

See the gradings for candidates A and B for an example:

Attribute	Candidate A	Candidate B
Fusty (Fy)	$Z^{Fy} = 10$	$Z^{Fy} = 12$
Winey (W)	$Z^{W} = 10$	$Z^{W} = 11$
Rancid (Rd)	$Z^{Rd} = 10$	$Z^{Rd} = 15$
Bitter (Bt)	$Z^{Bt} = 4$	$Z^{Bt} = 0$
	$\Sigma = 34$	$\Sigma = 38$

Given that the two candidates considered have respective Z values of 34 and 38, candidate A will be retained whereas candidate B will be rejected. When all the candidates with a grading above 34 have been eliminated, the remainder shall be classified according to their Z values until the twelve best candidates have been chosen.

9.5. Training

The chief aims of the training stage are:

a) to familiarise the tasters with the multiple olfactory-gustatory-tactile variants found in virgin olive oils;

b) to familiarise the tasters with the specific sensory methodology;

c) to heighten individual skill in recognising, identifying and quantifying the sensory attributes; and

d) to improve sensitivity and memory as regards the various attributes considered, so that the end result is precise and consistent assessments.

The training stage normally entails a number of sessions, depending on the possibilities open to the panel and the study, during which, after individually analysing the oils, the tasters discuss the difficulties they have encountered with the panel organiser and comment on the marks given so as to unify criteria and opinions.

The document COI/IGS/Doc. no. 8/Corr. 2 should be consulted to ensure that when the tasters are being trained, uniformity is achieved in the concepts used and in the intensity of the positive and negative attributes perceived in virgin olive oils, and that homogeneous grading criteria are applied.

The standard reached in training after a set number of sessions is assesssed in terms of the percentage increase in the exact replies - should discriminatory trials be used - or by analysing the variance in the average individual marks of the panel when tests using a scale are implemented.

The practical utility of this training period has been discussed at great length but at present it is considered very effective and even essential if exact, accurate sensory data are to be obtained.

9.6. Performance Checks

Panels of veteran tasters normally carry out tastings on a regular and continuous basis, involving sensory tests which require a great effort on their part. Decisions of great technological and commercial importance depend in a large majority of cases on their judgement. For this reason, after their selection and training, the tasters' performance should be checked to ensure that their results are precise.

After the panels have been set up and have gone through the routine trials, it would obviously be necessary to regularly check their performance at suitable intervals.

10. **PROCEDURE FOR THE ORGANOLEPTIC ASSESSMENT OF VIRGIN OLIVE OIL**

When the conditions indicated in the above standards are met, the necessary facilities are available, and the panel has been selected, each taster shall smell and taste 1/ the sample of oil up for analysis contained in the tasting glass. He shall analyse the olfactory, gustatory, tactile and kinaesthetic perceptions with the aid of the sheet shown under figure 2 in which he shall record the "notes" present and their degree of intensity. His next step shall be to grade the quality of the oil.

1/ He may refrain when he finds any extremely or intensely unpleasant attribute in the odour, recording this on the rating sheet as an exceptional occurrence.

10.1. Use of the Sheet in Figure 2 (Flavour Description
       and Quality Rating)

     Some of the most characteristic sensory perceptions more
frequently found in olive oils which describe their flavour are
listed on the left-hand side of the page. Should the taster
encounter any other stimuli that do not correspond to the
descriptors listed, he shall note them down under "others", using
the descriptor (s) which define them as accurately as possible.

     Stimuli shall be assessed in proportion to their intensity
which shall be indicated by a cross (x) in the appropriate box,
in accordance with the following criterion:

       0   =   none whatsoever
       1   =   barely perceptible
       2   =   slight
       3   =   average
       4   =   great
       5   =   extreme

     On the right-hand side of the sheet, a scale from 1 to 9
points is shown (9 for exceptional quality, 1 for the worst)
which the tasters shall use to give a single, overall rating for
the characteristics of the oil being examined. This rating
shall be consistent with the good points and defects of the oil
already noted down on the left-hand side of the sheet.

     The first column (defects) of the rating table is divided
up into five sections. Consequently, the classification of the
oils shall be based primarily on the total absence or presence of
defective flavours, as well as on how serious or intense such
flavours are. However, since the rating scale goes up to 9
points, certain nuances or aspects should be taken into account
that help reach a conclusive decision on the total quality
rating and that are described in the second column headed
"characteristics".

10.2. Final Rating

     The panel supervisor shall collect all the ratings
awarded by each taster and shall check that the attributes and
intensities with which such attributes were perceived and
recorded in the profile sheet agree satisfactorily with the
assessment of the oil entered in the rating table. Should there
be a noticeable difference, the panel supervisor shall ask the
taster to revise his rating and, if necessary, to repeat the
test.

The panel supervisor shall next tabulate all the ratings awarded by the panel and shall calculate the resultant arithmetic mean and the standard error (of the mean). If the standard error is higher than the error of the method, he must make the entire panel repeat the test. In the case of a repeat analysis, the panel shall have to repeat the test until three assessments are obtained per sample. The "final" rating for the sample shall be the mean of the three ratings awarded, to one decimal point.

If the mean intensity rating for bitterness and/or pungency is greater than 2.5, the oil should be marked accordingly, and it should be recorded that it is bitter and/or pungent.

Where analyses are carried out to check compliance with the standard, the panel supervisor shall state on the sample analysis certificate the category in which the sample is classified in terms of the rating it is awarded and of the organoleptic assessment limits adopted by the IOOC for each designation of virgin olive oil, as fixed in the international trade standard applying to olive oils and olive-pomace oils.

NOTE: The samples should be kept sealed in the refrigerator until they are analysed and should be returned to the refrigerator after each analysis until the test has been done in triplicate.

VIRGIN OLIVE OIL

PROFILE SHEET

RATING TABLE

OLFACTORY-GUSTATORY-TACTILE NOTES

Attributes	Intensity of Perception*					
	0	1	2	3	4	5
Olive fruity (green or ripe) 1/						
Apple						
Other ripe fruit						
Green (leaves, grass)						
Bitter						
Pungent						
Sweet						
Other allowable attribute (s)						
(Specify)						
Sour/Winey/Vinegary/Acid 1/						
Rough						
Metallic						
Mustiness/humidity						
Muddy sediment						
Fusty						
Rancid						
Other unallowable attribute(s)						
(Specify)						

1/ Delete where not applicable
* Intensity of Perception:
0 None whatsoever **
1 Barely perceptible
2 Slight
3 Average
4 Great
5 Extreme
** When the sensory attribute is not perceived, this must be indicated by a cross in the 0 box.

DEFECTS	CHARACTERISTICS	OVERALL MARK: POINTS
None	Olive fruity	9
	Olive fruity and fruitiness of other fresh fruit	8
		7
Slight and barely perceptible	Weak fruitiness of any type	6
Perceptible	Rather imperfect fruitiness, anomalous odours and tastes	5
Considerable, on the border of accepta-bility	Clearly imperfect, unpleasant odours and tastes	4
Great and/or serious, clearly perceptible	Totally inadmissible odours and tastes for consumption	3
		2
		1

REMARKS ....

....

NAME OF TASTER ....

LEGEND OF SAMPLE ....

DATE ....

Results of the Ring-Test Conducted in 1986

(Report COI/IGS/Doc. no.10 - July 1986)

Collaborative tests run in 1986 to test the method: 9 panels from 6 countries tested 12 samples of virgin olive oils.

Statistical analysis of the results that the various panels obtained for each sample gave the following margins of error:

Repeatability	± 0.36
Reproducibility	± 0.52
Confidence limits	± 1.0