



Review document on sensory analysis of wine

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Warning

This document has not been submitted to the step Procedure for Examining Resolutions and cannot in any way be treated as an OIV resolution. Only resolutions adopted by the Member States of the OIV have an official statute.

This document represents the consensus reached by the members of the group of experts Sub commission Methods of Analysis of the OIV. This document, drafted and developed on the initiative of the OIV, is a collective experts' report.

Considering that musts, wines and other beverages of vitivincultural origin can be sensory evaluated for other goals different from the sensory analysis, and, for example, wine competitions are excluded from the scope of this resolution

This document gather three parts concerning:

- **PART I- GENERAL CONDITIONS FOR PERFORMING SENSORY ANALYSIS TESTS**
- **PART II- PROPOSALS FOR ACCREDITATION FOR THE SENSORY ANALYSIS OF WINE**
- **PART III – SELECTION AND TRAINING OF A TASTING PANEL FOR EVALUATION OF A VISUAL, OLFACTIVE AND/OR TASTE ALTERATION IN WINE CHARACTER**

This proposal is not a reference document, but can be used in different ways to select and train a panel of tasters. The specific vocabulary can be adapted, especially depending on the type of wine (dry wine, fortified wine, ...), the colour of the wine (red, white, rosé) and any known characteristics of the wine.

PART I- GENERAL CONDITIONS FOR PERFORMING SENSORY ANALYSIS TESTS

1. Subject

This proposal suggests the general conditions for performing sensory analysis tests.

2. Scope

Musts, wines and other beverages of vitivinicultural origin.

This proposal does not create any obligation; it consists of some elements that can be freely used by each Member States according to their needs and purposes.

3. Tasting room, environmental conditions and equipment

3.1 Tasting room: The tasting room should be designed to conduct sensory analyses in known and controlled conditions as described in the ISO 8589 (1) standard.

Access must be controlled and floors easy to clean. The walls, ceiling and tasting booths must be light and neutral in colour.

There must be air-conditioning, humidity control and air exchange in the room. Temperature and humidity monitoring and the maintenance programme must be formalised; notes are made by the sensory analysis technician at the start of each tasting session.

There are standard dimensions for the booths and each is fitted with a light producing natural day light, a spittoon/sink and a frontal shelf allowing distribution of the wines to be tasted. They may also have an IT system used to automatically input the results.

IT equipment may be replaced by a tasting sheet and a pen

3.2 Sample preparation and storage facilities

These should be fitted with temperature-controlled rooms to store, preserve and temper the wines before sensory analysis (12 and 20 °C for example).

Evaluating temperature: in any event, it is essential that all same product types, in the same session, must be evaluated at the same temperature.

The organiser is free to choose the temperature range that he deems suitable for the best results. For example, some defects are more easily detected at a temperature higher than that recommended.

There may be a bench with a sink, scales and fume cupboard for the preparation of solutions or “test” wines needed for training and monitoring assessors, as well as cupboards for chemical products and the small equipment required for tapping, capping, reconditioning and labelling samples.

3.3 Tasting glasses

The tasting glasses must comply with the requirements of the ISO 3591 (2) standard. They are washed by hand or using a glass washer kept for this sole purpose along with an odourless detergent. They are rinsed with pure water (ultra-filtered and deionised).

The glasses are subject to an olfactory examination before use (by sampling).

These indications are recommended but they became mandatory in the case of accreditation.

However, specific glasses, such as “flutes” for example, may be used for sparkling wines.

3.4 Software

The use of an IT system with appropriate software is recommended in order to avoid human errors and provide faster results. This suggestion is more important when there are frequent sensory analyses.

Depending on the diversity and complexity of the sensory analyses, the laboratory may use a bespoke in-house software package or existing off-the-shelf solutions. The first option is recommended for taster groups who always perform the same type of analyses. The second is suggested for laboratories who conduct varied and standard sensory analyses.

4. Organisation of the sensory sessions

Sensory sessions should preferably take place in the morning. The samples must be presented to the panel blind, coded and with the least amount of information possible but with sufficient elements so that they can make a proper assessment of the beverage. **(SEE POINT 3.2)**

Sensory sheet: There may be a wide range of sensory sheets; each taster group should develop one that is best suited to its problem. Generally, for the evaluation of wines and spirituous beverages, three groups of sensory attributes should be assessed, namely the appearance, the odour and the flavour (=complex combination of the olfactory, gustatory and trigeminal sensations perceived during tasting). An overall verdict can also be provided.

5. Selection procedures for assessors

The panel is comprised of people recruited from members of the laboratory, body or external tasting specialists. Candidates who volunteer to become part of this panel are subject to a selection procedure, the selected candidates then form the panel of qualified assessors. They are subject to training, coaching and regular monitoring.

The panel leader is responsible for selecting, training and monitoring the assessors (in accordance with the standards ISO 8586-1 and/or 8586-2) (3, 4). He will also select the sensory tests to be conducted, the statistical calculation to be implemented and give guidance regarding the procedure for the sensory sessions.

In the case of accreditation: (see Part II "PROPOSAL FOR ACCREDITATION FOR THE SENSORY ANALYSIS OF WINE") the sensory analysis technical manager is the responsible and the assessors' individual performances are recorded. The frequency of training courses is decided by the technical manager in view of each assessor's performance and the sensory analysis requirements of the laboratory or body.

Among the selection criteria for assessors, it is very important to select the candidates in relation to the aim of the sensory test.

In some cases it is necessary to have "expert" interested in products of vitivincultural origin, and who can demonstrate experience in sensory evaluation activities.

In other cases this knowledge can often bias a panelist and cause him/her to record a result that they think should be present, rather than one they can actually perceive.

When selecting an assessor, his availability, motivation and ability to concentrate by shutting out external factors should be taken always into account.

Candidates must have basic theory training on the fundamental concepts related to tasting. If a candidate has unquestionable experience in sensory evaluation, he can be excused from the basic training.

After the initial theory training, different tests must be conducted so as to make the most appropriate selection possible. The final selection can only be made after the training and completion of the planned tasks. Candidates with the highest success rates will be assumed to be the most effective. The following items are suggested:

- a) Tests to detect inabilities
- b) Tests to determine sensory awareness
- c) participation in inter-laboratory tests

a) Tests to detect inabilities

Candidates should be in general good health.

Candidates should be tested to assess whether they are able to perform an accurate sensory analysis (ISO 3972 (5); ISO 5496 (6).

Colour vision can be checked using an ISHIHARA test (7) for example.

Research into the average threshold of each individual and group may be interesting at this level (ISO 13301(8)), particularly in terms of basic tastes and the most significant defects in wines and other beverages of vitivinicultural origin.

There are several types of test that can be used to establish these thresholds, such as the triangle test ISO 4120 (9) or duo-trio test ISO 10399 (10) or ranking ISO 8587 (11), for example.

b) Tests to determine sensory awareness

- **Tests to detect a stimulus**

In the detection of flavour stimuli, it is important to test the five basic tastes (sweet, sour, salty, umami and bitter) as well as the astringency. These tests can be performed on aqueous solutions of different substances representing these six tastes (table 1). During a triangle test ISO 4120 (9) or a duo-trio test ISO 10399 (10) one substance at a time is assessed in comparison to a sample of water or a neutral medium. The concentration of the tested product is based on the suprathreshold level (table 2). It is recommended that candidates get all of the answers correct.

As the aim of the sensory training is to improve people's sensibility and the sensibility of the assessors are different, the proposed concentrations of the solutions in all tables should be considered as an example.

Table 1 - Indicative concentrations of solutions used to detect a stimulus

Sucrose SWEET	10 g/L
Tartaric acid ACID	0.5 g/L
Sodium chloride SALTY	2 g/L
Quinine sulphate BITTER	6 mg/L
Monosodium L-glutamate UMAMI	0,6 g/L
Tannic acid ASTRINGENCY	1.0 g/L

Alternative concentrations (ISO 3972) Test solution for the identification of taste
 The recommended concentrations were detected and recognized by 50% of novice assessors.

Sucrose SWEET	5,76 g/L
Citric acid ACID	0.43 g/L
Sodium chloride SALTY	1,19 g/L
Caffeine BITTER	0,195 mg/L
Monosodium L-glutamate UMAMI	0,595 g/L
Iron (II)sulphate heptahydrate METALLIC	0,00475 g/L

- Tests to discriminate between intensity levels of a stimulus

For each stimulus , ranking ISO 8587 (11) can be applied to 4 samples with differing intensities for a considered criteria. These samples are presented randomly to the candidates who must rank them in increasing order of intensity.

The tests are conducted using stimuli for colour, odour, flavour (table 2). It is recommended that candidates get most or all of the answers correct.

Table 2 - Examples of solutions to be used for tests to discriminate between intensity levels of a stimulus:

Colour discrimination	
Indicative chromatic coordinates for red wines	Chromatic coordinates a: 30, 40, 50, 60 Chromatic coordinates L: 60, 50, 40, 30
Odour discrimination	
Acetic acid solution	(0.10g/L; 0.30g/L; 0.50g/L; 0,70g/L)
2,4,6 trichloroanisole (TCA) solution	(1 ng/L; 3 ng/L; 5 ng/L; 7 ng/L)
Ethyl acetate solution	(10 mg/L; 40 mg/L; 70 mg/L; 100 mg/L)
4 Ethylphenol solution	(0.05 mg/L; 0.15 mg/L; 0.30 mg/L; 0.45 mg/L)
Taste discrimination	
Sucrose solution	(2g/L; 6g/L; 10g/L; 14g/L)
Tartaric acid solution	(0.25g/L; 0.5g/L; 0.75g/L; 1g/L)
Sodium chloride solution	(0.5g/L; 2g/L; 3.5 g/L; 5 g/L)
Quinine sulphate solution	(0.5 mg/L; 2.5 mg/L; 4.5 mg/L; 6,5 mg/L)
Monosodium L-glutamate	(0.05 g/l; 0.3 g/L; 0.6 g/L; 0.9 g/L)
Astringency discrimination	
Tannic acid	(0.5 g/L, 0.75 g/L, 1g/L, 1.25 g/L)

Note: These tests are preferably conducted in tasteless water
 In alternative, following the concentrations indicated in ISO 3972 for taste and ISO 5496 for odours.
 The concentrations should be modified if the tests are conducted in wine.

c) Participation in inter-laboratory tests

Wherever possible, participation in inter-laboratory tests can provide precious information about the performance of assessors.

6. Training the assessors

Once the assessors have been selected and formed a panel, they should undergo training and continuous development. One of the objectives is to optimise the technical knowledge of experts by training them and developing their sensory potential.

Checking assessors' performance:

In accordance with the ISO 8586 1 and ISO 8586-2 standard (3-4), the assessor group's performances are assessed so as to verify that their evaluations are repeatable, reproducible and discriminatory.

For example, each assessor can be monitored as follows:

- Repeatability is monitored by the introduction of 3 identical samples within a series of at least 6 samples (intrasession measurement)
- Reproducibility is verified from the results obtained on the same "test" wine over several sensory sessions (intrasession measurement)
- Discriminatory power is checked for example by performing 3 different triangle tests on control wines and wines with defects during a sensory session (intrasession measurement). Candidates passing at least 2 out of 3 tests are considered to have a satisfactory discriminatory power.

All of these observations must be subject to an annual report on checking assessors.

Monitoring assessors' performance:

In each test series, a "Test" wine is anonymously placed in the series of wines to be tasted. If an assessor fails to respond correctly to this "test" wine, the other results he has provided during the same session are discounted., the assessor has to be demonstrably informed about the error in performance

If an assessor fails to respond correctly to 3 consecutive "test" tests, he must be subject to a new training course followed by a check.

There are various different tests that can be performed to provide training in beverages (defects for example), solutions or odour stimuli which help to consolidate assessors' olfactory memory. For example, the following items are suggested:

- a) Description of the odour
- b) Identification of defects in wine using solutions
- c) Identification of the most common defects in wine
- d) Sensory evaluation of different types of tannins

a) Odour description tests

The odour stimuli are presented to the candidates. These are preferably chosen in relation to the product(s) that will subsequently be assessed.

Between 5 and 10 odour stimuli are given to the candidates. The selected odours should be connected or normally appearing in wines or other beverages: raspberry, strawberry, cherry, vanilla, hazelnut, caramel, honey, lemon, etc. (12). After the sessions, the results should be discussed with the candidates who should review the odours that they found most difficult to identify.

b) Identification of defects in wine using solutions

The standards solutions to be used and the molecules used are described in the third part of the document: **SELECTION AND TRAINING OF A TASTING PANEL FOR EVALUATION OF A VISUAL, OLFACTIVE AND/OR TASTE ALTERATION IN WINE CHARACTER**

c) Identification of the most common defects in wine

Select at least five wines presenting distinct defects. For this training session, the use of black glasses is recommended. The defects to be identified must not be indicated to the assessors. The results are discussed with the panel at the end of the session. If some assessors do not correctly identify the defects, repeat the test, the following day if possible, or as soon as possible. The most common alterations in wines that should be tested are described in the third part of the document: **SELECTION AND TRAINING OF A TASTING PANEL FOR EVALUATION OF A VISUAL, OLFACTIVE AND/OR TASTE ALTERATION IN WINE CHARACTER**

d) Sensory evaluation of different types of tannins

It is important that the assessors undergo training on aspects related to alcohol content and astringency. It is possible to observe differences in alcohol content and astringency between the grape and wood tannins that are found in wines. Consequently, tests of solutions prepared with different types of tannins (grapes and wood) are proposed. For this, it is recommended that solutions of the same concentration (for example 0.1 g/L) are prepared for anthocyanidic tannins (grape), gallic tannins and ellagic tannins (from oak).

PART II- PROPOSALS FOR ACCREDITATION FOR THE SENSORY ANALYSIS OF WINES

1 - Preamble

This proposal is aimed at laboratories or bodies working in the field of wine who already have a quality management system (quality policy statement, quality manual, quality manager, controlled documentation and non-compliance tests, management reviews and internal audits) and who wish to incorporate a sensory analysis process into their quality system.

2 - Introduction

Authorised accreditation bodies only accredit objective sensory tests which are properly documented and validated.

A sensory analysis laboratory for wines must show that it is supervised and that within set limits it obtains the same result. As far as possible, it should also demonstrate that its results are the same as those obtained by other laboratories or bodies.

This proposal is inspired by works conducted in the field of olive oil (14) and is divided into two sections. The first is dedicated to the organisation of the sensory analysis process, while the second part is specifically interested in the sensory evaluation of wine, interpreted within the framework of the ISO/ IEC 17025 (15) standard.

3 - Subject and scope

This proposal does not create any obligation; it consists of some elements that can be freely used by each Member States according to their needs and purposes.

This proposal presents the methods for satisfying the conditions required by the ISO/ IEC 17025 (2) standard with a view to accrediting the sensory analysis of wine in particular, as part of the international accreditation system for test laboratories.

This proposal is intended to be a consultation tool for laboratories interested in the accreditation of sensory analysis and a guidance tool for appraisers responsible for auditing the sensory analysis of wine

This proposal refers to the standards to be applied, particularly with regards documentation, equipment, resources, premises and tests.

4 - Terms and definitions

Sensory analysis or evaluation: tasting

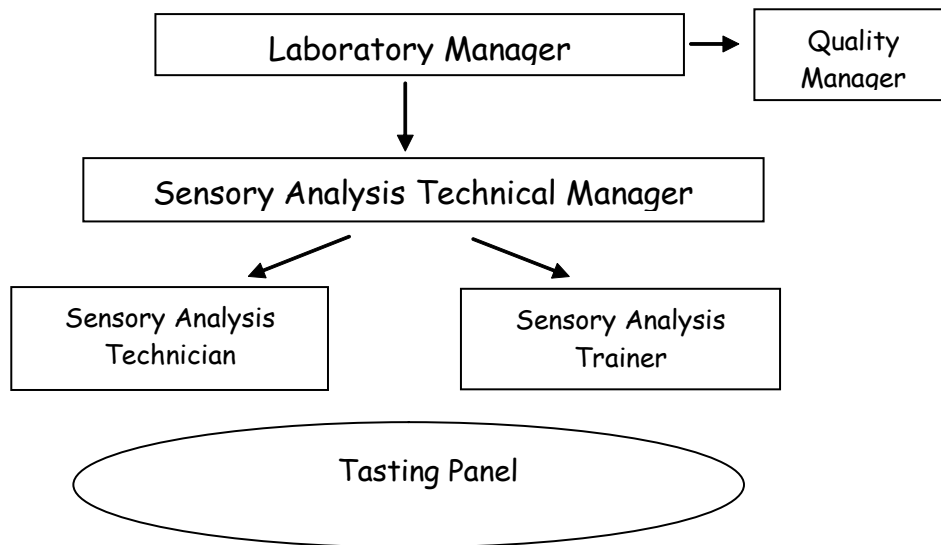
Qualified assessor: assessor educated and trained in the sensory analysis of wines

Organoleptic: sensory

Test: tasting test

5 - Personnel and structure

In a sensory analysis laboratory, the personnel can be represented on the organisation chart below:



Personnel involved directly with sensory analysis can be classified in two groups, namely technical personnel who ensure the functionality of the method, prepare the equipment necessary for its application and process the results, and members of the sensory evaluation panel for wines who form the analytical mechanism through which the test is performed. Two or more functions could be assumed by the same person

5.1 Technical personnel

The roles of the various people are as follows:

Sensory analysis technical manager:

- Carries out technical and management tasks related to sensory analysis along with administrative preparations for the tests (session planning, selection of tests to be implemented, selection of reference samples depending on the samples to be analysed, creation of an appropriate panel, supervision of the agents involved in organising sessions)
- Records and examines the results
- Manages data regarding monitoring of assessors
- Records the results and performs statistical calculations
- Interprets the results and drafts test reports
- Manages the quality assurance of the sensory analysis operation (drafting and updating of quality documents for sensory analysis, verifying that equipment is in working order (maintenance, calibration, verification))
- Sets up and monitors the quality control of the sensory analysis tests (reference materials and intercomparison tests)
- Monitors regulations and standards relating to sensory analysis

Sensory analysis technician:

- Checks the test samples on reception (identification, external appearance, content, potential leaks...)
- Ensures the cleanliness of the premises and equipment (checking the tasting room before the session, tidying the tasting room and cleaning the glasses after the session)
- Prepares the samples submitted for sensory evaluation (coding, presentation, order)
- Distributes samples and recording sheets for results during tasting sessions
- Notes the ambient conditions (tasting room temperature and humidity, temperature of tasted samples)

Sensory analysis trainer:

- Organises and runs initial and/or further training sessions in oenology (general wine knowledge) and sensory analysis of wine for members of the tasting panel, (needs to have teaching abilities as well as a solid background in oenology and sensory analysis)
- Selects wine likely to become reference samples

5.2 The tasting panel (see point 5 part I)

6 - Facilities and ambient conditions: (see point 3 part I)

7 - Testing methods

The testing methods used may consist in a strict application of general sensory analysis standards such as the triangle test (9) or duo-trio test (10) or ranking (11) for example. Internal methods specific to a laboratory, a requirement or wine type may also be developed as is the case for example, in the odour and taste evaluation of wine defects .

In all cases, these result in the drafting of an operating method appropriate to the laboratory.

7.1 The samples

The wines to be tasted are temporarily stored in conditions that preserve their intrinsic properties, so as to group a series of samples and convene the panel.

The same applies to the “test” wines which are either internal reference wines (or certified if they exist) recognised to be of average quality and without defect, or reference wines to which substances are added which are able to bring about particular qualities, defects or organoleptic character, and which are used to train assessors and monitor their performance.

7.2 Measurement traceability

Each panel member writes their results on a tasting sheet containing the date and the assessor's identification. The sheets are collected by the sensory analysis technical manager who processes the results using the statistical test associated with the type of test carried out and enters the final result and his interpretation on the test report.

The tasting sheets and the results processing sheets are collected and filed in chronological order by panel meeting and archived.

7.3 Results checking

Internal quality control:

The assessors’ performances are checked using the “test” wines tasted during training or test sessions, the results are recorded on a sheet for each of the assessors.

External quality control:

The laboratory or body should participate (if possible) in intercomparison tests. It will use this external quality control to detect potential systematic errors and verify the validity of its quality system.

8 - Document management

The organisation of the sensory analysis process is described in a procedure which is regularly updated (change in personnel, evaluation methods or extension of accreditations). Instructions are changed if the accreditation programme is revised, if the standards change or if there are personnel, premises or equipment changes with regards sensory analysis. The different versions of these documents are archived. The same applies for the recording documents used in tasting sessions (tasting sheets, results processing sheets...).

9 - Test report

Once a wine has been subject to a sensory evaluation conducted under accreditation, the information relating to the tasting must appear on the analysis report, noting in particular the description of the sample, the jury, the evaluation protocol and the results interpretation.

Bibliography

- 1- ISO 8589: 2010 Sensory Analysis - General guidance for the design of test rooms
- 2 - ISO 3591:1977 - Sensory Analysis - Apparatus - Wine-tasting glass

- 3 - ISO 8586-1: 1993 – General guidance for the selection, training and monitoring of assessors (selected assessors)
- 4 - ISO 8586-2: 2008 – General guidance for the selection, training and monitoring of assessors (expert sensory assessors)

- 5 - ISO 3972: 2005 - Sensory Analysis - Methodology - Method of investigating sensitivity of taste
- 6 - ISO 5496:2006 Sensory analysis -- Methodology -- Initiation and training of assessors in the detection and recognition of odours

- 7 - Ishihara test - <http://colorvisiontesting.com/ishihara.htm> (accessed in October 2013)
- 8 - ISO 13301: 2002 - Sensory Analysis - Methodology - General guidance for measuring odour, flavour and taste detection thresholds by a three-alternative forced-choice (3-AFC) procedure

- 9 - ISO 4120: 2007 - Sensory Analysis - Methodology - Triangle test

- 10 - ISO 10399:2004 Sensory analysis -- Methodology -- Duo-trio test

- 11 - ISO 8587: 2007 - Sensory Analysis - Methodology – Ranking

- 12 - Peynaud, É., Blouin J., (1996). Le goût du vin – Le grand livre de la dégustation. Dunot. Paris. Le Nez du Vin © - Accueil – Editions Jean Lenoir

- 14 - Guidelines for the accreditation of sensory analysis laboratories with particular reference to virgin olive oil in accordance with standard ISO/IEC 17025 2005, September 2007 – COI / T.28 / DOC No.1.

- 15 - Standard ISO/ IEC 17025 – General requirements for the competence of testing and calibration laboratories.

PART III - SELECTION AND TRAINING OF A TASTING PANEL FOR EVALUATION OF A VISUAL, OLFACTIVE AND/OR TASTE ALTERATION IN WINE CHARACTER

This document is established for selection and training of a tasting panel for evaluation of a visual, olfactive and/or taste alteration in wine character, including an example for the evaluation of a specific defect.

This proposal is not a reference document, but can be used in different ways by each Member State to select and train a panel of tasters. The specific vocabulary can be adapted, especially depending on the type of wine (dry wine, fortified wine, ...), the colour of the wine (red, white, rosé) and any known characteristics of the wine.

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1. Purpose

The purpose of this document is to establish a list of the main visual, olfactory, tactile and taste altered characteristics of wines and to propose a selection and training procedure for an assessor panel in order to arrive at a good understanding of certain particular characteristics, after defining and distinguishing (sometimes using the same “term” or a similar term), what may be considered as a “glaring defect or alteration” and what must be considered as the result of “established expertise” or the typicality of a grape variety.

2. Scope of application

The alterations described, which are subject to agreement, are applicable to still red, white and rosé wines. This type of evaluation is intended for a group of selected and trained assessors forming a panel. The olfactory, tactile and taste assessment of wine alterations is a specific evaluation.

3. Example of a list of visual alterations, smell and / or taste associated with a technical accident or to a known molecule

The main negative attributes of still wines can be classified in olfactory categories (vegetable, mouldy, acetic, reduced, oxidised, animal, lactic), taste categories (acidic, bitter) or tactile (astringent). These are presented in **Tables 2 and 3**.

Some molecules related with alterations in wines are known, as is their origin; they are quantifiable by chromatographic analyses. Certain olfactory alterations only appear when the molecules responsible are present in excessive concentrations.

If a wine has a combination of several olfactory alterations, these alterations must be evaluated individually.

Table 1: Main visual alterations in wine

Type of wine	Visual appearance	Possible Causes
	Hazy appearance	Yeast and bacteria, proteins, tannins
White	Browning	Oxidation of polyphenols and phenolic acids
	Pinking effect	Polyphenols and excess of sulphites
Red	Browning	Oxidative casse, oxidation of polyphenols
	Hazy appearance	Yeast and bacteria
	Lack of colour	Lack of pigments and excess of sulphites
	Premature brick-red colour	Insufficient tannin-anthocyanin combination

Table 2: Examples of Wine olfactory alterations

Attributes	Descriptor examples	Examples of molecules involved
Vegetable	Herbaceous, green bell pepper, ivy	C6 (1-Hexanol, Cis-3-hexen-1-ol) ¹ IBMP (Isobutyl-methoxy-pyrazine) ²
Mouldy/Earthy	Wet earth, mould, mushroom	Geosmin
	Dusty, musty, damp cellar	Trichloroanisole (TCA) Tetrachloroanisole 2,4,6-Tribromoanisole (TBA)
Acetic	Sour (sharpness, odour of vinegar)	Acetic acid
	Acescent (glue, nail, polish, solvent)	Ethyl acetate

¹ The 1-hexanol and cis-3-hexen-1-ol compounds (herbaceous, cut grass) are compounds produced during fermentation and they are always found in wines; they are not considered as olfactory alterations if they are present in limited quantities.

² Pyrazines are naturally present in grape varieties such as Cabernet Sauvignon, Merlot and Sauvignon Blanc and contribute to the distinctive attributes of wines made from those varieties. Pyrazines should only be considered a defect when they appear excessive and indicative of the use of unripe grapes taking into account the grape variety(ies) and wine style.

Attributes	Descriptor examples	Examples of molecules involved
Reduced	Rotted egg, gas, garlic, cabbages	Ethanethiol Mercaptan H ₂ S
Oxidised ³	Stale, rancid, overripe apple	Ethanal Sotolon
Animal	Phenol, leather, stable, horse sweat	Mix 4-ethylphenol/ 4-ethylgaicol ⁴
	Foxy	O-aminoacetophenone or Methyl anthranilate ⁵
Lactic	Buttered, Butyric	Diacetyl ⁶
Others	Geranium, odour specific to geranium	2-Ethoxy-hexa-3,5-diene
	Baked beans, odours of baked beans or of <i>fritillaria meleagris</i> bulbs or snake's head fritillary	Ethyl 2-sulfanylacetate
	Hydrocarbons, specific odour evocative of petrol and its derivatives ⁷	Generally 1,6- Trimethyl -1 ,2- dihydronaphthalene (TDN)
	Plastic, odour of epoxy resin	Styrene
	Rubber, odour characteristic of rubber or burnt rubber	Benzothiazole
	Pharmaceutical, medicinal odour, gouache, odour of fresh gouache paint	Vinyl-4-phenol and vinyl-4-guaiacol ⁸
	Bitter almond, bug, specific unpleasant odour	Benzaldehyde
	Other specific olfactory alterations, can be treated globally under the heading "other alterations" accompanied by a comment, or individually using a specially developed sheet. Further olfactory alterations and their descriptors are given as an example:	
<ul style="list-style-type: none"> - Premature aging attribute (wax, nuts, honey, prunes, madeirised) - Excessive wood attribute (plank of wood) - Other: see table below 		

³ The oxidised character is not considered a defect in certain wines but is the result of ageing (for example, sotolon is present in wood-aged Port and Madeira and Xerez/Sherry is high in ethanal; for the same wines, when aged for a long time in wood, they are high in volatile acidity.)

Table 3: Examples of Wine tactile and taste alterations

Attributes	Descriptor examples	Examples of molecules involved or standard molecules (ST)
Acid	Unripe grape, lemon	Tartaric acid Malic acid Citric acid(ST)
Bitter	Raw chicory, cocoa (unsweetened), green tea, quinine	Wine tannins or grape tannins Quinine sulphate (ST) Caffeine (ST)
Astringent (tactile alteration)	Artichoke leaves, aubergine (feeling of dryness and roughness in the mouth)	Wine tannins or Grape tannins Tannic acid Hydrated potassium aluminium sulfate (potassium alum)(ST)
Others	Mousiness, Odour reminiscent of mouse and acetamide ⁹	Acetyl-tetrahydropyridine
	Soapiness, Taste of varying intensity of soap	Caproate and ethyl caprate
	The attributes "acid", "bitter" and "astringent" are considered defects only when occurs excessive imbalance in the wine structure.	

⁴ Some individuals express a preference for wines containing limited quantities of the "animal" characters often resulting from contamination. They consider such wines to have increased "complexity".

⁵ The "foxy" character must not be considered one defect in the wines made from *vitis labrusca* grape varieties and hybrids, but a typical characteristic of this wines

⁶ Many consumers express preference for wines exhibiting a buttery character resulting from the production of diacetyl during a malolactic fermentation. The presence of diacetyl in wine does not inevitably have negative or undesirable consequences.

⁷ In some cases it is typical of a grape variety, as for example Riesling

⁸ These compounds are produced during alcoholic fermentation by yeasts, and they are considered an alteration if only present in high concentrations in wines.

⁹ This alteration is perceived especially in mouth , when you drink the wine, because the acetyl-tetrahydropyridine it is not volatile at the wine pH

4. Applicable standards

General and methodology standards:

- Sensory Analysis – General guidance – ISO 6658:2005
- Sensory Analysis – General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors – ISO 8586:2012
- Sensory Analysis – Methodology -- Guidelines for monitoring the performance of a quantitative sensory panel – ISO 11132:2009
- Sensory Analysis – General guidance for the design of test rooms – ISO 8589 : 2010
- Sensory Analysis – Apparatus – Wine-tasting glass – ISO 3591:1977
- Sensory Analysis – Vocabulary - ISO 5492:2008
- Sensory Analysis – Method of investigating sensitivity of taste – ISO 3972:2011
- Sensory Analysis – Initiation and training of assessors in the detection and recognition of odours – ISO 5496:2006
- Sensory Analysis – Magnitude estimation method – ISO 11056:1999
- Sensory Analysis – Paired comparison test – ISO 5495:2005
- Sensory Analysis – Triangle test – ISO 4120:2007
- Sensory Analysis – Guidelines for the use of quantitative response scales – ISO 4121:2003
- Sensory Analysis – Ranking – ISO 8587:2006
- Sensory analysis – Duo-trio test - ISO 10399:2004
- Sensory Analysis – General guidance for measuring odour, flavour, and taste detection thresholds by a three alternative forced choice (3-AFC) – ISO 13301:2002
- Sensory Analysis – General guidance for establishing a sensory profile – ISO 13299:2003

5. Selection and training of assessors in wine olfactory, tactile and taste alterations evaluation

The general rules for selecting and training a panel are described in part I of the document. Exercises specific to the search for wine olfactory, tactile and taste alterations are set out below.

5.1. Sensitising

In order to sensitise people, initiation tests will be carried out to make them familiar with the various odours of wine by emphasising organoleptic alterations. These sensory tests must be accompanied by explanations, possibly even general training on wine and more specific training on the various alterations. These data on the reality of olfactory training must not be neglected.

All the relevant molecules in water with concentrations higher than average thresholds will be presented to ensure that all the assessors understand the olfactory image.

Searching for the average threshold of the group can be interesting at this stage; this threshold will still be unreliable, but nonetheless interesting for the organiser and the trainees. Paired comparison tests may be performed with 5 pairs of samples per assessor and per molecule. The various concentrations are prepared by successive dilutions then presented at random. After each tasting, the assessors must be asked whether they believe that the two samples are identical or different. The average threshold of the group will be determined corresponding to 75% of correct answers.

5.2. Establishing the detection thresholds

A thorough search for the threshold for the main wine olfactory, tactile and taste alterations (approximately 10 molecules) will be carried out in order to provide information about the group's sensitivity, and to use data on people's hypersensitivity or specific hyposmia (ISO 13301 standard).

The selection of the molecules that are to be studied must take into account the specificities of the wines that the assessors will have to analyse (white or red wines, dry or sweet wines, young or old wines, etc.).

5.3. Training

Training in the detection of wine olfactory, tactile and taste alterations can consist of several tests. The main focus is on frequent contact with the odour of molecules, in association with oenological information, molecule names, their standard descriptor, and comparing these data with the individually observed profile.

Successive dilutions will therefore be performed with contents higher than the threshold in wines and different matrices. Paired comparison tests or duo-trio tests will help compare wines with standards. Classification tests performed during additions (4 concentrations) of certain molecules responsible for wine olfactory, tactile and taste alterations will help the training on quantitative references.

More specific training on the profile of altered wines will complete the training process. The eventual aim is to achieve a Quantitative Descriptive Analysis (QDA). The quantitative scale presentation is essential in order to get to grips with this relatively complex test. The ISO 4121 standard presents the guidelines for the use of quantitative response scales. A continuous scale is recommended if the use of direct or scanned data input is possible; otherwise, a scale of 8 is recommended.

Finally, many exercises containing observations using QDA datasheets will be carried out in order to become familiar with this sensory evaluation practice. Defect-free wines must be presented at each training or familiarisation session.

Wine sensitivity tests will be conducted periodically to observe people's performance and to define long-term profiles. They can take place during work or training sessions, or during testing sessions. The ISO 11132 standard presents the guidelines for monitoring the performance of a quantitative sensory panel.

6. Procedure for the evaluation of wine olfactory, tactile and taste alterations

In practice, the responses from each assessor are entered in a spreadsheet or a specific sensory analysis software programme.

Each assessor belonging to the panel must carry out an analytical examination of the wine, starting with a more or less prolonged visual

observation, before inhaling without swirling the glass, then after swirling the glass, so as to concentrate the volatile substances in the headspace. Finally after taking a first mouthful, the wine is allowed to warm for a few seconds while being moved all around the mouth, then inhaling through the nose and spitting. The assessors will write down their impressions on the finish and on any possible bad "taste".

Then they must then enter on the tasting sheet (or computer screen) the intensity at which they can perceive an altered characteristic (negative descriptor). If the assessors consider the wine or the solution unbearable or possibly if the operation involves a health hazard for them, the assessors will have to stop and state the exceptional circumstance on the sheet. An example of a sensory analysis sheet used by the assessor to characterise wine olfactory, tactile and taste alterations is given in paragraph 7.

7. Example of tasting sheet and graphic representation of the results

The olfactory, tactile and taste alterations taken into consideration on this sheet (figure 1) concern both aroma and taste. If the wine is accepted by the taster (test accepted/refused at top of sheet), the lower part of the sheet corresponding to the alterations should not be completed. However, if the wine is refused, all boxes must be completed, each taster expresses the intensity with which they experience each defect on a scale of 0 to 5; by convention, an unchecked intensity is equal to 0 (zero). A numerical value within the scale should be established to refuse the wine. If non-listed negative attributes are perceived, they must be written in the "other alterations" descriptor, including the intensity perceived, by using the term(s) that best describe the assessor's impression.

TASTING SHEET							
WINE OLFACTORY, TACTILE AND TASTE ALTERATIONS CHARACTERISATION							
DATE				TEST			
TASTER NAME	NAME :		Booth n°:	Glass n°:			
TEST – ACCEPTANCE REFUSAL				Do you accept this wine ? YES NO			
				<i>If NO, please complete the table below</i>			
TEST – CHARACTERISATION OF OLFACTORY, TACTILE AND TASTE ALTERATIONS				Intensity of the perception (*)			
ODOUR	Vegetable	0	1	2	3	4	5
	Mouldy	0	1	2	3	4	5
	Acetic	0	1	2	3	4	5
	Reduced	0	1	2	3	4	5
	Oxidised	0	1	2	3	4	5
	Animal	0	1	2	3	4	5
	Lactic	0	1	2	3	4	5
TASTE, TACTILE	Acid	0	1	2	3	4	5
	Bitter	0	1	2	3	4	5
	Astringent	0	1	2	3	4	5
Other alterations	0	1	2	3	4	5	
COMMENTS							
<i>(*) 0: total absence; 1: hardly perceptible; 2: light; 3: average; 4: strong; 5: extreme</i>							

Figure 1: Example of a wine olfactory, tactile and taste alterations characterisation sheet
The results of the Acceptance/Refusal test are governed by **binomial distribution** with a probability $p = \frac{1}{2}$.

To evaluate the olfactory, tactile and taste alterations, it is possible to refer to the standard ISO 11056 “Magnitude estimation method (data analysis section)” or use the works carried out by the International Olive Council on “the sensory evaluation of virgin olive oil”. In practice, the responses from each assessor are entered onto a specific sensory analysis software programme. The processing of the results is based on the following principle: for a given wine and for each defect reviewed, the median of the level of intensity revealed by all the assessors is calculated. An value strictly higher than zero for a given defect is an indication of the defect identified by the assessors. The results of the test may be presented in the form of a graph (figure 2).

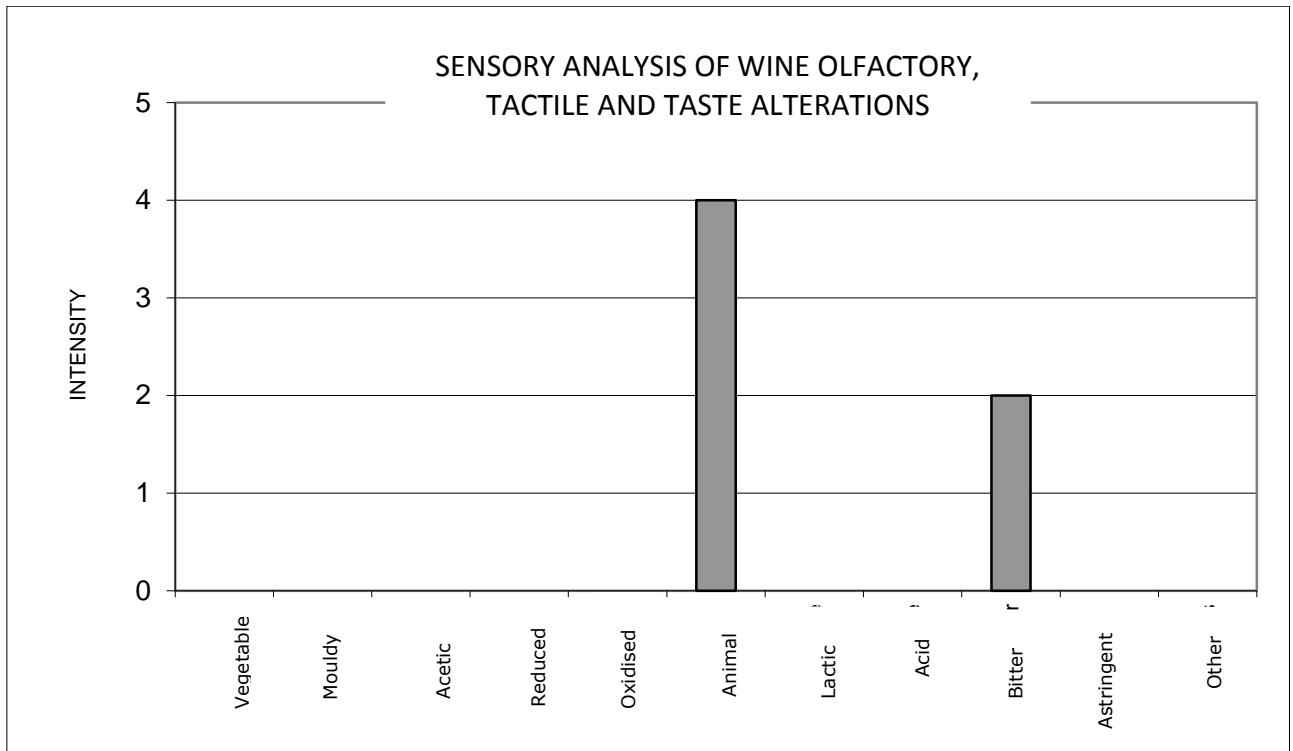


Figure 2: Example of presentation of wine olfactory, tactile and taste alterations characterisation results

8. Example of the evaluation of a specific defect: 2,4,6-trichloroanisole (TCA) in wines (smell of mould)

8.1. Scope of application

Identification of TCA (2,4,6-trichloroanisole) in wine by means of sensory evaluation.

8.2. Principle

This mould defect appears in the mouldy/earthy category. Commonly used descriptors are mould, earthy, mushroom, humus, dust and cardboard. The olfactory identification of TCA can be difficult due to the influence of the matrix, the difference in sensitisation of the panel, the level of qualification and training of the panel and finally the rapid saturation of sensory receptors. Use of an easily applicable method is proposed, comprising just olfactory tests, in view of the expertise or lack thereof of the panel only ask for an examination of this type of potentially contaminated products.

8.3. Equipment required

- Tasting room which has the features set out in the ISO 8589 standard,
- laboratory glassware,
- 100 mL graduated volumetric flasks,
- 2 mL HPLC vials,

- 50 mL graduated cylinders,
- 1, 10, 20, 25, 30 and 50 mL glass pipettes,
- 0.1mL micropipette,
- thermostatic bath (20°C),
- analytical balance,
- ISO 3591 tasting glasses.

8.4. Reagents and products

- Mineral water with minimal mineral content (referred to as water in the method),
- non-aromatic dry white wine, of the most recent vintages, produced and stored without using wood, with an alcohol content of between 10-12% vol.,
- non-aromatic dry red wine, of the most recent vintages, produced and stored without using wood, with an alcohol content of between 10-12% vol.,
- TCA, TBA, TeCA and geosmin concentrations must be lower than their detection limit (DL) in the test wines,
- absolute ethanol,
- TCA standard (purity 99.9%)
- stock solution A - 10 mg/L: 1 mg of the TCA standard is weighed out into a stoppered flask (to avoid dissipation of TCA, which is extremely volatile in the environment) and transferred into a 100 mL volumetric flask with absolute ethanol. This solution must be prepared 24 hours before tasting and kept in a refrigerator at 4°C for no more than 5 days,
- intermediate solution B - 0.10 mg/L: 1 mL of stock solution A is transferred into a 100 ml volumetric flask in a 50% solution of absolute ethanol and water,
- intermediate solution C - 0.001 mg/L: 1 mL of intermediate solution B is transferred into 100 mL of water or dry white wine or dry red wine, depending on the type of test which is to be prepared,
- intermediate solution D - 100 ng/L: 20 ml of intermediate solution C is transferred into 200 mL of water or dry white wine or dry red wine, depending on the type of test which is to be prepared,
- intermediate solution D is used to prepare the following solutions: 1.0-2.0-3.0-4.0-8.0-16.0 ng/L in water or dry white wine or dry red wine, depending on the type of test which is to be prepared,
- intermediate solution E - 10 ng/L: 10 ml of intermediate solution D in 100 ml of water or dry white wine or dry red wine, depending on the type of test which is to be prepared.
- the 0.25 ng/L and 0.5 ng/L solutions in water or dry white wine or dry red wine, depending on the type of test which is to be prepared, are prepared from intermediate solution E,
- all the intermediate and final solutions must be prepared 24 hours in advance,
- the intermediate solutions are used only once for preparing the final solutions,
- the final solutions are placed in crown-capped bottles and kept in a refrigerator at approx. 4°C, advisably for no more than 48 hours, and it is recommended not to reuse them once they have been opened.

8.5. Tasting group (Panel) composed of a minimal number of persons to be able to achieve the statistic evaluation, if possible both men and women, who are specifically trained and selected. If the assessors are not experts in perceiving TCA odour, they are specifically trained with this odour.

8.6. Selection of assessors

1st STAGE - Tests of the recognition of the odour of TCA are carried out.

Test I with water
Test II with dry white wine
Test III with dry red wine

Each test must be carried out with three repetitions, if possible on three different days. Ten glasses are presented in sequence, the first is water (reference) and the following ones may also contain pure water, pure wine, or water and wine with identical or increasing concentrations of TCA, the solutions to be used being: 0-0.25-0.5-1.0-2.0-3.0-4.0-8.0-16.0 ng/L. Each beaker contains the same quantity of liquid (30 mL), measured with a cylinder, at a temperature of 20-22°C.

The card presented to the assessors is worded as follows:

*Test for identifying the **detection threshold** and the **recognition threshold** for an odour. Answer YES if the sample is perceived to be identical to water, NO if it is different.
State the perceived odour for each glass and rate the intensity of the recognised odour on a rising scale (from 1 upwards).*

On the basis of the results, the recognition threshold of each assessor is calculated and those assessors who find it difficult to recognise TCA are excluded.

In particular, assessors whose recognition threshold exceeds 16 ng/L in water, white wine and red wine, are excluded.

At least the minimal number of assessors to be able to achieve the statistic evaluation should remain. The recognition threshold is deemed to be the quantity of TCA which allows the assessor to recognise the odour of mould or damp cardboard.

8.7. Determination of the recognition threshold of the panel

2nd STAGE – Discrimination tests (for example DUO-TRIO) are carried out to determine the recognition threshold of the *panel*, in two repetitions.

Three test series are performed:

Test series I with water
Series II with dry white wine
Series III with dry red wine

The **recognition threshold of the panel** is deemed to be the quantity of substance which is recognised by 50% of the assessors.

Each beaker contains the same quantity of liquid (30 mL), measured with a cylinder, at a temperature of 20-22°C.

The following solutions with TCA are submitted to the assessor for comparison with the test (absence of TCA):

water: 2.0 - 3.0 - 4.0 – 5.0 – 6.0 ng/L
dry white wine: 3.0 - 4.0 - 5.0 – 6.0 – 7.0 ng/L
dry red wine: 4.0 - 5.0 – 6.0 – 7.0 – 8.0 ng/L

Two repetitions are performed for each test series, the samples being presented in a different order for tasting, and carried out on the same day with a gap of at least one hour between one series and the next.

The duo-trio tests are processed depending on the number of assessors ($p < 95\%$) using the tables from duo-trio ISO standard.

8.8. Application to wines

The following procedures must be observed:

- Provide the samples, except for the control wine, with a randomly assigned 3-digit code clearly identifiable by the assessors to prevent bias (Lawless and Heymann 2010).
- Maximum number of samples to be evaluated per session: 8-10 samples.
- Each series of tastings should allow for the possibility of having an uncontaminated control wine, clearly indicated to the assessor as such, but also repeated between the potentially contaminated samples as a control without informing the assessor (for example: control, 4 potentially contaminated bottles, control, another 3 potentially contaminated bottles).
- An interval of at least 2 minutes should be allowed between one sample and the next.
- If, for practical reasons, it is not possible to carry out just one evaluation session of 8-10 samples per day, several tasting series may be carried out on the same day, but allowing an interval of at least 30 minutes between one sequence of samples and the next.
- The card must be designed such that it requires the assessor to identify any possible extraneous odours present in the samples provided, relative to the control wine: earthy, mushroom, fungus, mould, dusty, mud, damp cardboard, other.

WINE:		DATE		TASTER				
THE TASTER SHOULD INDICATE WHICH ODOUR HE/SHE CAN IDENTIFY FROM AMONG THOSE LISTED BELOW								
SAMPLE N°		312	457	674	129	281		
LIST OF ODOURS								
MOULD		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
EARTHY		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
MUSHROOM		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
MUD		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
DAMP CARDBOARD		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
DUSTY		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
OTHERS:		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
I CANNOT SMELL ANY OF THESE ODOURS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Figure 3: Reproduction of a card provided for identifying any possible TCA anomalous odours in the wines.

It is considered that a wine has a TCA smell if at least 50% of the trained assessors noted the presence of that defect in the examined sample.

9. Bibliography

Amaral, B., Cravero, M.C., Médina, B. de Revel, G., Tusseau, D. (2010) "Evaluation olfactive et gustative des défauts du vin". FV 1344.

Bertrand A (1998) Les principales altérations du vin in *œnologie, Fondements scientifiques et technologiques*. Flanzly C., Tech & Doc Ed.

Conseil Oléicole International. 2007 « Méthode d'évaluation organoleptique de l'huile d'olive vierge » COI/T.20/Doc. n° 15/Rév. 2.

Cravero MC, Pazo Alvarez MC, Bonello F, Tsolakis Ch, Ubigli, Borsa.D (2008) Metodo per la valutazione sensoriale dell'odore di tappo nei vini. FV 1271

Cravero M.C., Bonello F., Pazo Alvarez M.C., Tsolakis C., Borsa D., 2015 The Sensory evaluation of the 2,4,6-Trichloroanisole (TCA) in wines. J.Inst. Brew., 121, 3: in press.

Lima Ferreira, M Amaral B, Salagoity MH, Lagrèze C, De Revel G et Médina B. (2010.) Conditions générales pour la réalisation de tests d'analyse sensorielle.FV 1356.

Martin N., de Revel G. (1999) Evaluation sensorielle : bases scientifiques et applications œnologiques.in *La Dégustation* pp 85-98. Vigne et Vin Publication Internationale Ed.

Meilgaard,M., Civille, G., Carr, T. Sensory Evaluation Techniques, Fourth Edition. CRC PressINC, 2007, 448 pages.

O'Mahony, M. (1986). Sensory Evaluation of Food: Statistical Methods and Procedure. Marcel Dekker, 487 pages.

Ribereau-Gayon, P.; Boidron, J. N.; Terrier A. (1975) Aroma of Muscat grape varieties. J. Agric. Food Chem. 23, 1042-1047.

Ribereau-Gayon P., Glories Y., Maujean A., Dubourdieu D. (2004) *Traité d'œnologie*, vol. 2, 5ème édition. Dunod Ed.

Sicard G., Doublet S., Koenig O., Perello M.C., de Revel G. (2006) Effect of wine-tasting course on odorant identification ability. *ECRO 2006, 7th conference of the European Chemoreception Research Organisation*, Granada.