

Sensometrics 2010

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Method development for sensory quality control of products with certified quality labels: a case study on wine

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LASEHU

eman ta zabal zazu

Universidad
del País Vasco Euskal Herriko
Unibertsitatea

INTRODUCTION

Sensory quality evaluation of PDO products

Sensory characteristics linked to the **region**, **raw materials**, **elaboration procedure** or **cultural aspects** (Bertozzi, 1995; Ballester *et al.*, 2005; Cayot, 2007; Parr *et al.*, 2007)



Necessary to consider the “**typicity**”

Evaluation often focused on **avoiding** commercializing product with **serious defects**

Very few reports about methods **categorizing** the sensory quality:

Elaboration of the PDO label
(Rico, 2002)

Elaboration of the PDO label
(Rico, 2002)



Sensory quality evaluation of wine

European legislation
(OJEU, 2008)



Necessary to describe the
*“principal organoleptic
characteristics”* of PDO wines

Specifications
of many PDOs

of



mention to **“characteristic”**
properties

What is “characteristic”... ???

DOC Rioja regulations (BOE, 2004):



Production zone

Viticulture and enological practices

Harvest conditions

Grape yields

Physico-chemical characteristics

... and **organoleptic characteristics**

*Wines must present the **characteristic organoleptic properties** of color, odour and taste*

... what are these characteristic organoleptic properties ???

Sensory quality evaluation of wine

Score cards to measure the sensory quality:

Davis 20-point scale

(Ough & Baker, 1961; Amerine & Roessler, 1983)

Score card for **international wine competitions** of
the **International Organisation of Vine and Wine**
(OIV, 1994)

Score card of the **Union Internationale des**
Oenologues
(reproduced in OIV, 1994)

Hedonic wine tasting sheet for quality assessment
(Jackson, 2000)

Score card of the **Faculté d'oenologie de Bordeaux**
(reproduced in Peynaud & Blouin, 2002)

Score card of the **Unión Española de Catadores**
(reproduced in Del Castillo, 2005)

...

Sensory quality evaluation of wine

Some **problems** related to these score cards:

Usually, parameters **not defined enough**

what is “balance”?

what is “harmony”?

What is “genuineness”?

...

Scoring criteria **not specified enough**

Scoring very influenced by opinion, formation and experience of each expert

Lack of **specificity**

Wide range of wines: “Still wines”, “sparkling wines”...

Particularities **not considered**

Sensory quality evaluation of PDO products

Together with specific method development

Qualified panels necessary to apply them



How to train, qualificate and supervise the panel?

How to check the reliability of the panel?

Accreditation according
to ISO 17025 (2005)



Guarantee of **technical
competence**

Rioja Alavesa (RA)



66.842.000 L red wine
(2009)

275 wineries



Rioja Alavesa (RA)

Sensory characteristics of RA wines influenced by some particularities:

- **Climate:** Atlantic climate + Mediterranean climate
- **Orography:** slope from mountains to Ebro river
- **Soil composition:** 95% chalky-clayey
- **Grape varieties:** Tempranillo predominant
- **Many little wineries:** traditional practices

Young red wine (unoaked) → the most **traditional** one

Winemaking process: **carbonic maceration** and **destemming**

Main variety: **Tempranillo**



METHOD DEVELOPMENT

Sensory quality: a **controversial concept**

First question:

Who defines the sensory quality?



Consumers?



Experts?



Both?

Participants

12 wine experts: **enologists**, **winemakers** and **restaurateurs**

15 meetings of 2 hours and half

Wine samples

90 samples of young red wine from different villages of RA

Preparation and service of samples

Storage and serving at 17 ± 2°C

Standardized glasses (ISO, 1977)

covered with Petri dishes

Tasting room

Discussion room

Sensory booths

T^a : 21 ± 2°C / RH (60±20%)



1- Attribute generation

First 3 sessions:

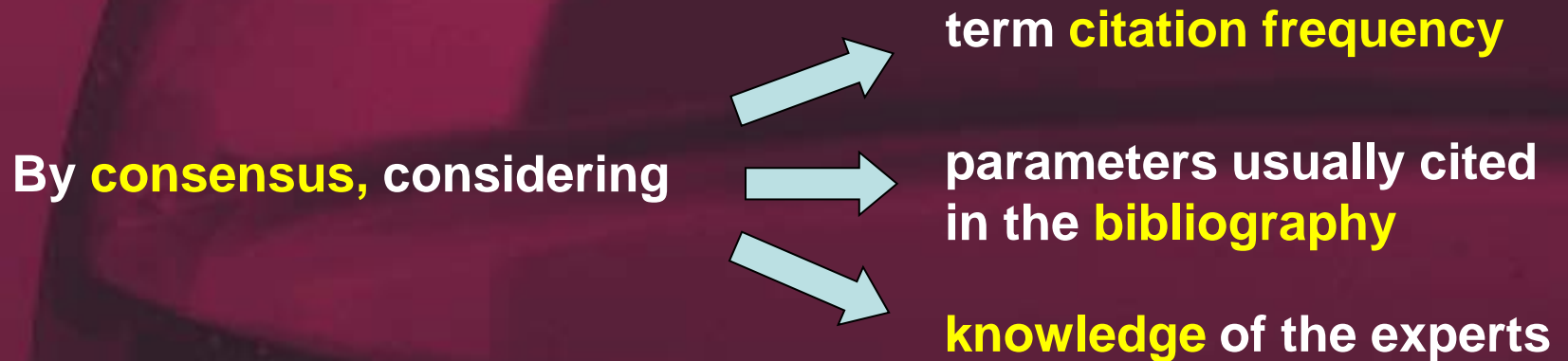
wine pair comparison with
18 wines

Terms of:

- odour
- aroma
- taste and mouth-feel
- appearance



2- Selection of parameters determining the sensory quality



2 questions to lead the discussion:

Does this parameter really influence the sensory quality of the wine?

Does this parameter differentiate among wines?

Parameters defining the sensory quality

Odour intensity	Global intensity of odour
Odour complexity	Amount and type of odour attributes, and how they are integrated
Aroma intensity	Global intensity of aroma (retronasal perception)
Aroma complexity	Amount and type of aroma attributes (retronasal perception), and how they are integrated
Balance and body	Balance: situation when acidity, astringency, and bitterness (if present) are compensated by sweetness. Body: intensity of taste and, specially, mouth-feel sensations. Consistency, density, “volume” in mouth
Global aroma persistence	Duration of overall aroma (no taste or mouth-feel sensations) that remains after the wine has been spitted out
Colour hue	Colour shade of the border layer of the wine in the glass
Colour intensity	How easily the light goes through the wine in the glass; colour “deepness”

3- Definition of the top situation, quality grading and scoring criteria for each parameter

“Top situation” definition:

What are the characteristics that a typical young red wine from RA must present to be considered the ideal one?

Consideration of **typicity !!**

Linking score - quality grading - sensory description:

1	2	3	4	5	6	7
Null quality	Very low quality	Low quality	Medium quality	High quality	Very high quality	Top quality

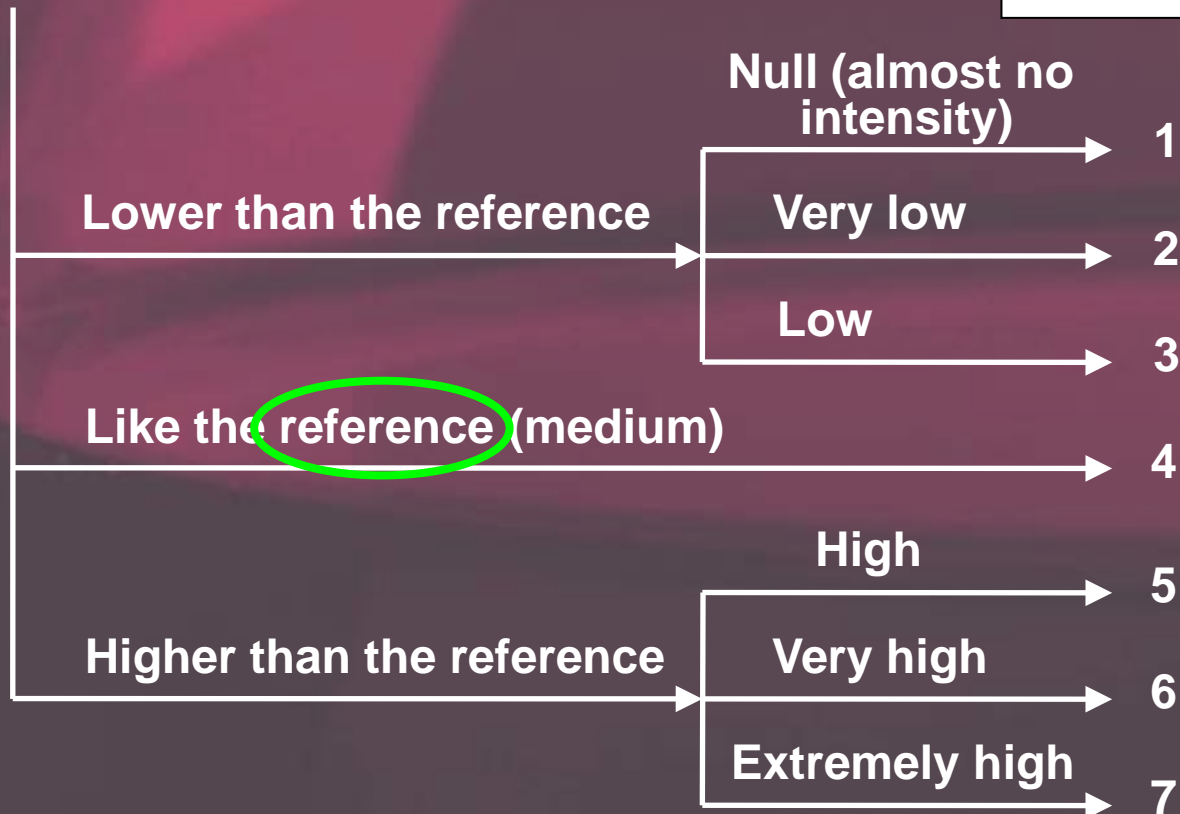
Scoring criteria determined by  **presence / absence** of particular attributes
intensities

Decission trees to make easier the scoring

Scoring criteria

Odour/aroma intensity

How is the aroma / flavour intensity?



* If an odour/aroma defect is perceived do not consider it for intensity evaluation. Just consider non-defect odour/aroma intensity. Thus, if a defect predominates the score will be in the low part of the scale.

Scoring criteria

Odour/aroma complexity

Do you perceive any defects in the wine?

NO

YES

Important

1

Slight

2

Very slight

3

Do you perceive any key attributes* in the wine?

None

One or more key attributes are perceived

(according to how the wine fits the definition of the ideal one)

The 3 key attributes perceived and well combined

4

5

6

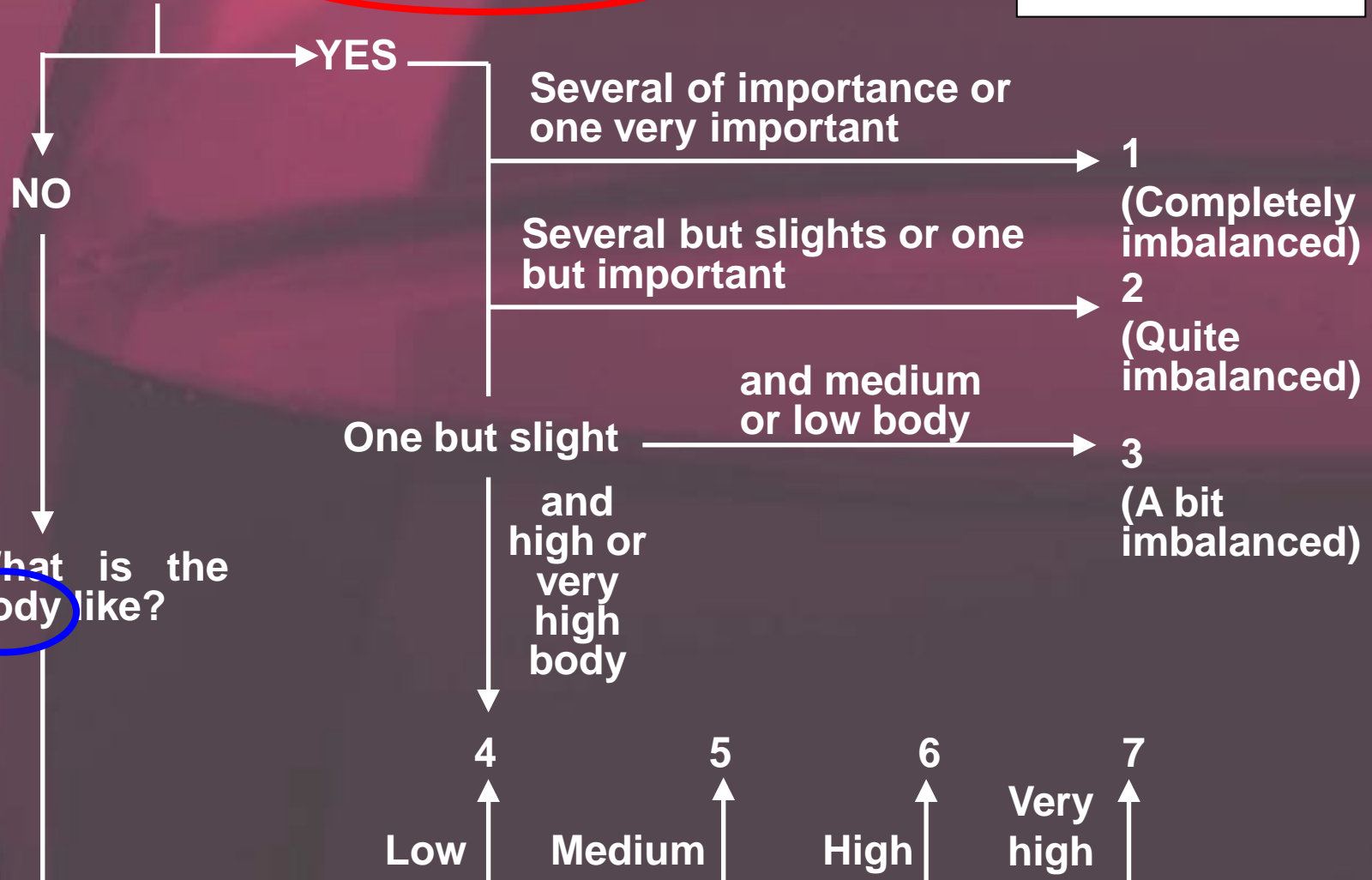
7

* Odour/aroma key attributes for the ideal young red wine from RA: ripe fruit, liquorice, floral

Scoring criteria

Balance and body

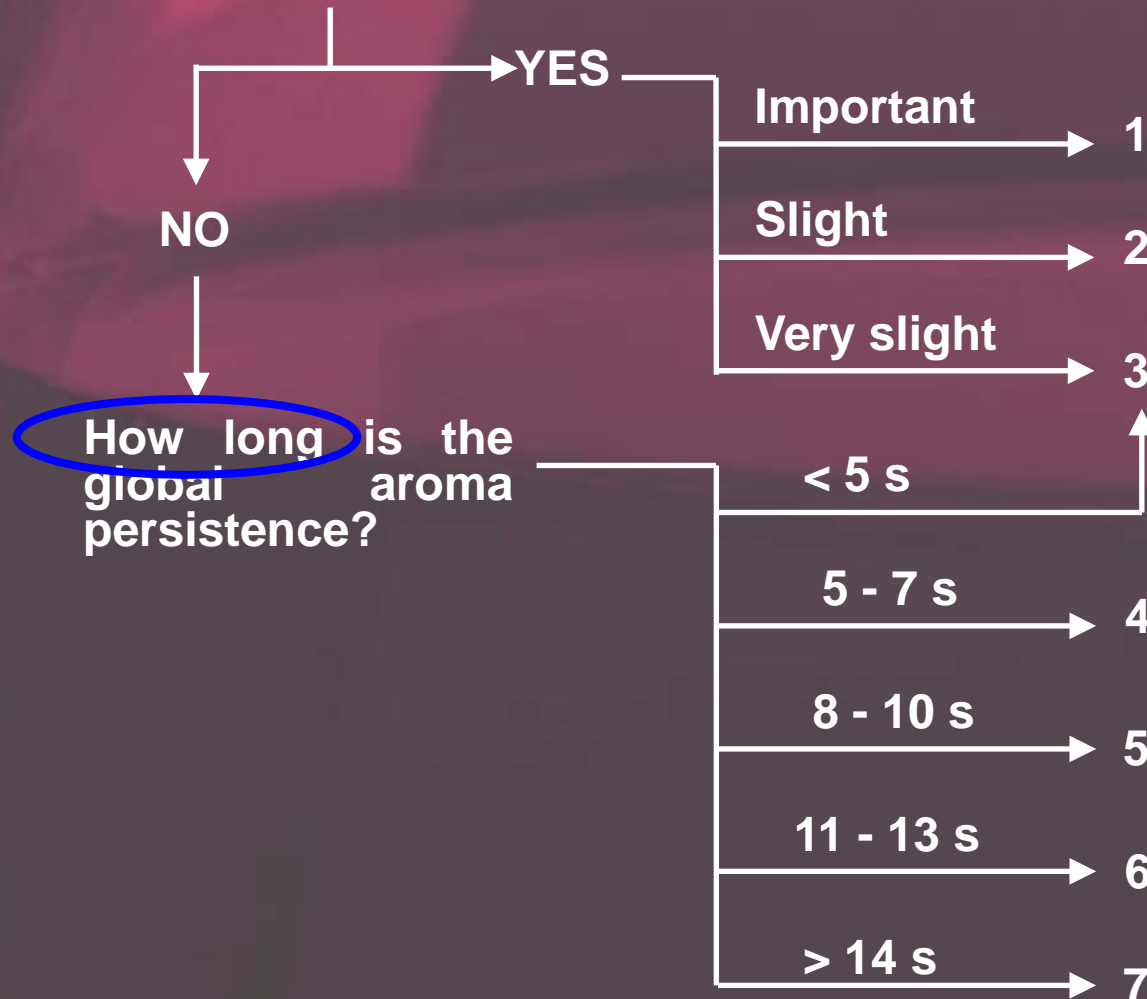
Has the wine any imbalance causes?



Scoring criteria

Global aroma persistence

Does any aroma defect remain after having spitted the wine out?

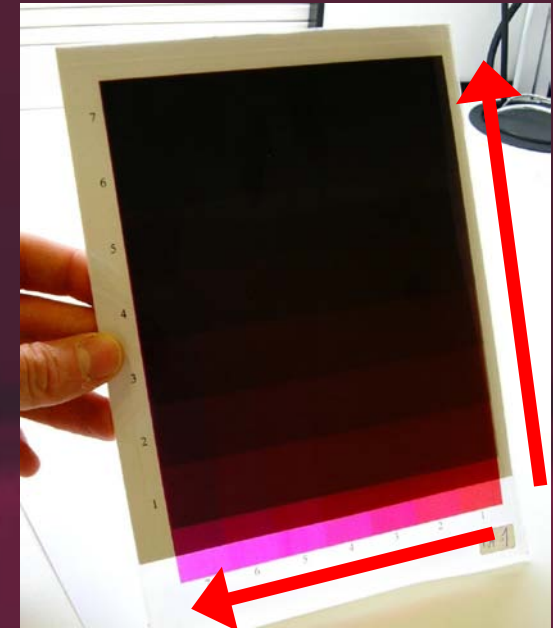


Scoring criteria

Colour hue / Colour intensity

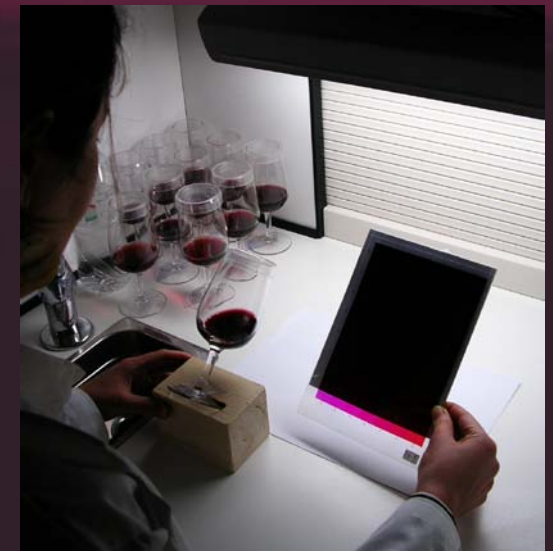
What colour hue and what colour intensity of the reference is more similar to the colour hue / intensity of the wine?

	↓	↓	↓	↓	↓	↓	↓
Point in the scale	1	2	3	4	5	6	7
	↓	↓	↓	↓	↓	↓	↓
Quality score	1	2	3	4	5	6	7



Color intensity scale

Color hue scale



4- Definition of the evaluation procedure

By **consensus**, throughout the first 4 sessions

Homogenization of tasting procedure



all the assessors evaluate the wine **in the same manner**

Detailed procedure in a **evaluation handbook** provided to each assessor



Evaluation procedure



Odour intensity

Without moving the glass remove the Petri-dish, wait 5 seconds and evaluate global odour intensity without considering the attributes. Score odour intensity by comparison with the intensity reference.

Odour complexity

Swirl the glass and smell the wine several times. Indicate all the attributes perceived and give a score by using the decision tree.

Aroma intensity and aroma complexity

Take a sip of wine, maintain it 5 seconds in the mouth (to increase a bit the temperature), swirl it three times by sipping air and expelling this volatile enriched air through the nose. Score the aroma intensity by comparison with the reference. Simultaneously indicate all the attributes perceived and score aroma complexity by using the decision tree.

Clean the mouth with water and crackers

Balance and body

Take a sip of wine and move it to wet all the surface of the tongue. If you perceive any imbalance causes point it. Score the balance and body by using the decision tree.

Global aroma persistence

Expectorate the sip of wine and count the time that the overall aroma maintains. Score global aroma persistence by using the decision tree and, in case of perceiving any aroma defect, indicate it.

Colour hue

Incline the glass 45° against a white background and look at the rim of the wine. Score colour hue by comparison with the reference.

Colour intensity

With the glass in the same position look at the center of the sample. Score colour intensity by comparison with the reference.

Score card Sample: 5- Definition of the score card

Nose parameters

Odour intensity

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Odour complexity

Attributes:

Ripe fruit ☐ Licorice ☐ Floral ☐
Un-ripe or un-determined fruit ☐ Over-ripe fruit ☐ Forest berries ☐ Tropical fruit ☐
Raisin ☐ Smoky ☐ Herbaceous ☐ Lactic ☐ Others ☐ _____

Defects:

Lactic (exc.) ☐ Herbaceous (exc.) ☐ Rotten eggs/onion peel ☐ Overheated ☐
Oxidized ☐ Pricked (acetic+glue) ☐ Sulfurous ☐ Moldy ☐ Others ☐ _____

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Mouth parameters

Aroma intensity

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Aroma complexity

Attributes:

Ripe fruit ☐ Licorice ☐ Floral ☐
Un-ripe or un-determined fruit ☐ Over-ripe fruit ☐ Forest berries ☐ Tropical fruit ☐
Raisin ☐ Smoky ☐ Herbaceous ☐ Lactic ☐ Others ☐ _____

Defects:

Lactic (exc.) ☐ Herbaceous (exc.) ☐ Rotten eggs/onion peel ☐ Overheated ☐
Oxidized ☐ Pricked (acetic+glue) ☐ Sulfurous ☐ Moldy ☐ Others ☐ _____

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Numerical scales of 7 points

List of attributes and defects most frequent

Balance and body

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Causes of imbalance:

Exc. astringency ☐ Exc. acidity ☐ Exc. bitterness ☐ Lack of acidity ☐
Other causes of imbalance ☐ _____

Global aroma persistence

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Defects

Lactic (exc.) ☐ Herbaceous (exc.) ☐ Rotten eggs/onion peel ☐ Overheated ☐
Oxidized ☐ Pricked (acetic+glue) ☐ Sulfurous ☐ Moldy ☐ Others ☐ _____

Appearance parameters

Colour hue

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Colour intensity

1- Null ☐ 2- Very low ☐ 3- Low ☐ 4- Medium ☐ 5- High ☐ 6- Very high ☐ 7- Top ☐

Other comments:

6- Definition of the contribution of each parameter to the overall quality

All the parameters do **not** have **the same importance...**

Weighting factor for each parameter defined by discussion



Integration of **partial qualities** from sensory parameters



Overall sensory quality of the wine

Contribution of each parameter to the overall quality

Parameters	Weight in the overall quality (%)
“By nose” parameters	30
Odour intensity	12
Odour complexity	18
“In mouth” parameters	60
Aroma intensity	10
Aroma complexity	15
Balance-Body	25
Global aroma persistence	10
Appearance parameters	10
Colour hue	6
Colour intensity	4
Total	100

7- Sensory reference development

To **homogenize** the **concepts** among the participants

To **train** de panel

Attribute / defect	Mother-solution (MS)	Reference preparation
Odour intensity/ aroma intensity / global aroma persistence	300 µL of butyl acetate and 300 µL of ethyl valerate in a final volume of 30 mL of absolute ethanol.	Add 150 µL of MS to 400 mL of a mix of commercial wines (100 mL oaked red table wine + 300 mL unoaked red table wine)
Ripe fruit	300 µL of butyl acetate in a final volume of 30 mL of absolute ethanol.	Add 250 µL of MS to 50 mL of BW
Forest berries	50 µL of “raspberry” flavour (International Flavors and Fragrances) and 250 µL of “blueberry” flavour (Givaudan) in a final volume of 30 mL of absolute ethanol.	Add 200 µL of MS to 50 mL of BW
Tropical fruit	300 µL of isoamyl acetate in a final volume of 30 mL of absolute ethanol.	Add 150 µL of MS to 50 mL of BW
Raisin		Add 10 mL of Pedro Ximenez raisin wine to 40 mL of BW
Floral	300 µL of linalool and 300 µL of geraniol in a final volume of 30 mL of absolute ethanol.	Add 25 µL of MS to 50 mL of BW
Liquorice	10 g of liquorice paste dissolved in 100 mL of distilled water	Add 2,5 mL of MS to 50 mL of BW
...

Analysis report



Analysis report

Report number: 5-S08-08

Analyzed wine:

Winery:

Reception date: 09/05/2008

Analysis date: 28/05/2008

Method identification: "PNTM-03 Sensory evaluation of young red wine from Rioja Alavesa"

Aroma intensity	Aroma complexity	Flavour intensity	Flavour complexity	Balance and body	Global flavour persistence	Colour hue	Colour intensity
4.3	4.4	4.4	4.7	4.3	4.6	4.9	3.3

Attributes:

Aroma: Ripe fruit, Forest berry, Tropical fruit
Flavour: Ripe fruit, Tropical fruit

Defects and imbalance causes:

Observations:

Signature of the laboratory manager:

Report sending date: 30/05/2008

Attributes and defects cited by ≥ 5 assessors

Uncertainty levels of the analysis are at client disposal.
Results of this analysis refer only to the wine analyzed.
This report cannot be reproduced without laboratory approval.

Analysis report



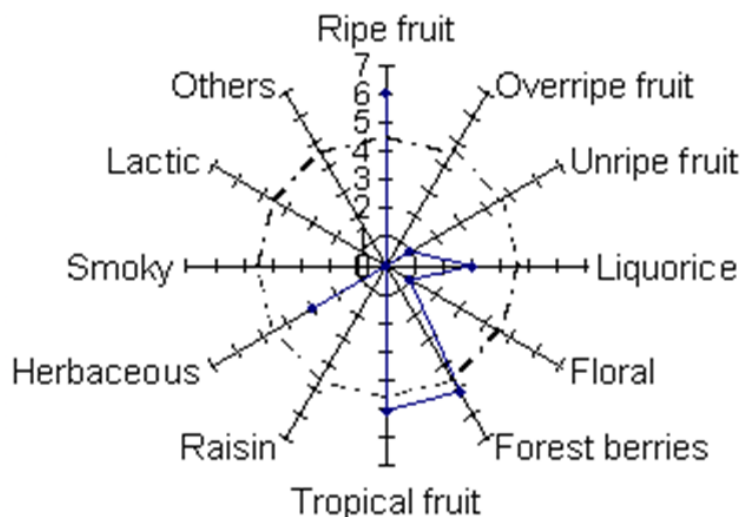
Analysis report

Report number: 5-S08-08

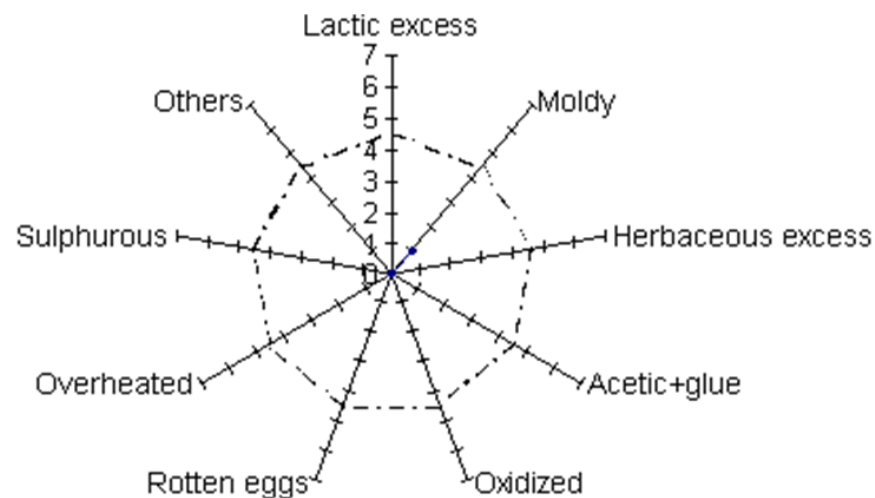
Analysis date: 28/05/2008

The next graphics show the citation frequency of attributes, defects and imbalance causes. When they are out from the discontinuous line (citation frequency ≥ 5) they are considered to be present in the wine.

Aroma attributes



Aroma defects



FORMATION OF AN EXPERT PANEL AND PERFORMANCE MONITORING

**Assessor
selection**

**Basic
training**

**Specific
training**

**Assessor
qualification**

**Method
validation**

Monitoring

Assessor selection

Basic training

Specific training

Assessor qualification

Method validation

Monitoring

**Objective: To detect problems in sensory perception
To assure enough sensibility**

Procedure and criteria described by Pérez Elortondo *et al.* (2007):

10 ISO tests in duplicate

Overcoming 75% of the test required

Test ^a	Reference
Colour vision test	Ishihara test
Taste identification test	ISO 3972, 1991
Duo-trio test with sapid substances	ISO 10399, 2004
Triangle test with sapid substances	ISO 4120, 2004
Ranking test	ISO 8587, 1988
colour / aroma / taste / texture	
Description test	ISO 8586-1, 1993
aroma / texture	

Assessor
selection

**Basic
training**

Specific
training

Assessor
qualification

Method
validation

Monitoring

Objective: To provide some basic knowledges and habilities in sensory evaluation of foods

Procedure and criteria described by Pérez Elortondo *et al.* (2007):
12 ISO tests

Overcoming **75%** of the test required

Test	Reference
Aroma pairing test	ISO 8586-1, 1993
Paired comparison test aroma / taste	ISO 5495, 1983
Duo-trio test	ISO 10399, 2004
Use of scales - one-dimensional parameters aroma / taste	ISO 4121, 2003
Use of scales - multidimensional parameters aroma / flavour-taste / texture	ISO 4121, 2003
Food product profiling aroma / flavour-taste	ISO 6564, 1985
Texture profiling of food products	ISO 11036, 1994

Assessor
selection

Basic
training

**Specific
training**

Assessor
qualification

Method
validation

Monitoring

Objective: To train the assessors to apply the method

15 sessions of 90-120 min

Reference evaluation

+

wine evaluation

+

discussion

1 → 9 wine samples per session



Assessor
selection

Basic
training

Specific
training

**Assessor
qualification**

Method
validation

Monitoring

Objective: To check if each assessor is ready to make up the expert panel

1- Repeatability in scores

Standard deviation in repeatability (SDR) ≤ 0.6 in $\geq 50\%$ of parameters

2- Reproducibility in scores

Standard deviation in reproducibility (SDRr) ≤ 0.6 in $\geq 50\%$ of parameters

3- Discrimination ability in scores

Discriminate the wines (A-B) by $\geq 50\%$ of parameters discriminative with the panel

Besides checking assessor scoring ...

**Necessary to check the ability to
identify attributes !!!**

Assessor
selection

Basic
training

Specific
training

Assessor
qualification

Method
validation

Monitoring

4- Reference identification

Correct identification of $\geq 50\%$ of references in each block

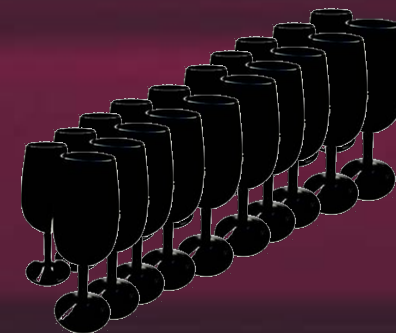
Correct identification of $\geq 65\%$ of all the references

Session 1

20 references of **odour**

20 references of **aroma**

10 references of **imbalance causes**



5- Attribute identification in wine

Citation of $\geq 50\%$ attributes cited by the panel

Sessions 2 and 3



Assessor
selection

Basic
training

Specific
training

Assessor
qualification

**Method
validation**

Monitoring

Objective: To check the reliability of the method applied by the expert panel

Parameters relative to scores:

1- Repeatability in scores

$\text{SDR} \leq 0.5$ for each parameter

2- Reproducibility in scores

$\text{SDRr} \leq 0.8$ for each parameter

3- Reproducibility in discrimination ability in scores

Discriminative parameters in session 2 between 50% and 150% of discriminative parameters in session 1

Assessor
selection

Basic
training

Specific
training

Assessor
qualification

Method
validation

Monitoring

How to deal with attribute citation ????

... no references available

Parameters relative to **attribute citation**:

4- Repeatability in attribute identification

Citation difference among replications ≤ 2 for $\geq 80\%$ of attributes with Citation Frequency (CF) $\geq 50\%$.

5- Reproducibility in attribute identification

Citation difference between sessions 1 and 2 ≤ 6 for $\geq 80\%$ of attributes with CF $\geq 50\%$.

6- Reproducibility in discrimination ability in attribute identification

Discriminative attributes in session 2 between 50% and 150% of the number of discriminative attributes in session 1.

Assessor
selection

Basic
training

Specific
training

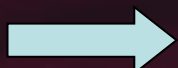
Assessor
qualification

Method
validation

Monitoring

Objective: To check the performance of the panel and each assessor
To check periodically the reliability of the method

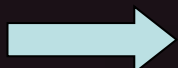
Annually



Assessor requalification

Same tests and criteria as in qualification

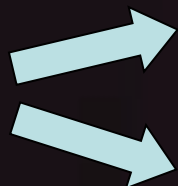
**Each 150
samples**



Quality control

Same tests and criteria as in method
validation

**At each
session**



Panel monitoring

Individual assessor monitoring

Assessor
selection

Basic
training

Specific
training

Assessor
qualification

Method
validation

Monitoring

At each session:

Panel monitoring

Score dispersion

SD ≤ 1 at least for 6 of the 8 parameters for each wine

Individual assessor monitoring

1- Score agreement with the panel

Assessor scores within rounded panel score ± 1 in at least 85% of the cases

2- Attribute agreement with the panel

2.a- Citation $\geq 50\%$ of the attributes identified by the panel

2.b- Number of attributes cited only by the assessor
 $< 3 \times$ number of samples



CONCLUSIONS

FIRST – The method developed in this work applied by a panel of expert assessors makes possible to evaluate the sensory quality of the young red wines from Rioja Alavesa in a rigorous and reliable way. The procedures and criteria about attribute citation developed for assessor qualification, method validation and control of assessor performance can be very useful for other laboratories and accreditation bodies.

SECOND – Working with a group of people with great knowledge of the product, use of decision trees and development of sensory references are very important aspects when developing methods to evaluate the sensory quality of specific products, especially when typicity is considered.

THIRD – The consideration of attribute citation frequency by the panel is an effective tool to determine the perception degree of an attribute in the product.

This information complements the numerical scores, so providing a more detailed description of the product quality.

Accreditation



Otorga la presente
Grants this Accreditation

ACREDITACIÓN

Vino tinto joven Rioja
Alavesa

Análisis sensorial:

- Mediante pruebas escalares
 - Intensidad de color
 - Matiz
 - Intensidad de olor
 - Complejidad de olor
 - Intensidad de aroma
 - Complejidad de aroma
 - Equilibrio - cuerpo
 - Persistencia aromática global

- Identificación de descriptores y defectos por mayoría

Procedimiento interno
PNTM-03

N, conforme a los criterios
LEC), para la realización de

MÉTODO DE ENSAYO

Procedimiento interno
PNTM-01

En Madrid, a 24 de Junio de 2005
In Madrid, June 24, 2005

El Presidente
President



D. Antonio Muñoz Muñoz

Este documento no tiene validez sin su anexo técnico correspondiente, cuyo número coincide con el de la acreditación.
The present accreditation is not valid without its corresponding technical annex, which number coincides with the accreditation.

La presente acreditación y su anexo técnico están sujetos a modificaciones, suspensiones temporales y retirada. El estado de vigencia de la misma puede confirmarse en el catálogo de ENAC (<http://www.enac.es>).
This accreditation and its technical annex could be modified, temporarily suspended and withdrawn. The state of validity of it can be confirmed at www.enac.es.

Ref. CLL2749



Acreditación nº 472/LE1020
Anexo Técnico Rev. 3
Fecha 29/02/08
Hoja 1 de 1

ALCANCE DE ACREDITACIÓN

UNIVERSIDAD DEL PAIS VASCO. Facultad de Farmacia
Departamento de Farmacia y Ciencias de los Alimentos
Laboratorio de Análisis Sensorial

Dirección: Facultad de Farmacia, Paseo de la Universidad, 7; 01006 Vitoria-Gasteiz (Álava)

Vino tinto joven Rioja
Alavesa

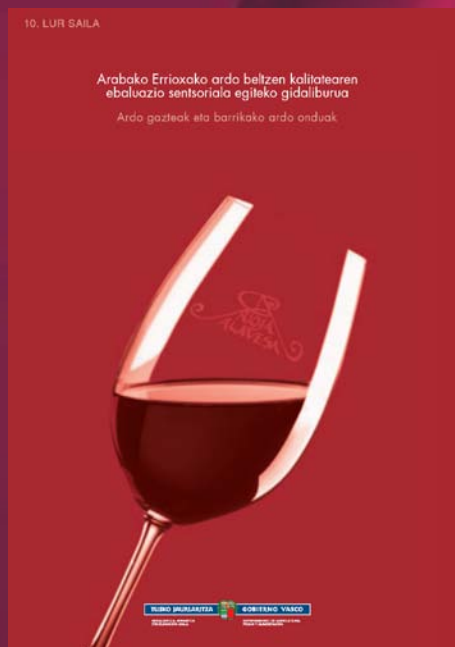
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 - Complejidad de aroma
 - Equilibrio - cuerpo
 - Persistencia aromática global

- Identificación de descriptores y defectos por mayoría

Procedimiento interno
PNTM-03

El presente anexo técnico está sujeto a posibles modificaciones. La vigencia de la acreditación puede confirmarse en la web de ENAC (<http://www.enac.es>)



Arabako Errioxako ardo beltzen kalitatearen ebaluazio sensoriala egiteko gidaliburua

Ardo gazteak eta barrikako ardo onduak

Guía para la evaluación sensorial de la calidad de los vinos tintos de Rioja Alavesa

Vinos jóvenes y vinos con crianza en barrica

Iñaki Etaio Alonso • Francisco José Pérez Elortondo • Marta Albisu Aguado
Jesús Salmerón Egea • Mónica Ojeda Atxiaga • Edurne Gastón Estanga

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Food Control (2009), doi:10.1016/j.foodcont.2009.08.013

Sensory quality control for food certification: A case study on wine. Method development

I. Etaio, M. Albisu, M. Ojeda, P.F. Gil, J. Salmerón, F.J. Pérez Elortondo *

Food Control (2009), doi:10.1016/j.foodcont.2009.08.011

Sensory quality control for food certification: A case study on wine. Panel training and qualification, method validation and monitoring

I. Etaio, M. Albisu, M. Ojeda, P.F. Gil, J. Salmerón, F.J. Pérez Elortondo *



**THANK YOU FOR YOUR
ATTENTION!**