TERRACOTTA VESSELS AND THE RESPECT TO THE OLD AND TRADITIONAL WINE MAKING

SENSORY EVALUATION OF WINE QUALITY

11th International Scientific Conference "Biotechnology and Quality of Raw Materials and Foodstuffs

Ángel A. Carbonell-Barrachina, Luis Noguera-Artiaga, Marina Blanco-Soriano, David López-Lluch, Pablo Calatayud, Francisco Burló

UNIVERSIDAD MIGUEL HERNÁNDEZ DE ELCHE

UNIVERSIDAD Miguel Hernández

ORIHUELA, ALICANTE (SPAIN)

PRIVATE COMPANIES

AJOS IMPERIO

MASSÓ

INNOFOOD

INNOFOOD I+D+I

LA CHINATA

ZURICH

Dialprix

natural antioxidant granatum plus

CONSERVAS FREDO Laredo

altabix

dicost

MUSGRAVE ESPAÑA

CampodeElche.com

Super Valu La compra ideal

DAFSA

ANGEL CAMACHO, S.A.

dialsur cash & carry

Danec s.a.

INDUSTRIAS LICORERAS DE GUATEMALA

Los más finos rones añejos... Para el mundo que celebra

PRIVATE COMPANIES

Consejo Regulador
de Jijona y Turrón de Alicante

GENERALITAT VALENCIANA
CONSELLERIA D'AGRICULTURA, PESCA I ALIMENTACIÓ

FUNDACIÓN TURRÓN DE JIJONA

1881 VALOR CHOCOLATES

TDC
Asociación de Fabricantes de Turrón, Derivados y Chocolate de la Comunidad Valenciana

SANCHIS MIRA, S.A.

Pablo Garrigós Ibáñez

1880
Desde 1725

el lobo

PICÓ

TURRONES Y DULCES
Enrique Garrigós Monerris

FOOD QUALITY AND SAFETY, CSA

QUALITY

- Effects of **units operation & farming practices** on **quality** (functionality, consumer, …) of fruits & vegetables:
  1. Pomegranate juice.
  2. Nuts: pistachio, almond.
  3. Olive, olive oil.
  4. *Turrón/nougat/torrone*.
- Application of **sensory evaluation** of food in the agro-food industry:
  1. Wine and rum.
  2. Chocolate, and confections.
  3. Ice-cream.
  4. Vegetables & fruits (juices).

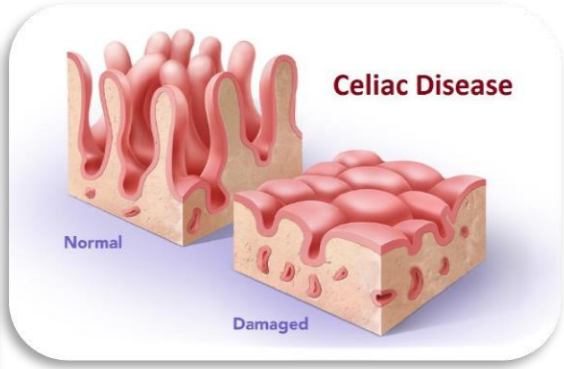
SAFETY

- Occurrence of **chemical pollutants (arsenic)** in foods:
  1. Vegetables from polluted areas (India).
  2. Infant foods.
  3. Food for celiac consumers.

SensoFood solutions

CSA

FOOD QUALITY AND SAFETY, CSA

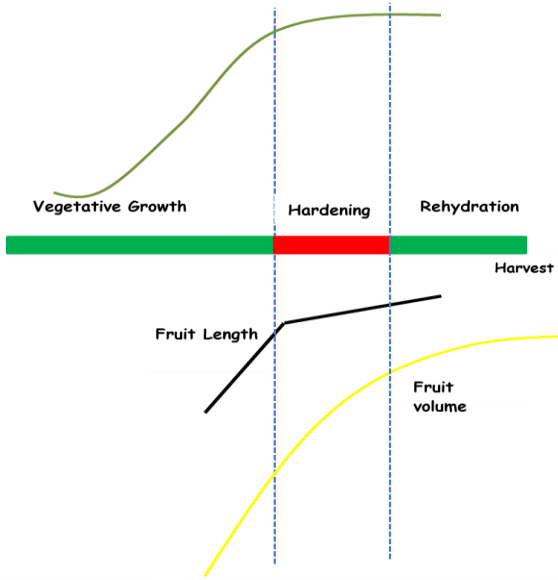


ARSENIC in rice products

PANEL TRAINING

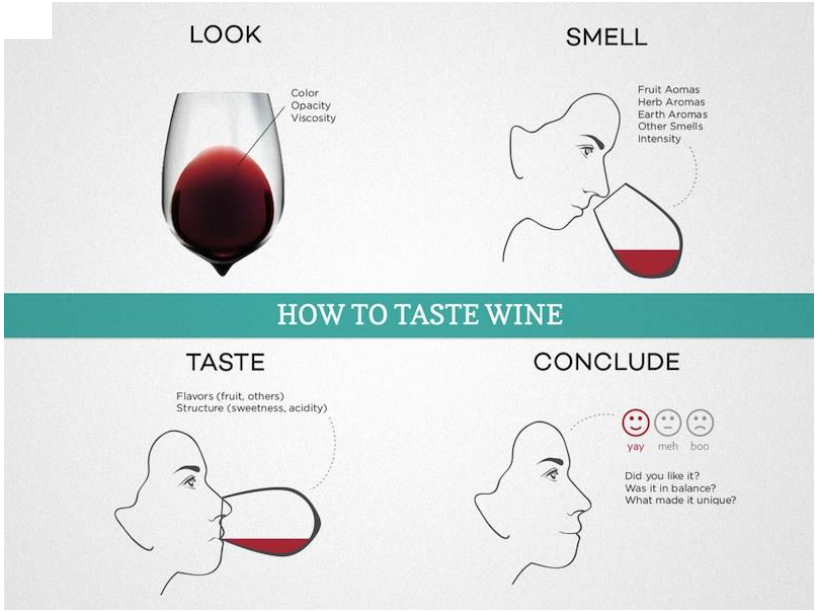
WINE quality

Hydro S.O.S tainable

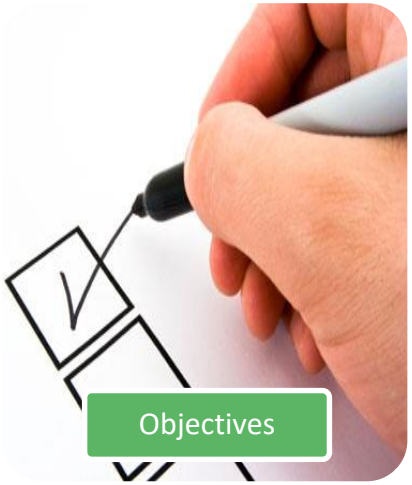


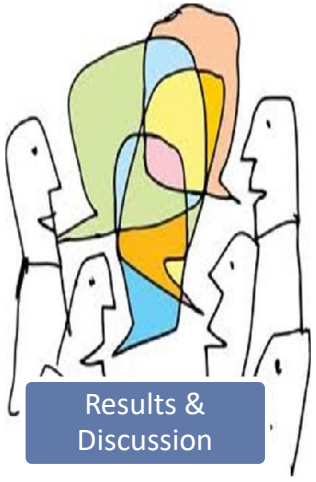
INDEX

1. Sensory evaluation of wine



2. Clay amphorae wine





TERRACOTTA VESSELS AND THE RESPECT TO THE OLD AND TRADITIONAL WINE MAKING

SENSORY EVALUATION OF WINE QUALITY

11th International Scientific Conference "Biotechnology and Quality of Raw Materials and Foodstuffs

Ángel A. Carbonell-Barrachina, Luis Noguera-Artiaga, Marina Blanco-Soriano, David López-Lluch, Pablo Calatayud, Francisco Burló

TRAINING OF SENSORY PANELS

http://www.bocopa.com

BOCOPA
BODEGAS

TRAINED PANELS: PDO WINES OF ALICANTE

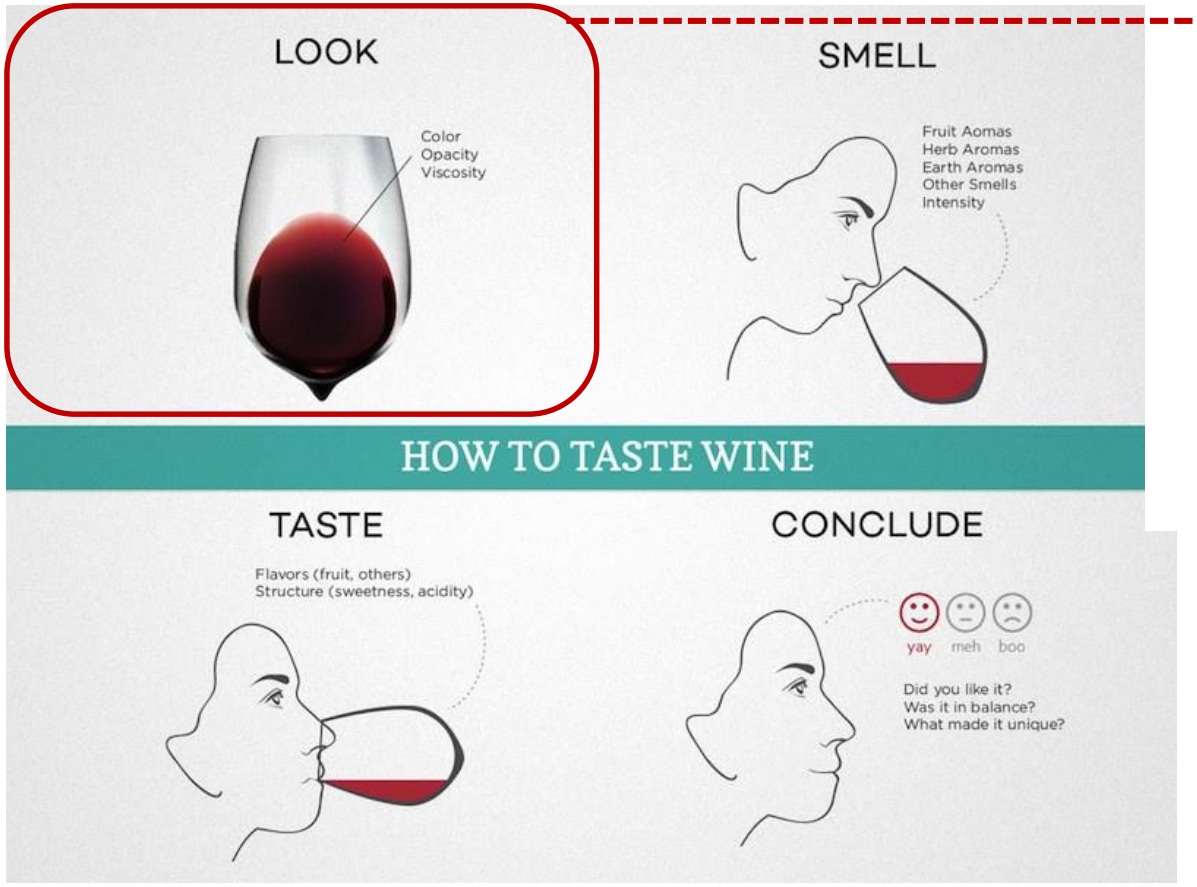
vinos alicante
DENOMINACIÓN DE ORIGEN

ISO 17065

http://www.vinosalicantedop.org/

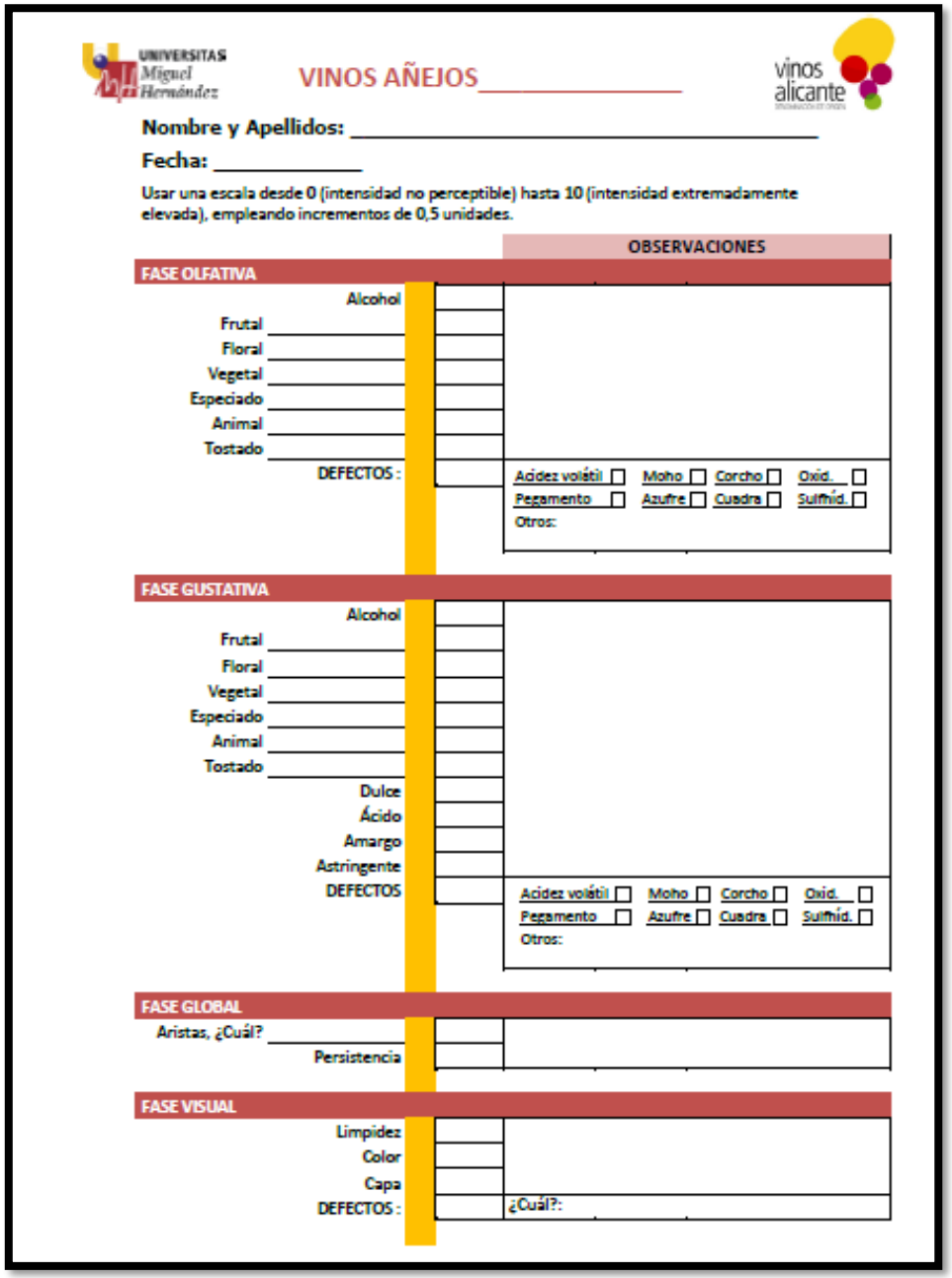
ENAC
CERTIFICACIÓN
Nº 118/C-PR198

Phases Order



Sensory evaluation			Clay amphorae		
Panels	Lexicon	*Fondillón*	Intro	M&M	R&D

Lexicon



UNIVERSITAS Miguel Hernández

VINOS AÑEJOS_____

vinos alicante

Nombre y Apellidos: _____

Fecha: _____

Usar una escala desde 0 (intensidad no perceptible) hasta 10 (intensidad extremadamente elevada), empleando incrementos de 0,5 unidades.

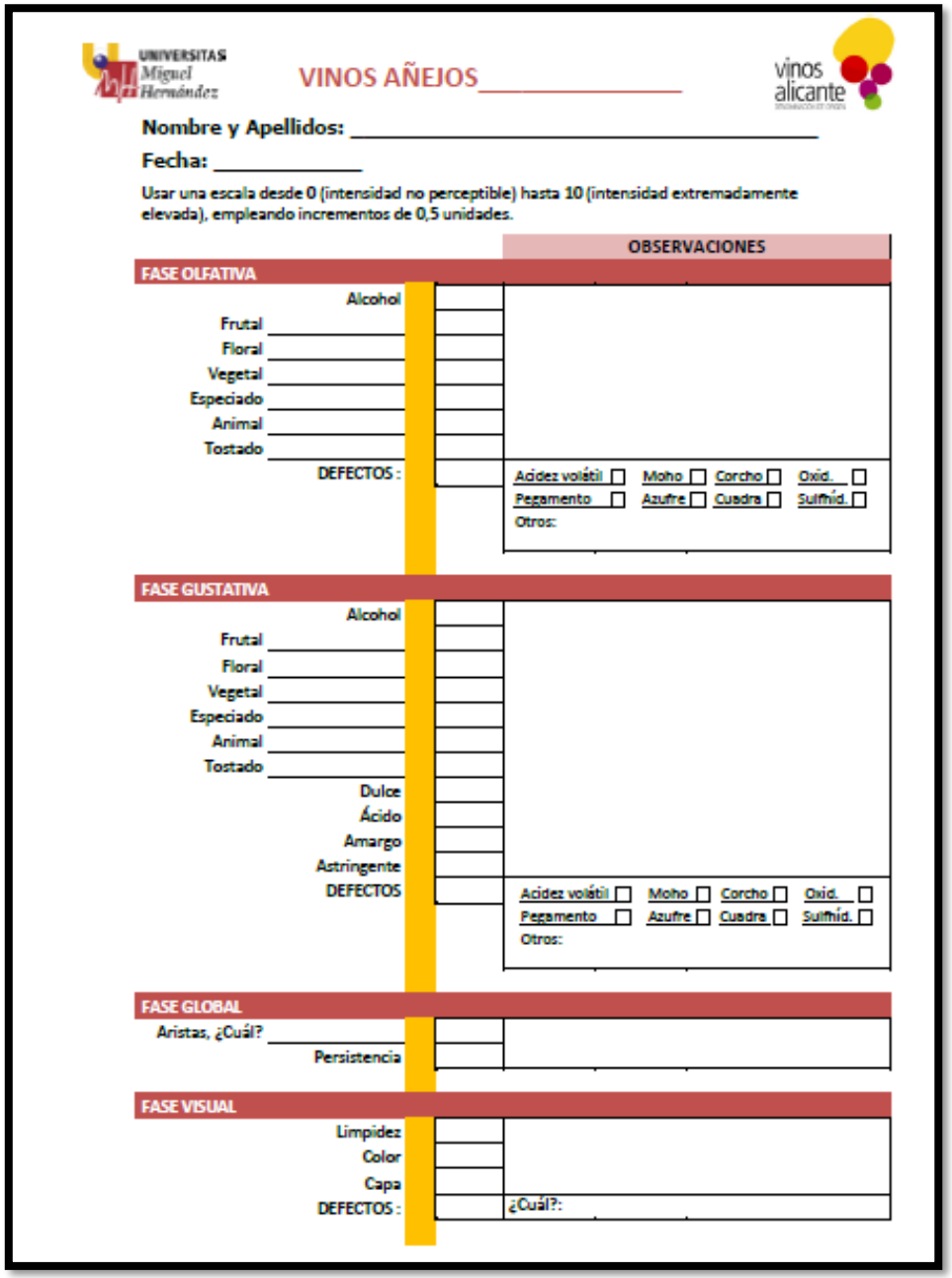
		OBSERVACIONES
FASE OLFATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
DEFECTOS :		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhid. ☐ Otros:
FASE GUSTATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
Dulce		
Ácido		
Amargo		
Astringente		
DEFECTOS		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhid. ☐ Otros:
FASE GLOBAL		
Aristas, ¿Cuál? _____		
Persistencia		
FASE VISUAL		
Limpidez		
Color		
Capa		
DEFECTOS :		¿Cuál?:

Avoid poetry: body??? Definition and …

Provide **reference materials** for each attribute.

Scale used from **0 to 10** (not 15)

Lexicon



UNIVERSITAS Miguel Hernández

VINOS AÑEJOS _____

vinos alicante

Nombre y Apellidos: _____

Fecha: _____

Usar una escala desde 0 (intensidad no perceptible) hasta 10 (intensidad extremadamente elevada), empleando incrementos de 0,5 unidades.

		OBSERVACIONES
FASE OLFATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
DEFECTOS :		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhíd. ☐ Otros:
FASE GUSTATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
Dulce		
Ácido		
Amargo		
Astringente		
DEFECTOS		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhíd. ☐ Otros:
FASE GLOBAL		
Aristas, ¿Cuál? _____		
Persistencia		
FASE VISUAL		
Limpidez		
Color		
Capa		
DEFECTOS :		¿Cuál?:

Rose: Floral aroma commonly associated to roses.

Reference: Geraniol

- 10 µg/L= 6

Odor Threshold (detection)= 4-75 µg/L (Burdock, 2010)

Range in wine= 1-221 µg/L

Sourness: Basic tasted associated to water or hydro-alcoholic solutions of tartaric acid.

Reference:

- 0,05 % Tartaric acid solution = 2.5
- 0,08 % Tartaric acid solution = 4,0
- 0,20 % Tartaric acid solution = 10,0

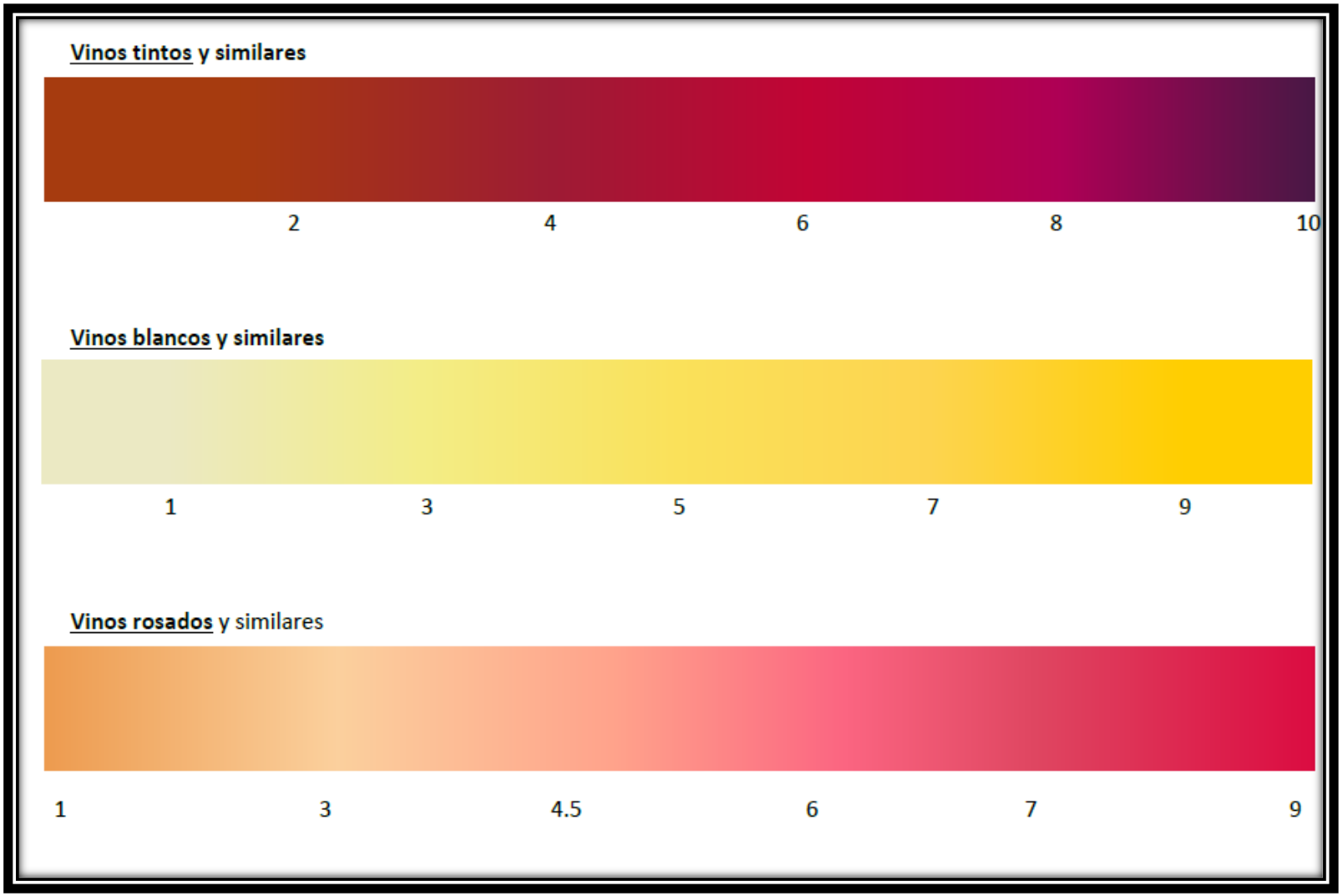
Bibliography: Spectrum (Meilgaard *et al.*, 2007) and Pickering y Demiglio 2008)

Imbalance: Attribute or attributes predominating over the rest, breaking the balance of the wine.

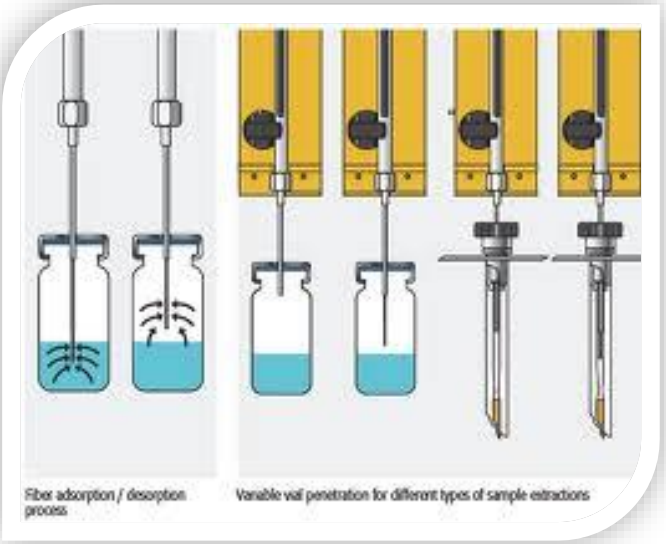
Reference:

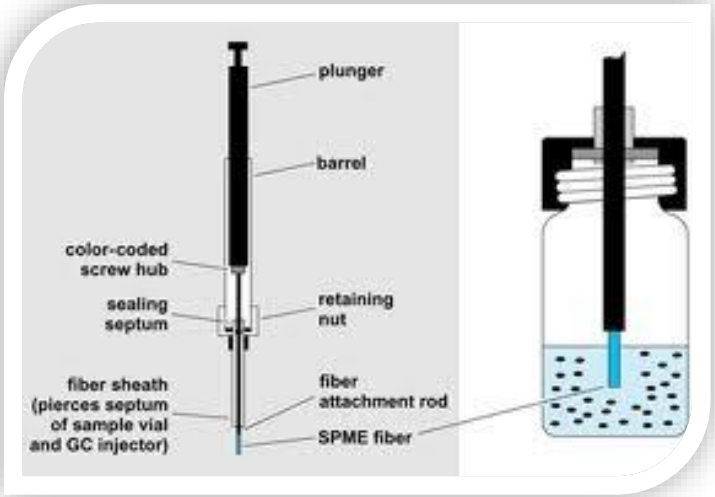
- None = 0
- *Sourness*: 2 g tartaric acid/L = 6
- *Astringency*: 4.0 g commercial tannin/L = 6
- *Bitterness*: 0.03 g quinine sulfate/L = 6
- *Alcohol*: 60 mL ethanol/L = 6

Bibliography: Etaio *et al.* (2010).

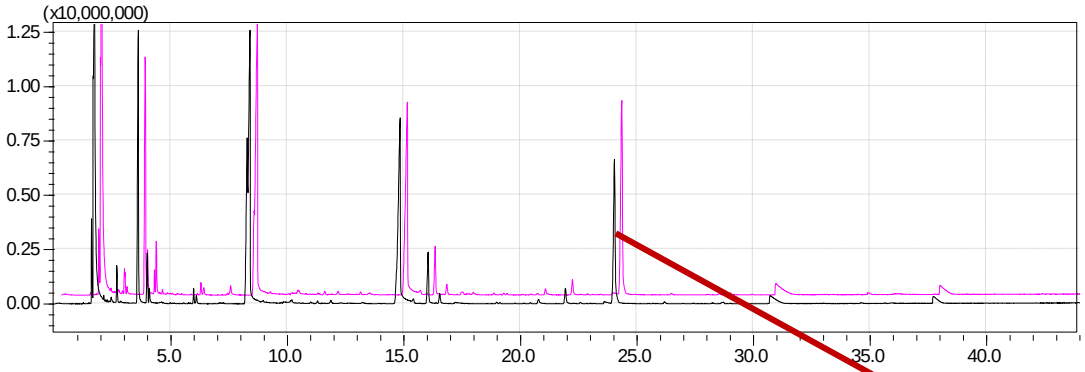

Vinos tintos y similares
2
4
6
8
10
Vinos blancos y similares
1
3
5
7
9
Vinos rosados y similares
1
3
4.5
6
7
9

Volatile Compounds





Volatile Compounds



UNIVERSITAS Miguel Hernández

VINOS AÑEJOS _____

vinos alicante

Nombre y Apellidos: _____

Fecha: _____

Usar una escala desde 0 (intensidad no perceptible) hasta 10 (intensidad extremadamente elevada), empleando incrementos de 0,5 unidades.

		OBSERVACIONES
FASE OLFATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
DEFECTOS :		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhíd. ☐ Otros:
FASE GUSTATIVA		
Alcohol		
Frutal _____		
Floral _____		
Vegetal _____		
Especiado _____		
Animal _____		
Tostado _____		
Dulce		
Ácido		
Amargo		
Astringente		
DEFECTOS		Acidez volátil ☐ Moho ☐ Corcho ☐ Oxid. ☐ Pegamento ☐ Azufre ☐ Cuadra ☐ Sulfhíd. ☐ Otros:
FASE GLOBAL		
Aristas, ¿Cuál? _____		
Persistencia		
FASE VISUAL		
Limpidez		
Color		
Capa		
DEFECTOS :		¿Cuál?:

Wine Aroma

Los aromas frutales	Los aromas frutales	Cítricos	1 Limón
			2 Pomelo
			3 Naranja
			4 Piña
		Frutas exóticas	5 Plátano
			6 Litchi
			7 Melón
			8 Uva moscatel
		Frutas con pepitas	9 Manzana
			10 Pera
			11 Membrillo
		Frutas rojas	12 Fresa
			13 Frambuesa
			14 Grosella
		Frutas negras	15 Grosella negra
			16 Arándano
			17 Mora
		Frutas con hueso	18 Cereza
			19 Albaricoque
			20 Melocotón
			21 Almendra (hueso)
		Frutos secos	22 Ciruela pasa
			23 Nuez
			24 Espino blanco
		Los aromas florales	25 Acacia
			26 Tilo
			27 Miel
			28 Rosa
			29 Violeta
Los aromas vegetales		Verdura	30 Pimiento verde
		Setas	31 Champiñón
			32 Trufa
			33 Levadura
		Maderizados	34 Cedro
			35 Pino
			36 Regaliz
		Herbáceos	37 Brote de grosella negra
			38 Heno cortado
			39 Tomillo
		Especiados	40 Vainilla
			41 Canela
			42 Clavo de olor
			43 Pimienta
			44 Azafrán
		Los aromas animales	45 Cuero
			46 Almizcle
			47 Mantequilla fresca
		Los aromas tostados	48 Pan tostado
			49 Almendra tostada
			50 Avellana tostada
			51 Caramelo
			52 Café
			53 Chocolate amargo
			54 Ahumado

Le Nez du Vin, Jean Lenoir

Low cost, low difficulty references

Classification

BLANCO CON ENVEJECIMIENTO

COLOR: entre amarillo y amarillo dorado
NARIZ: fruta golosa, toques de madera
BOCA: equilibrado, fresco, persistente. Mayor cuerpo

		DOP	Factor Determ.	Promedio	Media Acotada 20 %	Mediana
	Error admisible (unid.)	2.5				
FASE OLFATIVA	Alcohol	6.0		5.7	5.8	6.0
	Frutal	6.5	x	6.6	6.6	6.5
	Floral	4.0	x	4.1	4.3	4.5
	Vegetal	2.5	x	2.6	2.6	2.5
	Especiado	3.5		2.8	2.8	3.0
	Animal	1.0		0.6	0.5	0.0
	Tostado	2.5	x	1.1	1.1	1.0
	DEFECTOS	0.0	x	0.0	0.0	0.0
FASE GUSTATIVA	Alcohol	6.5		6.1	6.1	6.0
	Frutal	6.0	x	5.8	5.9	6.0
	Floral	4.0	x	5.2	5.3	6.0
	Vegetal	3.0	x	3.2	3.2	3.0
	Especiado	2.5		2.2	2.1	2.0
	Animal	1.0		0.2	0.1	0.0
	Tostado	2.0	x	0.4	0.4	0.5
	Dulce	1.5	x	1.7	1.6	1.5
	Ácido	5.5	x	6.8	6.8	6.5
	Amargo	2.5		2.2	2.2	2.0
	Astringente	1.5		1.6	1.6	1.5
	DEFECTOS	0.0	x	0.6	0.4	0.0
	Aristas	0.5	x	0.5	0.5	0.5
	Postgusto	6.5	x	6.2	6.2	6.0
FASE VISUAL	Limpidez	9.0		9.1	9.1	9.0
	Color	8.0		9.1	9.1	9.0
	DEFECTOS	0.0	x	0.0	0.0	0.0

DEFECTO	Sin defecto
RESULTADO ANÁLISIS	APTO

FONDILLÓN

vinos alicante
DENOMINACIÓN DE ORIGEN

http://www.vinosalicantedop.org/

FONDILLÓN

vinos alicante
DENOMINACIÓN DE ORIGEN

At least, **10 years of ageing**.

One of the oldest wines in the world.

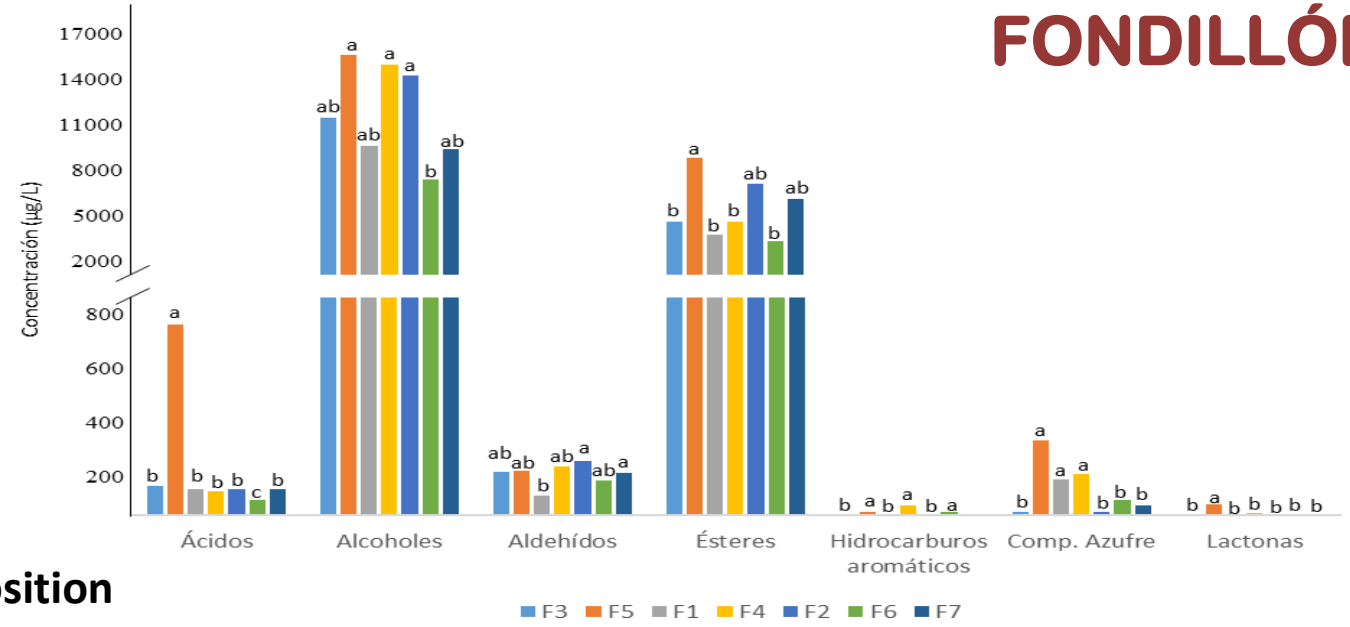
The Count of Monte Cristo used to drink Alicante wine, *fondillón*.

FONDILLÓN

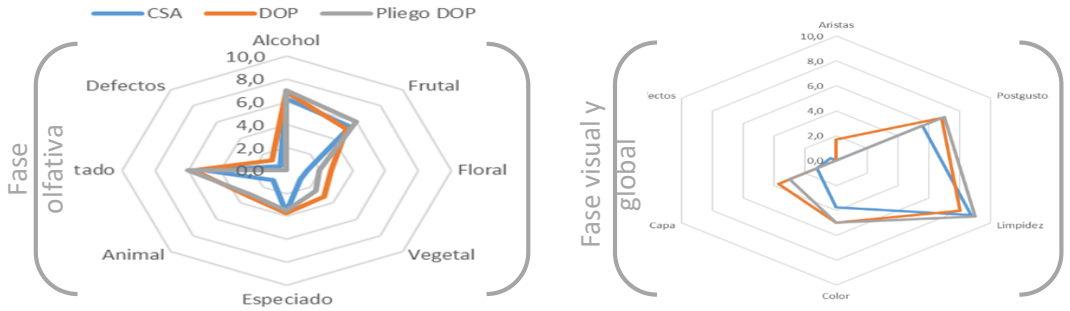
http://www.vinosalicantedop.org/

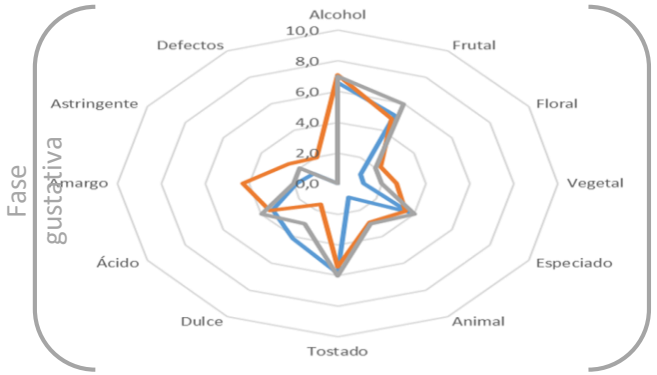
FONDILLÓN

vinos alicante
DENOMINACIÓN DE ORIGEN



Volatile composition





Sensory profile

TERRACOTTA VESSELS AND THE RESPECT TO THE OLD AND TRADITIONAL WINE MAKING

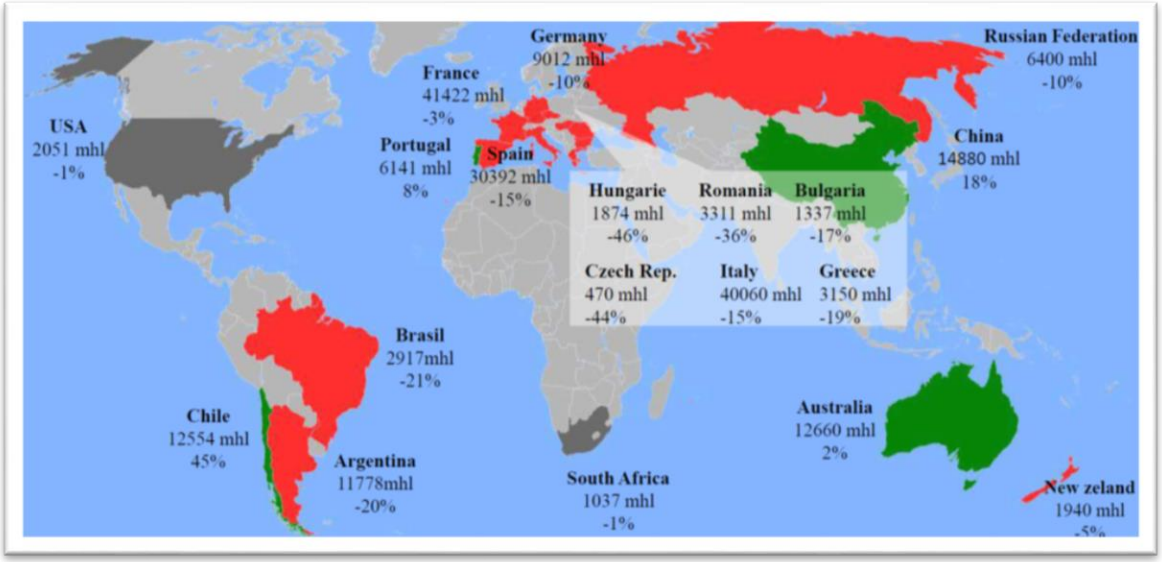
SENSORY EVALUATION OF WINE QUALITY

11th International Scientific Conference "Biotechnology and Quality of Raw Materials and Foodstuffs

Ángel A. Carbonell-Barrachina, Luis Noguera-Artiaga, Marina Blanco-Soriano, David López-Lluch, Pablo Calatayud, Francisco Burló

INTRODUCTION

TRENDS for Spanish wine



Top wine world exporters

	Mill. €				Mill. l.				€/l			
	2011	2012	Variation		2011	2012	Variation		2011	2012	Variation	
France	7 194.1	7 836.6	8.9%	7.2%	1 419.4	1 499.2	5.6%	-6.2%	5.07	5.23	3.1%	14.4%
Italy	4 404.7	4 690.6	6.5%		2 323.8	2 120.0	-8.8%		1.90	2.21	16.7%	
Spain	2 215.1	2 359.9	6.5%		2 254.9	1 947.2	-13.6%		0.98	1.21	23.4%	
Germany	981.4	973.7	-0.8%		415.1	396.0	-4.6%		2.36	2.46	4.0%	
Portugal	657.8	707.5	7.6%		307.6	338.6	10.1%		2.14	2.09	-2.3%	

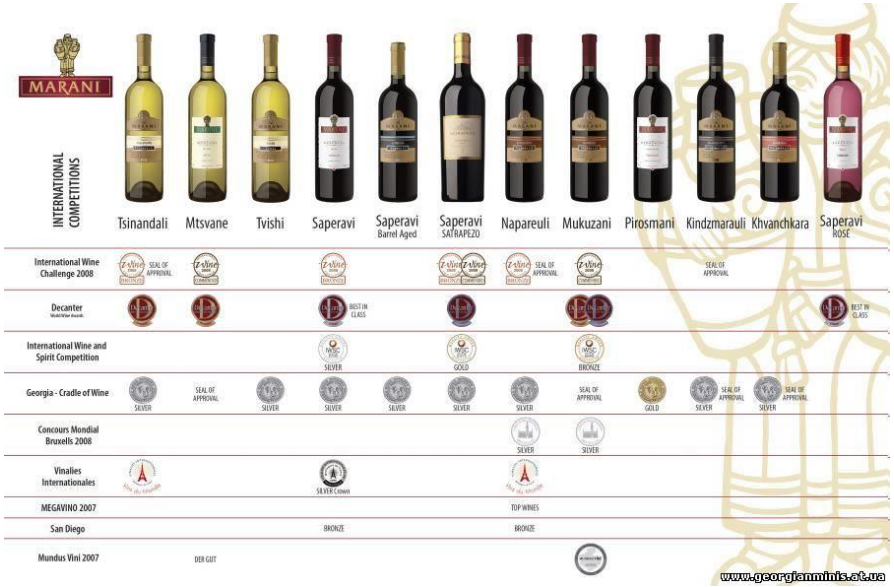
Spain needs to **produce less** volume of **wine**, especially of bulk wine, **but of HIGHER QUALITY**.

Wines with their own personality are needed.

This **could be** the case of the **wines** elaborated and/or aged in **CLAY JARS**.

An example of this type of wines is the Georgian **Kvevris**.

INTRODUCTION



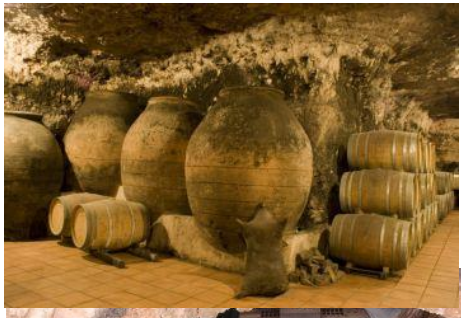
The success of the Georgian **Kvevris** wine is due to:

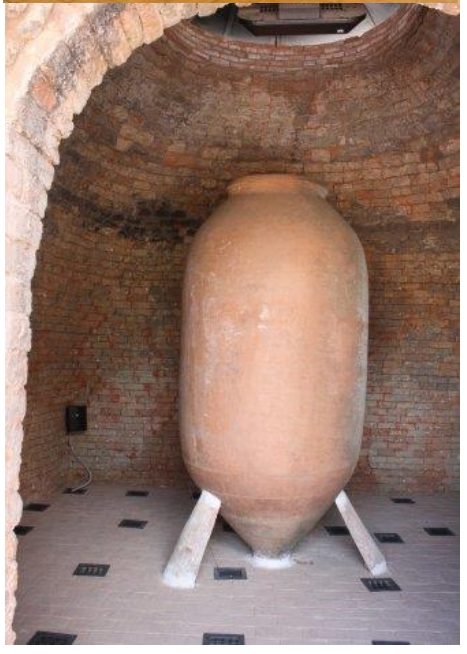
- Respect to the tradition & culture:
  - This wine is done by burying clay vessels since 4000 BC.
  - Use of local grape varieties.
  - …

These wines express:

- The sensory attributes of the local grapes without any extra artefact.

INTRODUCTION





Besides, this is nothing new in Spain.

Castilla-La Mancha region has a long tradition of using these clay containers.

So, why not to explore this type of wine and see how they behave… but **let's make a real scientific approach to the topic**.

1. INTRODUCTION

INTRODUCTION

History

In ancient times, various types and forms of amphorae (or jars) were used for storage of foods: wine, olive oil, table olives, etc.

In the Mediterranean sea, many amphorae have been found in ancient shipwrecks.

In amphorae excavated archaeological sites have been identified containing fish, grape seeds, cereal grains, and resins.

INTRODUCTION

Vessel type & wine storage & ageing

Why not?
What do you think?

INTRODUCTION

CLAY VESSELS & wine ageing

Wine ageing can be considered as a series of complex chemical reactions affecting the chemical composition of wine.

- Store
- Transport
- Serve

Ageing technic: clay vessels (amphorae)

Objective: reproduce the oxygen exchange happening in oak barrels but without the transfer of vanillin, tannins, and toasted notes.

Wines: different, with a clearer and more pronounced mineral and fresh characteristics

- Inert

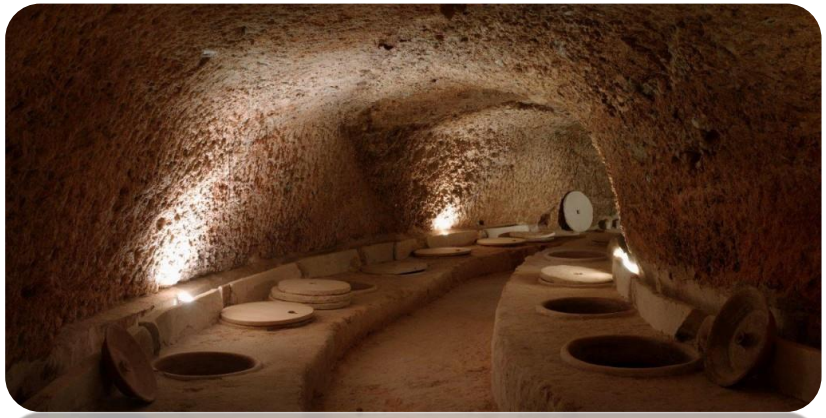
- Color
- Structure
- Phenolics
- Aroma

There is no scientific literature studying the effects of this type of wine ageing and comparing it with the traditional or current processes

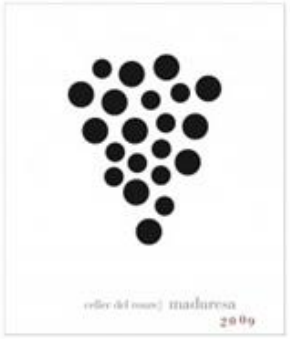
INTRODUCTION

Winery

Celler del Roure



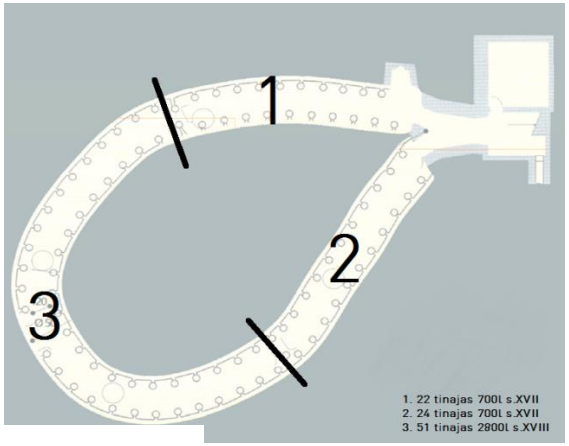
dragonfly

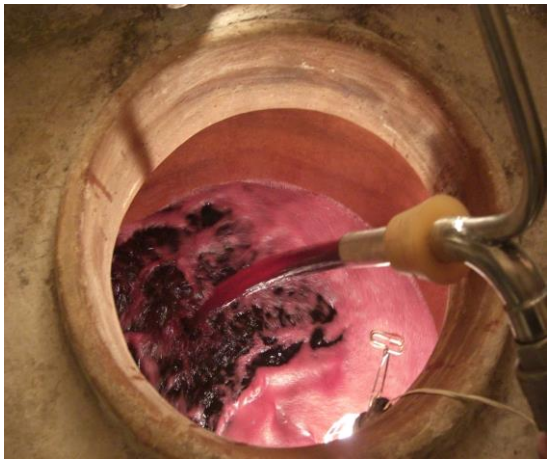


tadpole

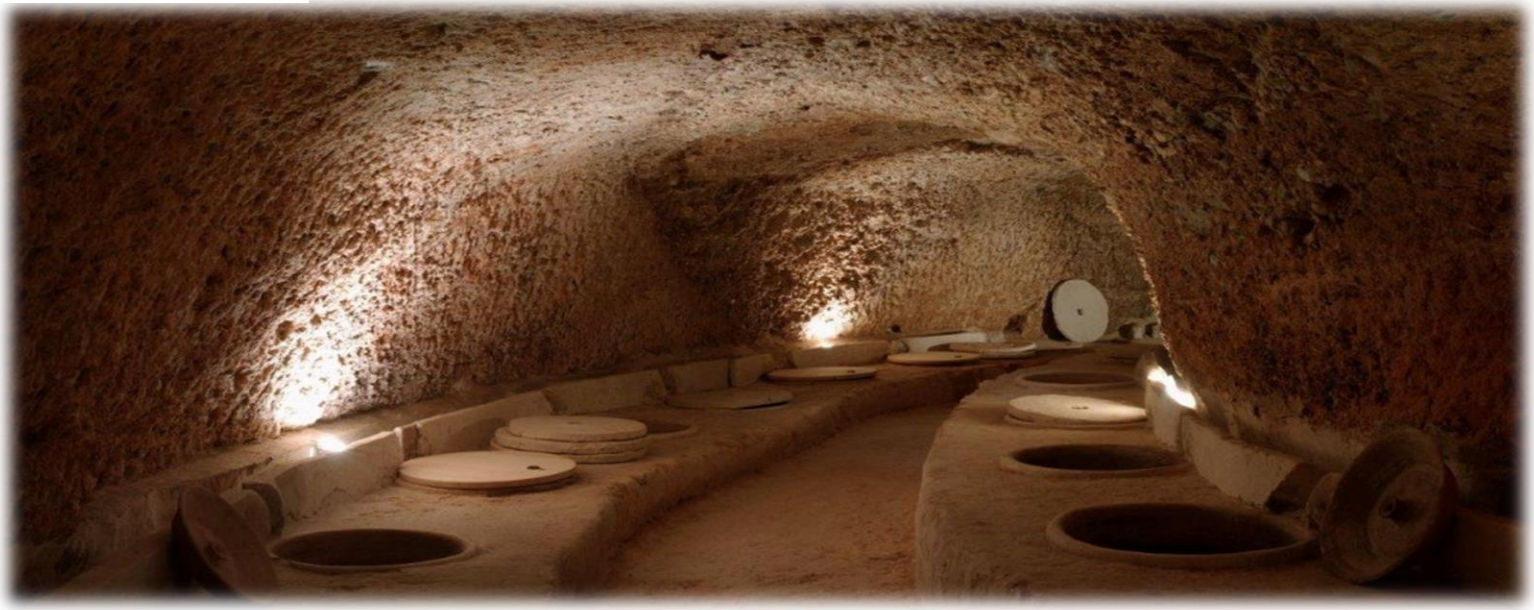
INTRODUCTION

This winery reopened “the deep winery (*bodega fonda*)”, which is a typical structure of this geographic area “*terres dels Alforins*”, where the clay vessels are buried in the ground and located in caves.





Celler del Roure



2. OBJECTIVES

OBJECTIVES

The aim of this work is to evaluate the potential use of two different types of containers (oak barrels & underground clay vessels) for the aging of wine. To achieve this aim, the following parameters are being controlled:

I PHYSICO-CHEMICAL

- pH.
- Acidity:
  - Total.
  - Volatile.
- Free and total sulfur dioxide.
- Reducing sugars.
- Volatile profile.
- Minerals.

II FUNCTIONAL

- Antioxidant activity.
- Total polyphenols.
- Hydroxycinnamic acids.
- Flavonols.
- Tannins.

III SENSORY

- Sensory evaluation.
- Consumer studies.

3. MATERIALS & METHODS

Wine comparison

Parotet (terracotta wine)

Control

- Same wine but stored in oak barrels

MATERIALS & METHODS

Wine → Garnacha tintorera

Winery → *Celler del Roure*

Ageing → OAK BARRELS: 31 October 2014
CLAY VESSELS: 31 October 2014

PRODUCT LAUNCH: January 2016

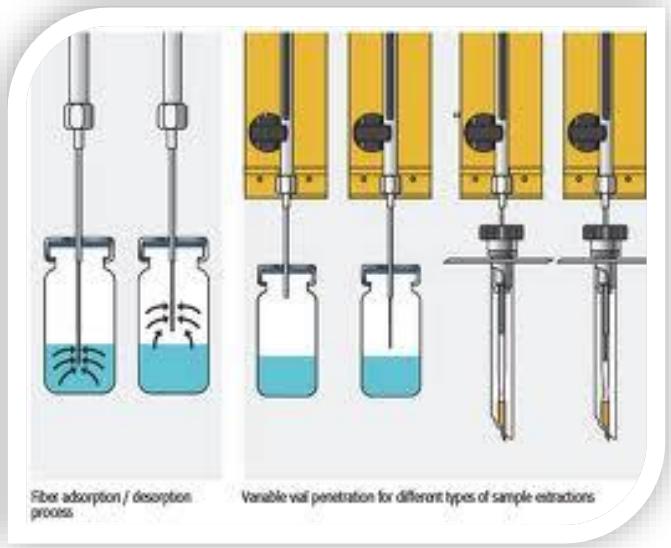
Sampling

- 27 July, 2015 (M1): 9 months.
- 10 August, 2015 (M2).
- 7 September, 2015 (M3)
- 21 September, 2015 (M4)
- 5 October, 2015 (M5).
- 31 January, 2016 (M6): 15 months.

STILL NOT FINISHED
ONGOING …

MATERIALS & METHODS

Physico-chemical analyses → Volatile compounds



SPME

GC Shimadzu GC-17A, GC-MS QP-5050

Will the volatile profile of clay wines be too simple as compared to that of oak wines?

MATERIALS & METHODS

Physico-chemical analyses → Minerals

Acid digestion using concentrated HNO_3

Atomic absorption-emission spectrometry, Unicam Solaar 969

Emission	K Na
Absorption	Ca Mg Cu Fe Mn Zn

Will contact with clay increase the contents of minerals in the wine?

MATERIALS & METHODS

Functional Analyses → Antioxidant capacity

DIRECT METHODS →

- DPPH•
- $ABTS^{+}$

INDIRECT METHOD →

- FRAP

Will aeration (contact with O_2) in clay vessels decrease the AA of the wine?

MATERIALS & METHODS

Affective sensory analysis → Triangle test, consumers (30, M5)

The judges received a set of 3 samples and were informed that 2 of the samples were the same and 1 was different.

MATERIALS & METHODS

Descriptive analysis → Sensory profile, trained panelists (7, M5)

	INTENSIDAD				
	Baja	Media/Baja	Media	Media/Alta	Alta
FASE OLFATIVA					
Alcohol	☐	☐	☐	☐	☐
Frutal	☐	☐	☐	☐	☐
Floral	☐	☐	☐	☐	☐
Vegetal	☐	☐	☐	☐	☐
Especiado	☐	☐	☐	☐	☐
Tostado	☐	☐	☐	☐	☐
FASE GUSTATIVA					
Alcohol	☐	☐	☐	☐	☐
Frutal	☐	☐	☐	☐	☐
Floral	☐	☐	☐	☐	☐
Vegetal	☐	☐	☐	☐	☐
Especiado	☐	☐	☐	☐	☐
Tostado	☐	☐	☐	☐	☐
Dulce	☐	☐	☐	☐	☐
Ácido	☐	☐	☐	☐	☐
Amargo	☐	☐	☐	☐	☐
Astringente	☐	☐	☐	☐	☐
FASE GLOBAL					
Persistencia	☐	☐	☐	☐	☐
FASE VISUAL					
Limpidez	☐	☐	☐	☐	☐
Capa	☐	☐	☐	☐	☐

DEFECTOS

SÍ ☐ NO ☐

↓

¿Cuál?:

MUCHAS GRACIAS POR SU COLABORACIÓN

4. RESULTS & DISCUSSION

RESULTS & DISCUSSION

Physico-chemical Analyses

pH, total acidity (g tartaric acid/L), volatile acidity (g acetic acid/L), free SO_2 (mg/L), total SO_2 (mg/L) and reducing sugars (g/L)

	PHYSICO-CHEMICAL ANALYSES					
	pH	Total acidity	Volatile acidity	Free SO_2	Total SO_2	Reducing sugars
			ANOVA TEST[+]			
Container	NS	NS	NS	NS	NS	NS
Time	NS	NS	NS	*	*	NS
			TUKEY TEST[‡]			
CONTAINER						
Clay jars	3,57	5,35	0,56	14,1	43,2	3,15
Oak barrel	3,54	5,35	0,61	14,5	45,7	3,40
TIME						
M1	3,55	5,35	0,60	15,2 a	39,2 b	3,25
M5	3,56	5,35	0,62	13,1 b	48,3 a	3,40

[†] NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

[‡] Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

RESULTS & DISCUSSION

Physico-chemical Analyses

Isoamyl acetate

Hexyl acetate

	VOLATILE COMPOSITION (µg/L)								
	CONTAINER			TIME					
	ANOVA⁺	Barrel	Jar	ANOVA⁺	M1	M2	M3	M4	M5
		(µg/L)					(µg/L)		
Acetato de etilo	*NS*	255	294	*NS*	253	360	222	248	290
Etanol	*NS*	4737	5137	*NS*	6822	4288	2478	4393	6707
Etil butirato	*NS*	4,6	6,2	*NS*	5,0	7,0	4,5	4,5	6,0
Etil 2 metilbutirato	*NS*	2,4	2,2	*NS*	2,0	2,5	2,0	1,5	3,5
Etil isovalerato	*NS*	2,6	3,0	*NS*	3,0	3,5	2,5	2,0	3,0
Ácido propiónico	*NS*	6,6	10,4	*NS*	7,0	10,0	6,5	9,0	10,0
Isoamyl acetate	*	33,6 b‡	54,4 a	*NS*	35,5	63,0	40,5	35,5	45,5
Alcohol isoamílico	*NS*	622	764	*NS*	746	810	499	607	804
Etil n-caproato	*NS*	76,0	98,0	*NS*	82,0	115,0	79,0	64,0	95,0
Hexyl acetate	*	1,0 b	2,2 a	*NS*	1,5	2,5	1,5	1,0	1,5
Etil heptanoato	*NS*	1,8	2,0	*NS*	2,0	2,0	2,0	1,5	2,0
1-octen-3-ol	*NS*	1,4	4,8	*NS*	5,5	2,5	2,0	3,0	5,0
Etil lactato	*NS*	41,2	46,8	*NS*	64,0	35,0	21,0	39,5	64,0
1-Hexanol	*NS*	11,8	15,4	*NS*	13,5	17,5	10,5	11,5	15,0
Octil acetato	*NS*	0,3	0,6	*NS*	1,5	0,1	0,3	0,1	0,4
Metil octanoato	*NS*	22,8	23,7	*NS*	1,1	2,0	1,8	1,1	2,6
Etil caprilato	*NS*	625	685	*NS*	735	657	636	501	749
Ácido acético	*NS*	63,9	57,4	*NS*	68,6	58,5	34,1	54,6	87,6
Decilaldehído	*NS*	2,5	5,6	*NS*	6,6	2,5	4,9	2,7	3,5
Indefinido	*NS*	11,8	11,0	*NS*	17,5	9,2	11,3	9,4	9,9
n-Octanol	*NS*	3,4	4,8	*NS*	3,8	4,9	3,6	3,6	4,6
Etil decanoato	*NS*	310	313	*NS*	347	269	316	233	392
Nonanol	*NS*	5,9	5,0	*NS*	7,4	4,2	6,5	3,6	5,8
Ácido butanedioico	*NS*	161	150	*NS*	183	169	118	118	189
Etil 9-decenoato	*NS*	11,9	8,3	*NS*	11,0	9,5	9,1	6,9	14,0
Fenetil acetato	*NS*	9,9	10,8	*NS*	11,3	10,4	7,8	8,9	13,3
Etil laurinato	*NS*	20,1	16,8	*NS*	19,9	15,5	21,1	14,7	21,0
Ácido hexanoico	*NS*	6,1	8,1	*NS*	3,1	9,2	6,9	5,9	10,6
Etil 3-metilbutil succinato	*NS*	12,2	8,8	*NS*	11,5	10,3	8,2	8,4	14,2
Fenetil alcohol	*NS*	376	416	*NS*	399	441	313	309	519
Dodecanol	*NS*	0,9	1,3	*NS*	1,8	0,9	0,8	0,9	1,4
Nerolidol	*NS*	2,1	1,8	*NS*	2,0	1,5	2,0	1,6	2,9
Ácido octanoico	*NS*	57,9	54,2	*NS*	58,1	61,1	48,7	41,6	70,8
Ácido decanoico	*NS*	22,9	23,4	*NS*	23,9	25,2	20,4	18,7	27,8

† NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

‡ Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

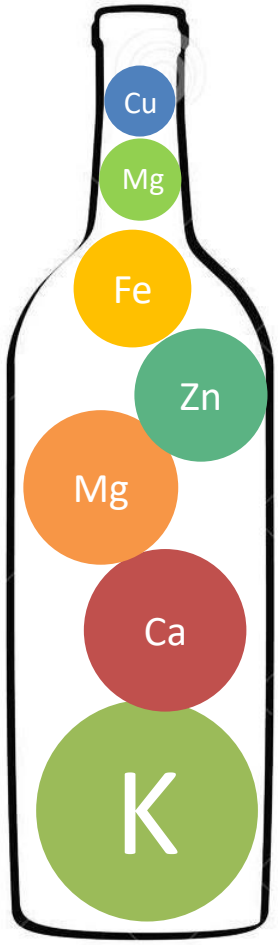
RESULTS & DISCUSSION

Physico-chemical Analyses

	MINERAL COMPOSITION (µg/L)							
	Micro-nutrients (µg/L)				Macro-nutrients (µg/L)			
	Fe	Cu	Mn	Zn	Mg	K	Ca	Na
	ANOVA TEST†							
Container	NS	NS	NS	NS	NS	*	*	NS
Time	**	NS	NS	NS	**	***	***	***
	TEST TUKEY‡							
CONTAINER								
Clay jar	2,3	0,27	0,48	0,57	116	774 a	55,6 a	31,9
Oak barrel	2,1	0,26	0,46	0,56	113	709 b	50,1 b	30,8
TIME								
M1	2,1 a	0,21	0,48	0,52	106,8 b	649 b	51,3 b	29,8 b
M2	2,5 a	0,23	0,46	0,54	103,8 b	737 b	61,3 a	23,6 b
M3	2,6 a	0,29	0,45	0,55	101,5 b	917 a	68,4 a	24,0 b
M4	1,6 b	0,25	0,51	0,59	133,6 a	714 b	47,6 b	40,6 a
M5	1,5 b	0,24	0,43	0,60	120,2 a	689 b	48,1 b	38,9 a

† NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

‡ Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).



Clay jar

RESULTS & DISCUSSION

Functional analyses

	ANTIOXIDANT CAPACITY (mmol)		
	ABTS	DPPH	FRAP
FACTOR		ANOVA[+]	
Container	NS	NS	NS
Time	NS	NS	NS
		TUKEY's TEST[‡]	
CONTAINER			
Clay jar	2,92	0,126	0,92
Oak barrel	2.85	0.124	0.89
TIME			
M1	2.66	0.133	0.90
M2	2.65	0.134	0.94
M3	2.81	0.131	0.91
M4	3.09	0.131	0.92
M5	3.22	0.131	0.85

[†] NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

[‡] Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

RESULTS & DISCUSSION

Functional analyses

	TOTAL POLYPHENOLS (mg/L) TPC
FACTOR	**ANOVA TEST⁺**
Container	NS
Time	NS
	TUKEY TEST‡
CONTAINER	
Clay jar	251
Oak barrel	262
TIME	
M1	269
M2	243
M3	268
M4	263
M5	240

	ÁCIDOS HIDROXICINÁMICOS (mg/L)
FACTOR	**ANOVA TEST⁺**
Container	NS
Time	NS
	TUKEY TEST‡
CONTAINER	
Clay jar	39,0
Oak barrel	38,9
TIME	
M1	37,1
M2	38,9
M3	37,8
M4	40,0
M5	38,6

† NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

‡ Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

RESULTS & DISCUSSION

Functional analyses

	FLAVONOLS (mg/L)
FACTOR	**ANOVA TEST†**
Container	NS
Time	NS
	TEST TUKEY‡
CONTAINER	
Clay jar	11,6
Oak barrel	11,5
TIME	
M1	11,43
M2	11,90
M3	11,85
M4	11,65
M5	10,85

	TANNINS (mg/L)
FACTOR	**ANOVA TEST†**
Container	NS
Time	NS
	TEST TUKEY‡
CONTAINER	
Clay jar	2,9
Oak barrel	3,1
TIME	
M1	3,0
M2	2,9
M3	3,0
M4	3,2
M5	3,0

† NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

‡ Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

RESULTS & DISCUSSION

Sensory Analyses

Triangle test:

16 right answers out of 40 panelists

NS

Tabla I

Niveles de significación de la prueba triangular

Número de respuestas	Número mínimo de respuestas necesarias para alcanzar un nivel de significación de			Número de respuestas	Número mínimo de respuestas necesarias para alcanzar un nivel de significación de			Número de respuestas	Número mínimo de respuestas necesarias para alcanzar un nivel de significación de		
	5%	1%	0,1%		5%	1%	0,1%		5%	1%	0,1%
5	4	5	–	37	18	20	22	69	31	33	36
6	5	6	–	38	19	21	23	70	31	34	37
7	5	6	7	39	19	21	23	71	31	34	37
8	6	7	8	40	19	21	24	72	32	34	38
9	6	7	8	41	20	22	24	73	32	35	38
10	7	8	9	42	20	22	25	74	32	35	39
11	7	8	10	43	20	23	25	75	33	36	39
12	8	9	10	44	21	23	26	76	33	36	39
13	8	9	11	45	21	24	26	77	34	36	40
14	9	10	11	46	22	24	27	78	34	37	40
15	9	10	12	47	22	24	27	79	34	37	41
16	9	11	12	48	22	25	27	80	35	38	41
17	10	11	13	49	23	25	28	81	35	38	41
18	10	12	13	50	23	26	28	82	35	38	42
19	11	12	14	51	24	26	29	83	36	39	42
20	11	13	14	52	24	26	29	84	36	39	43
21	12	13	15	53	24	27	30	85	37	40	43
22	12	14	15	54	25	27	30	86	37	40	44
23	12	14	16	55	25	28	30	87	37	40	44
24	13	15	16	56	26	28	31	88	38	41	44
25	13	15	17	57	26	28	31	89	38	41	45
26	14	15	17	58	26	29	32	90	38	42	45
27	14	16	18	59	27	29	32	91	39	42	46
28	15	16	18	60	27	30	33	92	39	42	46
29	15	17	19	61	27	30	33	93	40	43	46
30	15	17	19	62	28	30	33	94	40	43	47
31	16	18	20	63	28	31	34	95	40	44	47
32	16	18	20	64	29	31	34	96	41	44	48
33	17	18	21	65	29	32	35	97	41	44	48
34	17	19	21	66	29	32	35	98	41	45	48
35	17	19	22	67	30	33	36	99	42	45	49
36	18	20	22	68	30	33	36	100	42	46	49

NOTAS

1 Los valores dados en la tabla han sido calculados a partir de la fórmula exacta de la distribución binomial de parámetro $p = 1/3$ con n respuestas.

2 Cuando el número de respuestas es superior a 100 ($n > 100$) es necesario utilizar la fórmula siguiente, basada en la aproximación de la distribución binomial a la normal y que proporciona el número real de juicios a obtener con un error como máximo de 1 unidad.

El número mínimo de respuestas (X) es el valor entero más próximo a:

$$X = 0{,}417\,4\,z \cdot \sqrt{n} + \frac{(2n+3)}{6}$$

donde

$z = 1{,}64$, para $\alpha < 0{,}05$

$z = 2{,}33$, para $\alpha < 0{,}01$

$z = 3{,}10$, para $\alpha < 0{,}001$

RESULTS & DISCUSSION

Sensory Analyses

		SENSORY PROFILE		
		ANOVA[†]	Oak barrel	Clay jar
Odor	Alcohol	NS	2,4	2,5
	Fruity	NS	3,1	3,2
	Floral	NS	2,4	2,6
	Vegetal	NS	2,1	2,1
	Spicy	NS	2,5	2,6
	Toasted	NS	2,0	1,9
Flavor	Alcohol	NS	2,7	2,9
	Fruity	NS	2,6	2,8
	Floral	NS	2,5	2,3
	Vegetal	NS	2,4	2,2
	Spicy	*	2,8 a[‡]	2,4 b
	Toasted	NS	2,1	1,9
	Sweet	NS	2,0	2,2
	Sour	*	2,4 b	2,7 a
	Bitter	NS	2,7	2,5
	Astringent	NS	3,3	3,4
Global	Aftertaste	*	3,2 b	3,5 a
Appearance	Limpidity	NS	4,2	4,1
	Color intensity	NS	3,7	3,8
	Off-flavors	NS	NO	NO

[†] NS, not significant *Fratio* ($p \leq 0,05$). * difference significant at $p \leq 0,05$.

[‡] Values followed by the same letter, within the same factor, were not statistically different ($p \leq 0,05$).

5. CONCLUSIONS

CONCLUSIONS

- Wineries really have a need to include sensory evaluation in their quality systems. Thus, there is a need of sensory **professionals** to develop proper lexicons and to implement routine systems of quality control.

- **Spain needs** to change their global strategy regarding wine, **reducing** the **global production** especially of **bulk wine**, but **increasing the quality** of the wine (as previously done by Italy and France).

- **Wine** prepared in **clay jars** or terracotta vessels could be one of the several strategies to improve the quality of Spanish wine by preparing wines **reflecting the main sensory profiles of the local grape varieties** and not being masked by wood notes.

SensoFood Solutions
http://www.sensofoodsolutions.com

CSA team 2015


Merci beaucoup
Thank You
お疲れ様
Gracias
Danke
Grazie
Dank u
谢谢你
Thanks
Obrigado