

4rd International Conference and Exhibition on Food Processing & Technology

The identification of the main glass parameters involved on the definition of the expression of a wine during tasting experience.

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10-12 August, London, UK





... several kind of vessels are now available for the consumers

The design parameters are now guided more by aesthetic reasons rather than functional ones

Aim of the research...

...to select some parameters allowing to well correlate beverage sensory properties with glass characteristics which can be used for the design of a drinkware.

The best parameters selected can represent the key features to act on in order to redesign "the ideal glass" as a function of the type of the wine tasted.



WINE (Full bodied red or rosé) = tool



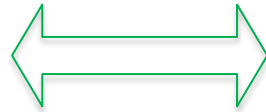
Object of investigation = VESSEL

The question is...

How to evaluate the influence of the glass characteristics on the wine expression as a function of the tasting time?

Our answers

Evolution of
chemical/physical
profile of poured wine



Evolution of sensorial
profile of poured wine



Final goal:

a new "integrated approach", deriving from the merging of the chemical, physical and sensorial data, can be used to design (or to select among those already existing) the optimum vessel for increasing the enjoyment of the consumer during the wine assessing.

Materials e methods

A full-bodied red wine (Castello di Ama, DOCG) aged in oak barrels and obtained utilizing grapes harvested in Chianti Classico region (Italy).

Blend: Sangiovese 80%, Merlot and Cabernet Franc 20%.

Wines utilised

Castello di Ama Rosato IGT is made through the saignée method from the lots of wine which go into the Castello di Ama DOCG, so that the resulting wine is closer in character to a red wine than to a white one. The grapes were harvested at Castello di Ama winery, in Chianti Classico region (Italy).



Vessels utilized for the experimental runs

Experimental code	Glass A	Glass B	Glass C	Glass D	Glass E	Glass F
Bormioli's factory code	Premium Mod. 1	Premium Mod. 2	Premium Mod. 5	Premium Mod. 10	Premium Mod. 15	Premium Mod. 9
Glass capacity (L)	0.720	0.378	0.574	0.465	0.556	0.289
Maximum diameter (m)	0.107	0.081	0.108	0.086	0.093	0.075
Top diameter (m)	0.084	0.062	0.090	0.067	0.067	0.054
Diameter of wine surface	0.098	0.078	0.098	0.083	0.093	0.074
						

Materials e methods

Main geometrical and chemical/physical evaluations

- Determination of the main geometrical parameters that characterise the vessels
- ✓ Oxigenation profile $\Leftrightarrow$ Wine evolution as induced by O_2
- ✓ Temperature profile $\Leftrightarrow$ Taste; smell
- ✓ Evaporation profile $\Leftrightarrow$ Loss of odors
- TTA and pH $\Leftrightarrow$ Taste
- Volatile acidity $\Leftrightarrow$ smell/franckness
- SO_2 free and combined $\Leftrightarrow$ color; taste; smell. Antyoxidant power
- Total phenols $\Leftrightarrow$ color; taste; structure
- Total Anthocyanins $\Leftrightarrow$ color
- Free Anthocyanins $\Leftrightarrow$ color stability
- Proanthocyanidins $\Leftrightarrow$ (color); taste; structure

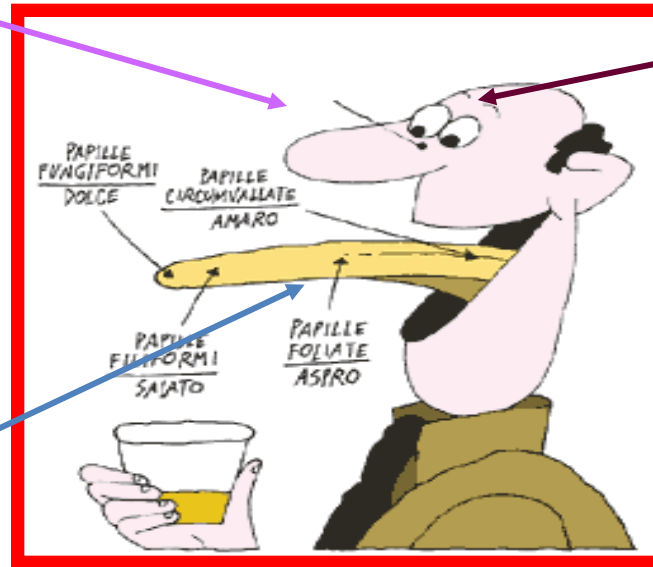
Materials e methods

Parameters evaluated by sensorial analysis of wine:

Smell:
fineness, intensity,
frankness, harmony

View:
clearness,
color and viscosity

Taste:
acidity, astringency
sweetness, balance,
frankness, structure



➤ All the
assessments were
repeated in double

➤ Tasting time = 120 min after the filling of the glasses, with three different assessments (t=0, 40', 120')

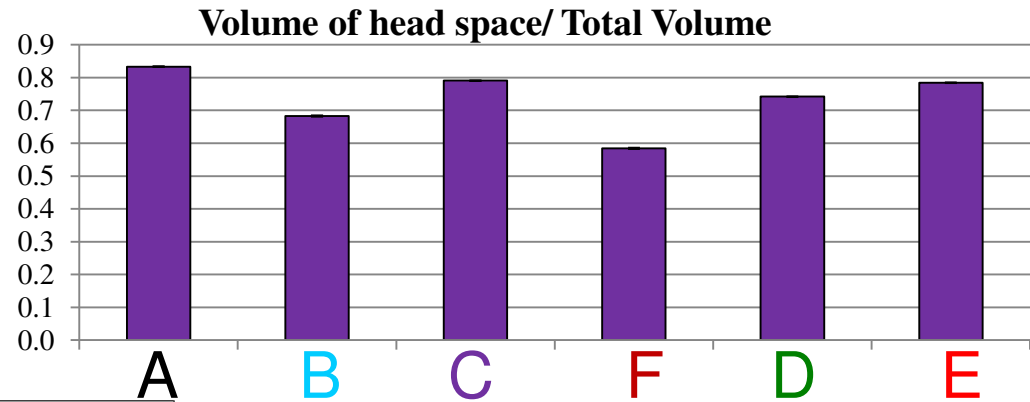
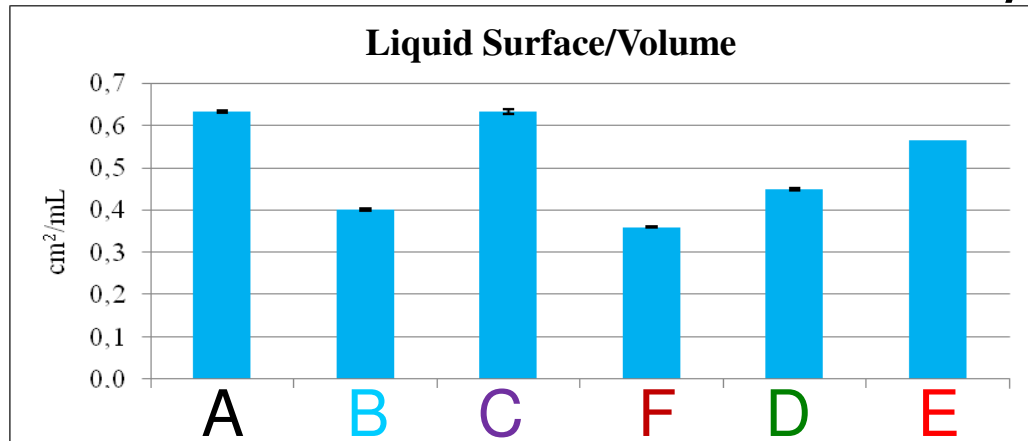


➤ Trained panel (10 pax) who used a sensorial sheet, specifically developed for this purpose, consisting of a not structured parametric descriptive wine scoring chart

Results and e discussion

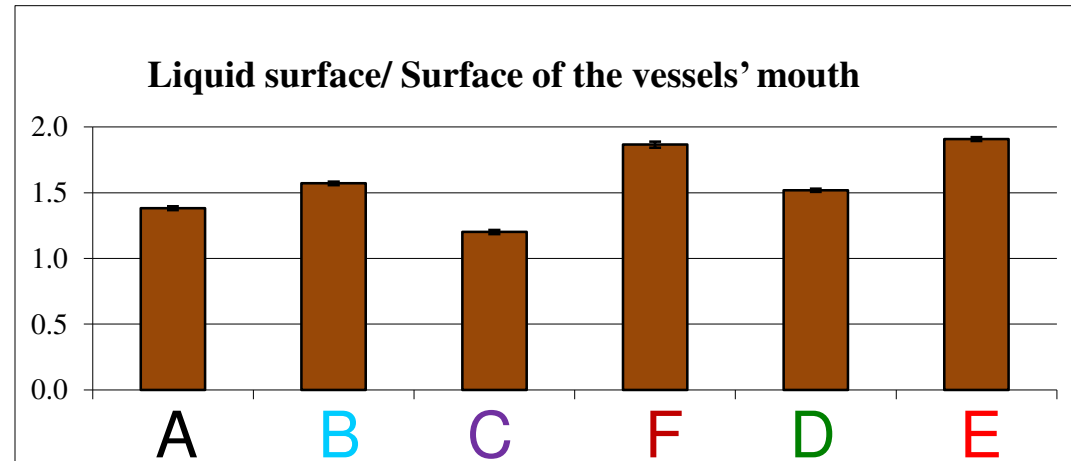
Geometrical characterisation of vessels: main significant indexes

✓ Useful to define the distribution of "full" and "empty" volumes inside the vessel



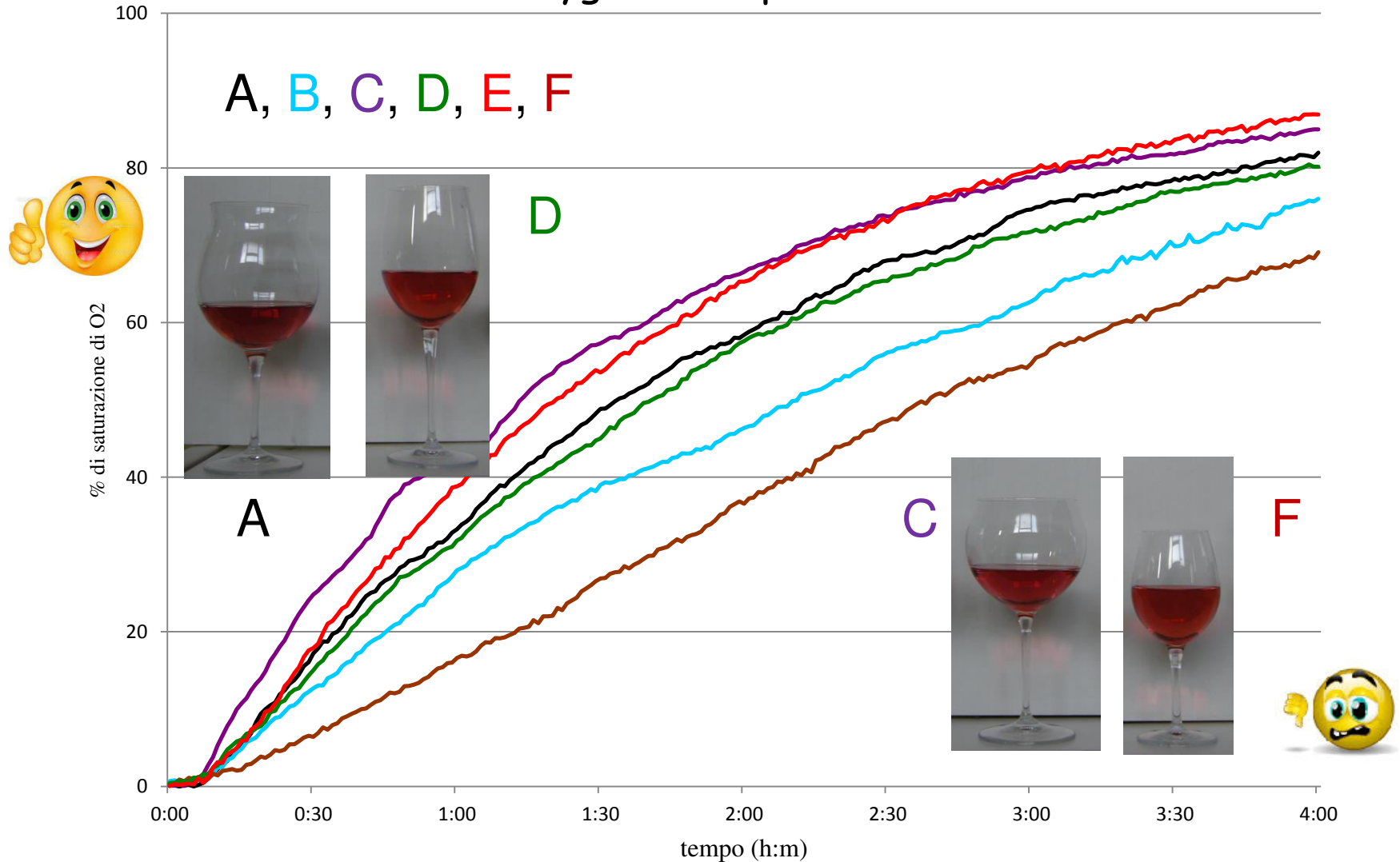
✓ Influences the oxigenation rate of the liquid medium

✓ Good way to represent the chimney effect of the vessel



Chemical/physical characterisation of the vessels

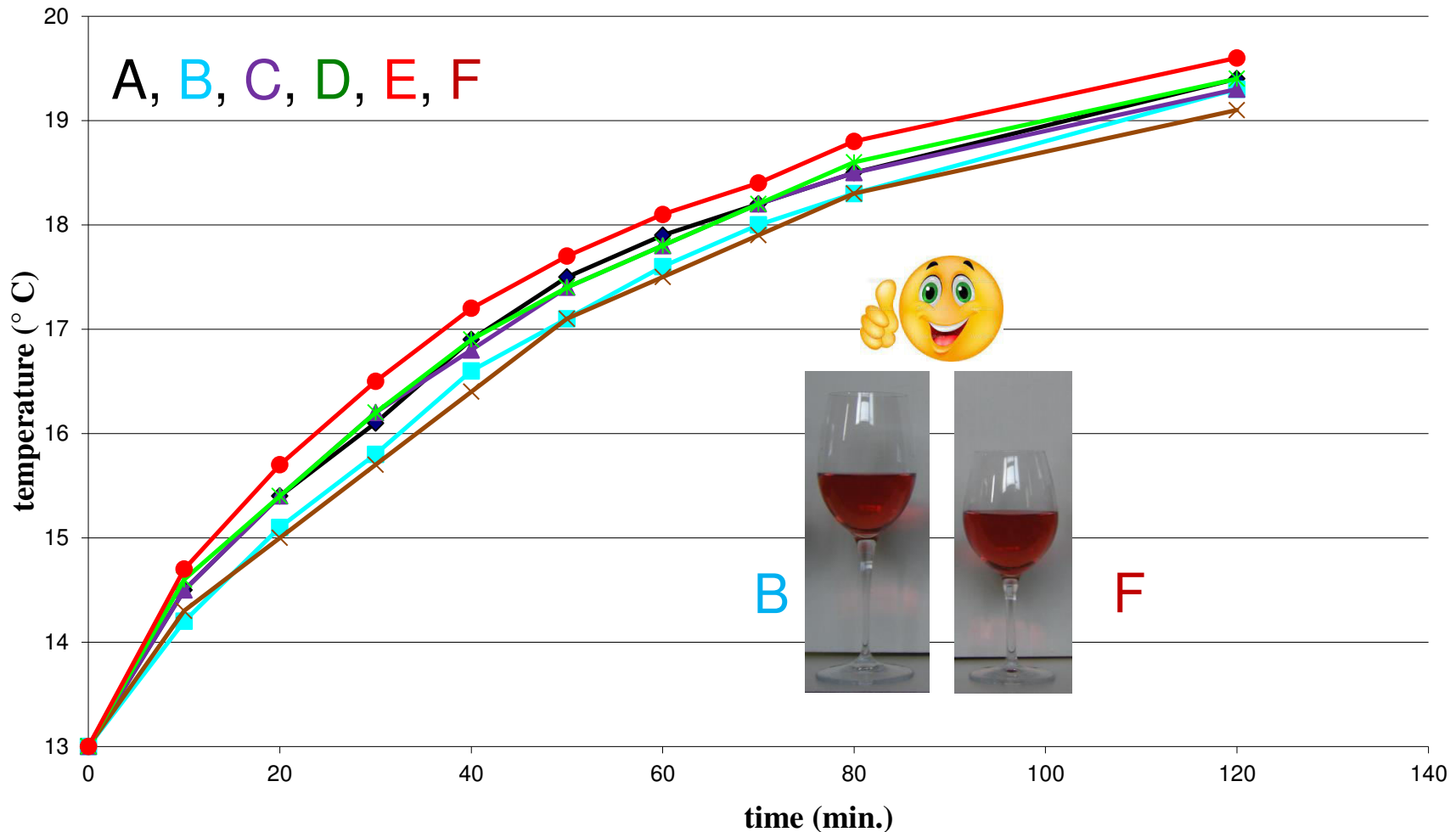
Oxygenation profiles



The most balanced degree of oxygenation were observed when Glasses A and D were utilized, while the glasses allowing the quickest and the slowest oxygenation rate were Glasses C and F.

Chemical/physical characterisation of the vessels

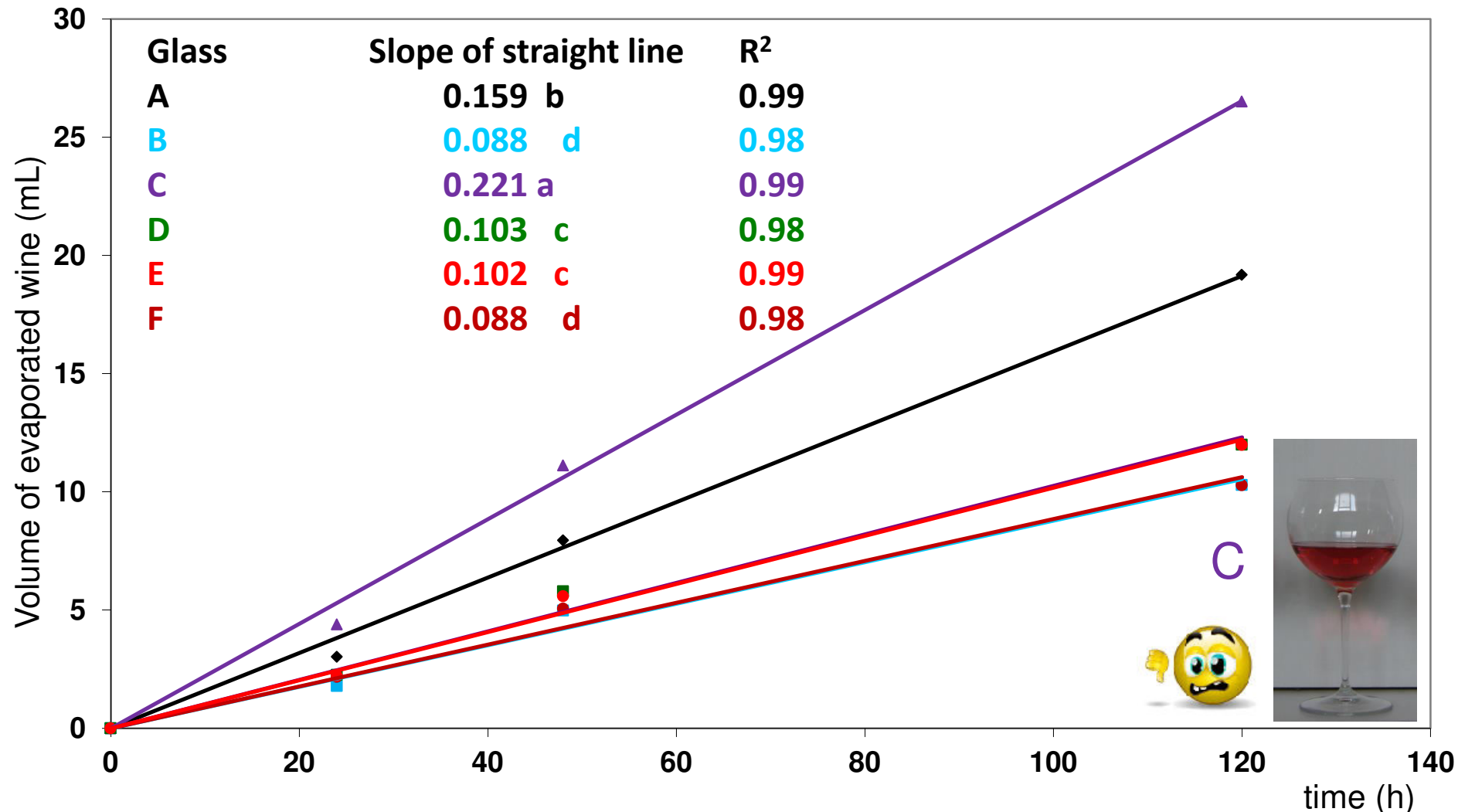
Temperature profiles



The greatest thermal inertia of the Glass **F**, closely followed by Glass **B**, can be considered a very useful property, particularly for white and rosé wines, because temperatures lower than room temperature ($T < 20^{\circ}\text{C}$) appear able to improve the balance of the taste attributes of these kind of wines.

Chemical/physical characterisation of the vessels

Evaporation profile of red wine



The same evaporation trend was obtained when rosé wine was poured in the vessels

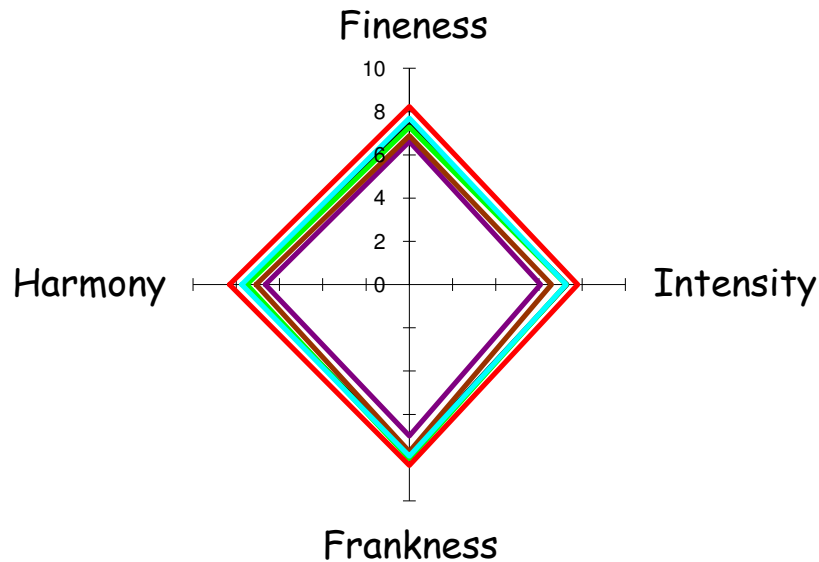
Chemical composition of **red wine** at different equilibration time (t=0, t=5 hours after filling the glasses)

Parameter	Test (mean ± c.i.) (t=0)	Glass A (mean ± c.i.) (t=5h)	Glass B (mean ± c.i.) (t=5h)	Glass C (mean ± c.i.) (t=5h)	Glass D (mean ± c.i.) (t=5h)	Glass E (mean ± c.i.) (t=5h)	Glass F (mean ± c.i.) (t=5h)
Titratable Acidity (g/L of tartaric acid)	5.38 ± 0.01 a*	5.38 ± 0.03 a	5.38 ± 0.03 a	5.38 ± 0.01 a	5.37 ± 0.39 a	5.36 ± 0.03 a	5.38 ± 0.01 a
Volatile Acidity (g/L of acetic acid)	0.496 ± 0.004 a	0.504 ± 0.005 a	0.495 ± 0.005 a	0.509 ± 0.010 a	0.499 ± 0.003 a	0.501 ± 0.004 a	0.494 ± 0.006 a
Free SO ₂ (mg/L)	10.1 ± 0.4 a	5.0 ± 1.4 b	7.3 ± 2.3 ab	5.8 ± 0.6 b	7.9 ± 0.2 ab	8.3 ± 0.4 ab	7.4 ± 3.3 ab
Proanthocyanidins (g/L of catechins)	1.67 ± 0.09 a	1.77 ± 0.01 a	1.72 ± 0.09 a	1.79 ± 0.06 a	1.66 ± 0.16 a	1.81 ± 0.17 a	1.72 ± 0.01 a
Free anthocyanins (g/L of malvidin)	0.08 ± 0.01 a	0.08 ± 0.01 a	0.08 ± 0.02 a	0.08 ± 0.08 a	0.08 ± 0.01 a	0.09 ± 0.02 a	0.08 ± 0.01 a
Total anthocyanins (g/L of malvidin)	0.55 ± 0.01 a	0.54 ± 0.01 a	0.54 ± 0.02 a	0.56 ± 0.02 a	0.54 ± 0.01 a	0.54 ± 0.01 a	0.53 ± 0.02 a
Total phenols (g/L of catechins)	2.99 ± 0.08 a	2.98 ± 0.03 a	3.02 ± 0.02 a	3.04 ± 0.05 a	3.01 ± 0.09 a	2.99 ± 0.06 a	2.99 ± 0.04 a

Among the data collected, the more suitable to follow the chemical evolution of the wine seems to be the **free fraction of SO₂**, that represents the most sensible antioxidant compound present inside the wine used.

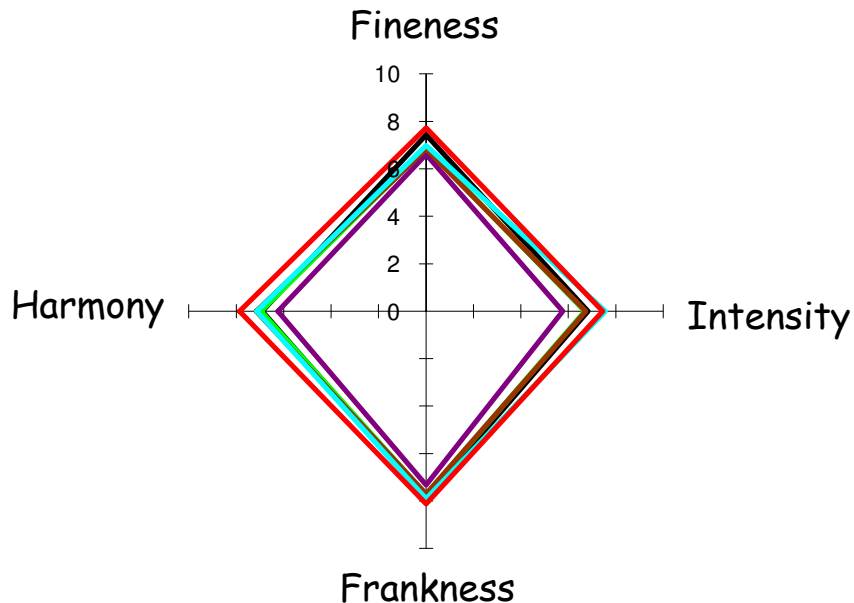
Sensorial characterisation of poured wine: red wine

Smell $t=0'$

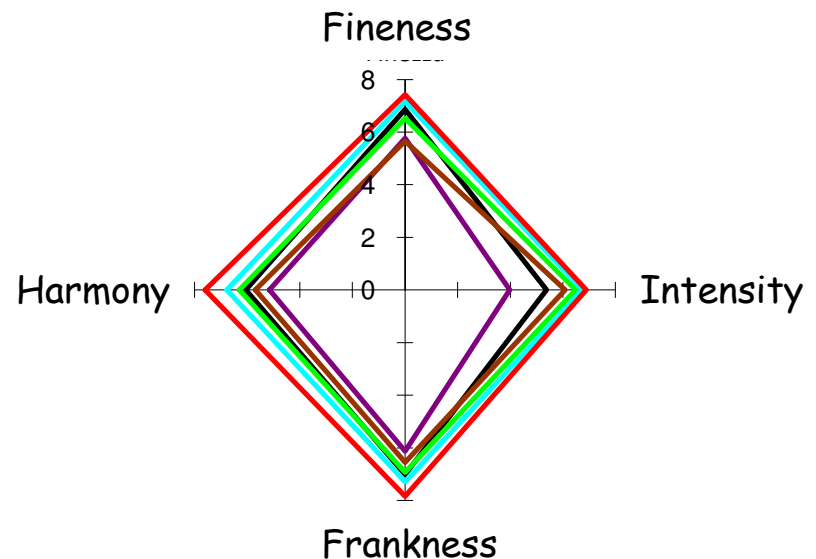


Among all the sensorial descriptors utilized, the parameters related to the smell expression appear suitable in order to discriminate the sensorial evolution of the wine as a function of vessel

Smell $t=40'$

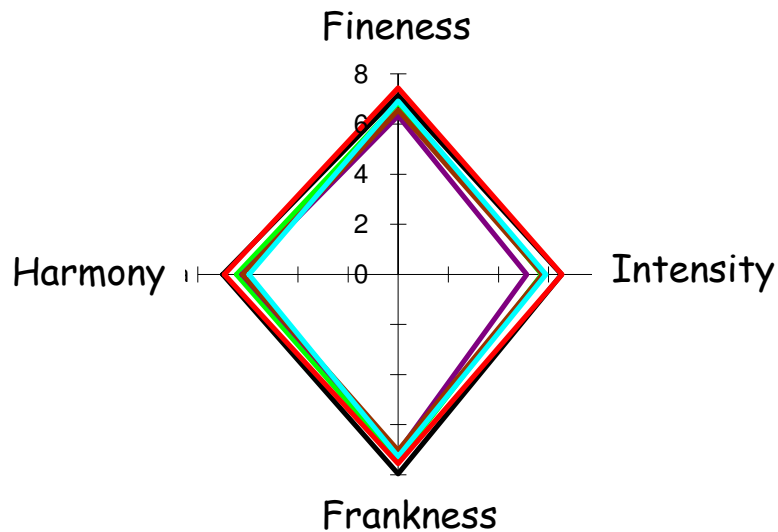


Smell $t=120'$

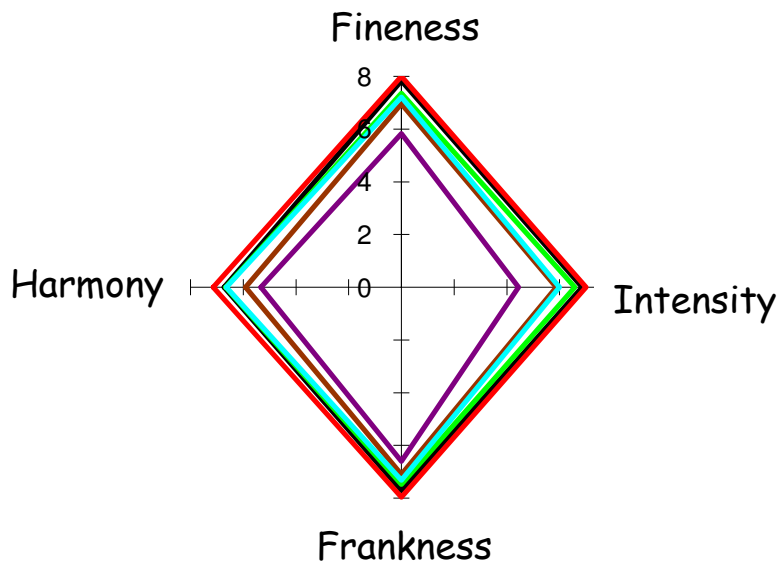


Sensorial characterisation of poured wine: rosé wine

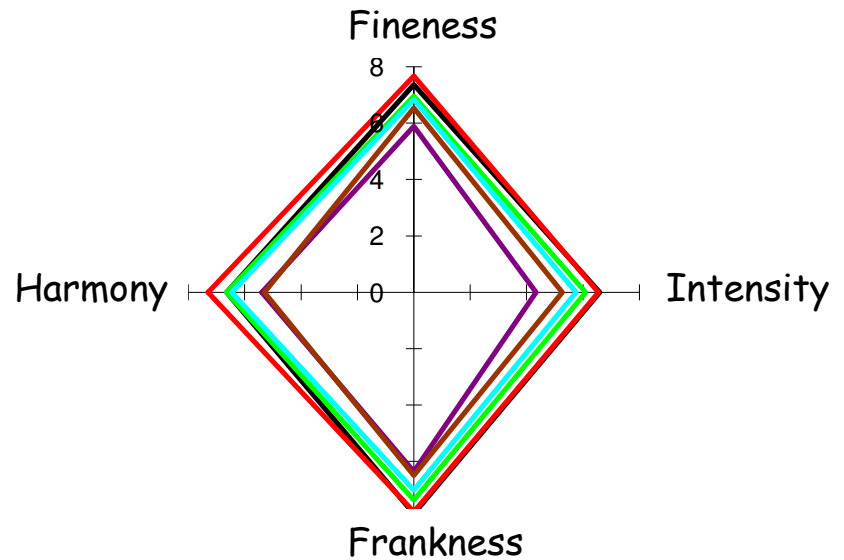
Smell $t=0'$



Smell $t=40'$

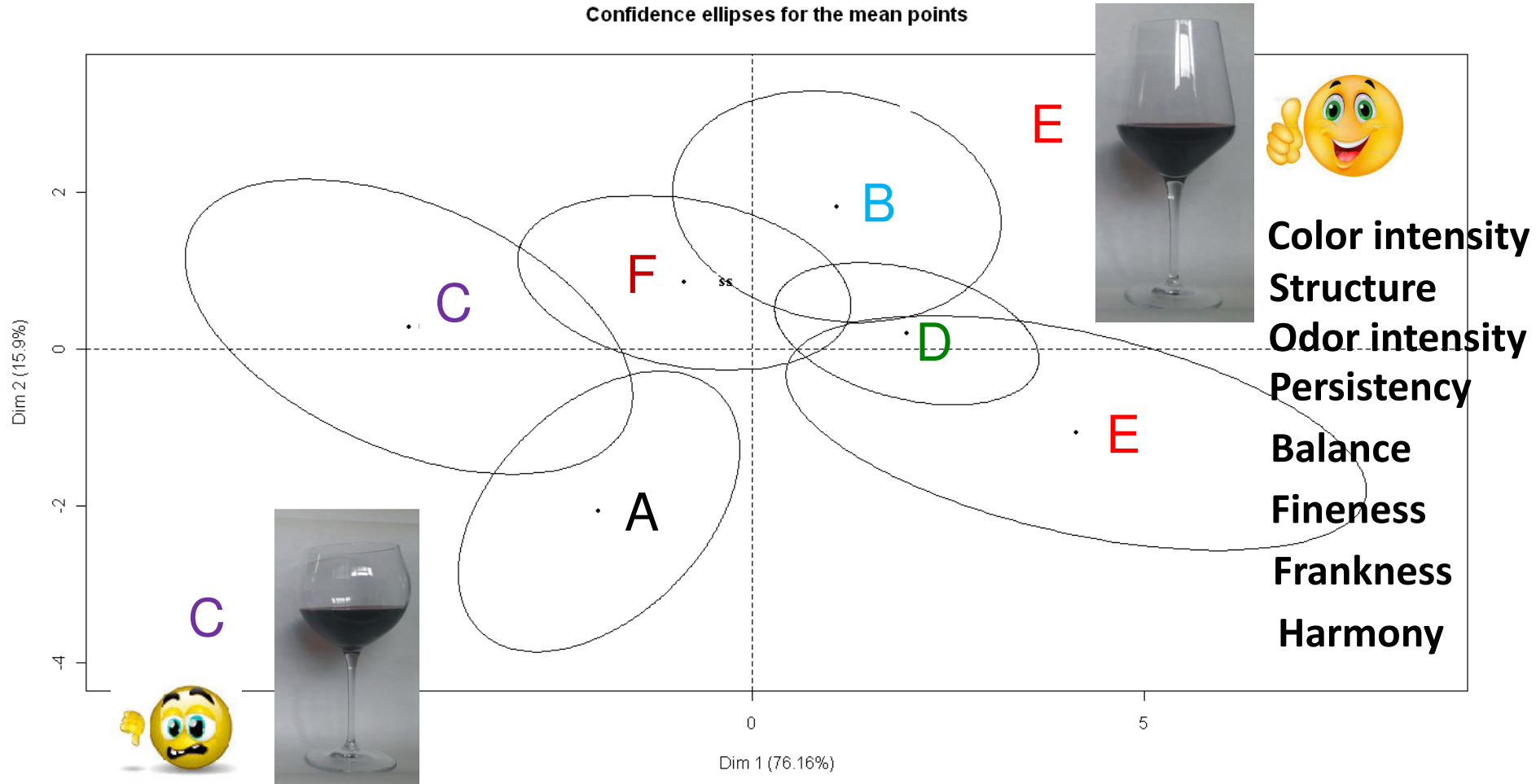


Smell $t=120'$



PCA of each sensory attribute across six different vessels

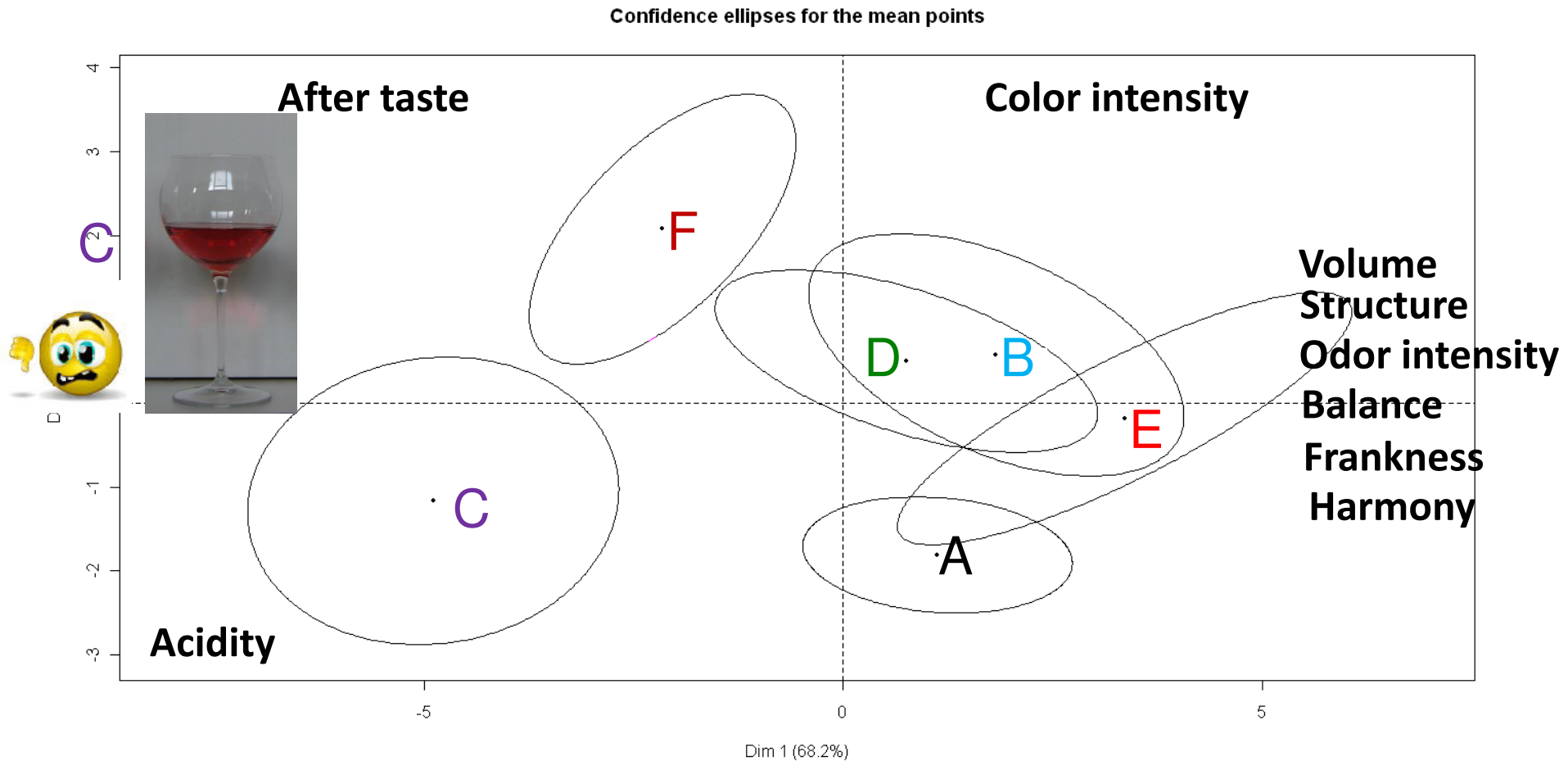
Red wine; $t = 120'$



At time = 120' after filling the glasses, the best sensorial profile was showed by the wine maintained in Glass **E**, closely followed by that in Glass **D**.

PCA of each sensory attribute across six different vessels

Rosé wine; $t = 120'$



At time = 120' the best sensorial profile was showed by the wine maintained in vessels **E**, **B** and **D** closely followed by that proposed in Glass **A**.

Conclusions

A score, related to the values assumed by the experimental parameters which showed reliable differences in sensory, chemical and physical evaluations, was assigned to each glass

- The ranking of the chemical evolution was defined as a function of the development of SO_2 concentration
- Physical-chemical evolution was expressed by evaporation, oxygenation and temperature profile (only for rosé wine)
- The sensorial evolution was ranked according to the main sensorial attributes useful in order to put in evidence the existence of reliable differences among the wine maintained inside the different glasses at $t=120'$ after filling the vessels

The final ranking, which comes from the sum of each partial score assigned, can be considered as a measure of the suitability of each vessel for the Red or Rosé wine tasting.

Final ranking of vessels: Red wine

Score	6pt	5pt	4pt	3pt	2pt	1pt
Sensorial profile (Overall appreciation)	E	D	B	A	F	C
Chemical evolution	E	D	F	B	C	A
Evaporation profile	B/F	E/D	A	C	--	--
Final ranking						
	I	II	III	IV	V	VI
Total score	E	D	B	F	A	C



Final ranking of vessels: **Rosé wine**

Score	6pt	5pt	4pt	3pt	2pt	1pt
Evaporation profile	D/E	-	A/B	-	C/F	-
Oxygenation profile	B/D	-	A/F	-	C/E	-
Temperature profile	F	B	A/D/C	-	-	E
Chemical evolution	F	B/D/E	-	-	A/C	-
View attributes	D/F	A/B/E	C			
Smell attributes	E	A	B	D	F	C
Taste attributes	E/B	A/D	F	C		
Final ranking						
	I		II	III	IV	V
Total score	B/D		E	F	A	C



Conclusions and further developments

The experimental results showed how the characteristics of a glass could affect wine's bouquet and flavor and suggest that their rational optimization, based on experimental data, could enhance consumer enjoyment of wines.

A new "integrated approach", deriving from the merging of the chemical, physical and sensorial data, can be used to design (or to select among those already existing) the optimum vessel for increasing the enjoyment of the consumer during the wine assessing.

As future trend of this research, it would be necessary to extend this approach to the tasting of each type of wine (i.e.: white, sweet, sparkling wines) as well as of other beverages (i.e. beer, cocktails, fruit juices) and determine the values of the main parameters for each of them.

The best parameters selected can represent the key features to act on in order to redesign "the ideal glass" as a function of the type of the beverage tasted.

Our last references on this topic

The expression of a full-bodied red wine as a function of the characteristics of the glass utilized for the tasting.

Francesca Venturi, Gianpaolo Andrich, Chiara Sanmartin, Giancarlo Scalabrelli, Giuseppe Ferroni, Angela Zinnai.

CyTA - Journal of Food 12:3, pp. 291-297

DOI: 10.1080/19476337.2013.848473

Glass and wine: a good example of the deep relationship between drinkware and beverage.

Francesca Venturi, Gianpaolo Andrich, Chiara Sanmartin, Giancarlo Scalabrelli, Giuseppe Ferroni, Angela Zinnai.

Under review for publication in "Journal of Wine Research"

A close-up photograph of two wine glasses being clinked together. The glasses are filled with a dark red wine. The background is a soft, out-of-focus sunset or sunrise scene with warm orange and pink hues. The glasses are held by hands, and the focus is sharp on the point where the glasses meet.

ENJOY

Thank you for your attention.