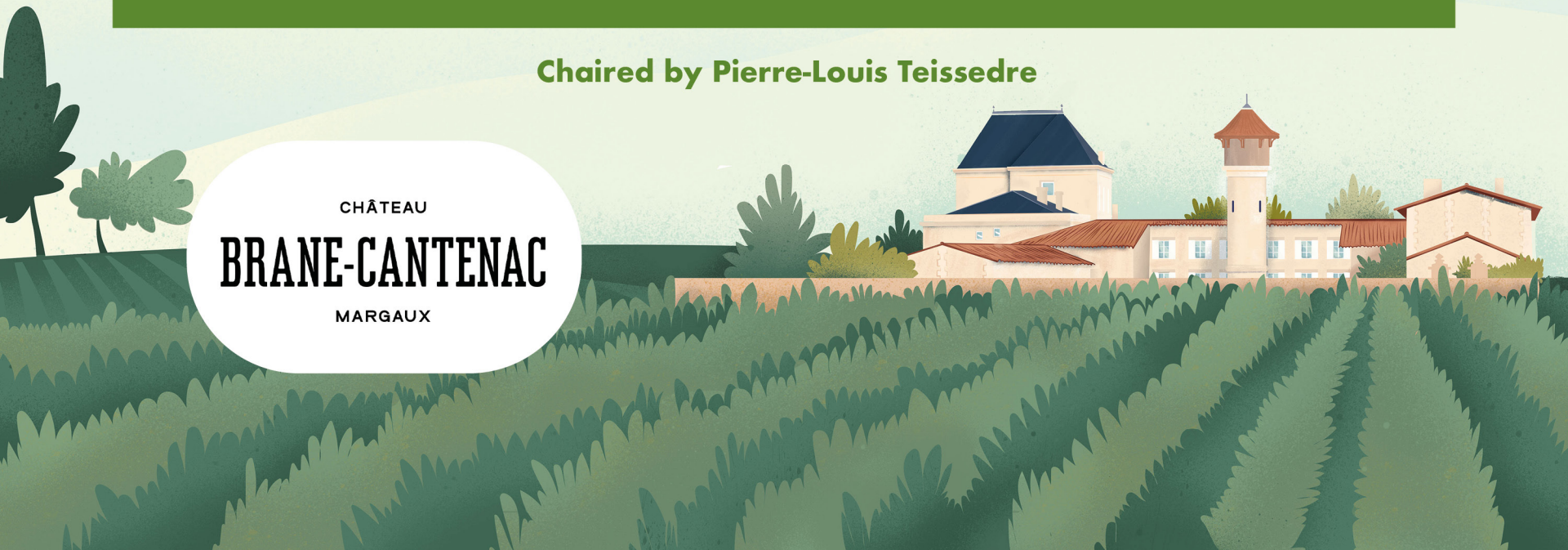


# SESSION 2 ENOLOGY

Chaired by Pierre-Louis Teissedre

CHÂTEAU  
**BRANE-CANTENAC**  
MARGAUX





# Sensory evaluation of the effect of anthocyanins on in-mouth perceptions

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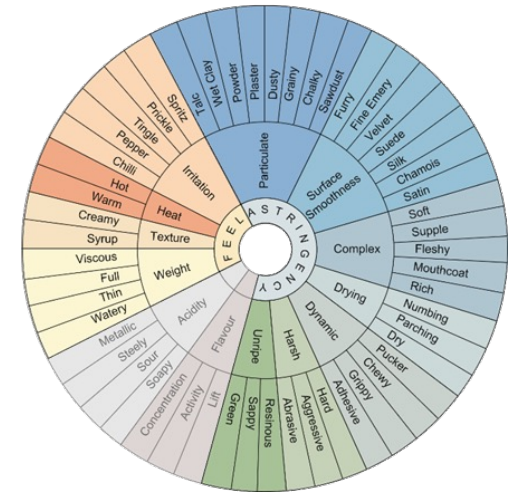
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# Wine in-mouth properties



- Taste
  - Bitterness*
  - Sweetness*
  - Acidity*
- Mouthfeel
- Astringency

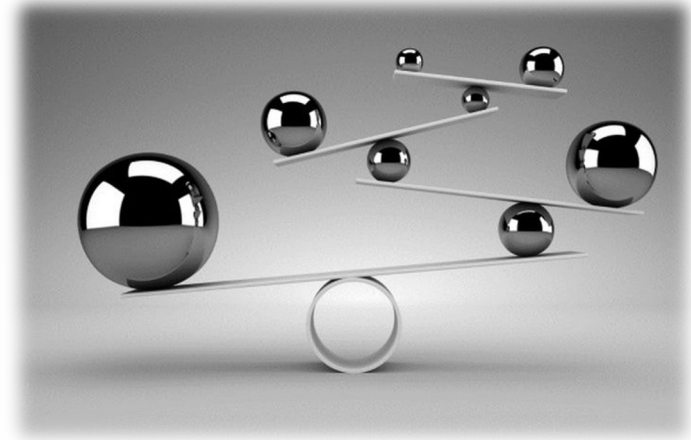


Gawel et al., 2000

## In-mouth sensations and wine quality

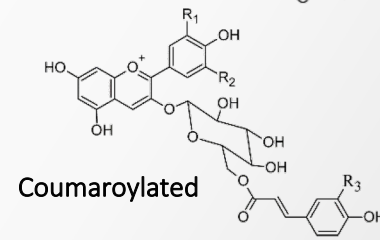
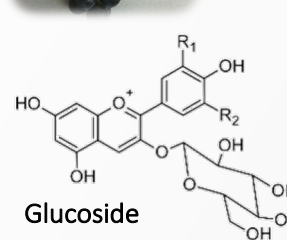
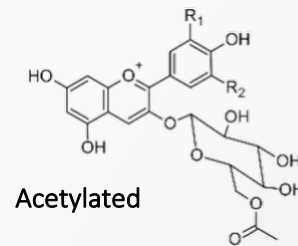
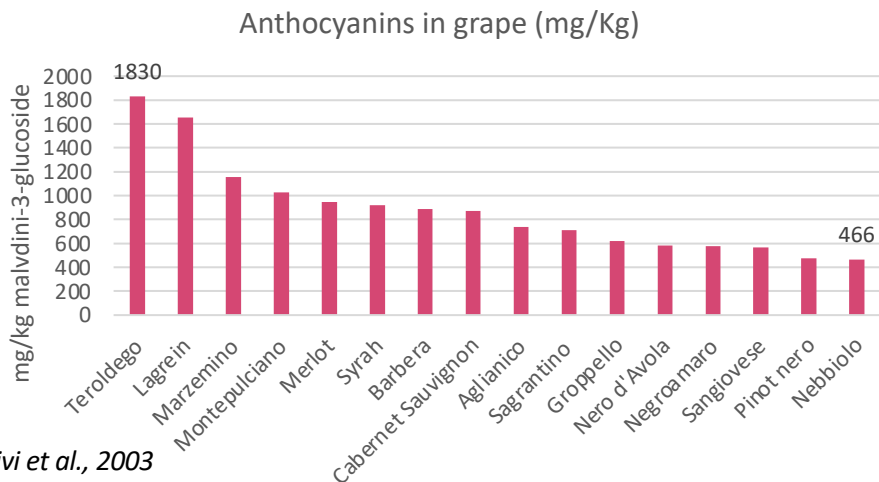


- Tannins
- Wine matrix
- Other compounds
  - Mannoproteins
  - Polyphenols



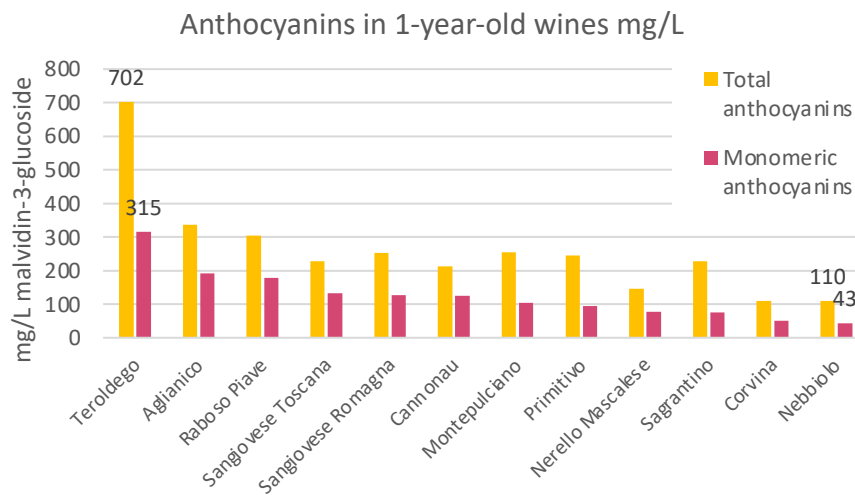
Several contributors in a complex balance

# Astringency: not just about tannins?



## Grape anthocyanins

## Red wine color



# Grape anthocyanins: not just about color?

## Red wine in-mouth sensations

Reduction of tannins astringency by condensation reactions

### Anthocyanins

### State-of-the-art

- **Activation of bitterness receptors**  
(Soares *et al.*, 2013)
- **Formation and modulation of complexes with salivary proteins**  
(Ferrer-Gallego *et al.*, 2015; Soares *et al.*, 2019)
- **Evoking in sensory analysis astringency attributes as *dry, rough, chalk, fullness, grippy, persistent* or *bitter***  
(Vidal *et al.*, 2004a,b,c; Oberholster *et al.*, 2009, Gonzalo-Diago *et al.*, 2014; Ferrer-Gallego *et al.*, 2015, Ferrero-del-Teso *et al.*, 2020;2022)



Are anthocyanins involved in wine in-mouth sensation?

# Materials & Methods: investigation strategy

Anthocyanin  
extraction

*To obtain anthocyanins  
in good quantity*

Fractionation

*To obtain anthocyanins  
depending on the acylation*

Sensory analysis:  
detection thresholds

*Are they perceived?*

Sensory analysis:  
Descriptors by Check-  
all-that-apply and  
Intensity scales

*How are they influencing in-  
mouth properties? Alone or  
with other polyphenols*



# Materials & Methods – extracts and fractions

## Anthocyanin extraction

- Grape skins cv. Nebbiolo and Barbera
- Extraction in MeOH 0.1% TFA
- Purification with XAD 16 resin
- Lyophilization

Total anthocyanin extract (TA)

## CPC fractionation

- Centrifugal Partition Chromatography and Prep-HPLC (Renault *et al.*, 1997)
- **Glucoside fraction (GF)**
- **Acetylated fraction (AF)**
- **Coumaroylated fraction (CF)**

and PREP HPLC



## Skins and Seeds polyphenols extracts

- Grape skins and seeds polyphenols from cv Nebbiolo and Barbera by Accelerated Solvent Extraction (ASE), purification C18 and lyophilization

# Materials & Methods – extracts and fractions

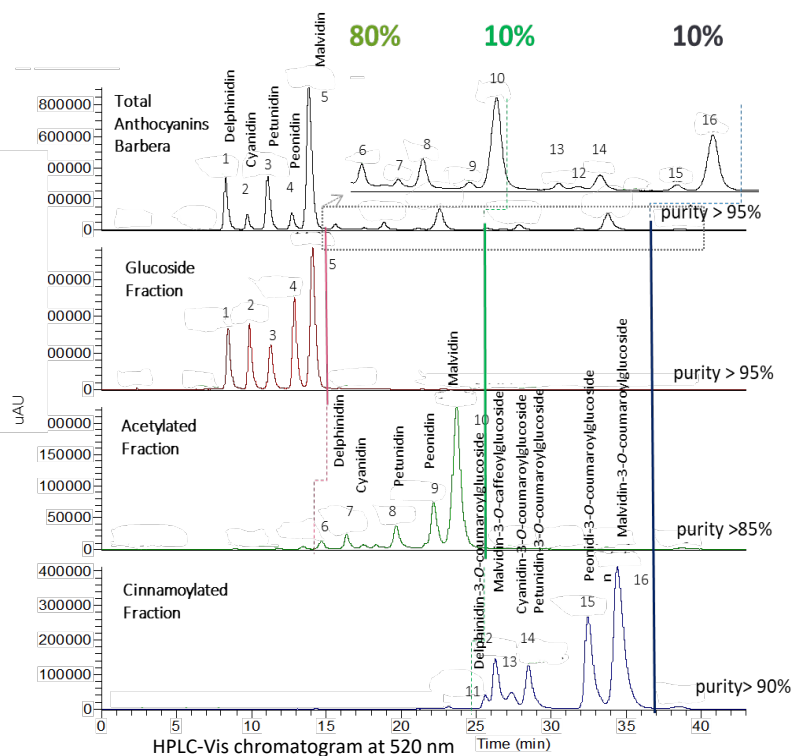
## Anthocyanins-based extracts and fractions:

- Total anthocyanins extract from Barbera
- Total anthocyanins extract from Nebbiolo
  - Glucoside fraction
  - Acetylated fraction
  - Coumaroylated fraction



## Sensory analysis: detection thresholds

- Best estimated **thresholds** (BET)
  - 3-AFC - three alternative forced-choice
  - Back ISO coded glasses
  - Wine-like solutions (12% ethanol, pH 3.5, tartaric acid 4 g/L)
  - Increasing dose (6 tests)
- Triangle test **thresholds** confirmation
  - With BET dose or slightly higher in wine range





# Results – anthocyanins detection



## Best estimated thresholds

- Total anthocyanins from 62.5 to 2000 mg/L
- Fraction glucoside from 31.25 to 1000 mg/L
- Fraction acetylated & Fraction coumaroylated from 3.125 to 100 mg/L

Wine-like solution (12% Ethanol, pH 3.5, 4 g/L tartaric acid); Tasters= 18

Fraction	Group	BET (mg/L)	Descriptors
TA	Total Anthocyanins	<b>255</b>	Astringency; Bitterness
GF	Glucosides	<b>297</b>	Astringency; Bitterness
AF	Acetylated	<b>68</b>	Bitterness, Astringency
CF	Coumaroylated	<b>58</b>	Bitterness, Astringency

Paissoni et al., 2018

## Triangle test



Sample	Concentration (mg/L)	Alternative	<i>p</i> value (n=16)
Total anthocyanins extract (Nebbiolo)	250	model wine	<b>0.01</b>
Total anthocyanins extract (Barbera)	250	model wine	<b>0.01</b>
Glucoside fraction	300	model wine	<b>0.05</b>
Glucoside fraction	400	model wine	<b>0.01</b>
Acetylated Fraction	100	model wine	<b>0.01</b>
Coumaroylated Fraction	100	model wine	<b>0.05</b>
<b>Total anthocyanins extract (Nebbiolo)</b>	<b>400</b>	<b>Total anthocyanins extract (Barbera)</b>	<i>ns</i>

- Different thresholds depending on the acylation
- Anthocyanins were perceived at young wine range
- No differences between the two varieties
- Assessors reported 'astringency', 'bitterness', 'irritation' sensations

Paissoni et al., 2020

16/06/2022

Paissoni M.A. - IVES Science Meeting, Bordeaux

# Materials & Methods – Descriptors selection by CATA

## Sensory analysis: Descriptors by Check-all-that-apply

- Total anthocyanins 300 mg/L
- Fraction glucoside 400 mg/L
- Skin polyphenols 1 g/L
- Seed polyphenols 1 g/L

Wine-like solution (12% EtOH, pH 3.5, 4 g/L tartaric acid)

**Selection criteria:**  
 - High citation frequency  
 - High discrimination ability

Descriptor	Grouping	
	Group	Subqualities <sup>a</sup>
Bitter ( <i>amer</i> )	Taste	
Acid ( <i>acide</i> )	Taste	
Sweet ( <i>sucré</i> )	Taste	
Salty ( <i>salé</i> )	Taste	
Hot ( <i>brûlant</i> )	Mouth-feel	heat
Dry ( <i>asséchant</i> )	Mouth-feel	drying
Tingle ( <i>piquant</i> )	Mouth-feel	irritation
Prickle ( <i>pointu</i> )	Mouth-feel	irritation
Oily ( <i>ontueux</i> )	Mouth-feel	texture
Watery ( <i>aqueux</i> )	Mouth-feel	weight
Dense ( <i>dense</i> )	Mouth-feel	weight
Emery ( <i>rugueux</i> )	Astringency sub-qualities	surface smoothness
Dusty ( <i>poussiéreux</i> )	Astringency sub-qualities	particulate
Grainy ( <i>granuleux</i> )	Astringency sub-qualities	particulate
Chalky ( <i>talc</i> )	Astringency sub-qualities	particulate
Silky ( <i>soyeux</i> )	Astringency sub-qualities	surface smoothness
Rich ( <i>gras</i> )	Complexive Astringency	
Adhesive ( <i>adhérant</i> )	Complexive Astringency	dynamic
Soft ( <i>doux</i> )	Complexive Astringency	complex
Mouthcoating ( <i>enrobant</i> )	Complexive Astringency	complex
Aggressive ( <i>agressive</i> )	Complexive Astringency	complex

<sup>a</sup> According to Gawel mouthfeel wheel

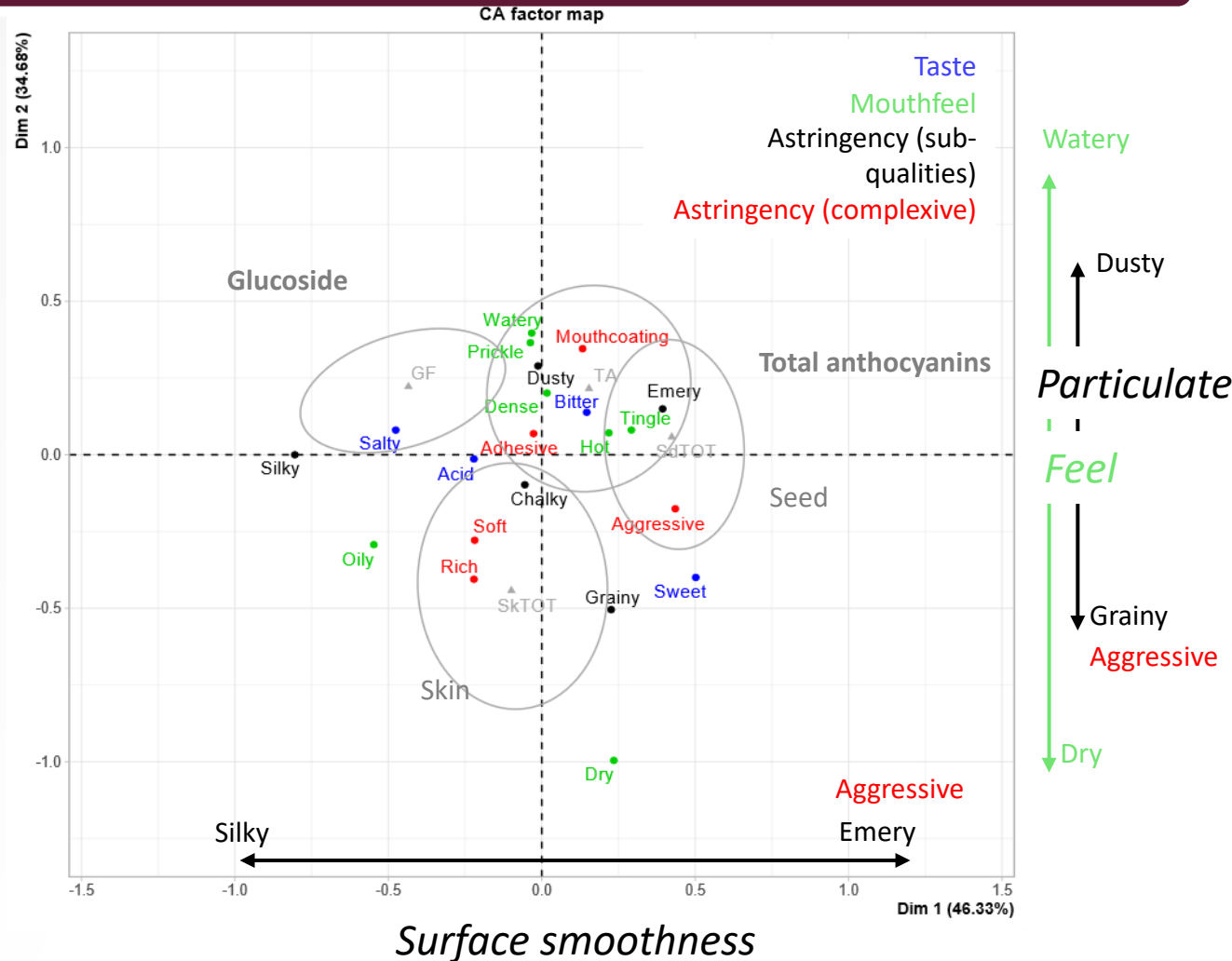
# Results – Descriptors selection CATA : discrimination ability

## Descriptors discrimination ability

- Total anthocyanins 300 mg/L
- Fraction glucoside 400 mg/L
- **Skin polyphenols (Sk-TOT) 1 g/L**
- **Seed polyphenols (Sd-TOT) 1 g/L**

Code	Sk-TOT	Sd-TOT
mDP	15.5 ± 0.45	3.7 ± 0.10
%PD	34.0 ± 0.23	-
%Galloyl	2.2 ± 0.1	15.2 ± 0.27

Wine-like solution (12% EtOH, pH 3.5, 4 g/L tartaric acid)



# Results – Descriptors selection CATA

## Final descriptors depending on the selection criteria

	Descriptor	Frequencies of citation			Subqualities <sup>b</sup>
		Rank	% in the group	% in total	
taste	Bitter	1	47.6	13.1	0.458
	Acid	4	22.2	6.1	0.475
	Sweet	13	7.9	2.2	0.732
mouthfeel	Salty	3	23.8	6.6	0.045
	Hot	4	21.9	6.1	0.651
	Dry	12	9.4	2.6	0.037
	Tingle	8	15.6	4.4	0.649
	Prickle	11	10.9	3.1	0.500
	Oily	7	17.2	4.8	0.069
	Watery	9	14.1	3.9	0.759
	Dense	12	9.4	2.6	1.000
	Viscous	16	1.6	0.4	1.000
	Astringency sub-qualities	Emery	6	24.0	5.2
Dustv		5	26.0	5.7	0.697
Sandy		14	6.0	1.3	0.055
Grainy		14	6.0	1.3	0.522
Chalky		8	20.0	4.4	0.743
Silky		9	18.0	3.9	0.036
Rich		12	11.8	2.6	0.327
overall	Adhesive	9	17.6	3.9	0.800
	Soft	8	19.6	4.4	0.475
	Round	15	3.9	0.9	0.272
	Mouthcoating	10	15.7	3.5	0.934
	Aggressive	2	31.4	7.0	0.071

High citation frequencies

High discrimination ability

- Bitterness
- Overall astringency
- Surface Smoothness
- Particulate

Descriptors chosen according to literature

<sup>a</sup> According to Cochran's Q test

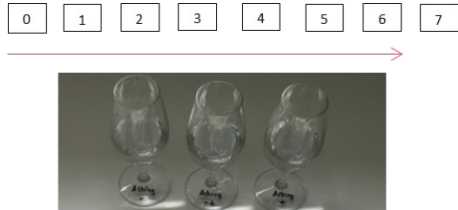
<sup>b</sup> According to Gawel mouthfeel wheel

# Materials & Methods – Descriptive analysis

## Descriptors for DA

- **Descriptors intensity by Descriptive analysis (DA)**
  - Rate the intensity of the descriptors
  - Training phase with standard solutions and tactile standards

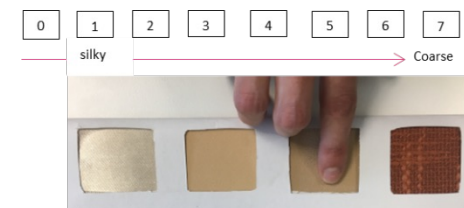
Bitterness  
Overall astringency



Particulate  
(in-mouth)



Surface smoothness  
(after expectoration)



- Together with the anthocyanin-based extracts **Polyphenols-based** extract were tasted:
- **Alone** or **added** of the anthocyanins based extracts to study a modulating effect

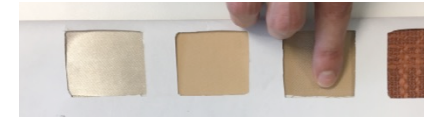
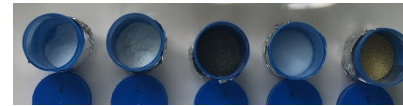


# Results – Descriptive analysis

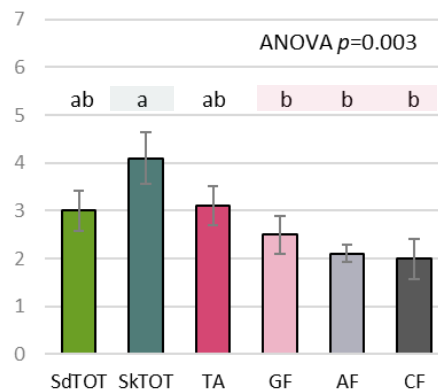
## Assessors trained on the selected descriptors

Skin polyphenols 1 g/L  
 Seed polyphenols 1 g/L  
 Total anthocyanins 300 mg/L  
 Fraction glucoside 400 mg/L  
 Fraction acetylated 100 mg/L  
 Fraction cinnamoylated 100 mg/L

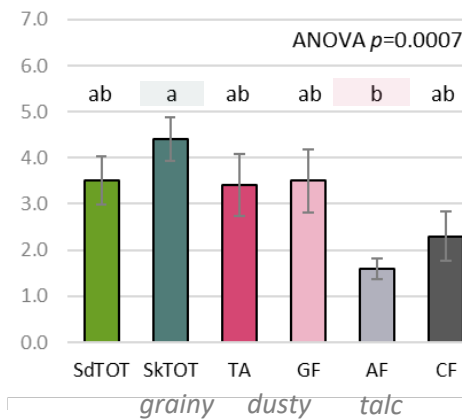
Wine-like solution (12% EtOH, pH 3.5, 4 g/L tartaric acid)



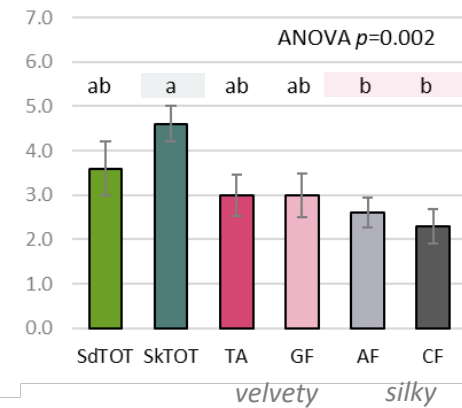
Overall Astringency



Particulate



Surface Smoothness



n=12; Two way ANOVA, assessor random

Paissoni et al., 2020

16/06/2022

Paissoni M.A. - IVES Science Meeting, Bordeaux



# Results – Descriptive analysis

## Synergic effect when are tasted in presence of tannins

- Skin polyphenols 1 g/L
- Seed polyphenols 1 g/L
- Total anthocyanins 300 mg/L
- Fraction glucoside 400 mg/L
- Fraction cinnamoylated 100 mg/L

Wine-like solution (12% EtOH, pH 3.5, 4 g/L tartaric acid)

*Different effect depending on the polyphenols extract*

Mixed extracts	Particulate	Surface Smoothness	Astringency
Sk-TOT	4.4 ± 0.5	4.6 ± 0.4 a	4.1 ± 0.5
Sk-TOT + TA	4.3 ± 0.6	4.1 ± 0.5 ab	3.9 ± 0.5
Sk-TOT + GF	5.3 ± 0.4	3.8 ± 0.3 b	5.4 ± 0.4
Sk-TOT + CF	4.6 ± 0.5	4.0 ± 0.6 ab	4.0 ± 0.7
<i>Sign</i>	ns	*	ns
<i>p value</i>	0.4413	0.0433	0.0767
Sd-TOT	3.5 ± 0.5 b	3.6 ± 0.6 b	3.0 ± 0.4 b
Sd-TOT + TA	4.0 ± 0.5 ab	4.0 ± 0.4 ab	3.6 ± 0.3 ab
Sd-TOT + GF	5.3 ± 0.5 a	5.1 ± 0.4 a	4.9 ± 0.5 a
Sd-TOT + CF	3.3 ± 0.4 b	4.1 ± 0.4 ab	3.4 ± 0.4 b
<i>Sign</i>	*	*	**
<i>p value</i>	0.0102	0.0302	0.009

n=12; Two way ANOVA, assessor random



# Conclusion



Extraction and fractionation

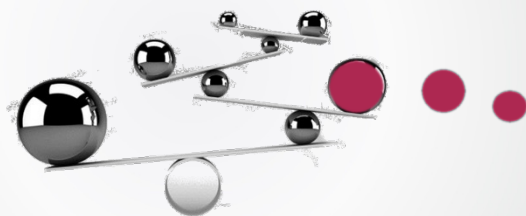
- Allowed to obtain total extracts and anthocyanin fractions

Detection thresholds

- Perceived in range of **young red wines**
- **Differences** depending on **acylation**  
*varietal implication*

Sensory analysis of anthocyanins

- **Involved in the “in-mouth” perception**
- Determined **different astringency and its sub-qualities** depending on the other polyphenols extract features
- In young wine may modulate the astringency depending on the tannic features



Not only tannins are involved in red wine *in-mouth* sensation:

**anthocyanins can modulate the balance of red wine astringency**



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# Thank you for your attention

## Sensory evaluation of the effect of anthocyanins on in-mouth perceptions

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