



ISVV
INSTITUT DES SCIENCES
DE LA VIGNE ET DU VIN
BORDEAUX AQUITAINE

R&D TONNELLERIE NADALIÉ

(2011-2018)

OAK WOOD EXTRACTIBLE COMPOSITION



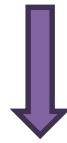
Wine Maturation With Oak Wood Modifies Its Smell Its Taste And Its Color



Volatile compounds and hydrosoluble tannins



Hydrosoluble tannins (gallotannins and ellagitannins)



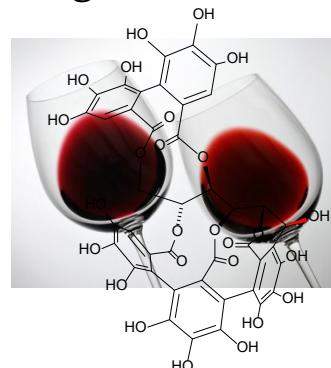
weak concentrations



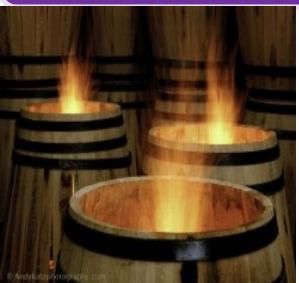
important concentrations

Ellagitannins may represent 10% of the dry weight

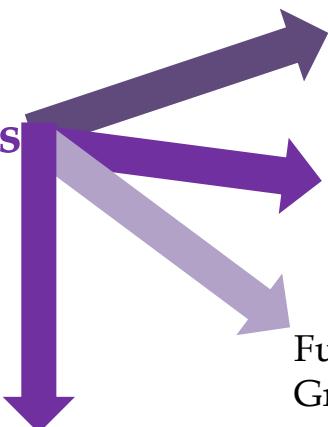
high wood durability
astringency, bitterness
wine color



OAK WOOD EXTRACTIBLE COMPOSITION



Volatile compounds



Oak lactone (*cis/trans*-Whisky lactone)
coconut woody note



Phenolic aldehydes (vanillin.....)
vanilla aroma



Furanic compounds (furfural.....)
Grilled flavor



Phenols (Eugenol, Guaiacol....)
Spicy, Smoky flavor



Threshold perception for aromatic compounds in red wine

Almond/Grilled Almond	Smokey/Toasted bread	Coconut/ whisky	Spicy	Vanilla
Furfural	Methyl-Furfural	Guaiacol	Methyl-Guaiacol	trans-Whisky lactone Cis-Whisky
Perception threshold in wine ($\mu\text{g/L}$)	20000	45000	75	65

	Furfural	Methyl-Furfural	Guaiacol	Methyl-Guaiacol	trans-Whisky lactone	Cis-Whisky	Eugenol + Isoeugenol	Vanillin
Perception threshold in wine ($\mu\text{g/L}$)	20000	45000	75	65	460	46	500	320

RESEARCH IN PROGRESS

I : Identification of Products from Thermal Ellagitannin Degradation

I -THERMAL ELLAGITANNIN DEGRADATION

Thermal Ellagitannin Products Or The Reaction Mechanisms Underlying The Ellagitannin Degradation Are Not Well Searched



- ➡ ELLAGITANIN CHANGES DURING TOASTING ???
- ➡ RESEARCH OF THESE ELLAGITANNINS IN COMMERCIAL OAK WOOD REPRESENTING DIFFERENT TOASTING METHODS

RESEARCH IN PROGRESS

I : Identification of Products from Thermal Ellagitannin Degradation

II : Oak Wood Chips during AF and/or MLF

II - OAK WOOD CHIPS DURING AF AND/OR MLF



3gr/L FINE
(2/3 UN et 1/3 MT)

Moût

Etape 1
FA

FA sans
copeaux



FA avec
copeaux

ÉCHANTILLONNAGE

Après FA
Après FML
2-3 fois pendant
l'élevage
À la fin de l'élevage



Merlot 2018

2 répliques/modalité à partir de la FML

Etape 2
FML

sans
copeaux

avec
copeaux

sans
copeaux

avec
copeaux

sans
copeaux

avec
copeaux

sans
copeaux

avec
copeaux

Etape 3
Elevage



M-I. Aucun
ajout en cuve



M-II. FML
avec copeaux
en cuve



M-III. Aucun
ajout en
barrique



M-IV. FML
avec copeaux
en barrique



M-V. FA avec
copeaux en
cuve



M-VI. FA+FML
avec copeaux en
cuve



M-VII. FA
avec copeaux
en barrique



M-VIII. FA+FML
avec copeaux en
barrique

II - OAK WOOD CHIPS DURING AF AND/OR MLF



3gr/L FINE
(2/3 UN et 1/3 MT)



ÉCHANTILLONNAGE

Après FA
Après FML
2-3 fois pendant
l'élevage
À la fin de l'élevage



Merlot 2018

❖ Chemical analysis

Oenological and chromatic parameters

Total Phenolics

Anthocyanins

Tannins

Ellagitannins

Aroma

Fruity

Woody

❖ Sensory analysis



Sensory profile

Olfactif descriptors

Spicy

Vanilla

Gustative descriptors

Sweetness

Bitterness

Smoky – Woody

Fruity

Astringency



M-I. Aucun
ajout en cuve



M-II. FML
avec copeaux
en cuve



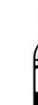
M-III. Aucun
ajout en
barrique



M-IV. FML
avec copeaux
en barrique



M-V. FA avec
copeaux en
cuve



M-VI. FA+FML
avec copeaux en
cuve



M-VII. FA
avec copeaux
en barrique



M-VIII. FA+FML
avec copeaux en
barrique

RESEARCH IN PROGRESS

I : Identification of Products from Thermal Ellagitannin Degradation

II : Oak Wood Chips during AF and/or MLF

III : Effect of Barrel Volume & Barrel Toasting on White Wines

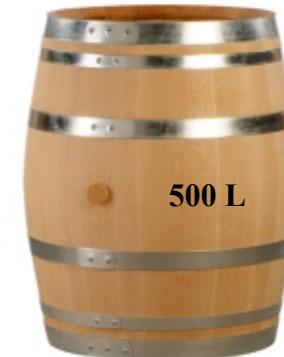
III – BARRELS – VOLUME EFFECT – WHITE WINES



Sauvignon
Blanc

Perle Blanche Barrels

Épicé & Fruité Toastings



→ DIFFERENT EXTRACTION KINETICS OF WOOD COMPOUNDS
DEPENDING ON BARREL VOLUME ???

→ RESEARCH OF ADDUCTS BETWEEN WINE AND WOOD COMPOUNDS

❖ Chemical analysis

Oenological and chromatic parameters

Total Phenolics

Anthocyanins

Tannins

Ellagitannins

Aroma

Fruity

Woody

❖ Sensory analysis



18-20 judges

Sensory profile

Triangular test

RESEARCH IN PROGRESS

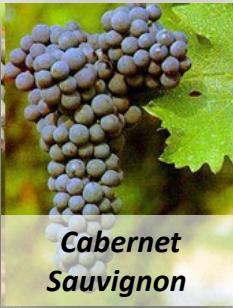
I : Identification of Products from Thermal Ellagitannin Degradation

II : Oak Wood Chips during AF and/or MLF

III : Effect of Barrel Volume & Barrel Toasting on White Wines

IV : Effect of Oak Wood Origin of Barrels – Red & White Wines

IV – EFFECT OF OAK WOOD ORIGIN OF BARRELS



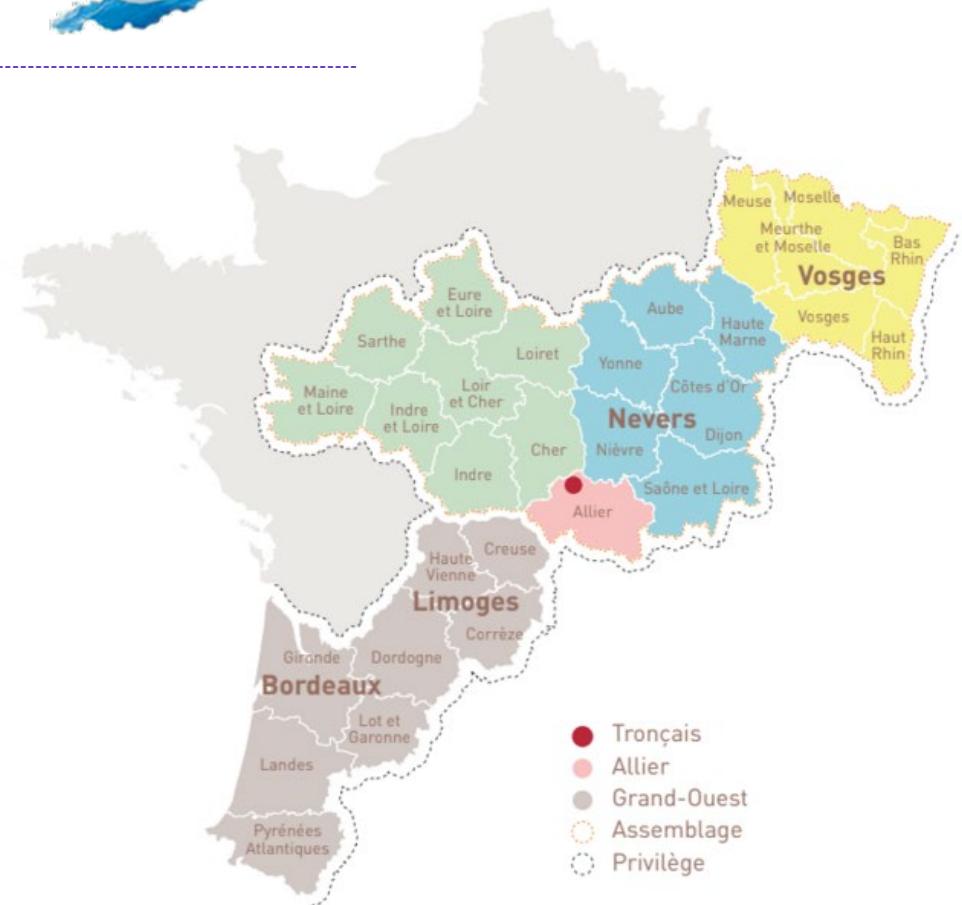
*Cabernet
Sauvignon*

Merlot



MT Toasting, 225 L

Elite, Privilège, Allier & Colbert Origins



RESEARCH IN PROGRESS

I : Identification of Products from Thermal Ellagitannin Degradation

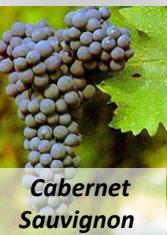
II : Oak Wood Chips during AF and/or MLF

III : Effect of Barrel Volume & Barrel Toasting on White Wines

IV : Effect of Oak Wood Origin of Barrels – Red & White Wines

V : Characterization of the New Range of Barrels – Red & White Wines

V - CHARACTERIZATION OF THE NEW RANGE OF BARRELS



Allier: LMT, Velours & Satin Toastings



Allier: MT & MTAA Toastings

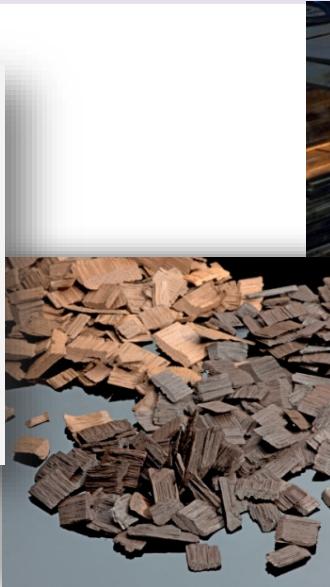


Perle Blanche: Épicé & Fruité Toastings

Elite: MTAA, LT+, Épicé & Fruité Toastings



OBJECTIFS R&D



Initial Objectifs

{ Oak wood characterization (chips, winewood, barrels)
Contact time everything is extracted?

Further Objectifs

{ Wine origin or toasting effect?
MLF container or toasting effect?

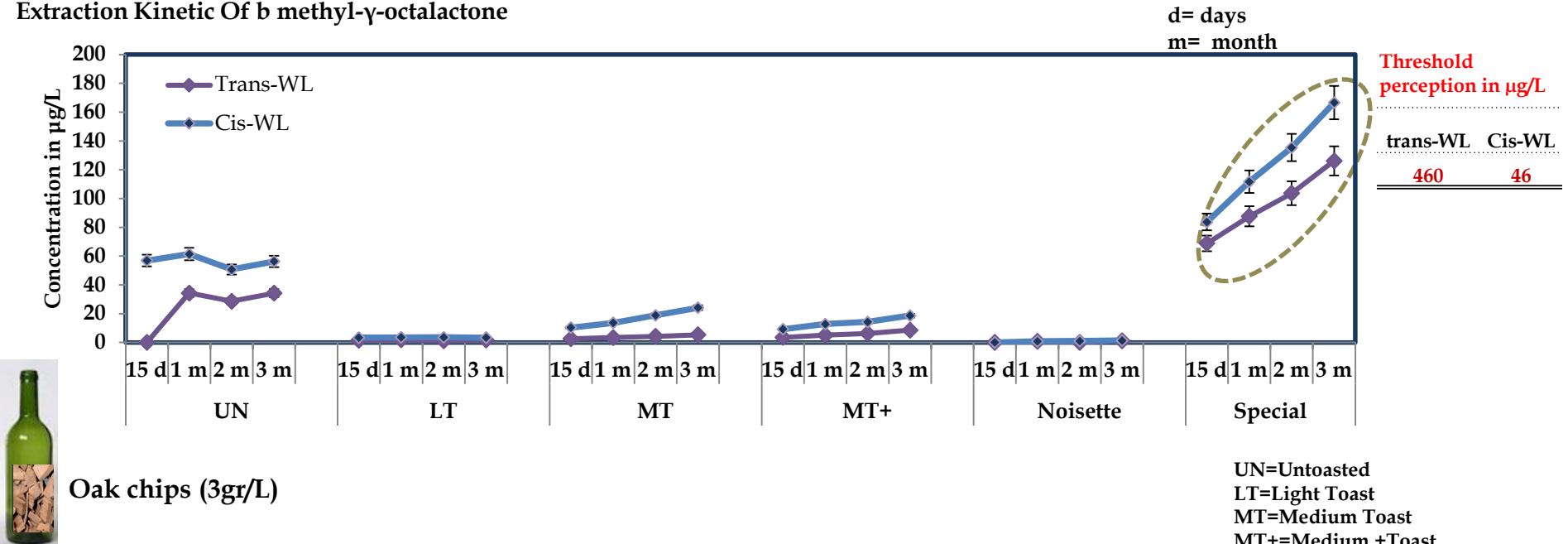
**Does oak influences
fruity aroma???**

RESULTS R&D

Results I : Oak Chips Characterization

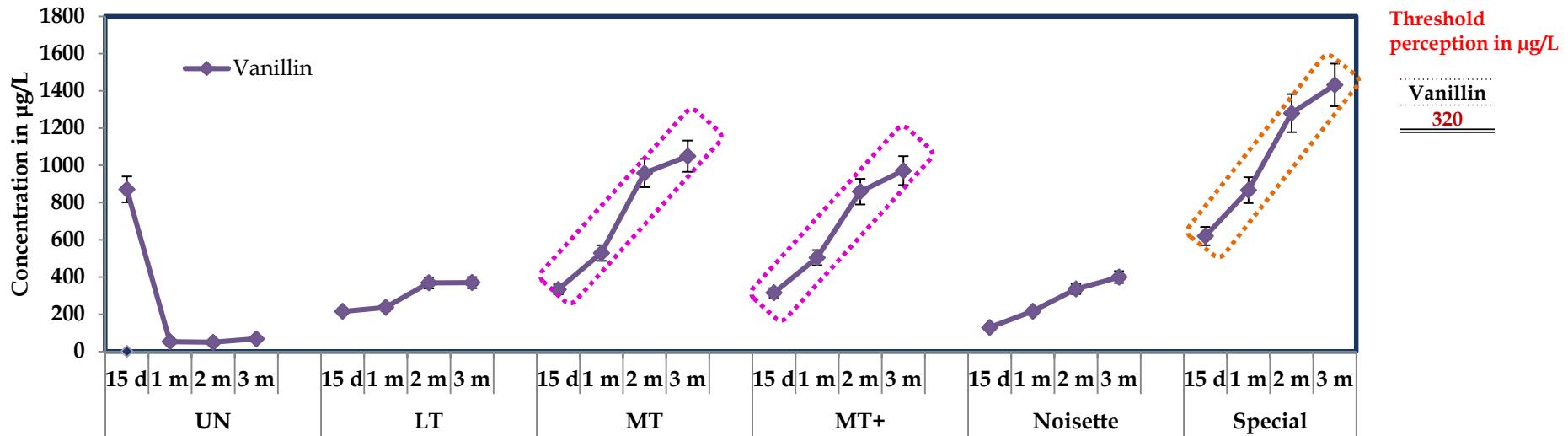
RESULTS I : OAK CHIPS VOLATILE COMPOUNDS

Extraction Kinetic Of β methyl- γ -octalactone



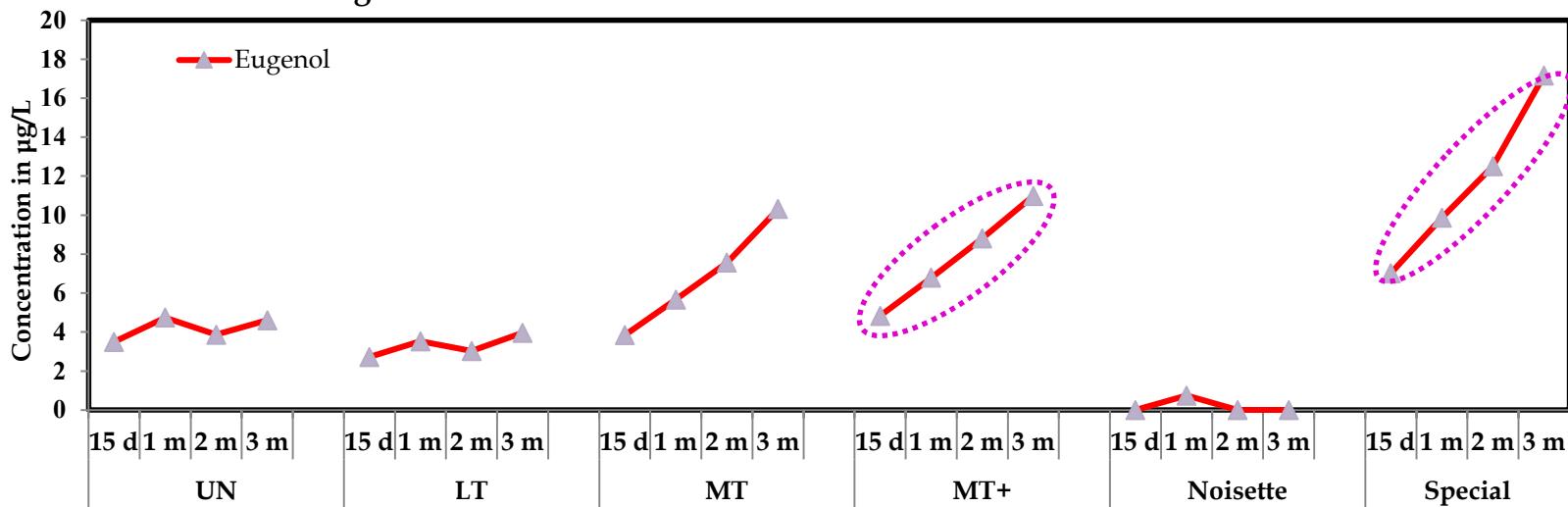
Oak chips (3gr/L)

Extraction Kinetic Of Aldehyde phenols

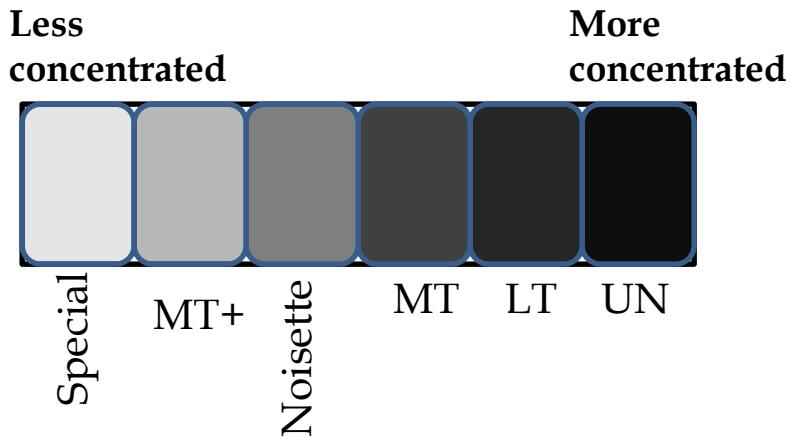


RESULTS I :OAK CHIPS VOLATILE COMPOUNDS AND ELLAGITANNIN

Extraction Kinetic Of Eugenol



The toasting method influences ellagitannin concentration



Stabilization and maximum extraction after two months



RESULTS I : OAK CHIPS SENSORY ANALYSIS

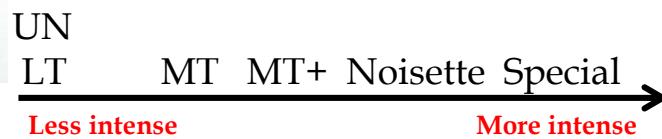
Olfactory



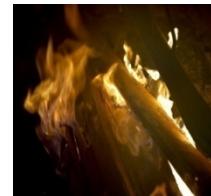
Vanilla



Spicy

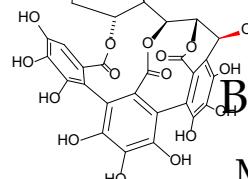
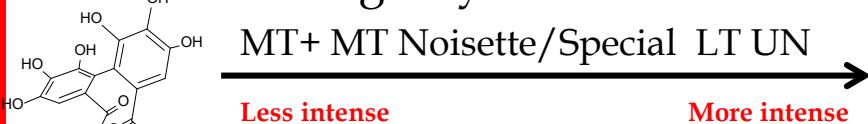


Overall woody



Gustative

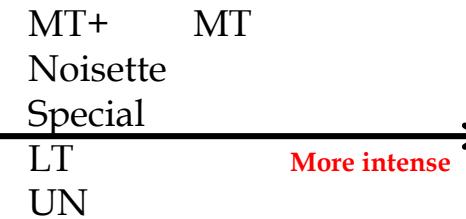
Astringency



Bitterness



Sweetness



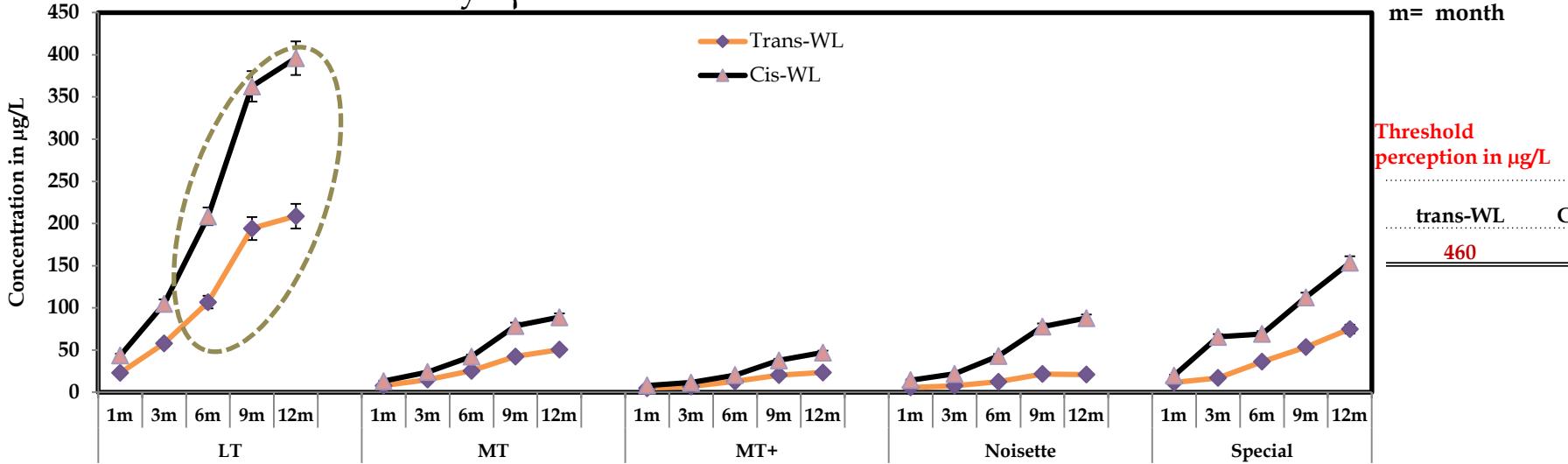
RESULTS R&D

Results I : Oak Chips Characterization

Results II : Winewood Characterization

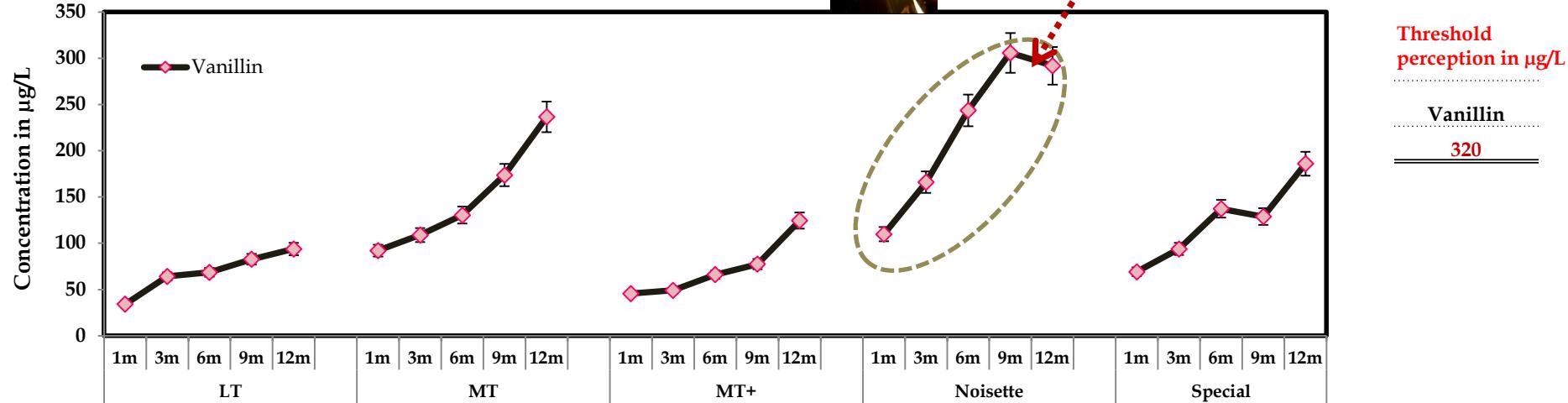
RESULTS II : WINEWOOD VOLATILE COMPOUNDS

Extraction Kinetic Of β methyl- γ -octalactone



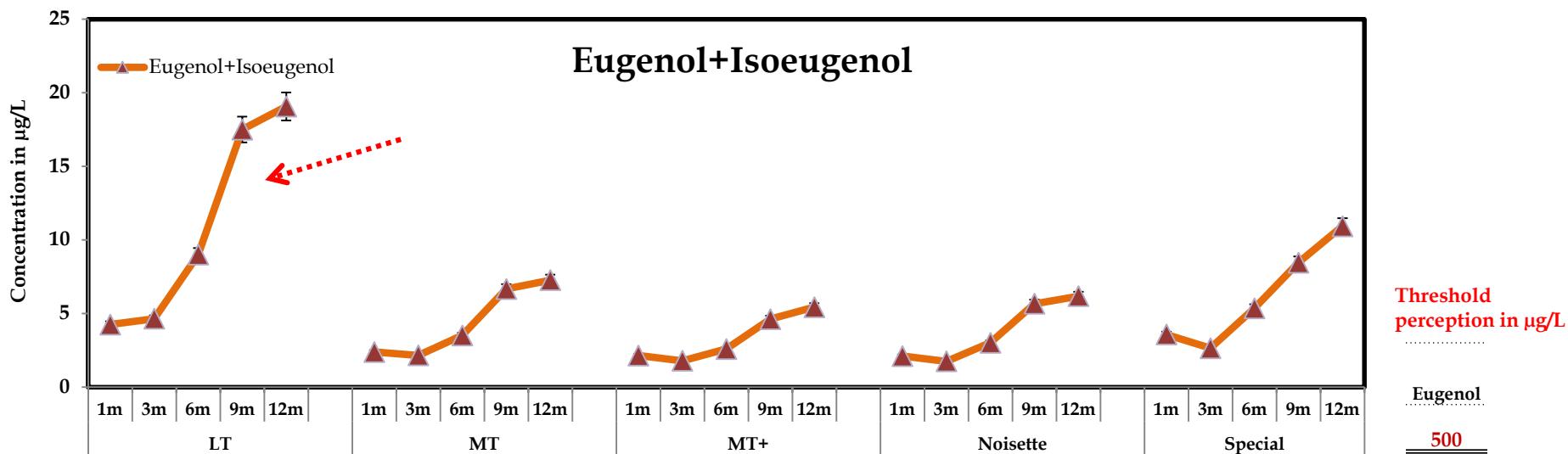
Wine
100% Merlot
2 winewood per hl

Extraction Kinetic Of Aldehyde Phenols

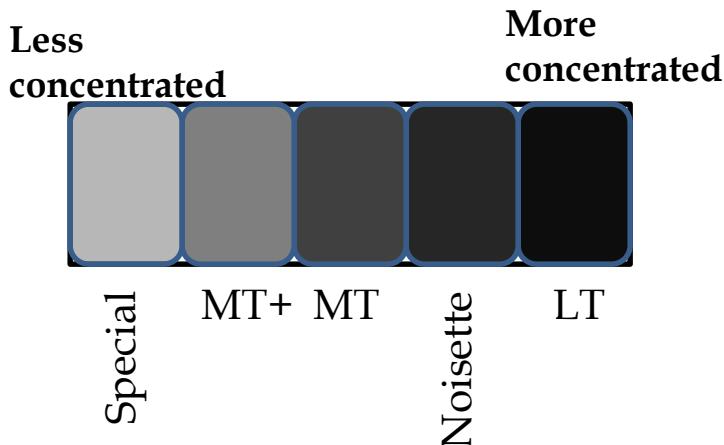


RESULTS II : WINWOOD VOLATILE COMPOUNDS AND ELLAGITANNINS

Extraction Kinetic Of Volatile Phenols



The toasting method influences ellagitannin concentration



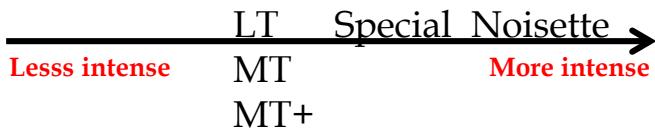
Maximum extraction after two or three months



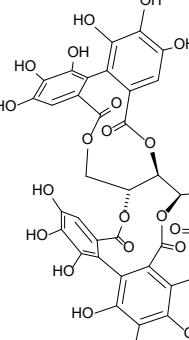
RESULTS II : WINEWOOD SENSORY ANALYSIS



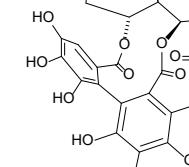
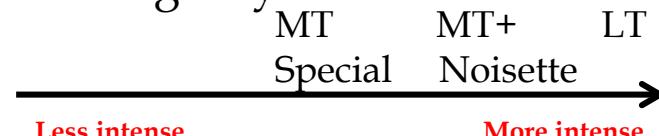
Vanilla



Spicy



Astringency



ess



Overall woody



Sweetness



RESULTS R&D

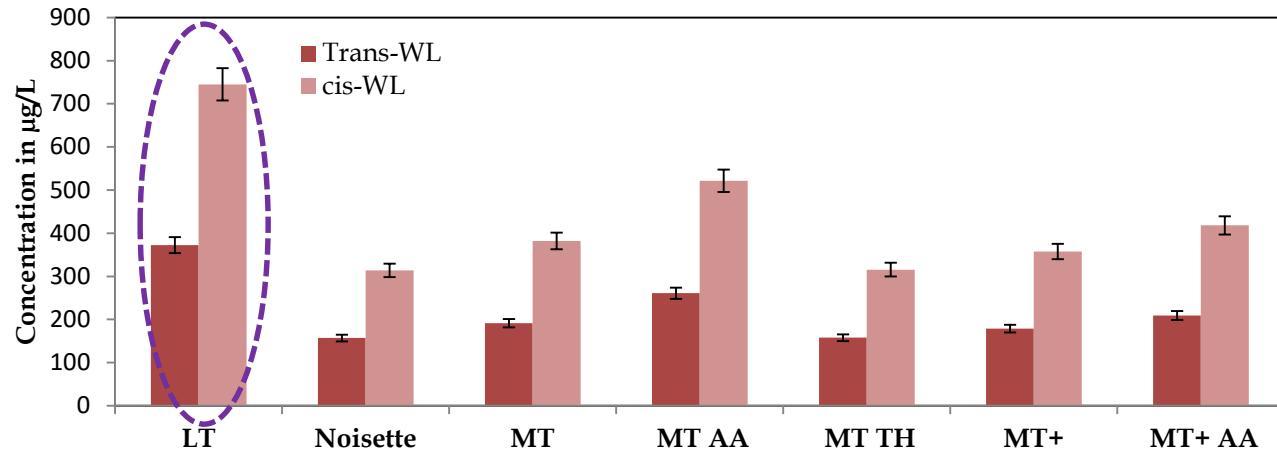
Results I : Oak Chips Characterization

Results II : Winewood Characterization

Results III : Barrel Characterization

RESULTS III : BARREL VOLATILE COMPOUNDS

Extraction Kinetic Of β methyl- γ -octalactone

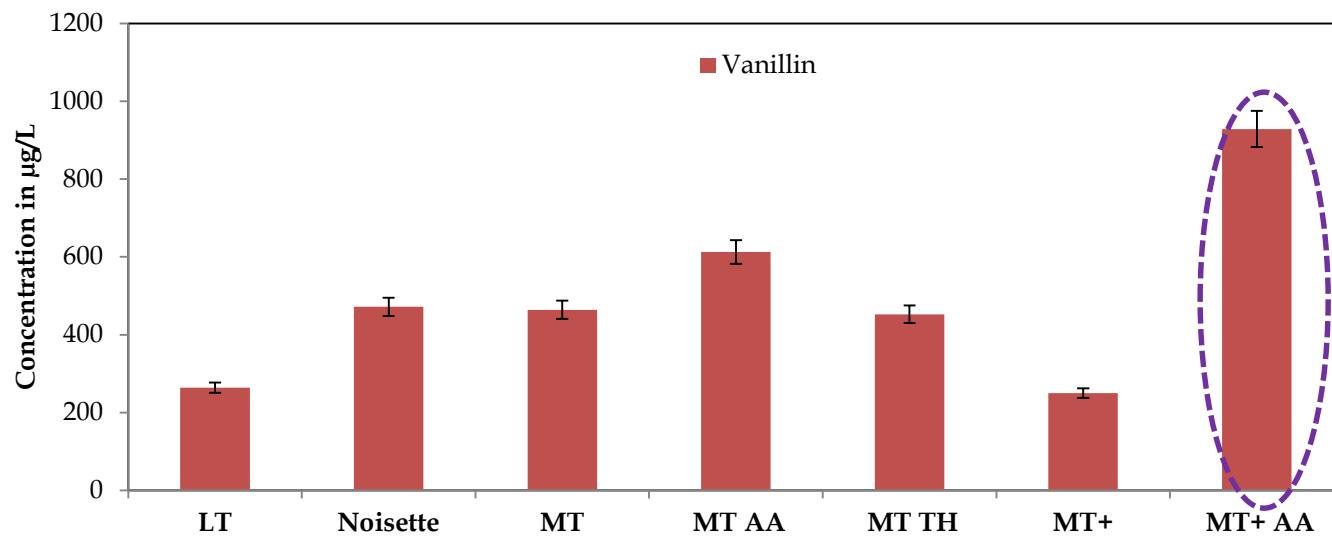


Threshold perception in $\mu\text{g/L}$

trans-WL Cis-WL
460 46

LT=Light Toast
MT=Medium Toast
MT AA= Medium Toast with watering
MT TH= Medium Toast with toasting head
MT+=Medium Plus Toast
MT +AA = Medium +Toast with watering

Extraction Kinetic Of Aldehyde Phenols



Threshold perception in $\mu\text{g/L}$

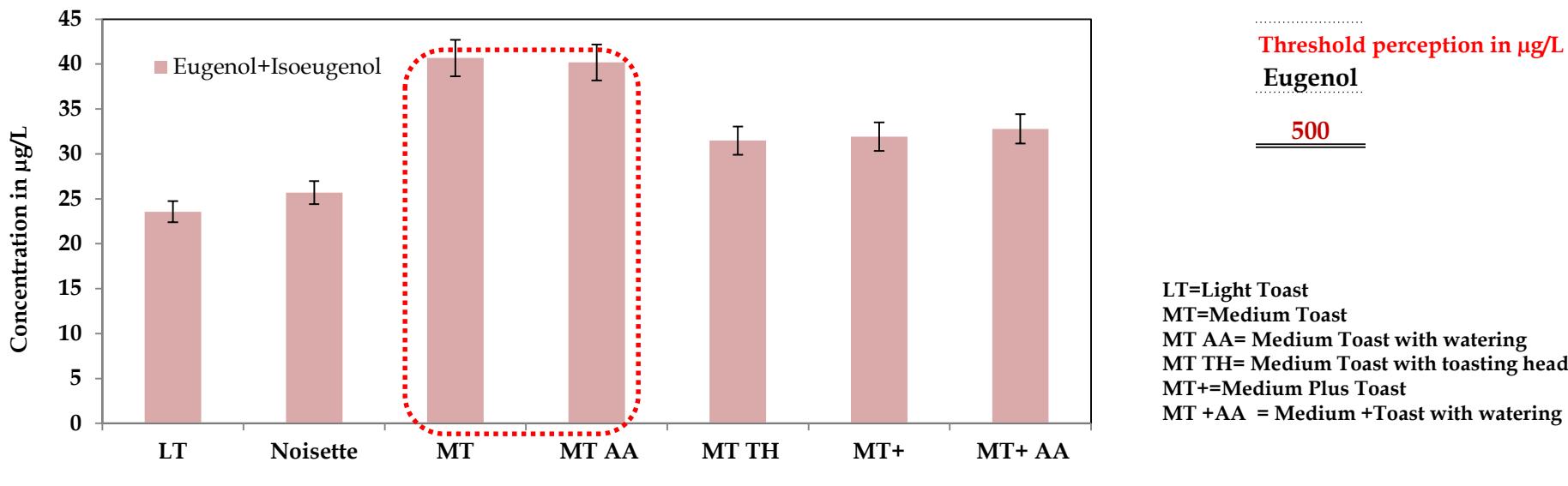
Vanillin
320

Merlot wine
12 months
aged in oak
barrels

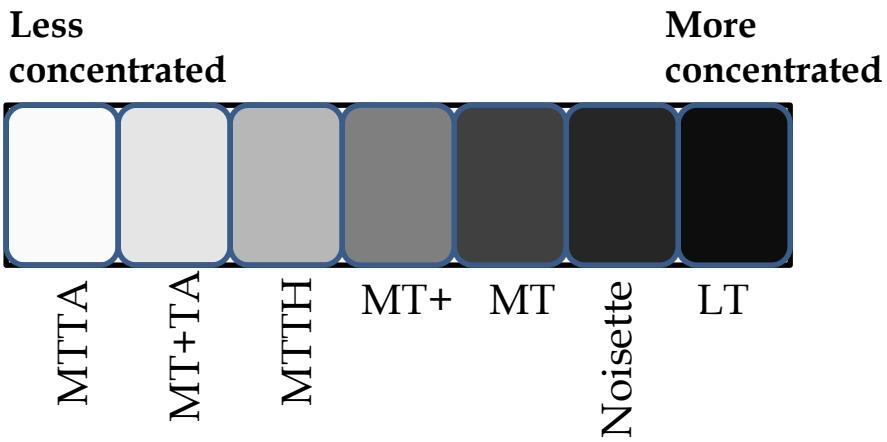


RESULTS III : BARREL VOLATILE COMPOUNDS AND ELLAGITANNINS

Extraction Kinetic Of Volatile Phenols



The toasting method influences ellagitannin concentration



Merlot wine
12 months
aged in oak
barrels



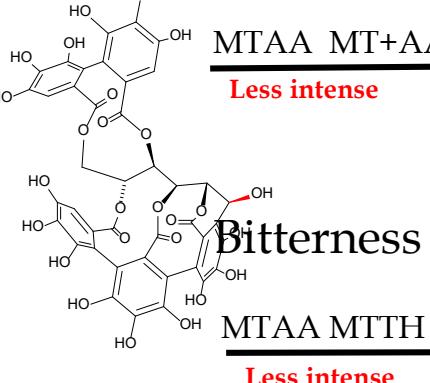
RESULTS III : BARRELS SENSORY ANALYSIS



Vanilla



Spicy



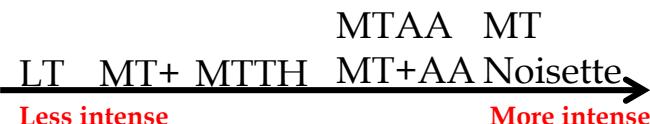
Astringency

Bitterness

Less intense More intense

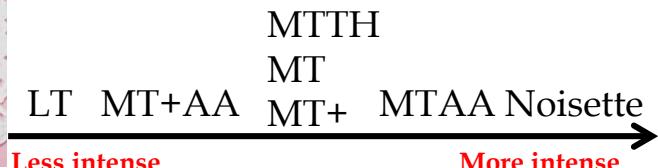
MTAA MTTH MT+AA Noisette /MT+ MT LT

Overall woody



Gustative

Sweetness



RESULTS R&D

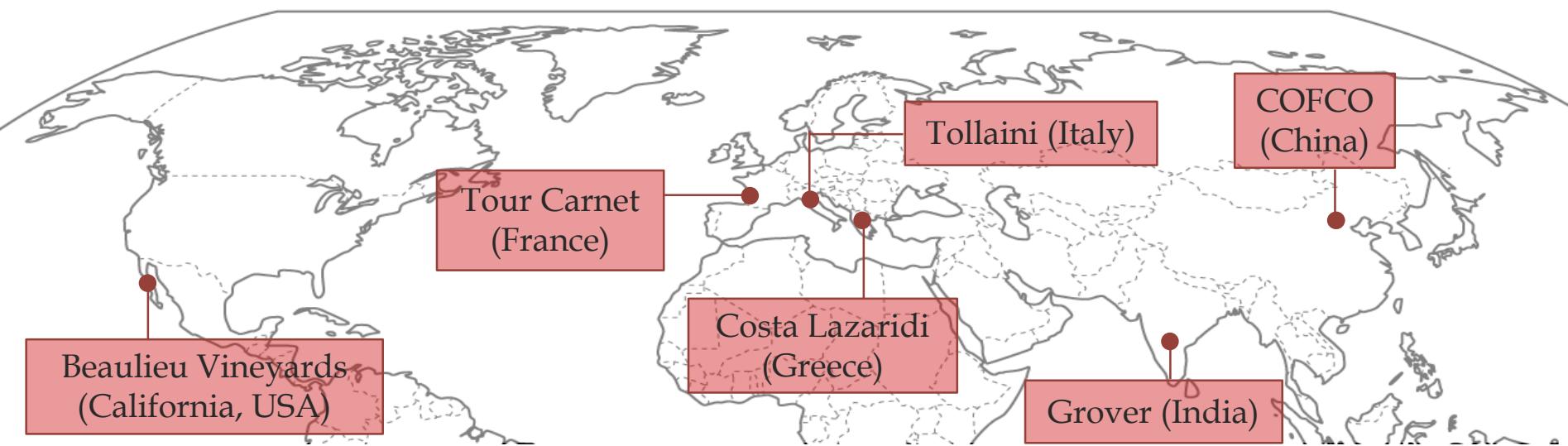
Results I : Oak Chips Characterization

Results II : Winewood Characterization

Results III : Barrel Characterization

Results IV : Effect of Barrel Toasting & Wine Origin on Red Wines

EXPERIMENTAL DESIGN IV - BARRELS - TOASTING EFFECT - RED WINES



MLF, malolactic fermentation



After MLF...

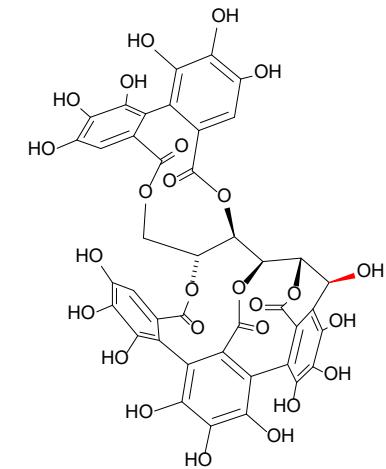
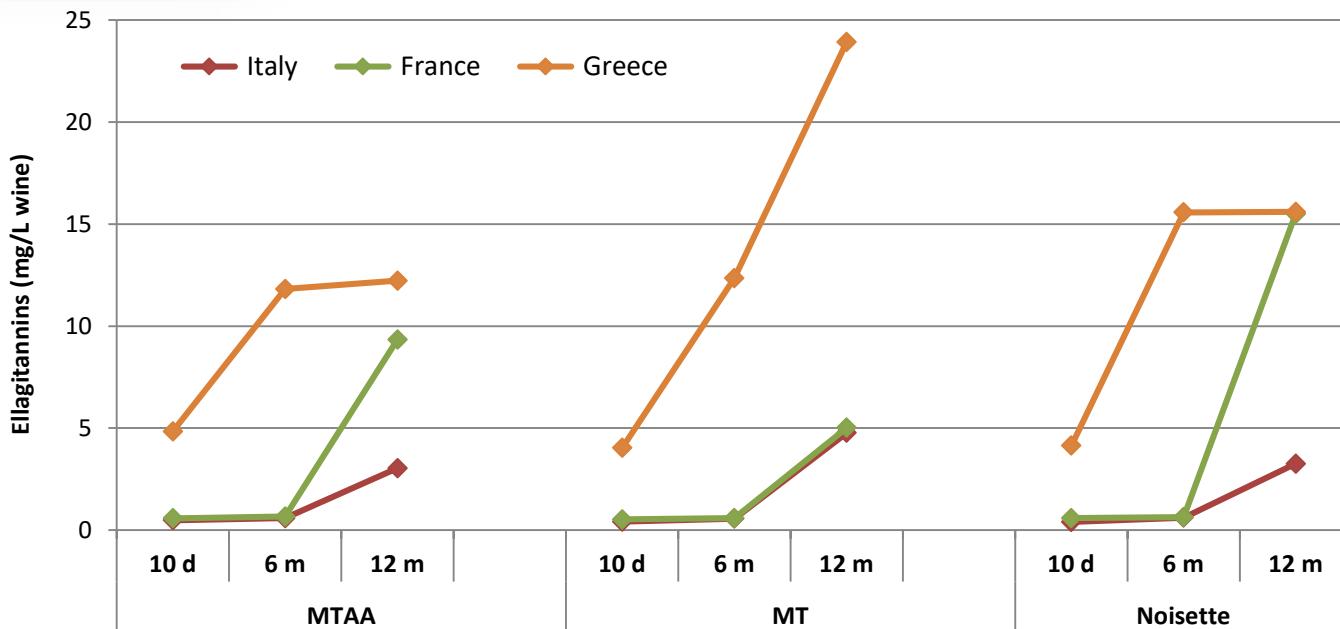
100% Cabernet Sauvignon wine
Vintage 2012/2013



WINE SAMPLING: 10 days, 6 months, 12 months

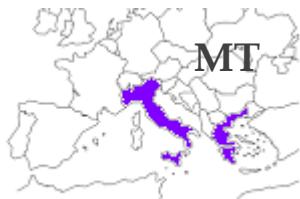
RESULTS IV - BARRELS - TOASTING EFFECT - RED WINES

Ellagitannins



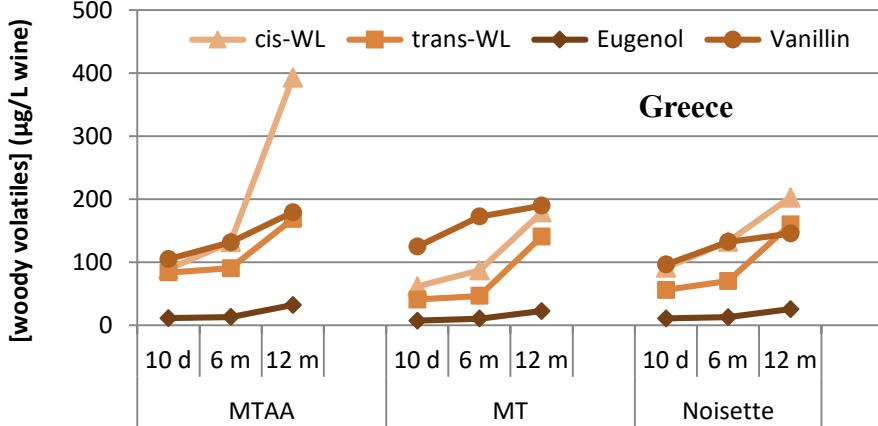
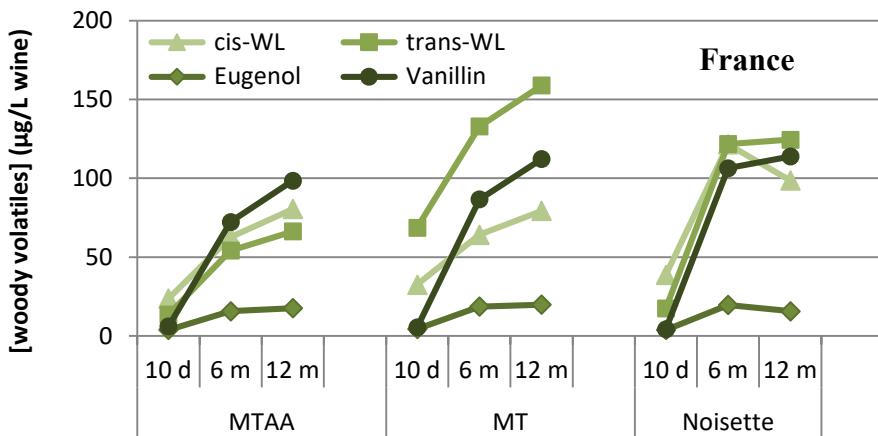
❖ Both barrel toasting and wine origin influenced ellagitannin content

❖ Maximum extraction of ellagitannins after 12 months in barrels

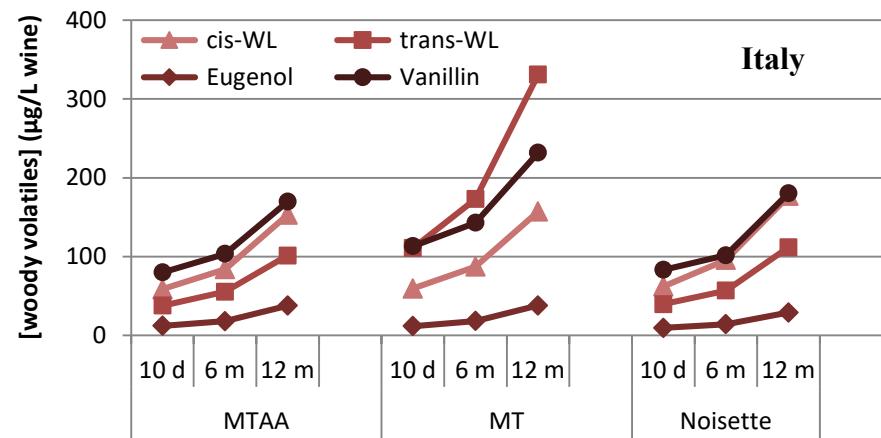


RESULTS IV - BARRELS - TOASTING EFFECT - RED WINES

Woody aroma



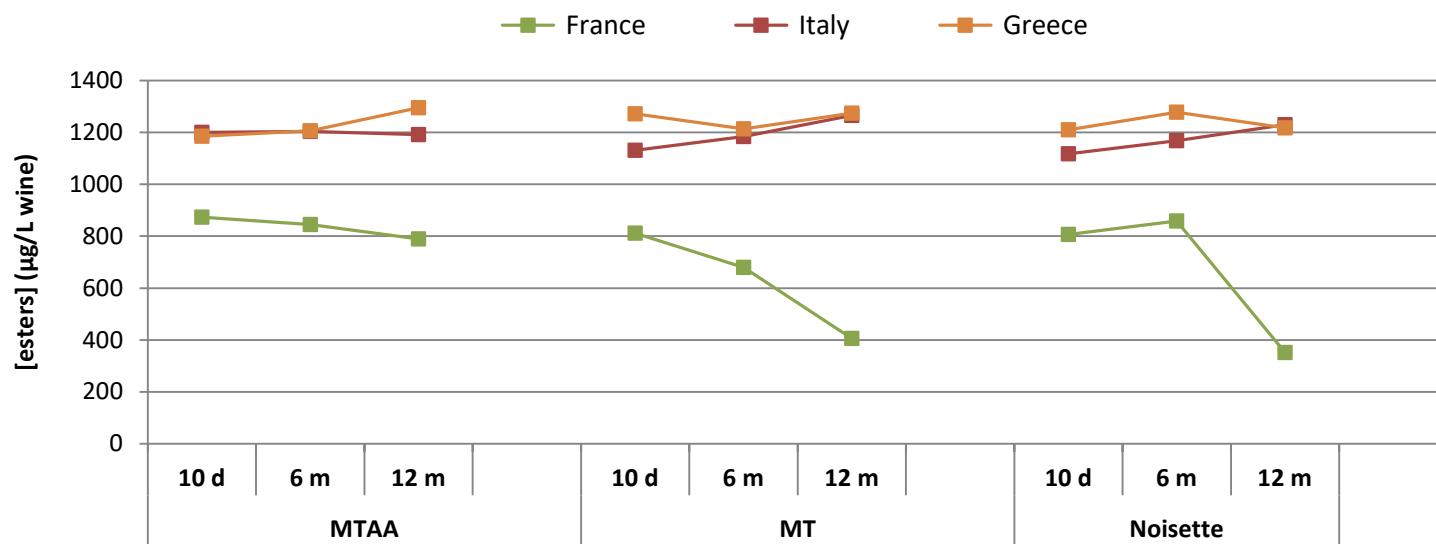
❖ Extraction of woody volatiles linearly increased with wood contact



❖ The obtained woody aroma profiles depended on both barrel toasting and wine origin

RESULTS IV - BARRELS - TOASTING EFFECT - RED WINES

Fruity aroma - Esters



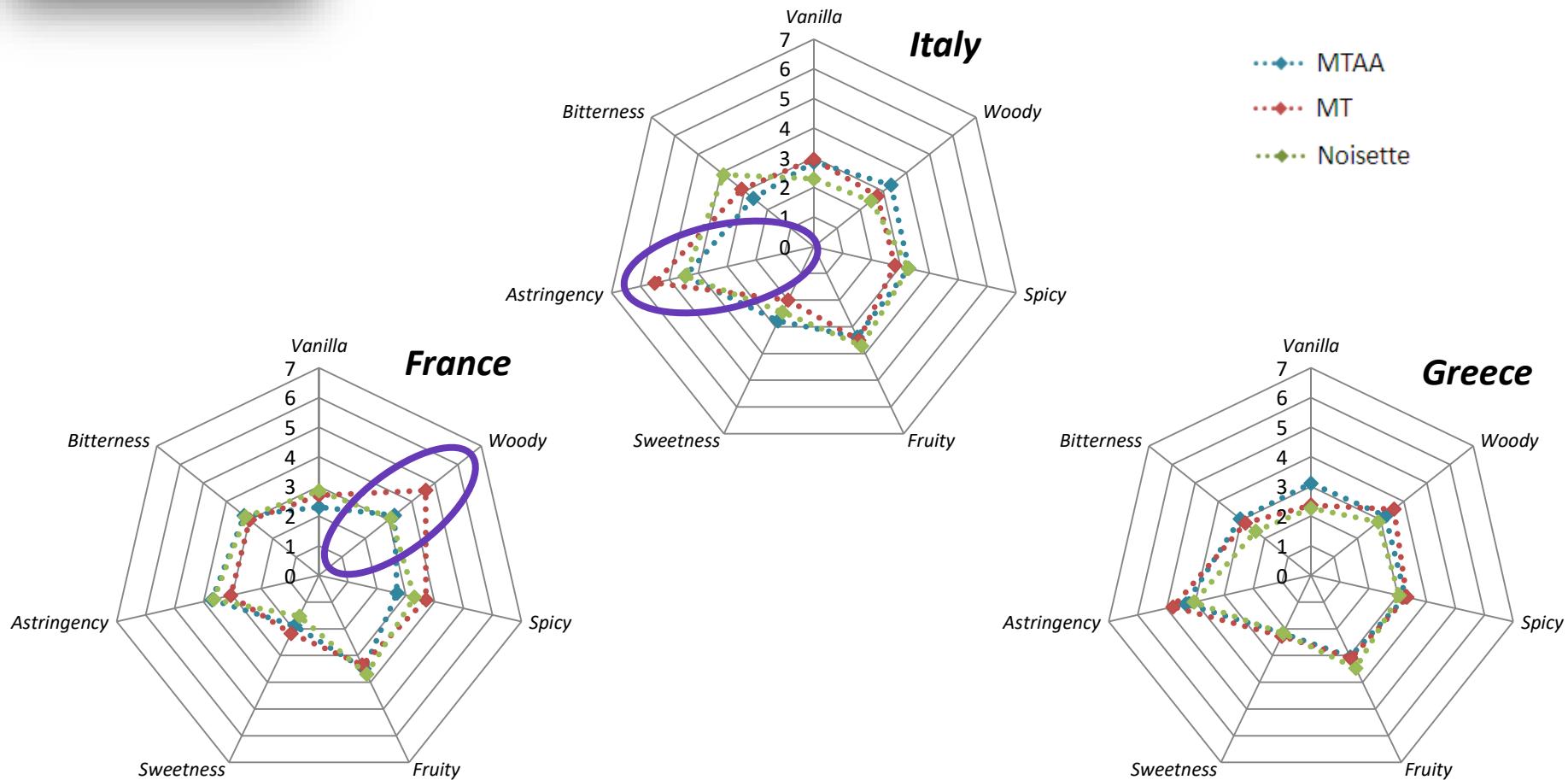
❖ A constant ester concentration was observed during barrel ageing



❖ Fruity character of wines is not masked by woody aroma

RESULTS IV - BARRELS - TOASTING EFFECT - RED WINES

Sensory analysis



❖ No general conclusions can be stated for all countries

RESULTS R&D

Results I : Oak Chips Characterization

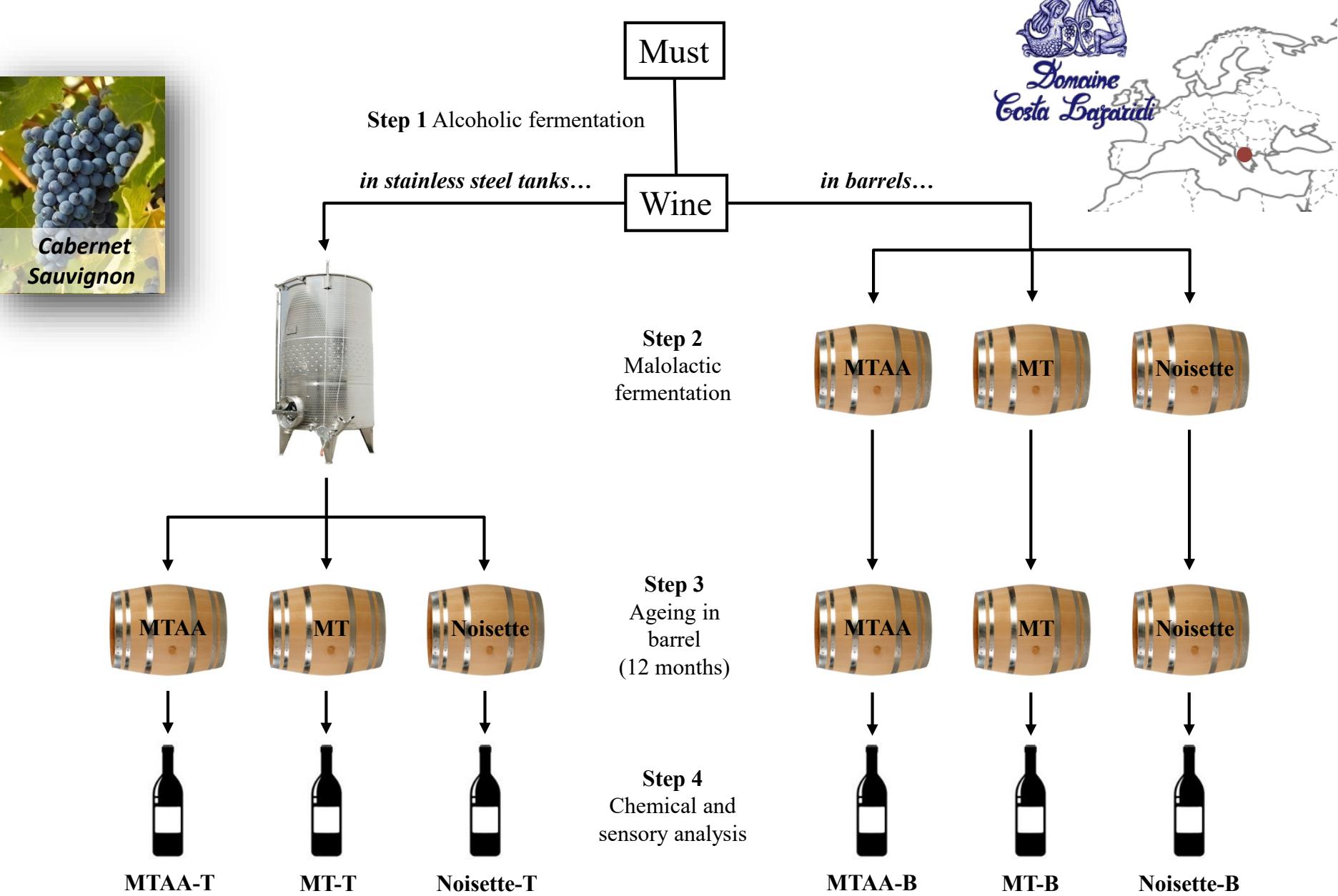
Results II : Winewood Characterization

Results III : Barrel Characterization

Results IV : Effect of Barrel Toasting & Wine Origin on Red Wines

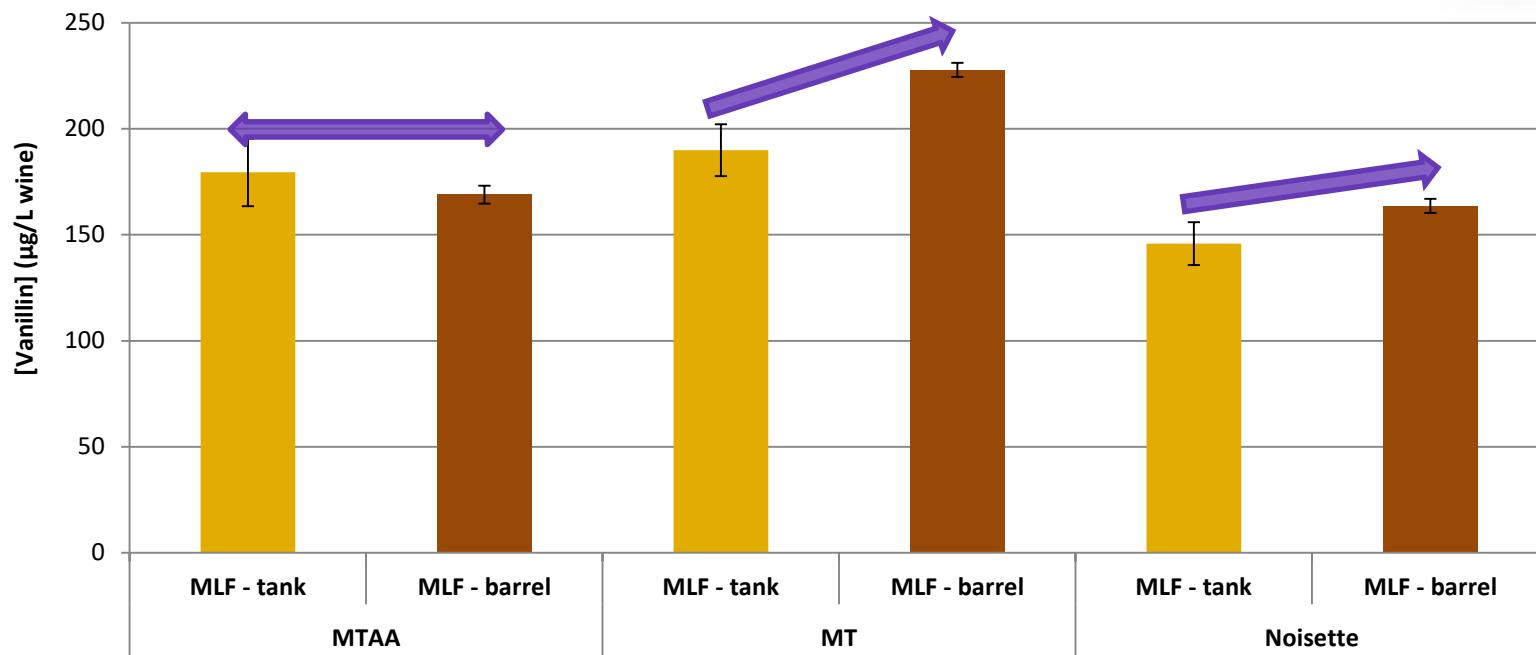
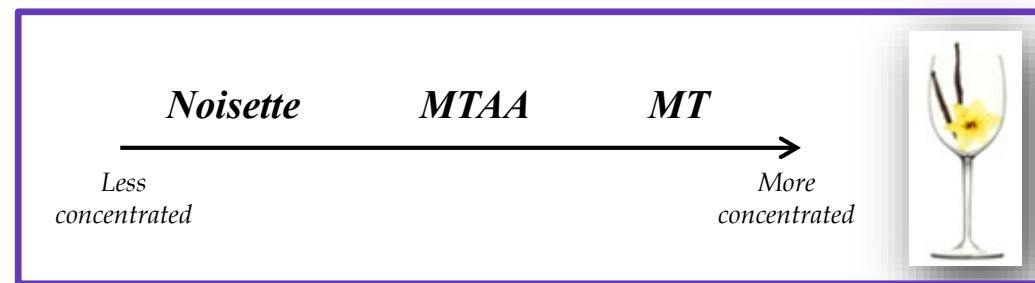
Results V : Effect of Barrel Toasting & MLF-container on Red Wines

EXPERIMENTAL DESIGN V - MLF IN BARRELS - RED WINES



RESULTS V - MLF IN BARRELS - RED WINES

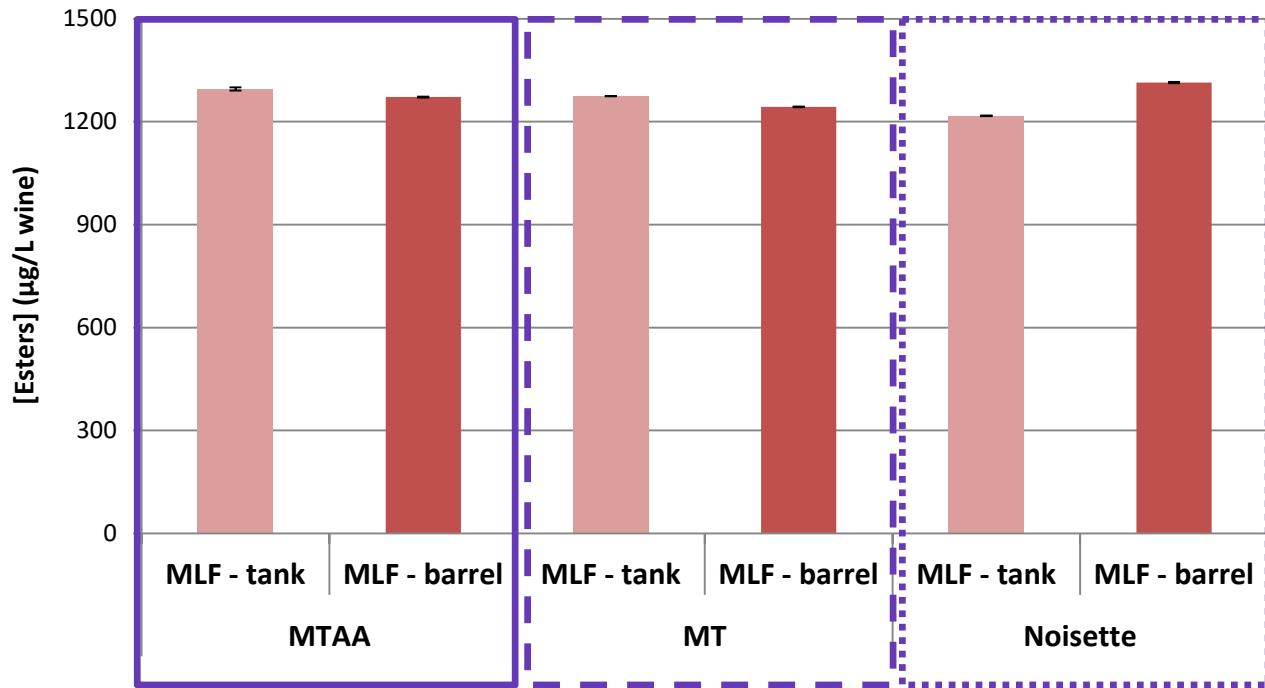
Woody aroma - Vanillin



- ❖ MT / Noisette toastings: higher vanillin content for barrel-fermented wines
 - ❖ MTAA toasting: similar vanillin content for both MLF-modalities

RESULTS V – MLF IN BARRELS – RED WINES

Fruity aroma - Esters



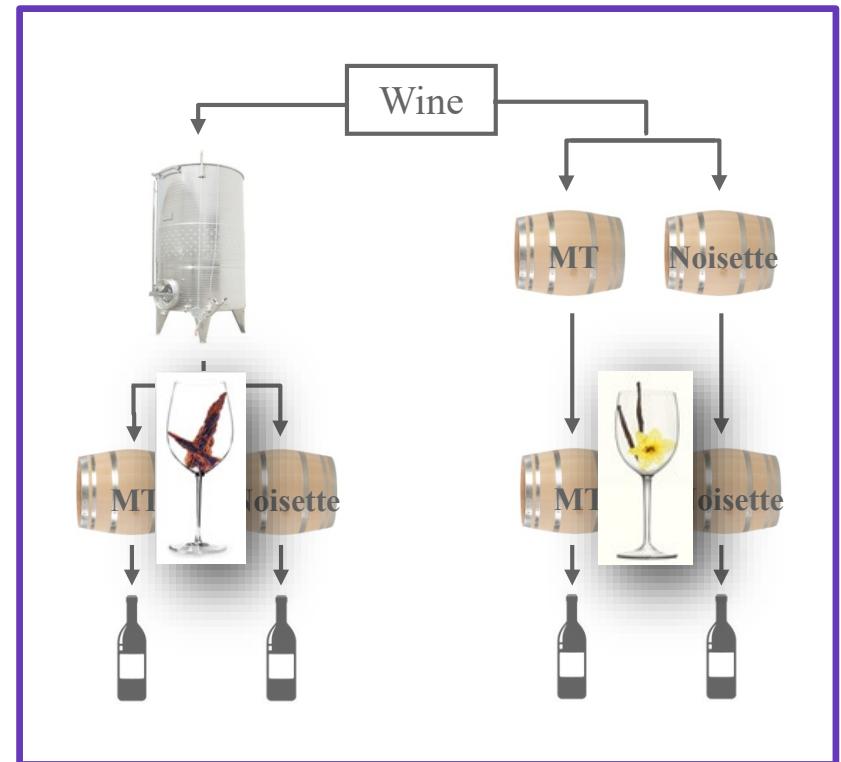
- ❖ Ester concentration was not influenced neither by MLF-container nor the barrel toasting

RESULTS V – MLF IN BARRELS – RED WINES

Sensory analysis

	MLF in tanks		MLF in barrels	
	Olfactory	Gustative	Olfactory	Gustative
Most preferred	MTAA (42%)	MT (39%)	MTAA (42%)	MTAA (50%)
Least preferred	Noisette (47%)	Noisette (39%)	Noisette (47%)	Noisette (39%)

- ❖ Barrel toasting did not impact significantly the organoleptic perception of wines
- ❖ In the case of MT and Noisette toastings, MLF-container led to significant differences



RESULTS R&D

Results I : Oak Chips Characterization

Results II : Winewood Characterization

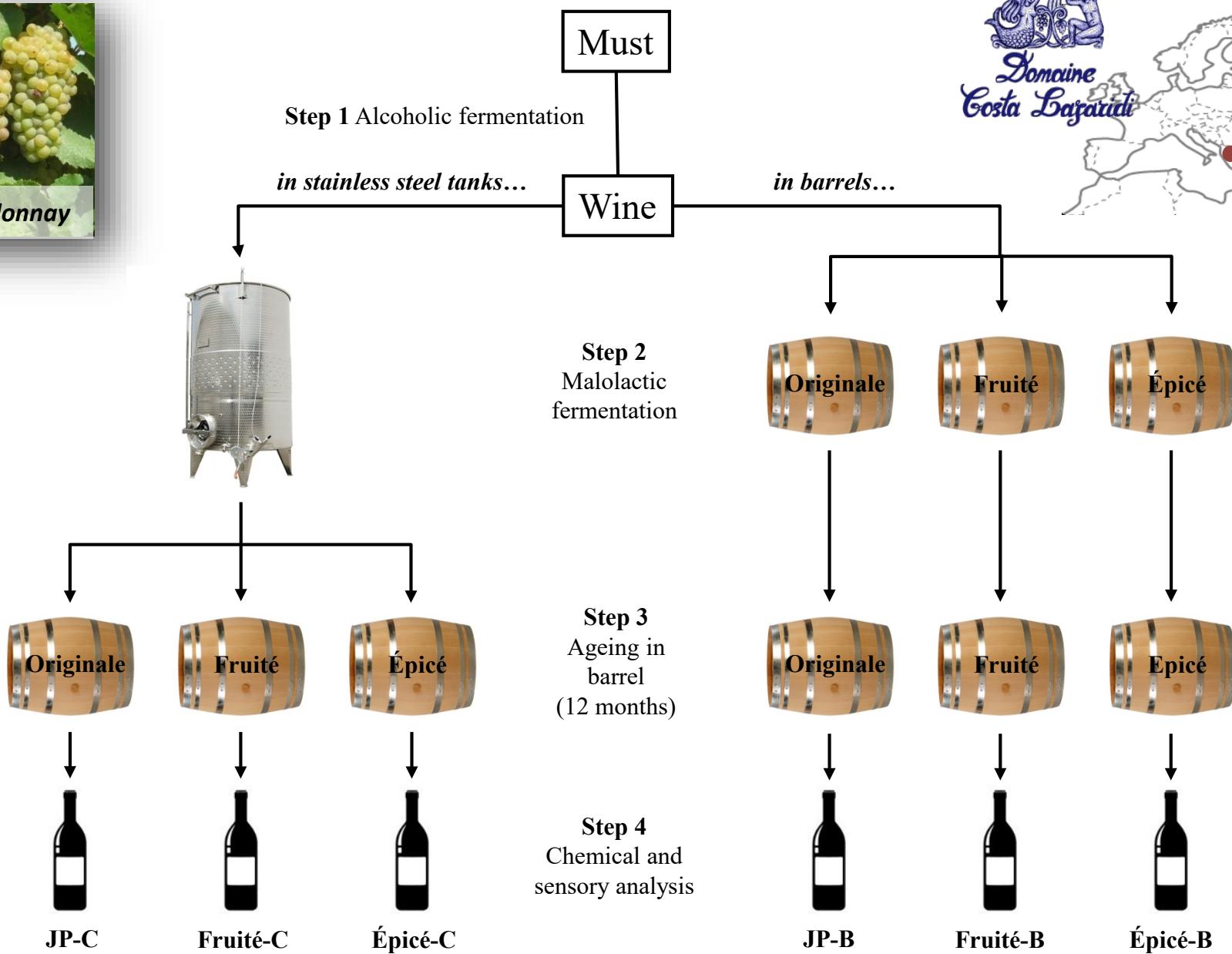
Results III : Barrel Characterization

Results IV : Effect of Barrel Toasting & Wine Origin on Red Wines

Results V : Effect of Barrel Toasting & MLF-container on Red Wines

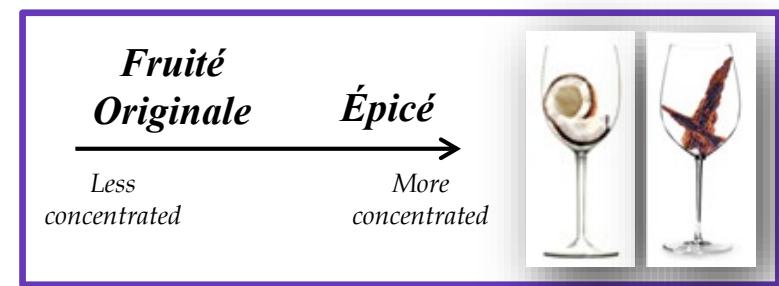
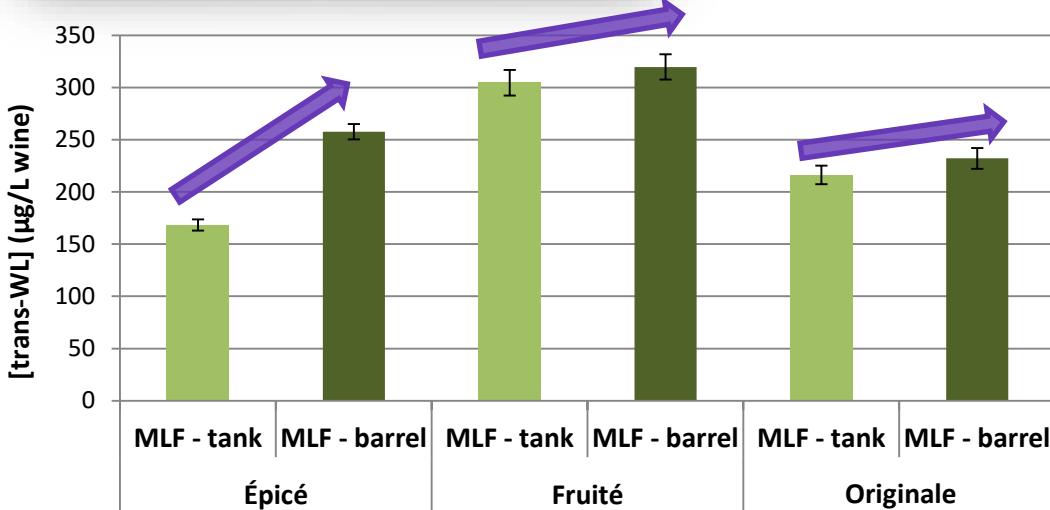
Results VI : Effect of Barrel Toasting & MLF-container on White Wines

EXPERIMENTAL DESIGN VI – MLF IN BARRELS – WHITE WINES

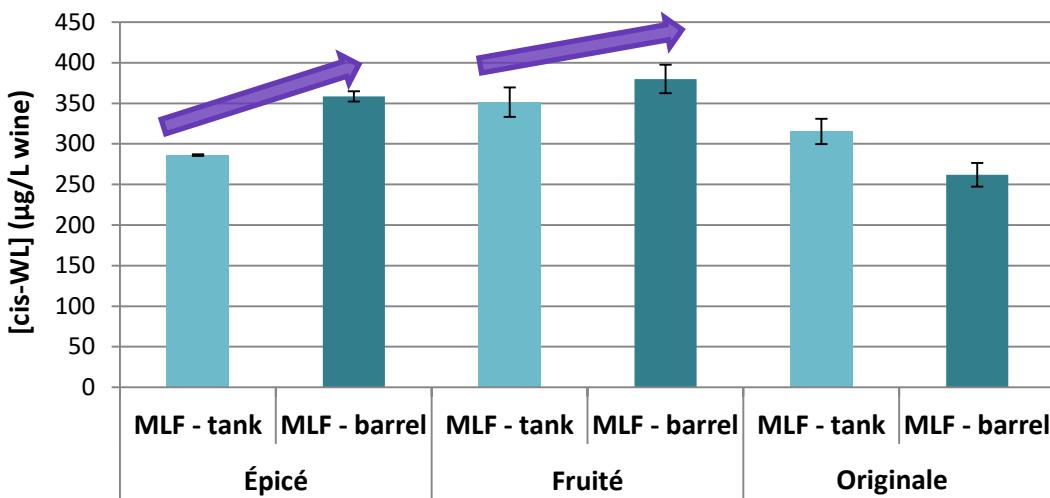


RESULTS VI - MLF IN BARRELS - WHITE WINES

Woody aroma - Whiskeylactones



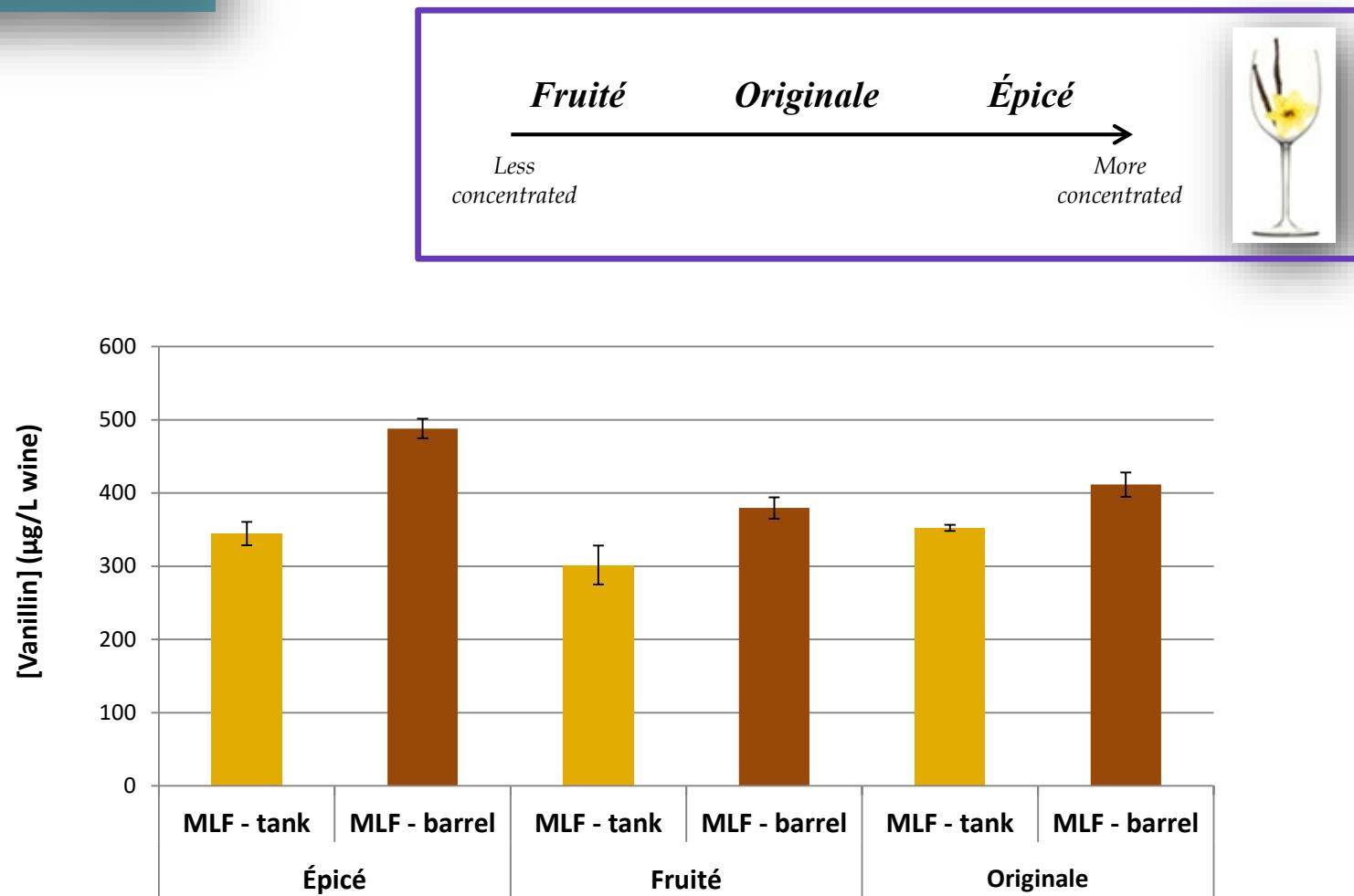
❖ Both barrel toasting and MLF-container impact the whiskeylactones content



❖ In general, the barrel-fermented wines presented higher values

RESULTS VI - MLF IN BARRELS - WHITE WINES

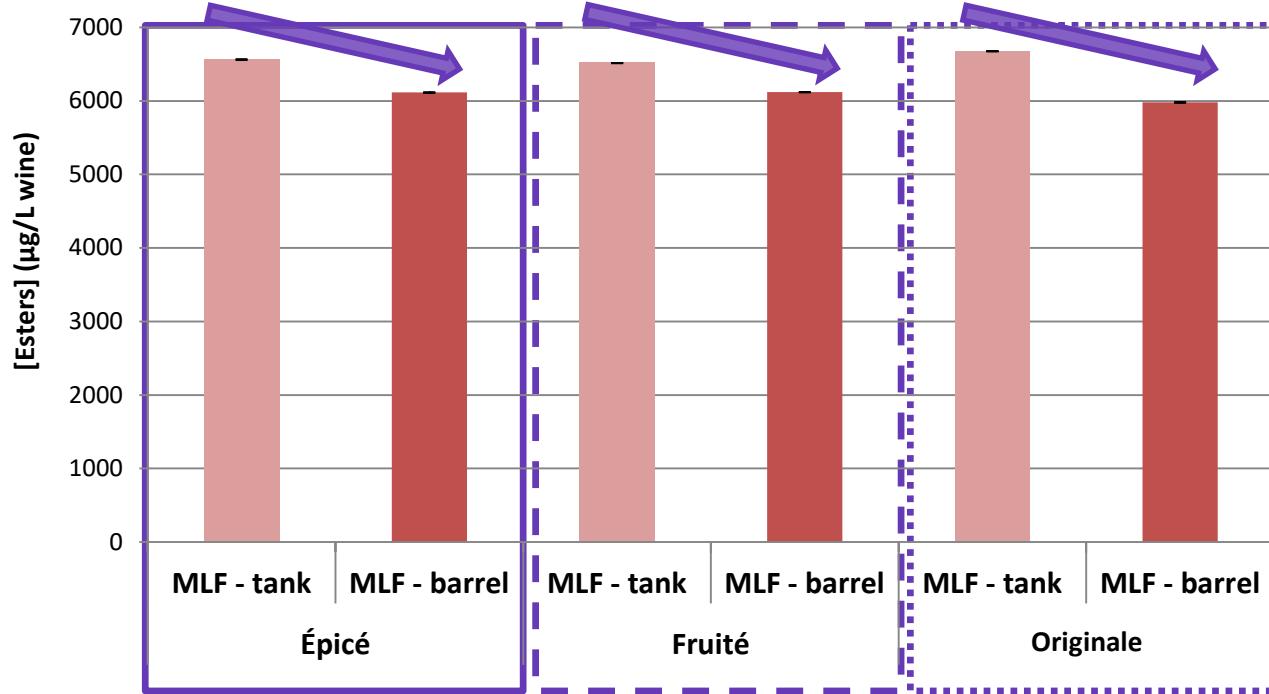
Woody aroma - Vanillin



- ❖ As observed for WL, barrel-fermented wines presented higher vanillin content

RESULTS VI - MLF IN BARRELS - WHITE WINES

Fruity aroma - Esters



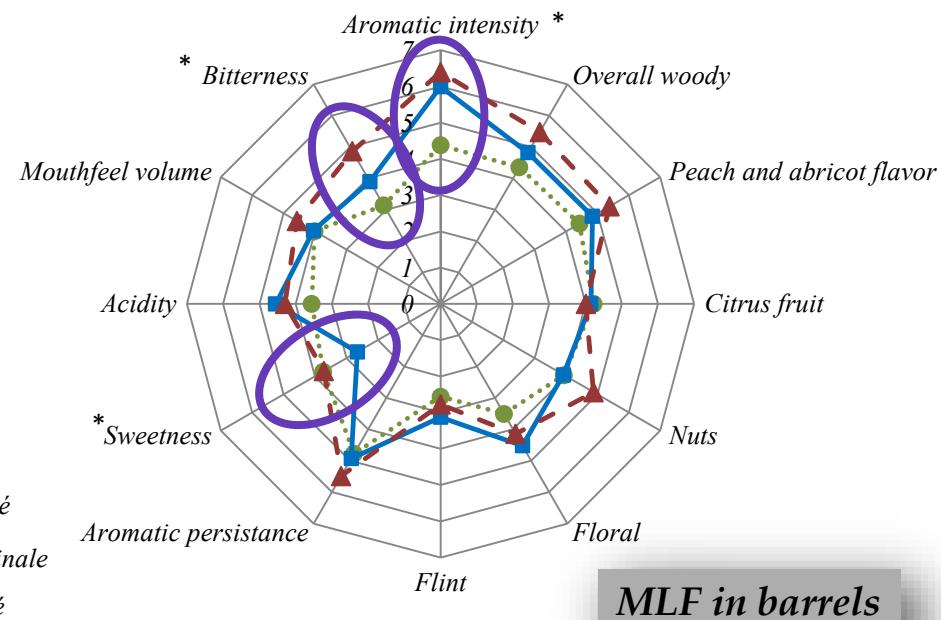
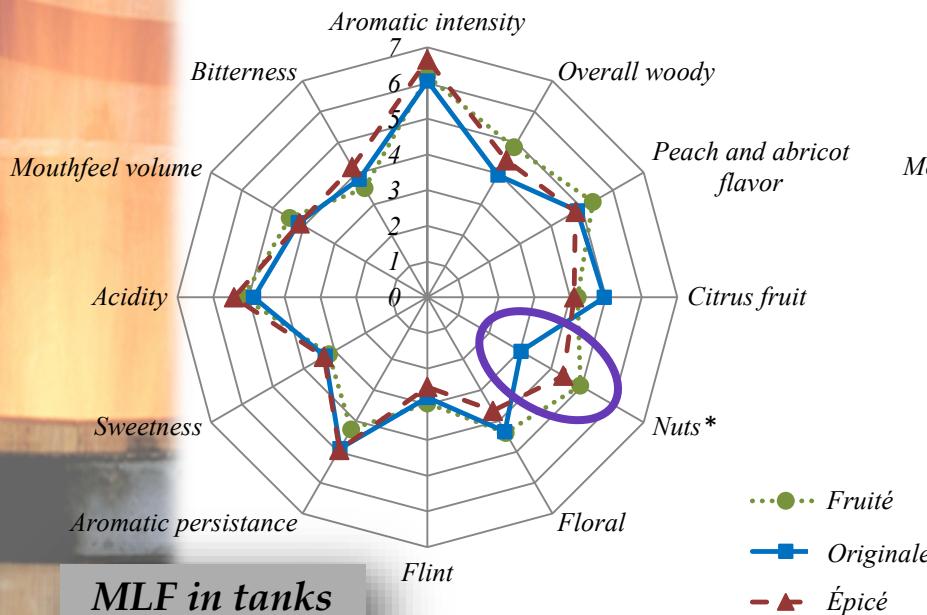
- ❖ Fruity aroma profile was not influenced by barrel toasting, but was impacted by MLF-container

RESULTS VI – MLF IN BARRELS – WHITE WINES

Sensory analysis

	MLF in tanks		MLF in barrels	
	Olfactory	Gustative	Olfactory	Gustative
Most preferred	Originale (44%)	Fruité (42 %)	Fruité (42 %)	Fruité (63 %)
Least preferred	Épicé (56%)	Épicé (42%)	Originale (47%)	Épicé (47%)

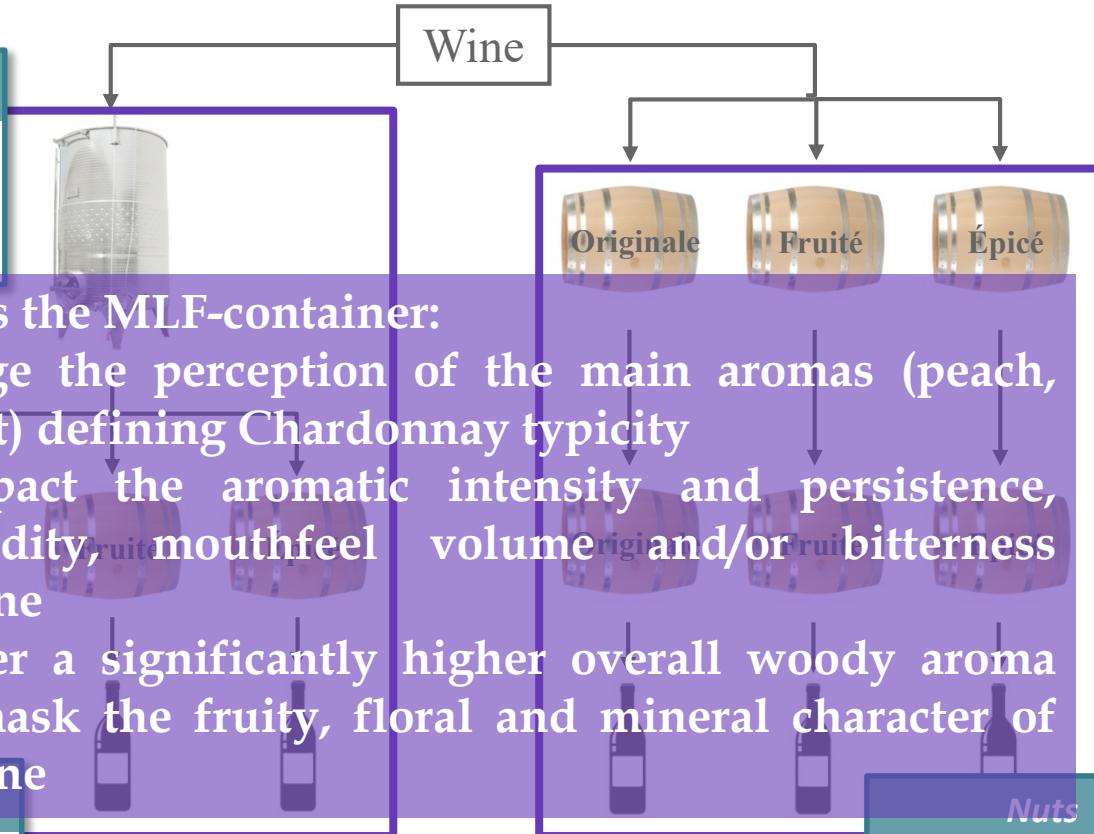
- ❖ Significant differences were found with regard to the toasting method



RESULTS VI – MLF IN BARRELS – WHITE WINES

Sensory analysis

- ❖ MLF-container led to significant differences for all three toastings



The use of barrels as the MLF-container:

- i) does not change the perception of the main aromas (peach, apricot and flint) defining Chardonnay typicity
- ii) does not impact the aromatic intensity and persistence, volume and/or bitterness attributes of wine
- iii) does not confer a significantly higher overall woody aroma which might mask the fruity, floral and mineral character of Chardonnay wine



RESULTS R&D

Results I : Oak Chips Characterization

Results II : Winewood Characterization

Results III : Barrel Characterization

Results IV : Effect of Barrel Toasting & Wine Origin on Red Wines

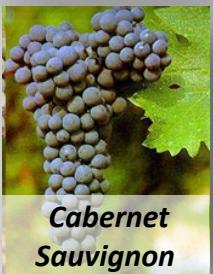
Results V : Effect of Barrel Toasting & MLF-container on Red Wines

Results VI : Effect of Barrel Toasting & MLF-container on White Wines

Results VII : Oak Wood Chips - Gallo Project

EXPERIMENTAL DESIGN VII – OAK WOOD CHIPS – GALLO PROJECT

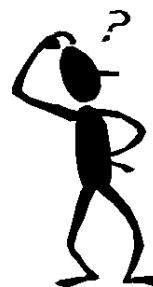
TEST I: CABERNET SAUVIGNON WINES IN CONTACT WITH OAK WOOD CHIPS OF DIFFERENT TOASTING DURING 2 WEEKS



Cabernet
Sauvignon

10 MODALITIES + CONTROL WINE (WITHOUT WOOD CONTACT)

Toasting	French oak wood chips	American oak wood chips
HT (high toasting)	X	---
MT+ (medium toasting +)	---	X
Special MT (medium toasting with watering)	X	X
MT2 (double medium toasting)	---	X
Noisette	X	X
LT+ (light toasting +)	X	X
UN (untoasted)	X	---

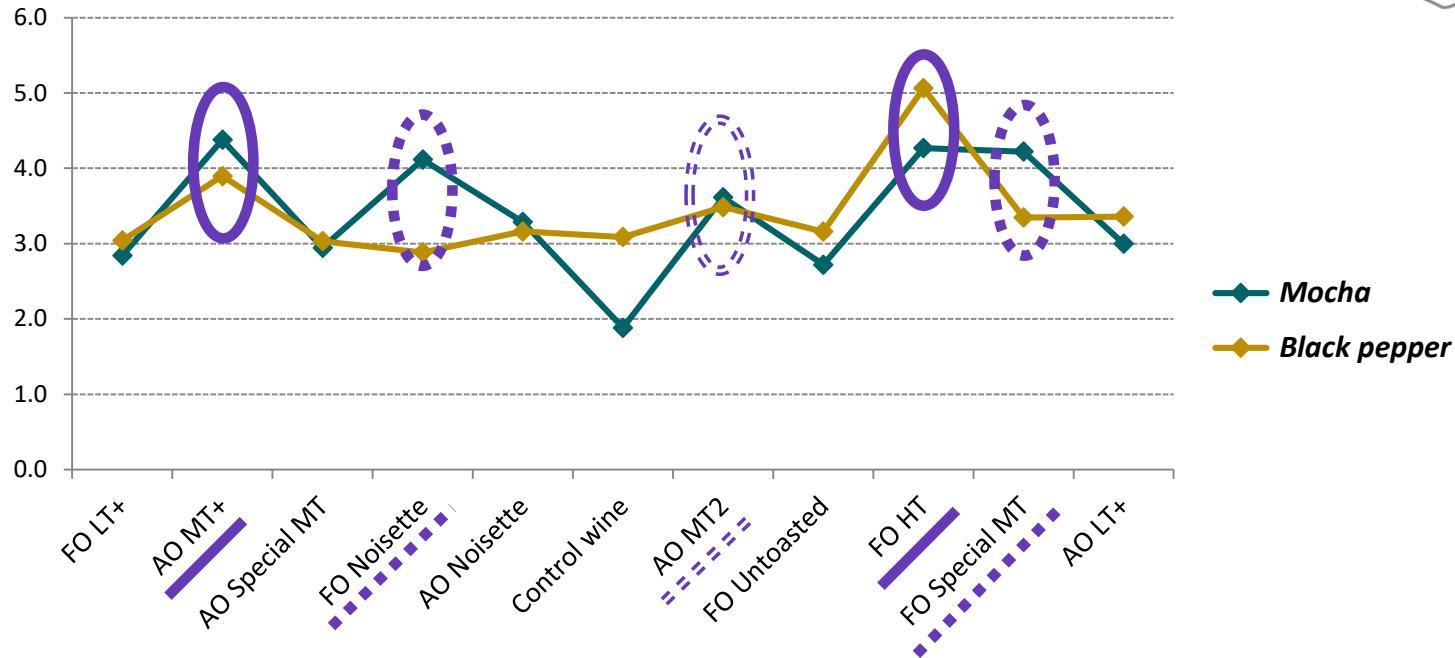


2 weeks of contact

RESULTS VII – OAK WOOD CHIPS – GALLO PROJECT



Preference	
<i>Most preferred</i>	FO Noisette, FO LT+, FO Special MT
<i>Least preferred</i>	AO MT+



- ❖ Toastings leading to wines with the highest mocha and black pepper aroma intensities are...



RESULTS VII – OAK WOOD CHIPS – GALLO PROJECT

TEST II : OAK CHIPS LEADING TO WINES WITH MORE MOCHA AND BLACK PEPPER AROMA WERE MIXED AND TEST I WAS RUN AGAIN



*Mix of oak wood chips
(2.5 g + 2.5 g/bottle)*

Mix of oak wood chips

AO MT / FO HT

FO HT / AO MT2

FO Noisette / FO Special MT

3 MIX MODALITIES
+
CONTROL WINE
(WITHOUT WOOD CONTACT)



Preference	
<i>Most preferred</i>	FO Noisette / FO Special MT, FO HT / AO MT2
<i>Least preferred</i>	Vin contrôle

- ❖ Control wine was characterized by the lowest 'mocha' and 'black pepper' intensities
- ❖ Judges evaluated equally the three wines in contact with different mix of oak wood chips

