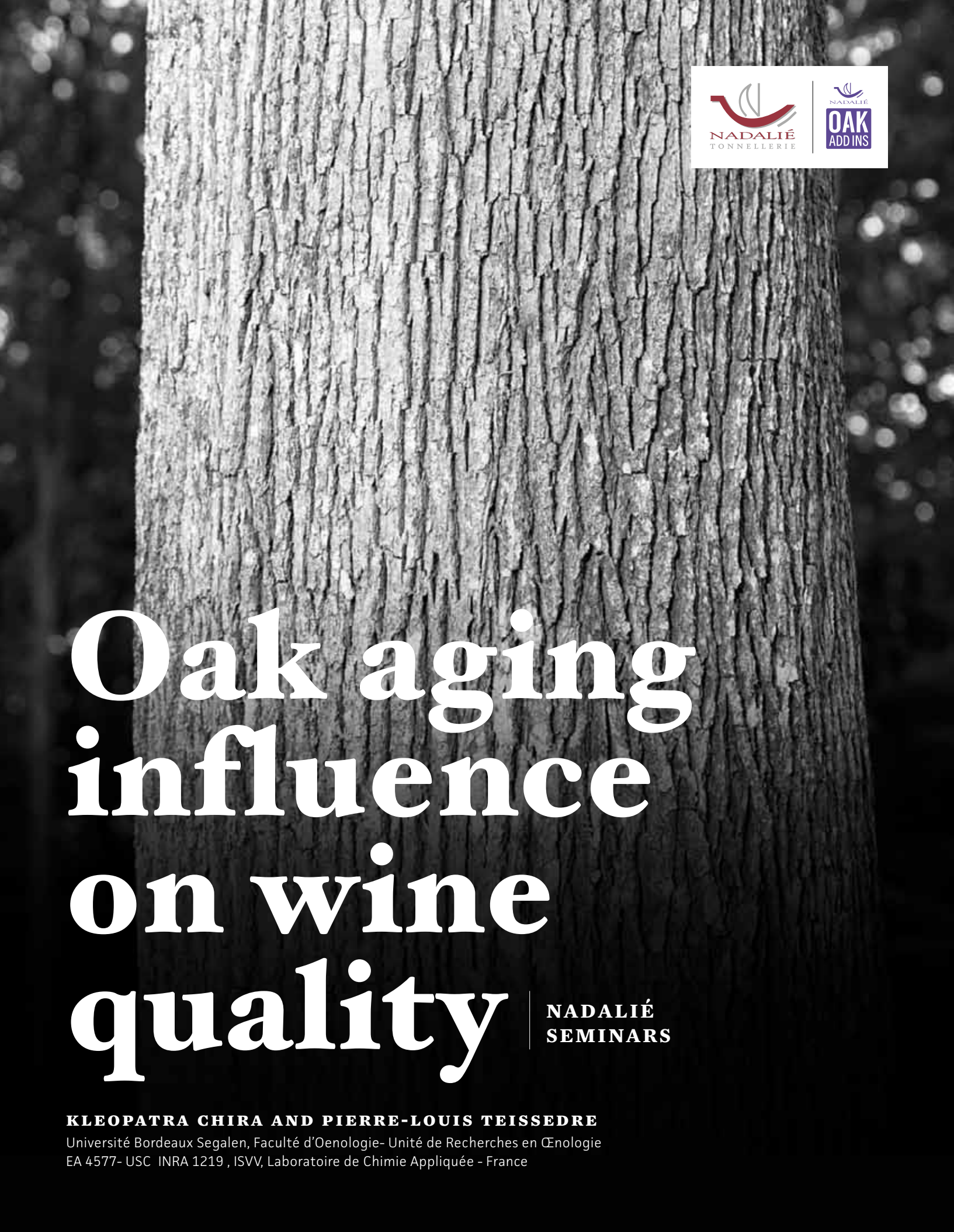

Oak aging influence on wine quality

NADALIÉ SEMINARS

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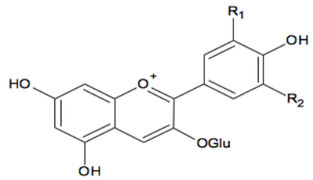
INDEX

Introduction

01 Introduction

Phenolic Compounds → **Wine Quality Parameters**

Anthocyanins → Color (Glories, 1984)



Tannins → **Condensed Tannins** (procyanidins, prodelphinidins) **Hydrosoluble Tannins** (ellagitannins and gallotannins) → Color Stabilization

↓

Sensory Properties
Astringency And Bitterness

↓ ↘

Astringency: Mouthfeel, Tactile Sensation (Bate-Smith,1954, Breslin et al., 1993)

Bitterness : Taste (Noble, 1990)

02 Oak Wood Extractible Composition

→

→ **Volatile compounds** + **Phenolic compounds**

Phenolic compounds → **Hydrosoluble tannins** (gallotannins and ellagitannins)

↓ after acid hydrolysis

Ellagic acid

Volatile compounds →

cis/trans-Whisky lactone
Vanillin, Eugenol, Guaiacol, 4-methyl Guaiacol, o-cresol, Syringol, Furfural, 5-Methylfurfural, Syringaldeyde and Ethyl-Vanillin

03

Volatile compounds

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

- Phenolic aldehydes (vanillin…), vanilla aroma

- Furanic compounds (furfural…), grilled flavor

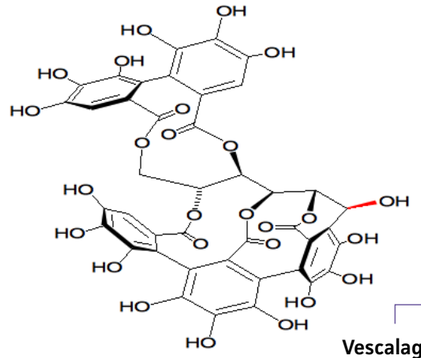
- Phenols (Eugenol, Guaiacol…), spicy, smoky flavor

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	Eugenol + Isoeugenol	Vanillin
Perception threshold in wine (µg/L)	20000	45000	75	65	460	46	500	320

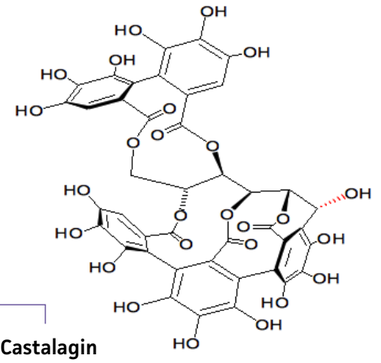
04

Ellagitannins



Monomers

Vescalagin



Castalagin

Roburin A ; R1 = β-OH
Roburin D ; R1 = α-OH
Dimers

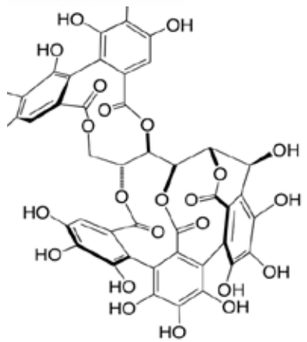
60 -70% of oak wood ellagitannins

Grandinin ; Lyxose
Roburin E ; Xylose
Glucosidic Monomers

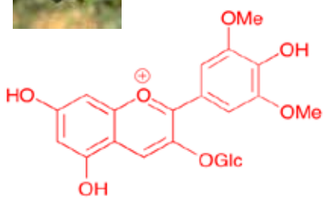
Roburin B ; R1 = Lyxose
Roburin C ; R1 = Xylose
Glucosidic Dimers

05 Formation of Anthocyano-Ellagitannins in wine after oak barrels aging

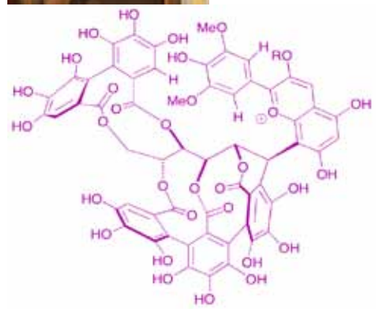
Vescalagin



Oenin
most abundant anthocyanin pigment in red grapes



Oenin-8-c-vescalagin



Purple-colored anthocyano-ellagitannins, derived from the oak ellagitannins vescalagin and the red-colored grape pigments oenin and malvidin, are likely actors in wine color modulation during aging in oak barrels.

S. Chassaing, D. Lefeuvre,R. Jacquet,M. Jourdes, L. Ducasse,S. Galland, A. Grelard, C. Saucier, P. L. Teissedre, O. Dangles, S. Quideau. Physicochemical studies of new anthocyano-ellagitannin hybrid pigments: About the origin of the influence of oak C-glycosidic ellagitannins on wine color, Eur. Jour. of Organic Chemistry, Issue 1, 2010, Pages 55-63 .

06 Organoleptic impact of Ellagitannins

Half-mouth test in aqueous solution pH 4.5

Aqueous Solution pH 4.5

compound	threshold concentration for astringency[a] µmol/L	astringency[a] mg/L	bitterness[b] µmol/L	bitterness[b] mg/L
grandinin (Glucosidic Monomers)	0.2	0.21	615	655.6
roburin E (Glucosidic Monomers)	0.2	0.21	615	437.1
vescalagin (Monomers)	1.1	1.03	1690	1578.5
castalagin (Monomers)	1.1	1.03	1690	1578.5
33-deoxy-33-carboxyvescalagin	2.6	2.50	666	640.1
roburin A (Dimers)	2.9	5.37	742	1535.5
roburin D (Dimers)	3.0	5.55	768	1372.7
roburin B (Dimers)	6.1	12.09	585	1159.5
roburin C (Dimers)	6.3	12.49	605	1199.1
1,2,3,4,6-pentagalloyl-β-d-glucose	1.8	1.69	ND[c]	ND[c]
ellagic acid	6.6	1.99	ND[d]	ND[d]
gallic acid	292.0	44.97	ND[e]	ND[e]
epigallocatechin 3-gallate	190.0	87.00	190.0	87.00
caffeine	ND[f]	ND[f]	500	81.00

Glycosylated monomers are 5 times more astringent than monomers and 3 times more bitter.

Monomers are astringents but very low bitterness.

Dimers are less astringent than monomers but 2 times more bitter.

Glabasnia A. & Hofmann T., 2006, Journal of Agricultural and Food Chemistry 54 (9), pp. 3380-3390

07 Objectives

Extraction kinetic of aromas and tannins of oak chips, staves in wine/model solution and extraction kinetic of aromas and tannins of wines aging in barrels. Impact of toasting level on aromas and tannins.

Oak chips

Staves

Barrels

Chemical analysis :
Aromatic compounds
and hydrolysable tannins

Sensory analysis :
Aromatic descriptors
and tannin perception

Extraction Kinetic of aromas, tannins in wine/model solution

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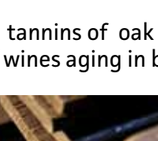
Impact of toasting level

08 Experimental design

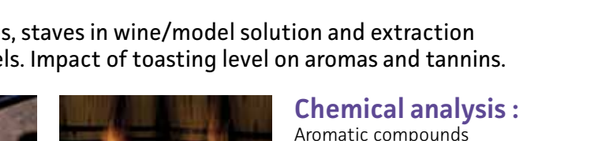
Total Ellagitannins

Oak chips

Staves



Barrels



Aromatic compounds

cis/trans - Whisky lactone
Vanillin, Eugenol,
Guaiacol, 4-methyl
Guaiacol, o-crésol, Syringol,
Furfural, 5-Methylfurfural...

Chemical analysis

Aroma
(vanilla, grilled/smokey, spicy)
Perception
(sweet, astringency, bitterness)

20 judges
(16 training sessions, according to ISO 8586-2:2008)

Evaluation of descriptors in a point scale of 0 to 7

0	1	2	3	4	5	6	7

Absent — Intensive

Astringency
- 0 amorphous
- 1 hollow
- 2 soft
- 3 mellow
- 4 slight astringency
- 5 tannic
- 6 hard
- 7 rough

Bitterness
- 0 nil
- 1 very weak
- 2 weak
- 3 mean
- 4 barely strong
- 5 strong
- 6 very strong
- 7 depreciative

Sensory analysis

Results

1. Barrels
2. Oak Chips
3. Staves

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09 **Results**

1. Barrels

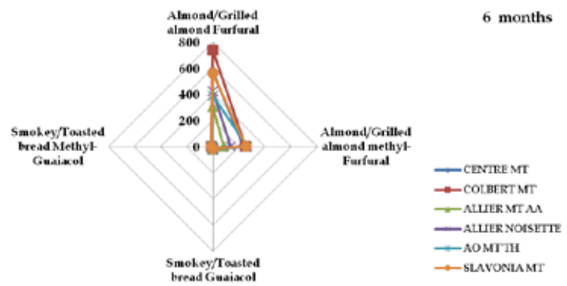
Château 1 **Médoc**	Centre MT Colbert MT Allier MT with watering (MT AA) Allier Noisette American MT with toasted head (AO MT TH) Slavonia MT
Château 2 **Macau Médoc**	
Château 3 **Graves**	
Château 4 **Pessac Léognan**	Allier LT Allier MT Allier MT+ Allier Noisette Allier MT with watering (MT AA) MT with toasted head (MT TH)

10 **Aromatic compounds in wine after six and twelve months in contact with barrels.**

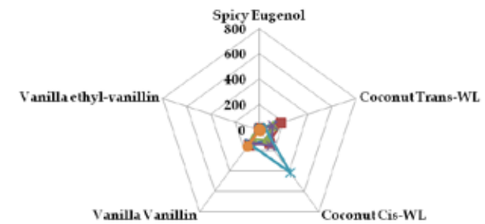
Château 1

GRILLED / SMOKEY AROMAS

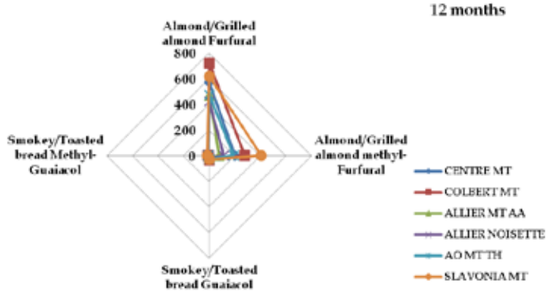
6 months

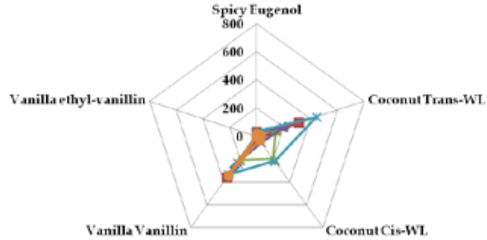


VANILLA / SPICY AROMAS



12 months

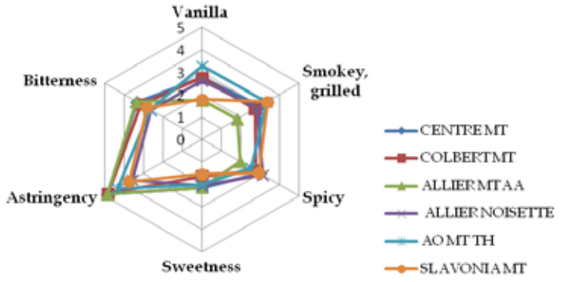


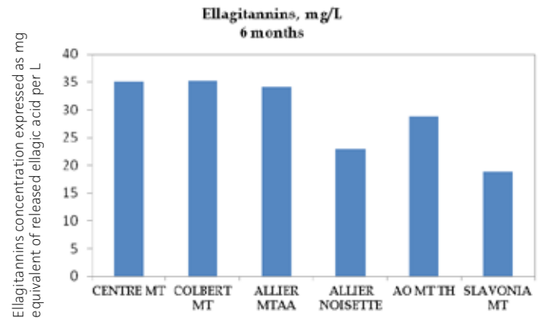


11 **Sensory profile, ellagitannins perception and total ellagitannins concentration.**

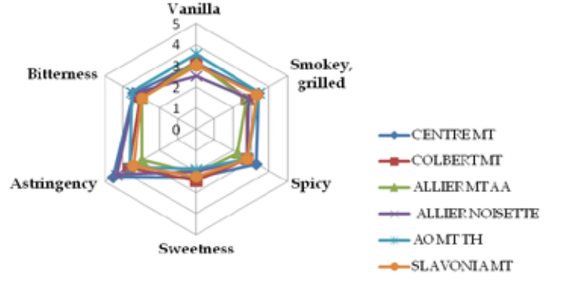
Château 1

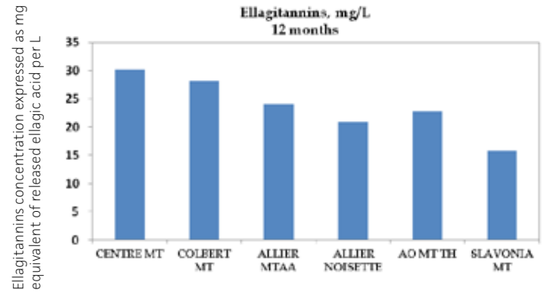
6 months





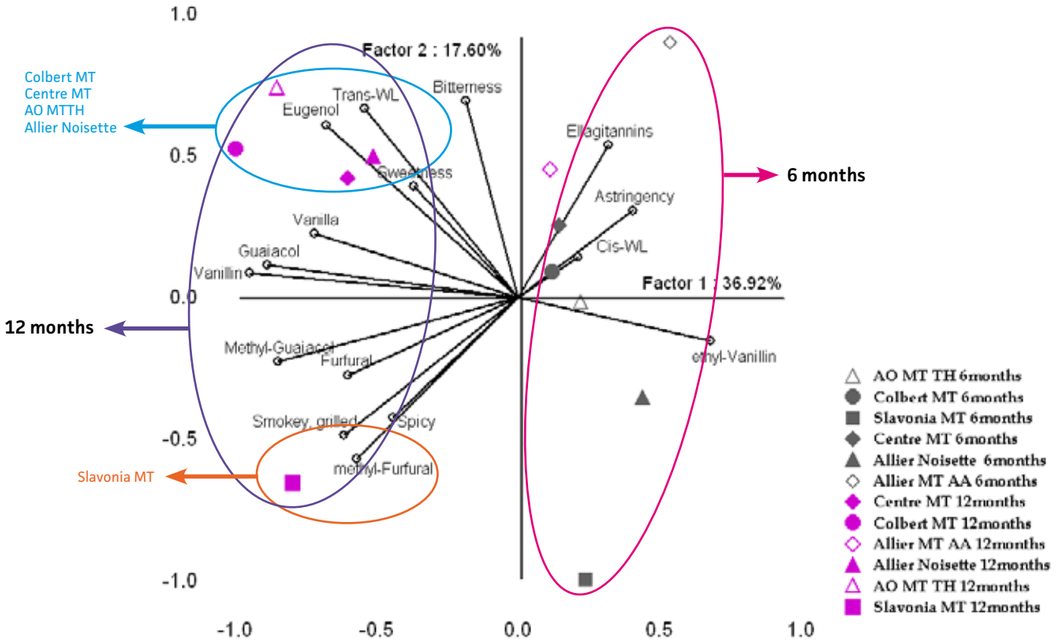
12 months





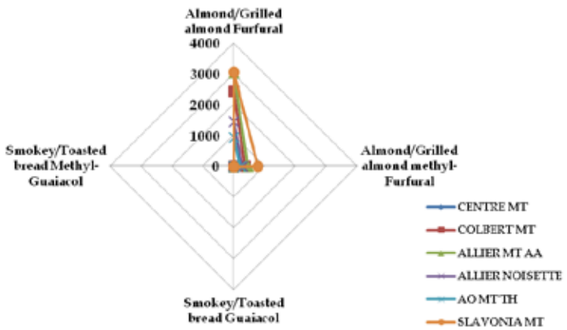
12 Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.

Château 1

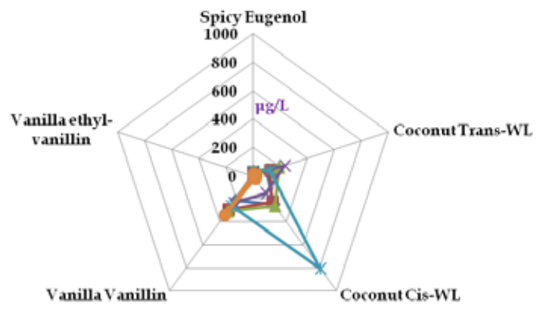


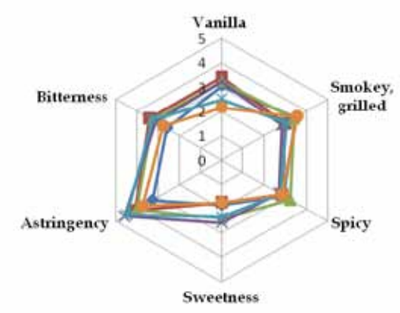
Château 2

GRILLED / SMOKEY AROMAS

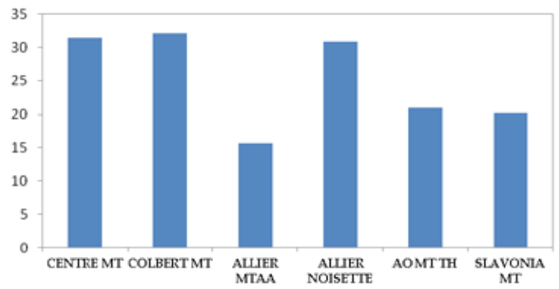


VANILLA / SPICY AROMAS



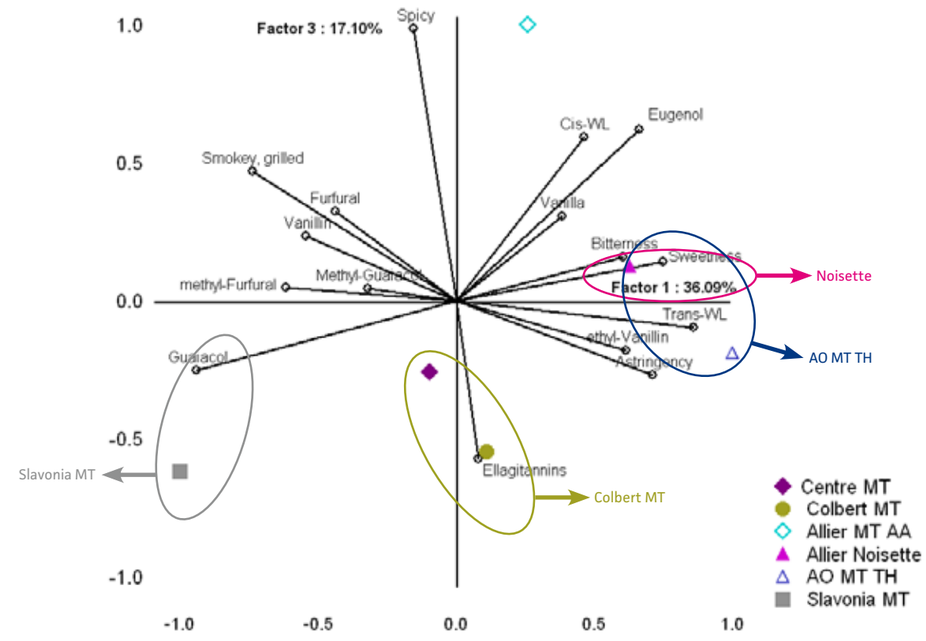


Ellagitannins, mg/L



13 Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.

Château 2

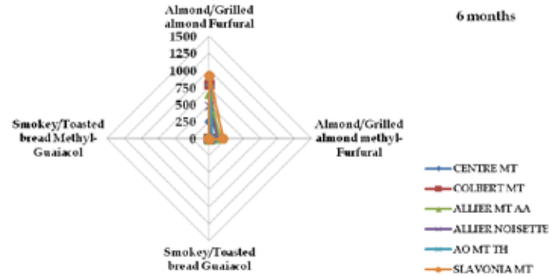


14 Aromatic compounds in wine after six and twelve months in contact with barrels.

Château 3

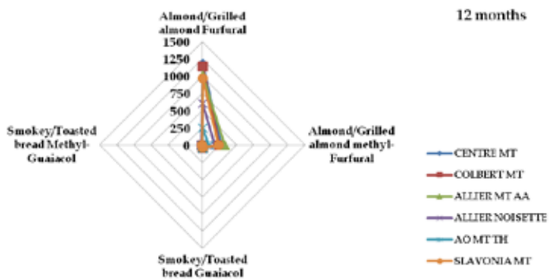
GRILLED / SMOKEY AROMAS

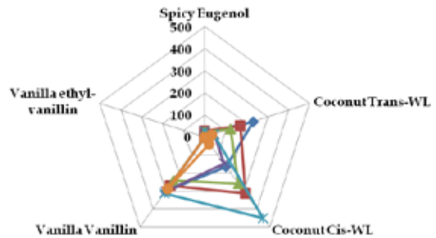
6 months



VANILLA / SPICY AROMAS

12 months

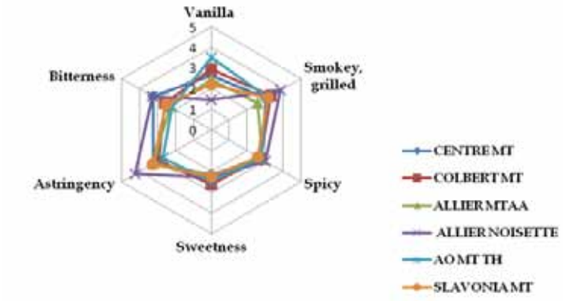


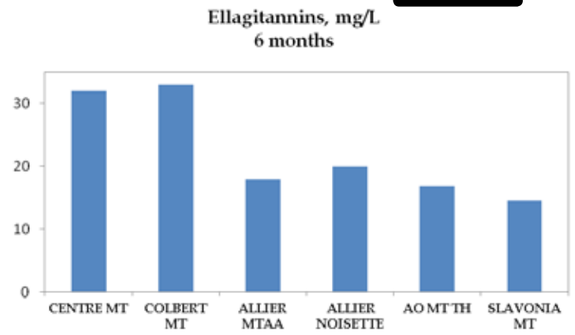


15 Sensory profile, ellagitannins perception and total ellagitannins concentration.

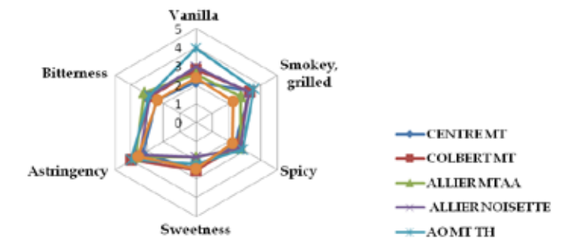
Château 3

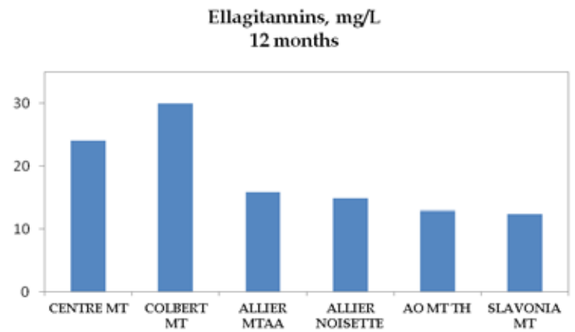
6 months





12 months



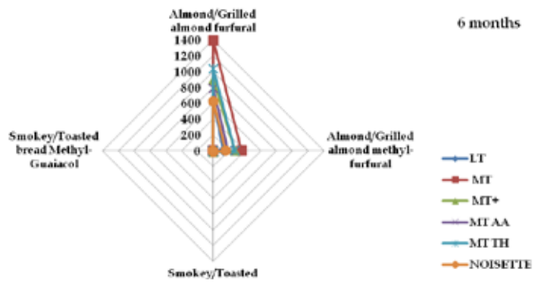


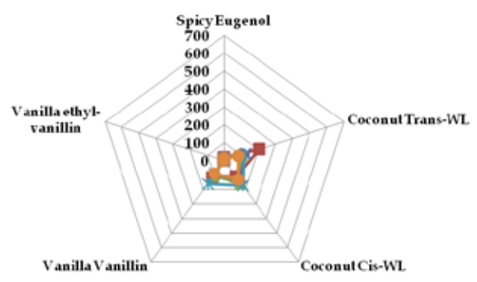
16 Aromatic compounds in wine after six and twelve months in contact with barrels.

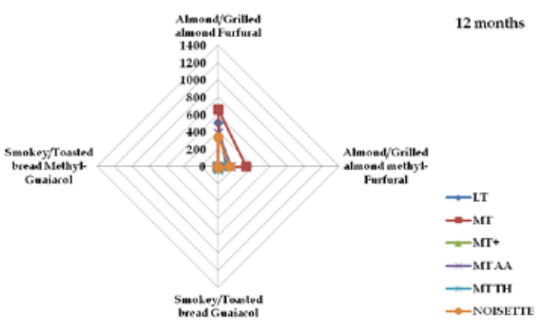
Château 4

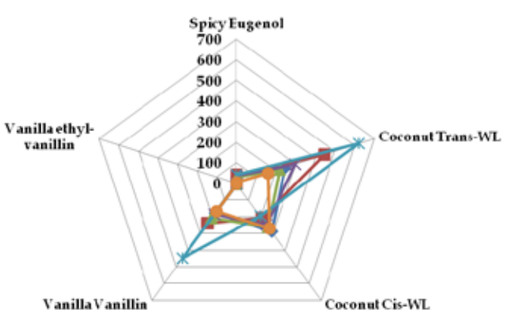
GRILLED / SMOKEY AROMAS

VANILLA / SPICY AROMAS





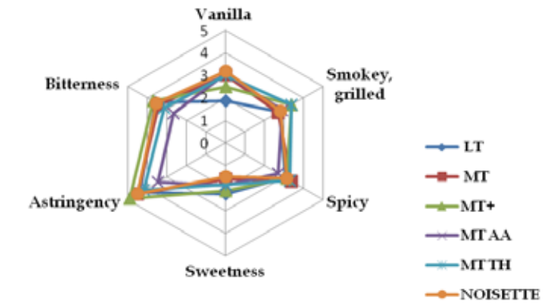


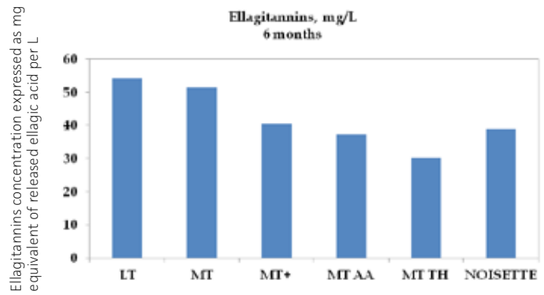


17 Sensory profile, ellagitannins perception and total ellagitannins concentration.

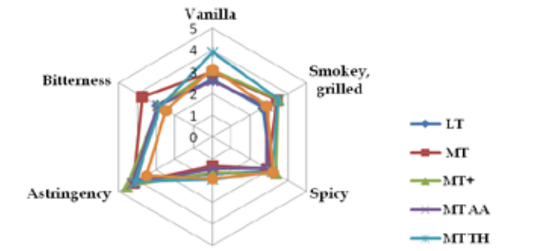
Château 4

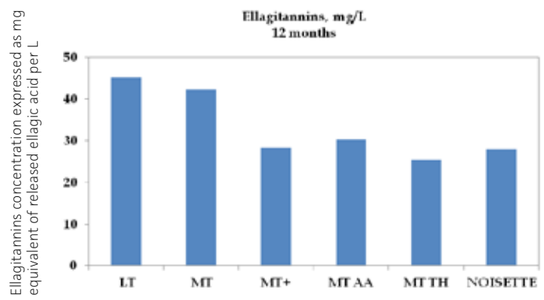
6 months





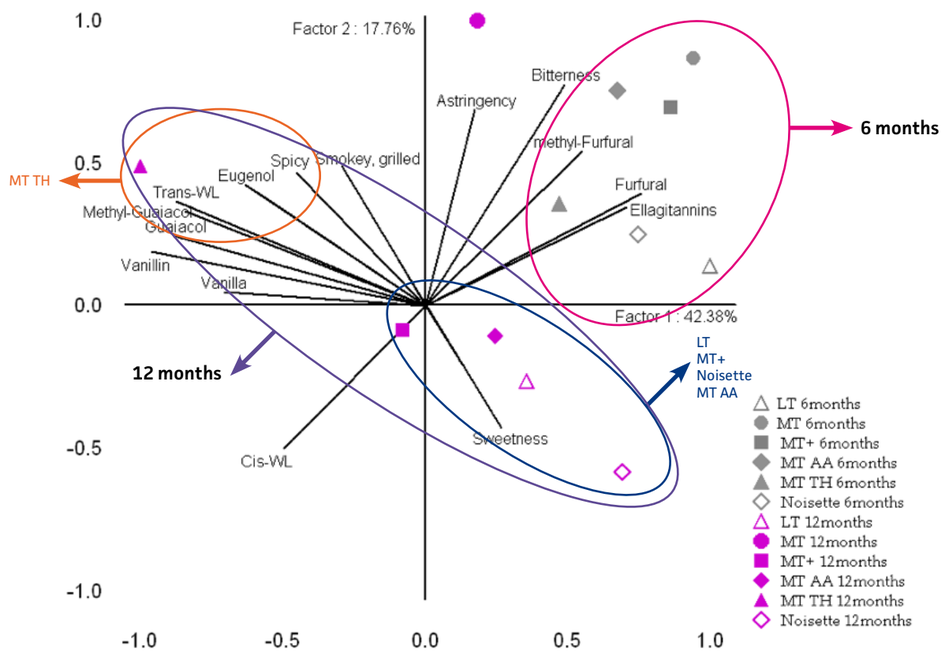
12 months





18 Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.

Château 4



Conclusion (barrels)

Aromas and tannins kinetics extractions varied according to wine, toasting method and forest origin.

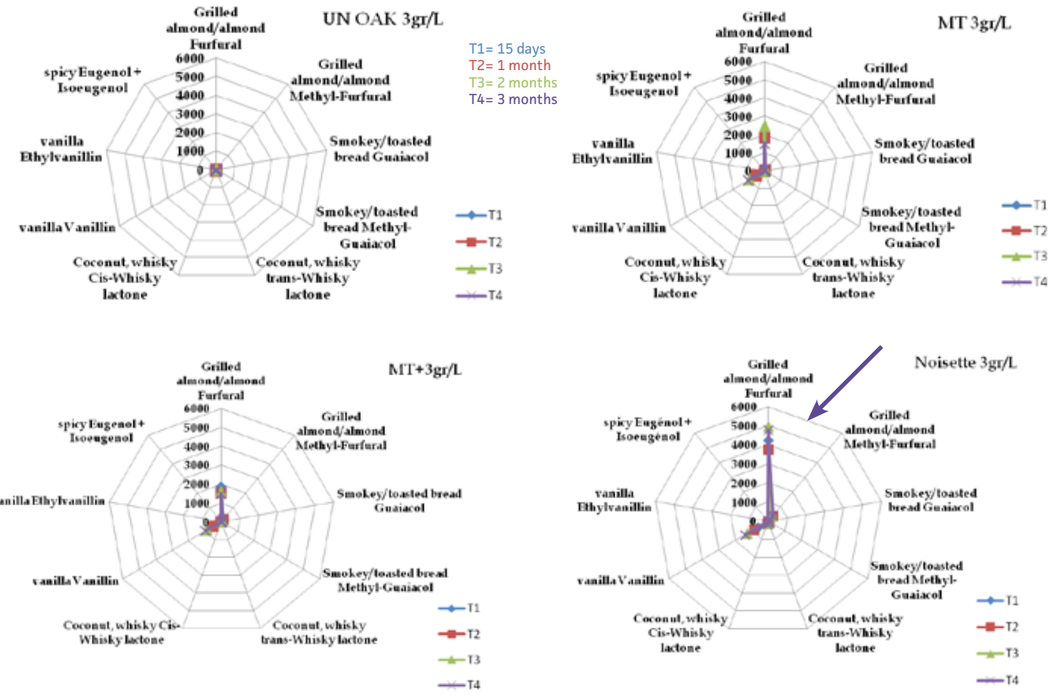
- Wines aged in «Colbert « and « Centre MT « present higher ellagitannins levels whereas wines aged in «Slavonia» MT present lower ellagitannins levels.
- Wines aged in «AO MT TH « and in «Slavonia MT « presented the higher levels of whisky lactone and vanillin respectively, at the same time were perceived to dispose more vanilla flavor.
- Independent of varietal, wines aged in barrels «Colbert MT» have the most important concentrations of furfural (grilled almond).
- The vanillin (aromatic compound) as well as the vanilla flavor intensify during aging (≈ 30%-50% for vanillin , ≈ 10%-30% for vanilla flavor).
- Regarding sensory evaluation, the sweetness perception increases during aging and tannins perceived softer and mellow.

Results

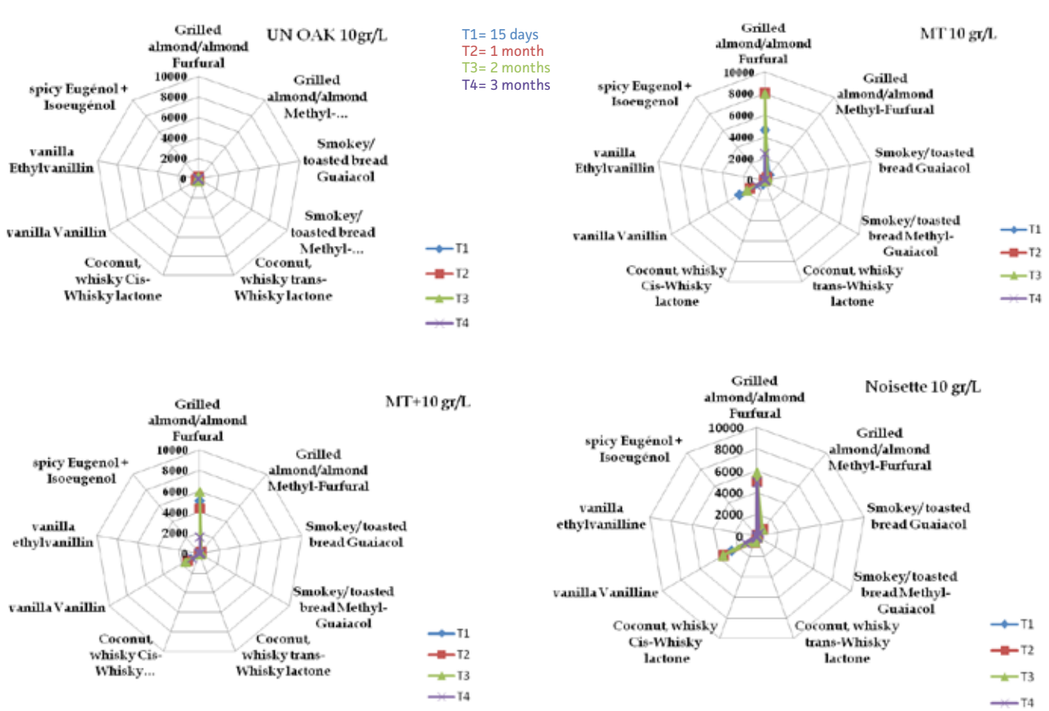
2. Oak Chips (3 gr/L and 10 gr/L)

UN (Untoasted)
MT (Medium Toast)
MT+ (Medium Plus Toast)
«Noisette»

21 OAK CHIPS aromatic profile (3 gr/L)



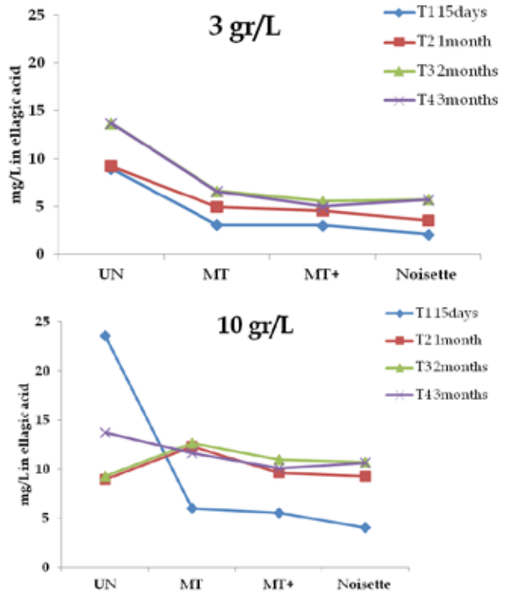
22 OAK CHIPS aromatic profile (10 gr/L)



23 Extraction kinetic of oak wood ellagitannins (3 and 10 gr/L)

Extraction Kinetic Of Ellagitannins In Model Wine Solution during three months.

Ellagitannins concentration estimated by acidic hydrolysis
and expressed as mg equivalent of released ellagic acid per L.

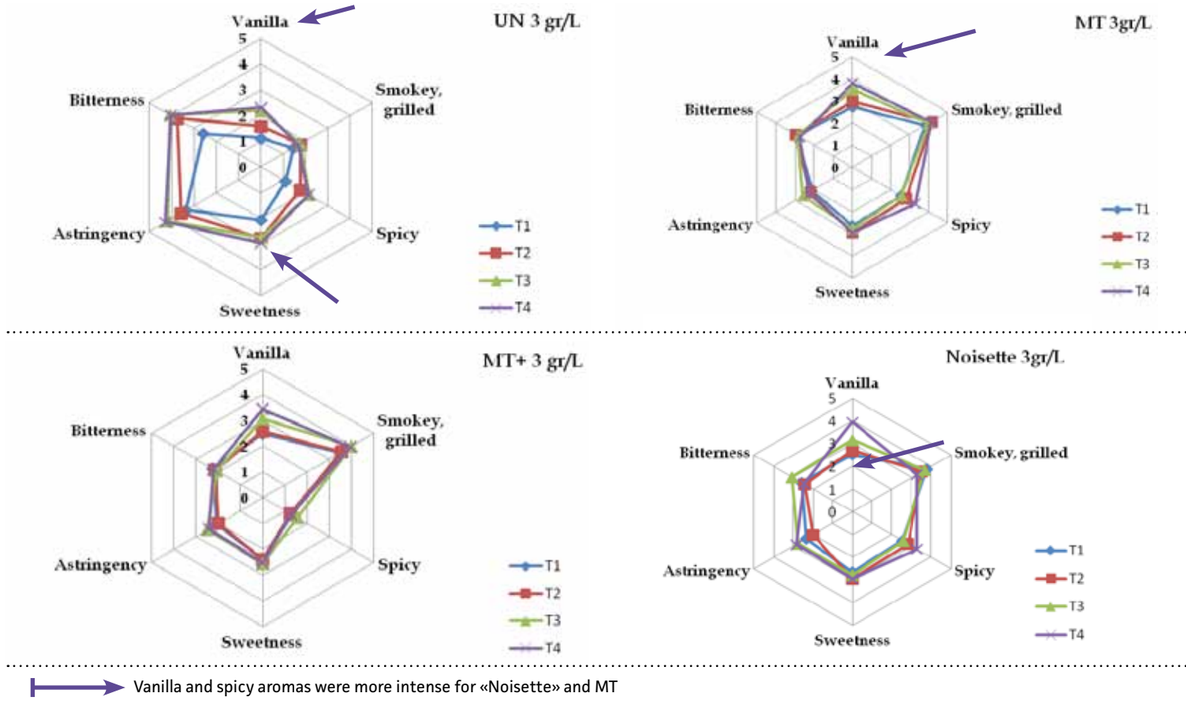


Stabilization and maximum extraction after two months.

The size of the wood pieces as well as the type of heating influence ellagitannins concentrations.

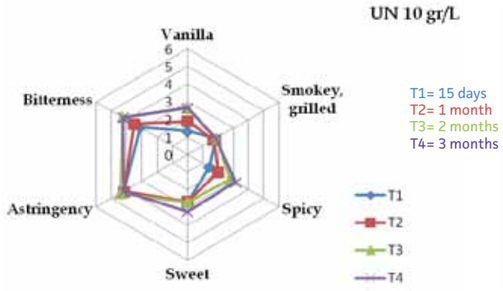
The untoasted showed the highest concentrations of ellagitannins.

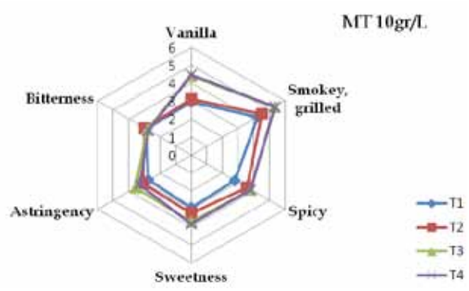
24 Sensory profile (oak 3 gr/L)

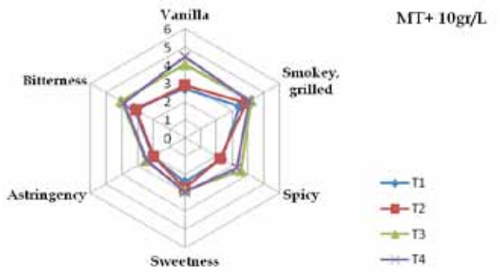


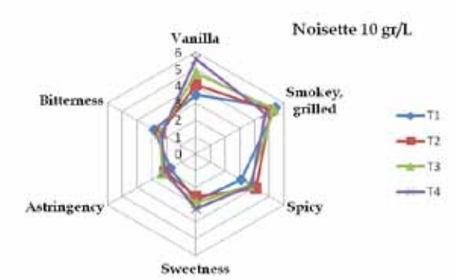
Vanilla and spicy aromas were more intense for «Noisette» and MT

25 Sensory profile (oak 10 gr/L)



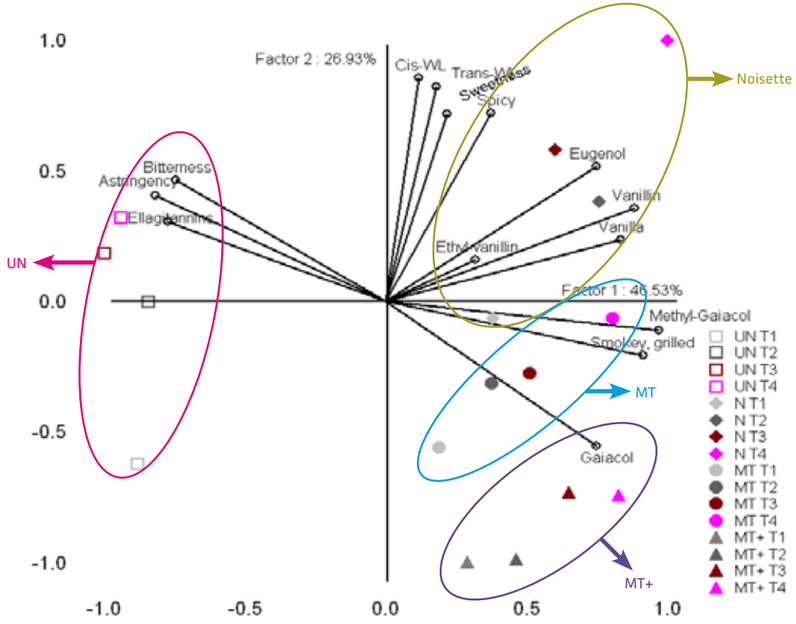






Vanilla and spicy aromas were more intense for «Noisette» and MT.

26 Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration in model wine solution (wood pieces concentration 3 gr/L).



T1= 15 days
T2= 1 month
T3= 2 months
T4= 3 months

The untoasted wood pieces showed the highest concentrations of ellagi-tannins and the highest intensities of bitterness and astringency.

The "Noisette" showed the higher concentrations of eugenol, vanillin and present more vanilla and spicy aromas.

The MT and MT+ showed higher concentrations of methy-guaiacol and guaiacol and were perceived more smokey and grilled.

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27 Results

3. Staves

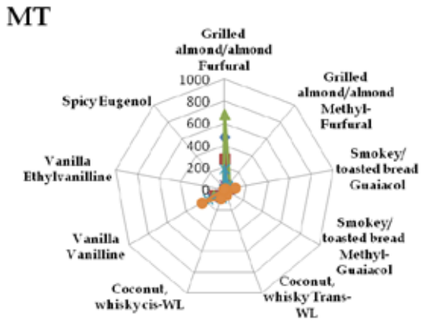
CONTROL
MT (Medium Toast)
MT+ (Medium Plus Toast)
«NOISETTE «
SPECIAL

2 ww / hl
2 ww / 2,4 gallons

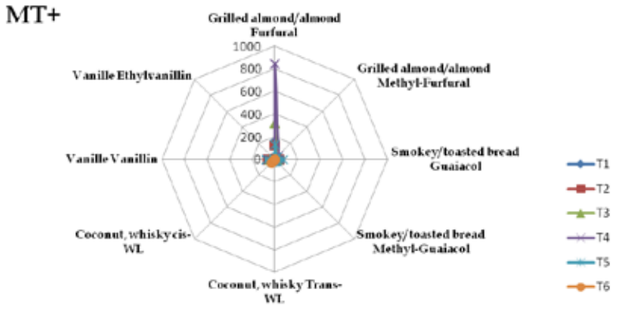
Wine 100% Merlot

CHAUFFÉS AU FEU DE BOIS

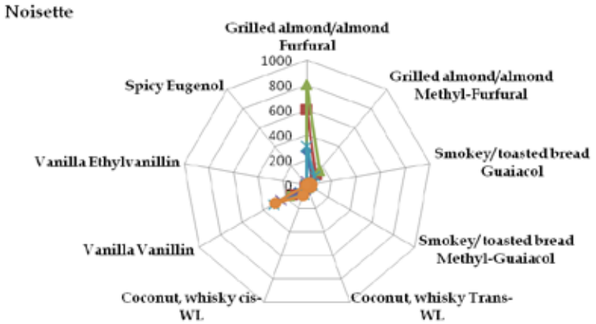
28 Extraction kinetic of staves aromas in wine during twelve months.



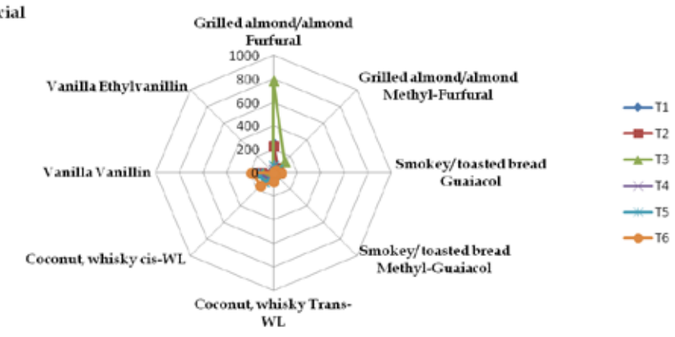
T1= 1 month
T2= 2 months
T3= 3 months
T4= 6 months
T5= 9months
T6= 12 months



29 Extraction kinetic of staves aromas in wine during twelve months.

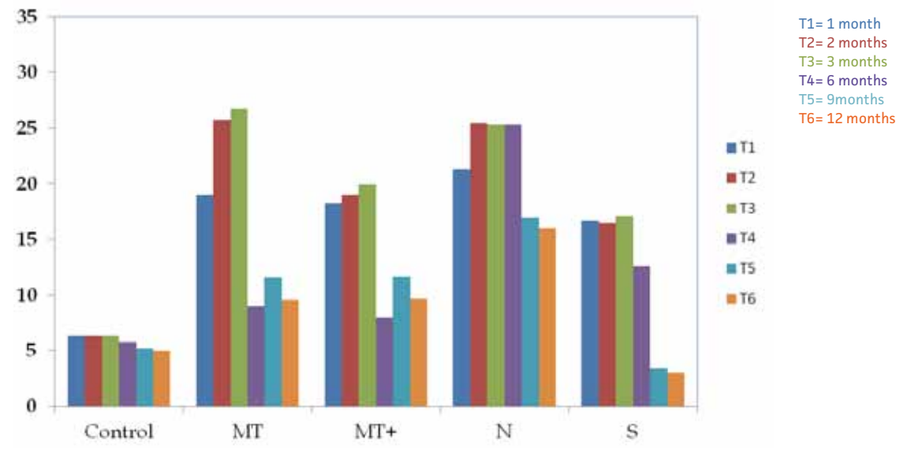


T1= 1 month
T2= 2 months
T3= 3 months
T4= 6 months
T5= 9months
T6= 12 months



30 Extraction kinetic of staves ellagitannins.

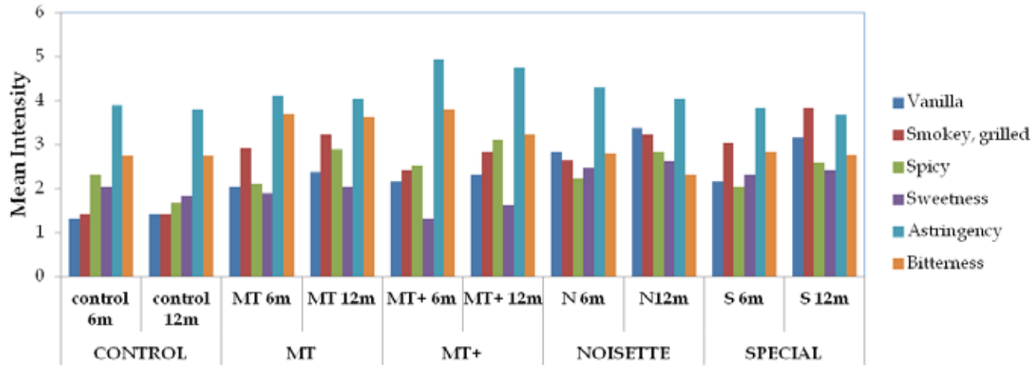
Extraction kinetic of staves ellagitannins in wine during twelve months.



T1= 1 month
T2= 2 months
T3= 3 months
T4= 6 months
T5= 9months
T6= 12 months

Maximum extraction after two or three months.
The MT showed the highest concentrations of ellagitannins after 3 months.

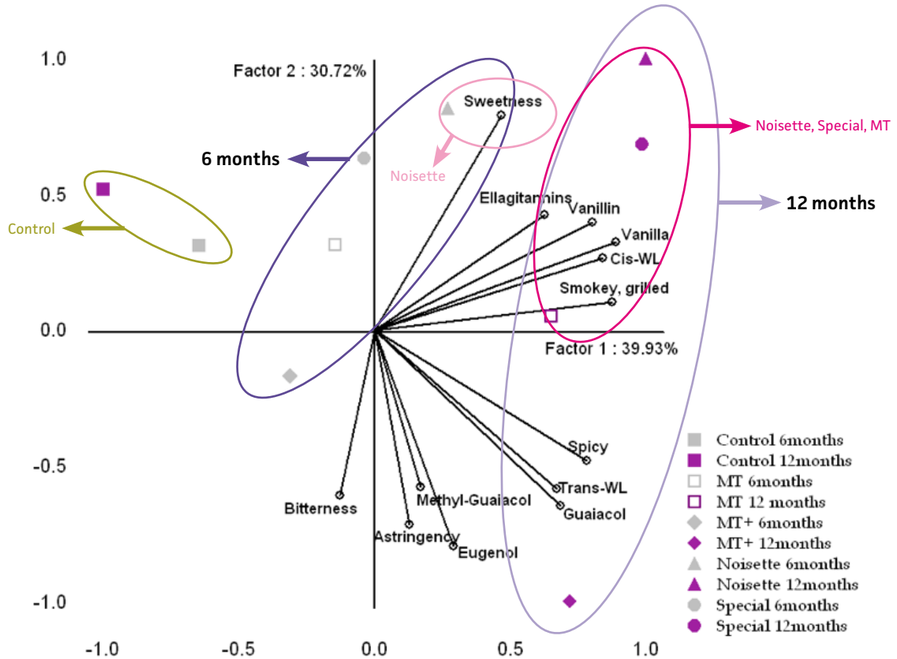
31 Sensory profile, ellagitannins perception of staves after six and twelve months.



All the aromas and and the sweet flavor have a tendency to intensifie during 12 months.

32

Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.



33

Conclusion (Oak Chips and Staves)

Aromas and tannins kinetics extractions of wood pieces in model solution and wine as well as their organoleptic perception depend on their toasting level and maceration time.

- Aromas and ellagitannins extraction is maximum after 2 months (OAK CHIPS).
- Noisette Toast and Medium Toast were perceived more spicy and with more vanilla flavor (OAK CHIPS).
- The 10gr/L dosage in comparison with the dosage 3gr/L permit to extract the same aromatic compounds and ellagitannins but quicker and with highest concentrations (≈ 50%-70% for aromatic compounds and ≈ 50% for ellagitannins). At sensory level the 10g/L dosage in comparison with the 3gr/L dosage permit to intensify the aromas (≈ 10%-15%) (OAK CHIPS)
- Grilled almond/almond and vanilla flavors become maximum after 3 and 12 months respectively (STAVES).
- At sensory level the aromas like vanilla become more intense (≈ 10%), tannins are perceived softer and the sweet flavor increases (≈ 10%) during time (STAVES).
- The untoasted (OAK CHIPS) give highest concentrations of total ellagitannins.

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