

Oak aging influence on wine quality

NADALIÉ
SEMINARS

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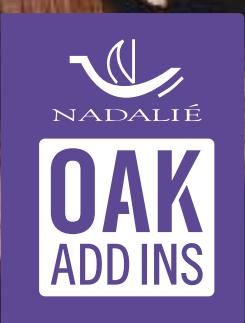
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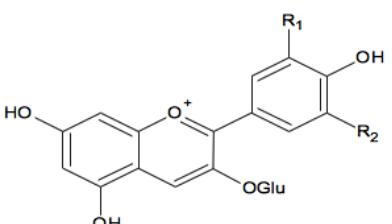
Conclusion OAK CHIPS AND STAVES

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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)

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



02 Oak Wood Extractible Composition



→ **Volatile compounds + Phenolic compounds**

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

↓ after acid hydrolysis
Ellagic acid

Volatile compounds

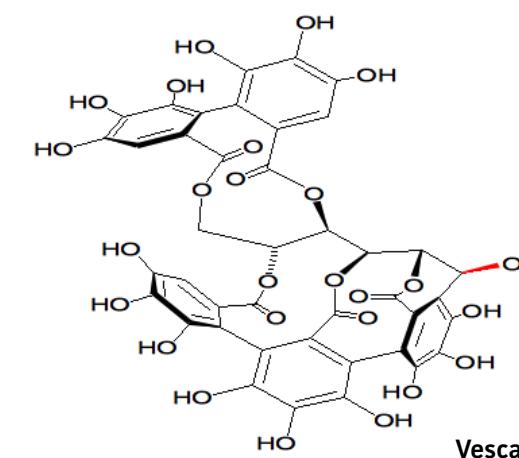


→ cis/trans-Whisky lactone
Vanillin, Eugenol, Guaiacol, 4-methyl Guaiacol, o-cresol, Syringol, Furfural, 5-Methylfurfural, Syringaldehyde and Ethyl-Vanillin

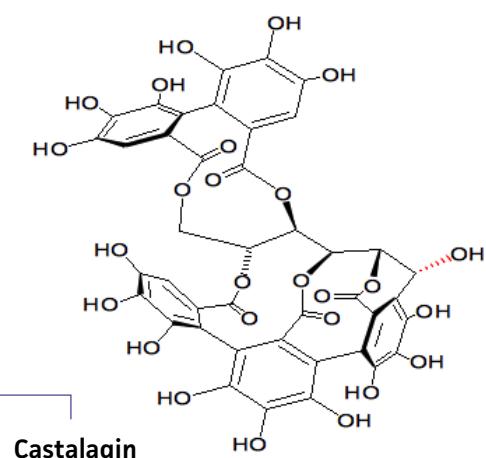


Threshold perception for aromatic compounds in red wine

	Almond/Grilled Almond	Smokey/Toasted bread	Coconut/ whisky	Spicy	Vanilla			
	Furfural	Methyl-Furfural	Guaia col	Methyl-Guaia col	trans-Whisky lactone	Cis-Whisky	Eugenol + Isoeugenol	Vanillin
Perception threshold in wine ($\mu\text{g/L}$)	20000	45000	75	65	460	46	500	320



Vescalagin



Castalagin

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

Dimers

60 -70% of oak wood ellagitannins

Grandinin ; Lyxose
Roburin E ; Xylose

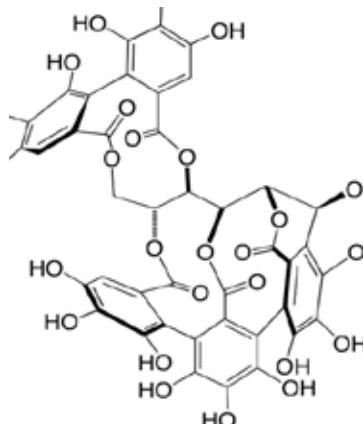
Glucosidic Monomers

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

Glucosidic Dimers

Formation of Anthocyano-Ellagitannins in wine after oak barrels aging

Vescalagin



Oenin
most abundant anthocyanin
pigment in red grapes



Oenin-8-c-escalagin



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. Lefèuvre, 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.

Organoleptic impact of Ellagitannins

Half-mouth test in aqueous solution pH 4.5

Aqueous Solution pH 4.5

compound	threshold concentration for			
	astringency ^a		bitterness ^b	
	μmol/L	mg/L	μmol/L	mg/L
grandinin	0.2	0.21	615	655.6
roburin E	0.2	0.21	615	437.1
vescalagin	1.1	1.03	1690	1578.5
castalagin	1.1	1.03	1690	1578.5
33-deoxy-33-carboxyvescalagin	2.6	2.50	666	640.1
roburin A	2.9	5.37	742	1535.5
roburin D	3.0	5.55	768	1372.7
roburin B	6.1	12.09	585	1159.5
roburin C	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

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

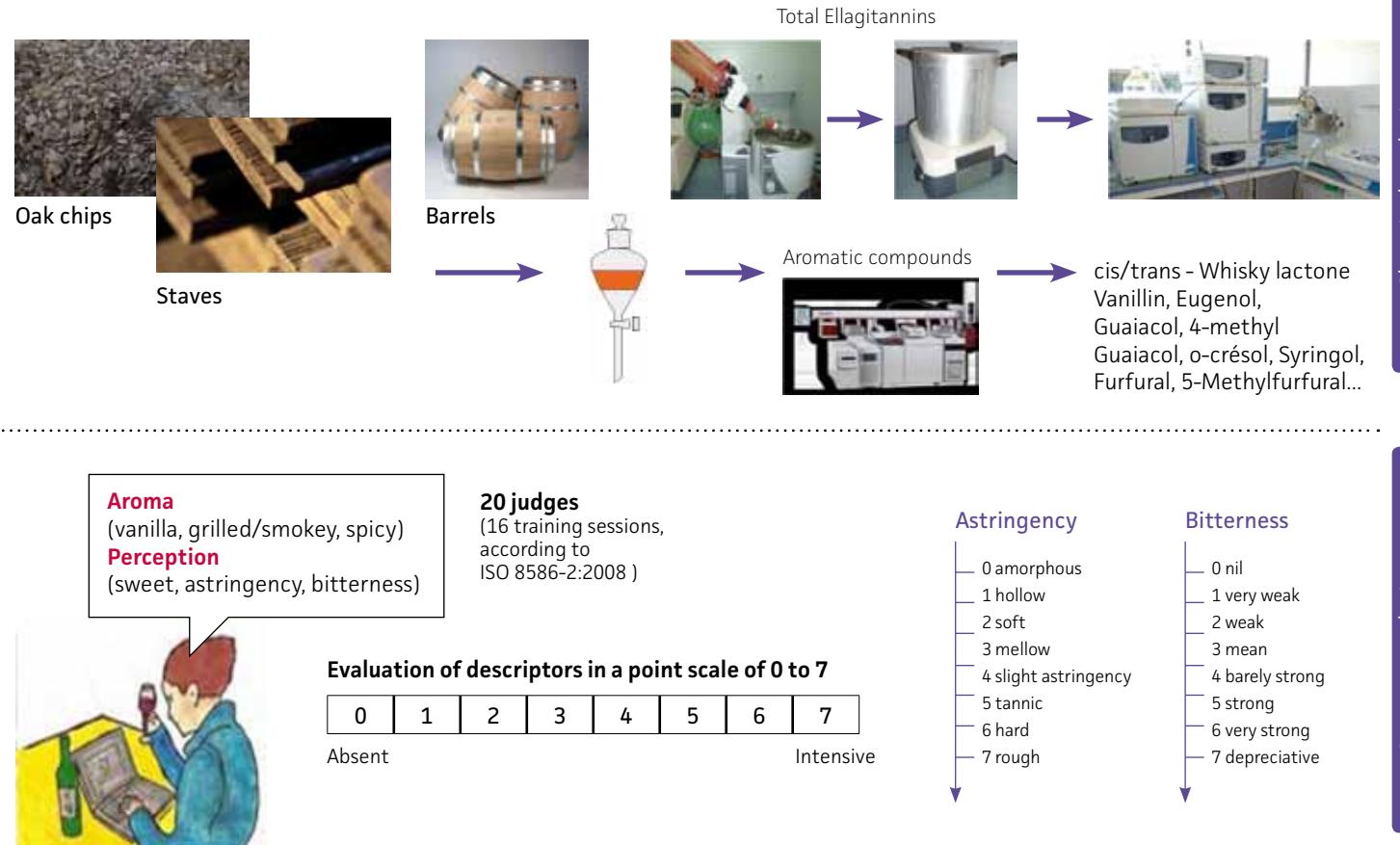
Sensory analysis :
Aromatic descriptors and tannin perception

Extraction Kinetic
of aromas, tannins in wine/model solution



Impact of toasting level

Experimental design



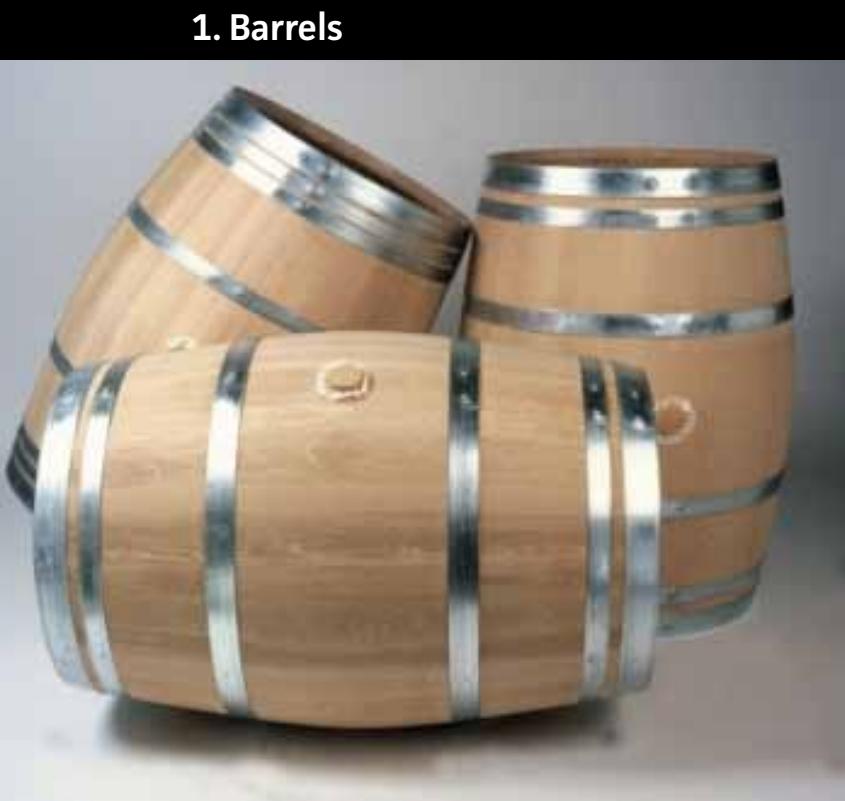
Results

1. Barrels
2. Oak Chips
3. Staves

09

Results

1. Barrels



Château 1 Médoc

Château 2 Macau Médoc

Château 3 Graves

Château 4 Pessac Léognan

Centre MT
Colbert MT

Allier MT with watering (MT AA)
Allier Noisette

American MT with toasted head (AO MT TH)
Slavonia MT

Allier LT
Allier MT

Allier MT+
Allier Noisette

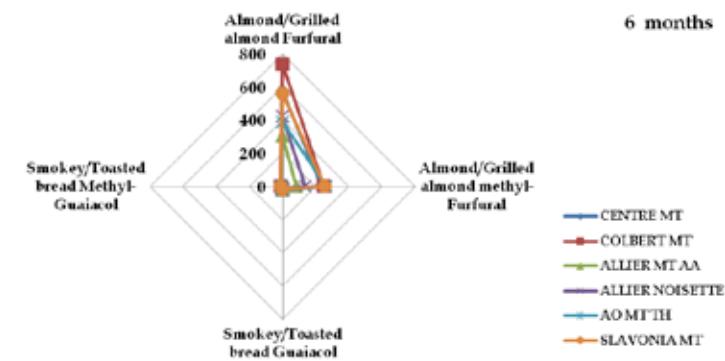
Allier MT with watering (MT AA)
MT with toasted head (MT TH)

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

10

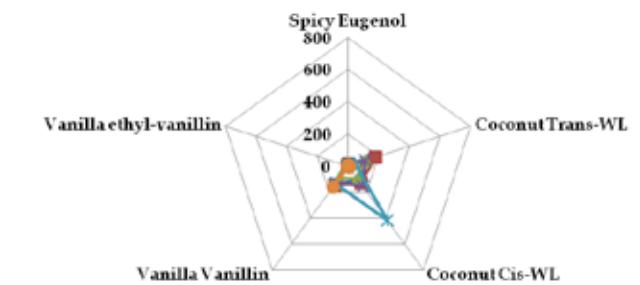
Château 1

GRILLED / SMOKEY AROMAS

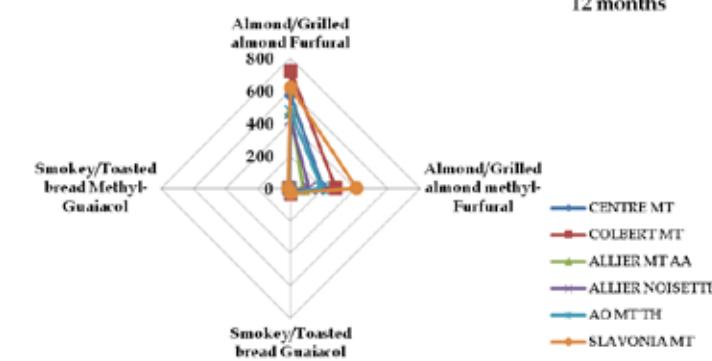


6 months

VANILLA / SPICY AROMAS



12 months

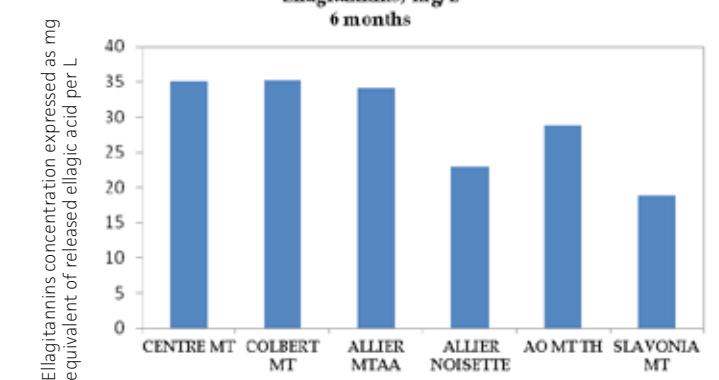
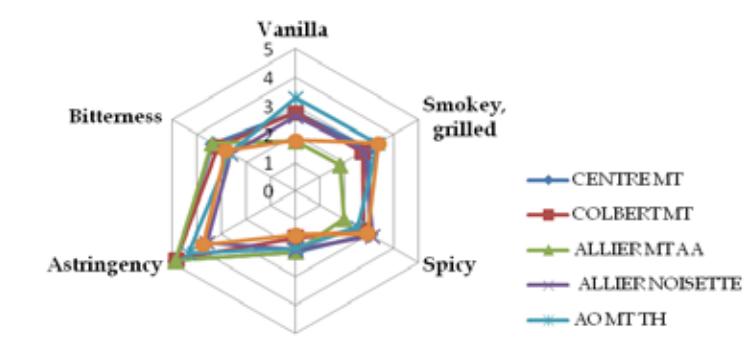


Sensory profile, ellagitannins perception and total ellagitannins concentration.

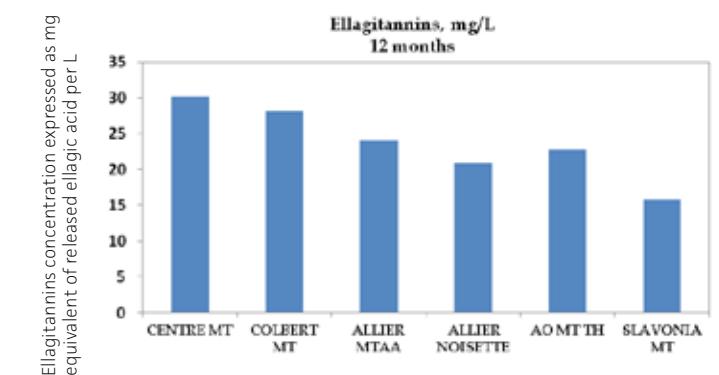
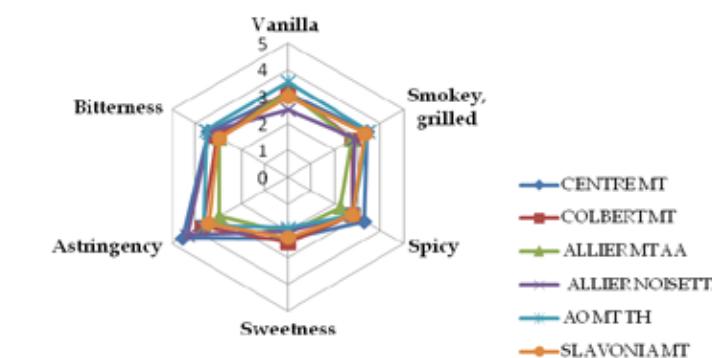
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Château 1

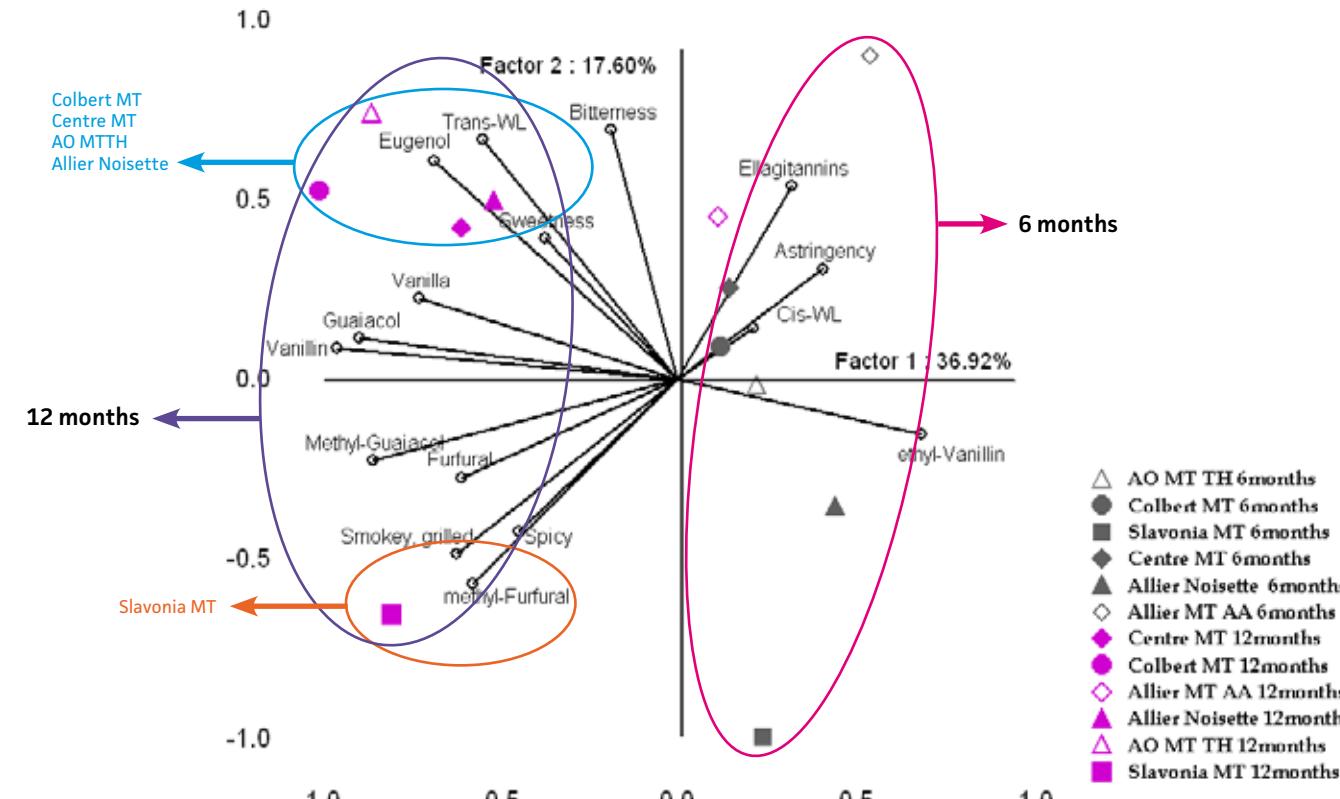
6 months



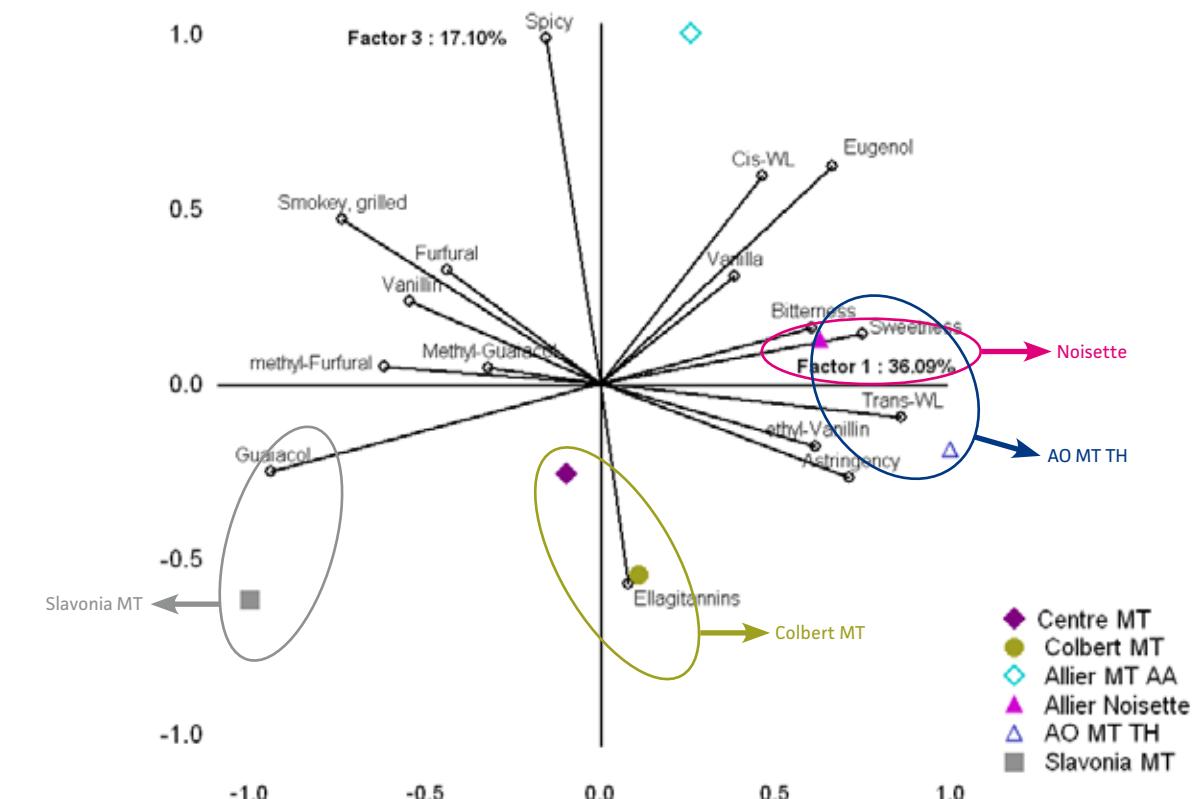
12 months



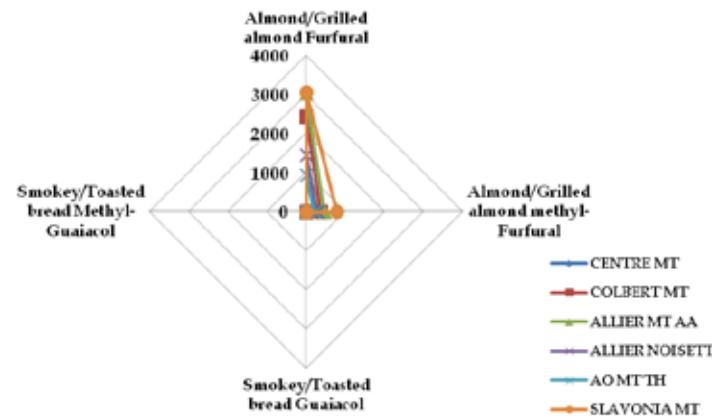
Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.



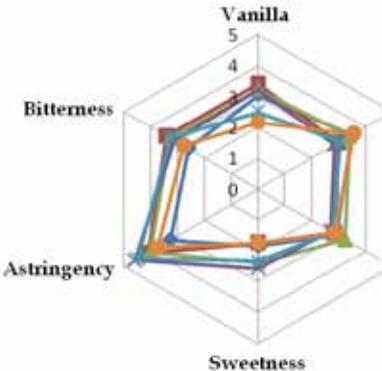
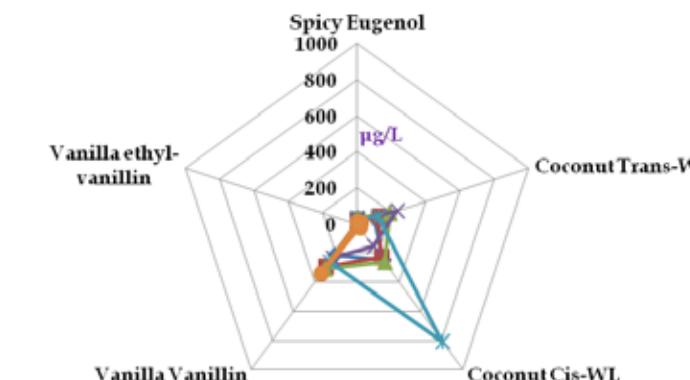
Aromatic and sensory profile, ellagitannins perception and total ellagitannins concentration.



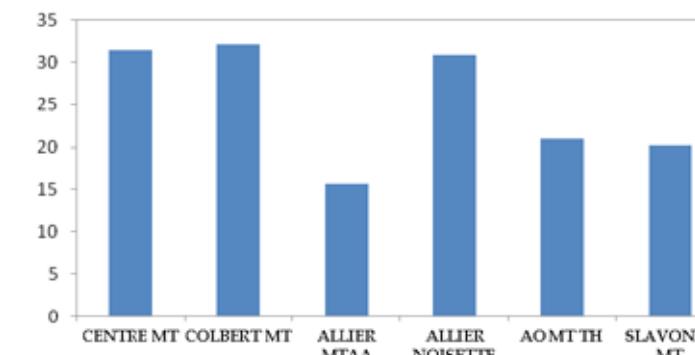
GRILLED / SMOKEY AROMAS



VANILLA / SPICY AROMAS

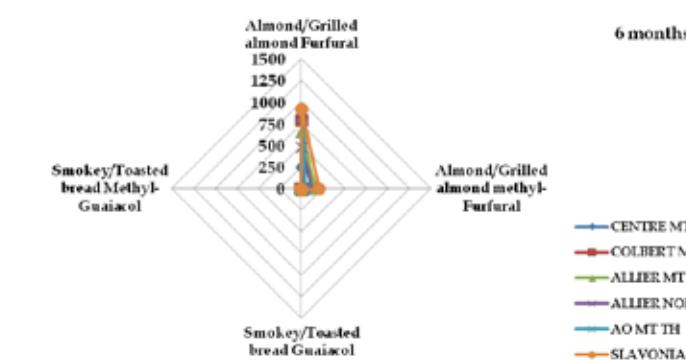


Ellagittannins, mg/L

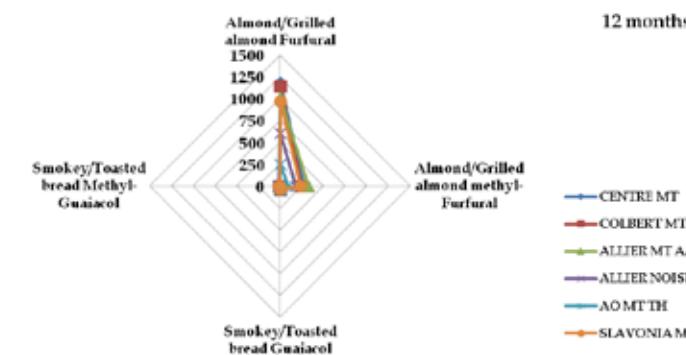
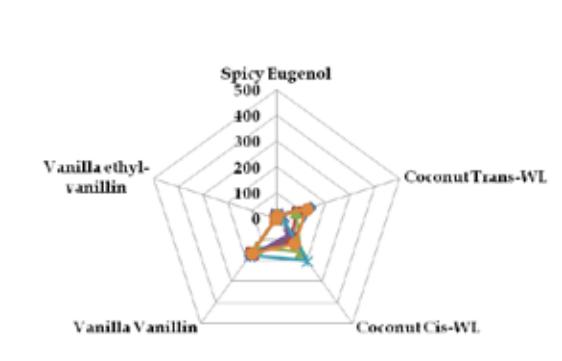


Aromatic compounds in wine after six and twelve months in contact with barrels.

GRILLED / SMOKEY AROMAS



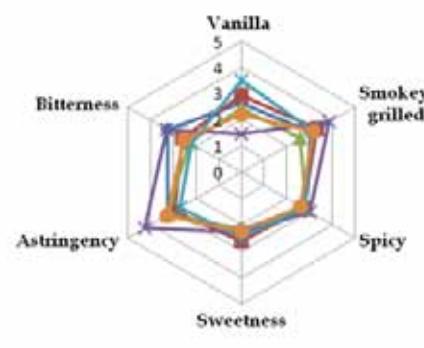
VANILLA / SPICY AROMAS



Château 3

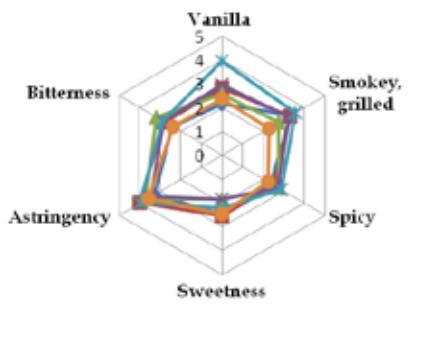
Sensory profile, ellagitannins perception and total ellagitannins concentration.

6 months



Château 3
Ellagittannins, mg/L
6 months

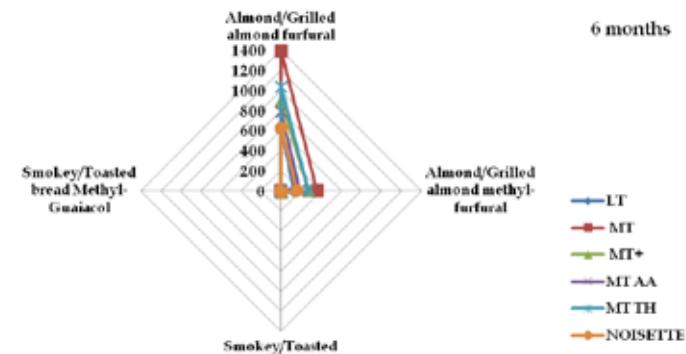
12 months



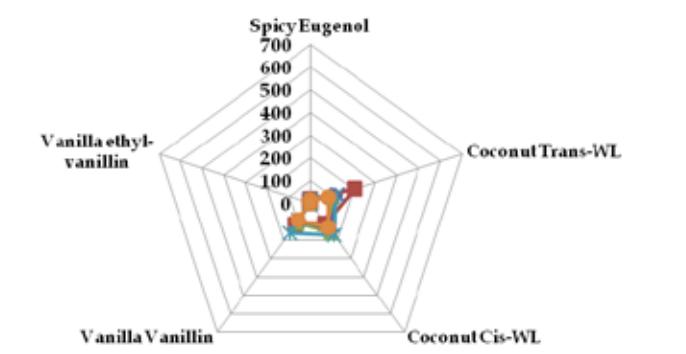
Ellagittannins, mg/L
12 months

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

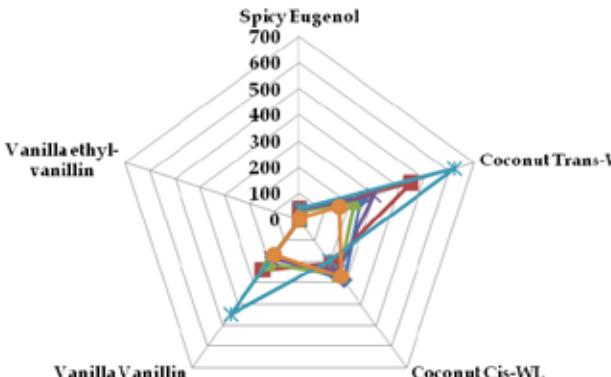
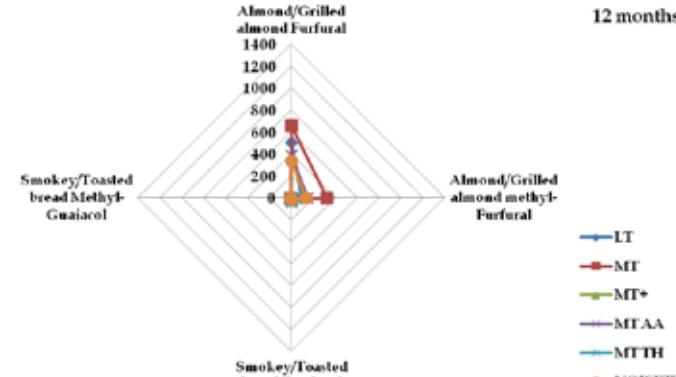
GRILLED / SMOKEY AROMAS



VANILLA / SPICY AROMAS

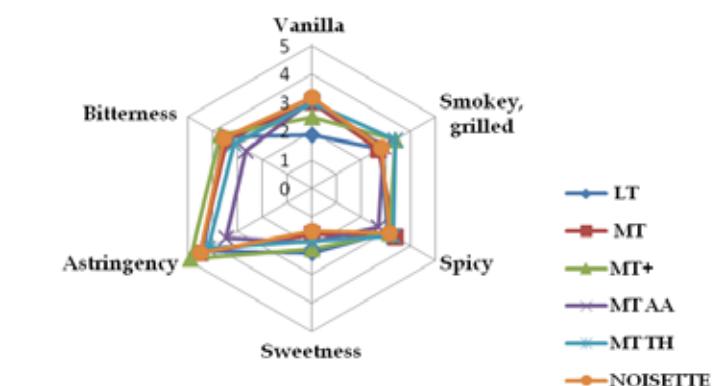


Château 4

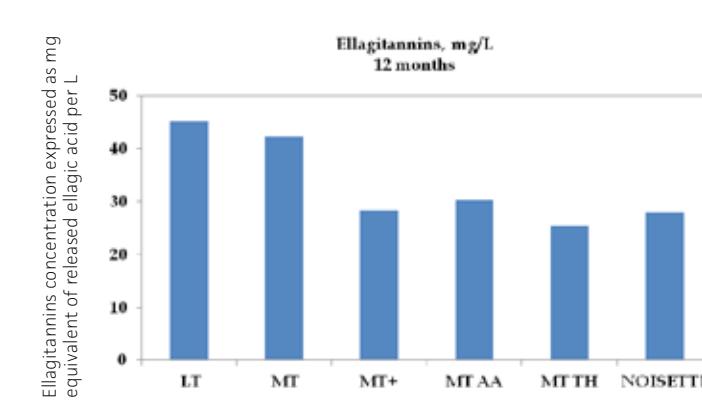
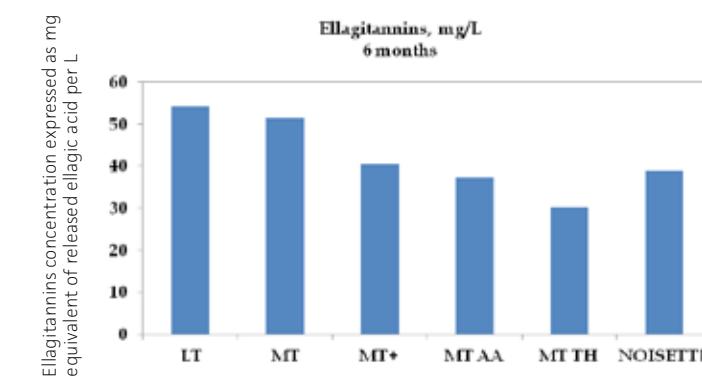
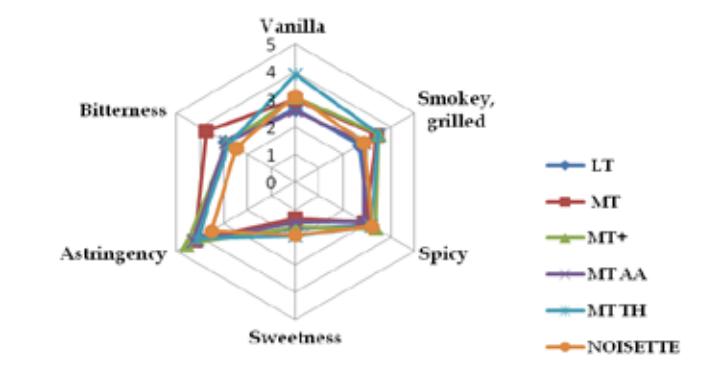


Sensory profile, ellagitannins perception and total ellagitannins concentration.

6 months



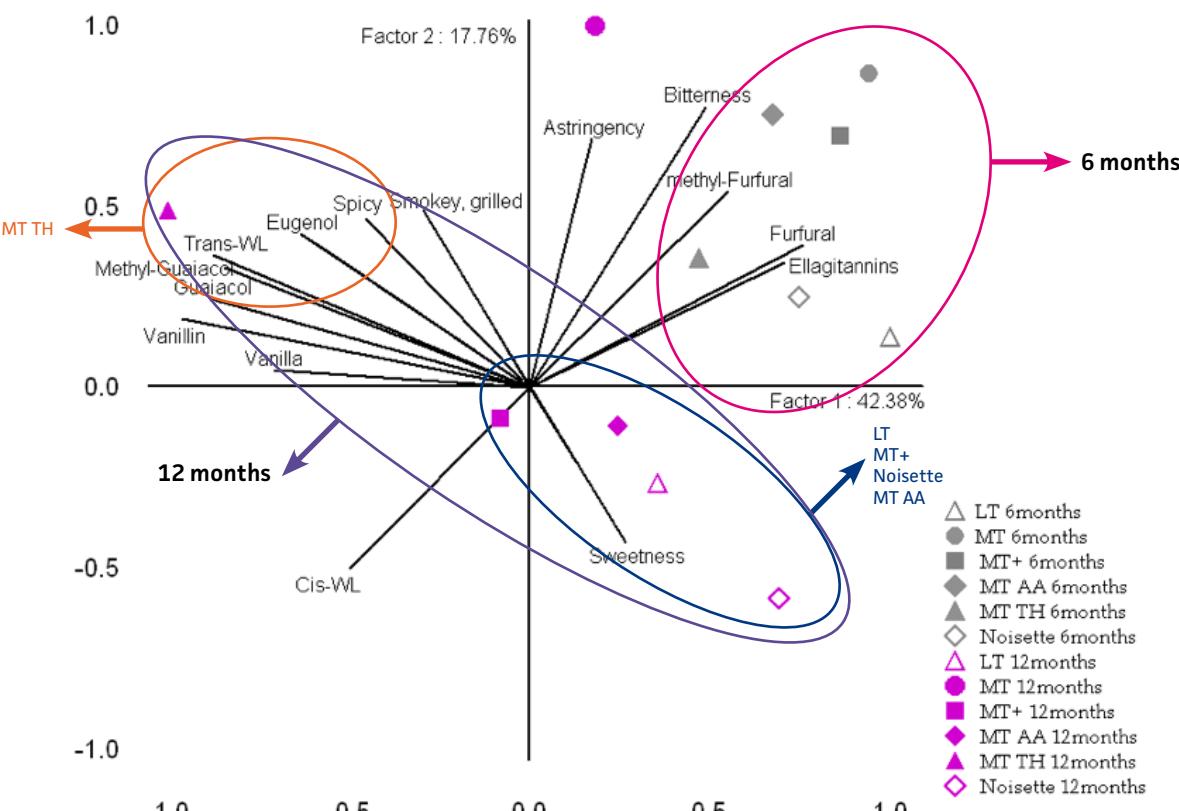
12 months



Château 4

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

Château 4

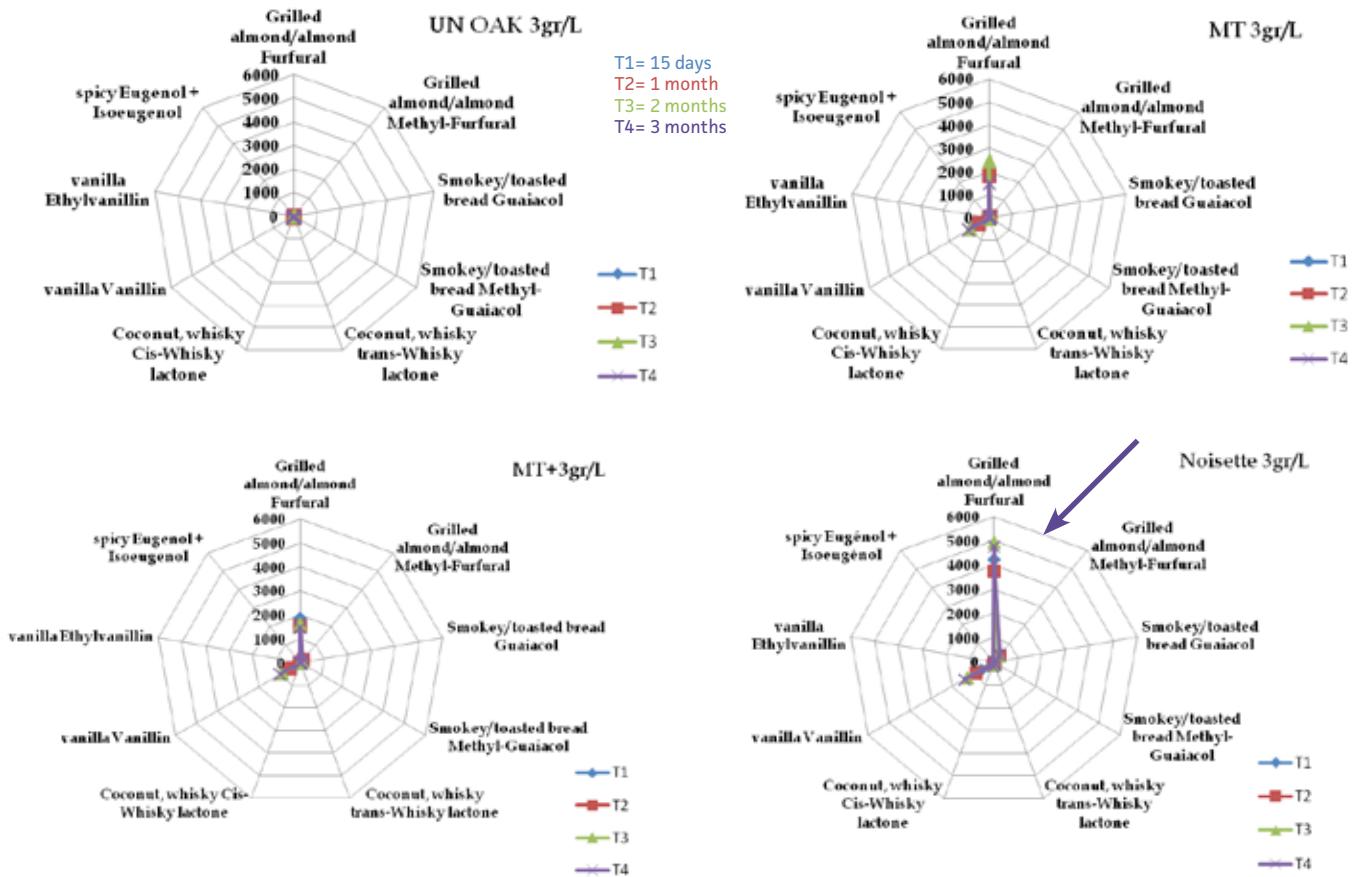


Conclusion (barrels)

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 ($\approx 30\%-50\%$ for vanillin, $\approx 10\%-30\%$ for vanilla flavor).
- Regarding sensory evaluation, the sweetness perception increases during aging and tannins perceived softer and mellow.

OAK CHIPS aromatic profile (3 gr/L)



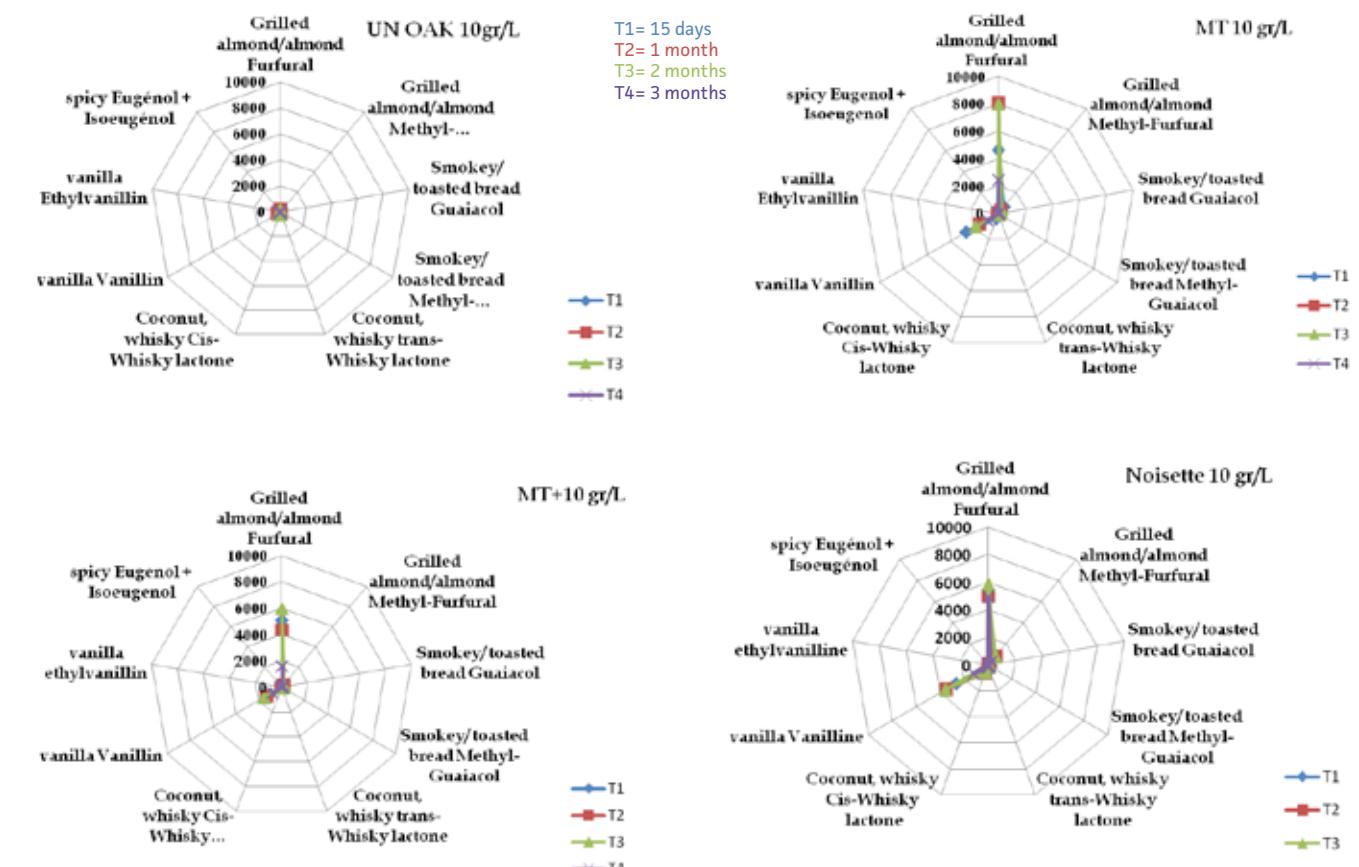
Results

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



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

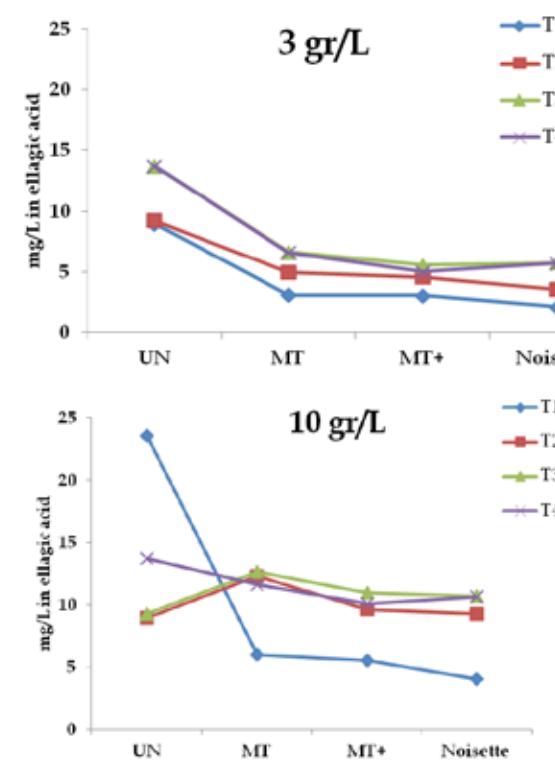
OAK CHIPS aromatic profile (10 gr/L)



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.

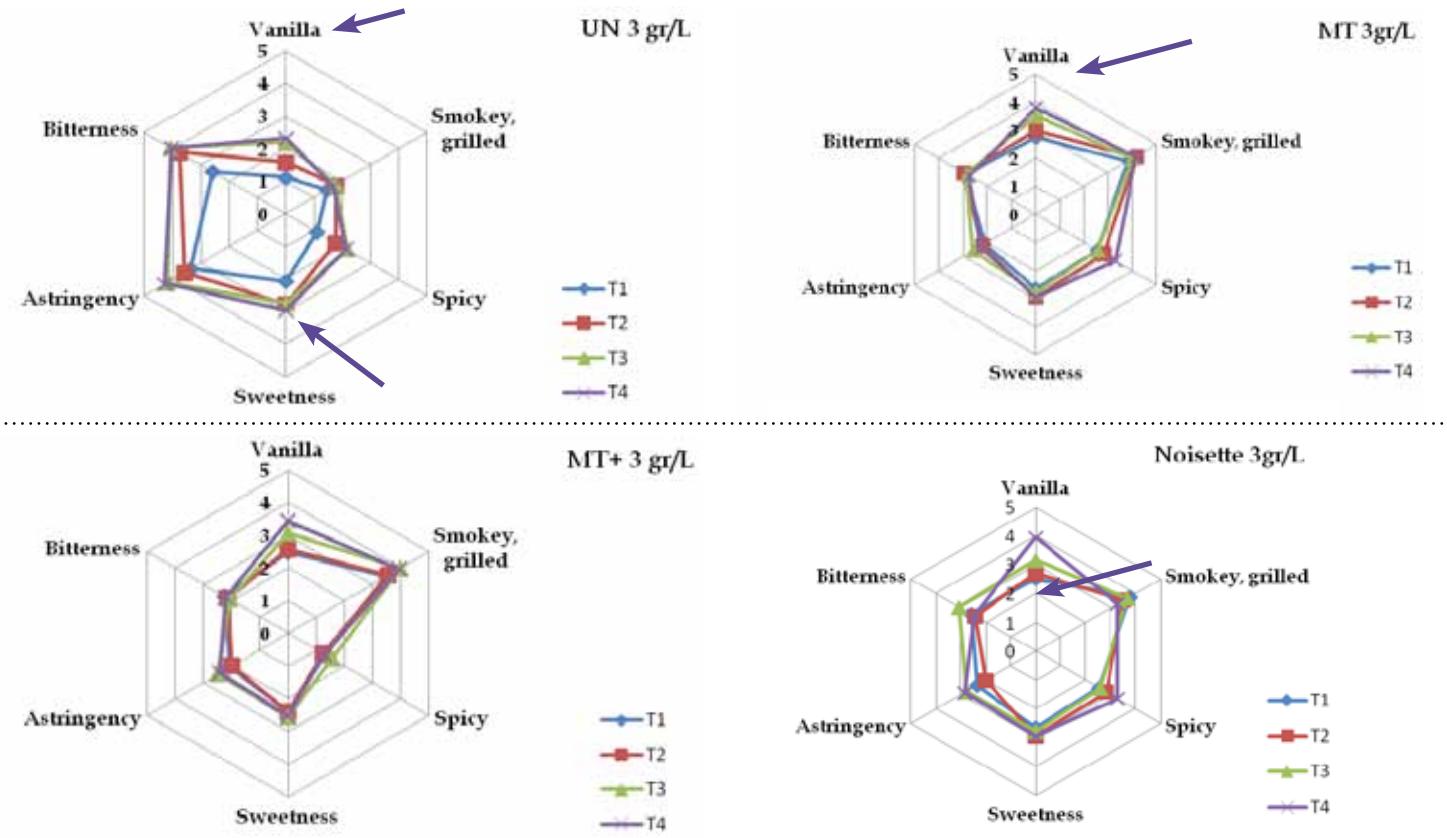


Stabilization and maximum extraction after two months.

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

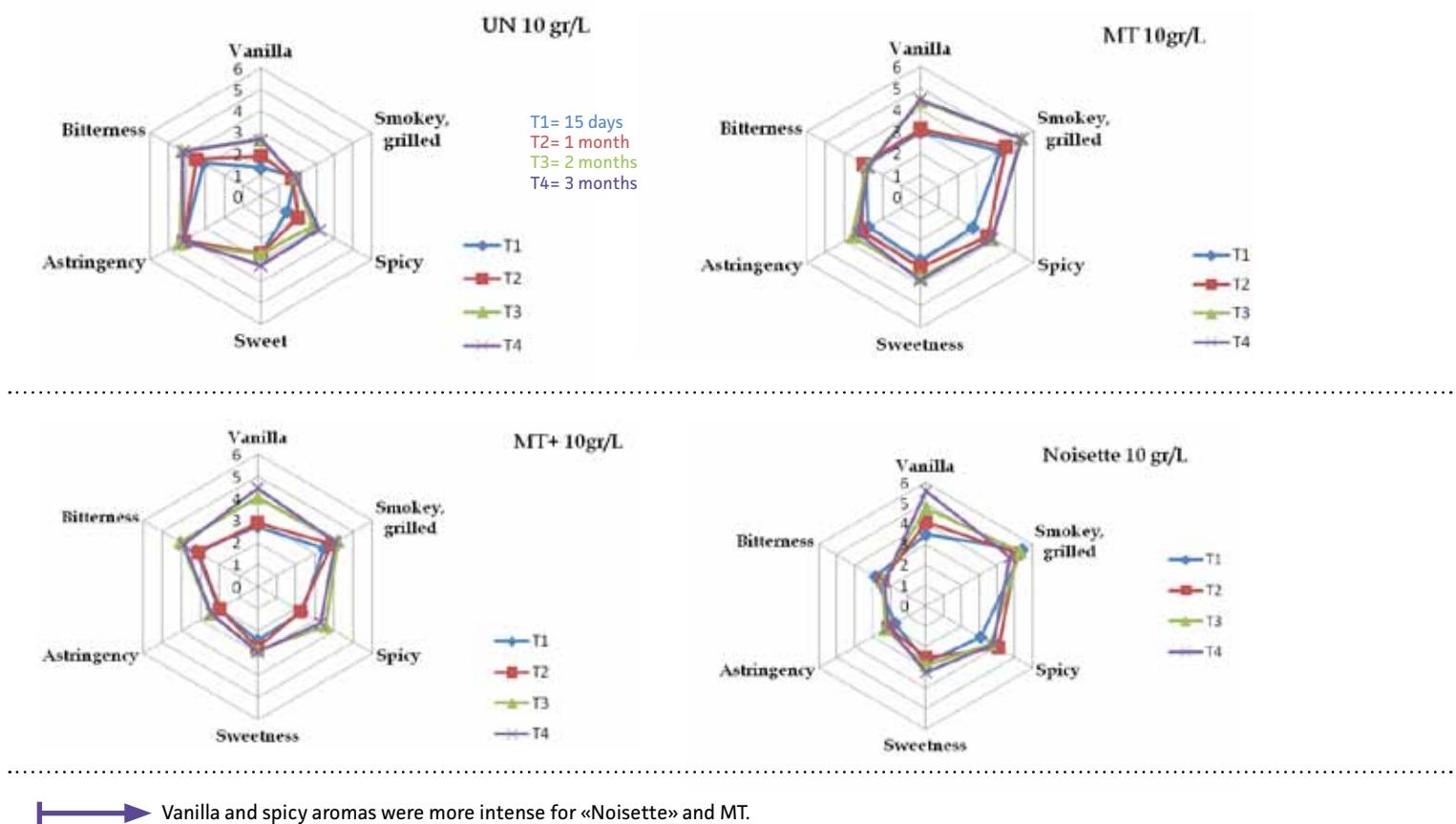
The untoasted showed the highest concentrations of ellagitannins.

Sensory profile (oak 3 gr/L)

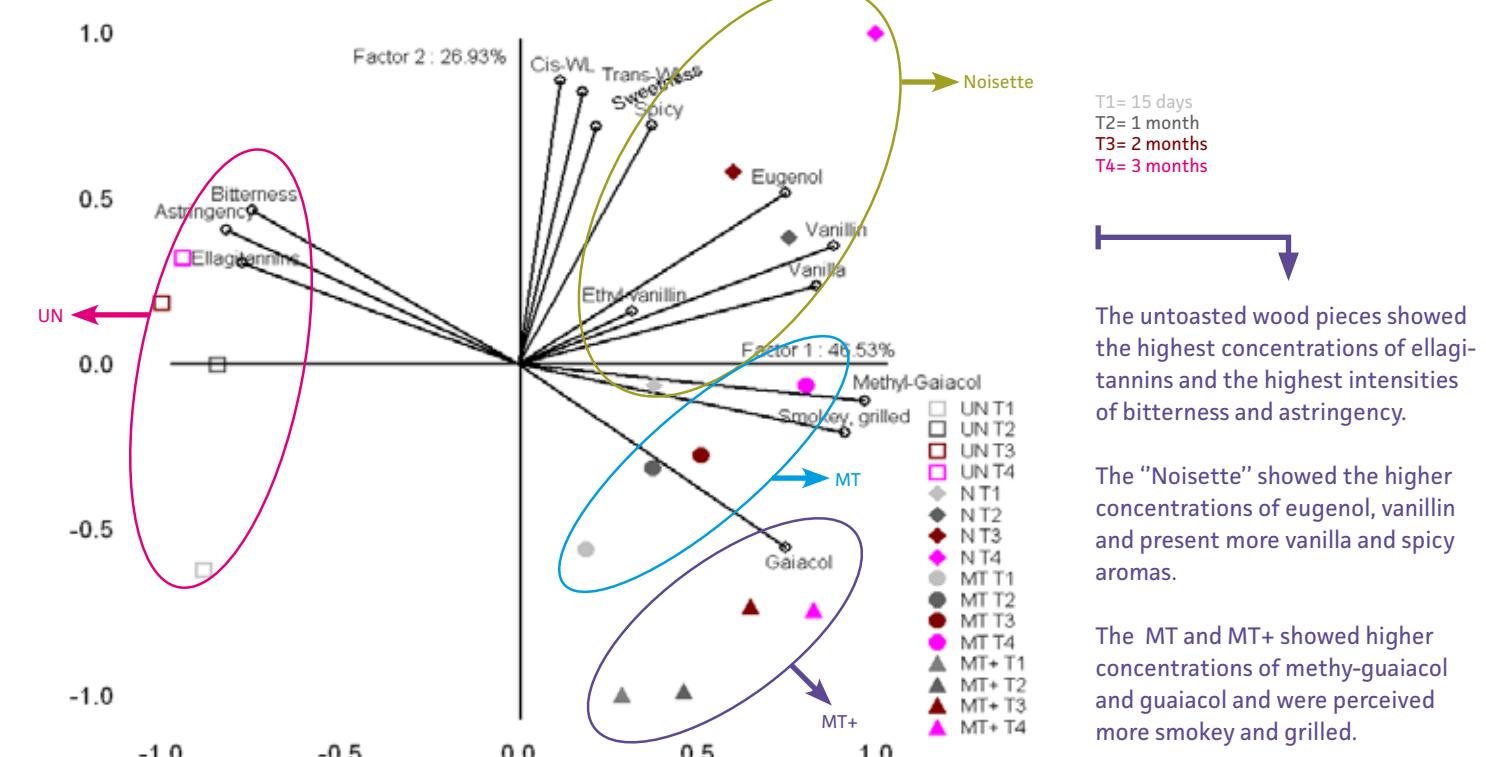


Vanilla and spicy aromas were more intense for «Noisette» and MT

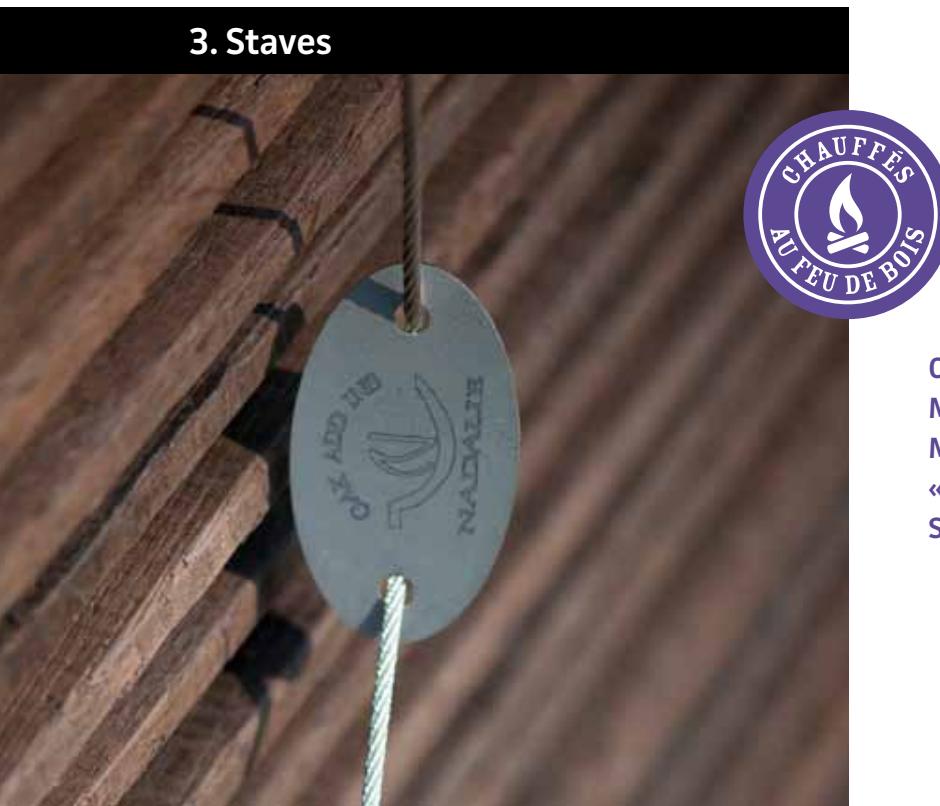
Sensory profile (oak 10 gr/L)



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



Results



3. Staves

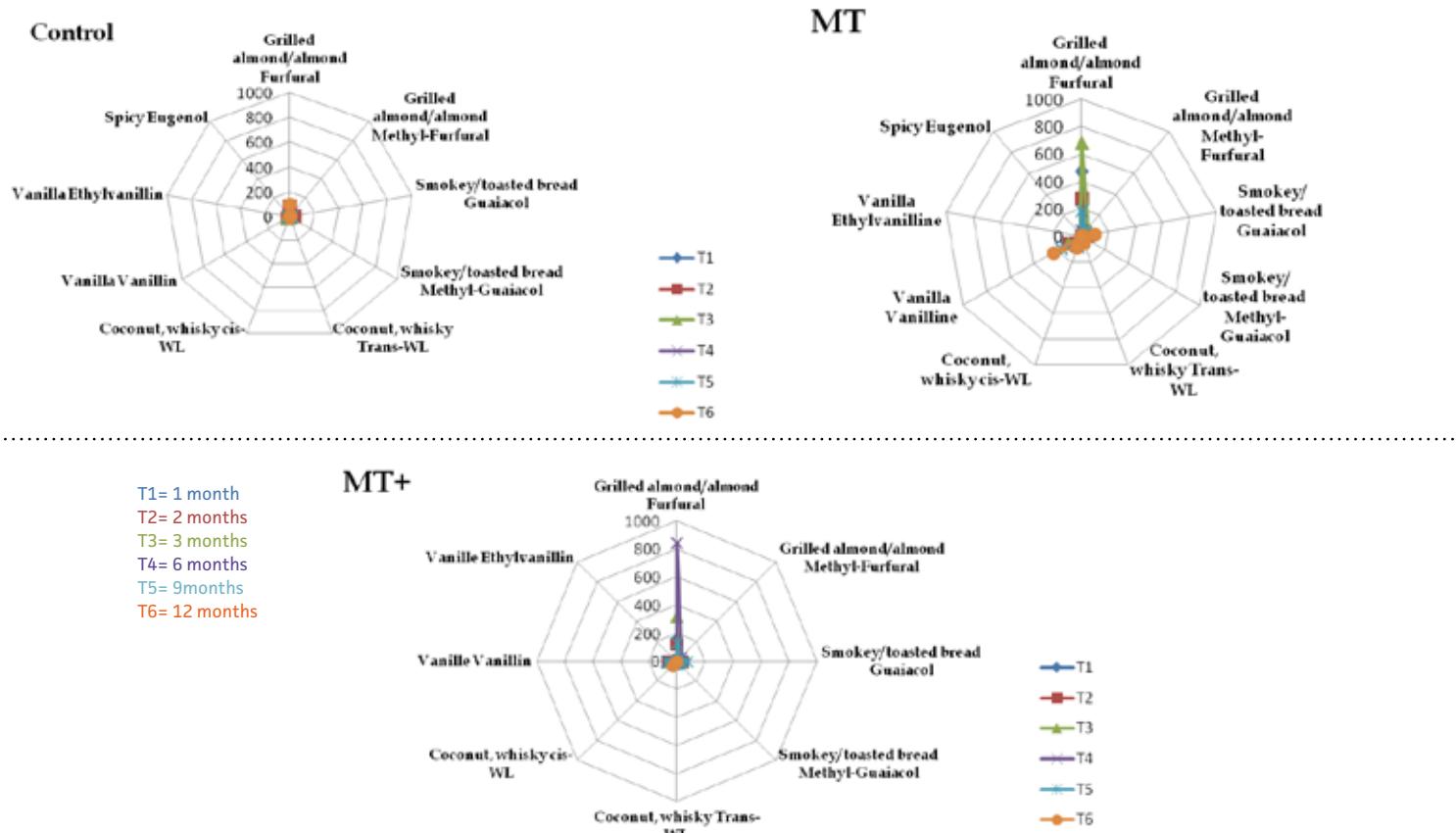
CONTROL
MT (Medium Toast)
MT+ (Medium Plus Toast)
«NOISETTE»
SPECIAL

2 ww / hl
 2 ww / 2,4 gallons

Wine 100% Merlot

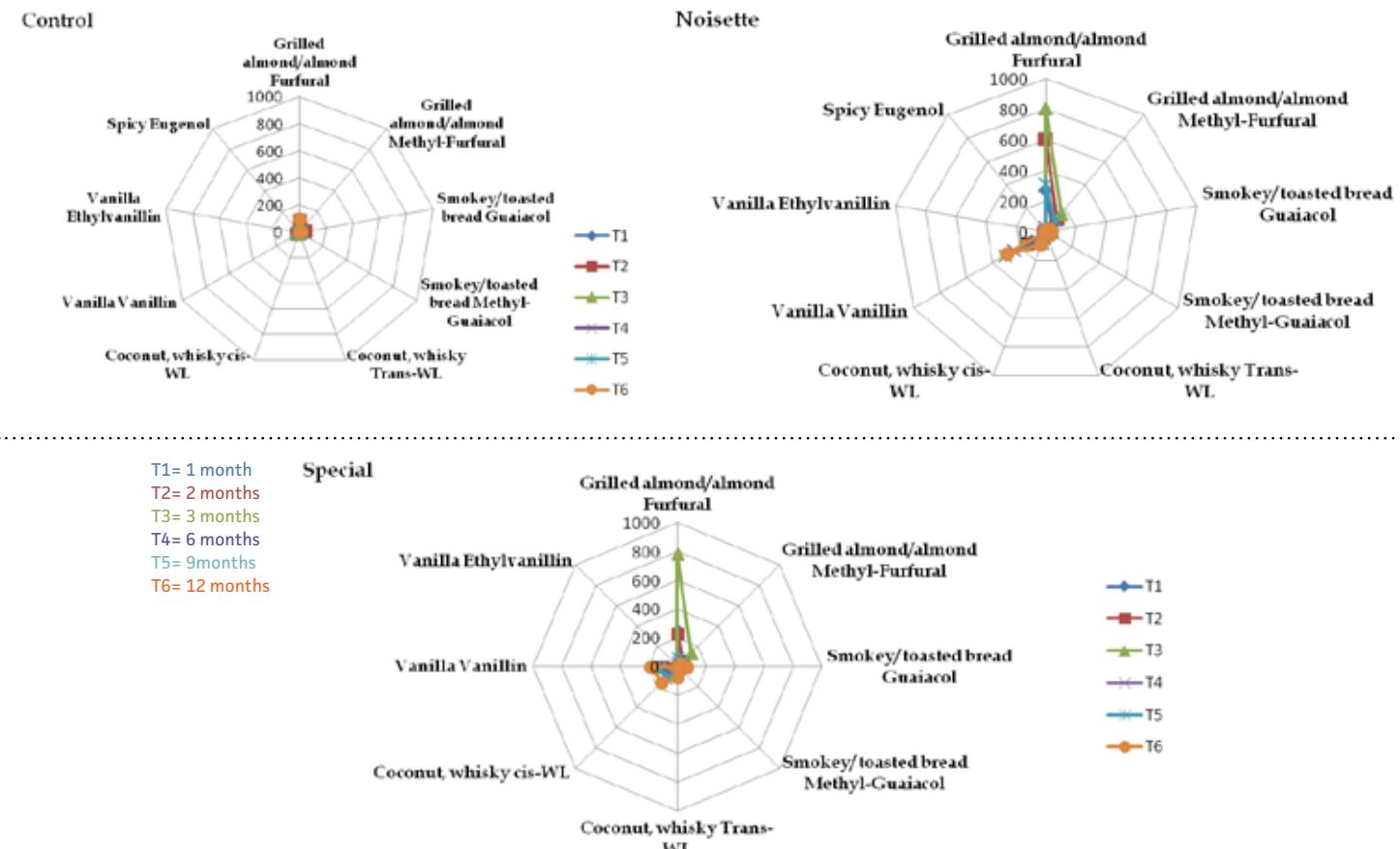


Extraction kinetic of staves aromas in wine during twelve months.



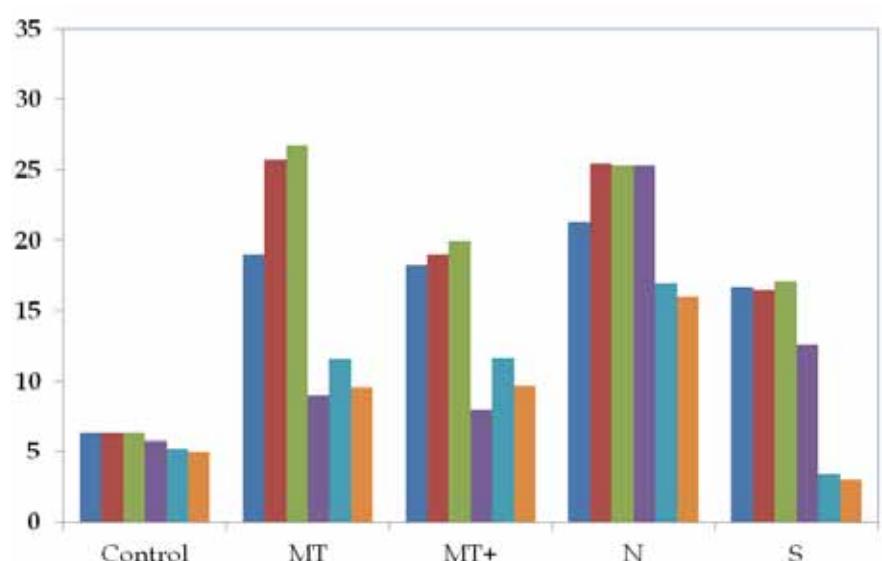
T1= 1 month
 T2= 2 months
 T3= 3 months
 T4= 6 months
 T5= 9months
 T6= 12 months

Extraction kinetic of staves aromas in wine during twelve months.



Extraction kinetic of staves ellagitannins.

Extraction kinetic of staves ellagitannins in wine during twelve months.

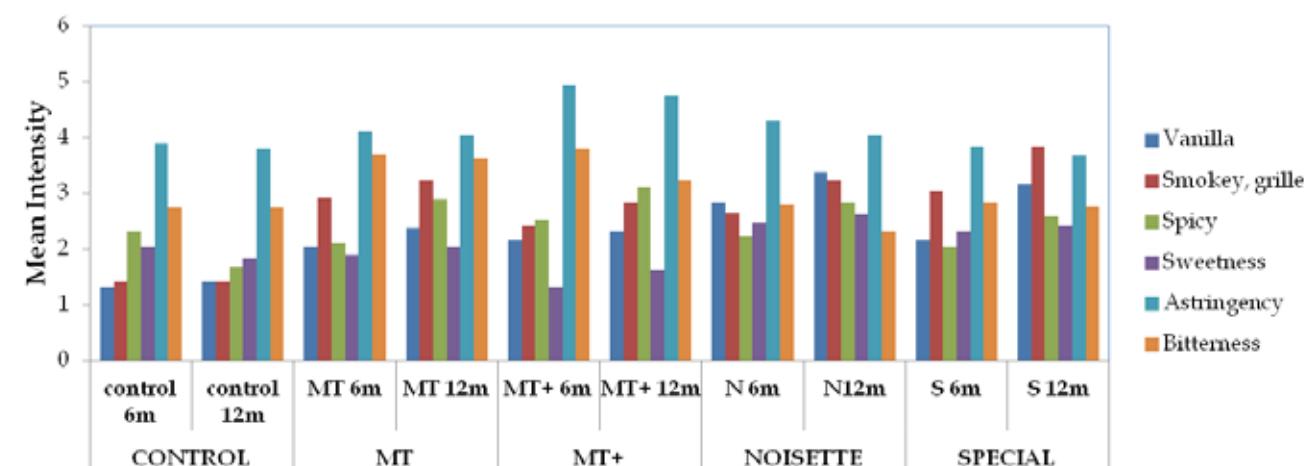


T1= 1 month
 T2= 2 months
 T3= 3 months
 T4= 6 months
 T5= 9months
 T6= 12 months

T1
 T2
 T3
 T4
 T5
 T6

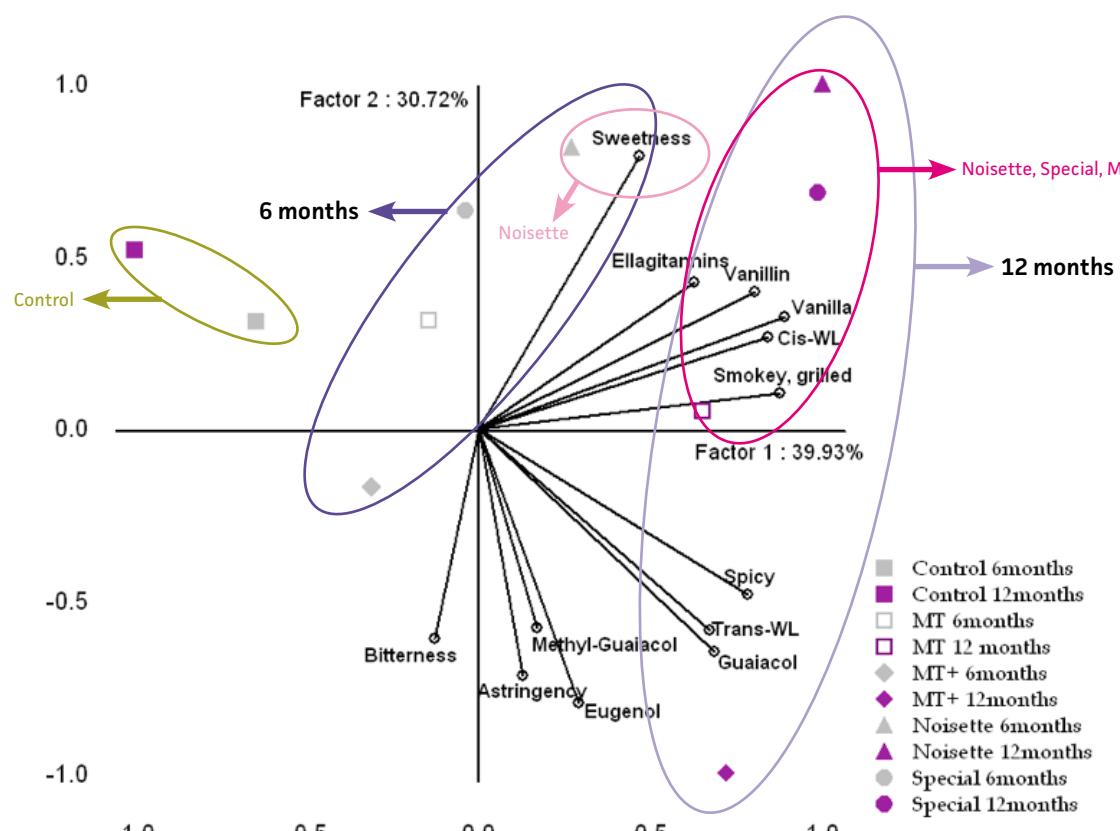
Maximum extraction after two or three months.
 The MT showed the highest concentrations of ellagitannins after 3 months.

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.

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



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 ($\approx 50\%-70\%$ for aromatic compounds and $\approx 50\%$ for ellagitannins). At sensory level the 10g/L dosage in comparison with the 3gr/L dosage permit to intensify the aromas ($\approx 10\%-15\%$) (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 ($\approx 10\%$), tannins are perceived softer and the sweet flavor increases ($\approx 10\%$) during time (STAVES).
- The untoasted (OAK CHIPS) give highest concentrations of total ellagitannins.



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