PRONEKTAR
Le fruit du bois

Oak Fermentation Seminar

Tuesday, January 27, 2009.

Sacramento

RADOUX

Raphaële Verdier

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Plan

Introduction

I. What are the effects of using oak wood on the wine during different fermentations?

II. Which solution for which wine?

Conclusion

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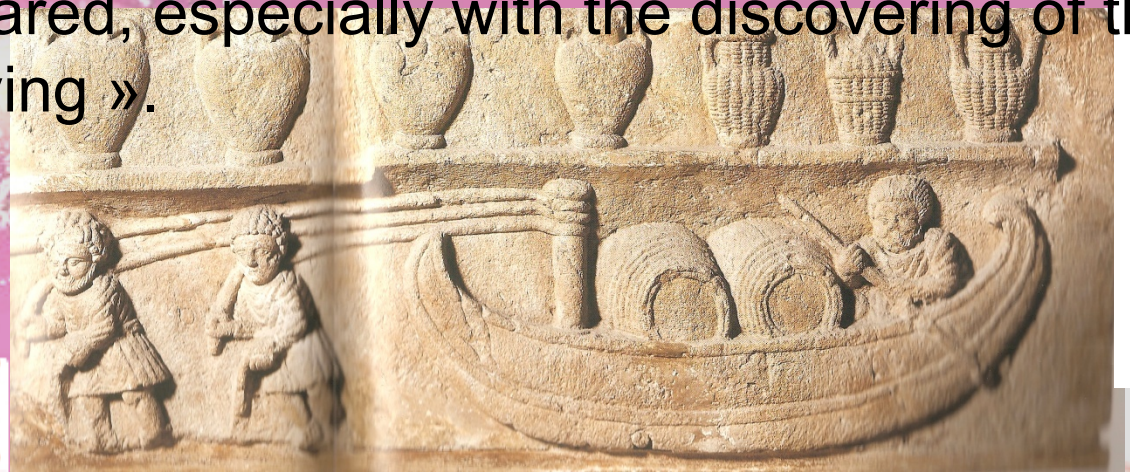
History of the use of oak wood in wine-making.

- Human always needs containers for the liquid to preserve and travel with.
- The first materials was animals skin (leather container)
- Then, we could find earthenware in 2500 BC.
  - fragile, heavy, bad taste (adding of spices and honey).
- 225 years BC, the wooden containers appeared, especially with the discovering of the « curving ».



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History

Advantages of the barrels in relation to the amphorus.

- More robust to the pressure, shocks and piling up.
- Easy travel by rolling
- The form allows the sediment of the lees.
- Good evolution of the taste during the maturation.

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History

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Then barrel becomes essential for the wine-making.

- develop the commercial exchange.

- real notion of MATURATION of the wine.

That's why the barrel will be so used by the « grand cru ».

Improvement of sensory profile of the wines

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First Part : The effects of the use of oak during fermentation.

– Reminder of the oak wood extractives and their chemical characteristics.

– The different consequences on the wine.

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Oak wood extractives

- Ellagic tannins (mostly Vescalagin and Castalagin)
- Polysaccharides : involved in the"fat" sensation in the mouth.
- Aromatic volatile compounds :
  - Dissolution of compounds involved in "woodiness": Methyl-Octalactones (whisky-lactone)
  - Dissolution of compounds involved in the "toastiness", "smokiness" and "vanilla" characters :
    - Thermal degradation of polysaccharides = Furanic aldehydes by-products (furfural)
    - Thermal degradation of Lignin and phenolic acids = Phenolic aldehydes and volatile phenols (vanillin, eugenol)

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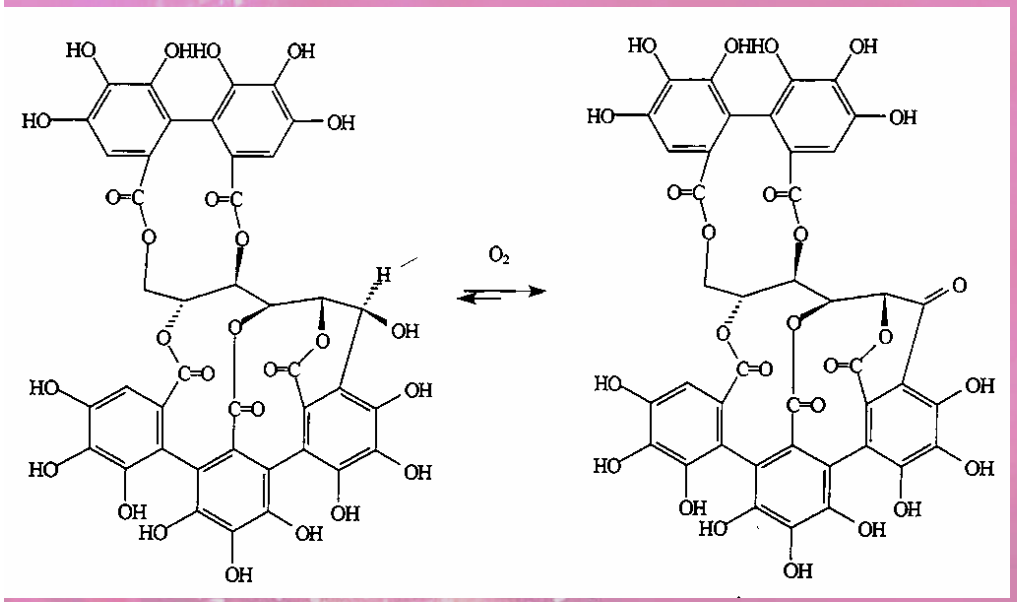
Chemical Characteristics of ellagic tannins



Time (days)	Total phenols OD280	Total Ellagitanins (mg/l eq castalgine)
0	16	651
8	16,5	496
15	15,8	236
30	14,2	127
45	13,5	77

Evolution des ellagitanins conservés en milieu hydro-alcoolique et en présence d'air (milieu : 12% vol.EtOH,pH=3,5). N.Vivas

Ellagic tannins from oak wood are very sensitive to **hydrolysis,** and **oxidation** in wine and disappear quickly

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The consequences on the wine.

1. Chemical effects :
   - Antioxidation effect
   - Effect on the color on the red wine
   - Effect on the color on the white wine
   - Effect on structuration (structure and volume)
   - Effect on the reduced character
   - Effect on altered grapes by the grey rot

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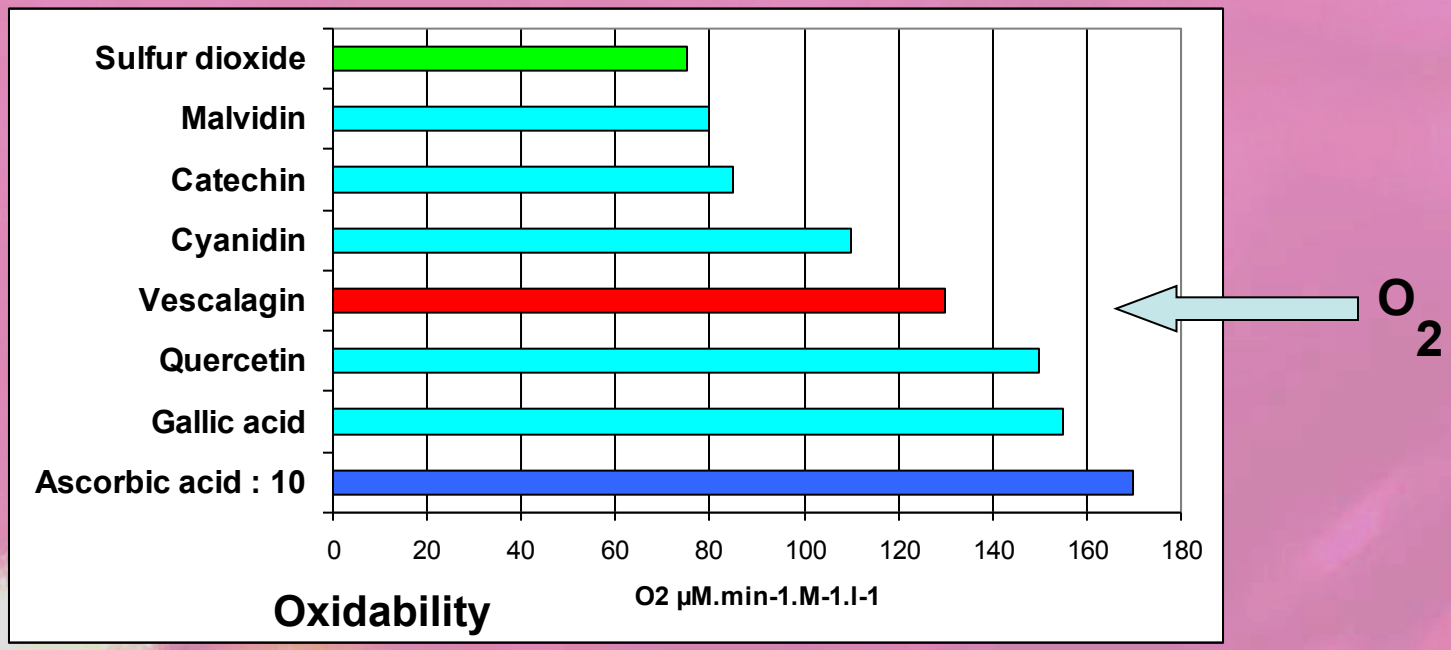
Antioxydant effect



Ellagic tannins from oak are much more reactive than most of the polyphenols of white and red wines with dissolved oxygen => oxygen is quickly trapped by these tannins.

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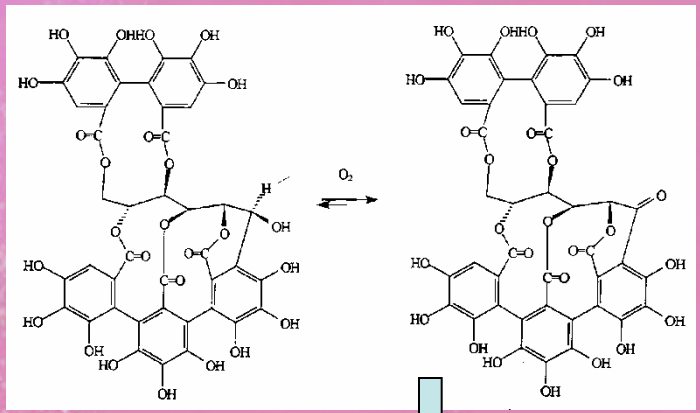
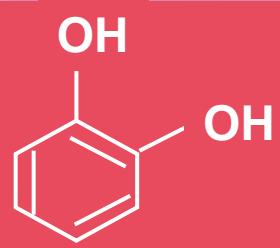
Effect on the color of the red wines

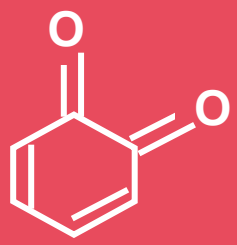


Oxidation of ellagic tannins

Formation of Ethanal (acetaldehyde) from Ethanol (Singleton, 1987)



$+ O_2 \longrightarrow$



$+ H_2O_2$

$H_2O_2 + CH_3CH_2OH \longrightarrow CH_3CHO + 2\ H_2O$

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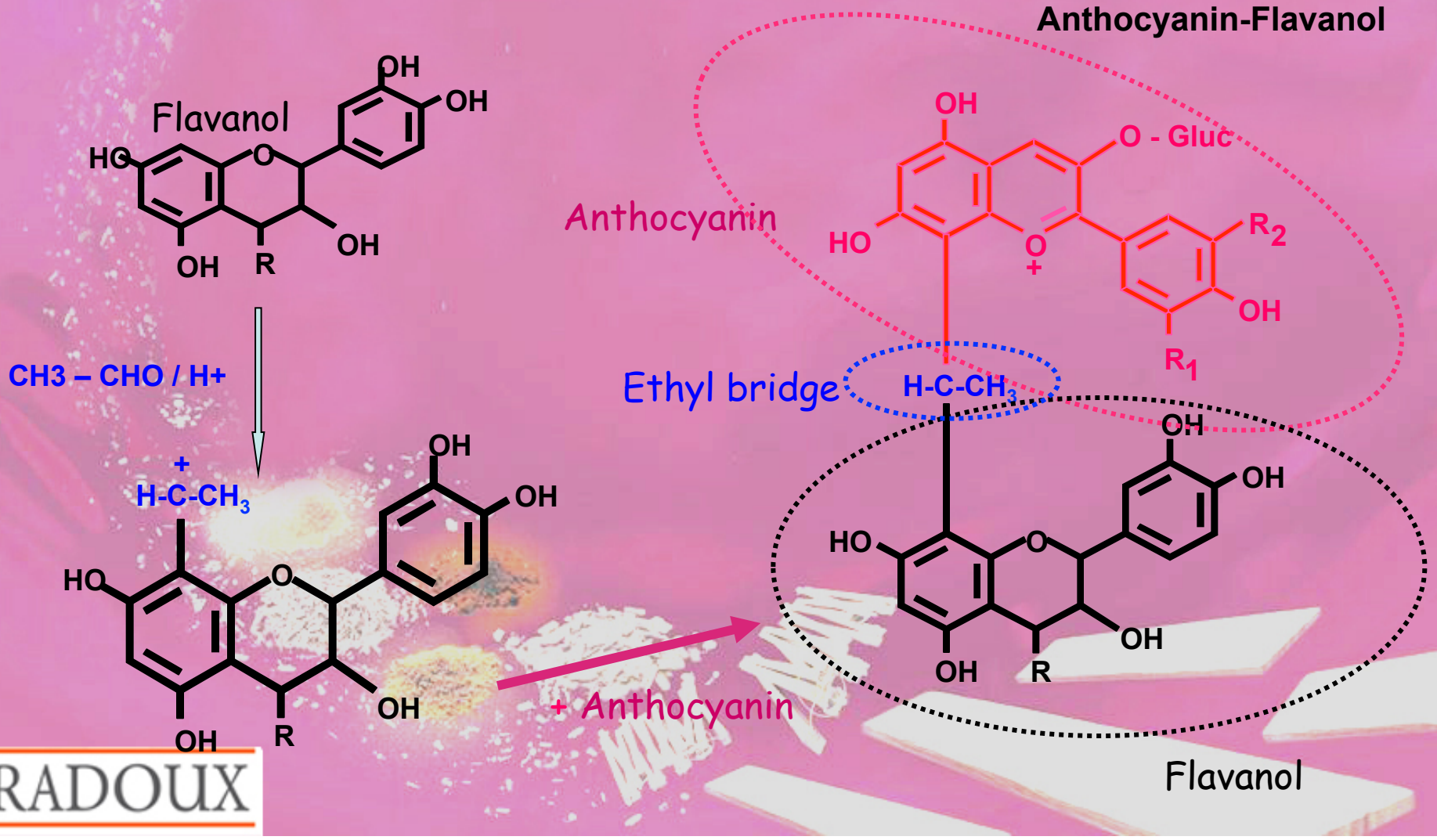
Reactivity of wine polyphenols with acetaldehyde



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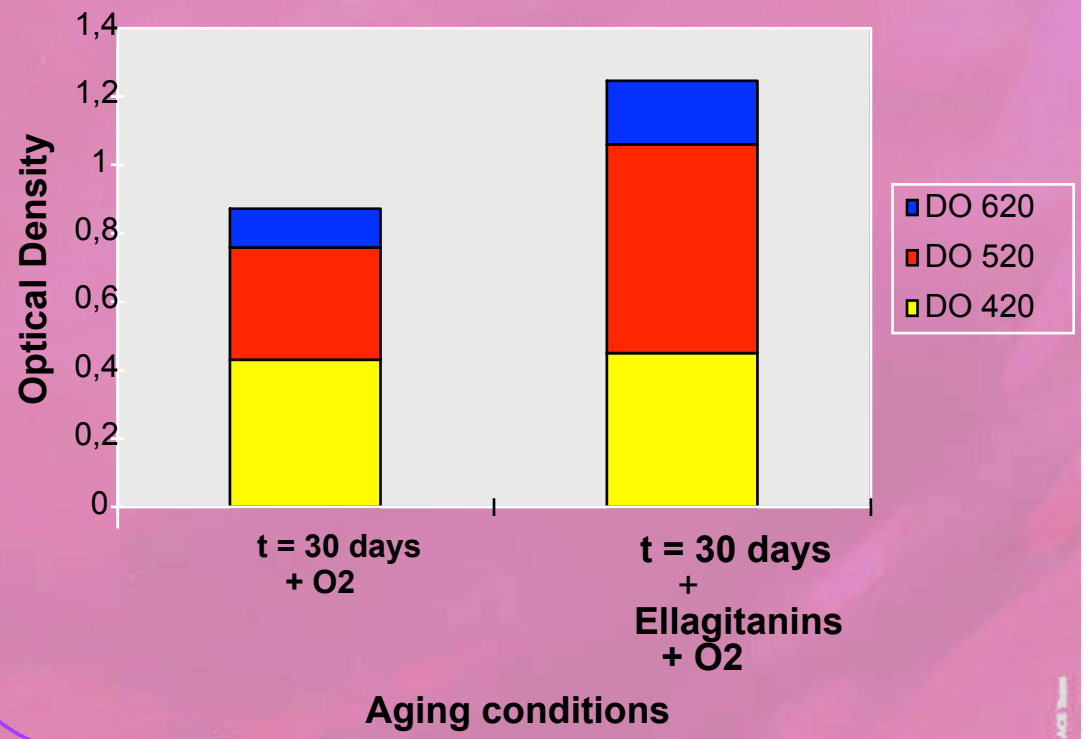
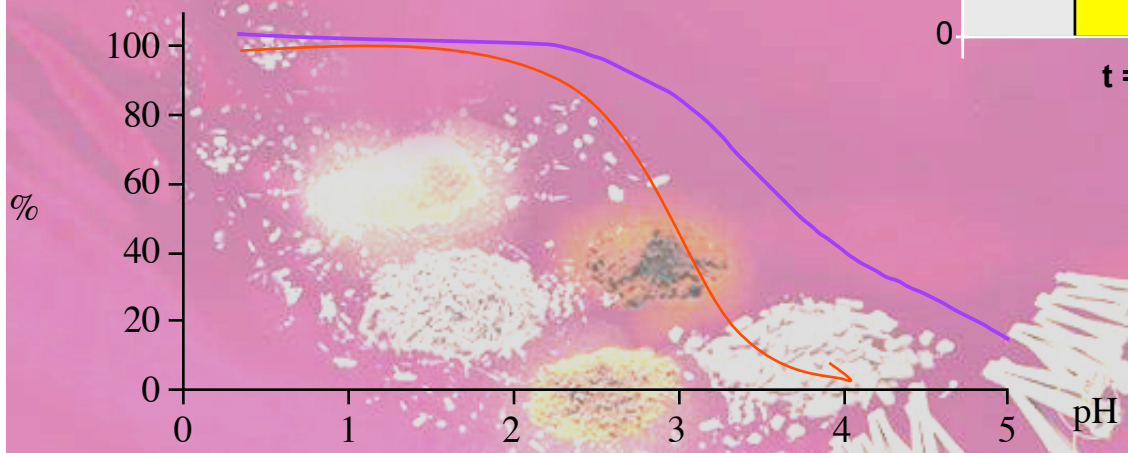
Influence of Anthocyanin-Flavanol copigments on the color of red wines

— Free anthocyanins
Red colored, Flavylium (A+)

— Anthocyanins copigment
Red-Blue Colored (FA+)





Deeper Color, less tendancy to lose color through the action of SO2.

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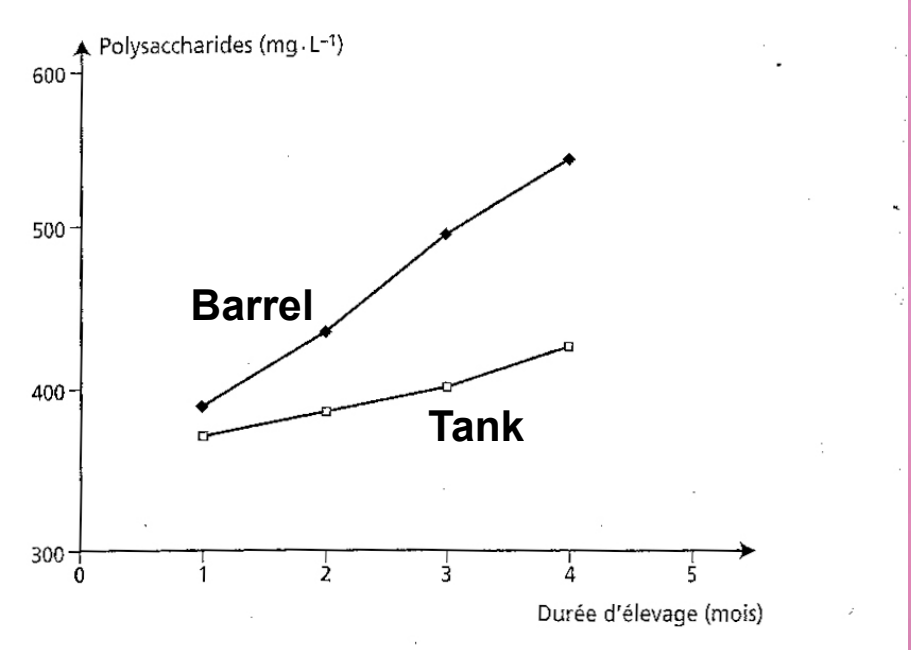
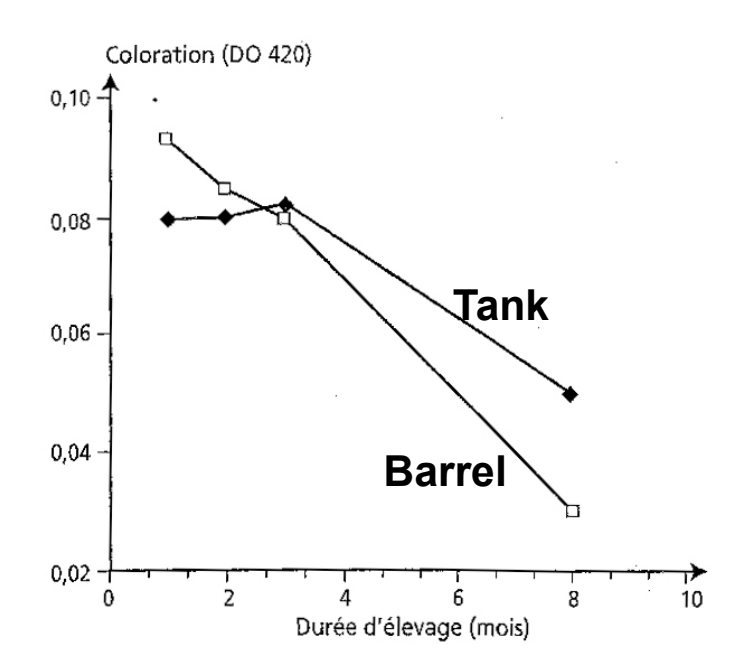
Effect on the color of the white wines



Evolution of the level of total polysaccharides in a white wine, during his aging in tank with fine lees or in barrel with total lees.



Evolution of the yellow color (OD 420),of a white wine, during his aging in tank with fine lees or in barrel with total lees. (Chatonnet et al,1992).

The released polysaccharides by the lees will combine with the polyphenols of the white wine. Thus the yellow color is less pronounced, and therefore appears less developed.

Effect on structuration : Reaction of Flavanol with acetaldehyde

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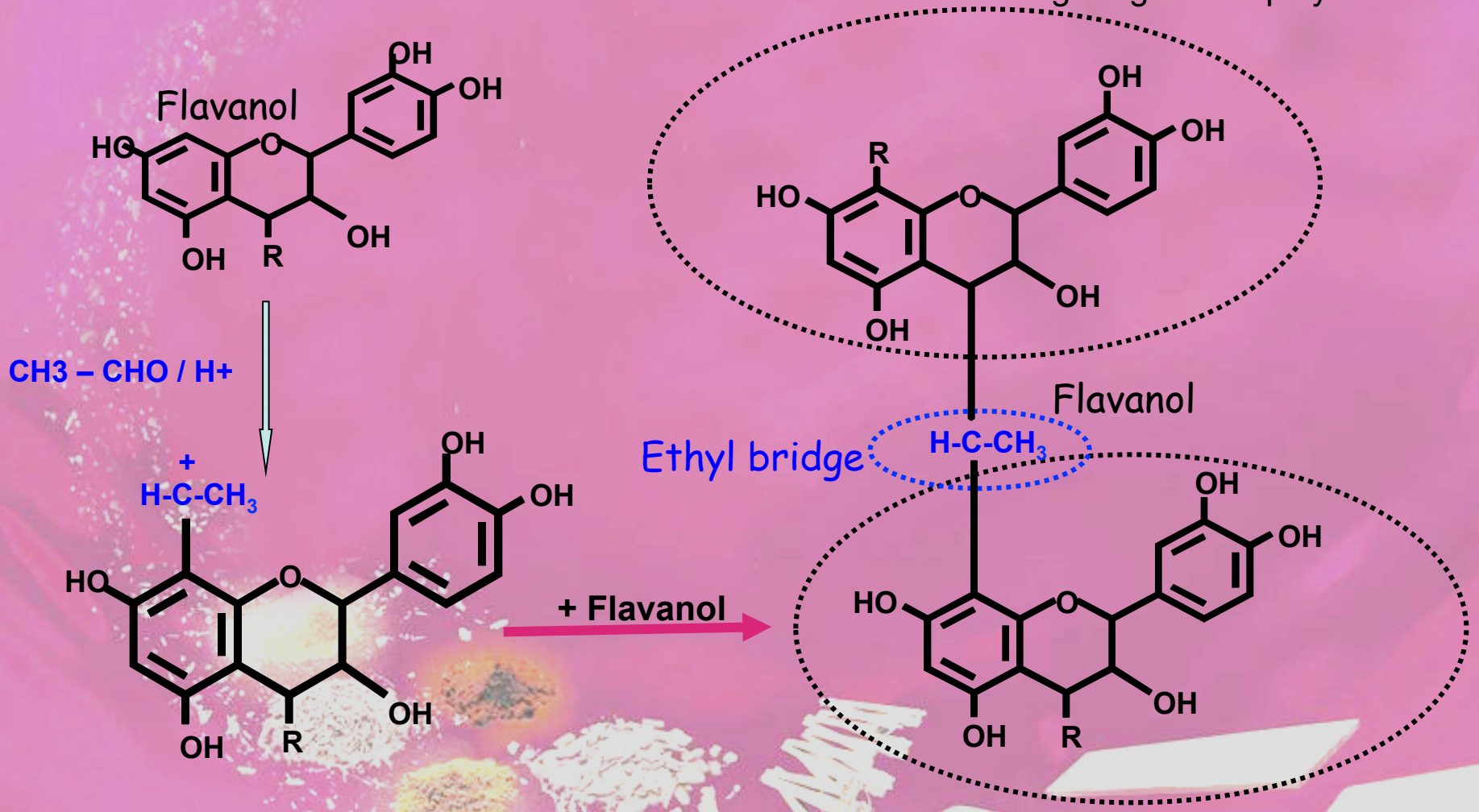
Condensed tannins of higher grade of polymerization



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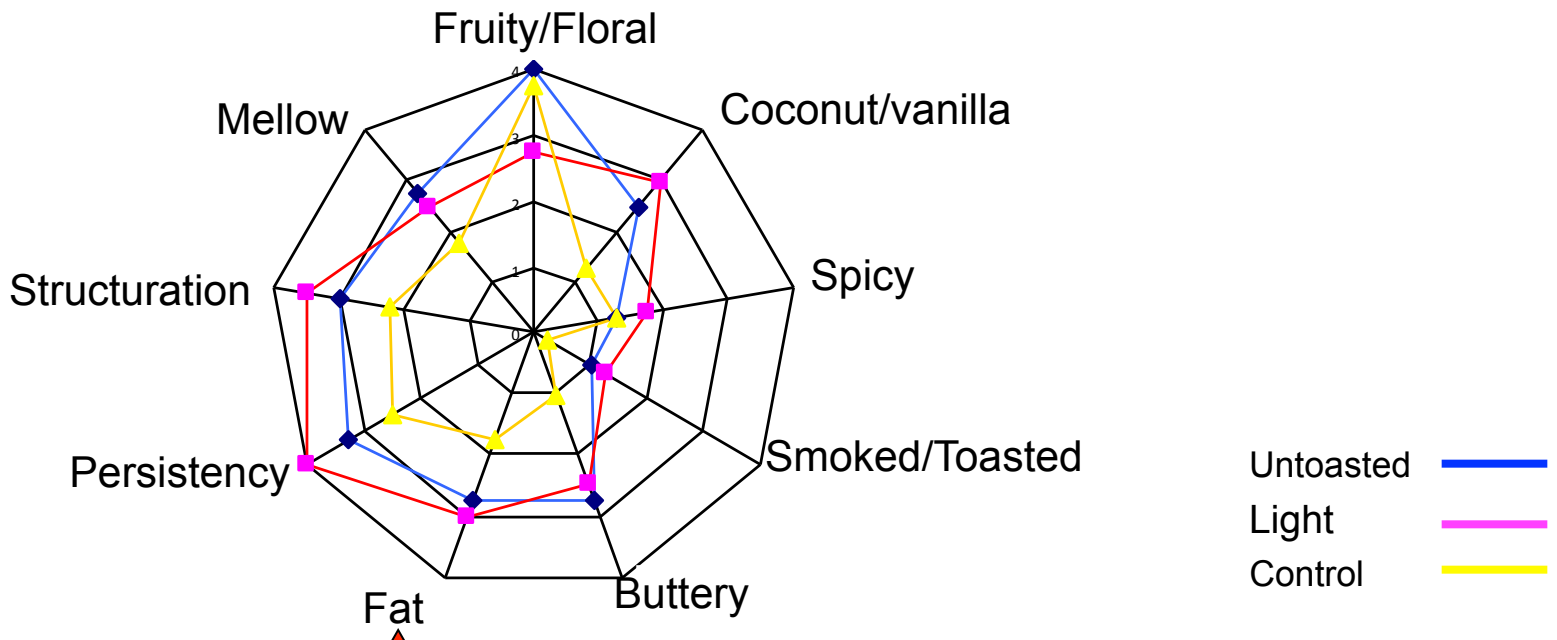
Less Astrengency

More sensation of « fat in the mouth »

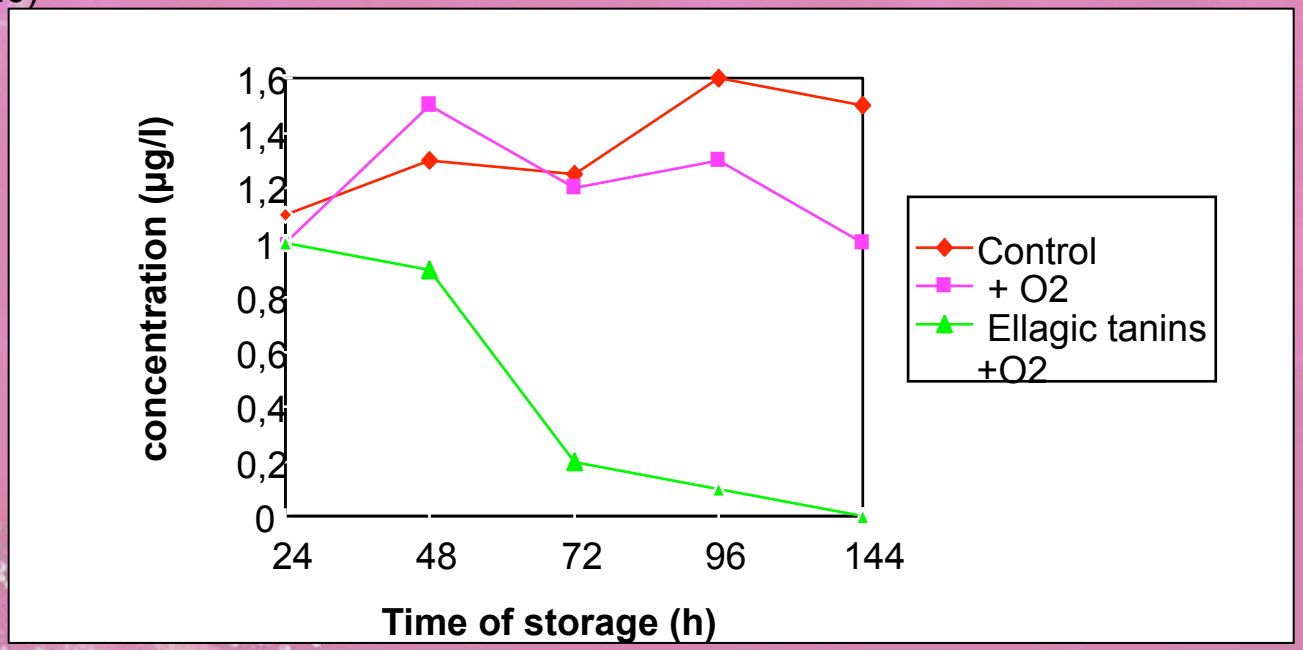
Results of the taste of a Merlot in 2007 fermented with french oak granulates (2g/L after the crusher).



Higher Sensation of Fat in the mouth.

Effect on the reduced character

- Influence of ellagic tannins (6 mg/l) on Methanethiol CH_3SH in model solution (12 % vol. EtOH , pH 3.6)



De Chatonnet 1991 DERUB Thesis Université Bordeaux II

The presence of free Ellagic Tanins induced a quick decrease of Mercaptans as Methylmercaptan (perception = 1 µg/L) involved in the reduced character of wine by :
Trapping.
Oxidation to dimethyl-sulfide (DMS) less odorant (perception threshold = 10 µg/l) after hydrolysis and oxidation through the ortho-diphenols functions of the ellagic tannins.

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Effect on spoiled grape harvest

- **Laccase**, released enzyme by Botrytis Cinerea :
  - Resistant to the action of SO2
  - Causes many negative effects by oxidation

→ Destruction of unsettled Tannins and Anthocyanes

→ Effects on the aromas

Use french oak (more rich in ellagitannins)

Less risk of oxidation

Hide bad earthy taste (Geosmine)

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The consequences on the wine.

2. Aromatic effects :

- On the white wine
  - Better integration of wood aromas
  - Better preparation for further oak aging
  - Less bitterness
- On the red wine
  - More aromas
  - More toastiness
- Hidden effect on the vegetal character

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Aromatic Impact of the Fermentation of White Wines with Oak

Chardonnay Fermented or not in presence of Oak	**No oak (no lees)**	**Fermented and aged with oak chips (4 weeks, total lees)**	**Fermented without oak then put in contact with oak chips (4 weeks, no lees)**
Total phenols (A280 nm/PVPP)	3.6	**4.9**	**6.0**
Color (A420 nm)	0.08	**0.08**	**0.20**
Total Polysaccharides (mg/l)	318	**636**	**318**
Furanic by-products (µg/l)	0.1	3700	3600
Furfural (µg/l)	0.1	**500**	**2500**
Volatile phenols from oak (µg/l)	0	33	44
Vanillin (µg/l)	Traces	**360**	**490**
Methyl-octalactones (µg/l)	0	**160**	**230**

Fermentation of wine with oak produce always :
-A lower impact of the wood
-A better integration of the wood aromas and polyphenols
-A better preparation of the wine, especially in the case of the whites, to allow more work with oak wood for the maturation.

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from CHATONNET et al. Sci. Alim. 1992 12 665-680

Interaction between Ellagic Tanins and Yeast Lees

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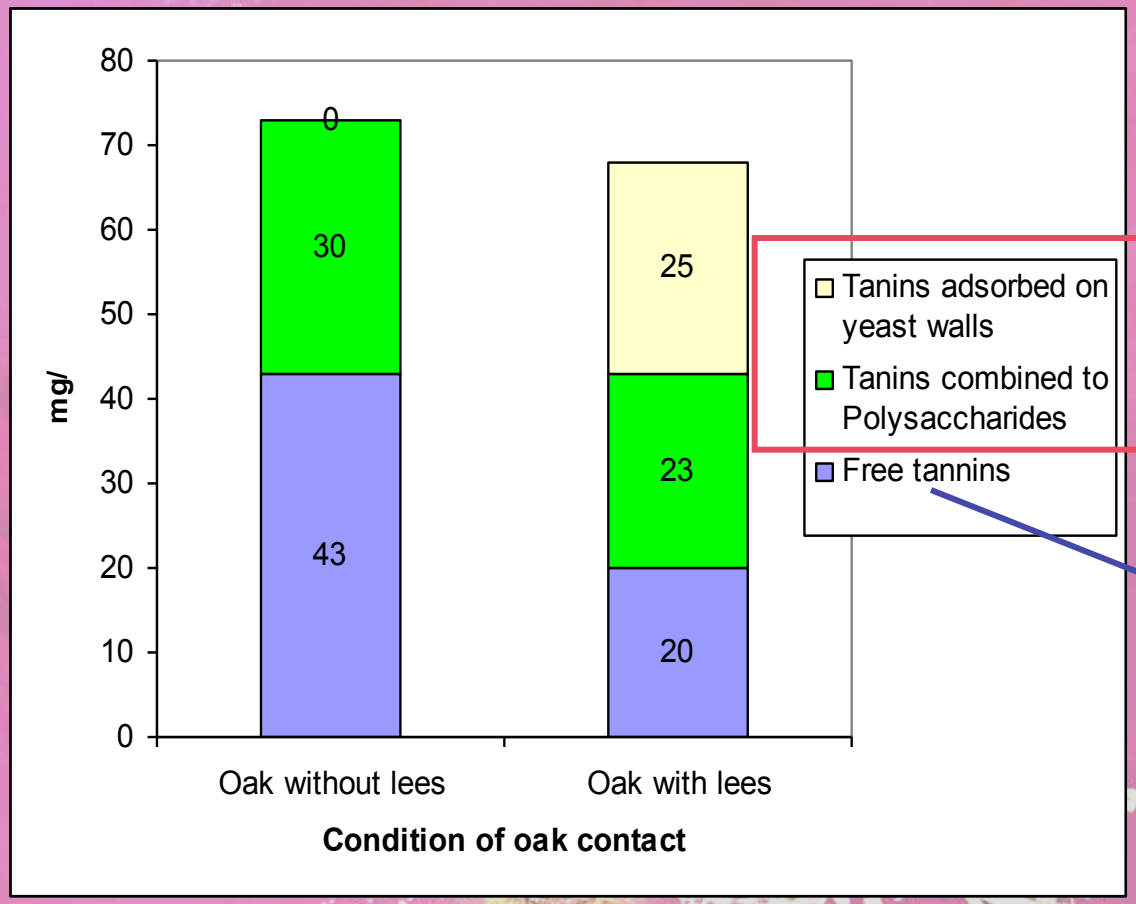

Combination with mannoproteins :
No taste
Prevention of the reduction from the yeast lees
No or lower oxidability
No induced color

Free tannins :
Bitter taste
Sensitive to oxygen and coupled oxidation
Colored products

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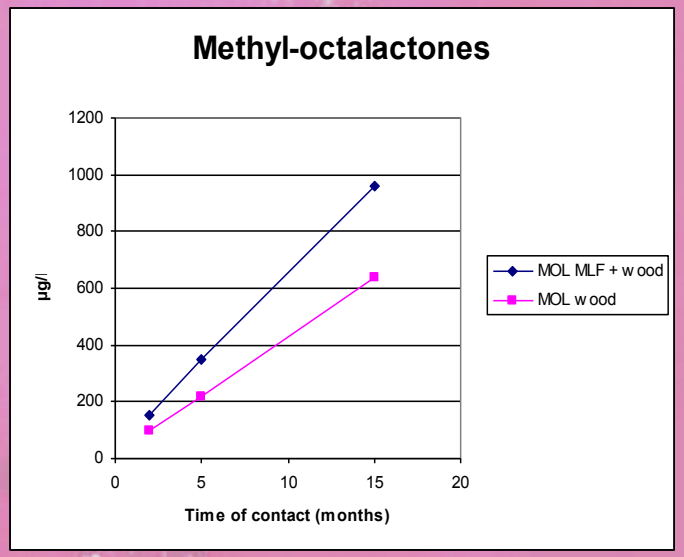
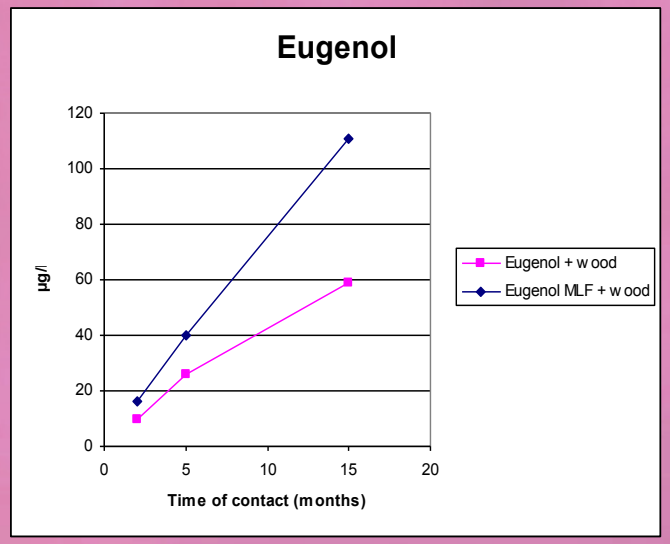
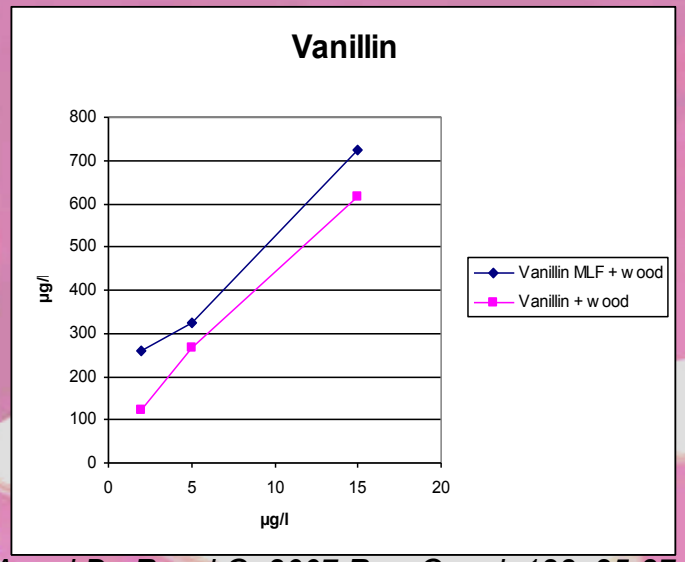
from CHATONNET et al. Sci. Alim. 1992 12 665-680

Influence of Malo-Lactic Fermentation on Oak Wood Aromas





The simultaneous presence of Lactic Bacteria and Oak Wood seems to allow higher release of some oak wood odorant compounds (as Vanillin, eugenol and lactones).
Probably due to the presence of glycosidase in the lactic bactéria.



from Bloem. A and De Revel G. 2007 Rev. Oenol. 123, 25-27

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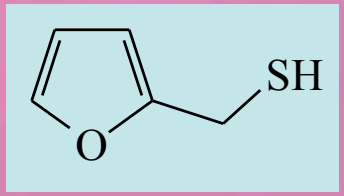
Effect on the development of the « Coffee Character » and the « Toastiness »

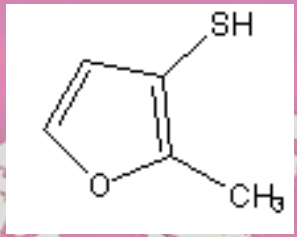
Furanic aldehydes are well correlated with the development of "toastiness" in wine in contact with oak wood <u>but they are not directly responsible for this typical and positive aromatic character</u>

(Perception threshold > 15 mg/l, Bioreduction of Furfural into Furfuryl alcohol less odorant)

2-Furanmethanethiol (2-FM)
(0,4 ng/l)



2-Methyl-3-furamethanethiol (2-M-3FT) (4 ng/l)



Furyl-Mercaptans have been Identified as the most important compounds to explain "toastiness" in wine but they are absent in the toasted oak wood !

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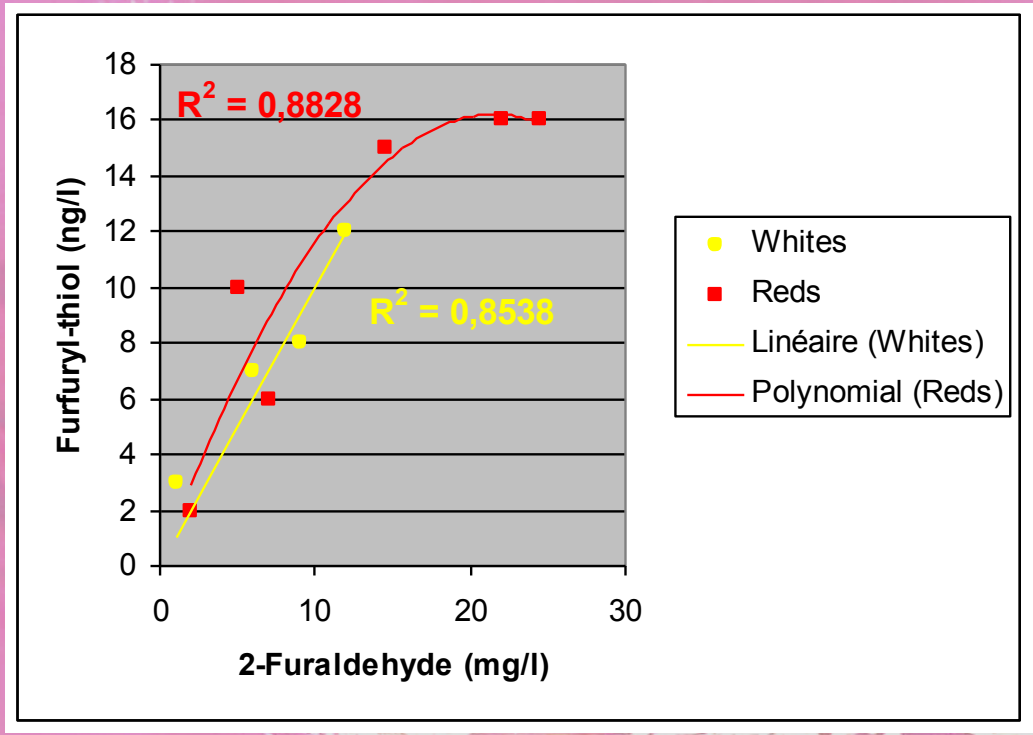
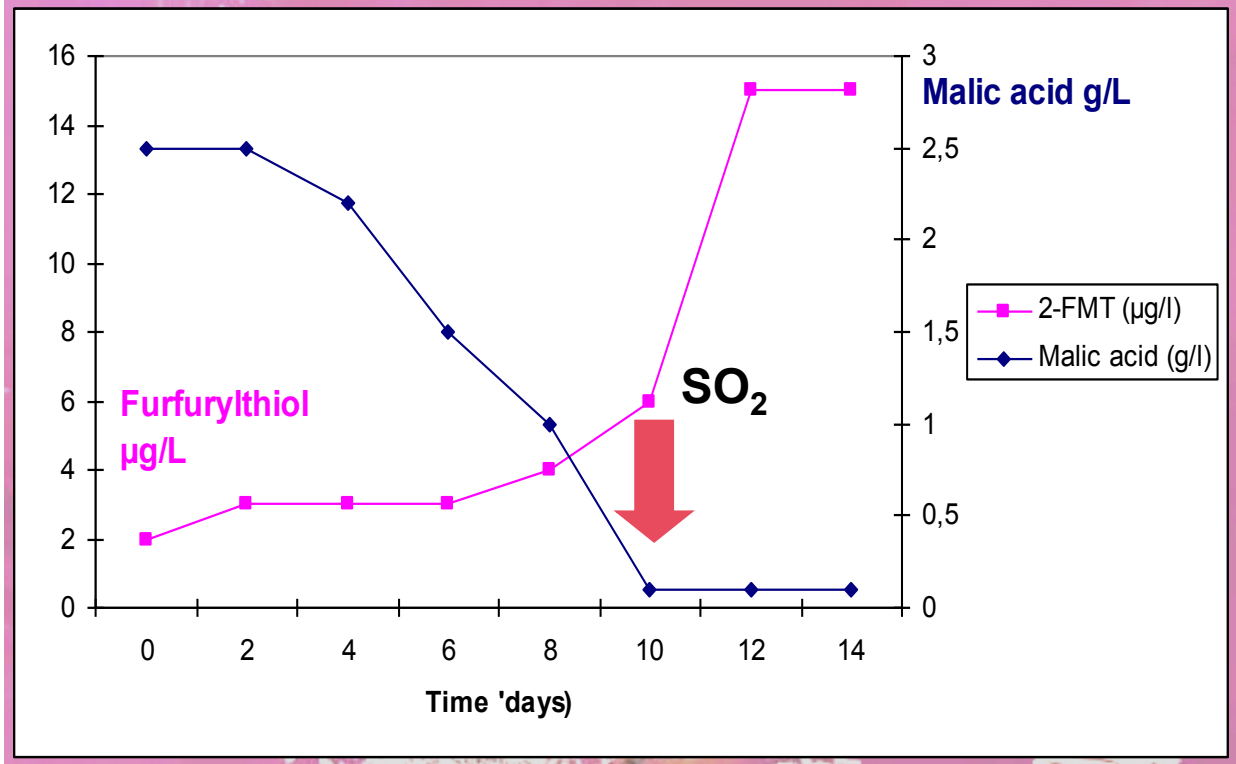
from Blanchard, 2001 and Tominaga et al., 2004

Relation between FFT in Wine and Furfural Released by the Toasted Oak



Furanic aldéhydes play the role of precursor. They change into FFT during primary and malolactic fermentation. (contact indispensable between Oak Wood and yeast)

Development of 2-FMT and "Toastiness" during Malo-Lactic Fermentation



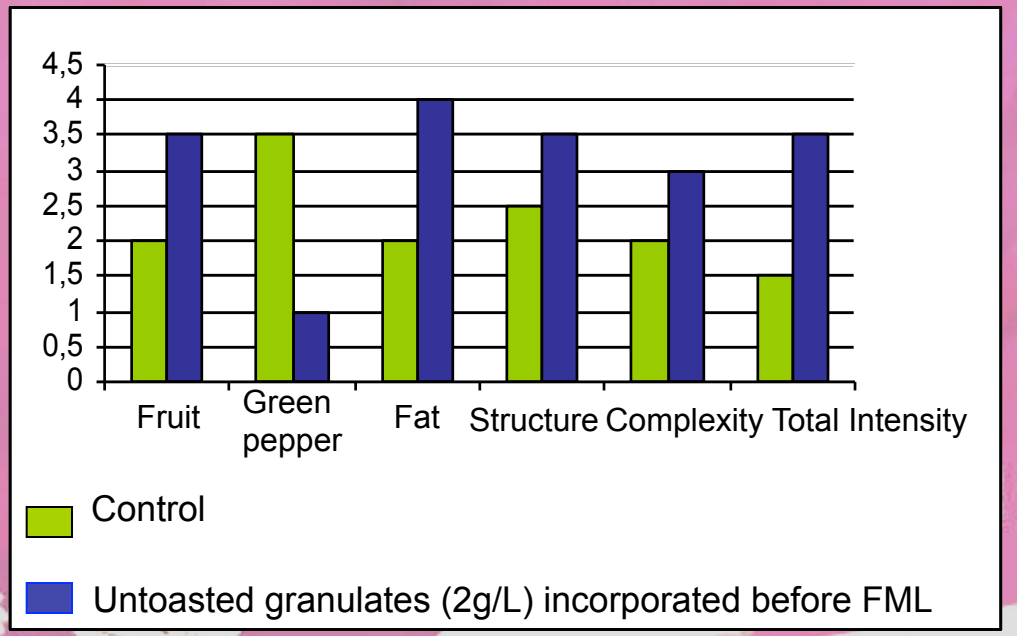
2-FMT doesn't develop during MLF even if Furfural is present <u>but increase highly immediately after the use of sulfur dioxide to eliminate the lactic acid bacteria</u>

from Tominaga et al., 2004

Effect on the vegetal character

- Hidden effect on the vegetal character, especially the green pepper taste, due to the méthoxypyrazines.

Cabernet Sauvignon 2007



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Part II : Which solution for which wine?

1. The case of the white wine
   - The use of oak alternatives
   - AF in barrel
2. The case of the red wine
   - The use of oak alternatives
   - AF in barrel
   - AF in oak tank

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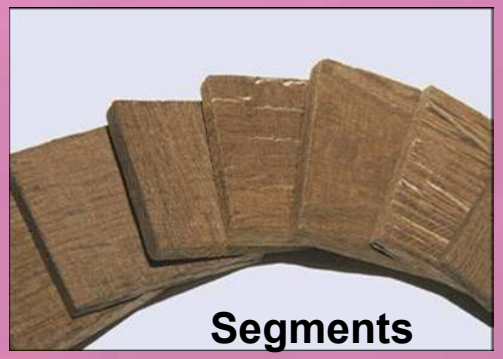
White wine and oak alternatives

Powder

Granulates

Chips



Segments

Staves

Sticks

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White wine and oak alternatives

1. For white wines which are not very stable with possible herbal character

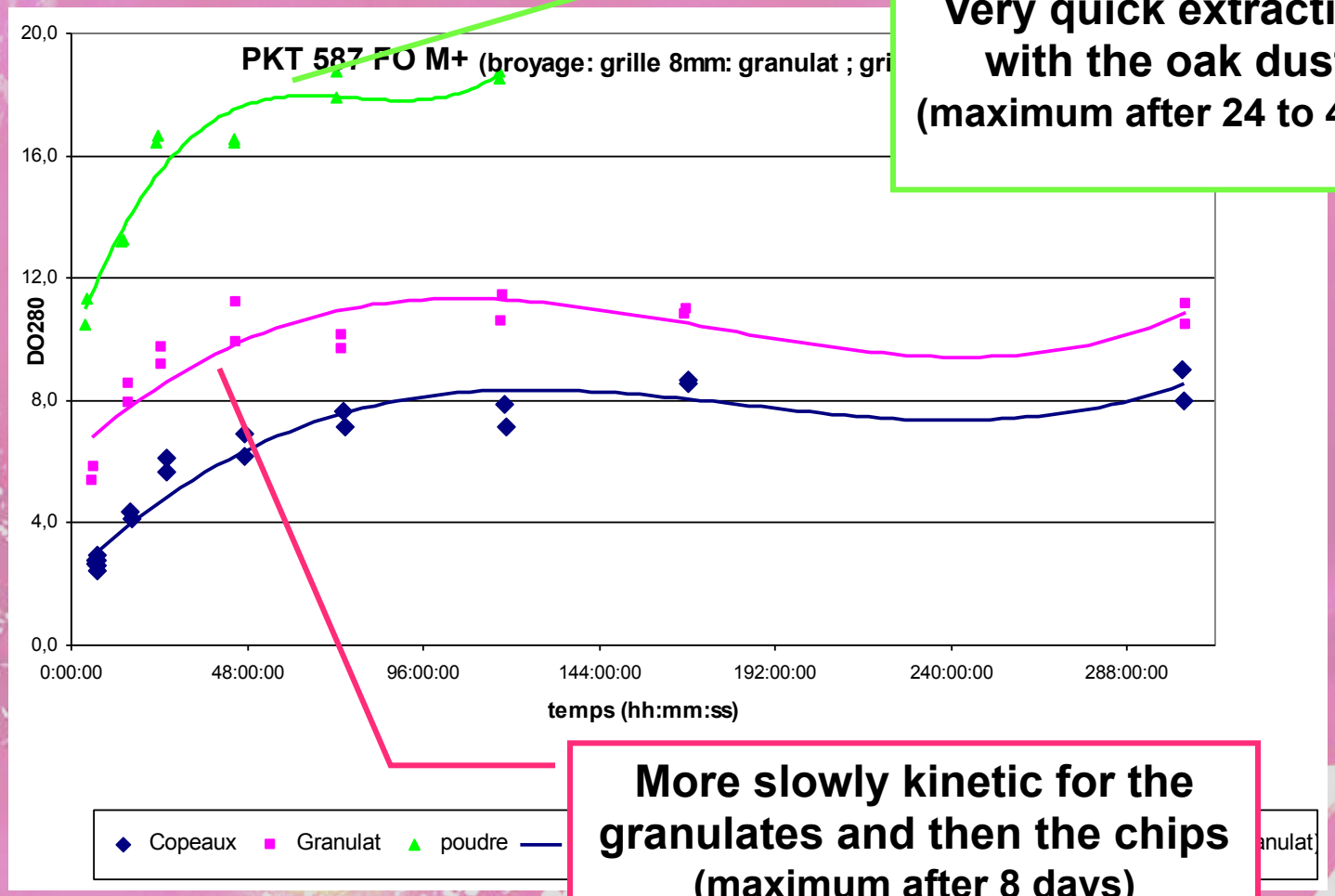
- WHY?
  - Antioxydant effect
  - Hidden effect on bad taste
  - Less vegetal character
  - Better structure in mouth

- WHAT?

- French oak Powder for altered grapes
  Untoasted or light toasted
  When? ASAP

- French oak Granulates/ Chips
  Untoasted or light toasted ,
  When? After settlement, when the fermentation is just beginning

Dust, Granulates vs Chips ? Very different kinetics of extraction



Very quick extraction with the oak dust (maximum after 24 to 48 h)

More slowly kinetic for the granulates and then the chips (maximum after 8 days)

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White wine and oak alternatives

2. For rapid or average turnover.

- WHY?
  - Antioxydant effect
  - Aromatic effect
  - Add sweetness
  - Better structure in mouth

- WHAT?

- French or/and American oak
- Granulates/Chips Light, Medium or Medium plus toasted ,
  When? After settlement, when the fermentation is just beginning

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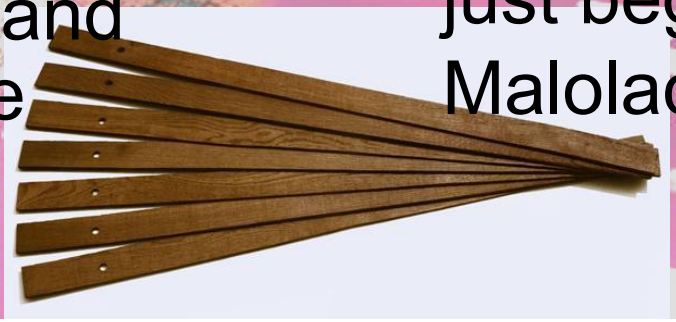
White wine and oak alternatives

3. For more complex wine

- WHY?
  - Aromatic complexity
  - Add sweetness
  - Prepare the wines for aging by giving them more structure, clarity and volume

- WHAT?
  - French or/and American oak
  - Segments or staves Light, Medium or Medium plus toasted ,
    When? After settlement, when the fermentation is just beginning or during Malolactic fermentation.



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White wine and oak alternatives

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- It's necessary to introduce oak as soon as possible to obtain the best result (more harmony between the oak and the wine).
- The oak allows to have no risk of reduction neither oxidation
- More fat and full taste, more complexity
- The powder is particulary efficient for altered grapes with botrytis because of its kinetic of extraction.

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AF of white wine in barrel

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- For better quality wines (fine, fat, complex)
- Different volume available for more or less oak wood taste (from 225L to 600L)
- Necessary to work with total lees
- Keep the barrel in a air-conditionned room
- No risk of reduced character
- Natural sedimentation of the lees at the end of the maturation
- More proteic stabilisation
- Particulary adapted for Chardonnay.

Be carefull with Sauvignon Blanc (because of the reactivity of 3-Mercaptohexanol with the ellagic tannins. Actually uncontrolled oxidation in presence of Ellagic Tannins will produce a strong decrease of the varietal “fruity” character).

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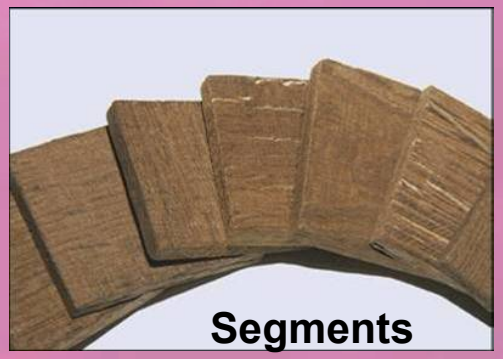
Red wine and oak alternatives

Powder

Granulates

Chips



Segments

Staves

Sticks

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Red wine and oak alternatives

1. For red wines which are not very stable with possible herbal character

- WHY?
  - Antioxydant effect
  - Hidden effect on bad taste
  - Less vegetal character
  - Better structure in mouth

- WHAT?

- French oak Powder for altered grapes
  Untoasted or light toasted
  When? ASAP

- French oak Granulates/ Chips
  Untoasted or light toasted ,
  When? In the hopper, in vat before fermentation begins

Red wine and oak alternatives

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2. For rapid turnover red wines

- WHY?
  - Antioxydant effect
  - Help to set the color
  - Favor and preserve the expression of the fruit
  - Add sweetness
  - Prepare the wines for aging by giving them more structure, clarity and volume

- WHAT?

- French oak
  Granulates or Chips
  Untoasted or light toasted
  When? In the hopper, in vat before fermentation begins

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Red wine and oak alternatives

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3. For average turnover red wines

- WHY?
  - Help maintain the color
  - Favor and preserve the expression of the fruit
  - Add sweetness
  - Prepare the wines for aging by giving them more structure, clarity and volume
  - Develop an oak character

- WHAT?

- French or american oak Granulates or Chips Untoasted, Light, medium, medium plus toasted.
When?In the Hopper or in vat before fermentation begins During malolactic fermentation

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Red wine and oak alternatives

4. For a well integrated oak character

- WHY?
  - Aromatic complexity
  - Develop an oak character
  - Add sweetness and fat
  - Prepare the wines for aging by giving them more structure, clarity and volume

- WHAT?

- French or/and american oak Segment or staves Light, medium, medium plus toasted.
When? During malolactic fermentation

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Red wine and oak alternatives

- Fully oenological product : Improve the sensory profile without giving an oak character

- Development of a well integrated oak character

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Use of untoasted oak

- **The use of strictly untoasted oak is risky** because the possibility of bad taste (bitterness) and aroma (sawdust aroma, green wood/sap character, dustiness) coming from the wood or the condition of storage (mold development with mustiness) in case of high humidity levels.
- A sufficient drying is necessary (< 7 % relative humidity) with a thermal disinfection (heating > 105°C) with an analytical control of the absence of contaminants as haloanisoles (absence ofTCA, TeCA and TBA…) !

Red wine and oak alternatives

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- Be carrefull, use only « qualitative » untoasted oak (dry oak, and controlled without contaminants)
- French oak is particularly efficient for fermentation (more ellagic tannins)
- Use toasted Chips or Staves during malo-lactic fermentation with an extended biomass contact and a controlled oxygenation for a quick and early stabilization of the color, sulfur dioxide stabilization on the wood to develop eventually more « **toastiness ».**
- It's absolutely necessary to work before adding sulfits at the end of FML.

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AF of Red Wine in oak barrel

- Different volume available for more or less oak wood taste (from 225L to 600L)
- Only for very qualitative grapes because of a full extraction of all grapes components (skin and seeds ripe)
- A better integration of the wood aromas and polyphenols (fine and harmonious wine)
- Particularly adapted for microselection (garage wine) (not for large volume)
- After running off, re-use of the barrel for malolactic fermentation and maturation.
- Lot of manual-work and high cost:
  - remove and reinstall heads
  - Punching of the cap by hand
  - Essential to have a good hygiene after fermentation
  - Take a lot of space

AF of Red Wine in oak fermenters

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AF of Red Wine in oak fermenters

- Different volume available (from 10 HL to 30 HL)
- Can be used as open top or closed fermenters
  - Open top : good when the year is very warm, with grapes of high potential alcohol, because there is more contact with air. Thus, the fermentation is more complete, and there is less risk of high temperature.
  - Closed fermenters : better if it's a cold year, no risk of oxidation.
- Good compromise between barrel and tank
  - Takes less place than barrel.
  - Allows also vinification with parcels selection.
  - Good ratio between the cap and the volume of juice.
  - Good ratio between the juice and the contact of the wood for a good release of ellagic tannins.
- Easy to use
  - Easy to rack off (it can be lifted and tipped with a fork lift just like a T-bin)
    - Easy to clean
    - Can be used for the maturation as « garde vin » . (adjustable volume wood tank))

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AF of Red Wine in oak tanks

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AF of Red Wine in oak tanks

- The shape of the wooden tank (conical) is well adapted for optimal extraction.
  - Pumping-over : the cap is destructured easily, more extraction and no preferential ways than in a conic, or up right tank.
  - Punching the cap : more extraction than pumping-over, because the cap is less compact, and the skin of the grapes are more destructured to release their contents. Particularly adapted for ripe grapes or for grape variety as Pinot Noir which are not rich.

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AF of Red Wine in oak tanks

- The wooden tanks are more insulated than the stainless steel tank : less use of energy (thermic inertia)
- Good ratio between the volume of juice and the contact with the solid part. (never too high)
- Better preparation for the maturation in barrel thanks to the release of ellagic tannins (but less than with the other solutions.
- Necessity to have a good hygiene if the tank is stored empty between two vinifications.
- For the used wooden tank (more than 5 years), you can add untoasted oak chips during the fermentation to release ellagic tannins again.

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Conclusion

- Using oak solutions during fermentation allows your wine to have some benefits like for a real complete oenological product.

  (Improve the sensory profile without giving necessarily an oak character)
- Prepares the wine for aging
- Many solutions for different wines and objectives (from basic wines to great wines)

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Conclusion

- The Radoux cooperage has always been concerned by offering solutions to improve the quality of the wine.

  That's why Radoux has developed **Radoux OakScan™**, a system for rapid analysis, stave by stave, based on Near Infrared Spectrometry.
- This unique process helps to analyze accurately the ellagic tanins which are in the oak. As we have just seen before, the tannins have an essential impact on the organoleptic properties of wines or spirits.
- Thanks to this new process, oenologists will be able, with our help, to pilot the tannic contribution of each barrel with great accuracy, and to better associate their barrels according to their oenological objectives.
- This will help greatly limit all the variabilities relating to the structural potential and to obtain a **reproducibility** year after year.
- Today, **Radoux OakScan™** is used only for the production of barrels, but in the future, Radoux will apply this process to all the production of oak solutions.

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Conclusion

Thank you for your attention.

Is there any questions?

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