

Functions and benefits of OAK BARRELS for fermentation/élevage

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What is an oak barrel for? The French word "élevage," which means bringing up, can give us a clue. It is to achieve the potential of a wine through maturation and to enrich it with new characteristics that come from oak. This involves a long process that is respectful of the nature of the wine.

Barrels can be used for alcoholic and malolactic fermentation prior to élevage, but it is quite unusual to use barrels for fermentation only and not for élevage afterwards. Indeed, most often barrels are used mainly for élevage. What occurs during élevage?

What are the functions of barrels and what benefits can we expect from them?

Barrels serve to:

- Enrich the wine with new compounds,
- Play a role as an interface between the wine and the environment, and
- Allow specific physical reactions to occur.

FIRST FUNCTION — Enriching the wine with new compounds

Which compounds are released into a wine and how do they improve a wine? To answer these

questions we need to look more closely at the raw oak and its chemical composition.

a. Raw oak composition

Different polymers are clearly identified in oak.

Figure II shows the chemical structure of these different compounds.

Two sugar polymers are present. Cellulose represents 40% of oak's chemical composition and contributes to its strength, and hemicellulose represents 25%. Both of these sugar polymers provide support. There is also a phenol polymer called lignin, which represents 25% of the oak and helps to add structure to the oak. These polymers will not be released

in the wine but they will be transformed during the barrel making processes.

Some extractable components are also present, that are releasable. About 10% of the oak components are phenolic compounds (tannins, phenols, coumarins — bitter phenols, etc.). Between 1 to 5% are represented by other components such as minerals, terpenes, and aromatic compounds.

The geographical origins of the oak, the forest where it comes from, and the type of grain will influence the chemical composition of the wood.

b. Compounds released from oak into the wine

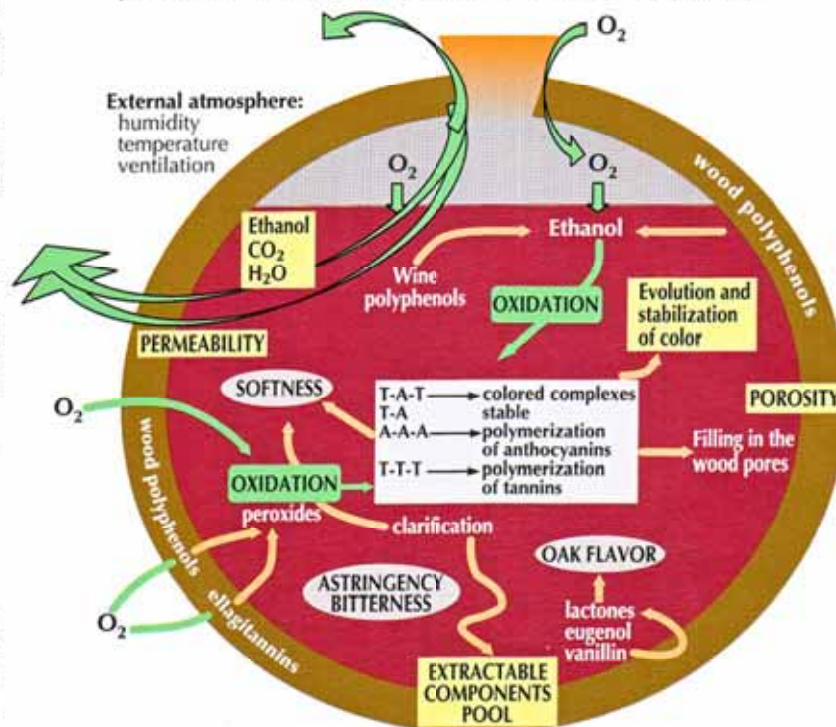
There are two main categories:

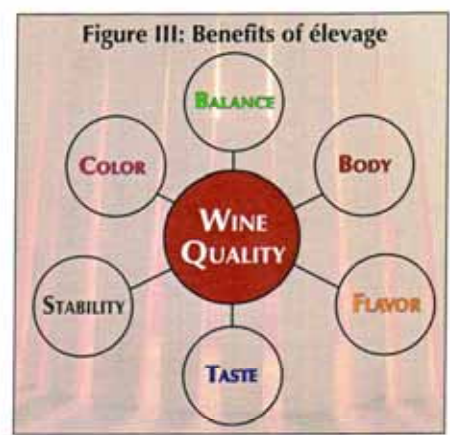
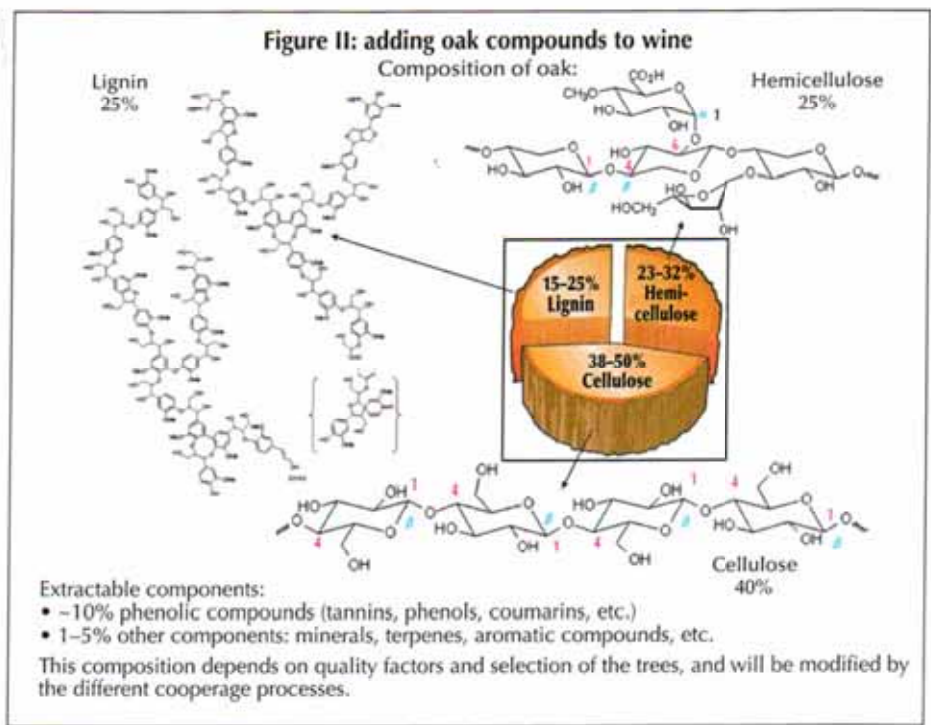
Aromatic compounds such as lactones, eugenol, and vanillin that will contribute to the flavor of the wine. Wood polyphenols and ellagitannins will contribute to the structure and taste of the wine.

First, in terms of flavor, different aromas are identified:

- Furfural (almonds and smoke),
- Methylactalactone (coconut),
- Eugenol, isoeugenol (cloves and spices),
- Vanillin (vanilla),
- Maltol, cyclotene (caramel and toffee), and
- Guaiacol (smoky notes).

Figure I: Reactions and exchanges with the barrel as membrane.





The *bouquet* of a wine aged in barrels is therefore richer and more complex than that of unoaked wine.

Second, some compounds influence barrel taste and mouthfeel. Tannins from winegrapes represent between 2 and 4 g/L. But oak tannins extracted by ageing in a barrel can be up to 0.2 g/L. These oak tannins have strong

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antioxidant properties. They make the wine more tannic (enriching its structure) and they also make it tastier.

At the same time, other components add some sweetness to the wine.

The cooperage processes, such as the seasoning of staves and the different barrel-making steps including toasting, will change the oak composition and in particular the nature and the concentrations of the above-mentioned compounds.

SECOND FUNCTION —

The barrel is a membrane between wine and cellar environment.

When we discuss the environment of a barrel, we refer to the cellar's humidity, average temperature, and ventilation.

a. Oxygen

Oxygen in the atmosphere will interact with wine in a barrel. The permeability and porosity of the barrel allow for several interactions:

- Oxygen can enter the barrel between the bung and the staves and then dissolves in the wine.
- Oxygen can travel through the wood of the barrel.
- Oxygen can enter between the staves into the wine.

Different steps in the winemaking process also allow oxygenation to occur. The following statistics are what we found in different sources in the technical literature.

- During each racking, 6 mg/L of oxygen dissolves into the wine,
- Each topping up of a barrel adds around 4 mg /L to the wine, and
- Maturation itself — the transfer of oxygen when the wine remains in the cask — can represent 35 mg/L.

In summary, a large amount of oxygen is brought to a wine during *élevage* in barrels, through the barrels themselves and during different steps of *élevage* (racking and topping up).

b. Reactions allowed by this interaction with oxygen

Barrels in the cellar are interacting with the environment. Oxygen crosses the limits of the barrel through different pathways, and is diluted into the wine. Oxygen allows ethanal to be produced in the wine. Both oak and wine polyphenols

can interact with ethanal and generate different combinations: between tannins, between anthocyanins, and between tannins and anthocyanins together.

The consequences of these chemical reactions are the following:

- The color of the wine is stabilized and its intensity increases,
- There is a decrease in the bitterness and astringency of the wine, and
- Tannins are transformed to give the wine its softness.

c. Other exchanges through the membrane

One must consider porosity to gas and permeability to liquid and gas. If it works one way for oxygen (from outside to inside the barrel), it can work the other way for components such as ethanol, water, and gas as carbon dioxide. Although there is an apparent loss, the wine becomes more concentrated — this phenomenon is called the angels' share.

THIRD FUNCTION —

Physical properties of oak allow certain reactions to occur.

Barrels are good in that they stabilize and protect the wine in them. Indeed, oak vessels limit variations in temperature as their temperature conductivity is more than 100 times less than stainless steel.

What is more, because barrels are small vessels, they allow certain colloidal reactions to occur. Among these reactions, the precipitation of unstable compounds allows the clarification of the wine. It is also possible to do the ageing on lees — known as reductive ageing — which gives the wine some body and sweetness.

Conclusion

To sum up, here are the main benefits of ageing (*élevage* of) wine in a barrel:

- Improves the wine's stability,
- Deepens the color of the wine,
- Gives the wine more balance,
- Contributes to the taste of the wine,
- Helps the body become fatter, and
- Adds to the flavor of the wine.

All these different parameters determine a great part of wine quality, making barrels a crucial tool for winemaking and contributing to wine style. ■