Oak Information Paper

A MoreManual!™ By Shea A.J. Comfort
www.MoreWine.com
1-800-823-0010

Toasted oak has been an integral part of winemaking for centuries, and for good reason. Its unique combination of structuring tannins along with the sweet toasty vanilla, butterscotch, floral, smoke, and spice elements perfectly compliment the berry-like fruitiness of the fermented grape. Oak and wine support each other in a way that truly brings out the best that both can offer. As winemakers, the more we can learn about using oak the better we become at crafting our wines. This is because just as with any good chef, the ability to create a work of art is based on how well we have understood the individual components that went into to making it. So let's first take a closer look at the complexities of the wood itself, and then we can focus on its use during winemaking.

All About Oak

American oak (*Quercus alba*) has about 21% non-tannic phenolic content while its French (and Hungarian) counterpart (*Quercus robur*), contains around 14%. However, French (and Hungarian to a lesser content) has 2.5 times the extraction of total phenolics than does the American oak. In everyday English, this means that American Oak will be much more perfumed, but French and Hungarian will generally have better inherent structuring abilities. Other than these basic differences, the two different species generally react in the same way to toasting (more on this later).

The way in which the raw wood is processed has a major affect on the final flavor and aroma profile of the oak, regardless of species variation. When oak for winemaking is cut, it has to undergo a period of drying and conditioning before it can be used, and this is referred to as *seasoning*. This period usually lasts between 2 to 3 years and basically involves stacking the staves in the open air and letting the elements (rain and sun) work its magic on the oak. The stacks are usually stacked and re-stacked throughout this period so that the staves on the top one year are at the bottom during the next year, and so on. This is done to in order to better equalize the seasoning differences that exist between the top of the stack (more exposure to sun and air) and the bottom (more moisture and less light). All throughout the seasoning period, basically what is going on is that various fungal micro flora attack and colonize the wood. As they do so, they release a series of enzymes that are responsible for the following desired reactions: the wood extract becomes lighter in color and less astringent, the harsher and bitter elements of the wood are greatly reduced, and various positive aromatic compounds are boosted; including vanilla, clove, and especially coconut. Besides being interesting on its own, what is even more fascinating about all of this is that it turns out that the amount and ratio of these compounds that are transformed in the wood turns out to be site-specific. In fact, experiments done at the Bouchard cooperage in France with the same wood that was seasoned in two different regions and then brought together and identically coopered to the same toast level in the same facility produced two different sets of flavors and aromas! This was directly attributed to the differences in the seasoning conditions of the two woods. Therefore, in addition to species differences, it is important to keep in mind that the way in which a wood is seasoned also will affect the final qualities of the oak once it is toasted.

As for the toasting itself, it should be noted that the duration and the intensity of the heat during the coopering and toasting process has a tremendous effect on the amount of individual compounds that are produced in a barrel, even from the same woods which have received the same seasoning. However, there are in fact some basic generalities for how some of the various compounds in oak will behave when they are toasted. Understanding these can only help when trying to decide which level of toasting will be more apt to give the desired character to a particular wine:

Oak Compounds:

Hemicellulose: A class of compounds comprised of several simple sugars that when toasted give caramelized products which have a sweet, toasty quality and which help to contribute to the "body" of a wine. The more intense the heat, the "darker" the caramel flavors become.

- *Furfural* is "sweet" and "caramel-like",
- *5-methyl-furfural* is more of a "butterscotch" type of flavor.

Lignin: is made up of two building blocks: *Guaiacyl* and *Syringyl*. Sweet vanilla increases up to a medium plus toast, but then it starts to decrease as the heat is raised towards a more heavy toast or a char. Interestingly enough, with the higher heat also comes the appearance of more smoke and spice (clove) notes.

- *Vanillin* is vanilla,
- *Guaiacol* is "smoky",
- *4-methyl-guaiacol* is "spicy" & "smoky",
- *Eugenol* is "clove-like".

Lipids: are made up of the oils, fats, and waxes found in the wood and are responsible for the oak lactones. Seasoning greatly increases the level of lipids in the wood. With toasting levels up to medium/medium plus, the level of oak lactones

increases, however it breaks down and decreases after that as the heat is raised further.

- *Cis-oak lactone* is "woody" and "fresh oak" like,
- *Trans-oak lactone* is "coconut-like"

Summing-up, some applicable generalizations of toast levels on oak:

- The lower the toast, the more tannins ("structure") and lactones ("wood-like" and "coconut") will be present in each of the oaks.
- The higher the toast, the more spice and smoke notes will be present
- The deeper the toast, the more deep the caramel tones will be (moving into butterscotch at medium plus).
- Vanilla will increase up through a medium-plus toast and then decrease with a heavy toast and char.
- American oak will be more aromatic, but French oak will give more structure (Hungarian will give less than the French but more than the American).
- The greater the toast level, the lower the lactones ("wood" and "coconut") for all three woods.

Medium plus is the most complex of all of the toast levels, and the most popular. Depending on the wine being made, this may or may not be a good thing!

A comparison of French, Hungarian, and American Oaks

The following are results from research done at Stavin and should only be used to give an approximation of what each of these three varieties of oak can bring to your wine. Each sample was made using oak cubes with a two-month contact time and evaluated with no bottle ageing. ***Note:*** *Due to the complexities of flavor chemistry these findings may or may not translate to your wine 100%. However, this information should be helpful in finding out which type of oak may the best to start with as you refine your oaking tastes.*

French Oak Flavor Summary

- All toast levels have a perceived aromatic sweetness and full mouthfeel.
- French oak has a fruity, cinnamon/allspice character, along with custard/ crème brûlée, milk chocolate and campfire/ roasted coffee notes*. *(*Especially at higher toast levels.)*
- As the toast levels increased the fruity descriptor for the wine changed from fresh to jammy to cooked fruit/raisin in character.

American Oak Flavor Summary

- The American oak had aromatic sweetness and a campfire/ roasted coffee attribute present in all three toast levels, with Medium Plus and Heavy toast having the highest intensity.
- American oak had cooked fruit more than a fresh or jammy quality.
- American Oak imparted mouthfeel/fullness, especially in Medium Plus.

Hungarian Oak Flavor Summary

- The Hungarian oak at Medium toast displayed a high perceived-vanillin content, with roasted coffee, bittersweet chocolate and black pepper characters.
- Medium Plus and Heavy toast imparted mouthfeel fullness, with only a slight amount of campfire/roasted coffee. Heavy also had pronounced vanillin. At all toast levels, there were unique attributes such as leather and black pepper, not observed in other oak origins.

Oak in winemaking: barrels and their alternatives

Barrels:

Up until about twenty or so years ago, when we spoke of oak in winemaking it was understood that we were talking about barrels. Barrels have been in use throughout the ages and have many positive characteristics. They contribute the tannins and flavor compounds we are looking for in our wines, and they have the ability to positively structure our wines by micro-oxidative processes due to the limited porosity of the wood itself. The ideal ratio of wine volume to wood surface area is found in a 60 gallon barrel, and final wine quantities larger than this are often the result of blending a series of these 60 gallon vessels together. Since every barrel is slightly different in its make-up of flavors and aromas, by blending together a larger lot of wine that was aged in several different types of barrels, we can create a greater complexity in the wine than would have been the result of only using a single wood source.

However, there are also some negative qualities to barrels as well. First, they are expensive, and as the majority of their extractable compounds are usually spent within four years they can represent a constant high dollar investment. Second, they require a high degree of maintenance, and being porous they are almost impossible to keep sanitary in cases of microbial spoilage. Still, due to its micro-oxidative capabilities, a barrel will be able to structure a wine better than any inert glass or stainless vessel would ever be able to do on its own.

For complete information on using barrels, see MoreWine!'s Oak Barrel Care Guide.

Beans/Cubes and Stave Segments:

While a barrel is best at structuring a wine, its ability to add tannins along with complementary flavors and aromas is no longer unique. Thanks to companies like Stavin, modern winemaking now includes alternative forms of oak available as chips, beans/cubes, and staves. Used by many of California's finest wineries, these beans and staves are crafted from carefully selected tight-grain French, American and Hungarian oak that has been allowed to naturally season in the open air for

three years. The staves and beans are cut to a precise thickness that takes into account the exact dimensions that the wine will penetrate into the wood from all 6 sides over time, which maximizes the efficiency of the extraction process, meaning that you will get to use 100% of the oak flavors that you paid for. The beans are made from the same exact wood as the staves; the only difference is that they go through the additional step of being cubed. Once sized, both the cubes and staves are traditionally fire toasted using Stavin's proprietary methods. The result is an oak product with a gradation of toasting that gradually delivers a multitude of complex, positive oak flavor compounds into the wine throughout the entire aging process, just as the highest quality barrels would do, but without the cost or added work associated with a barrel itself.

Chips:

When comparing cubes and staves to chips, it is important to keep in mind the following: chips are often made from lower quality, un-seasoned wood and depending on the source this will most definitely come through in the finished wine with various degrees of harshness. That being said, there are exceptions and some sources do get their chips from actual cooperages - instead of a cabinet shop or furniture mill - and the flavors and aromas from these can be quite good. However, the reason why these should be viewed as a tool rather than a complete oaking solution is directly related to their thin shape and size. During toasting, due to their lack of mass chips react quite quickly to the heat and they all toast to a comparable level, leaving them monochromatic with no gradations of color or toast level. Since, when toasting oak, what you see is also what you taste, this lack of gradations unfortunately translates into a lack of complexity in the toasted chips final flavors and aromas. In addition to the toasting issues, the smaller size of the chips makes for a full release of all of their compounds in a very short period of time. This may be great for quickly getting toasted oak components into a fermentation, indeed this is probably the single best use for the chips. However when the ideal scenario is a slow and steady extraction rate over a period of several months to a year or so, unless winemakers are in need of a quick fix, they should probably forego the chips in favor of the cubes or staves.

Alternative Oak products and fermentation:

It is interesting to note that during a red wine fermentation, compounds derived from toasted oak are a highly effective, natural additive responsible for initiating the stabilization of color and cross-linking grape tannins to help build mid-palate structure, and for getting an early start to building complexity in the flavor and aromas of the young wine. These components can come from chips, cubes, segments or staves and all are effective. However, each will differ in their rate of extraction based on surface area and exposure to end grain (the end grain extracts at a quicker rate than the rest of the wood surface). The extraction rates for the different oaks can be broken down as follows, from quickest to slowest:

- **Chips** (around 7 days)
- **Cubes** (2 months minimum, up to 1 year of useful life)
- **Segments** (3 months minimum, 18 months of useful life)
- **Staves** (3 months minimum, useful life of 2 years)

So, with the exception of the chips, we can see that once the 2 to 4 weeks of a primary fermentation are over, each of the toasted oak products still have a significant amount of useful life left in them. Therefore, the winemaker has the choice to either continue to use the same oak in a subsequent alcoholic fermentation*, for instance if you have more grapes coming around the corner; or to just carry the oak through with the wine into the next tank in order to continue the extraction during the structuring and maturation periods.

> **When saving an oak product to add to an upcoming alcoholic fermentation, it is best to get the next ferment started as quickly as possible to avoid spoilage of the wine-soaked oak if it were to become exposed to oxygen.*

When using toasted oak to help structure a red wine fermentation, it is important to realize that in order to be effective, the oak really needs to be in constant contact with the liquid portion of the must. Therefore, the winemaker needs to make sure that the wood remains ***under*** the cap at all times. If loose wood is simply thrown into the must at the crush, until it becomes saturated with wine the oak will just float on the surface of the liquid and be carried up with the cap during the fermentation. The result is that the oak will become separated from the working wine and the desired components will not be transferred into the wine during this critical phase. However, it is equally important that the wood not get buried in the lees at the bottom of the vessel. This could be a factor if loose wood were being used to structure a second fermentation and it was already saturated enough to sink to the bottom of the fermenter - being buried in the lees will also effectively separate the oak from a working wine! So, with this in mind, it is recommended to use a food-grade nylon bag (usually for the beans and segments) and either weight it down or tie it off in the fermenter so that the wood remains under the cap. The nylon bag also makes transferring the oak into the next vessel post-press all that much easier.

> ***Note** that the ideal placement of the wood would be just under the cap since this is the zone most concentrated in the extraction of the compounds that need to be interacting with the oak.*

Stavin's Recommended Oak Dosage rate for Fermentation:

Per the research conducted at Stavin, the minimum amount of toasted oak needed to achieve cross-linking and structuring is: 4-8 lbs per ton (1 ton gives around 160 gallons or 606 liters of must when crushed).

Broken down, this works out to: .025 to .050 lb per gallon (.4 to .8 ounces per gallon), or (.1 to .2 grams per liter).

MoreWine! recommends using: 2 to 2.5 ounces of oak cubes per 5 gallons of liquid wine (not must). More can always be added later, if needed.

A final note on gaining complexity by blending

Wineries use American, French and increasingly, Hungarian oak at various ratios in their wines to garner the best qualities that the different woods have to offer. You can easily simulate this by either creating your own blend in a single addition or by using some of one type of oak in one addition, and some of another in a second one. ***Note*** *that if you happen to have more than one carboy/tank of the same type of wine, it is a great idea to take advantage of this and use a different type of wood or toast level in each of the different carboys/tanks. This way you have a real-world example of how these woods interact with your wine and you can better choose the combinations that will give you the qualities you are after when they are blended together.*