

# THE OXFORD COMPANION TO BEER, PART THREE

## AN EXCERPT ON BARREL AGING

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Last year, a new book on beer saw the light of day. In itself not really breaking news, but this particular book was *The Oxford Companion to Beer* – the most comprehensive book on all things beer related ever published. Garrett Oliver became the editor-in-chief with the main responsibility for the enormous task of compiling the material for the book. In the previous two issues of the SBR, we have featured Garrett’s account of the process of editing this book, and in this issue we finish the coverage of the first edition of the OCB by publishing – with the kind permission of Oxford University Press – an excerpt from the book on ‘Barrel Aging’. Hopefully, we hereby can convey to our readers the amazing wealth of beer and brewing knowledge that can be sourced from the OCB.

**Excerpt on barrel aging from *The Oxford Companion to Beer*, Oxford University Press, 2011:**

**barrel-aging.** For most of us, the sight of wooden barrels brings wine most readily to mind, but this would not always have been so. For centuries, in the days before the manufacture of metal containers became commonplace, the wooden barrel was among the standard containers for storing and shipping just about any liquid. Water, beer, wine, olive oil, rum, chili sauces, vats of fermented fish paste – all have been stored and traveled the world in wood. Originally there was no particular intention to have the wood impart its own flavor to the liquid it held; the barrel was simply the container at hand. “Sweetness,” or at least a lack of sour character, was the most that people expected from a barrel in terms of flavor.

Decades into the 20th century, most beer was delivered to the bars of the world in wooden barrels. These were heavy oak barrels built to withstand the pressure of the carbonation within. They were usually tapped very much as British casks are tapped today, by driving a heavy wooden or metal tap through a reinforced aperture with a thin spot in the center. See CASK. Some British breweries use such wooden casks to this day, though none for the majority of their production.

Many beer enthusiasts, having heard tales of India pale ale (IPA) traveling the seas for months in large wooden barrels, have supposed that wood flavors were common in these beers. In fact, at least from the early 1800s on, brewers worked hard to avoid wood flavors in beer, and contemporary writings give the impression that they were successful in this. New barrels, usually made of oak, were often filled with successive soakings of boiling water and hydrochloric acid to remove wood flavor. See OAK. Only once the barrel had been rendered neutral was it thought fit to hold beer. German and later American brewers lined their barrels with pitch, minimizing both wood flavor and leakage.

In time, stainless steel tanks, fermenting vessels and kegs have taken over a beer industry obsessed with sterility and concerned about costs and ease of use. Today, craft brewers, particularly in the United States, have once again brought wood into the brewery, but this time the purposes are entirely different. The barrel is no longer a mere container. The modern brewer ages beer in wood so that the wood will influence the flavor and aroma of the beer. Here we speak mostly of varieties of oak, though other woods are in use as well. Chestnut, ash, poplar, cedar, acacia, cypress, redwood, pine, and even eucalyptus have been used for barrels with varying success.

Oak, however, remains the wood of choice for most barrels. When heated and steamed, oak is easily bent into barrel staves, and the structure of the wood renders it watertight. The same qualities once prized for ships are still prized for barrels. Though there are surely variations upon these themes, the modern brewer has essentially four different but often interlocking qualities that he wants from barrel-aging.

### WOOD FLAVORS

Oak, even though watertight, is porous, and contains a complex array of flavors that can be extracted into beer. In the United States, where barrel-aging has recently become commonplace among craft brewers, the most common barrel in use is the bourbon barrel. By US law, whiskey designated as “straight bourbon” must be aged for a minimum of two years in *new* American white oak barrels. This means that a barrel can only be used once to age true bourbon whiskey, a fact that turns a used barrel into a surplus item for a bourbon distillery. American oak has powerful flavors, and these are accentuated by charring of the barrel interior before the barrel heads are affixed. Each distillery will use its own blend of oak and its own level of charring, leading to distinct differences in the sorts of flavors that brewers can derive from the used wood. Used bourbon barrels were once cheap and easily available, but those days are over. As of 2011, prices easily reached as high as \$200 per 200-liter barrel, and increased competition from other brewers and from whiskey producers in Scotland, India, and China seems likely to drive prices ever skyward.

Wine barrels are usually made from either French oak or American oak, though oak from parts of Eastern Europe is also in use. French oak is denser, more mildly flavored, and far more expensive than American oak, as its flavor contributions are felt to be more sophisticated and balanced. American oak is more powerfully flavored and therefore tends to be used more sparingly in wine production, where it can easily overwhelm the flavors of the wine itself. Below, the major wood flavors at work are addressed.

*Lactones*, lipids contained within the oak itself, make up a large part of the aroma we associate with oak. In lower concentrations, it strikes the nose as simply “oaky” and pleasantly herbaceous, but higher concentrations can become rose-like, with the highest concentrations giving powerful impressions of coconut. Open air seasoning of oak staves tends to decrease lactone content, but charring of oak can bring this character forward. As a result, both the seasoning of the wood and the char of the wood will affect its flavor. Balanced with →





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other flavors, lactone character can be highly pleasant, but in excess, many people will find it cloying.

*Phenolic aldehydes* are derived from lignins, complex polymers that make up part of the oak structure. Phenolic aldehydes, the most important of which is vanillin, are degradation products of lignin, and are formed under the influence of gentle heat or mild acid. Vanillin, of course, gives a vanilla-like flavor, and is the main ingredient in artificial vanilla food flavorings. The mild heat applied in barrel toasting for wine barrels tends to promote the conversion of lignin compounds to vanillin. Charring, however, while leaving some vanillin intact, can break down lignin compounds to simpler steam volatile phenols, and these are responsible for smoky and medicinal flavors in the wood and any beers later aged in it. Other phenolic compounds include guaiacols (sweet spice, cinnamon) and eugenol (clove).

*Hemicelluloses* are part of the wood structure, polymers made up of several simple sugars. Upon heating, these compounds degrade into their constituent sugars, which then caramelize into furfurals, maltol, cyclotene, and other compounds that give flavors ranging from bitter almond to toasty, to sweet caramel and burnt sugar. Maltol, which has caramelized flavors reminiscent of freshly baked bread, is also a flavor enhancer and can increase the perception of maltiness in beer. Furfurals, when in contact with active yeasts, can transform from a bitter

almond character to smoky, meaty, and leathery flavors that can be desirable in certain aged beers.

Oak tannins are hydrolysable substances that break down into other flavor-active compounds in the presence of beer. While tannins can lend astringency, they are broken down to a large extent by toasting of wine barrels and to a greater extent by bourbon barrel charring. Any previous resident of the barrels is likely to have extracted a large proportion of the tannins, and there is rarely enough left behind to trouble the brewer. Tannins are also powerful antioxidants and therefore provide something of a buffer to the inevitable oxygenation that occurs through porous woods.

#### PREVIOUS RESIDENTS

Concurrent with the flavor of the wood itself may be the flavor of whatever beverage the barrel held previously. While some brewers do buy new barrels, this is relatively rare; not only are they very expensive, but their flavors can be overwhelming. The spirits or wine a barrel previously held will have extracted a lot of this flavor, but also left much intact and possibly imparted its own flavors. Before whiskey is aged in barrels it is clear in color and referred to variously as “high wine,” “white dog,” “new make spirit,” or the somewhat pejorative “moonshine.” It is very strong, up to 160 proof, and can be packed with agricultural character, some of the flavors of the corn, wheat, rye, or barley that went into the original whiskey mash. Some brewers feel that they can detect the influence of the sour mash technique used for bourbons and some Tennessee whiskeys, though distillers insist that sour mashing is a mere pH adjustment technique used to aid fermentation. Alcohols, soaked up to an inch into the wood, may also be extracted into beer, bringing higher alcohol flavors and grappa-like notes.

Beers have also been aged in barrels that previously held Calvados or applejack, lending fresh apple and cider flavors to beer. Though most Scotch whisky barrels originated as bourbon barrels, the second use for the Scotch can bring powerful flavors of its own, especially if the whisky was made from heavily peated malts. British brewers, with these Scotch barrels readily at hand, are experimenting with these barrels and deriving a wonderful array of malt and peat flavors from them.

Especially in wine-rich California, previously used wine barrels bring a whole other range of flavors, both from the wine itself and from the microflora that fermented it. Red wine barrels can lend a pink tinge and notable berry flavors, while white wine barrels can show grape varietal characteristics, especially

from riesling, gewürztraminer, and other powerfully flavored grapes. Chardonnay barrels are more common in the U.S., and tend to be more variable, probably because the grape expresses itself so differently depending upon terroir and winemaking technique. At its best, chardonnay can impart flavors of tropical fruit, peaches, roses and other pleasant flavors into its barrels, and these flavors can transfer well to paler beer styles. In Italy, a great wine-producing country suddenly boasting more than three hundred craft breweries, barrel-aging is quickly becoming a natural part of the craft beer culture. Within a short period of time, we can expect to see more Italian beers aged in wine barrels, perhaps lending flavors from the famed Barolos of Piemonte and the esteemed traminers of the Alto Adige.

### OXYGEN

*Oxygenation*, whether desired or not, is an integral fact when aging a beverage in barrels. Oak is porous and oxygen slowly makes its way into beer through the wood. In wine, slow and

steady oxygenation is an important part of barrel maturation and produces, particularly in red wines, more agreeable flavors. Over the past 20 years, wine-makers have actually instituted a technique, dubbed micro-oxygenation, that mimics the effects of slow oxygen transfer through barrels. This has allowed tank-aging of cheaper wines, where the heavy cost of barrel-aging may not be justified.

Brewers are taught from their first days in the industry that oxygen is an enemy to be avoided at all costs. See OXIDATION and OXYGEN. Oxygen is largely unwelcome in the mash vessel and the kettle, and after oxygen is introduced during cast-out to help initiate yeast reproduction, it is afterwards anathema. But slow oxidation is a part of all aging of beer, whether in barrels, bottles, or kegs, and when properly controlled, it can impart pleasant flavors. Hop bitterness softens considerably over months, malt flavors can step further forward, and flavors can marry into complex sherry-like notes that seem more than the →





sum of their parts. Carefully managed, many beers will develop positive flavor characteristics rather than the musty, papery flavors we associate with more violent uncontrolled oxidation. Over-oxygenation, however, can allow the development of acetic flavors, as acetobacter bacteria thrive in aerobic environments. As with any form of aging, oxidation will occur more slowly at lower temperatures.

### **BIOLOGICAL DIVERSITY**

*Microflora* other than normal brewing yeasts are increasingly a friend to the craft brewer interested in the creation of a wider range of flavors than *Saccharomyces* yeasts can create. Barrel-aging is traditional for lambic beers and is almost always practiced in the creation of the new generation of sour beer styles. See LAMBIC and SOUR BEER. It has long been known that although many yeasts and bacteria find their way into lambic beer during the cooling process, many others will await the fermenting wort inside the receiving barrels. Lambic brewers sometimes scour their barrels between uses, but this does not eliminate wild residents under the surface of the barrel walls and between the staves. Wood not only harbors wild yeasts and bacterial strains, allowing their easy transfer from one batch of beer to the next, but they provide the slow oxygenation that is crucial for the development of such complexing agents as *Brettanomyces* yeasts. See BRETTANOMYCES. These microflora are often unwelcome in the brewery's main facility or in tanks where they could wreak havoc on more "normal" beers, and barrels provide a place for them to live, work, and grow without tying up tank space or acting as contaminants in other fermentations. Interestingly, research indicates that seasoning and toasting of oak can break down wood cellulose into cellobiose, which then provides additional nutrients for *Brettanomyces* yeasts.

### **RACKING AND STORAGE**

Most brewers rinse barrels when readying them for use. In the case of bourbon barrels, rinsing removes loose wood char, which the brewer does not want ending up in finished beer. Some soak barrels in very hot water, which may reduce any biological contamination, but also removes notable barrel flavor. Others trust to the bacteriostatic quality of the cask-strength bourbon that the barrel previously contained, and prefer to leave the barrel untouched. In all cases brewers will prefer to get barrels as soon as possible after they've been

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emptied. This not only lowers the risk of bacterial infection, but also the risk of leaks due to drying and shrinkage of the wood. Barrels are sometimes flushed with CO<sub>2</sub> before being filled, and then set on barrel racks if they are needed.

Temperature is a major determinant of the extent and quality of barrel flavors, especially in barrels that are seeing their first use after spirits or wine. At warmer temperatures, above 60°F (15.5°C), wood flavors and those of the previous barrel tenant will develop quickly in the beer, but those flavors can often be rough, coarse, or hot. If allowed to age out over time, they will diminish and can gain finesse. Warmer temperatures also speed evaporation of liquid through the wood, so there may be need to top up barrels more frequently. Finally, warmer temperatures encourage oxidation and the development of any yeasts or bacteria that may reside in the barrel, desired or unwelcome as they may be. Some brewers of sour beers will allow barrels to rise to ambient warehouse temperatures, even though these may reach well over 90°F.

Conversely, colder temperatures will slow developments and tends to allow greater mellowness. Brewers will each decide their own golden mean, depending on whether they are merely aging for wood character or trying to cultivate microflora. For the former purpose, most settle in the 50°F to 60°F (10°C–15.5°C) range when it is attainable.

Barrels are also often staging areas for various steepings and for aging on fruit. Everything from the traditional cherries used to make kriel, to other fruits, cacao nibs, and various other spices may be introduced into the barrel for aging along with the beer. Barrel-aging, a technique seemingly emerging out of the past, is in fact appearing in new forms every day, bringing new flavors to craft beers around the world. <sup>1</sup>

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