https://www.sworldjournal.com/index.php/swj/article/view/swj29-02-054
DOI: 10.30888/2663-5712.2025-29-02-054

WINE AGING AND THE SCIENCE OF BARRELS: A STUDY ON THE USE OF OREGON OAK AS AN ALTERNATIVE TO IMPORTED OAK IN AGING PORTLAND WINES AND ITS IMPACT ON FLAVOR DEVELOPMENT

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Abstract. *The article examines the use of Oregon oak as an alternative to imported oak in aging Portland wines and its impact on flavor development. The study aims to establish the relationship between the properties of Oregon oak wood and the quality and organoleptic characteristics of wines after aging. The research employed general scientific methods of cognition, including analysis, synthesis, comparison, observation, and experimentation. The findings reveal that innovations in the use of Oregon oak open new opportunities for winemakers seeking to diversify the impact of barrel aging on wine. Oregon oak offers significant advantages, such as availability and cost-effectiveness, making it a viable alternative to imported materials. Its affordability enables wineries to reduce costs while maintaining high product quality. Additionally, the use of local resources strengthens the regional economy, which is an important factor in the sustainable development of the wine industry. The study also found that Oregon oak imparts unique flavor characteristics to wine. Wines aged in barrels made from this material exhibit distinctive aromatic notes, including vanilla, spices, and caramel. This enriches the wine's organoleptic profile, adding complexity and depth of flavor. Such an approach allows winemakers to create unique products that cater to diverse consumer preferences. Furthermore, Oregon oak is considered an environmentally responsible alternative to traditional imported barrels, contributing to a reduced ecological footprint and supporting local resources. The integration of this material into winemaking not only diversifies production processes but also opens up prospects for innovative aging experiments, enabling the creation of wines with distinctive individual characteristics. The practical significance of the study lies in promoting the development of cost-effective and innovative approaches to barrel aging in winemaking.*

Keywords: *oregon oak, wine aging, organoleptic properties, sustainable development, winemaking.*

Introduction

Terroir is a French term that describes the influence of soil, climate, and storage environment on wine flavor, based on the theory that the land imparts a unique flavor profile to grapes, unattainable elsewhere. However, globally renowned wineries take the concept of terroir further, replicating flavor properties through storage conditions and the materials used. Scientific interest in alternative sources of wood for barrels arises not only from the potential to expand the range of flavor variations but also from the need to reduce reliance on imported resources. Identifying specific properties of Oregon oak, such as tannin content, aromatic components, and their stability during aging, opens new opportunities for winemakers in barrel selection.

In wine regions like France and Hungary, wines are aged in barrels made from

locally sourced wood. The question arises whether the same approach can be applied in Oregon, known for its winemaking and native tree species capable of imparting distinctive flavors to wine. This question is the focus of the present study.

Literature Review

The impact of using Oregon oak as an alternative to imported oak for aging Portland wines remains insufficiently studied. Despite limited scientific data, there is significant interest among international experts in the aging of wine and the role of different types of oak in shaping flavor profiles.

Key contributions to the study of oak's impact on wine flavor have been made by authors such as M. Eller, E. Luís Menezes de Almeida, L. Campos, and S. Montoya [3], who presented the current state of research on natural wines, including their aging in barrels made from various types of oak. Their work covers a wide range of issues, particularly the role of oak's chemical components in forming organoleptic properties. T. Yoncheva, N. Stoyanov, and D. Dimitrov [10] studied the influence of oak wood on the chemical and organoleptic profiles of white wines, focusing on flavor variations depending on oak type. In 1999, J. Mosedale, J.-L. Puech, and F. Feuillat [6] laid the groundwork for understanding the role of oak heartwood components in shaping wine aroma, and their research remains relevant due to its fundamental approach to studying the natural variability of wood. N. Lee [5] highlighted differences between French and American oak, emphasizing the advantages of each depending on the type of wine. Regional characteristics of oak have also received considerable attention. T. Belgard [1] described Oregon's unique terroir and its potential for winemaking, positioning Oregon oak as a promising material for wine aging. Similarly, D. Stewart [8] analyzed the use of American oak species other than Quercus Alba to create new flavor profiles.

Research in this field is further supplemented by contemporary publications on online platforms, such as Delfino Fine Wines [2], which highlight modern trends in oak selection for wine aging, and Travel Portland [9], which focuses on Oregon's winemaking traditions.

Despite the substantial body of literature on this topic, there is a lack of systematic material specifically addressing the use of Oregon oak, particularly regarding its long-

term effects on wine aging. To address this gap, various methods of scientific inquiry were applied to analyze, categorize, and systematize information for a deeper understanding of the research topic.

Purpose of the article

The goal of the study is to determine how variations in wood properties influence the quality and characteristics of wines after aging.

Research results

Winemaking in Oregon, particularly in Portland, is characterized by unique features shaped by the region's distinct microclimate and production strategies focused on quality and sustainability. Portland and its surrounding areas, including the Willamette Valley, offer ideal climatic conditions for grape cultivation, especially for Pinot Noir. The region is renowned for its cool maritime climate, which imparts elegance and complexity to its wines. Oregon winemakers emphasize a minimal-intervention approach to winemaking and the use of organic and biodynamic methods. This not only supports environmental sustainability but also enhances the production of wines that clearly express the local terroir.

Portland is also home to a growing number of urban wineries that produce wines from locally sourced grape varieties, some of which are even grown within the city itself. This enables residents and tourists to experience the authentic spirit of Oregon winemaking without needing to leave the city [7]. Given the diversity of wineries in Portland, Oregon, each has its unique specialization and approach to grape cultivation and wine production.

Urban wineries in Portland, collectively known as PDX Urban Wineries, provide a local winemaking experience, allowing residents and visitors to explore wine production without leaving the city limits. These wineries typically produce wines in small batches, often focusing on innovative production methods and unique grape varieties [9].

Market consolidation is evident through the creation of associations such as PDX Urban Wineries, which consists of 12 key members, including Division Winemaking Company and Seven Bridges Winery. These wineries host annual and quarterly events

such as the PDX Urban Wine Experience and "Wine Weekends," promoting local wines and stimulating wine tourism in the region [9].

Additionally, consumer engagement strategies, such as guided wine tasting tours, help reduce logistical barriers and offer convenience to visitors. These tours provide the opportunity to visit multiple wineries, sample a variety of wines, and learn about unique winemaking methods without the need for personal transportation, which is crucial for participants' safety [9].

Considering the diversity of producers and innovative approaches to wine production in Portland, it can be concluded that this market has demonstrated resilience and adaptability to growing consumer demands and market trends, ensuring its sustainable development and national recognition [9].

For an overall review of Portland's wineries, it is essential to take into account the various aspects of each location, including aging methods and the types of barrels used. Table 1 below presents information on the key features of some prominent Portland wineries, with a focus on their wine aging methods.

Table 1 – The most popular private wineries in Portland and their wine aging methods

Winery Name	Wine Specialization	Aging Methods	Barrel Types
Elk Cove Vineyards	Pinot Noir, Pinot Gris	Long-term aging	Oak barrels (French oak)
Fullerton Wines	Pinot Noir, Chardonnay	Aging on lees	Stainless steel, oak barrels
Hawks View Winery	Pinot Noir, Chardonnay	Short-term aging	Oak barrels (American oak)
Argyle Winery	Sparkling wines	Traditional method (Champagne method)	Oak barrels
Domaine Drouhin	Pinot Noir, Chardonnay	Aging with partial malolactic fermentation	Oak barrels (French oak)

Source: [7]

These aging methods and techniques influence the overall characteristics of wine, including its tannin structure, aroma, and aging potential. It is important to note that each winery in Portland strives to create a unique product that reflects the local terroir and the winemaker's personal philosophy.

In the winemaking process, oak barrels play a key role in shaping the flavor, texture, and complexity of the wine. The choice of oak type for aging significantly impacts the final product, imparting different aromas, flavors, and tannin levels. Each oak barrel uniquely influences the wine's characteristics. From the fine grain of French oak to the open-grain structure of American oak and the traditional use of Slavonian oak in large casks, every type of oak contributes to shaping the flavor and aroma of wines. The influence of different types of oak on wine characteristics is summarized in Table 2.

Table 2 – Influence of different types of oak on wine characteristics

Type of Oak	Origin	Influence
French oak	Limousin, Allier, Vosges	French oak, with its fine grain, provides controlled release of tannins, resulting in refined aromas of vanilla, almond, and spices. Soft tannins create a smooth texture, ideal for premium red wines by balancing woody and fruity notes without one overpowering the other.
American oak	Missouri, Minnesota	Due to its coarser grain, American oak releases compounds into wine more quickly, imparting intense aromas of vanilla, coconut, dill, and caramel. Stronger tannins give the wine body and richness, making it perfect for bold reds like Zinfandel or Syrah. Faster-growing trees and a less expensive production process make American barrels more affordable.
Slavonian oak	Italy, Croatia	Traditionally used in large casks known as "botti," Slavonian oak has a larger grain that allows for slow aroma release. This provides a delicate influence on the wine, allowing natural flavors and terroir characteristics to shine. This type of oak is ideal for aging traditional European wines, such as Barolo or Brunello di Montalcino, where purity and grape integrity must be preserved. Slavonian barrels are moderately priced, especially given their suitability for extended aging periods.

Source: compiled based on sources [2,4]

The differences between American and European oak barrels for winemaking lie in both production methods and their impact on wine characteristics. The main distinction is in cost and the influence on wine due to the different types of wood and processing techniques. French barrels are significantly more expensive than American ones due to differences in material usage, more complex manufacturing methods, and overall quality evaluation. The prices for American barrels start at approximately $400, while French barrels can cost $1,200 or more, depending on the oak source and

cooperage. This is because French barrels offer a more delicate interaction with wine and are considered superior for revealing the complexity and nuances of the grapes, while American barrels provide a bolder, faster impact on wine structure and flavor [5].

Given this price factor, it is important to understand the feasibility for Oregon winemakers to transition to domestic materials. To explore this, we turn to dendrology. In the United States, out of 58 native oak species, only 10 white oak species have been noted for use in barrel production. Although oak forests naturally occur in 47 of the 48 contiguous states, significant oak reserves are located in half of the U.S., east of the 97th meridian.

The most prominent species used in barrel production is undoubtedly Quercus alba. Other common oak species include Q. garryana, Q. bicolor, Q. muehlenbergii, Q. stellata, Q. macrocarpa, Q. lyrata, Q. prinus, and Q. virginiana. Among these, Q. macrocarpa is significantly more abundant than Q. garryana (or Oregon oak) [6].

The only oak that grows in Washington and northern Oregon is Quercus garryana, also known as Oregon oak or Garry oak. One of the first to use garryana for barrel production was Rick DeFerrari of Oregon Barrel Works in McMinnville. After learning the craft of barrel making in France, DeFerrari opened a cooperage to serve the West Coast wine industry, which required barrels. He quickly realized that Oregon oak has several quality advantages over other oak species [6].

Oregon oak (Quercus garryana) plays a significant role in winemaking due to its unique characteristics, which differ from the more traditionally used French and American oaks. This species of oak is characterized by dense and sturdy grain, which makes it comparable to French oak and sets it apart from the American white oak commonly used for bourbon aging. Proper preparation of Oregon oak can significantly impact winemaking, offering a more subtle influence on wine without overly dominant oak flavors. The process involves careful air-drying of the wood and low-temperature barrel toasting, which avoids deep charring that could adversely affect the wine's aromas.

A long air-drying process, which can last three years or more, is critical for

reducing the tannin content in the oak. This practice, adopted from French winemaking, allows the oak to achieve softness and complexity, minimizing potential bitterness and astringency in the finished wine.

The density of Oregon oak wood is accompanied by an intensity of flavor. This is a highly impactful oak, which, after air-drying for three to four years, slightly reduces its influence and imparts complex and multifaceted aromas to beverages: nutmeg, clove, and other signature notes that are difficult to compare but have earned a distinct nickname, "Kansas City barbecue," characterized by an intense molasses concentration with a hint of tomato-like spiciness.

According to the head distiller at Portland's Clear Creek Distillery, Oregon oak provides significant flavor saturation to spirits. The influence of this wood type on alcoholic beverages does not suppress but rather enhances the drink's characteristics, ensuring a balance between bold and aromatic components. The interaction of Oregon oak with McCarthy's peated malt creates a "beautiful harmony" in the glass, effectively blending heavy and powerful flavors, resulting in a complex and deep flavor profile. Such an approach to selecting wood for spirit aging is a critical aspect of production, as it allows for achieving the desired intensity and depth of flavor [1].

Quercus garryana oak is used not only in its pure form but also in combination with other barrel types to achieve the desired organoleptic characteristics of wine or whiskey. For example, using barrels previously filled with red wine or Pedro Ximénez (PX) sherry alongside Oregon oak barrels enhances the sweetness and depth of fruity notes in beverages. This strategy of using mixed barrels not only ensures the desired flavor profile but also creates the opportunity to completely replace expensive imported oak barrels.

Products made using this strategy, such as Garryana from Westland and McCarthy’s from Clear Creek, have achieved high ratings and international recognition, confirming their quality and competitiveness. For instance, the latest release of Garryana ranked third in Whisky Advocate’s Top 20 list for 2023, while McCarthy’s earned the highest-ever rating for an American single malt whiskey in the magazine’s history. These successes highlight the effectiveness of using Oregon oak

in combination with other barrel types, ensuring high product quality and independence from imports [8].

The approach to using new and old barrels holds strategic importance. Minimizing the use of new barrels to 5–15% ensures that oak influence does not overwhelm the sensory characteristics of the wine. This maintains a balance between new and used barrels, allowing wines to develop more subtle and complex profiles without excessive tannicity [1].

The textural differences observed with the use of Oregon oak emphasize the importance of the interaction between the wine and the barrel. The character of wine aged in Oregon oak barrels tends to focus more on the tip of the tongue, creating a sensation of freshness and tension, in contrast to the broader texture of wines aged in French oak barrels [1].

However, despite the strengths of using Oregon oak, there are also weaknesses and even disadvantages that winemakers need to consider. Unlike the forests of France, where tall, straight trees grow, oaks from the wild forests of Oregon often have "defects" that complicate barrel production. As a result, any knots and other irregularities are considered defective material, meaning the yield of usable staves from each tree is significantly lower than that of French or American oak.

Additionally, the leftover wood from processing Oregon oak poses further challenges. It is denser than French or American oak, which leads to greater wear and tear on woodworking equipment [8]. Most sawmills are set up to process other types of wood, making the production of high-quality barrels more difficult. At the same time, the lack of widespread experience in processing this specific type of oak on a large scale creates additional logistical and financial barriers.

Mastering the techniques of producing and using Oregon oak requires intensive collaboration between cooperages and winemakers to achieve the desired expression of wine and wood. This process not only demands great attention to detail in barrel crafting but also necessitates adapting winemaking practices to the unique characteristics of the wood.

Conclusions

Research and innovations in the use of Oregon oak open new horizons for winemakers seeking to expand the range of influences on wine. The use of Oregon oak in barrel production offers significant advantages, including availability and cost-effectiveness. Oregon oak is more affordable compared to imported oak, which can help reduce costs for wineries while maintaining high product quality. Its use strengthens the local economy by promoting the utilization of domestic resources, which is important for the sustainable development of the region's wine industry.

Oregon oak imparts unique flavor notes to the wine aged in it. Wines aged in barrels made from Oregon oak often exhibit distinctive aromas such as vanilla, spices, and additional caramel notes, enriching the overall aromatic profile of the wine. This not only enhances the wine's organoleptic properties but also enables winemakers to create products with greater complexity and depth of flavor.

Given the aforementioned aspects, Oregon oak can be considered a cost-effective and environmentally responsible alternative to traditional imported materials. The introduction of Oregon oak barrels not only diversifies wine production but also opens up opportunities for innovation in winemaking. Experimentation with different types of barrels, including those made from Oregon oak, can contribute to the creation of unique wines with distinctive characteristics that cater to diverse consumer tastes.

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