Weinakademiker Thesis D7 Abstract

Exploring the Effects of Underwater Aging on Sparkling, White, and Red Wines: A Comparative Study of Maturation and Quality

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This thesis was driven by both professional and personal interest. As a recreational diver and wine enthusiast, I am fascinated by how underwater environments, which are marked by low temperatures, reduced oxygen, constant pressure, and complete darkness, might influence the evolution of wine. With underwater cellars becoming more common, it is increasingly important to understand their impact on the aging process of sparkling, white, and red wines.

Underwater wine aging has emerged as an innovative alternative to traditional cellar maturation, attracting interest due to the unique environmental conditions it provides. This method leverages the natural characteristics of underwater settings, such as stable, cool temperatures, minimal oxygen exposure, gentle movement, increased pressure, and complete absence of light. These factors combine to influence the chemical composition, sensory profile, and overall aging trajectory of wines in ways that differ notably from conventional land-based aging.

While underwater aging is a relatively recent trend in modern winemaking, its origins are rooted in a historical curiosity: the discovery of shipwrecked wines and champagnes that had aged for decades, sometimes even centuries, at the bottom of the sea. One of the most famous examples occurred in 2010, when divers recovered bottles of 19th-century Champagne from a shipwreck in the Baltic Sea. Remarkably, many of these wines were not only drinkable but displayed impressive freshness and complexity. This sparked widespread fascination and prompted winemakers around the world to experiment with subaquatic cellaring. These discoveries served as a catalyst, suggesting that the underwater environment might offer protective and even enhancing effects on wine over time.

The stable, cool temperatures found underwater, typically ranging from 4 to 12°C depending on depth, slow down key chemical reactions such as oxidation and ester hydrolysis. This temperature stability preserves primary fruit aromas and acidity, promoting a gradual and controlled maturation process. Unlike traditional cellars, where temperature fluctuations may accelerate aging or spoilage, the underwater environment allows a steadier evolution of the wine's sensory qualities. Moreover, the reduced oxygen exposure underwater significantly slows oxidative processes, protecting phenolic compounds and helping wines retain freshness and complexity over extended periods. The surrounding water pressure further reduces oxygen ingress through closures, creating a highly reductive environment that favors delicate aromatic preservation.

Another distinct feature of underwater aging is the gentle, constant movement caused by ocean currents. This subtle agitation prevents sediment from settling heavily and can enhance the interaction between wine and lees, contributing positively to texture and mouthfeel. This dynamic environment is thought to influence gas dissolution in sparkling wines, potentially refining effervescence and mousse quality, while supporting more balanced aromatic development in still wines.

Pressure is another critical environmental factor. Increased hydrostatic pressure at various depths influences chemical reactions within the wine and affects gas retention, notably preserving dissolved carbon dioxide in sparkling wines. This retention enhances bubble structure and texture, distinguishing underwater-aged sparkling wines from those matured conventionally. However, pressure also necessitates careful consideration of bottle and closure materials, especially for still wines, to prevent damage and ensure optimal aging conditions.

In addition to these physical factors, underwater aging offers complete protection from light exposure, particularly UV rays known to accelerate oxidation and degrade aromatic compounds. The natural shielding provided by depth preserves wine freshness and prevents the development of light-struck off-flavors.

This thesis includes findings from a controlled underwater aging experiment comparing bottles aged in underwater conditions with those stored in traditional cellars. Analytical and sensory evaluations indicate that underwater-aged wines exhibit preserved freshness, enhanced aromatic complexity, and subtle tertiary characteristics distinct from their land-aged counterparts. The results also suggest improved retention of color vibrancy and refined texture, likely due to the combined effects of stable temperature, reduced oxygen, pressure, and gentle movement.

To deepen understanding, I conducted two expert interviews with winemakers and oenologists (Hervé Jestin from Leclerc Briant and Yiannis Paraskevopoulos from Gaia Wines) engaged in underwater aging projects. These interviews offered insights into both scientific perspectives and philosophical approaches to this emerging technique. Furthermore, a comparative tasting session was hosted, enabling sensory evaluation and direct comparison of underwater and traditionally aged wines, providing practical evidence of the unique aging influence of the underwater environment.

Overall, underwater wine aging presents a promising avenue for innovation in wine maturation. The interplay of environmental factors underwater contributes to a controlled, gradual evolution of wine, preserving freshness while fostering complexity and textural refinement. What began with the chance discovery of shipwrecked bottles has evolved into a deliberate and increasingly sophisticated winemaking approach. As this method continues to attract attention and experimentation, ongoing research will be essential to fully understand its long-term effects, best practices, and potential role in the future of the wine industry.