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HHP Revolutionizes Wine Production

High Hydrostatic Pressure Offers New Frontiers in Winemaking

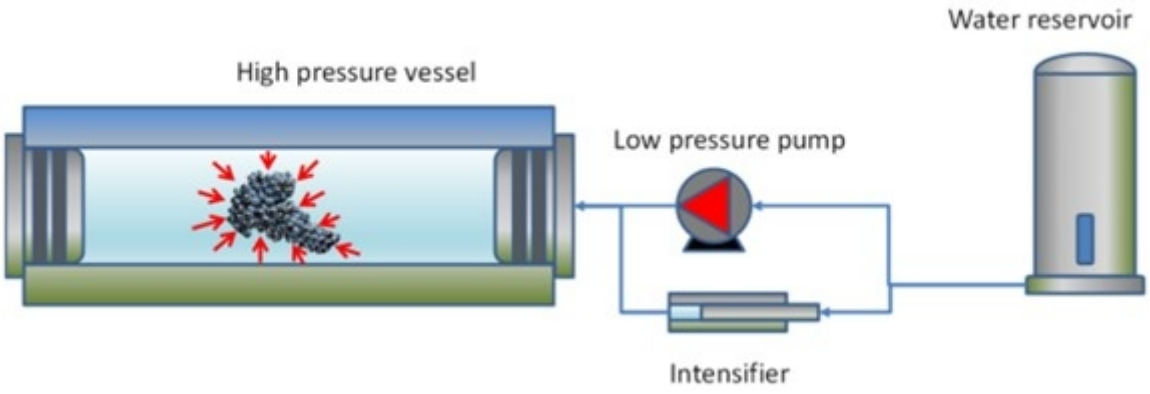
Wednesday, September 11, 2024



High Hydrostatic Pressure (HHP) is emerging as a significant technological advance in winemaking, offering the potential to accelerate grape maceration, facilitate the adoption of biotechnologies, and reduce the use of sulfur dioxide (SO2) in the winemaking process. Researchers from the Technical University of Madrid, in collaboration with the Institute of Food Science and Technology and Nutrition at the Spanish National Research Council (CSIC), have been studying the impact of HHP on

wine. Notable contributors to these studies include Antonio Morata, Iris Loira, and Carlos Escott, who have collectively published a range of research on the topic since 2015. The most recent findings from this team are presented in a 2023 paper published in the journal Antioxidants.

HHP was officially added to the catalog of winemaking practices by the International Organisation of Vine and Wine (OIV) in 2019, following a proposal led by Spain at that year's assembly in Geneva. This technique uses pressures as high as 600 MPa and offers the advantage of eliminating microorganisms without compromising the sensory quality of the wine. Unlike traditional thermal treatments, HHP does not significantly alter the chemical compounds responsible for a wine's taste and aroma. According to research published by Morata et al. in 2017 in Trends in Food Science & Technology, the process has minimal impact on key wine components such as aromas, pigments, tannins, and polysaccharides. This makes it a gentler method compared to heat-based alternatives, which are more likely to modify the delicate balance of a wine's flavor profile.



Accelerating Maceration and Enhancing Phenolic Extraction

One of the most promising applications of HHP is its ability to accelerate maceration, the process by which phenolic compounds like anthocyanins and tannins are extracted from grape skins into the juice. Phenolic compounds play a critical role in determining a wine's color, structure, and aging potential. Research conducted by Morata and his colleagues in 2015, and published in Food Bioprocess Technology, demonstrated that applying HHP at pressures between 400 and 600 MPa significantly accelerates this extraction process. Whereas traditional maceration can take several days, the use of

HHP reduces the time required to just 3 to 10 minutes.

This acceleration has significant implications for wineries, especially those looking to optimize production without compromising quality. HHP allows for faster production cycles and more efficient use of equipment, potentially reducing operational costs. Moreover, the technique enables a more controlled extraction of phenolic compounds, which could lead to more consistent wine profiles year after year. This is particularly valuable in an industry where fluctuations in climate and grape quality can result in varying wine characteristics.

Microbial Control and Reducing the Need for Sulfites

Another critical benefit of HHP is its ability to control microbial populations in the wine without relying on high levels of sulfur dioxide. Sulfites are commonly used in winemaking to inhibit microbial growth and preserve wine quality, but there is a growing consumer demand for wines with lower sulfite content. This is due to concerns about potential allergic reactions and a general preference for wines perceived as more "natural."

Studies such as those by Bañuelos et al. (2016) have shown that HHP is effective in inactivating yeasts and bacteria at pressures exceeding 400 MPa, without the need for SO2. This opens up new possibilities for winemakers to explore alternative biotechnologies, such as the use of non-Saccharomyces yeasts. These yeasts are known to enhance the sensory complexity of wines, contributing unique flavors and aromas. However, in conventional winemaking, they often struggle to compete with the dominant Saccharomyces cerevisiae strains. By reducing the initial microbial load through HHP, winemakers can create a more favorable environment for non-Saccharomyces yeasts to thrive, as highlighted in Morata et al.'s 2020 study published in Biomolecules.

Sterilization of Wine Before Bottling

Sterilization is another area where HHP has proven effective. Traditionally, wineries use techniques such as sterile filtration to remove spoilage organisms like Brettanomyces, which can produce undesirable flavors and aromas in wine. However, sterile filtration can also remove desirable volatile compounds, affecting the wine's overall sensory profile. In contrast, HHP offers a non-invasive alternative that can achieve microbial control without compromising the wine's aromatic and flavor components.

Morata et al.'s 2012 study provided compelling evidence that HHP can eliminate spoilage organisms while preserving the wine's sensory qualities. This makes it a highly attractive option for wineries aiming to produce wines with greater microbial stability, particularly in markets where consumers are demanding fewer chemical interventions and more naturally produced wines.

Future Potential and Industry Adoption

The adoption of HHP by the OIV marks an important step forward in the recognition of its potential to revolutionize winemaking. The technology is still relatively new, and while it has demonstrated clear benefits in terms of accelerating maceration, enhancing microbial control, and reducing sulfite use, further research is needed to explore its full range of applications. Additionally, the high initial investment required for HHP equipment may be a barrier for some smaller wineries, although the long-term benefits in terms of efficiency and product quality could offset these costs.

The research efforts led by Morata and his team, supported by funding from the Spanish Ministry of Science and Innovation through projects like ENOINNOVAPRESS and UHPH4wines, underscore the growing scientific and practical interest in HHP. As the wine industry continues to evolve, driven by both consumer preferences and the need for more sustainable production methods, innovations like HHP are likely to play an increasingly important role.

In conclusion, High Hydrostatic Pressure is a cutting-edge technology with the potential to transform winemaking practices. Its ability to preserve sensory qualities while offering faster production times and reducing reliance on sulfites makes it an exciting

development for producers and consumers alike. As more wineries begin to explore and adopt this technology, it may become a standard tool in the quest to balance tradition with innovation in the world of wine.