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Spanish Scientists Develop Grape Pomace-Based Agent to Clarify Red Wine Without Animal Products

New method uses white grape by-products to remove wine impurities, offering a sustainable and allergen-free solution for winemakers.

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Researchers in Spain have identified a new plant-based alternative to traditional wine fining agents, using cell wall material from white grape pomace. The study, published in the journal Foods and led by José Miguel Hernández-Hierro at the Universidad de Sevilla, focused on pomace from Zalema, Pedro Ximénez, and Moscatel grapes. These varieties are widely grown in Andalusia, where the research was conducted. The team aimed to find sustainable and allergen-free options for clarifying red wine, addressing concerns about animal-derived fining agents that can cause allergic reactions and are unsuitable for vegetarians and vegans.

The process of fining is essential in winemaking to remove compounds that affect clarity, stability, and taste. Traditionally, animal proteins such as gelatin, egg albumin, and caseinates have been used for this purpose. However, these substances present regulatory and health challenges. As a result, there is growing interest in plant-based alternatives that align with sustainability goals and circular economy principles.

The Spanish research group extracted cell wall material from white grape pomace—a by-product of winemaking that includes skins, seeds, and stems. This material is rich in structural polysaccharides like pectins, cellulose, hemicellulose, lignin, and arabinogalactans. Using advanced analytical techniques such as attenuated total reflectance Fourier-transform infrared (ATR-FTIR) spectroscopy and principal component analysis (PCA), the scientists characterized the chemical composition of the cell wall samples.

Key findings showed that low-esterified pectins within the cell wall matrix play a central role in interacting with wine phenolics—compounds responsible for astringency and bitterness—through hydrogen bonding and hydrophobic associations. The ATR-FTIR marker at 1746 cm^{-1} indicated that lower pectin esterification increases available carboxylate groups, which strengthens interactions with phenolic compounds and facilitates their precipitation out of the wine.

The PCA results demonstrated that the fining potential of these cell wall materials is determined more by their compositional and structural heterogeneity than by grape variety. Samples from Zalema, Pedro Ximénez, and Moscatel did not cluster according to varietal origin but rather showed variability based on their internal structure. This

suggests that the effectiveness of grape pomace as a fining agent depends on its specific chemical makeup rather than the type of grape used.

During laboratory trials, researchers added powdered cell wall material to red wine at a dose of 0.1 g/L. After six days at 25°C in darkness, they analyzed the sediments formed during clarification. Compared to control samples without fining agents, wines treated with grape pomace cell walls produced sediments enriched in phenolic compounds, carbohydrates, and proteins. Spectral analysis confirmed that these components were actively involved in forming insoluble aggregates that precipitated out of solution.

The mechanism behind this process involves non-covalent interactions—hydrogen bonds, ionic interactions, and hydrophobic associations—between functional groups on the cell wall (such as hydroxyl and carboxylate groups) and wine phenolics. Low-esterified pectins enhance this effect by providing more binding sites for phenolic compounds. The entire matrix of polysaccharides works together to form macromolecular aggregates that also incorporate unstable proteins from the wine.

Importantly, no single polymer fraction dominated the interaction; instead, it was the synergy among pectins, cellulose, hemicellulose, lignin, and arabinogalactans that underpinned the formation of insoluble complexes. This whole-matrix approach distinguishes grape pomace cell walls from other plant-based fining agents that rely on isolated proteins or polysaccharides.

The study’s results support the use of white grape pomace as an effective natural alternative to conventional fining agents. Its application could reduce reliance on animal-derived products while valorizing a major winery by-product. This aligns with European policies promoting waste reduction and resource efficiency in agriculture.

Further research is planned to confirm these findings through electron microscopy and detailed chemical analysis of cell wall matrices. The team also intends to refine their understanding of how structural differences within pomace samples influence fining performance.

The adoption of grape pomace cell walls as fining agents could help wineries improve product stability and sensory quality without introducing allergens or animal-based ingredients. As consumer demand grows for sustainable and vegan-friendly wines,

innovations like this may become increasingly important for producers seeking to meet new market expectations while reducing environmental impact.