Research in Plain English

Pathogenesis-related Proteins Limit the Retention of Condensed Tannin Additions to Red Wines

Research in Plain English provides brief, non-technical summaries of journal articles by Cornell faculty, students, and staff.

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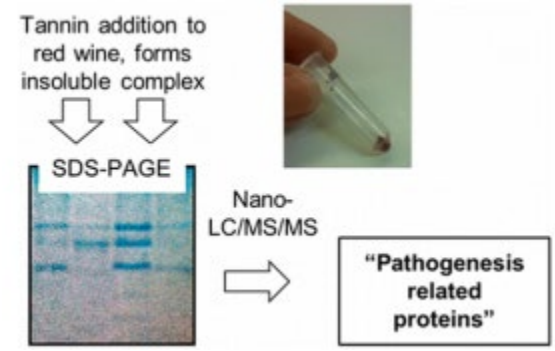
Summary by Alex Koeberle

Small scale fermentations to evaluate tannin extractability. Photo by Lindsay Springer.

Introduction:
Polymers of flavan-3-ols, or condensed tannins ("tannins" or CT) are critical to the astringency and body of red wine, and also play a role in color stabilization. Although most tannins in wine are extracted from the grape skin and seeds, it is not uncommon for winemakers to add commercially purchased tannins to wines. However, previous studies have shown that the majority of added tannin is not retained by red wines, and as such, has little to no effect on sensory qualities. Poor tannin retention is particularly pronounced in interspecific hybrids (crosses between V. *vinifera* and other *Vitis* species), and previous work had shown that grapes with high tannin binding capacity also had high protein content. This study investigated the chemical factors responsible for low tannin retention, particularly in red wines made from interspecific hybrids.



Methods:

To determine the chemical components in wine that could bind tannin, the researchers produced a purified seed tannin extract and added it to different red wines, resulting in a precipitate. The precipitate was isolated by centrifuge and its major components (tannin, polysaccharide, protein) were quantified. Specific proteins in the pellet were then isolated and identified using liquid-chromatography-mass spectrometry.

To determine if protein content was correlated with tannin retention experiments, wines were vinified from three types of grapes: wild *Vitis* species, *Vitis vinifera*, and interspecific hybrids. Protein and tannin content were measured in both juice and in finished wine. Purified tannin was then added to individual wines, and the tannin content of each wine was measured again to determine tannin retention.

Results:

- **Protein identification and compositional analysis of pellets formed following purified seed tannin addition**. Precipitate immediately formed after adding purified seed tannin extract to Baco noir, Marechal Foch, Corot Noir, DeChaunac, Cabernet Franc, Merlot, Cabernet Sauvignon, and Pinot Noir – perhaps explaining why previous studies have indicated incomplete recoveries of CT additions to wine. As more tannin was added to wine samples, both protein and tannin content in the resulting precipitants also increased. As such, protein appeared to be the main nontannin component in CT addition precipitates. These proteins were then determined to be the same proteins responsible for haze in white wines (putative "pathogenesis-related proteins").
- **Tannin and protein in 2013 fruit, juice, and experimental wines**. For tannins – V. *vinifera* contained more CT in skins and seed tissues than interspecific hybrids. For proteins – Juices *and* wines produced from wild *Vitis* had more protein than those produced from interspecific hybrids or V. *vinifera* cultivars.
- **Tannin retention in experimental wines**. Wild *Vitis* wines precipitated more tannin than V. *vinifera* and interspecific hybrid wines. Researchers also found that the amount of tannin lost following addition was well modeled from the amount of protein in the wine. Lower CT retention can be expected

in wines with high proteins as a result of high juice protein or low berry CT, which are common conditions in interspecific hybrids.

- **Role of specific vs. total pathogenesis-related proteins in tannin loss**. This study found differences in concentrations of pathogenesis-related proteins across wine samples. However, the amount of tannin loss did not depend on the type of protein – instead, the total amount of protein was the best predictor of tannin loss.

Discussion:
Addition of tannins to red wines can react with grape-derived proteins to result in an insoluble precipitate. These proteins are the same as those responsible for haze in white wines, and are so-called "pathogenesis related-proteins" because related proteins have been shown to have a role in plant disease response – however, their role in grapes is still not clear. Concentrations of these proteins in juices and red wines were highest in native *Vitis* species, followed by interspecific hybrids and *V. vinifera*. These results indicate that CT retention decreases with higher protein concentrations in finished wines. Because both proteins and tannins precipitated in wine samples, this supports the assertion that protein-to-tannin ratios are higher in interspecific hybrid and native *Vitis spp.* than in *V. vinifera*.

Bottom Line:
Winemakers commonly add condensed tannin to must or wine to improve sensory characteristics, yet previous studies indicate these additions have little to no impact on finished wines. This study shows that pathogenesis-related proteins (particularly in wines made from interspecific hybrids) may limit the effectiveness of these tannin additions. Additional steps to remove protein prior to winemaking, such as bentonite additions, may help to improve CT retention in finished red wines. This could lead to red hybrid wines with more favorable mouthfeel and complexity.

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