Technical notes

Impacts of winemaking practices on tannin in red wines

The AWRI recently published a review of the scientific literature on the impacts of winemaking practices on tannin in red wine (AWRI publication 1756). This article summarises the key messages from that review. There are many points during the red wine production process that influence the concentration and composition of tannins, but this article will focus from the point of crushing onwards and includes a summary of recent findings on the effects of maceration, yeast selection, addition of mannoproteins and oenotannins, fining and oxygen exposure.

While tannin chemistry is complex, some clear messages are developing about how winemaking practices affect tannins, both in terms of their *concentration* and *composition*. To use a metaphor, tannin concentration is about the *amount* of trees in the forest and tannin composition is about the *types* of trees in the forest. If you're a forester harvesting trees it's important to know both the amount and the type, ditto if you're a winemaker harvesting tannins.

Tannins are highly reactive polyphenolic compounds and at various stages of wine production different types of reactions happen at different rates and the outcome of these reactions determines the final colour and taste properties. Tannins are one of the critical polyphenol classes that undergo significant changes during winemaking, in particular the conversion of 'grape' tannins into more chemically complex 'wine' tannins.

Maceration

Maceration is obviously a key step in the red winemaking process, where colour, flavour and tannin compounds present in the grape skins and seeds are extracted into the must or wine, before, during and sometimes after fermentation. There are a number of different options for conducting this step, all of which can affect the wine's eventual tannin concentration and composition.

The literature highlights that during the early stages of fermentation, tannin extraction from grape skins exceeds that from grape seeds, while in the later stages of maceration, seed tannin extraction predominates. Skin tannin extraction may be more variable depending upon the conditions of maceration, while seed tannin appears to increase in a linear manner over time due to hydration of the seed (more so than increased ethanol leading to increased seed extraction).

In terms of tannin management specifically, it is now well established that enzyme addition and extended maceration are winemaking techniques that consistently increase the amount of tannin in finished wine. Extended maceration is a technique where cap contact is held for longer than the usual short period during which alcoholic fermentation occurs (5–10 days) and instead extends up to 50 days. Generally, extended maceration does not enhance anthocyanin (colour) in wine, but the primary effect is on total phenolics, polymeric pigments, or tannin. For most studies of extended maceration, an increase in seed tannin extraction has been observed as cap contact is continued.

Cold soaking is another maceration option where must is kept cold for a period before fermentation. Recent studies of cold soaking have reported a high level of variability in results, due to grape variety, vintage, regional and/or environmental factors which may limit the effectiveness of the method. While cold soaking was found to increase tannin concentration in wine in some cases, the effect was not consistent across grape varieties.

The impacts of different temperature regimes during fermentation on wine tannin and colour have recently also been reported. Tannin showed a relatively constant increase in extraction over time and increasing fermentation temperatures led to increased total tannin extraction and seed tannin extraction for all treatments during active fermentation.

Wines made following flash détente (a combination of high temperature and vacuum treatment) had higher tannin concentrations as well as an increased tannin-to-anthocyanin ratio. However, when pressed directly after treatment, polyphenols were lost. Cap maceration was therefore an important aspect of the treatment.

Another method where heat is applied to grape must is the use of microwave maceration, which (unlike flash détente) is not yet applied on commercial scale. It is, however, noted to be a promising technology for traditionally tannin-poor varieties such as Pinot Noir. Similar to the results for flash détente, microwave-treated Pinot Noir resulted in higher wine tannin concentrations only when fermented with continued cap contact (as opposed to early press off).

A further promising technique which is non-thermal, but may facilitate extraction during maceration by disruption of cellular integrity, is pulsed electric field (PEF). Studies of PEF treatment of Cabernet Sauvignon showed that high energy, long duration PEF produced wine with 34% higher tannin than a standard maceration treatment. While results from this technique are encouraging, it requires considerable optimisation before it becomes more widely applied.

Yeast

The wide ranging impact of different yeasts on wine aroma and colour has been well established over many years; the effect of yeast on tannin, however, has been less thoroughly investigated. With recent advances in analytical methods for determining tannin concentration and composition, research has demonstrated that choice of yeast can also have a major effect on tannin in wine.

As examples, 11 commercially available *Saccharomyces* strains were used in one study with Australian Cabernet Sauvignon. Yeast selection increased final tannin concentration by up to 33% and also significantly modified colour properties. Yeast selection has also been shown to be an effective tool in diversifying colour stability, tannin concentration and composition in Pinot Noir wines. In particular, the wines made with yeast RC212 showed significantly higher tannin concentration post-ferment and after six months.

Mannoprotein addition

Mannoproteins, naturally present in wines and derived from the cell walls of *Saccharomyces cerevisae*, are increasingly being added in oenological products to wines with the intention of preventing tartrate instabilities or modulating mouth-feel. In red wines, they have the potential to interact with tannins and other phenolics by forming colloids of relatively unknown stability and, as such, there is interest in the effect of mannoprotein addition on colour effects and tannin. The addition of mannoproteins at the start of winemaking resulted in a decrease in wine proanthocyanidin content and wine stable colour but no effect on tannin concentration and, in some studies, was shown to reduce astringency.

Oenotannin addition

A key observation from studies on the addition of oenotannins is that, in general, such additions have little impact on colour stabilisation regardless of timing, dose, oenotannin type or grape variety or maturity. However, in the few reports where the sensory impacts of tannin additions were evaluated, some changes to mouth-feel properties were reported.

Fining

A number of studies have reported on the impacts of animal protein and new plant–based fining agents on tannin, showing a range of different effects in modifying both tannin concentration and composition. More detail can be found in the full review article.

Oxygen exposure

The impacts of micro-oxygenation are varied and hard to predict, but are summarised in the review. One of the newest areas of research involving tannins and winery processing is

the use of macro-oxygenation in red wines. Oxygenation normally occurs during primary fermentation through pump-overs, although the amount of oxygen ingress can vary greatly depending on how the process is carried out. In a more controlled environment, bubbling large volumes of air through active ferments in rotary fermenters has been shown to induce changes in tannin and astringency that are consistent with characteristics of aged wines. These oxygen-treated wines demonstrated tannin characteristics after two months of ageing that were similar to those of the control wines after two years of ageing, and the differences between the control and oxygen treated wines were still significant after two years of bottle ageing. The oxygen-treated ferments contained lower concentrations of tannins and smaller sized tannins. Further research into controlled macro-oxygenation is warranted and ongoing.

Summary

In summary, research has shown that significant impacts on red wine tannin concentration and composition occur at many points of the wine production process, including maceration, yeast selection, addition of mannoproteins or oenotannins, fining, filtration, oxygen exposure, barrel treatment, packaging/bottling and accelerated-ageing techniques. Application by grapegrowers and winemakers of the knowledge developed will provide the opportunity for improved management of vineyards and winemaking to optimise tannin in grape and wine, and for increased capacity to meet wine specification, consumer expectations and profitability.

To request a copy of the review article, contact the AWRI Library at infoservices@awri.com.au

Reference

AWRI publication #1756. Smith, P.A., McRae, J.M., Bindon K.A. (2015) Impact of winemaking practices on the concentration and composition of tannins in red wine. Aust. J. Grape Wine Res. 21: 601–614.

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