TANNINS VS. OAK CHIPS: WHAT DOES EACH CONTRIBUTE TO YOUR WINE?

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An investigation into the effects of additions of VR Supra (and two experimental tannins) against oak chips found that while the oak chips provided a benefit in hue comparable to the fermentation tannins, total phenolic load and wine colour density were superior when fermentation tannins were used. In terms of winemaker preference, although initially the oak chip-treated wine was preferred by the winemakers conducting the trial, ultimately the wines with added fermentation tannins were ranked ahead of the control and oak chip-treated wines. The trial also indicated that a period of at least 6 months is required for a meaningful palate evaluation to be conducted. When the wines were shown masked to 9 independent winemakers, significant preference was shown for the wines with added fermentation tannins in terms of colour density and structural quality.

INTRODUCTION

Exogenous tannins have been used in the global wine industry for many years now. While some winemakers maintain that tannin additions do not suit their individual winestyles, it is arguable that even though many winemakers choose to use exogenous tannin additions for reasons of wine style or structure, sometimes they are a necessity. For example, the heat waves suffered in Australia through the 08, and now also the 09 vintages, caused severe vine (and therefore fruit) stress, in turn resulting in undesirable fruit phenolic structure. In wine regions where wet weather during vintage is common, such as Bordeaux, exogenous tannin additions are used prolifically, but for reasons of elimination of the oxidative enzyme laccase (from *Botrytis* infection) in addition to wine structural considerations.

There are important distinctions that should be made when discussing tannins, as they all differ in terms of chemical functions and organoleptic contribution. Simple wood extracts possess very different characteristics from more complex blended fermentation tannins, such as **VR SUPRA®**. Also, when using oak chips, tannin must be extracted from the chip itself, whilst when using exogenous fermentation tannins no extraction step is required.

Oak chips are now in common use in winemaking. Some winemakers have been informed that the tannin extracted from oak chips during fermentation will deliver the same result as an exogenous fermentation tannin addition in terms of wine colour intensity and hue, colour stability over time and also in terms of wine palate structure. To investigate these claims **LAFFORT**, in partnership with a winery in Victoria, in the 2007 vintage conducted a winemaking "tannins vs. oak chips" trial. The primary aim of the trial was to evaluate the relative effectiveness of both oak chips and exogenous fermentation tannin additions with respect to influence on wine colour and palate structural quality.

TANNIN STRUCTURES

Oak tannins are characterised by ellagitannins, which are structurally defined by cross-linked gallic acid units (marked in blue, figure 1a) esterified to a sugar core. The galloyl esters provide the phenolic component of ellagitannins and are able to participate in co-pigmentation to provide an increase in colour expression, yet they lack sufficient nucleophilic capacity to covalently combine with (and thus stabilise) anthocyanins.

LAFFORT's **VR SUPRA®**, in comparison, contains both resourcinol and phloroglucinol-based phenolics (figures 1b and 1c respectively), which display far greater nucleophilicity due to the *meta*-positioning of the hydroxyl (OH) groups on the aromatic ring, allowing them to effectively combine with anthocyanins, leading to colour stabilisation and palate modification of the wines.

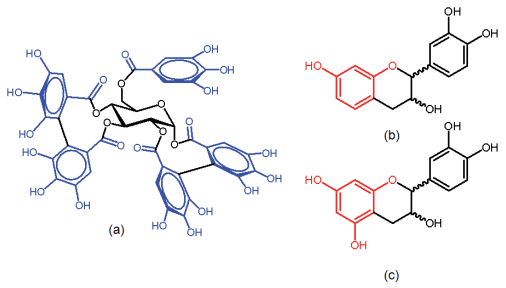

Fig. 1. Example structures of ellagitannin derived from oak (a) and the resourcinol-based (b; resourcinol core in red) and phloroglucinol-based (c; phloroglucinol core in red) tannins found in VR SUPRA®.

Based on the differences in the tannin structures of oak chips and exogenous fermentation tannins, it was anticipated that there would be significant differences in the wines produced from this trial both in terms of colour development and stability over time, in addition to palate structure.

In the case of oak chips, the nature and amount of tannin extracted is dependent upon several factors, notably the alcohol concentration of the must, fermentation temperature, duration of fermentation and fermentation management practices. In addition, the toast level of the wood plays a role in the amount of extractable tannin in oak chips, since phenolic materials in the wood are converted into aromatic compounds during toasting, such as vanillin and guaiacol. Figure 2 illustrates the relationship between the toasting level and the amount of extractable tannin in an oak sample. It is obvious that for maximum structural contribution a lightly-toasted chip should be used, whilst for maximum aromatic contribution a heavy toast should be used.

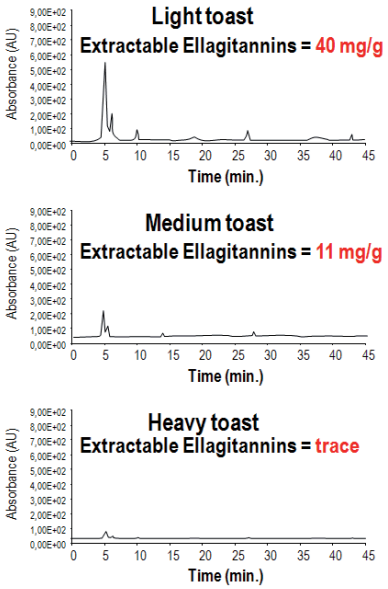

Fig. 2. Quantification of the extractable tannin content of oak at three different toast levels, illustrating the inverse correlation between extractable ellagitannin and toast level.

TRIAL OUTLINE

The wine segment targeted for the trial was a wine in the $15-20 range that would typically spend 12-18 months in barrel. Shiraz was sourced from the Bendigo region and was received at 13.8 Baumé. Five x 5.5 ton ferments in total were conducted: 3 x tannin additions, the oak chip treatment and a control (no additions). The three tannins examined in the trial were all from **LAFFORT**: **VR SUPRA®** and two experimental tannin blends (Blend 1 and Blend 2). Tannins were added at the first pump-over at a rate of 300 ppm, with pump-overs twice daily. Medium toast American oak chips sourced from the usual supplier used by the winery were added to the must at a rate of 3 kg/ton. All fermentations were yeast inoculated and conducted under the same operating parameters at nominal temperatures of 22-26 °C. MLF was conducted with indigenous microflora, with final malic acid concentrations < 0.1 g/L. Final wine parameters were thus (with only minor variations between treatments): alcohol 14.0 %; TA 6.8 g/L T.A.E.; pH 3.6; RS 1 g/L; FSO_2 25 ppm; TSO_2 40 ppm; VA 0.25 g/L. The wines were then each placed into 2 x 500 L 4-year old barrels to provide a barrel maturation environment without significant intrusion of oak character. The winery laboratory conducted periodic colour analyses and blind sensory assessments (employing simple preference ranking of 1 to 5, where 1 = most preferred) over the next 14 months.

POST-MLF RESULTS, MAY 2007

Immediately post-MLF Somers colour analyses of the wines were conducted at the University of Adelaide. The data represented a snapshot of the wines very early in their production lives, which is when some winemakers evaluate such trials. The continuous analytical data (following sections) serve to illustrate the value of long-term trials, given the changes observed over time.

The initial colour density (intensity) of the wines (figure 3) indicated minimal initial difference between the control and oak chip-treated wines. All tannin additions delivered a significant boosts in colour intensity (9-blends 21% over the control).

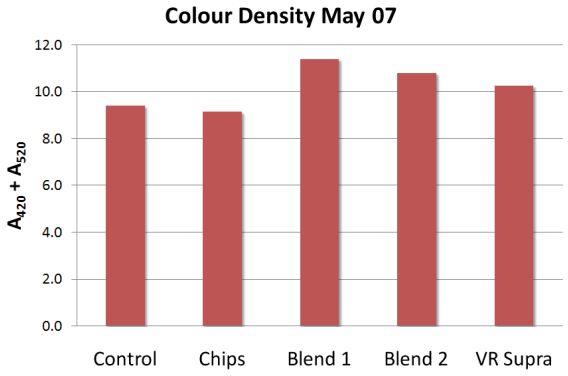

Fig. 3. A comparison of the colour density (intensity; A420 + A520) for the wines in May 2007. At this time point all tannin-added wines had increased colour density compared with the control and oak chip-treated wine.

Initial wine hue (the ratio of brown (A_{420}) to red (A_{520}) colouration in the wine) indicated minor differences between treatments, with the control being the reddest wine and the oak chip-treated wine showing the brownest colour (figure 4).

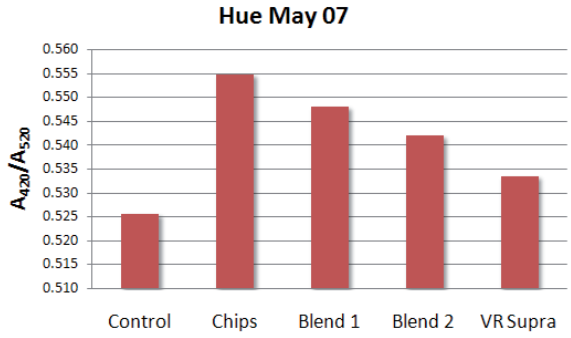

Fig. 4. A comparison of the hue (ratio of brown: red; A420/A520) of the wines in May 2007. The wine made with oak chips had at this time the brownest colouration.

As expected, the phenolic load of each of the tannin-added wines was higher than the control (figure 5), with gains of 22-28 % in phenolic content over the control. The oak chip-treated wine, in comparison, gained only 7% phenolic load over the control. Thus, the oak chips delivered only 25-32% tannin compared with the wines containing exogenous fermentation tannins.

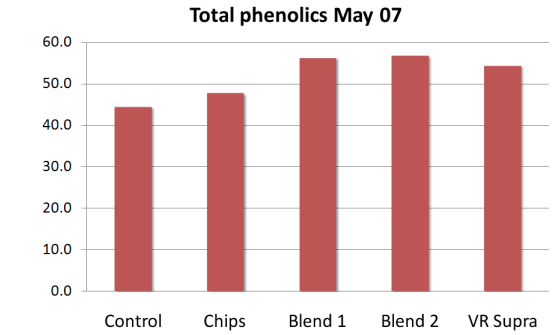

Fig. 5. A comparison of the phenolic contents (A280) of the wines in May 2007. These values are directly proportional to the phenolic loads in the wines.

Initial sensory assessments of the wines was made in late April of 2007, conducted blind by 5 winemakers, are given in table 1. The comments indicated that post-MLF the oak-chip wine was the most acceptable on general terms, although all winemakers agreed that since it was the only wine showing oak character this skewed the preference significantly. Comments on the wine palates indicated a certain level of tannin aggressiveness in the wines where tannin was added.

Wine Treatment	Av. winemaker ranking (n = 5)	Winemaker comments
Oak chips	1	Sweet fruit; some flesh; more density and weight
Blend 1	2	Medium weight; clean & round; good structure & density; some grainy tannin
Control	3	Medium weight fruit; soft; bit herbal; balanced tannin
VR Supra	4	Plain; tannins up-front; bit short ; thin
Blend 2	5	Palate grippy; obvious tannin; some harshness; lacking fruit

Table 1. Initial sensory analysis preference ranking and comments for the wines in April 2007. 1 = most preferred, 5 = least preferred.

ANALYSIS TO JUNE 2008

The winery conducting the trial supplied its own colour analysis data for the following graphs, based on the Somers colour measures.

COLOUR DENSITY

Figure 6 shows the colour density analyses over the following months of the trial up to June 2008. The oak chip-treated wine improved in colour intensity, presumably due to the non-stabilising co-pigmentation effect. The control wine also improved marginally over the trial period, whilst the tannin-treated wines all showed approximately the same colour intensity, which was significantly greater than either the control or oak-treated wi

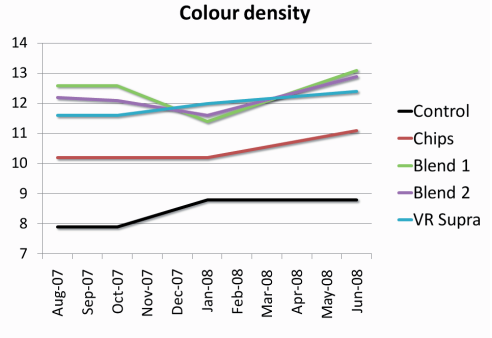

Fig. 6. Colour density of the trial wines over the duration of the trial.

HUE

Although wine hue varied initially across treatments, after 14 months there was remarkable similarity between the tannin and oak-chip treatments (figure 7). The control wine, in contrast, took on a noticeable brown colouration over time. This was presumably a result of the lower phenolic content of the control wine in combination with the use of an older barrel for maturation, which would contribute minimal tannin to the wine, thus lowering its overall anti-oxidant capacity.

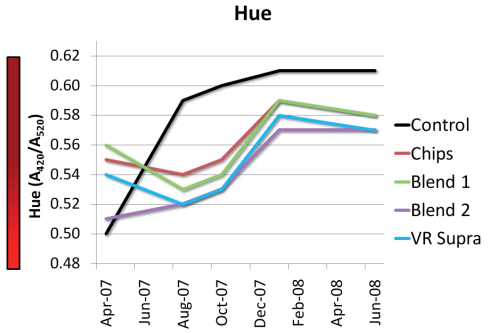

Fig. 7. Hue of the trial wines over the duration of the trial. The colour bar to the left gives a nominal indication of the chart scale as it pertains to colour.

Phenolic content

Noticeable and consistent difference in phenolic load was noted between the tannin-treated wines and the control and oak chip-treated wines over the duration of the trial (figure 8).

These differences were found to reflect the sensory evaluations with respect to palate structure (see following section). The data indicate that minimal phenolic material was extracted from the oak chips during the fermentation, and that a far greater phenolic contribution was made to the wines through the tannin additions.

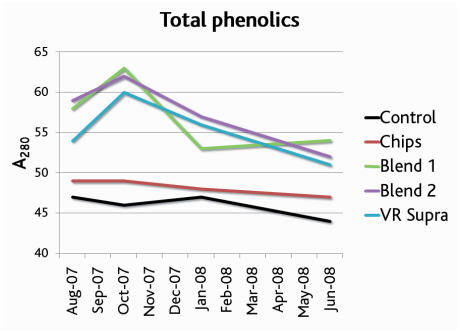

Fig. 8. Phenolic content of the trial wines over the duration of the trial. Note the decline of phenolic content over time, which is indicative of the passive oxidation that normally occurs during barrel maturation of wine. The difference in values between the upper (tannin-added) group compared with the lower (control and oak chip-treated) group is reflective of comments made by the tasters regarding the palate structures of the wines.

Wine preference

Figure 9 indicates the changes in averaged winemaker wine preference over time. The control wine was ranked 3rd post-MLF on the grounds that it was not harsh and had reasonable colour at the time. It rapidly moved to 5th place, in concert with the development of some brown pigmentation through passive oxidation, indicating insufficient phenolic anti-oxidant protection (i.e. insufficient phenolic load). The oak chip-treated wine was initially ranked 1st, but progressively declined to 4th place over the duration of the trial (14 months), as it became apparent that it was lacking in both colour depth and palate tannin structure.

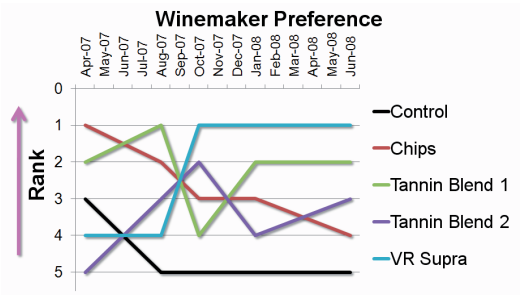

Fig. 9. Averaged wine quality preference of the trial wines over the duration of the trial. 1 = most preferred; 5 = least preferred. The minimum number of tasters involved at each stage was 5. Note the period between August 2007 and October 2007 (wine age of 4-6 months) where significant preference variation occurred, which was presumably reflective of structural changes in the wines.

Comments from the January 2008 sensory assessment (table 2), when the wine preferences began to stabilise, reflected that the oak chip-treated wine was showing noticeable resinous "chip character", and that the control was now looking "dull and thin".

Wine Treatment	Av. winemaker ranking (n = 5)	Winemaker comments
VR Supra	1	Fresh colour; berry fruit; good tannins; more structure
Blend 1	2	Good colour; more grip but has structure
Oak chips	3	Chip character
Blend 2	4	Good colour; good balance; OK.
Control	5	Light colour; dull and thin

Table 2. January 2008 sensory analysis preference ranking and comments for the trial wines. 1 = most preferred, 5 = least preferred.

The wines with added tannin appeared to go through a transition phase at around 4-6 months post-ferment, where preferences varied dramatically, indicating some structural changes in the wine. Given that the wine style targeted for this trial required the wine to be in barrel for between 12-18 months, this is a highly significant result: the structural changes indicated by the sensory analyses in the 4-6 month window suggest that any qualitative evaluation of wine quality or structure within this wine style segment (or a segment of higher price point) is best left until a period of *at least 6 months post-ferment*. in fact scored very close to the **VR SUPRA®** wine. At the conclusion of the trial the wine made with **VR SUPRA®** was deemed to possess the best overall quality and structure. Although the Blend 1 tannin was ranked 2nd in absolute terms, it in fact scored very close to the **VR SUPRA®** wine. The wine made with the Blend 2 tannin was ranked 3rd at the trial completion.

COULD INDEPENDENT WINEMAKERS SEE AND TASTE THE DIFFERENCE?

The winemakers involved were clearly able to observe significant differences between the wine treatments. Was it then possible for winemakers not involved in the trial to do the same? To answer this question, winemakers from the Riverland wine region of South Australia were asked to evaluate the trial wines by ranking them in terms of colour intensity and also in terms of the quality of wine structure.

All wines made with tannin additions received far greater rankings for colour intensity than either the control wine or the oak-chip treated wine, which were ranked equal 4th (fig. 10). Given the small sample size (n = 9), absolute rankings are not noteworthy, but the wines can nevertheless be divided into two discrete groups: those with high colour intensity (all made with exogenous fermentation tannin additions) and those with low colour intensity (made without exogenous fermentation tannin additions).

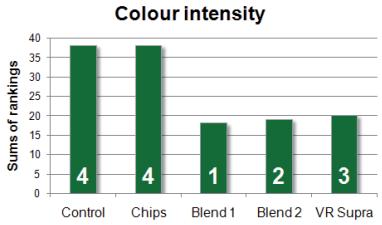

Fig. 10. Colour intensity rankings for the trial wines by independent winemakers (n = 9). Columns reflect the sums of rankings, hence a lower score indicates higher wine colour intensity, as noted by the column base label.

In terms of an evaluation of wine structural quality (fig. 11), the distinction was equally as clear, with the wines made with tannin additions again occupying the top rankings. The least preferred wine on structural quality grounds was the control wine, which is in agreement with the quality evaluations made by the winemakers conducting the trial and, also the Somers colour data.

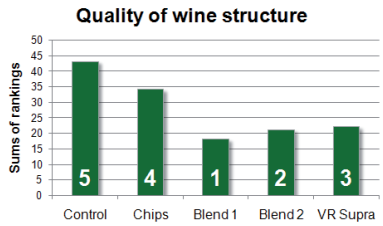

Fig. 11. Wine structural quality rankings for the trial wines by independent winemakers (n = 9). Columns reflect the sums of rankings, hence a lower score indicates higher wine structural quality, as noted by the column base labels.

Cost comparaison

The cost of the examined additives to make the oak chip-treated wine cost was around $15.60/ton. In comparison, the cost of using the exogenous fermentation tannins was about $7.20/ton. Of course, oak maturation and oak flavour must still be factored into this equation if required, but since the wines were made for a wine segment where 12-18 months barrel maturation is nominal, barrel costings are not so relevant. In addition, given that the premise for the trial was that oak chip-derived tannins could replace exogenous fermentation tannins, a direct cost comparison seems reasonable.

SUMMARY

While using oak chips can provide some extractable tannin to a wine, which can in turn elevate the wine's colour intensity through co-pigmentation, it cannot replace the broad spectrum of functions that an addition of exogenous fermentation tannin provides. Aside from the clear advantages offered by fermentation tannins over oak chips in terms of wine hue (reflective of wine oxidation state) and phenolic load (reflective of palate structure), ellagitannins simply do not possess the required chemical activity to stabilise wine colour. In terms of absolute wine quality, all wines in this trial made with exogenous fermentation tannins were rated above the control and oak chip-treated wines, which was independently verified. This trial also indicates the need for an appropriate period of evaluation of such wine parameters, given the observed changes over the 14 month trial period. Lastly, and perhaps most tellingly, the advantages offered by exogenous fermentation tannins like **VR SUPRA®** are observable in the real world, as evidenced by independent winemaker evaluation.

Products discussed in this article are available in Australia through **LAFFORT**, *phone 08 8260 7974 and in New Zealand from Oenological Resources (Greg Wilkin: greg@oenological.co.nz), phone 0213 22290. www.laffort.com.*

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