Introduction
The nature and contribution of tannins to red wine quality, is a topic currently at the forefront of interest in red winemaking. In Australia, this is reflected in the ambitious effort and resources being directed to the grape tannin and colour specification project, currently being conducted by the AWRI and the University of Adelaide, in cooperation with INRA-IPV Montpellier.

Specifically concerning cv Merlot, the considerable perceived gap in quality between the best wines of Pomerol, St Emilion and the Medoc, with those produced in other regions both within France and elsewhere in the world, has to date raised many questions about tannin structures in Merlot. The difficulty in achieving strong tannin structures with appropriate ripe flavour profiles and mouth-feel with Merlot wines outside these areas of Bordeaux, has presented a constant challenge to winemakers.

Ironically, the lack of a strong tannin structure in many Merlots, and the soft plummy mouth-feel especially in mid range price brackets, is arguably the appeal of this varietal to many consumers who do not like tannic wines.

In Australia the limited number of cv Merlot clones available, and the quality of these clones has been frequently cited as the reason for lack of flavour depth and structure in Merlot wines. The ongoing search for the ideal soil types for Merlot has also been the topic of considerable discussion in regard to Merlot quality. With a few exceptions, very few Merlots are represented in Australia’s super premium category compared to Shiraz, Cabernet Sauvignon, or even Chardonnay.

In considering what is the role of tannins in Merlot and what directions are available with this variety this paper will examine:

• What are the unique characteristics of Merlot wines?
• The role of tannins in merlot structure
• Viticultural and winemaking practices which influence tannin structure in Merlot, and,
• The contribution of Merlot to blends.

Roundness and round mouth-feel
The flavour profile of Merlot wines is undoubtedly different to Cabernet Sauvignon, with descriptors such as plum, satsuma plum, damson, liquorice, along with tobacco earthy and tealeaf being used in conjunction with more typical Cabernet descriptors such as cassis, dark berry, chocolate, mint, leafy or inky. However the cross over of flavours between these varieties often makes these differences very subtle. These differences become finer when oak and age begin to modify the flavour profile.

When we consider the mouth-feel characteristics however, the difference in palate structure is generally much more obvious. The roundness in the mouth of Merlot wines, the flesher feel, and the lack of a mid-palate backbone characteristic of Cabernet, characterise Merlots across a wide range of wine qualities. This round mouth-feel is arguably the unique and determinate characteristic of Merlot wines.

Tannins in Merlot
Tannins, anthocyanins and polymeric pigments have undoubtedly a significant role in the round palate structure of Merlot. However despite the current interest in Merlot, little research work appears to have been conducted specifically on the tannin structure in this variety. Donovan J.L. et al. (1999) examined the effects of fining agents on the phenolic composition of Merlot using HPLC separations and chemical analysis. While they separated many phenolic compounds, they did not contrast this with other varieties. Francis I.L. et al. (1999) looked at a comparison of flavour components of Merlot and Cabernet Sauvignon from both California and Australia, but did not look at phenolics.

Experience at Balnaves with Merlot shows that it is particularly difficult in terms of producing wines with satisfactory flavour and tannin depth. The aim is not for styles which are light, soft or low in tannin. Balnaves are attempting to produce wines that can stand next to Cabernet Sauvignon from Coonawarra in terms of palate weight and wine quality.

Fig 1 Merlot palate (left) and Cabernet Sauvignon palate (right).
Low tannin levels are invariably evident where crop level is too high, or where there is excessive vigour. In these cases, there will be late season colour and tannin development and larger berry size. In this way Merlot performs similarly to Pinot Noir, in that it is very sensitive to crop loads beyond a certain point. In Merlot this may be around 3 tonnes/acre.

However, when aiming for solid structure the tannin which is extracted must be ripe and fine grained, or it will break up the round Merlot mouth-feel, the definitive characteristic to retain in any Merlot wine.

The aim is for supple tannins which produce a heavy palate weight with a velvet mouth-feel, and fine grained texture which runs around the edges of the round mid palate, rather than producing a firm backbone running through it. (Diagrammatically represented in Fig. 1). The straight line depicts the palate shape and the scribble where the tannin is felt.

A good extract level of tannin will also add more complex flavours to the wine such as sweet earth, coffee, tobacco and spice.

Conversely, under-ripe fruit with greener astringent tannins will diminish the round supple mouth-feel, as well as leave characteristic tomato leaf, beany, herbal flavours in the wine. Excessive maceration of even ripe fruit can also extract coarser tannins, which have the same effect. This is more evident in under-ripe fruit especially, by excessive rolling of Vinimatics, or use of mechanical fermenters such as Russian Reactors. (Photo 1, Figure 2). The internal spiral mixing blades in these reactors drag down the cap under the fermenting wine and are turned regularly along with pumping over. When wines are over extracted the velvet and round fine-grained texture is diminished.

**Viticultural and winemaking practices which affect tannins**

1 Picking time

Fruit which is under ripe can come from a number of reasons. These include excess crop, late season wet soils, canopy shading and simply picking too early. Balnaves experience is that Merlot at 13.0 or 13.5 baume can still experience has proven that waiting for basal leaf yellowing canonawarra.

Conversely, the fruit shaded in the umbrella underneath the canopy beneath the foliage is more likely to be bird damaged with consequent off-flavours. This fruit produces lighter, earthier wine which develops quickly and simply lacks depth of flavour, compared with fruit which has good light exposure with shade during the hottest part of the day. Recent work by Haselgrove et al (2000) has demonstrated the negative affect of heat on anthocyanin and tannin synthesis. Conversely, the fruit shaded in the umbrella underneath may have problems with pyrazine retention and under ripe characters.

The best results to date are from non-foliage wire blocks, where shoot length is small enough to maintain an upright growth habit and provide midday shade to the fruit. If the shoots are too long for this, the next best option is vertical positioning with foliage wires and leaf plucking.

2 Canopy management

Balnaves manage Merlot vineyards on a number of trellising systems, including single wire, double wire vertical, and VSP. One of the main issues with Merlot is sunburn and excess fruit exposure due to the pendulous nature of the variety. The fruit in full exposure to midday sun will show lower colour, lower tannin and cooked flavours, as well as being more likely to be bird damaged with consequent off-flavours. This fruit produces lighter, earthier wine which develops quickly and simply lacks depth of flavour, compared with fruit which has good light exposure with shade during the hottest part of the day. Recent work by Haselgrove et al (2000) has demonstrated the negative affect of heat on anthocyanin and tannin synthesis. Conversely, the fruit shaded in the umbrella underneath may have problems with pyrazine retention and under ripe characters.

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3 Total Acidity

High total acidity will affect the mouth-feel characteristics of Merlot and generally diminish the roundness of the palate. At Balnaves, around 6.0 gms/L total acidity is the target TA for Merlot. This allows reasonable pHs (in the range 3.50-3.60) and maintenance of roundness via lower TA. Table 1 shows intake pH and TAs and baumes for the same three wines, all from Coonawarra vintage 2000.

<table>
<thead>
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<th>pH</th>
<th>TA</th>
<th>Baume</th>
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<tr>
<td>3.51</td>
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<td>6.3</td>
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<tr>
<td>3.71</td>
<td>4.5</td>
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<td>5.4</td>
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**Table 1 : Acid balance of three Merlot musts Coonawarra vintage 2000.**

Data collected from Chateau Fonplegade in St Emilion in 1985 shown in Table 3 demonstrates even lower TAs with reasonable pHs, with the exception of the pressings C77 and C65. (Note TAs have been expressed as Tartaric acid for ease of comparison) Many producers and regions will accept significantly higher pHs and lower TAs than those shown here in the search for softer and rounder mouth-feel. The risks of microbiological spoilage problems and oxidation need to be considered when pursuing this higher pH philosophy.
Table 3: Acid balances of tanks post-malo Ch. Fonplegade St Emilion Vintage 1985.

<table>
<thead>
<tr>
<th></th>
<th>C77P</th>
<th>C79</th>
<th>C70</th>
<th>C69</th>
<th>C67</th>
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<tr>
<td>Alcohol % v/v</td>
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<td>13.6</td>
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</tbody>
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4 Alcohol adjustment

Higher alcohol levels (13.5-14.5% v/v) help immensely to round out the mid-palate in Merlot and add to the round mouth-feel characteristic. A higher alcohol level aids significantly in extraction of colour and tannins, as well as directly to the sweetness of the palate and contributing to the volume of the wine. In very warm vintages such as vintage 2001, low acidity can trigger picking, and the baumes will be under the desired level. Juice concentrate additions are very effective in both adding alcohol and some berry flavours where red concentrates are used.

5 Punch-downs and soft handling techniques

One way to ensure the required round mouth-feel and fine-grained tannin structure is to use soft must handling with punch-down ferments. This works particularly well with Merlot, provided skin structure can be broken down enough to give reasonable extract. Balnaves did extensive 1 tonne punch-down ferments on Merlot during the 2001 vintage; however the strong skin structure of berries due to the hot summer made extraction difficult and many wines were disappointingly light compared to the same fruit in 8 tonne open-topped static fermenters that were conventionally pumped over. Maintenance of higher fermentation temperatures in small bins was difficult, which reduced extraction.

Using punch-downs the tannin structures are lighter but also finer. This approach is gaining widespread acceptance. Photos 2, 3, and 4 show the whole fruit and soft handling grape system at Canon La Gaffelière in St Emilion, along with their automated punch-down system. Photo 5 depicts the sorting tables and small must bins at Château La Rivière at Fronsac. These bins lift over the top of the open wooden fermenters and drop must in to avoid pumping.

This soft handling approach can fall short in tannin structure, so is usually combined with long macerations and heating post fermentation. In Bordeaux many chateau are equipped with combined heating and cooling systems which chill the ferment to 30°C during fermentation, and then maintain this temperature for the entire period of the long maceration of two and a half to four weeks. This practice ensures good extraction and interaction between tannin monomers, softening the structure and producing finer tannins.

6 Oak tannin and added tannin

In helping to build a strong tannin structure, oak tannin can play an important role, but as with grape extractives, the oak tannins are best if they are finer and less astringent. At Balnaves the best results have been with tight grain French oak and worst with open grained American oak. Fine grained oak tannins will sit on the perimeter of the palate mouth-feel and build the wine without rawness; whereas coarser tannins start impacting on the roundness of the mid palate and also look furry and big rather than tight and fine.

During oak maturation with Merlot, an enormous change in structure occurs between filling and 18 months later. Wines become more solid and round and much more complete. In this way Merlot behaves a little like Pinot Noir where the volume of the wine and the weight are disproportionately compared to the colour and visual aspect. This phenomenon appears to be more marked with wines that have plunging or softer handling, and more marked in new oak.
This aspect of Merlot makes selection of wines for blends significantly more problematic, ‘bigger’ is not necessarily ‘better’. Nor is ‘bigger’ even ‘bigger’ following maturation. After many years experimenting Balnaves have had no success with adding tannin to Merlot to improve structure. The added tannins will run through the palate rather than around it and remain hard and angular. It appears there is not the fruit depth to balance added tannins, as can be found in Shiraz or Cabernet Sauvignon. Balnaves have moved away from even small additions (up to 50mg/L) to no additions in recent years. They rely instead on fine-grained oak to build the wine.

**Blending with Merlot**

The rounded quality of Merlot as a single varietal is also the predominant characteristic it brings to Cabernet-Merlot and other Bordeaux variety blends. Depending on the base wine, typically 10-30% Merlot can round out the middle palate giving more mid-palate volume and flesh. In addition Merlot can modify the grain or texture of the mid palate making it tighter and finer in mouth-feel. These characteristics of Merlot are different to other varieties used in Bordeaux blends. Cabernet Franc for example traditionally adds to the acid structure and tannin backbone of a blend, as well as combining mint chocolate flavours. Petit Verdot on the other hand adds colour, perfume to the nose, and firm grainy tannins on the finish, but is often lacking in the mid palate. Cabernet Sauvignon provides a firm backbone structure, flavour depth and length as well as tannins on the finish. In many cool climate regions such as Bordeaux, straight Cabernet Sauvignons are too lean to be bottled unblended. Merlot ripens earlier, and in difficult years the percentage of Merlot is increased to add volume and balance. This philosophy of blending, in Coonawarra at least, is not quite driven by the same parameters as it is in Bordeaux. In most years Cabernet Sauvignon can be ripened to 13.5 –14.0 baume and sometimes above this, producing wines that are sufficiently rounded and balanced without blending. Moreover by using different vinification techniques, Cabernets of different structure can be made using alternative fermentation techniques to produce well balanced 100% Cabernet Sauvignons. Further acid levels can be adjusted directly and Petit Verdot or Caberent Franc do not have to be added to achieve this. However there are still benefits from blending, and these are somewhat stylistic. Merlot helps with flavour complexity adding sweet earthy/ tobacco/ cedar characters with age; but importantly as mentioned earlier, with tannin mouth-feel giving more volume in the mid palate and finer grain to the tannin feel. Until recently ‘Cabernet Merlot’ on the label created considerable consumer interest. In terms of blending where Merlot is the dominant variety, normally Cabernet Sauvignon and/or Cabernet Franc is blended to improve the length of the palate and depth to the mid palate as depicted in Fig 2. The Cabernet is used in a percentage which fills out the front, and more significantly, the back of the palate without detracting from the roundness of the palate structure. Bordeaux Merlot dominant wines from St Emilion and Pomerol are almost without exception blends of Merlot and one or more of Cabernet Franc, Cabernet Sauvignon or in some cases Malbec. The Merlot percentage ranging from 95% at Ch Petrus and down to 30% at Ch Figeac, with 50-60% being typical. (Parker 1985) The requirement to blend to get balance in these regions also exists in Australia and may be one reason for the relatively few straight Merlots in the super premium category. Balnaves produce a Merlot based blend which is normally 40% Merlot, 35% Cabernet Sauvignon and 25% Cabernet Franc. We have not produced a Merlot from Balnaves property to date, which would allow an increase in the percentage of Merlot used for this blend. Parker Coonawarra Estate however do have a Merlot vineyard which can produce wines rich enough to stand up with 15% Cabernet Sauvignon, and have produced a Merlot wine since 1998.

**Conclusion**

This paper has put forward the proposition that it is the mouth-feel and roundness of Merlot which is its determinate characteristic. Tannins in Merlot are important to this character, and tannins from any winemaking input will impact on this feature of a Merlot wine. When considering how to improve the quality of Merlot being made, the winemaker may need to look at fermentation techniques outside what is working well in Cabernet Sauvignon and Shiraz, for example Pinot Noir. Further, there is also the need to consider blending to produce the best-balanced wines.

**References**


