Tannin and Winemaking
by Duncan Ainslie

The subject of tannins goes off in a multitude of different directions. The only unifying theme is the dryness of the subject.

The language of tannins is even sleep inducing. There are actually 2 languages:

The first language is wine chemistry chat – an example: The Cabernet Sauvignon LPP-to-SPP ratio, as percent of color, ranged from 0.11 during cold soak to 0.37 at dejuicing. The SPP would be expected to contain pigment dimers and trimers formed by acetaldehyde cross linking of anthocyanin and flavan-3-ols.28 The LPP fraction likely contains anthocyanins that have reacted directly with polymeric flavan-3-ols, or by acetaldehyde crosslinks, to form polymeric pigments large enough to precipitate with BSA in the assay.

The second language is wine appreciation bafflegab: here from the Scott Lab catalogue are the descriptions of 3 recommended cab Sauv yeasts:

1. stable colour, intense fore mouth feel, mid-palate tannin structure and fresh after taste.

2. creates high fore-mouth volume, big mid palate mouth feel, and an intense fine grain tannin sensation

3. contributes high fore-mouth feel and big mid-palate mouth feel.

I don't know about you, but this verbiage conveys nothing to me to help select a yeast – and so I focus in stead on comments on alcohol tolerance and other better communicated aspects of yeasts – and leave tannins in their impenetrable verbiage thicket.

Recent History

I started making wine and joined VAWA in 1993, 18 years ago. At that time, Ted Underhill's "Making Better Wines" was the go to manual for many of us that date back that far.

I went back to the section in the manual that addresses "Starting a Wine from Grapes." The discussion runs over 4 pages and addresses sugar, acid, pH and grape freshness. Grape tannins are not mentioned. Similarly during the early and mid 90s, premium grape growers in the Okanagan were picking based on the 3 variables of acid, pH and sugar plus the x factor of the weather forecast.

The evolution to a different approach to wine grape growing, timing of harvest and wine making started at different times in different regions. It is possible that Australia lead the way towards red wines that could be consumed earlier and without meat, by using riper fruit, softer tannins, higher pHs and perhaps residual sugar. In the Okanagan, it has been suggested that Sandra Oldfield lead the way to emphasizing tannin ripeness as the prime indicator of the ideal time to pick.

This about face in wine grape growing from tannin being a non factor to being the critical factor is not a 100% success story. Well maybe it's a success story for producers whose aim is to sell 3 year old reds to consumers who grew up on soft drinks and lite beer.

As home wine makers we are faced with new challenges: excess alcohol potential, yeasts that can't finish, solutions including replacing juice with water and a more bug friendly high pH ferment to name just a few. Last year, our high priced Sonoma Pinot experienced a heat spike that drove

it to Zinfandel like Brix just before it was picked. The vineyard owner suggested we ferment it then take it to a dealcoholizing plant, as if such facilities were as accessible as a 7-11.

Some Background on Tannins

Tannins are bitter, astringent compounds found in most plants.

They serve 2 defensive roles in plants – one against micro-organisms and the other against herbivores such as deer that find the taste bitter. These compounds, collectively called flavanols – catechin, epicatechin and epigallocatechin can exist as monomers but dearly love to link up into multi-unit chains – polymers. To qualify as tannin, at least 2 units have to be intertwined. Tannins bind with all manner of compounds, making their family tree large and complicated.

The **benefits of tannins** in red wine include:

- stabilizing colour,
- serving as an anti-oxidant,
- acting as natural fining agents by binding with haze-causing proteins,
- enhancing mouth feel and contributing to balancing the reduced acid (compared to whites) alcohol and residual sweetness (from both the grapes and the oak).

Some of us use a pH guideline for bottling dry whites of 3.30 – 3.35, these whites should have little or no tannin. For reds we use a pH guideline of 3.60 - 3.70. I think of that 0.3 pH difference between whites and reds as what tannins contribute to balance in reds.

Tannins at Harvest

"Wines are made in the vineyard." Influences include:

1. Terroir: Soil type, temperature, rainfall, sunshine, terrain, prevailing wind. Amount of tannin per berry varies within a vineyard in the same year and certainly from year to year. The weather is the variable factor; but both during the growing season but also in the preceding year when the vines where laying down the next year's buds.

2. Canopy Management: Some varietals don not respond to bunch exposure vs. shade (Shiraz), in others shaded fruit has more tannin (Merlot) and lastly some shaded varietal bunches had lower tannin.

3. Rootstock

4. Irrigation: Studies show that it has no effect on tannin volume other than to reduce or increase berry size. Others suggest that, particularly during a hot spell close to picking time, some water is essential to keeping the vines alive so that the tannins can mature.

5. Vine vigour: Vines with high vigour have lower tannins. Studies suggest vine vigour is the main driver in tannin variability.

6. Varietal: Cab Sauvignon, Tempranillo and Nebbiiolo are high in potential tannins, Merlot, Syrah and Zin somewhere in the middle while Grenache, Cinsault and Gamay are at the low end. Smaller berries with a higher skin to pulp ratio will have more tannins.

In California, Cabernet Sauvignon is the most tannic major varietal with up to about 1,500 mg/l. California Pinot Noir has from 300 to 990 mg/l, with an average of about 340 mg/l. A Beaujolais Nouveau might have as little as 30 mg/l, whereas a top Australian Shiraz usually

has a bit less than the finest Napa Cabernets; the Penfolds South Australia Grange 1998, for example, had 870 mg/l.

While Sandra notes above that Okanagan grapes are less likely to have huge tannins, others note that cooler climate grapes may have more acid and less sugar producing less alcohol, so the same level of tannins would seem much more bitter and astringent.

Central Valley grapes have plenty of tannins in their thicker, tougher skins but that makes the tannin and colour difficult to extract. In Argentina, the high altitude Salta region (highest wine growing region at up to 1700 meters and closest to equator) produces thick skinned grapes with higher acidity that produce more robust wines than those of Mendoza.

Seeds and seed tannins – In a wine grape, seed tannins weigh 3.5 – 5 milligrams compared with 0.5 – 0.9 milligrams of skin tannins, making seed tannins about 6 times more plentiful.

Seeds make up 6% of the weight of grapes. Delestage is able to remove up to 1/3 of seeds.

For all the new found interest in tasting seeds as the critical factor in determining time to pick, I have found very little in the literature explaining the difference between unripe and ripe grape tannins. One study found that seed tannins in Syrah grapes declined by about half from véraison to harvest, and were about three times greater than skin tannin concentrations.

Tannins in the Ferment

In the ferment, the less plentiful **skin tannins** come out earlier and more easily as most are water soluble and don't need heat or ethanol for extraction (ergo cold soak).

Seed tannins come out only with ethanol as a solvent and at a much slower pace. While skin tannin extraction plateaus, seed tannins come out slowly and steadily for a longer time including during any extended maceration.

Seed tannins comprise about 60% of total phenols in **conventionally produced** wine with nearly half of extractable bittering compounds in grape seeds transferred to wine.

As home winemakers, we can influence this 60/40 figure in a number of ways:

Cold Soaking: Sulphite at 25 mg/L and do daily punch downs to stimulate colour extraction and to reduce bacterial infection risk. Temperatures of 7 C or lower are suggested. Some Barossa shiraz is being cold soaked for 1 – 2 months using dry ice pellets. If grapes are not impeccable on receipt, do not cold soak as the mould or ? will take off and eat up the nutrients needed by the yeast and ML.

Colour Pro and other colour enhancing enzymes enhance tannin extraction. Similarly **yeast selection** can favour enhanced structure and mouth feel while others emphasize varietal character and fruitiness – if you can overcome the tannin vocabulary.

Catechins are more soluble in alcohol so removing seeds early in the ferment is the optimal time.

Time of Pressing: At 2 – 4 brix, the wine has all the colour and flavour you will get, so continuing on the skins/seeds **will only increase bitter seed tannin extraction**.

Ferment temperature: While the Scott Lab catalogue recommends keeping ferment temps below 82 F for high brix musts, others suggest a brief temp spike into the mid 90s F can promote some desirable reactions to happen as skins break down. Temperature is the primary factor in

tannin extraction from skins; duration of ferment influences extraction from seeds. Hotter will pull out more of everything while cooler extracts fewer tannins and preserves more fruity flavours and aromatic esters.

Before anyone becomes overly focused on maximizing skin tannins and minimizing seed tannins, please note that a huge focus has been put on the contribution of short chain seed tannins to bitterness as compared with the contribution of longer chain skin tannins to astringency.

Astringency – the tactile sensation of dryness and roughness in the mouth. Through wine making technique and aging tannin molecules join into medium and long molecules. It is believed that long molecules taste astringent while short young molecules taste bitter.

Bitterness – one of the 5 basic flavours (the others being sweetness, saltiness, acidity and umani). Small molecules, those found in seeds, impart bitterness. The reason for this is thought to be that the bitterness receptors in our taste buds are too small to taste the big tannin chains that come off as astringent.

But as Steve Jobs would say, "There's one more thing." Most qualified wine judges, even when asked to differentiate between bitterness and astringency, are not able to do so.

And so, as we begin a ferment, maybe we should think more about total tannins and less about manipulating the 60/40 ratio between seed and skin tannins. Factors to consider when assess total tannins include:

- **A high concentration of extractable seed tannins** has been shown to negatively impact wine quality

grape source - where the grapes came from with hotter regions usually producing bigger tannins

- **assessing by taste** the total volume of tannins in the grapes and how bold the fruit taste is to carry large tannin volumes

- **assessing by number of seeds** – the average grape has 1.5 seeds. If your grapes have 2 – 3 seeds per berry your must has the potential for being overly tannic.

- **age of drinkability** - are you aiming for enough tannin for the wine to be in its prime between 7 – 20 years? If you don't have the storage space and stock pile of drinkable wines for those next 7 years, you may want to restrict tannins and maybe raise pH.

- **meat or greet?** Is this wine to compliment red meat or will it being consumed without food?

Once in suspension, tannin chains begin to form, reform and break apart:

- Some change through oxidative reactions, others through reaction to acid.

- Others bind with anthocyanins (colour compounds) forming pigments that provide long term colour stability.

- Others morph into forms that provide structure and mouth feel.

Tannins in Wine

By the end, only 20% of wine tannins have the same structure as the preceding grape tannins. This transformation is individual to each batch of wine and the contribution of half the compounds is unclear.

Myth**:** **Tannins that remain in suspension do not continue to form longer chains** which is fortunate as aging wine would become overly astringent. Those that do form long chains through oxidization or binding with proteins (fining) drop out.

A 50 year vertical of a single Australian cab sauv found lots of vintage variation, but there was no sign of tannin drop-off; some of the oldest had more phenolics than recent vintages.

Some wines start and stay hard, but more often perceived tannin levels drop and, if there is still some fruit, the balance in a well aged red shifts harmoniously. Research has determined that the tannins don't form longer chains and they don't drop out – but **what they do to improve is not known.**

Because tannins are bitter and astringent they contribute to the **mouth feel** of the wine.

Tannins precipitate the salivary proteins that lubricate the mouth and make it easy to chew and swallow food. This causes the drying and puckering sensation associated with drinking red wine. In addition to protein, tannins also interact with polysaccharides in saliva as well as cells in the oral cavity. These interactions are impacted upon by the alcohol concentration and viscosity of the wine and can be masked by residual sugar and other flavour and aroma characters, such as fruit intensity. The perception of mouth feel is also affected by tannin concentration, polymer length and polymer composition. We know that epicatechin-gallate is perceived as coarser than epicatechin, while epigallocatechin is perceived as smoother, however the sensory character of oligomers and polymers and combinations of tannins and other elements such as polysaccharides is unknown.

Tannins most important benefit is their affinity to bind with oxygen and so they function as an antioxidant slowing the transformation of phenolics into browning compounds and alcohol into acetaldehyde, a common spoilage compound.

Types of tannins

1. Hydrolyzable tannins

Tannins attached to sugar molecules which, when diluted in water, can be cleaved into the subcomponents of gallotannins and ellagitannins. These are relatively soft tannins found in low concentrations in grape juice. The ellagitannins, castalagin and vescalagin are abundant in oak and chestnut. So if you want to add more pronounced yet rounder mouthfeel, add a wood based tannin mix.

2. Condensed tannins

Condensed tannins are found in seeds, to a lesser extent in stems, and very little in the skins. These tannins are able to polymerize (bind) with anthocyanins so as to make the wine colour more stable with less dropping out.. All, condensed tannins are derivatives of the flavanol,

catechin. Since anthocyanins are more soluble in grape juice, do a cold soak before fermenting, having sulphited at 25 mg/L and do daily punchdowns to stimulate colour extraction and to reduce bacterial infection risk. If grapes are not impeccable on receipt, do not cold soak as the mould or ? will take off and eat up the nutrients needed by the yeast and ML.
Catechins are more soluble in alcohol so removing seeds early in the ferment is the optimal time.

3. Complex tannins

Both types of tannins evolve over time in carboys, barrels and bottles into large, high-molecular weight complex tannins. They also bind with anthocyanins and precipitate resulting in a lighter colour and reduced bitterness.

Points to Ponder (Stuff I could not find a better place to fit in)

Emile Peynaud: “A considerable amount of tannin is more acceptable if acidity is low and alcohol is high. The less tannic a red wine is, the more acidity it can support (and needs for freshness)”.

Testing tannin: There are tests for tannin which are both expensive and time consuming. But even if you had access to testing the results would be of little value unless you had several years of past numbers for those vineyards and samples of the wine produced.

Eleni Papadakis speaking on Managing Tannins: Toasted oak is **caramelized sugar** so its addition serves to soften the grape and oak tannins.

Sandra Oldfield: With the heat in California, they get huge tannins and their techniques are geared to minimizing tannin extraction. BC reds do not develop big tannins and for Tinhorn’s reds, we are often looking to add tannins. (perhaps referring to Merlot and Cab Franc).

I focus on **how the wine drinks after 3 years** when it goes to market and do not attempt to speed processes that occur naturally over time (such as tannin polymerization).

Fining with egg white or gelatine does reduce tannins but they can result in a less desirable wine, so bench tests should be done first.

Many suggest keeping the **pressed wine separate** from the free run and possibly fining the pressed before combining. Tom Schillimore noted that they used to keep pressed and free run separate and that over time the pressed wines had longevity (10 – 15 years for Tom) while the free run were over the hill rapidly

The **grapes** certainly limit our options, especially since we usually have no control over picking decision. And most of us seem to have a “Bigger is Better” mindset. Keep in mind with respect to crushing and destemming that the more whole berries that come through and the fewer shredded skins and broken seeds, the greater the potential for a lighter style with reduced tannin extraction. (Since most of us have no control of crusher settings, so an alternative could entail the time consuming manual removal of some whole berries from the stems.

Using Oak Adjunct: If fruit tastes big but has vegetal hints, adding an oak adjunct will increase overall structure, not overwhelm fruit and get rid of the vegetal character.

Other options: **add skins from a different ferment** in must or at time of pressing. Addition of whites may stabilize colour and provide aromatics

Delestage

Delestage means the process of fermenting red wine with skins and seeds, and doing sub-heroic treatments to the fermenting mass to insure not only a complete fermentation, but to achieve a finished wine with good fruit, soft tannins and stable color. Part of the motivation to study and to perform the process called delestage is the advancement of the date of marketability of the red wines treated this way. Simply put: delestage may enhance not only wine quality, but cash flow as well. Professor Bruce Zoecklein at Virginia Tech has done some excellent research on the quality of the results of this process. In detail, the delestage procedure is as follows:

1) The de-stemmed and crushed red grapes are pumped or dumped into a fermenter. The fermenter is usually open-topped, and equipped with a drain valve at the edge or the center of the tank bottom.

2) The fermentation is begun in the standard way.

3) The delestage really starts here: the first step is to drain the tank through a bottom valve, into an intermediate container by letting the juice/wine flow freely across a screen to capture and remove some of the seeds, a step known as seed deportation. (Seed deportation is not really a part of the word delestage. However, seed removal is so important in the improvement of the wine that I think of it as an integral part of the process.)

4) From the intermediate container, a pump then sends the juice/wine to a second tank.

5) This trip is done with some fanfare: the wine entering the second tank goes in over the top to become aerated, read that 'sprayed,' into the receiving tank. Magnificent aromas fill the fermenting room as a result.

6) The seed-catching screen is emptied as necessary to keep a good flow without spilling the juice out of the screen or the small intermediate container.

7) After all the juice/wine has been removed from the starting tank it is, in fact, returned to starting tank, where the huddled mass of grape skins waits.

8) The returning wine also goes in over the top, with spraying, to accomplish a second aeration.

Whether the delestage process is performed once a day, or twice a day, or every other day, seems to vary from winery to winery. The amount of seed deportation varies as well, being somewhat dependent on the slope of the tank bottom and the location of the drain valve used. The fermentation is normally completed in five to seven days.

Benefits of the Delestage Process

Several articles on delestage all emphasize:

- total drainage of juice from the cap
- removal of up to 1/3rd of seeds from out flowing juice
- leaving skins and liquid separate for about 2 hours
- vigorous and rapid spraying of the juice over the skins.

I am guessing that most of us trying to follow this process by bucketing from full to empty primaries are not achieving several of these points.

Pump Over Alternative

Quote from Adrian Capenata – owner and winemaker at Cassini Cellars: "Winemaking is a lot of work; I hate doing pump-overs, but I'm doing pump-overs continually because it makes a difference."

Some commercial wineries that use pump over in stead of delestage or cap punching think that pump over does not get enough oxygen into the wine and so they add venturis into their return hose for added aeration. A big volume pump and facilities when this amount of splashing can be managed are just not in the world of home wine maker possibilities.

Home Wine Making Considerations

Home Delestage: I would suggest that those that are doing it are more successful at the seed removal part of the process rather than the aeration. Might pressing at 2 – 4 brix restrict seed tannins in a more labour saving manner?

Why Oxygenate? Oxidized tannins bind into large enough chains to drop out; so the effect is to reduce tannins. Commercial wine makers speak glowingly about the wonderful aromas that come into the winery when doing pump overs and maybe delestage. Those aromas are certainly not going to be in the wine when bottled. Aren't most commercial wineries doing this to speed the marketability of their product?

Aquarium pumps: If we think our tannins may be excessive we can remove seeds by bucketing, press early and maybe expand our use of aquarium pumps which most of us use now for yeast health.

Most comments in the literature regarding macro oxygenation during red ferments refer to maintaining healthy yeast, minimizing H2S and possibly enhancing colour. Others speak to it softening tannins but I found very little suggesting how much oxygen is optimal nor any practical home method of managing the oxygen volume our wine absorbs.

Through micro-oxygenation, a new barrel delivers 1 mL or oxygen per litre per month to wine. Oxygen can be artificially delivered at rates of over 10/ month but such high rates may favour SO2 as opposed to phenolic compounds. More details? See: http://www.micro-ox.com/micro_tytib.htm

Tannin Related Web Links

1. Tannins vs. oak chips: what does each contribute to your wine?:
http://www.laffort.com/en/research-and-innovation/laffort-news

2. Tannin management keys
A premium Mediterranean approach including criteria for yeast selection:http://www.delteil-consultant.com/pdf/revues/pwv98.pdf

3. Tannin discussion covering sensing tannins, influence on colour, and aging:
http://www.wineanorak.com/tannins.htm

4. An Australian general discussion of tannins: http://www.gwrdc.com.au/webdata/resources/files/GWR_063_Managing_Tannin_Fact_Sheet_FINAL.pdf

5. A pro delestage discussion: http://www.winebusiness.com/wbm/?go=getArticle&dataId=27894

6. Bruce W. Zoecklein analysis of 3 years of controlled experiments on Merlot and Cab Sauv fermented using delestage, pump over and cap punching. Appreciation of article may require masters in Bio Chem and a fondness for obtuse writing. Be sure to begin by going to P7 and reading conclusion: http://www.practicalwinery.com/julaug09/page1.htm

7. Easy to read Winemaker mag article on delestage: http://www.winemakermag.com/stories/techniques/article/indices/35-techniques/237-delestage-fermentation-techniques

8. Scott Lab tannin products: Overview, fermentation tannins, cellaring tannins, finishing tannins and FAQs: http://www.scottlab.com/products-29.aspx

9. Laffort winemaking protocols by varietal (suggested timing and uses of Lafase HE Grand Cru, Tannin VR Supra, Tannin VR Colour, Biolees, tan'cor Grand Cru, Biotan as well as nutrients, ML, etc.: http://laffort.com/en/winemaking-protocol.

10. Fining to Reduce Astringency (found on VAWA web site): http://winegrapes.wsu.edu/Wineweb/newsletter/documents/vol15-3-2005-1.pdf

11. Wine Tasting- A Professional Handbook. A 300+ page handbook on wine tasting written by a Canadian: http://issuu.com/winemarshal/docs/wine_tasting_-_a_professional_handbook

12. Taming the Tannins. A non technical article on new approaches to tannin: http://articles.sfgate.com/2003-02-20/wine/17478892_1_tannins-wine-structure-winemaking-process

Duncan Ainslie

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