Viticulture, enology and marketing for cold-hardy grapes

Enhancement of Red Wine Structure and Mouthfeel Through the Addition of Enological Tannins

Tassel Ridge Winery
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Background and Rationale: Tannins are important to the quality of red wines, particularly to the color stability and structure (body and mouthfeel) of the wine. Cold hardy grapes tend to be lower in tannin content as compared to *Vitis* vinifera (traditional wine grapes). The addition of enological tannins has become a popular technique to increase the tannin levels in wine. The current study was undertaken to evaluate the effects of tannin additions on the phenolic composition and mouthfeel improvements of Marquette and Frontenac wines.

Treatments: Five tannin treatments were investigated (T1-T5) using 4 different commercial tannin products. Treatments were compared to the control (T6). The factors investigated were the type of tannins, the amount used, and the timing of addition. The 4 tannins used fall into the categories of fermentation (Ft. Rouge Soft and UvaTan-Soft), cellaring (Tannin Estate and UvaTan-Soft), and finishing (Tannin Riche) tannins, which refers to when the tannin additions are made during the winemaking process. In addition, combinations of the tannins were also evaluated.

Table 1. Tannin additions, treatment and timing.

Treatment	Tannin Type	Rate	Timing of addition
T1	Ft. Rouge Soft	1200mg/l	beginning of fermentation
T2	a.Uvatan Soft	400mg/l	beginning of fermentation
	b.second dose	400 mg/l	after first racking
T3	Tannin Estate	400 mg/l	after first racking
T4	Tannin Riche	400 mg/l	after second racking
T5	a.FT Rouge Soft	600 mg/l	beginning of fermentation
	b.UvaTan Soft	200 mg/l	beginning of fermentation
	c.Tannin Riche	200 mg/l	after second racking
T6	NO tannin addition (Control treatment)		

Methods:

Winemaking

Wines were made from Frontenac and Marquette varietals from the 2012 vintage. The grapes were provided by Tassel Ridge Winery (Oskaloosa, IA) and the wines were made by ISU staff in the Tassel Ridge warehouse facility. The Marquette and Frontenac grapes were machine harvested on August 22nd and September 15th, respectively. At the time of harvest the berries had a chemistry of 27 ˚Brix, titratable acidity of 10.60 g/L and pH 3.28 for Marquette and 23.3 ˚Brix, titratable acidity of 8.40 g/L and pH 3.55 for Frontenac. Grapes were de-stemmed and crushed at Tassel Ridge Winery in Leighton IA. Sulfur dioxide (SO_2) at 50 mg/L of Potassium metabilsulfite was added to the must which was then transported to a cold storage facility. Must was stored at -12 ˚F until further processing.

The Marquette grapes were removed from cold storage on Monday October 3, 2012, and transported to the processing facility. After 24 hours, 80 pounds (about 26 liters) of partially frozen must was placed into 18 (6 treatments and 3 replications) 20 gallons capacity food grade plastic fermenting containers. On October 19th, the process was repeated with the Frontenac grapes. Unless otherwise stated the tannin addition treatments, yeast inoculation and fermentation management practices were identical for both wines.

The must was allowed to sit until completely thawed prior to enological tannin additions. The must was mixed thoroughly and enological tannin treatments were applied according to the manufacturer's instructions.

The day following the tannin additions the must was inoculated with *Saccharomyces cerevisiae*, strain Vitilevure 3001, at the concentration of 0.3 g/L. The yeast were rehydrated with GoFerm, per the supplier's instructions then added to the must and mixed to disperse the yeast.

The fermentation temperature and degrees brix were monitored daily and the cap was punched twice a day. For the Marquette must, distilled water (0.9 L) was added to each container and mixed to lower the brix of fermenting must. It was not necessary to do this with the Frontenac must. After completion of fermentation, the must was pressed, 50 mg/L SO_2 was added, and the wines were stored in 5 gallon carboys equipped with air locks.

After approximately 1 month in storage the wines were racked for the first time, tannins were added to the appropriate treatments (T2 b and T3), sulfured (20mg/L), and stored. A month after first racking, the wine was racked for the second time, tannins were added (T4 and T5 c), and SO_2 was added to attain 0.8 molecular SO_2.

In mid-February 2013, after all tannin additions were complete and the wine had been stored for several months, samples were taken and sent to ETS Laboratories (St. Helena, CA) for the phenolic profile analysis. In June 2013, the wines were sampled again and sent out for phenolic profile analysis.

In March 2013, the wines were bottled and the Marquette wines were presented to wine industry members for sensory evaluation, at the Iowa Wine Growers Association annual meeting.

Wine analysis

Samples of each treatment were taken in June, 2013 to evaluate the effect of the tannin additions on basic wine chemistry and organic acid profile. Basic wine analysis evaluated pH, titratable acidity, volatile acidity, free and total SO_2, residual sugars, and alcohol content. These procedures were carried

out using standard methods. The phenolic profile analysis performed by ETS Laboratories was also performed using HPLC, using the lab's proprietary methods.

Results:

Wine Chemistry. The tannin additions do not appear to have an effect on overall wine chemistry in terms of pH, titratable acidity (TA), volatile acidity (VA), residual sugars (RS), and alcohol (OH) between treatments (Table 2). These results indicate that enological tannin additions have little to no effect on yeast performance and the basic chemical properties of the wines.

Table 2. Basic chemical analysis of the research Marquette and Frontenac wines with enological tannin additions.

Marquette	Control	M T1	M T2	M T3	M T4	M T5
pH	3.5	3.3	3.3	3.3	3.5	3.5
TA	9.5	10.0	9.8	9.6	9.6	9.5
VA	0.8	1.0	0.8	0.8	0.7	0.8
FSO_2	49.9	49.8	43.2	26.1	15.2	46.9
TSO_2	70.6	76.6	70.6	45.1	21.7	71.3
OH (% v/w)	12.6%	14.0%	13.9%	13.3%	13.4%	12.7%
RS (% w/w)	0.3%	0.2%	0.2%	0.3%	0.3%	0.3%

Frontenac	Control	F T1	F T2	F T3	F T4	F T5
pH	3.7	3.5	3.5	3.6	3.6	3.6
TA	9.7	10.0	10.4	9.9	10.1	10.1
VA	0.8	0.7	0.7	0.8	0.8	0.9
FSO_2	66.9	57.5	48.9	70.0	43.4	75.4
TSO_2	119.1	102.6	83.0	131.4	74.4	124.0
OH (% v/w)	12.1%	12.1%	12.0%	12.2%	11.9%	11.7%
RS (% w/w)	0.4%	0.5%	0.4%	0.4%	0.4%	0.4%

Phenolic Profile. At six months of age, the main results observed between the control and the various tannin addition treatments were an overall increase in the concentration of –tannins in the wine compared to the control (Figure 1). As expected, those wines that received the highest concentration of tannin additions (T1 and T5) had the greatest concentration of quantifiable tannins. This value however did not correlate with an additive function; fewer tannins were quantified compared to what was added. The other notable difference in the phenolic profile of these wines can be observed in the anthocyanin concentration (Figure 2). In the case of the Marquette wine, an increase in the concentration of the total anthocyanins and monomeric anthocyanins was observed in the treated wines when comparing the means of two replicates. This increase was not observed in the Frontenac wine.

The phenolic profile was measured again -after wines had been aged for 9 months. Compared to the young wine samples (6 months) a similar trend in the phenolic profiles was observed for tannins and total anthocyanin concentration (Figure 1 and 2). The tannin additions had little effect on any phenolic compound concentrations other than the tannins. The total anthocyanin content did however decrease with aging.

Statistical analysis of this data (one-way ANOVA) revealed that in young Marquette wines (6 months) there was no statistically significant difference observed between the treatments in terms of tannin concentration (mg/L) or total anthocyanin levels (p=0.05). However, at 9 months a significant difference in the tannin levels was observed between treatments. This may indicate that the levels are increasing with age depending on the treatment, as observed in treatments M T1, M T2, M T3, and M T4 (Figure 1). Though there is not a mathematically significant difference between treatments there is in fact a numerical difference in the concentrations of tannins and total anthocyanins which could account for any perceived sensory differences.

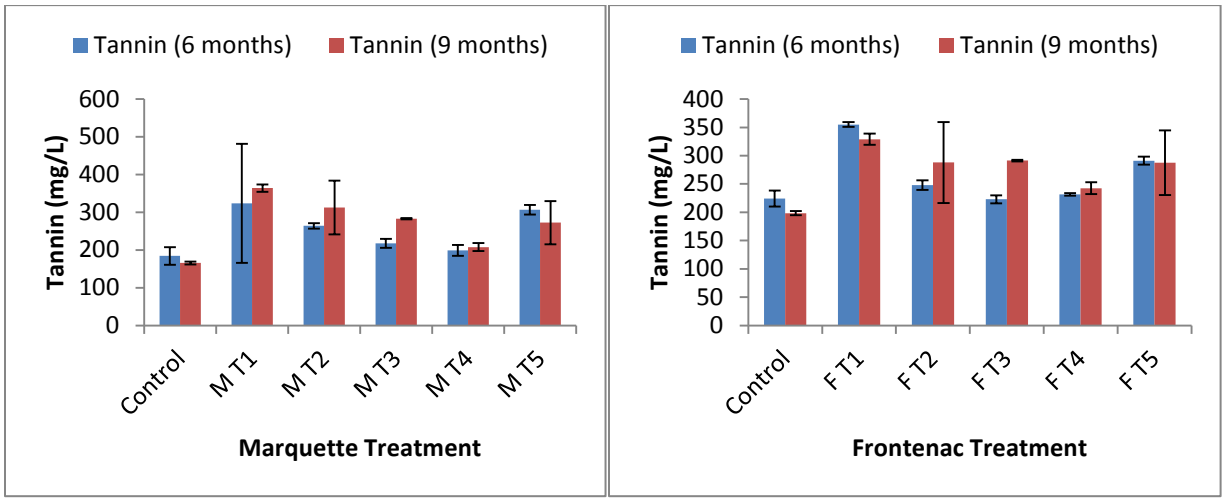

Figure 1. Tannins in young wines (6 months old) and aged wines (9 months old) treated with enological tannins. Values reported as mean concentration (mg/L) of each compound (n=2).

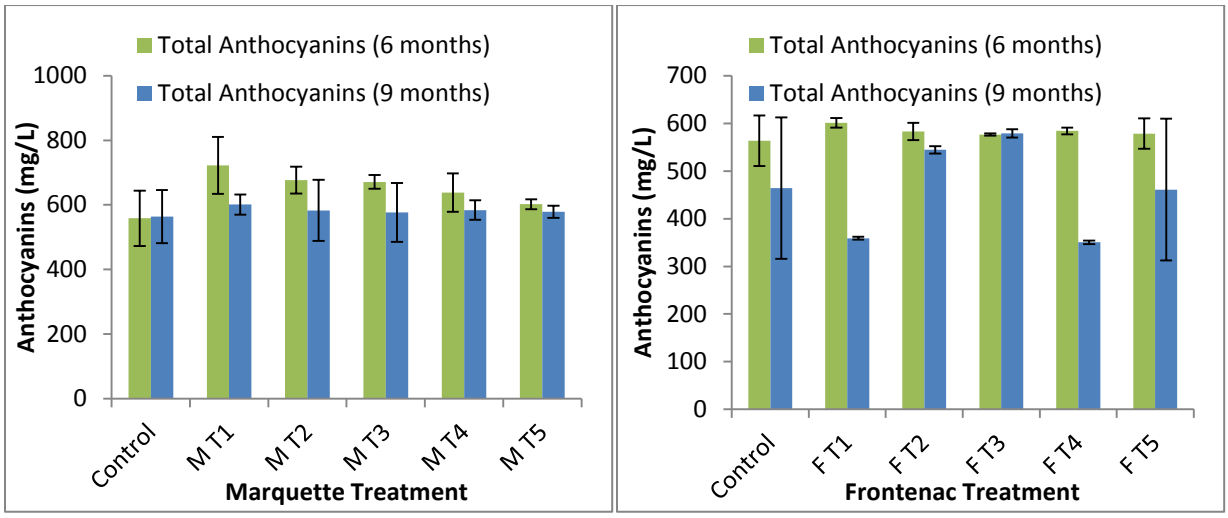

Figure 2. Total anthocyanins in young wines (6 months old) and aged wines (9 months old) treated with enological tannins. Values reported as mean concentration (mg/L) of each compound (n=2).

Industry Evaluation. The young Marquette wines underwent sensory evaluation to determine the effects of tannin additions on body (thin to full) and mouth feel (harsh to soft). The panelist were untrained industry members that were asked to rate the wines on a scale of 1-5 (1 being thin and 5 being full; 1 being harsh and 5 being soft). The overall trend of the sensory analysis showed that for all

treatments the tannin additions lead to a fuller body wine (Figure 3). Due to lack of aging and integration of the tannins, all of the treated wines were rated as harsher than the control. It is expected that this effect should soften with time. In terms of preference, the industry panel preferred treatment 4 (Tannin Riche) to the control and the other treatments. Tannin Riche are derived from 100% toasted French oak. We will be taking another phenolic profile measurement at 18 months and preforming an additional industry tasting to gather more information about the effect of these enological tannin additions.

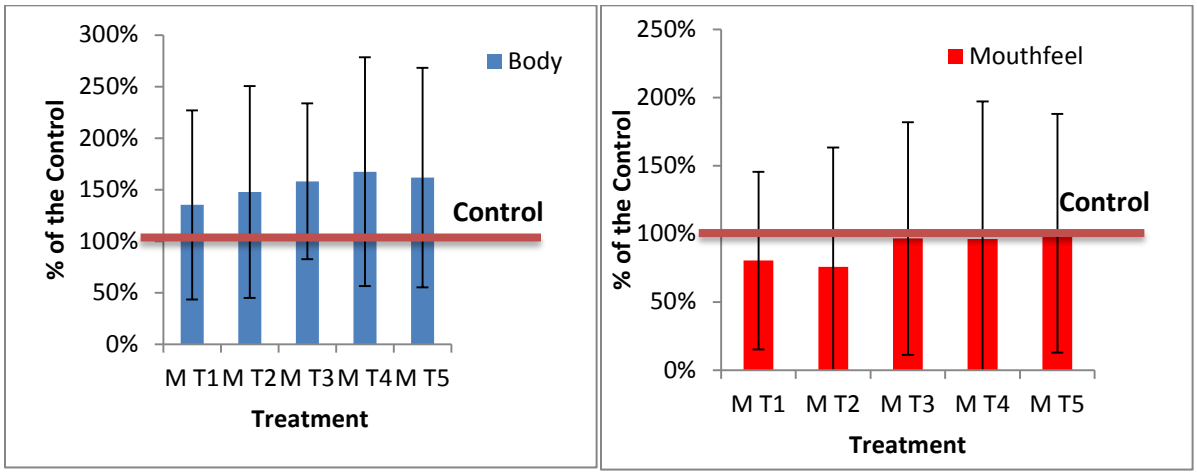

Figure 3. The effect of enological tannin additions on sensory perception of body (thin to full) and mouth feel (harsh to soft) of wine made from Marquette grapes. The treated wines were both fuller and harsher compared to the control. In an informal survey treatment 4 was the preferred treatment.

What the results mean:

- Marquette and Frontenac wines treated with enological tannins exhibited high concentrations of tannins and total anthocyanins compared to the controls. This infers they can be used as a means to increase the tannin content of cold-hardy varietals.
- The addition of enological tannins has no effect on the overall wine chemistry outside of its phenolic profile. Meaning the addition of these tannins would not have an effect on balance and final alcohol content of treated wines.
- The addition of enological tannins had no effect on the outcome of the fermentation regardless of their time of addition.
- For all Marquette treatments the addition of enological tannins resulted in a change in the sensory perception of the wine.