FINAL REPORT

August 30, 2015

Virginia Wine Board

Creating Amarone-Style Wines Using an Enhanced Dehydration Technique.

Principal Investigators:

Molly Kelly, Enology Extension Specialist
Virginia Tech
Department of Food Science and Technology
22 FST Building, MC 0418
Blacksburg, VA 24061

Phone: 540-231-2158
Fax: 540-231-9293
Email: mkkelly@vt.edu

Commitment: 70%

Bruce Zoecklein, Emeritus Professor
Virginia Tech
Department of Food Science and Technology
22 FST Building, MC 0418
Blacksburg, VA 24061

Phone: 540-998-9025
Fax: 540-231-9293
Email: bzoeckle@vt.edu

Commitment: 30%

Start date: July 1, 2014

Type of project: Research

Amount funded in current year: $28,231

A. OBJECTIVES:

1. To enhance the process of grape dehydration, thereby lowering the cost of production and improving wine quality.
2. To support the technical growth and development of Virginia's wine industry, through applied viticultural and enological research.
3. To evaluate a novel viticulture and processing method of fruit dehydration for Virginia.

B. SUMMARY:

Our research has demonstrated the effectiveness of oleic acid esters in increasing the dehydration of fruit both on the vine and in dehydration sheds. Preliminary data was collected in 2013 and the study fully elaborated (as a result of Board funding) in 2014.

C. RESEARCH PROGRESS

Dehydration Chamber Study: Cabernet franc and Merlot were collected (1) at harvest, (2) 48 hrs post dehydration in a converted tobacco barn and (3) after being sprayed and dried 48 hrs in a converted tobacco barn. Berry samples were weighed and primary chemistries conducted. Results in **Table 1** demonstrate changes in all berry parameters, including increased degrees Brix and decreased berry weights as a result of spray treatment.

Vineyard Study: Cabernet franc and Merlot vines were treated with spray at approximately 19 degrees Brix and harvested at 22 degrees Brix. Treated fruit was evaluated and compared with control vines and dehydration chamber fruit. Similar changes were observed as with dehydration barn samples as seen in **Table 2**.

Electronic nose: Using a conducting polymer multisensory array system, volatiles present in both berry samples, as well as wine samples, were measured. Changes in the sensors create a distinct pattern of volatiles. The electronic nose was able to distinguish among dehydration barn treatments as indicated in **Figure 1**. Non-intersecting circles demonstrate that the electronic nose was able to differentiate among treatments in both Cab franc and Merlot, likely due to variation in fruit volatile compounds.

Gas chromatography-mass spectrometry (GC/MS): Wine samples are currently being analyzed as described by Whiton and Zoecklein (2000), to measure volatile aroma/flavor compounds to further elucidate treatment effects.

Sensory Evaluations. The 2014 wines will be evaluated in March at the Food Science and Technology Sensory Lab, Virginia Tech, Blacksburg, VA, using triangle difference testing for separate evaluation of aroma, flavor (retronasal) and color as described by (Meilgaard et al. 1999).

Juice Primary Chemistries: In all cases treatments increased Brix, pH, TA and malic acid concentrations. Under normal conditions dehydration enhances the rate of respiration. Thus, fruit that is dehydrated can lose a relatively high concentration of malic acid vs. tartaric acid, negatively impacting wine balance. That was not the case with this study.

Wine chemistries/phenols: Basic wine chemistries were performed as described by Zoecklein et al (1991) and demonstrated differences in treatment wines **(Figures 2 and 3)**. Wine phenols were assayed by a reference laboratory as these analyses are specialized. Differences were observed in a number of phenols that contribute to wine quality **(Figures 2 and 3)**. The nature of the various grape and wine phenols listed in the figures are outlined below:

Monomeric anthocyanins form initial red wine color. They are unstable in wine and bind with tannins to form stable polymeric-anthocyanin pigments. Thus, as wine maturity and stability increases the concentration of monomers diminishes while the concentration of polymers increases. The higher the relative level of polymeric pigments the greater is the color stability. Polymeric pigments form wine colloids which help to integrate aroma/flavor.

Total anthocyanins refers to the compilation of red colored pigments in all forms. This measure relates to spectral color, however is not the same as a result of pH effects, among others.

Malvidin glucoside is one of 5 pigments found in *Vitis vinifera*. As the principle pigment, malvidin makes up about 50% or more of the total pigment complex in Merlot and Cabernet franc. The concentration of this monomeric pigment is highest in fruit and young wine.

Tannins are phenolic compounds with a molecular weight between 500 and 3500. They are the source of structure in a red wine, contribute to color stability, astringency and bitterness. They can undergo oxidative polymerization or binding together which can impact both mouth-feel and color by forming colloids. The qualitative nature of tannin phenols may be more important than quantitative.

Polymeric pigments refers to tannins and anthocyanins that have bound together to form chains via oxidative and non- oxidative polymerization. This chain formation increases color stability. Polymeric pigments form colloids thus aiding in aromatic integration.

Total phenols are a broad class of organic compounds that contribute to wine color, texture and flavor.

Quercetin is a flavonol phenol which is localized in grape skins. These compounds act as the grape's sun screen and are produced in higher concentration in sun exposed fruit. The can act as cofactors to enhance color.

Gallic acid is a simple phenol and used as a standard measure for phenol concentration. It can act as a source of color enhancement by acting as a cofactor for enhanced visual color.

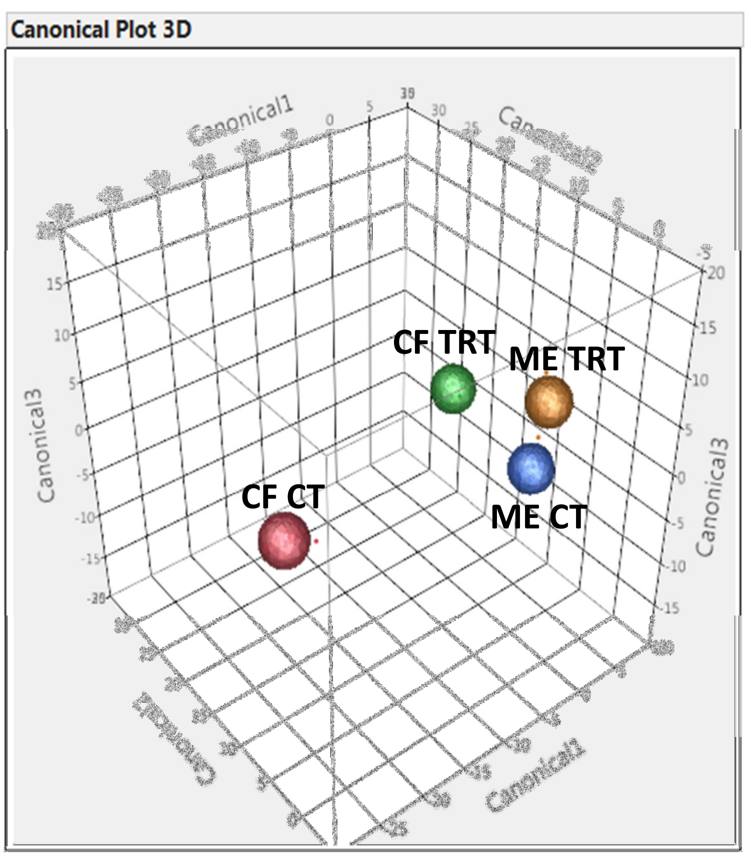
Table 1 Primary chemistries of Merlot and Cab franc fruit from dehydration barn samples (untreated: control, sprayed: treated)

Merlot dehydration barn	Brix	pH	TA (g/L)	YAN (mg/L N)	MALIC ACID (g/L)	Berry weight (g)
Control	26.80	3.91	5.98	152.67	2.42	1.17
Treated	29.33	4.16	6.32	179.33	2.78	1.00
Cab franc dehydration barn						
Control	28.53	4.20	5.27	169.67	3.48	1.41
Treated	31.93	4.40	6.62	229.33	4.37	1.19

Table 2 Primary chemistries of Merlot and Cab franc fruit from fruit treated in the vineyard (untreated: control, sprayed: treated)

Merlot vineyard treatment	Brix	pH	TA (g/L)	YAN (mg/L N)	MALIC ACID (g/L)	Berry weight (g)
Control	19.78	3.87	5.16	135.00	2.56	1.39
Treated	23.03	4.06	6.09	164.00	3.68	1.15
Cab franc vineyard treatment						
Control	20.08	3.81	6.46	172.75	3.16	1.55
Treated	21.98	3.86	6.71	181.75	3.66	1.42

Figure 1 shows the electronic nose analyses for 2014. Data in this spacial array represent mean values and are represented as circles. As can be seen, treatment vs. control data are clustered in different plot regions, illustrating that volatile component were statically significantly different between control and treatments (95% confidence limit). Thus, clearly there was a treatment effect. GC/MS analysis of individual volatile components along with sensory difference testing is pending.
CF: Cabernet franc; ME: Merlot; CT: control, no treatment in dehydration chamber; TRT: treatment in dehydration chamber.



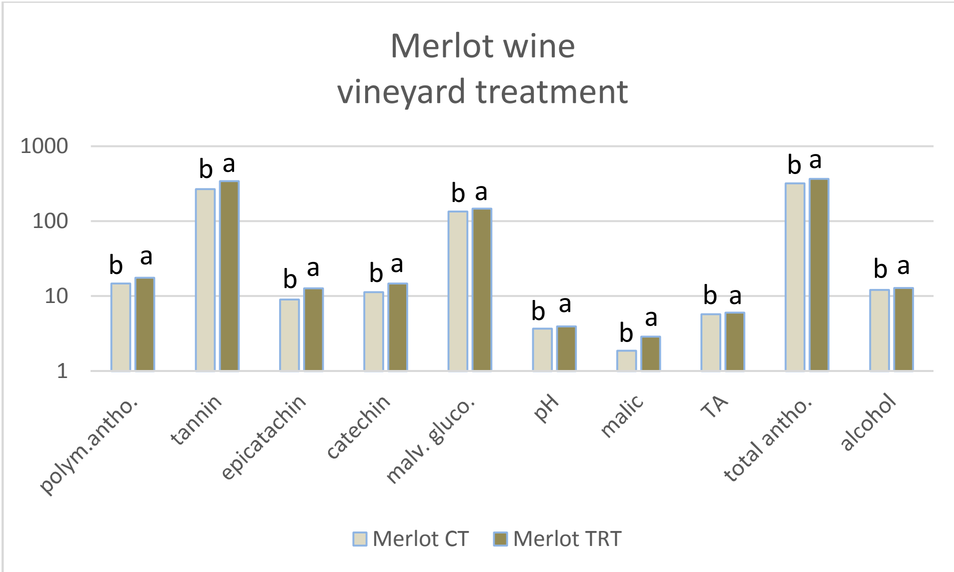


Figure 2 Effect of vineyard dehydration control (CT) and treatment (TRT) on wine phenols and primary chemistries. Different letters indicate significance at α = 0.05.

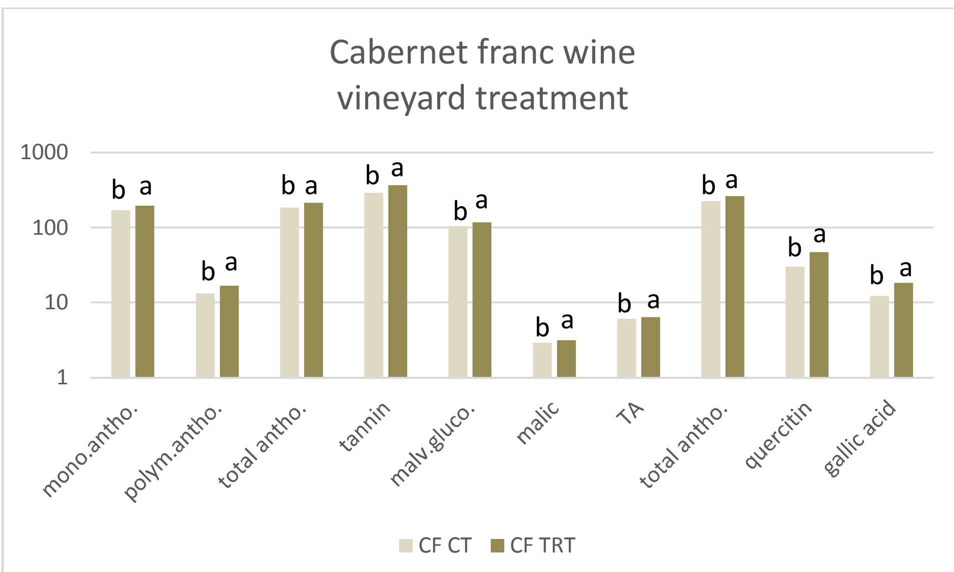


Figure 3 Effect of vineyard dehydration control (CT) and treatment (TRT) on wine phenols and primary chemistries. Different letters indicate significance at α = 0.05.

D. OUTCOMES AND BENEFITS EXPECTED:

Based on data generated from the 2013 and 2014 vintages we are confident that this research has practical merit.

- Growers may be able to reduce the risks to wine quality associated with early harvest.

- By reducing the shed dehydration time there is a significant savings in energy cost.
- Reducing the dehydration time may aid in the control of acetic acid production, a problem with this style of wine.
- This modified dehydration procedure may lower methoxypryrazine concentration (herbaceous character) thus increasing the fruit aroma potential.
- Using a more rapid dehydration system will help maximize the limited dehydration shed space in Virginia and allow for increased volume of fruit treated.
- Vineyard treated clusters may be a viable option compared to shed dehydration by reducing energy costs and optimizing efficiency.
- This modified procedure (either in the vineyard or sheds) may expand the stylistic variations of many VA cultivars.

E. EXPENDITURES:

Expense	Allocation	% of category spent as of 6/2015
Employee wages/fringe	**19,281**	**100**
Contractual services	**3,000**	**76.85**
Travel	**1,750**	**48.71**
Supplies and Materials	**4,200**	**134.25**
TOTAL	**$28,231**	**100 (20.12)***

***OVERSPENT $20.12-COVERED BY FOOD SCIENCE DEPARTMENT**

References

Meilgaard, M., G.V. Civille, and B.T. Carr. 1999. Sensory evaluation techniques. 3rd ed. CRC Press, Boca Raton, FL.

Whiton, R.S., and B.W. Zoecklein. 2000. Optimization of headspace solid-phase microextraction for analysis of wine aroma compounds. Am. J. Enol. Vitic. 51:379-382.

Zoecklein, B.W., K.C. Fugelsang, B.H. Gump, and F.s. Nury. 1999. Wine analysis and production. Kluwer Academic Publishers, New York