# REPORT

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: June 1, 2015

Type of project: Research

Amount funded in FY2015-2016: $40,208

## A. OBJECTIVES:

- To evaluate a novel on-the-vine fruit dehydration method for the Virginia grape and wine industry
- To evaluate this method as a means of lowering the cost of production and improving wine quality.
- To investigate this procedure as a way to increase potential stylistic variations for the Virginia wine industry
- To support the technical growth and development of the Virginia's wine industry through applied viticultural and enological research.

## B. SUMMARY:

Our research demonstrated the effectiveness of oleic acid esters in increasing the dehydration of fruit both on the vine and in dehydration sheds. The study was funded in 2014 and 2015.

**This document does not represent a final report**. This study was conducted two, quite different growing seasons. We requested an additional year's funding particularly for the field dehydration, but were denied.

As a result, we are unable to provide authoritative recommendations to growers regarding the field procedures and practices in used in this research. Additionally, we are unable to publish this research as a result of having but two growing seasons.

By not funding the third and final year the Board has not maximized their investment potential. We will subsequently request support for a third and final year.

## C. RESEARCH RESULTS

**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 berry parameters, including increased TA and malic acid 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 approximately 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 vineyard 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 were analyzed as described by Whiton and Zoecklein (2000), to measure volatile aroma/flavor compounds to further elucidate treatment effects. **Table 3** lists a number of volatile compounds that differed between treated and untreated Cab franc and Merlot wines produced from fruit sprayed on-the-vine. The associated aroma descriptors are indicated in the table. Different letters indicate significant differences exist between wines produced from control (untreated) and treated (sprayed) fruit.

**Sensory Evaluations.** The 2015 wines were evaluated 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). Unlike sensory evaluation of 2014 wines, no differences were found in 2015.

**Juice Primary Chemistries:** Basic chemistries were performed as described by Zoecklein et al (1991) and demonstrated differences in treatment juice **(Figure 2).** In all cases, treatments increased 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. Treatments also increased yeast assimilable nitrogen (YAN), potentially impacting fermentation kinetics and formation of wine flavor/aroma compounds.

**Phenols**: Phenols were assayed by a reference laboratory as these analyses are specialized. Differences were observed in a number of juice phenols that may impact wine quality **(Figure 3)**. The nature of the various phenols listed in the figure 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.

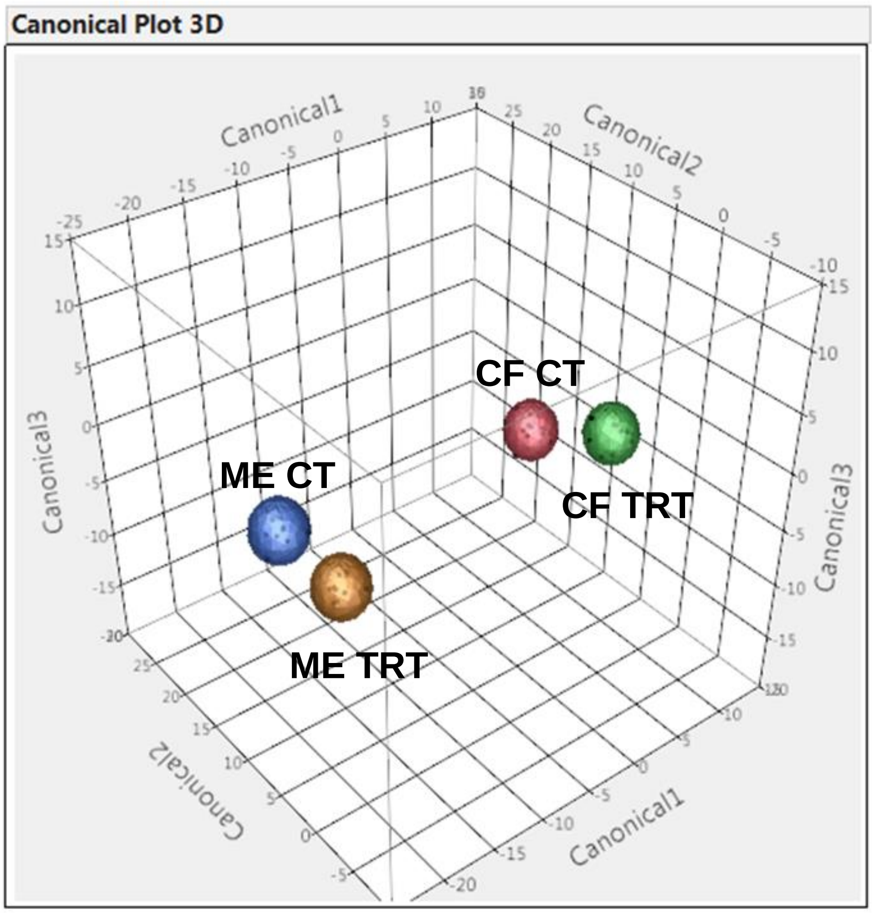
**Table 1** Primary chemistries of Merlot and Cab franc fruit from dehydration barn samples (untreated: control, sprayed: treated) (2015)

| Merlot dehydration barn | Brix | pH | TA (g/L) | YAN (mg/L N) | MALIC ACID (g/L) | Berry weight (g) |
|---|---|---|---|---|---|---|
| Control | 30.1 | 4.42 | 4.17 | 247.33 | 3.19 | 1.00 |
| Treated | 29.4 | 4.36 | 5.53 | 228.0 | 3.51 | 0.92 |
| Cab franc dehydration barn | | | | | | |
| Control | 26.17 | 4.33 | 4.76 | 207.33 | 3.42 | 0.98 |
| Treated | 26.63 | 4.42 | 5.04 | 201.67 | 3.61 | 0.90 |

**Table 2** Primary chemistries of Merlot and Cab franc fruit from fruit treated in the vineyard (untreated: control, sprayed: treated) (2015)

| Merlot vineyard treatment | Brix | pH | TA (g/L) | YAN (mg/L N) | MALIC ACID (g/L) | Berry weight (g) |
|---|---|---|---|---|---|---|
| Control | 20.63 | 3.93 | 3.86 | 192.00 | 3.02 | 1.61 |
| Treated | 23.05 | 4.08 | 4.00 | 217.25 | 3.73 | 1.18 |
| **Cab franc vineyard treatment** | | | | | | |
| Control | 20.28 | 4.22 | 3.13 | 132.75 | 2.02 | 1.39 |
| Treated | 20.63 | 4.24 | 3.50 | 141.50 | 2.37 | 1.31 |

**Figure 1** shows the 2015 electronic nose analyses for vineyard treated fruit. 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 components were statically significantly different between control and treatments (95% confidence limit). Thus, clearly there was a treatment effect.
CF: Cabernet franc; ME: Merlot;
CT: control, no treatment in vineyard; TRT: treatment in vineyard.



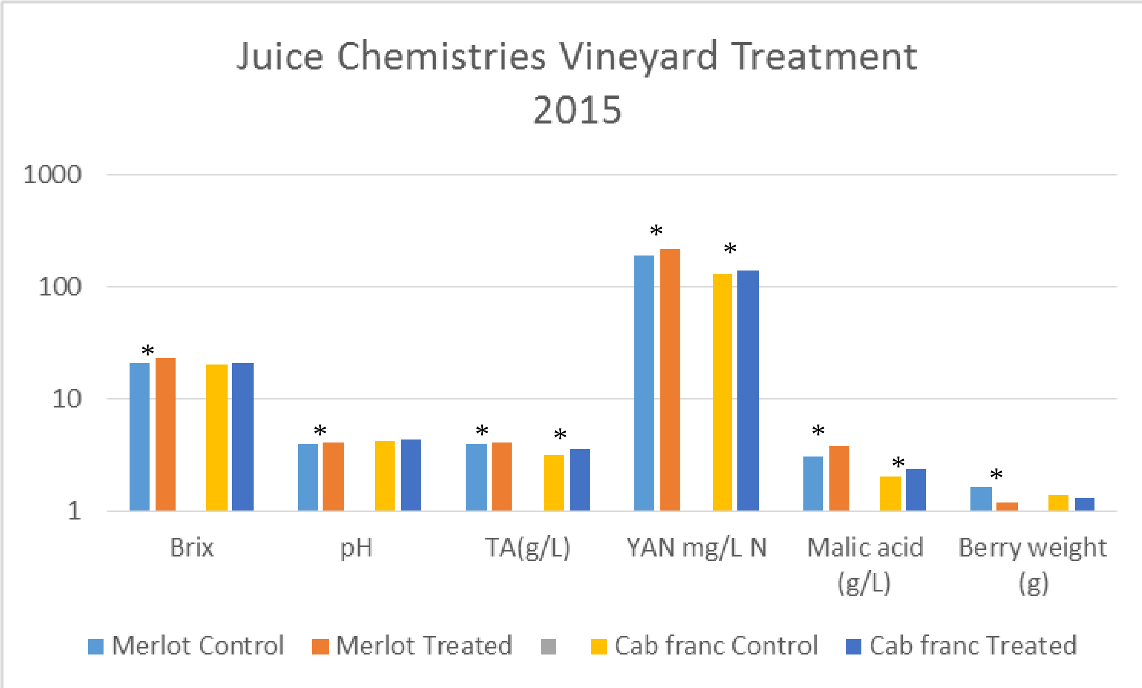



**Figure 2** Effect of vineyard dehydration control (untreated) and treatment (sprayed) on juice primary chemistries and berry weight. *indicate significance at α = 0.05.

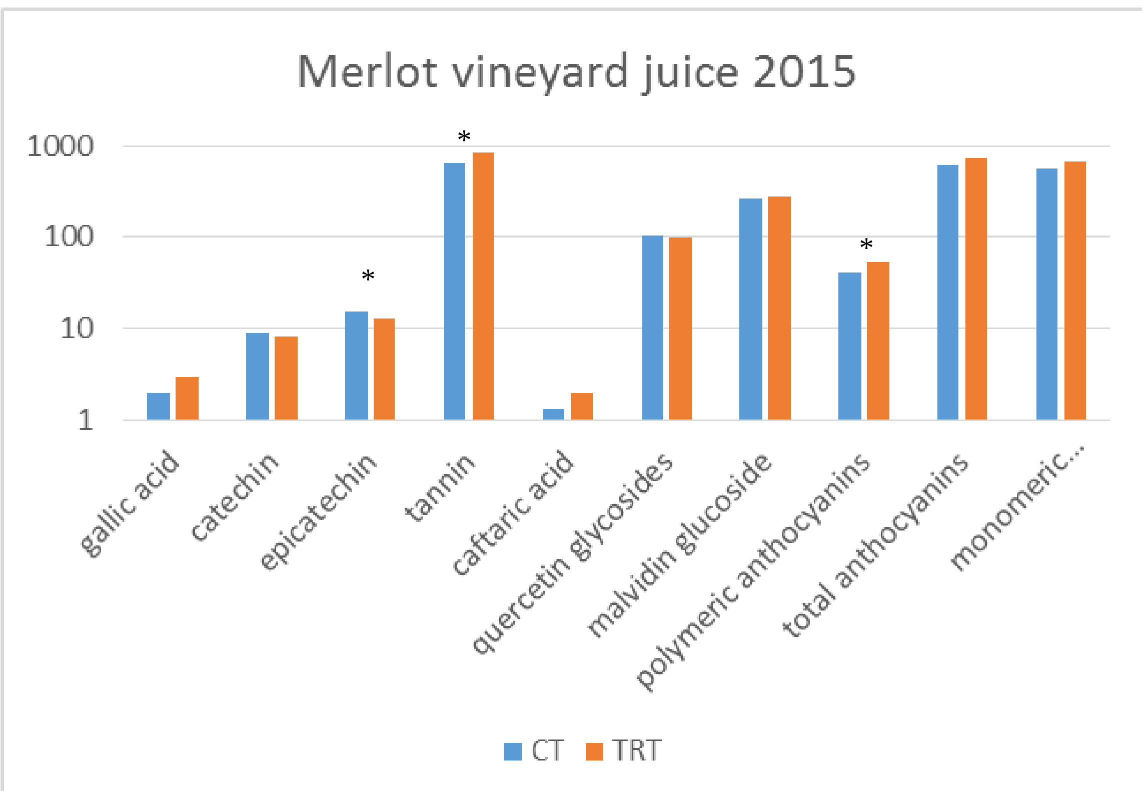



**Figure 3** Effect of vineyard dehydration control (CT) and treatment (TRT) on juice phenols. * indicate significance at α = 0.05.

**Table 3** Volatile compounds in Cab franc and Merlot wines produced from vineyard-treated fruit (µg/L)
CT: untreated, TRT: treated
Different letters indicate significant differences (α=0.05)
NS: no significant differences

| | 1-octanol | gamma-butyrolactone | nonanol | linalool | hexyl formate |
|---|---|---|---|---|---|
| **Cab franc CT** | 12.17b | 2253.33b | 18.66b | NS | NS |
| **Cab franc TRT** | 20.88a | 2276.67a | 27.83a | NS | NS |
| | | | | | |
| **Merlot CT** | 7.25b | NS | NS | 0.40b | 50.38b |
| **Merlot TRT** | 19.14a | NS | NS | 1.03a | 241.50a |
| | | | | | |
| **aroma descriptor** | citrus | fruity | floral | floral | plum |

## D. OUTCOMES AND BENEFITS EXPECTED:

This research conducted to date indicates the following:

- Growers may be able to reduce the risks to wine quality associated with early harvest.
- By reducing the shed dehydration time there may be 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 may 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 7/2016 |
|---|---|---|
| **Employee wages/fringe** | **30,534** | **104.17** |
| **Contractual services** | **2,811.50** | **99.77** |
| **Travel** | **1,820** | **91.49** |
| **Supplies and Materials** | **5,042.50** | **101.44** |
| **TOTAL** | **$40,208** | **99.97** |

## References


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

Petrucci, V.E., and C. Clary. 2001. A treatise on raison production, processing and marketing. Malcohm Media Press, clovis, CA. pp.268

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