

FINAL Report

Project Number and Project Title

ASC-12

TanninAlert: Improving Ontario red wine quality and consumer acceptance through winemaking techniques by grape variety and tannin level

Applicants: Debra Inglis (PI) and Belinda Kemp (co-PI)

Report: Final Report

Reporting Period: April 1, 2019-March 31, 2020

Date of Submission: February 24, 2020

Program Coordinator: Debra Inglis (PI) and Belinda Kemp (co-PI)

1. Executive Summary

Over the last decade, the increasing popularity of red wines has driven consumer market growth in Ontario and Canada. However, foreign imports have profited the most from these recent trends, representing about 84% of red wine sales nationally in 2014-2015. Similar trends are reported in Ontario, with red wine representing 60% (\$1.2 billion) of total wine sales, yet only 22% (\$149 million) of red wines sold are from Ontario wineries (2014-2015 Liquor Control Board of Ontario, LCBO).

Consumers favour wine products/brands that demonstrate a consistent quality despite annual weather or vintage variations. The dominant market share by foreign imports emphasizes a clear challenge faced by many of Ontario's wineries – that of producing consistent, high quality red wines. Given the overall trend of increased red wine consumption in Ontario and Canada, there is a tremendous opportunity for growth in Ontario's red wine sales and production. However, given its smaller size, higher labour costs and cool climate, Ontario's wine industry is unable to compete against imports on price alone. Therefore, strategic initiatives that are focused on developing product and process innovations to improve quality are the key to meeting consumer demands and subsequent growth of the industry.

Tannins are one of the most defining components of the quality of red wine. Knowledge of grape tannin concentration and composition at harvest and understanding how to best manage winemaking techniques accordingly are important steps towards improving red wine quality. Achieving the necessary colour, flavour and tannin for consumer acceptance of red wine can be a challenge during some growing seasons, which can lead to unfavourable characteristics in the final wine (less fruity flavours, lighter colour, more green flavours and increased astringency).

One solution to this problem is a unique precision oenology tool for winemakers that measures the maturation of red grapes, specifically TanninAlert. The tool analyzes tannin concentration in skins and seeds separately to evaluate phenolic levels in red grapes, then matches levels to winemaking technique.

The main objective of the overall Tannin project is to improve Ontario red wine quality by ensuring grape phenolic ripeness is incorporated into harvest decisions. Scientific knowledge for the Ontario wine industry regarding tannin concentrations in seeds and skins of varieties specific to wine style will be acquired. This will result in red winemaking guidelines tailored to tannin concentrations from the Ontario grape tannin database.

The portion of this project funded by MVIP has the following objectives to be achieved by March 31 of 2020. These Objectives include:

- 1) Collect skin and seed tannin values during ripening and at harvest in 2019 for the following red grape varieties to add into the TanninAlert database: Pinot noir, Cabernet franc, Cabernet sauvignon
- 2) Identify the tannin management techniques for winemaking in 2019 for Cabernet franc at variable skin and seed tannin levels.
- 3) Produce wines for Cabernet franc according to skin and seed tannin levels (i.e. low, medium and high).
- 4) Sensory and consumer preference studies of 2018 Cabernet franc wines.

Comparison of intended outcomes to actual outcomes

Milestone Description	Intended Outcome 2019-20	Actual Outcome 2019-20
1. Collect skin and seed tannin values for the following red grape varieties to add into the TanninAlert database: Pinot noir, Cabernet franc, Cabernet sauvignon	Travel to all vineyard sites, sample each variety and analyse for pH, Brix, acidity, skin & seed tannin levels. Analyse data and input information into the TanninAlert database to use to categorise each variety according to their low, medium or high skin & seed tannins.	All intended outcomes were achieved. Tannin and chemical data have been measured and will be input into the tannin database by end of March, 2020. Histograms of the data distribution have been compiled. Low tannin is at the 0-33 percentile, medium tannin is at the 34-66 percentile and high tannin is at the 67 and above percentile.
2. Identify the tannin management techniques for best winemaking for Cabernet franc grapes at variable skin and seed tannin levels.	Investigate winemaking techniques and latest products for Cabernet franc Test methods & products at lab scale on small fermentations for low, medium & high tannin levels	Winemaking techniques were investigated through a complete literature review. The treatments will compare pre-fermentation press and concentration treatments, alone or in combination compared to the control. Treatment 1 involved pre-pressing the grapes prior to fermentation to damage the skins to allow for better skin tannin extraction, treatment 2 removed some of the free-run juice to increase the skin to juice ratio for better tannin extraction, treatment 3 was a combination of treatment 1 and 2. Each treatment was compared to the control where pressing only occurred at the end of the fermentation.
3. Produce wines of Cabernet franc according to skin and seed tannin levels (i.e. low, medium and high).	Upscale laboratory tests at harvest by matching grape skin & seed tannin levels to variety. Categorize Cab Franc by low, medium or high skin and seed tannins. Make wines according to chemical composition and tannin levels vs. control.	Cabernet franc from two sites were harvested. Skin and seed tannin values were measured for grapes from each site. Each batch of grapes were fermented according to the experimental design listed above for pre-fermentation press and concentration treatments. Chemical analysis of the juice and wines are complete. The wines have been sulfited, and will be bottled in March, 2020. Tannin stability is being monitored post fermentation, 3 months and 6 months. Although initially wines from the different treatments showed differences in tannin levels, the differences have dissipated over time.
4. Sensory analysis: Difference testing & consumer preference testing of 2018 Cab franc.	Determine if there are sensory differences between the wine treatments and if consumers prefer certain treatments over others.	All sensory and consumer preference testing has been completed on the cabernet franc 2018 wines from the two locations. Chemical analysis showed no difference in total tannin values

		<p>between the treatments. There were sensorial differences perceived between the treatments. The entire consumer panel of 120 participants did not prefer any one treatment over the other, supporting the lack of chemical differences in total extractable tannin in the wine. However, there were groups (3) divided up within the consumer panel that did show preferences. Further data analysis on the groupings to understand what defines each group will be completed by end of March to relate consumer liking of treatment to consumer demographic.</p>
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2. Detailed Description of the Project

a) Objectives and Project Input

The project objectives include:

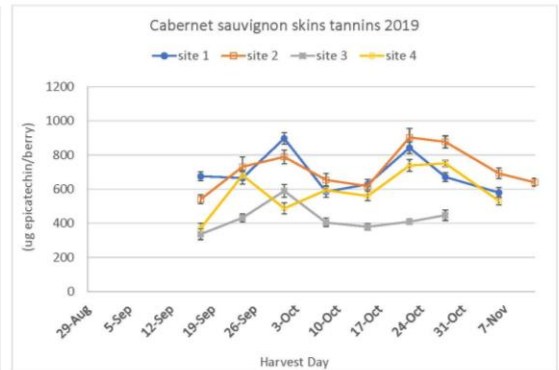
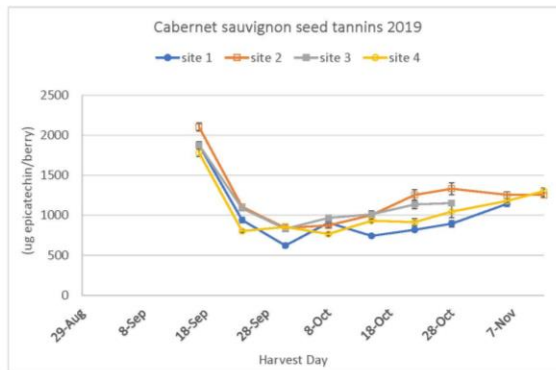
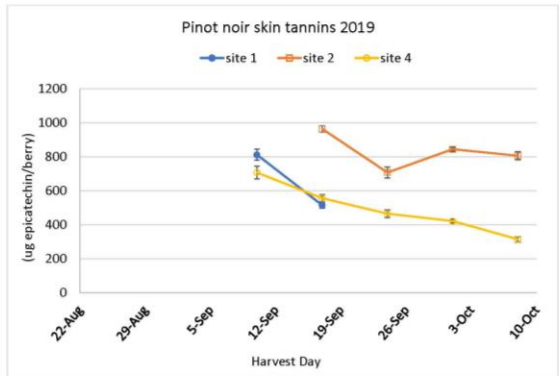
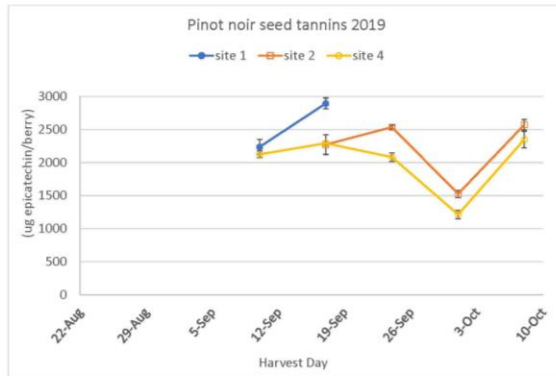
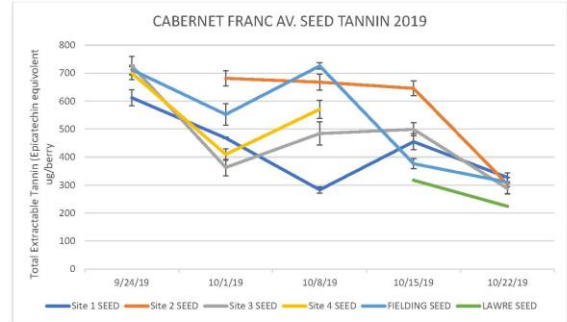
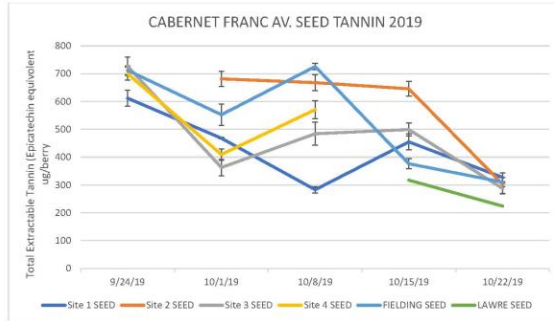
- 1) Collect skin and seed tannin values during ripening and at harvest in 2019 for the following red grape varieties to add into the TanninAlert database: Pinot noir, Cabernet franc, Cabernet sauvignon
- 2) Identify the tannin management techniques for winemaking in 2019 for Cabernet franc at variable skin and seed tannin levels.
- 3) Produce wines for Cabernet franc according to skin and seed tannin levels (i.e. low, medium and high).
- 4) Sensory and consumer preference studies of 2018 Cabernet franc wines.

The Project inputs included an MSc graduate student (Leah deFelice Renton), Dr. Belinda Kemp and Dr. Debra Inglis. MVIP funding covered a portion of Dr. Belinda Kemp's time on this project. All grapes for sampling and winemaking were donated from industry partners on this project.

b) Project Activities and Outputs

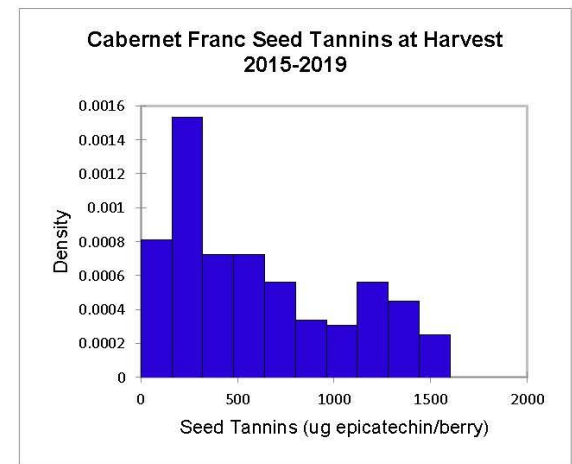
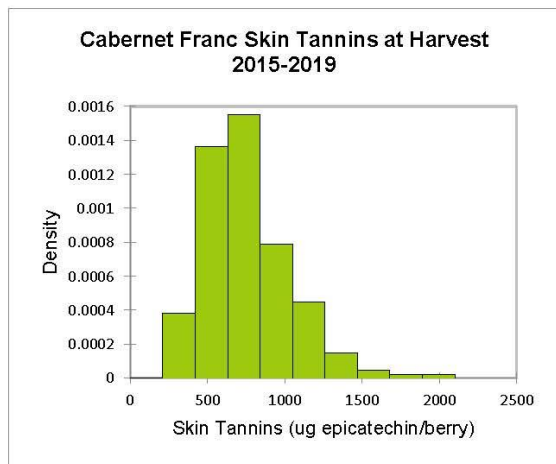
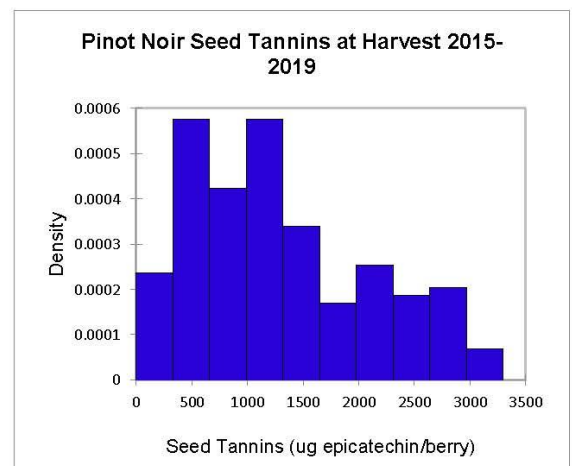
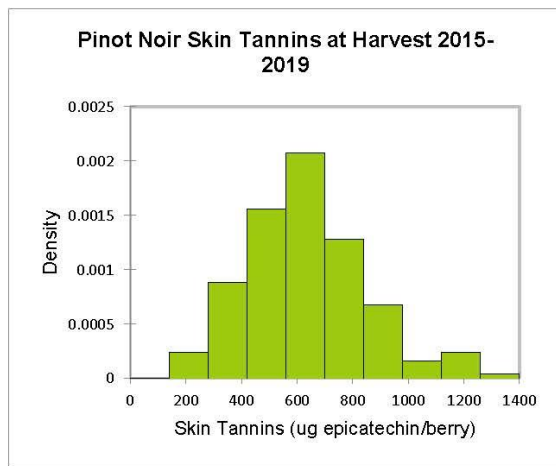
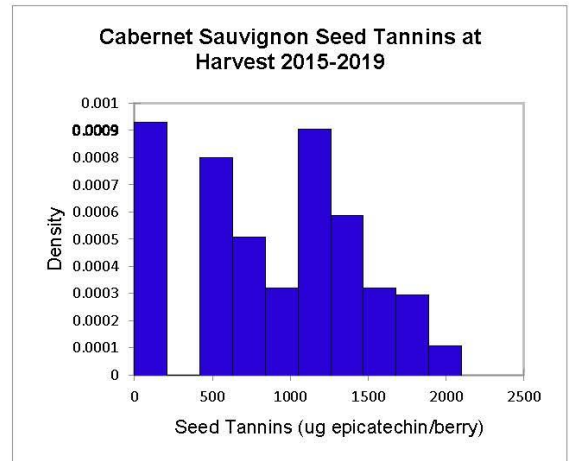
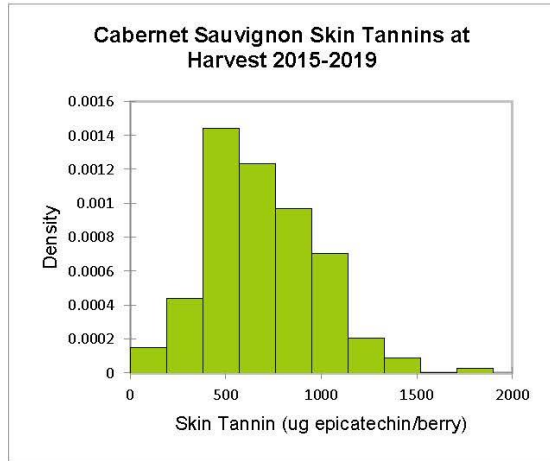
1. Collect skin and seed tannin values during ripening and at harvest in 2019 for the following red grape varieties to add into the TanninAlert database: Pinot noir, Cabernet franc, Cabernet sauvignon

Extractable skin and seed tannin values were monitored for the three grape varieties and plotted out as a function of time, depicted below.



At harvest, the extractable skin and seed data were measured for all three varieties. The 2019 data was combined with the previous years data. Histograms were generated with the entire data set and are presented below.

2015-2019 Skin and Seed Tannin Concentrations at Harvest



Tannin categories were determined for each variety as follows:

Table 1: Extractable skin tannin concentrations (μg epicatechin content/berry) at harvest of Pinot noir, Cabernet franc and Cabernet sauvignon from 2015-2019.

Variety	Test Method	Low	Medium	High
Cabernet Sauvignon	(33 rd & 66 th percentile)	40-524	525-794	795-1900
Pinot Noir	(33 rd & 66 th percentile)	191-548	549-691	692-1326
Cabernet Franc	(33 rd & 66 th percentile)	213-619	620-818	819-2097

Table 2: Extractable seed tannin concentrations (μg epicatechin content/berry) at harvest of Pinot noir, Cabernet franc and Cabernet sauvignon from 2015-2019.

Variety	Test Method	Low	Medium	High
Cabernet Sauvignon	(33 rd & 66 th percentile)	31-606	607-1219	1220-2025
Pinot Noir	(33 rd & 66 th percentile)	89-845	846-1381	1382-3269
Cabernet Franc	(33 rd & 66 th percentile)	12-281	282-704	705-1590

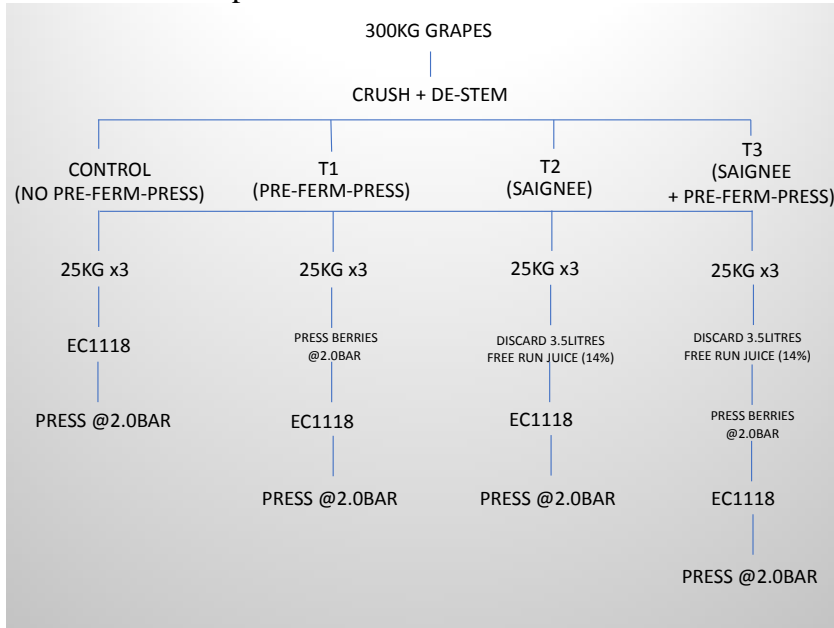
- Identify the tannin management techniques for winemaking in 2019 for Cabernet franc at variable skin and seed tannin levels.

Winemaking treatments were tested for Cabernet franc for grapes harvested at two sites. At site F, the skin tannin was 800 μg epicatechin/berry (Medium category) and seed tannin was 288 μg epicatechin/berry (Medium category). At site L, the skin and seed tannin were measurably lower than site F at 479 μg epicatechin/berry (Low category) and 224 μg epicatechin/berry (Low category).

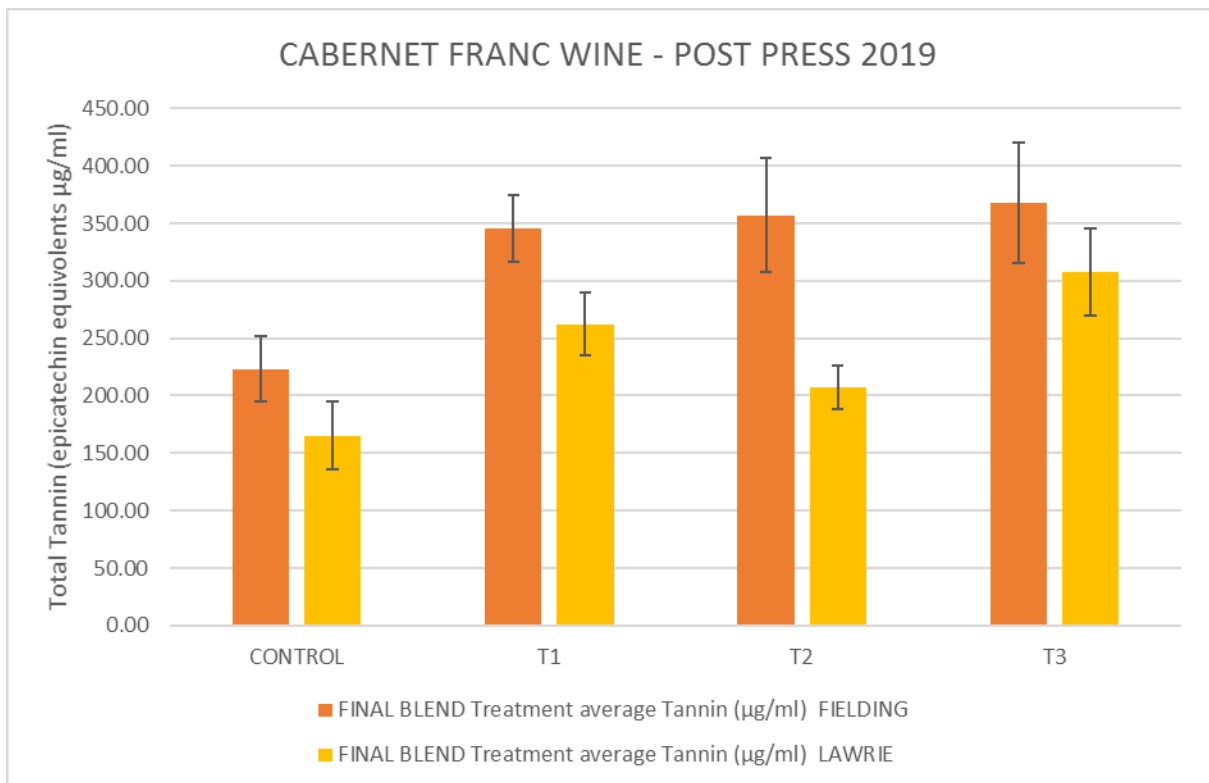
- Produce wines for Cabernet franc according to skin and seed tannin levels (i.e. low, medium and high).

Since post-pressing treatments of 2018 did not result in any difference in wine tannin values, in 2019, pre-fermentation treatments were tested to increase the tannin extraction from the skins. The treatments included pre-pressing the grapes at 2 bar to damage the skins, draining off 13% of the free run juice to increase the skin to juice ratio, and a combination of these two treatments in comparison to the control treatment, with traditional red wine making with no pre-fermentation treatment and pressing after

fermentation completion at 2 bar.



Results from the experiments show that the treatments did increase the extractable tannin immediately after fermentation and pressing. The tannin evolution will continue to be monitored to determine if these differences continue over time.



4. Sensory and consumer preference studies of 2018 Cabernet franc wines. The sensory and consumer preference studies are now completed but data analysis is currently underway. It is anticipated to be completed in March as the graduate student leading this is expected to be granted permission to write up her MSc in March.

c) Reach and Communication

The primary target audience for this research are winemakers in Ontario but there is also interest from winemakers in British Columbia, Quebec and Nova Scotia. The broader research community in red wine production and tannin stability will also have an interest in this research.

There are approximately 180 wineries in Ontario so potentially 180 Ontario winemakers to reach. Across Canada, there are over 600 wineries. At the Ontario Fruit and Vegetable Convention (Feb 2020), typically 80-100 winemakers attend the winemaking sessions. At the Viticulture and Oenology conference in the Okanagan in British Columbia in July of 2019, there are approximately 200 conference attendees.

OGWRI is acknowledged as the funding resource in manuscripts and posters (see attached documents).

Peer reviewed Publication:

Kemp, B., Trussler, S., Willwerth, J. and Inglis, D. (2019). Applying Temporal Check-All-That-Apply (TCATA) to mouthfeel and texture properties of red wines. *Journal of Sensory Studies*. DOI: 10.1111/joss.1250

Conferences presented at in 2019-20

British Columbia Industry Conference

- *Holford R, Kemp B, Inglis D. (2019). The impact of extended maceration of Cabernet sauvignon on wine tannin four months post fermentation. Conference Proceedings of the 19th Enology and Viticulture Conference, Sustainable Winemaking. 19th Enology and Viticulture Conference of the British Columbia Wine Grape Council, Penticton, BC, Canada. Conference Date: 2019/7 (Poster)
- *Holford R, Kemp B, *Kelly J, Inglis D. (2019). Tannin addition for low tannin grape varieties (*Vitis vinifera* L. Cv Gamay noir and Pinot noir). Conference proceedings of the 19th Enology and Viticulture Conference, Sustainable Winemaking. 19th Enology and Viticulture Conference of the British Columbia Wine Grape Council, Penticton, Canada. Conference Date: 2019/7 (Poster)
- *De Felice Renton L, Kemp B, Inglis D. (2019). Niagara Cabernet franc tannin concentrations: Hard pressed to find a difference . Conference Proceeding of the 19th Enology and Viticulture Conference, Sustainable Winemaking. 19th Enology and Viticulture Conference of the British Columbia Wine Grape Council, Penticton, Canada. Conference Date: 2019/7 (Poster)
- Kemp B, Yang F, Wang T, Shakya S, *De Felice Renton L, *Holford R, Inglis D. (2019). Skin versus seed tannin development of red grape varieties in Ontario from veraison to harvest. Conference Proceeding of the 19th Enology and

Viticulture Conference, Sustainable Winemaking. 19th Enology and Viticulture Conference of the British Columbia Wine Grape Council, Penticton, Canada
 Conference Date: 2019/7 (Poster)

Ontario Industry Conference

- Marcotte, C, Inglis, D and Kemp, B. (2020). Winemaking optimization based on the skin and seed tannin of Cabernet sauvignon grapes from Ontario. Ontario Fruit and Vegetable Convention (OFVC), Scotiabank Convention Centre, Niagara Falls, Ontario, Canada. 19th – 20th February 2020.

Upcoming Conferences where abstracts have been accepted for presentation:

International Cool Climate Wine Symposium

- Marcotte, C, Inglis, D. and Kemp, B. OPTIMIZATION OF COLOR AND MOUTHFEEL BY TANNIN AND ENZYME ADDITION IN PINOT NOIR WINE MADE IN ONTARIO (CANADA) . Accepted to 10th International Cool Climate Wine Symposium, Brock University, ON, Canada, July 12-16 2020.
- de Felice Renton, L., Inglis, D.L. and Kemp, B. HARD PRESSED TO FIND A DIFFERENCE: EVALUATING THE TOTAL TANNIN CONTENT OF CABERNET FRANC VARIETAL WINES MADE USING PRE AND POST-FERMENTATION PRESSING TREATMENTS. Accepted to 10th International Cool Climate Wine Symposium, Brock University, ON, Canada, July 12-16 2020.

3. Project Outcomes (actual vs. expected) at short and long-term

a) *Short-term*

Milestone Description	Intended Outcome 2019-20	Actual Outcome 2019-20
1. Collect skin and seed tannin values for the following red grape varieties to add into the TanninAlert database: Pinot noir, Cabernet franc, Cabernet sauvignon	Travel to all vineyard sites, sample each variety and analyse for pH, Brix, acidity, skin & seed tannin levels. Analyse data and input information into the TanninAlert database to use to categorise each variety according to their low, medium or high skin & seed tannins.	All intended outcomes were achieved. Tannin and chemical data have been measured and will be input into the tannin database by end of March, 2020. Histograms of the data distribution have been compiled. Low tannin is at the 0-33 percentile, medium tannin is at the 34-66 percentile and high tannin is at the 67 and above percentile.
2. Identify the tannin management techniques for best winemaking for Cabernet franc grapes at variable skin and seed tannin levels.	Investigate winemaking techniques and latest products for Cabernet franc Test methods & products at lab scale on small fermentations for low, medium & high tannin levels	Winemaking techniques were investigated through a complete literature review. The treatments will compare pre-fermentation press and concentration treatments, alone or in combination compared to the control. Treatment 1 involved pre-pressing the grapes prior to fermentation to damage the

		skins to allow for better skin tannin extraction, treatment 2 removed some of the free-run juice to increase the skin to juice ratio for better tannin extraction, treatment 3 was a combination of treatment 1 and 2. Each treatment was compared to the control where pressing only occurred at the end of the fermentation.
3. Produce wines of Cabernet franc according to skin and seed tannin levels (i.e. low, medium and high).	Upscale laboratory tests at harvest by matching grape skin & seed tannin levels to variety. Categorize Cab Franc by low, medium or high skin and seed tannins. Make wines according to chemical composition and tannin levels vs. control.	Cabernet franc from two sites were harvested. Skin and seed tannin values were measured for grapes from each site. Each batch of grapes were fermented according to the experimental design listed above for pre-fermentation press and concentration treatments. Chemical analysis of the juice and wines are complete. The wines have been sulfited, and will be bottled in March, 2020. Tannin stability is being monitored post fermentation, 3 months and 6 months. Although initially wines from the different treatments showed differences in tannin levels, the differences have dissipated over time.
5. Sensory analysis: Difference testing & consumer preference testing of 2018 Cab franc.	Determine if there are sensory differences between the wine treatments and if consumers prefer certain treatments over others.	All sensory and consumer preference testing has been completed on the cabernet franc 2018 wines from the two locations. Chemical analysis showed no difference in total tannin values between the treatments. There were sensorial differences perceived between the treatments. The entire consumer panel of 120 participants did not prefer any one treatment over the other, supporting the lack of chemical differences in total extractable tannin in the wine. However, there were groups (3) divided up within the consumer panel that did show preferences. Further data analysis on the groupings to understand what defines each group will be completed by end of March to relate consumer liking of treatment to consumer demographic.

If applicable to the project, please include the following information:

- Policy dialogue: Project must indicate if, as a result of the project undertaken, the current or emerging issue has been redefined. Explain and provide a revised description of the policy issue.
 - Not applicable
- Market-trend studies: What further action/response (if any) you need to take based on the results? What trends and factors have been identified?
 - Not yet applicable. This study will be continuing for 3 more years, and at that time, a better understanding of market trends based on consumer science will have evolved.
- Pre-commercialization: Is the project a commercially viable opportunity? Explain the viability or lack of viability
 - Yes, the project has commercial viability once the tannin database is extended. Results to date confirm large extractable tannin differences between varieties, vintage variation in tannin development in grape skin and seed as well as variation at harvest from site location, requiring wine-making techniques to be matched to tannin level in the grapes in order to optimize tannin profile in the wines for each vintage, as well as site location. Winemakers have indicated they will pay for extractable tannin analysis and access to the tannin database to categorize their tannins in skin and seed into the low, medium and high categories. Based on this information, winemakers can then choose winemaking options to optimize the extraction of tannin from the skin while minimizing tannin from the seed.
- Value: As a result of the project, are you selling a product, process or technology? What is being sold? What is the unit value of the item sold? How many items have been sold?
 - We are not yet at the point of selling a product or service based on tannin measurements.

b) Long Term

- Indicate the key indicators you will be using to measure the project success in the long-term. Please indicate where applicable:
 - The number of jobs created
 - a. Estimate two additional lab technician jobs to run tanninalert at CCOVI in 5 years once product is launched.
 - b. Estimate additional 400 jobs in the market due to increased wine sales and demand
 - Increased sales

- a. Estimate increased revenue to CCOVI service lab in 5 years by \$350,000 once tannin alert roles out
 - b. Estimate increased wine sales from 22% domestic market share in red wine (\$685 million) to 33% domestic market share in red wine sales (\$850 million).
 - Increased use of Ontario products
 - a. Estimate increase in domestic wine market share from 22% to 33%.
 - Increased yield or production of Ontario products
 - a. See above
 - Any other indicators outlined in milestone schedule
- c) *Doing things differently*
- Knowing what you know now, identify what you would have done differently in relation to the Project.
 - Rather than do consumer preference testing on research red wines that have not seen oak treatment, it would be better to use a winemaker panel for treatment evaluation since winemakers are accustomed to unfinished red wine assessments to see the potential in the wines. Additionally, once viable treatment options have been identified, those treatments could be tested in partnership with a commercial winery to make finished commercial wines to then test with a consumer panel. The consumer would then be more familiar with the end product and better able to assess likeness of products.

4. Final Comments and Conclusions

- Identify any deviations from the project workplan, budget or schedule and discuss the effects of the deviations and the solutions
- Provide a discussion of “lessons learned”, recommendations and overall perception of project success
 - No further comments to add.