INTERNATIONAL COOL CLIMATE WINE SYMPOSIUM
CANADA · 2020

Cool Climate Oenology & Viticulture Institute

Brock University

Effect on honey, dusty off-flavours and acetic acid in sparkling wines made from varying amounts of sour rotten grapes

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2020 CCOVI Lecture Series

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What is sour rot?

Photographs courtesy of Dr Wendy McFadden-Smith, OMAFRA.

Figure 1. Pictures of red and white grapes with sour rot infection

What is sour rot?

- **Caused by combination of physical factors: wounding and berry splitting, microbiological factors including yeasts, bacteria & fungi, and spread by vinegar flies.**
- **Non-*saccharomyces* involved in the rotting process *(can differ in species depending on region)* *(Barata et al. 2011)***
- **Sour rot = decrease in °Brix from conversion of sugar to acetic acid, gluconic acid, uronic acid, ethyl acetate & glycerol.**
- **Most important is oxidation of ethanol into acetic acid (vinegar) *(Barata et al. 2011)***

For further information about sour rot please refer to reports from OGWRI funded projects by Wendy McFadden-Smith (OMAFRA) on their website.

Ontario sour rot research reports

https://ontariograpeandwineresearch.com/en/projects

Detection thresholds for acetic acid and ethyl acetate

Detection Thresholds

Definition ***(Cliff & Pickering 2006)***

The concentration at which there is 75% correct detection

- **Acetic acid** ***(differs with wine style i.e. Icewine)***

0.8 g/L Maximum permitted volatile acidity concentration in still wine in Ontario is 1.3 g/L of acetic acid.

[Corison et al., (1979), Vintners Quality Alliance (1999)]

- **Ethyl acetate** ***(differs with wine style i.e. Madeira)***

White still wine: 170 mg/L

Red still wine: 160 mg/L

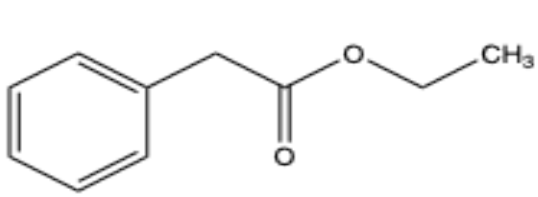
(Corison et al., 1979)

Phenylacetic acid (PhAA) & Ethylphenyl acetate (EPhA)

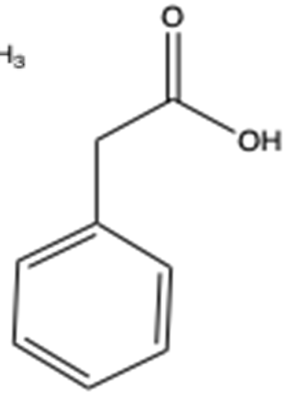
https://pubchem.ncbi.nlm.nih.gov/compound/Phenylacetic-acid

- **Phenylacetic acid (PhAA)** is a monocarboxylic acid.
- Role as a toxin, a plant metabolite, a *S. cerevisiae* metabolite, a plant growth retardant, an allergen and an auxin.
- PhAA is a direct degradation product of phenylalanine possibly from shikimic acid pathway. *(Tat et al. 2007)*
- Precursor of EPhA

- **Ethylphenyl acetate (EPhA)**
- Produced from PhAA by some yeast during fermentation & maturation.



Ethyl phenylacetate



Phenylacetic acid

Thresholds for Ethylphenyl acetate (EPhA) & Phenylacetic acid (PhAA) in wine

Detection thresholds

- **Phenylacetic acid (PhAA) in red wine *(Aglianco)* 73ug/L**

(Tat et al. 2007)

- **Ethylphenyl acetate (EPhA) in sparkling wines 263ug/L**

(Kemp et al. 2019)

Consumer Rejection thresholds (CRT) *(Campo et al. 2012)*

- Combination of EPhA & PhAA
- **EPhA is 140ug/L & PhAA 700ug/L** (red wine)

CRT not determined in sparkling wine

Reason: Lack of 75% agreement

Detection & rejection thresholds in wine of PhAA & EPhA

Some might not care!

Some might hate it!

Honey, sweet, off-flavour

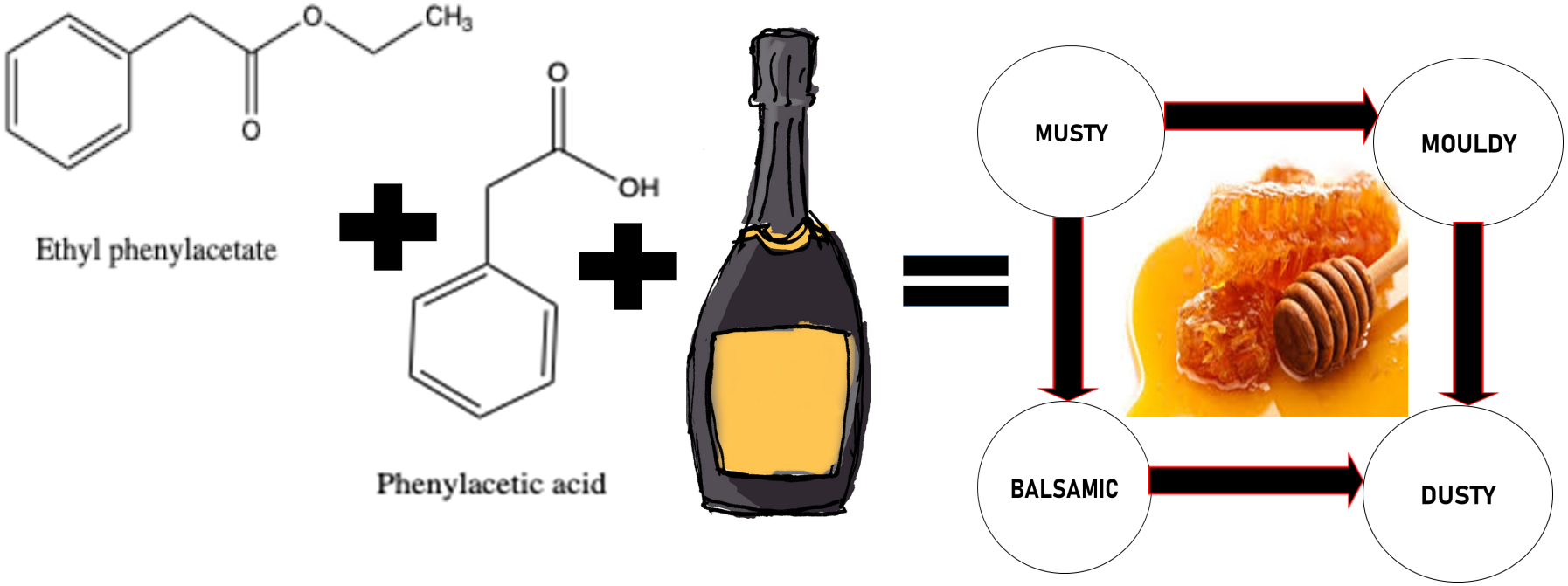


Figure 2. Diagram illustrating the influence of EPhA and PhAA on wine aroma.

Honey, dusty off-flavour in wine & honey

- EPhA produced from PhAA
- PhAA can increase during wine aging

(some yeasts produce more PhAA than others + N additions)

Other "honey" compounds in wine but not associated with sour rot

Is it a fault in wine?

- **High concentrations that mask other compounds/aroma**
- **Unpleasant, musty odour reduces wine complexity & likeness**
- **Fault in red wines from Italy, Spain & Portugal**

Concentrations of EPhAA & PhAA (combined) causes the fault!

Is it present in honey?

Determines the botanical origin of some specific honey types!

- EPhA marker for authenticity of thyme honey made in Italy

(Piasenzotto et al. 2003)

- PhAA marker for authenticity of *Salvia offinalis* L. (sage) honey made in Croatia *(Jerković et al. 2007)*

American Honey Society (2020)

FLORAL

FLOWERS: violet, rose, geranium, peony, hyacinth, honeysuckle, jasmine

FRUIT

FRESH: pineapple, strawberry, melon, apple, pear, mango, peach, grape

BERRY: blackcurrant, raspberry, blackberry, cherry, cranberry

DRIED: prune, raisin, fig, apricot, cooked fruit, jammy, candied fruit

CITRUS: citrus zest, lemon, orange, grapefruit, tangerine, candied peel

WARM

BURNED: caramel, molasses, smoky, coffee, chocolate, burnt sugar, maple

CARAMEL: butterscotch, toffee, brown sugar, beeswax

NUT: toasted, chestnut, hazelnut, walnut, almond, peanut, pine nut

LACTIC: milk, fresh butter, cooked butter, rancid butter, yogurt

CONFECTIONARY: vanilla, white chocolate, cotton candy, marshmallow, fondant

FRESH

REFRESHING: lemon verbena, peppermint, eucalyptus, anise, herbaceous, rain

CAMPHOROUS: rosemary, lavender, thyme, menthol, balsamic

VEGETAL

GREEN: fresh plants, grass clippings, raw vegetables, wet grass, wet hay, hops, artichoke, green bananas, kiwi, stems, bay leaf

DRY: hay, tea, herbal tea, straw

ANIMAL

GAMEY: sweat, manure, barnyard, stable, leather, cheese, gym bag, fresh fish, cat pee, daisy, dandelion

WOODY

DRY: wood, sandalwood, cedar, boxwood, shell, incense, oak

RESINOUS: pine resin, propolis, turpentine

SPICY: cinnamon, clove, nutmeg, pepper, ginger

CHEMICAL

MEDICINE: plastic, turpentine, cardboard, soap

PETRO-CHEMICAL: metal, cabbage, sulfur, ash, tar, tobacco

SPOILED

YEAST: fermentation, vinegar, beer, cider, malt, baked bread

EARTHY: musty basement, moldy, mildew, rotting leaves, humus, peat moss, mushroom, truffle, chalk, pollen

Background to our study

- Observations in Ontario identified this prevailing honey/off-flavour aroma in some sparkling wines made from Pinot noir grapes
- Some Ontario grapes can suffer from sour rot

"less honey and sweetness is a path to complexity and style"

Anthony Gismondi *(wine writer)*

Project details
Sparkling and still red wine quality

1. Quantify EPhA, PhAA, ethyl acetate & acetic acid levels from clean & sour rot infected grapes during ripening (Biomarker/predictor of sour rot?)

2. **Produce Pinot noir sparkling & still red wines with varying amounts of sour rot.** Determine EPhA, PhAA, ethyl acetate & acetic acid concentrations.

3. **Determine the potential of the Brock yeast (CN1) to reduce acetic acid, EPhA & PhAA in sparkling & still red wines.**

Pinot noir during ripening 2019

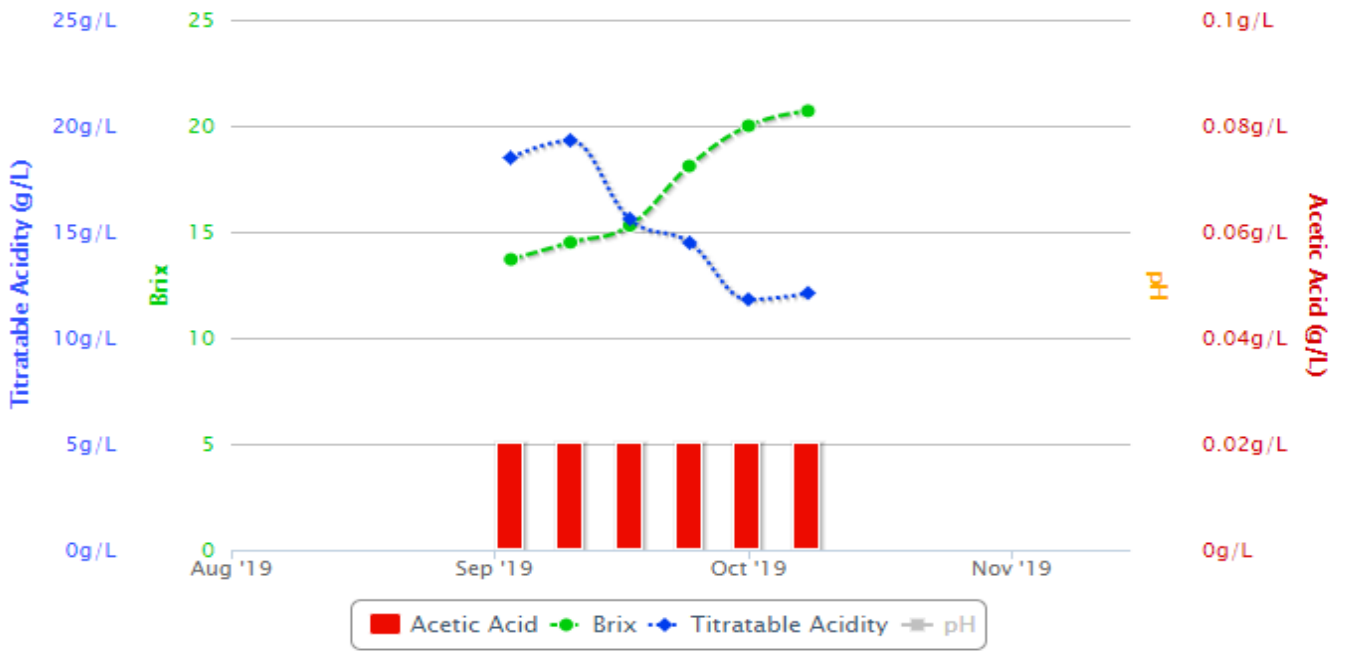
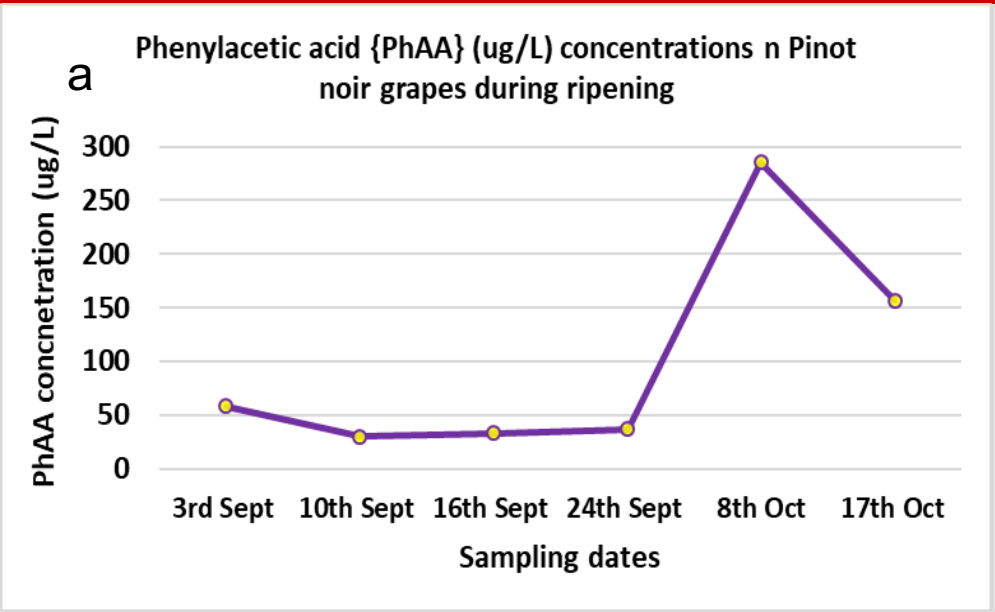


Figure 4. Acetic acid, °Brix and TA (g/L) in Pinot noir during grape ripening.

EPhA & PhAA during grape ripening 2019



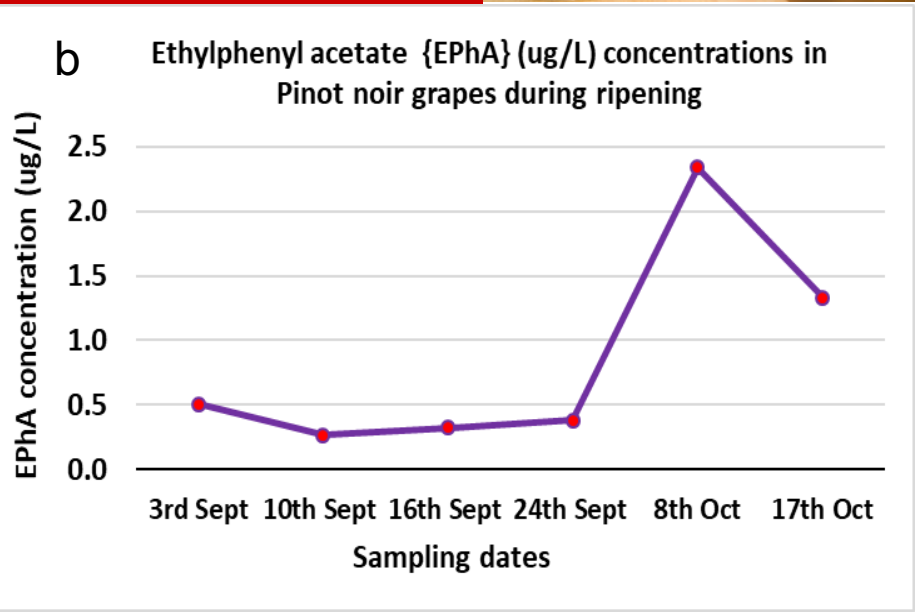


Figure 5 a & b. PhAA & EPhA concentrations during grape ripening in 2019.

Summary

- **PhAA higher than EPhA during ripening**
- **Same trend for both**
- **Increase during ripening but with peaks for both compounds in 2019**

- Acetic acid concentrations: below 0.02g/L throughout sampling

Sparkling wine experimental design

Hand picked sour rot bunches → **Whole bunch pressed sour rot grapes**

Hand picked clean bunches → **Whole bunch pressed clean grapes**

Settled with enzymes (24 hrs) Lallzyme Cuvee Blanc

***Sterile filtered juice prior to yeast build up**

Treatments by % of sour rot juice (15L in triplicate)
0%, 10% (1.5L), 20% (3L), 30% (4.5L), 40% (6L) of *sour rot juice*
Fermentations with EC1118 & CN1 = 30 wines
YAN (mg N/L) Fermaid K added

Base wine → bottling & 2nd fermentation → Riddling, disgorging & *dosage*

**To ensure inoculation excluded all yeasts except EC1118 or CN1 yeasts*

Juice chemical composition

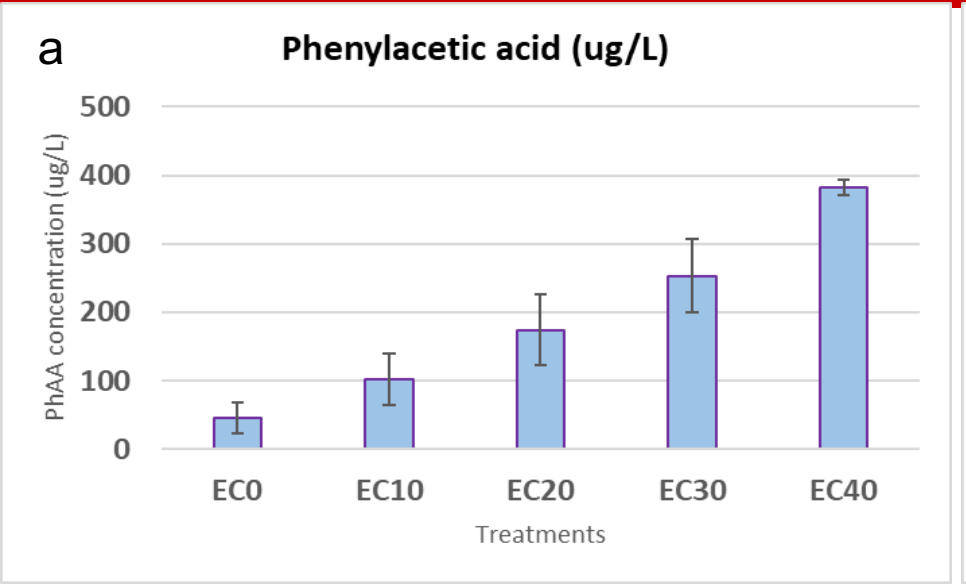
Table 1. Juice chemical analysis.

Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40).

Analysis	EC0	EC10	EC20	EC30	EC40
°Brix	17.9 ±0.1	18.0 ±0.0	18.2 ±0.1	18.4 ±0.1	18.2 ±0.1
pH	3.1 ±0.0	3.1 ±0.0	3.1 ±0.0	3.1 ±0.0	3.1 ±0.0
*Titratable acidity (g/L)	12.6 ±0.1b	12.8 ±0.1b	13.2 ±0.1b	13.4 ±0.1a	13.2 ±0.1a
Ammonia (mg N/L)	29 ±2.5	28 ±3.6	28 ±2.9	27±1.7	26 ± 2.2
Amino acids (mg N/L)	78 ±5.2	84 ±16.0	83 ±8.9	77 ±5.7	80 ±6.5
YAN (mg N/L)	107±7.6	113 ±19.6	110 ±11.7	103 ±7.4	107 ±8.7

** Significance: P = 0.05*

EPhA & PhAA concentrations in juice



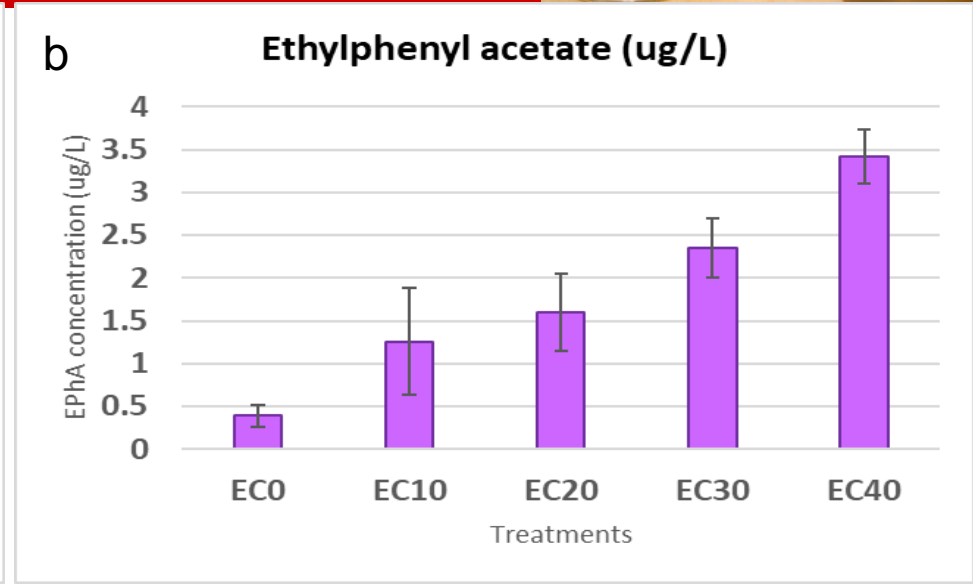


Figure 6 a & b. Concentrations of PhAA & EPhA (ug/L) in juice before primary fermentation. Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40). *Error bars represent standard deviations.*

Summary points

- **Not statistically significant *(ANOVA & Tukeys test)* between treatments despite increase in concentrations. Replicate variability within treatments.**
- **Concentration scales i.e. 3.4 (ug/L) in EC40 EPhA & 380 (ug/L) in EC40 PhAA**

Acetic acid (g/L) concentrations in juice at harvest

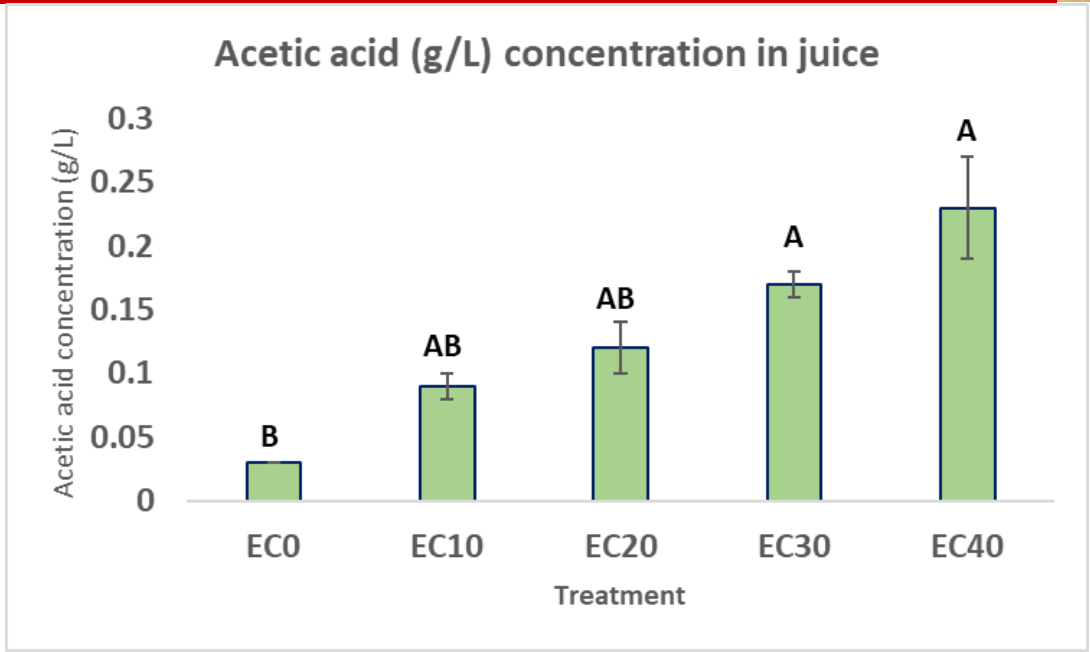


Figure 7. Acetic acid (g/L) concentrations in juice after treatment.
Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40).
Error bars represent standard deviations. Significance P = 0.001.

Summary points

- **Increase of acetic acid concentration with increase L of sour rot juice**
- **Ethyl acetate below limit of detection for the method**

Base wine chemical composition

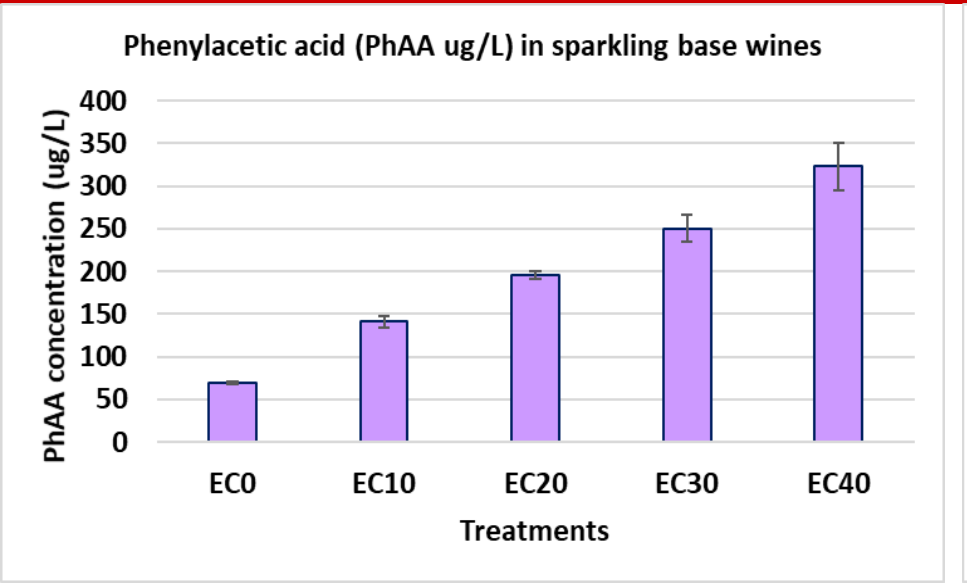
Table 2. **Base wine chemical analysis.**

Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40).

Analysis	EC0	EC10	EC20	EC30	EC40
pH	**3.1** ±0.0	**3.1** ±0.0	**3.1** ±0.0	**3.1** ±0.0	**3.1** ±0.0
Titratable acidity (g/L)	**10.9** ±0.1	**10.9** ±0.1	**11.2** ±0.1	**11.5** ±1.0	**11.5** ±0.1
*Malic acid (g/L)	**5.3** ±0.0b	**5.4** ±0.1b	**5.6** ±0.2a	**5.7** ±0.1a	**5.6** ±0.1a
Residual sugar (g/L)	**0.3** ±0.1 a	**0.5** ±0.1b	**0.5** ±0.1b	**0.5** ±0.1b	**0.5** ±0.1b
Alcohol (% v/v)	**8.5** ±0.8	**9.2** ±0.3	**9.3** ±0.5	**9.0** ±1.0	**9.0** ±1.2

** Significance: P = 0.001*

EPhA & PhAA concentrations in base wine



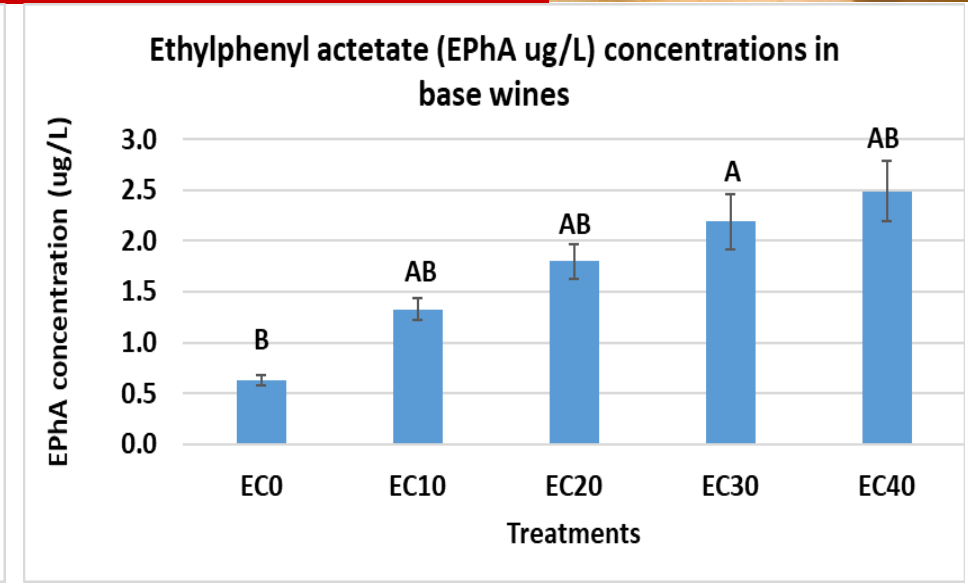


Figure 8. EPhA & PhAA concentrations in base wines.
Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40).
Error bars represent standard deviations (±). Significance P = 0.03.

Summary points

- **EPhA concentration statistically significant**
- **Low concentrations of PhAA & EPhA – EC1118 yeast**

Acetic acid (g/L) concentrations in base wine

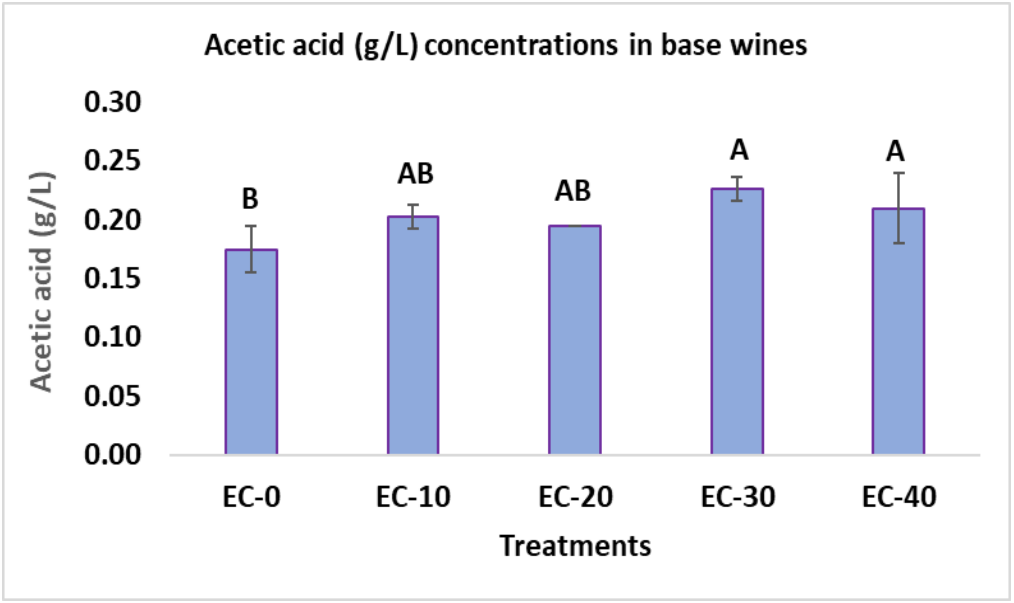


Figure 9. Concentration of acetic acid (g/L) in base wines.
Treatment codes: Control (EC0). 10% sour rot juice (EC10), 20% sour rot juice (EC20), 30% sour rot juice (EC30) and 40% sour rot juice (EC40).
Error bars represent standard deviations (±). Significance P = 0.02.

❖ **Ethyl acetate concentration range: 40 - 45 mg/L *(no statistical difference)***

Summary of EPhA & PhAA results to date……

Possible biomarker for sour rot during grape ripening?

- ✓ PhAA & EpHA increased during ripening
- ✓ Needs more years of data to confirm

Juice

- ✓ Increased PhAA & EpHA concentrations with increased sour rot %

Base wine

- ➢ Both PhAA & EPhA in base wines
- ➢ Juice & base wine concentrations similar
- ➢ Concentrations below threshold levels

Further research

- **Bottling, 2nd fermentation, riddling disgorging & *dosage* with EC1118 yeast**
- **Comparison of data for EC1118 yeast with CN1**
- **Chemical analysis of 2019 finished sparkling wines PhAA & EpHA of sparkling wines during aging**

Do PhAA & EPhA concentrations fluctuate during aging on lees?

- **Two more vintages 2020 & 2021**
- **Sensory analysis of 2019, 2020 & 2021**

How can a winemaker transfer this knowledge to their winemaking?

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Canadian Grapevine Certification Network
CGCN-RCCV
Réseau Canadien de Certification de la Vigne

In-kind partners

ANDREW PELLER LIMITED

Huebel Grapes Estates
Custom Farming · Custom Harvesting · GPS Planting

- Malcolm Lawrie owner of Lawrie Vineyard, NOTL, ON.

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WHO?
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QUESTIONS
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