



Eastern Winery

EXPOSITION +
CONFERENCE

March 24-26, 2026 | Richmond, VA

Session #W01a Building a Practical Quality Control Plan for Winery Labs

Joy Ting



*Promoting innovation through experimentation and
education in the wine industry*

www.winemakersresearchexchange.com

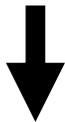
“Why does my wine have VA? The fruit looked great when it came in...”

“This didn’t have *Brett* last time I tasted it!”

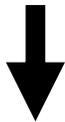
“The wine was great when I put it in the bottle. Why is it reduced/oxidized/fizzy/cheesy now?”

Hazard Analysis and Critical Control Points (HAACP)

Monitoring



Critical Control Point



Monitoring



Critical Control Point



Monitoring



Critical Control Point



Safe to consume
Within legal limits
Without faults
Desired wine style



Quality Assurance

Quality Control

Seven Steps to a HACCP-like plan (Zoecklein)

Conduct a hazard analysis: list all the steps in the process and identify possible risks to wine quality associated with that step

Determine critical control points: points in the process that, if not correctly controlled, could result in unacceptable deviation (a quality failure)

Establish critical limits: could be a specific cutoff or a range of values

May be different at different points in the process

Ex: acetic acid at end of fermentation vs. after aging for 12 months

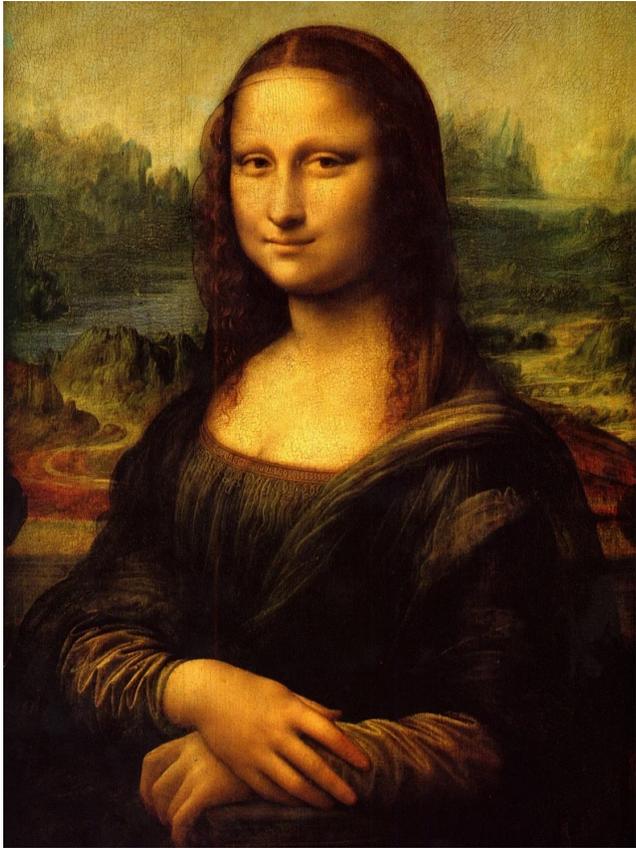
Develop a monitoring procedure for each CCP: May include single or multiple tests

Establish a plan for corrective action if critical limit is not met

Not just about taking numbers but about acting to ensure quality

Establish a system to record results and document any corrective actions

Develop a verification plan for all analyses





Example:

A medium bodied barrel fermented Chardonnay.

MLF depends on balance of acidity at the end of fermentation.

Quality Control:

- Within legal limits
- Without faults/flaws
 - Limited volatile acidity (<0.6 g/L)
 - Cold and heat stable
- Alcohol between 12-13%
- Freshness and minerality

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Harvest



Grape Processing



Alcoholic Fermentation



Malolactic Fermentation



Aging in tank/barrel



Blending/Stabilization



Bottling

Racking off lees

Pre-Fermentation Additions

Yeast Selection, Rehydration & Inoculation

Nutrient additions and aeration

Temperature regulation

Hygiene



Harvest



Grape
Processing



Alcoholic Fermentation



Malolactic Fermentation



Aging in tank/barrel



Blending/Stabilization



Bottling

Risks:

Fermentation starts before racking

Turbidity too high (stinky)

Unfavorable yeast strain

- undesired aromas, lack of desired aromas

Fermentation too fast

Fermentation too slow

Stuck fermentation

Acetic acid production

H₂S production

Ethyl acetate production

Unwanted MLF during fermentation

Not enough alcohol

Acidity too high or too low

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Pre-fermentation risks and monitoring



What do I need to know now to ensure wine quality later?

What corrective action will I take?

Clarity at racking

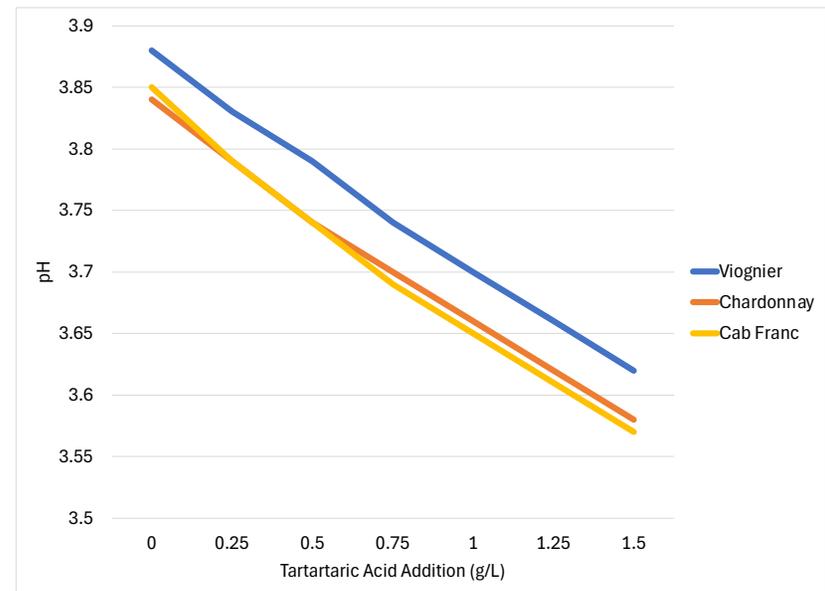
- measure turbidity (NTU)

Alcohol between 12-13%

- measure Brix or density

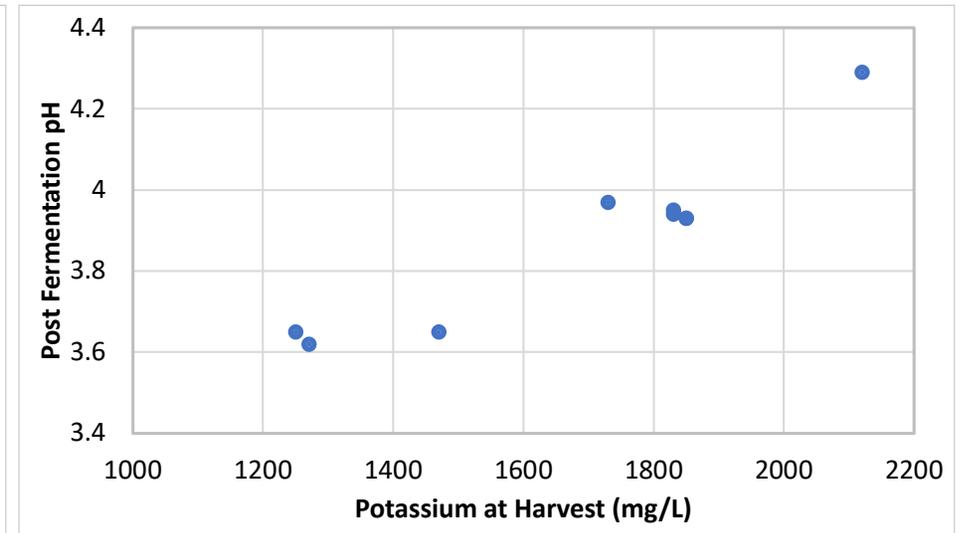
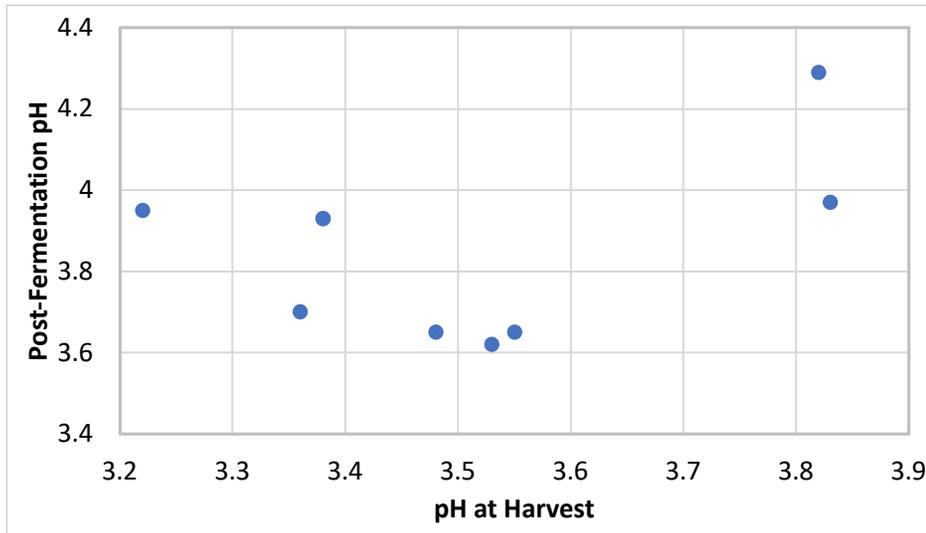
Preventing microbial faults

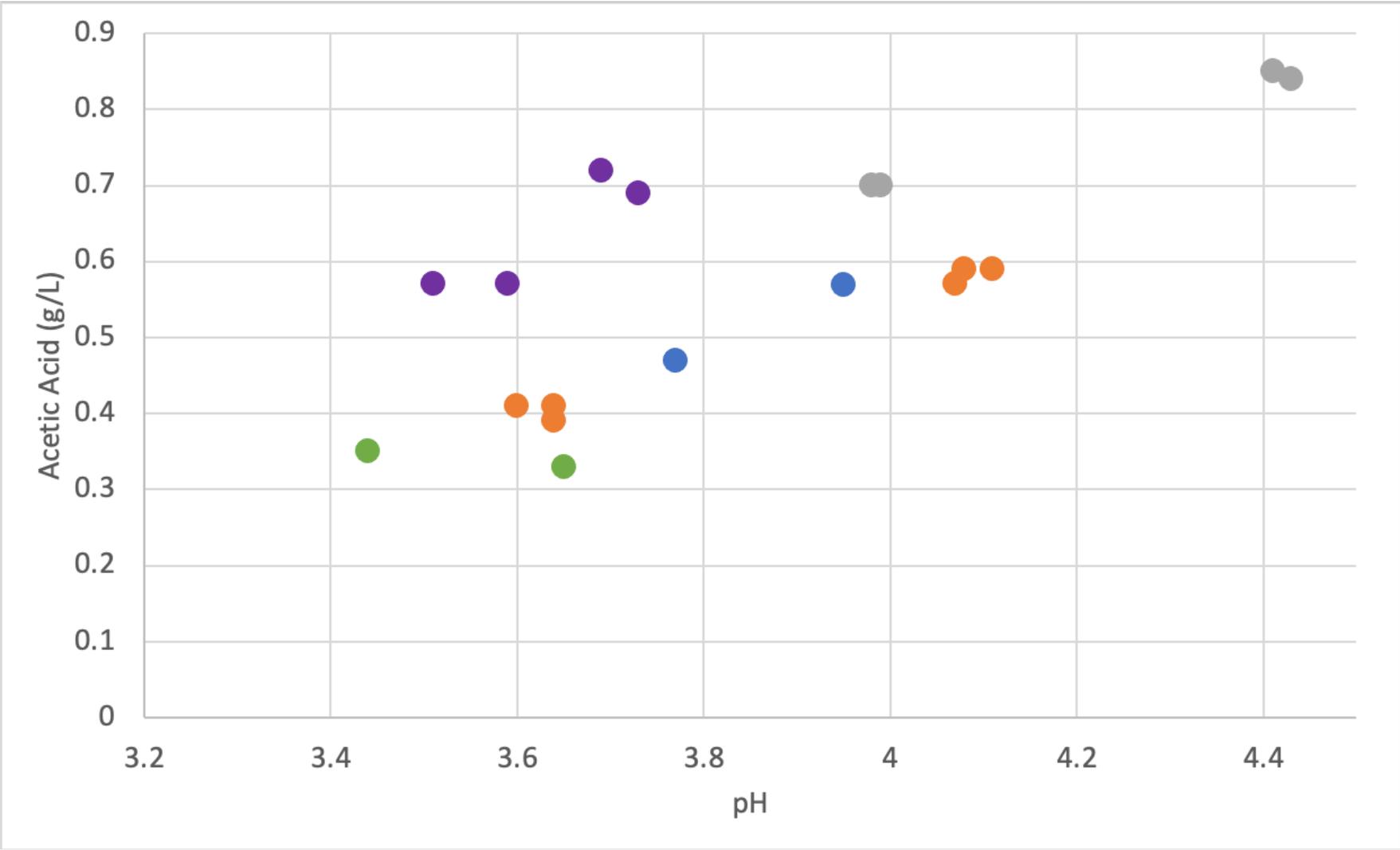
- measure pH
- perform an acid trial





Potassium is a better predictor of post-fermentation pH







Pre-fermentation risks and monitoring



What do I need to do now to ensure wine quality later?

Sugar addition? (Brix)

Clarity/NTU at racking

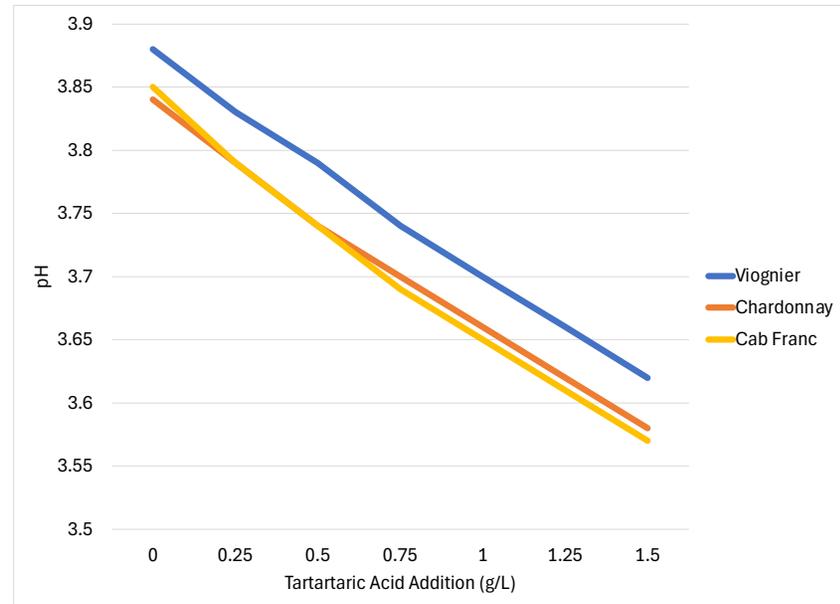
Acid addition?

pH

Acid trial

Potassium

Titratable acidity





Critical Limits



	Metric	Range	Method
Clarity	NTU	120-250	Turbidity Meter
Sugar	Brix/density	21-22.8° Brix	Refractometer or Hydrometer
Acidity	pH	3.10 – 3.40	pH meter
	TA	6 - 8 g/L	Titration, Sentia
	Potassium	1000-1500	Service Lab



Harvest



Grape
Processing



Alcoholic Fermentation



Malolactic Fermentation



Aging in tank/barrel



Blending/Stabilization



Bottling

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Not enough alcohol

Acidity too high or too low



Yeast Assimilable Nitrogen (YAN)



Amino Acids, Peptides (organic) & Ammonia (inorganic)

$$\text{YAN (mg/L)} = (0.8225 \times \text{Ammonia}) + \text{NOPA}$$

AWRI Targets	Whites	Reds
Low Risk	150	100
Clean & Fruity	250-350	N/A
Max	330 - 470 (400)	



Harvest



Grape
Processing

Post racking, Pre-fermentation Juice/must Sample:
Brix, pH, TA, potassium, NTU, YAN



Alcoholic Fermentation

After inoculation: yeast count



Malolactic Fermentation



Aging in tank/barrel



Blending/Stabilization



Bottling



Harvest

Representative grape samples: Berry weight, Brix/Density, pH, TA, sugar per berry



Grape Processing

Cold settling: Temperature, Brix, Sensory

Juice/Must Sample (After racking in whites)
Brix, pH, TA, potassium, NTU, YAN, acid trial



Alcoholic Fermentation

After inoculation: yeast count

Fermentation Monitoring: Daily Brix/Density, Temperature



Malolactic Fermentation

End of Fermentation: RS < 1.0 g/L, pH, TA, acetic acid, malic acid, acid trial with sensory, alcohol (or at blending)

Malolactic Fermentation Monitoring: malic acid, acetic acid



Aging in tank/barrel

End of Malolactic Fermentation: malic acid < 0.05 g/L*
pH, TA, acid trial with sensory

During Aging: fSO₂ monthly, acetic acid bimonthly, cellar temp, sensory



Blending/Stabilization

At blending: pH, TA, acid trial with sensory, alcohol, cold stability, bentonite trial, alcohol



Bottling

Pre-bottling: fSO₂, DO, CO₂ at racking, after filtration, day before, day of

Post-bottling: fSO₂, DO, CO₂, microbiology

	Brix	Temp	pH	TA	YAN	K+	RS	MA	AA	SO ₂	Alc	CS	BT	DO	Micro
Press	1		1												
Setting	1														
Racking	1		1	1	1	1									
Fermentation	30	30													
End of Fermentation			1	1			1	1	1		1				
During ML								4	4						
End of ML			1	1				1	1						
One month after SO ₂			1	1					1	1					
Monthly during aging									3	6					
At racking/blending			1	1						1		1	1	1	
Prior to filtration										1				1	
Post filtration										1				1	
Pre Bottling										1				1	
Post Bottling														1	1
Total	33	30	6	5	1	1	1	6	10	11	1	1	1	5	1

Criteria for in-house testing

Frequency

Urgency

Stability

EVERY winery should be able to confidently test...

Brix or Density

Refract OK for juice
Hydrometer for fermenting wine
Multiple hydrometers

Temperature

Instant read thermometer

pH

You MUST trust your in-house pH!
See W01C
WRE protocol on website



Titrateable acidity

Guides harvest decisions &
acid additions
WRE validation study

Free SO₂

Frequency, Urgency
Sample degrades in transit
See W01b
WRE validation study

Precision and Accuracy



A



B

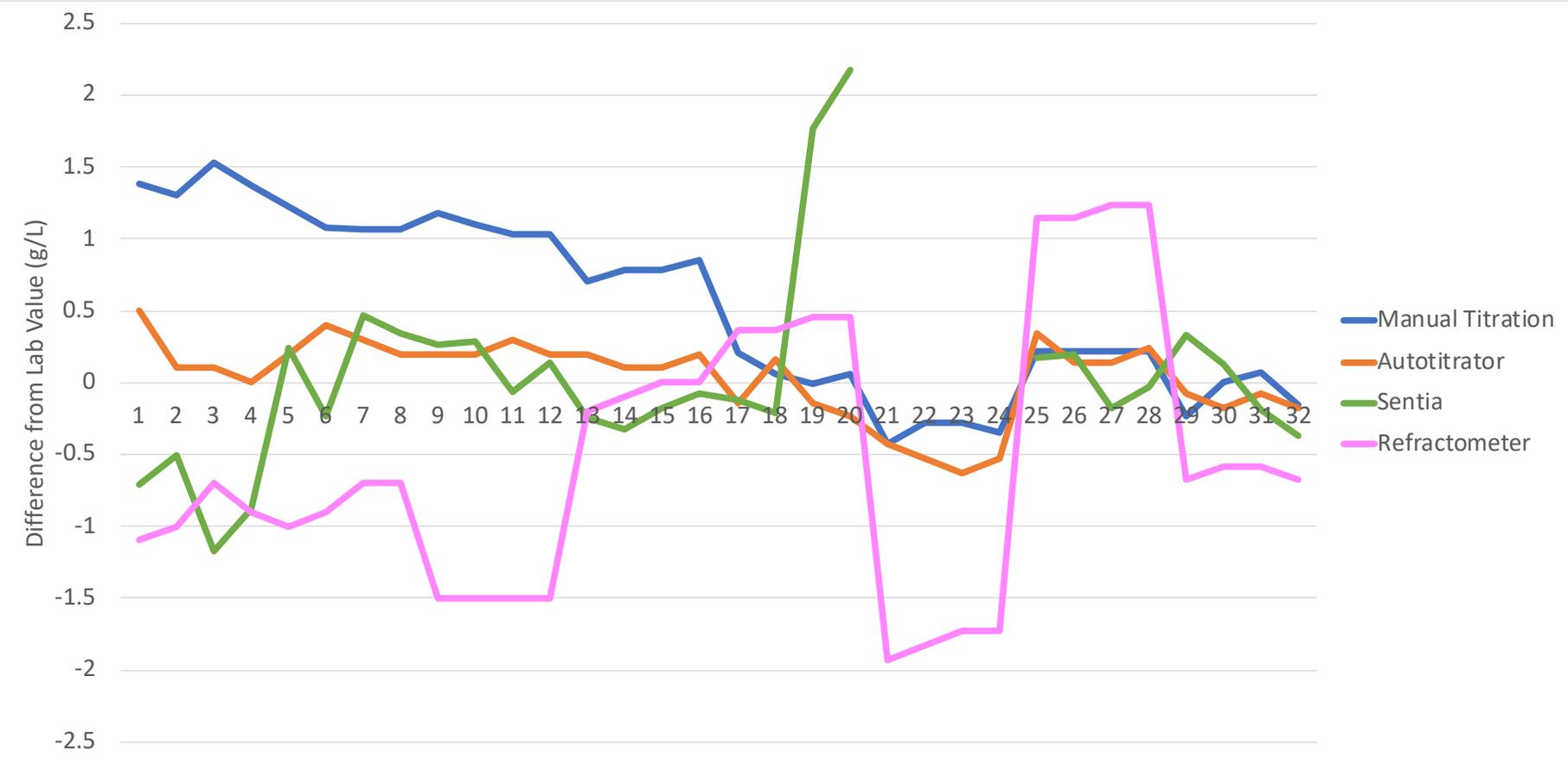


C



D

Relative standard deviation for 4 TA testing methods



Cost & Ease of Use

	Startup Cost	Cost per test	Limits of detection (g)	Minutes per sample	Ease of Use
Manual	\$306	\$1.15		5	Moderate
HANNA Titrator	\$1,185	\$1.87	4.0 - 25.0	4	Easy
Sentia	\$2,274	\$7.00	3.0 - 10.0	1	Easy
Refractometer	\$770	\$0.05	1.0 - 40.0	1	Easy

Manual: time and focus intensive, risk of over titration

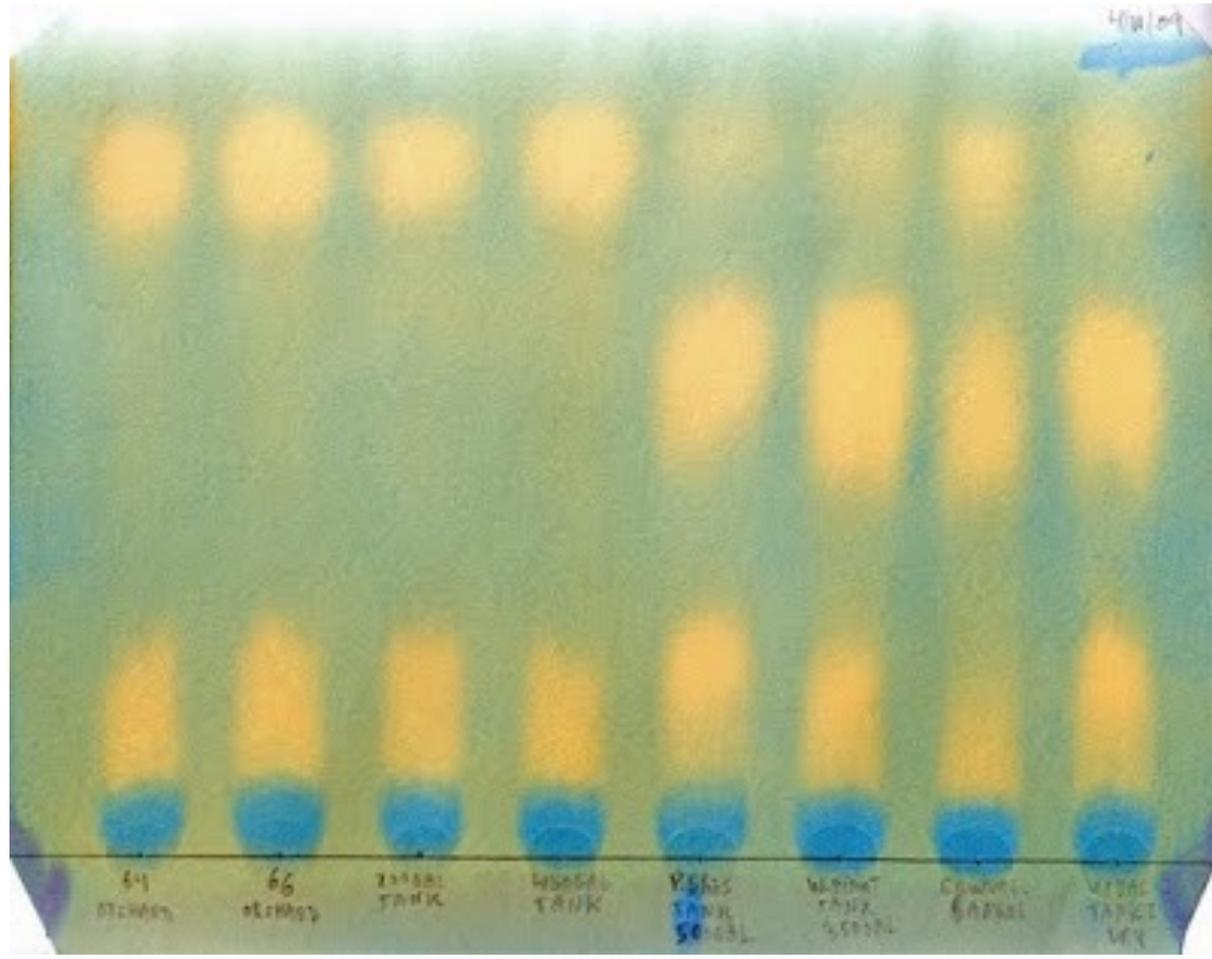
HANNA: more time to calibrate, simple after that, allows multitasking

Sentia: requires centrifugation, testing itself is simple

Refractometer: weighing sample for dilution is cumbersome; testing itself is easy and fast

	Brix	Temp	pH	TA	YAN	K+	RS	MA	AA	SO ₂	Alc	CS	BT	DO	Micro
Press	1		1												
Setting	1														
Racking	1		1	1	1	1									
Fermentation	30	30													
End of Fermentation			1	1			1	1	1		1				
During ML								4	4						
End of ML			1	1				1	1						
One month after SO ₂			1	1					1	1					
Monthly during aging									3	6					
At racking/blending			1	1						1		1	1	1	
Prior to filtration										1				1	
Post filtration										1				1	
Pre Bottling										1				1	
Post Bottling														1	1
Total	✓33	✓30	✓6	✓5	1	1	1	6	10	✓11	1	1	1	5	1

4/11/09



64

66

TANK

TANK

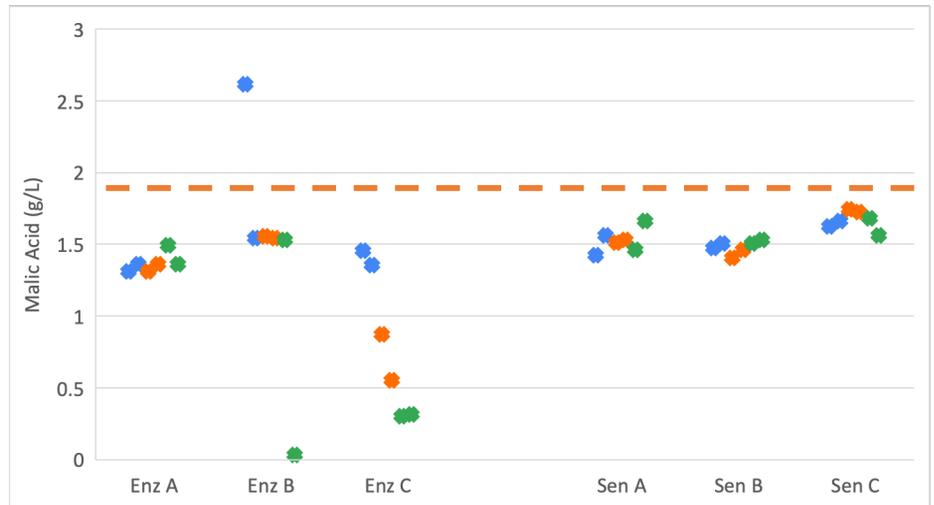
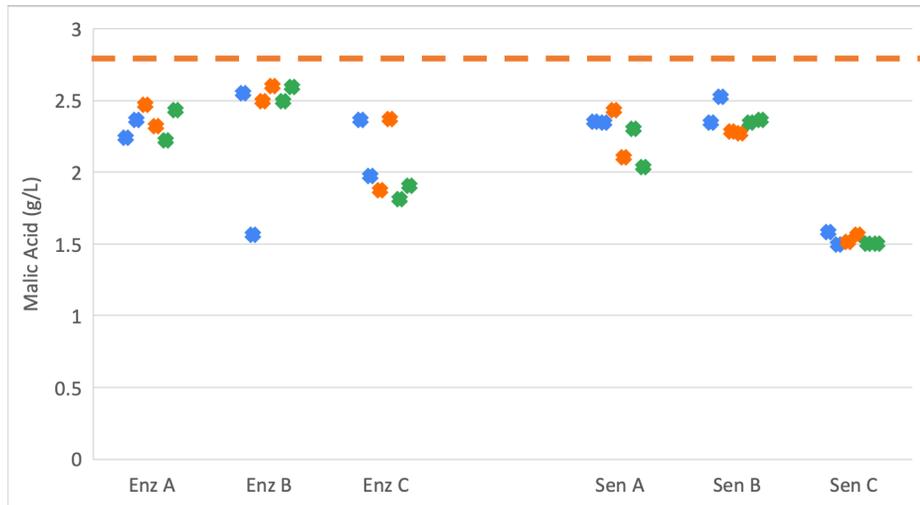
TANK

TANK

TANK

TANK

Malic Acid Testing: Enzymatic vs. Sentia



	Brix	Temp	pH	TA	YAN	K+	RS	MA	AA	SO ₂	Alc	CS	BT	DO	Micro
Press	1		1												
Setting	1														
Racking	1		1	1	1	1									
Fermentation	30	30													
End of Fermentation			1	1			1	1	1		1				
During ML								4	4						
End of ML			1	1				1	1						
One month after SO ₂			1	1					1	1					
Monthly during aging									3	6					
At racking/blending			1	1						1		1	1	1	
Prior to filtration										1				1	
Post filtration										1				1	
Pre Bottling										1				1	
Post Bottling														1	1
Total	✓33	✓30	✓6	✓5	1	1	1	✓6	10	✓11	1	1	1	5	1

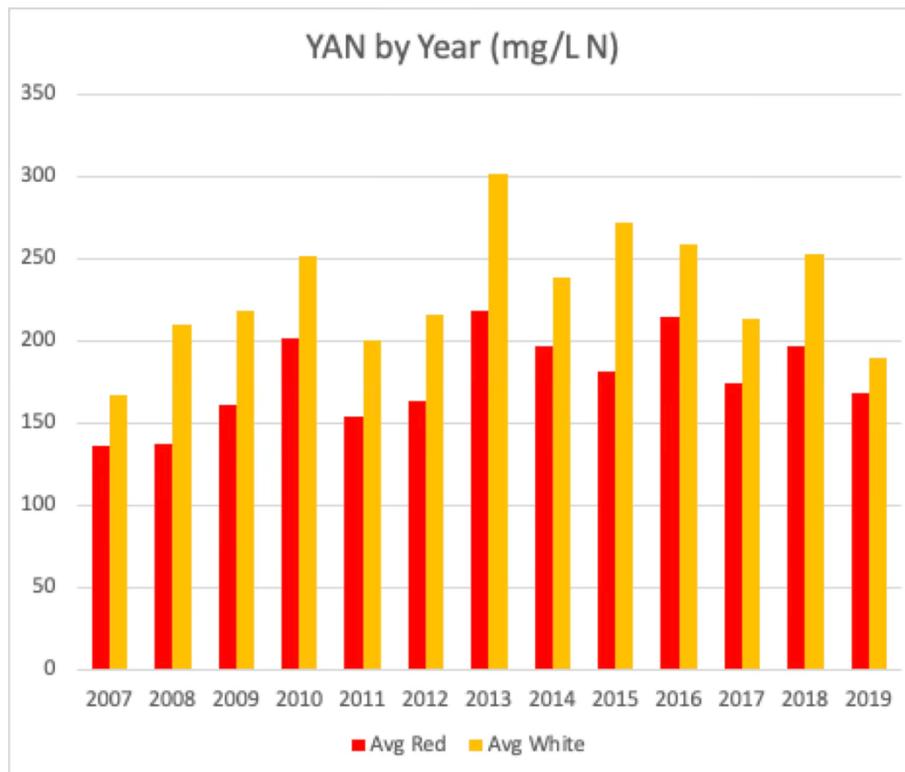
	Sentia Wine Analyzer	Spectrophotometer	ETS
Typical startup cost	\$2200	\$4000	
Titrateable Acidity	\$5	X	\$22
Malic acid	\$6.01	\$4.60	\$30
Acetic acid	\$5	\$5.80	\$33
Residual sugar	\$7.01	\$4.60	\$30
YAN	X	\$6.50	\$66
Potassium	X	X	\$34
Time to result	~5 minutes	10 – 30 minutes (prep + assay) multiple samples/run	Days
Expertise needed	low	moderate	none

	Brix	Temp	pH	TA	YAN	K+	RS	MA	AA	SO ₂	Alc	CS	BT	DO	Micro
Press	1		1												
Setting	1														
Racking	1		1	1	1	1									
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Prior to filtration										1				1	
Post filtration										1				1	
Pre Bottling										1				1	
Post Bottling														1	1
Total	✓33	✓30	✓6	✓5	1	1	1	✓6	✓10	✓11	1	1	1	5	1



Survey of YAN 2007-2019

Virginia Tech Enology Services Lab, Ken Hurley, 2019



No correlation with region

Significant Vintage differences

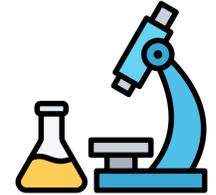
Strongest correlation: vineyard management

Take sample after racking

No fermentation during shipping



In-house vs. Service Lab



In-house: easy, frequent, time-sensitive

Brix, Temperature, pH, TA, free SO₂

With equipment: YAN, malic acid, acetic acid, residual sugar

Service Lab: technically challenging, accuracy for decision points

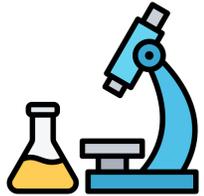
Cold stability

Alcohol

Bentonite Trial (?)

Potassium

Microbiology



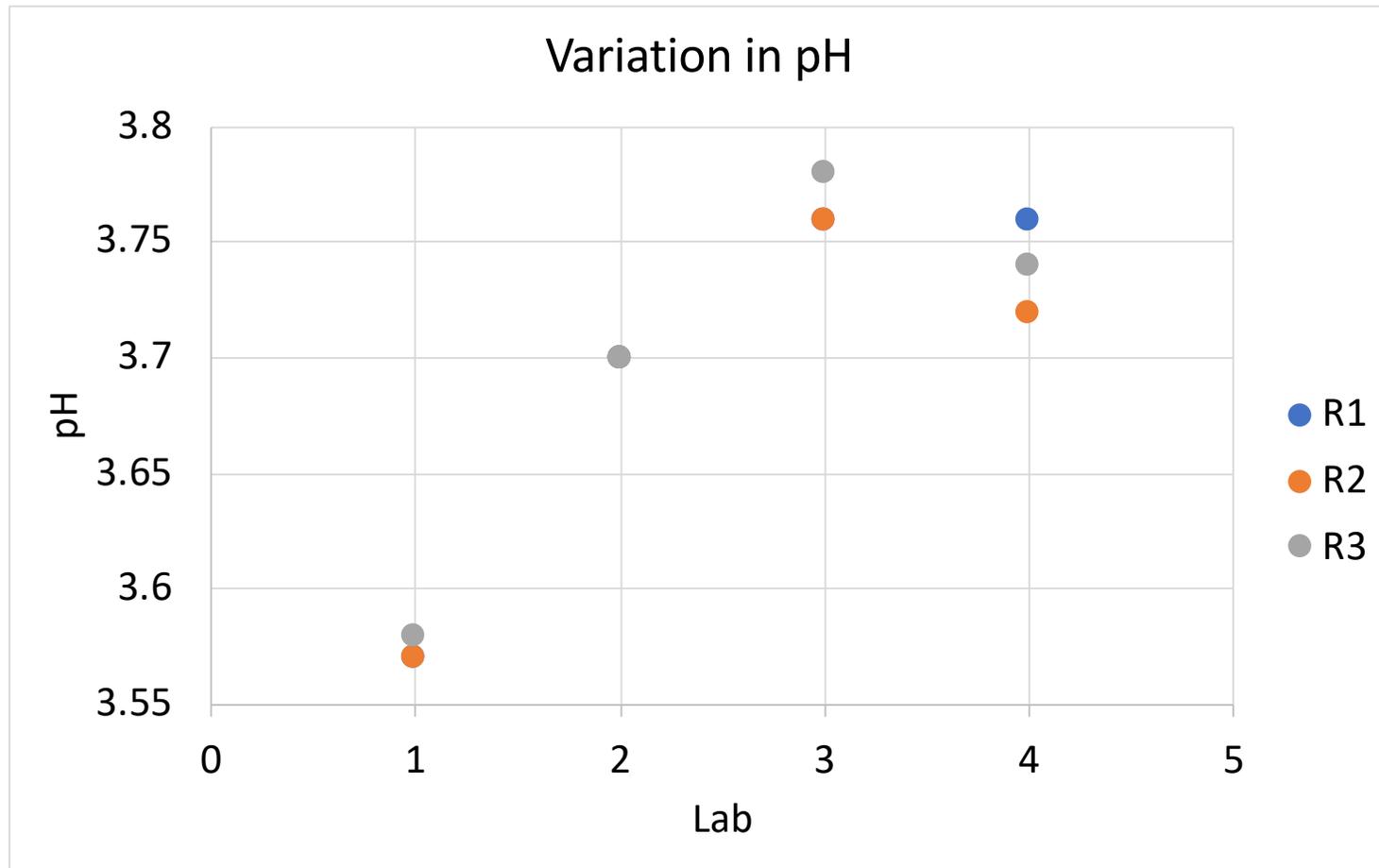
Guidelines for Service Lab Samples

1. Proper sample selection, preparation, and transit ensure lab results accurately represent the lot being evaluated.

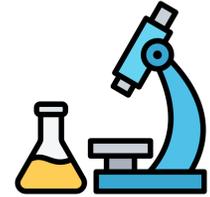
How perishable is the sample? Will it change in transit?

Juice samples vs. wine with SO₂

Delaplane Service Lab Survey, 2021



Sending juice samples to the lab



Written for ETS Tubes, can be adapted for other containers

Fill sample tube with juice up to the line.

Weigh the tube on a lab grade scale (W_0). Record the weight.

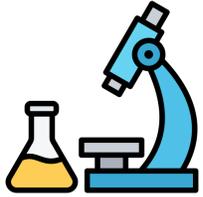
Briefly heat the tubes to boiling in the microwave.

Cap and invert the tube to homogenize heat. (Should be $>90^\circ\text{C}$)

Uncap and weigh the tube again (W_1).

Add distilled water dropwise to restore to W_0 .

Ship overnight to the lab



Guidelines for Service Lab Samples

1. Proper sample selection, preparation, and transit ensure lab results accurately represent the lot being evaluated.

How perishable is the sample? Will it change in transit?

Juice samples vs. wine with SO_2

2. Consider the methodology used by the lab re: precision vs. accuracy.
3. Interpret service lab data alongside in-house trends.

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Requirements for Record Keeping System

For TTB Report

- Fruit weights
- Sugar Additions
- Water for amelioration
- Brandy additions
- Bulk wine losses
 - Racking (Lees)
 - Topping (Evaporation)

For HAACP

- Operations (steps in QA)
 - Racking, Aeration, etc..
- Additions with rates & amounts
 - Yeast strain, nutrients
- Monitoring data
 - Lab analyses
 - Sensory impressions
- Validation data relative to in-house numbers

ALWAYS include amounts and dates



Pre-Harvest Record Keeping



Date	Vineyard	Variety	Berry Weight	Brix	pH	TA	Notes
8/31	A	Chardonnay	1.02	18.2	3.12	8.5	Tart/green
8/31	A	Sauv Blanc	1.2	18.4	3.10	8.2	ready
8/31	A	Viognier	1.3	19	3.34	6.5	Dilute, green



Pre-Harvest Record Keeping



Date	Vineyard	Variety	Berry Weight	Brix	pH	TA	Notes
8/31	A	Chardonnay	1.02	18.2	3.12	8.5	Tart/green
9/7	A	Chardonnay	1.07	19.5	3.23	7.4	Dilute, almost
9/14	A	Chardonnay	1.10	21	3.34	6.5	ready

Lot Name: _____

Juice	Tank/Barrel:						
	Date	Brix	pH	TA	YAN	MA	Pot Alc
Initial							(0.55 for reds)
After settling							(0.60 fo whites)

Acid Trials:	g/L add	pH		Addn	Date:	Amt
Target:	0.00		2.25	sugar		
Whites: 3.25	0.25		2.50	tartaric		
Reds: 3.45	0.50		2.75	yeast		
	0.75		3.00	Nutrients		
	1.00		3.25	Nutrients		
	1.25		3.50			
	1.50		3.75			
	1.75		4.00			
	2.00		4.25			

Date	RS	VA

End 1° Fermentat Tank/Barrel:

Date	RS	pH	TA	ALC	VA	MA

Acid Trials:	g/L add	pH		Addn	Date	Amt
Target:	0.00		2.25	tartaric		
Whites: 3.25	0.25		2.50	SO2		
Reds: 3.50	0.50		2.75			
	0.75		3.00			
	1.00		3.25			
	1.25		3.50			
	1.50		3.75			
	1.75		4.00			
	2.00		4.25			

Date	MA	VA

Primary Sulfur Tank/Barrel:

Date	fSO2	pH	VA	TA

g/L add	pH	Addn	Date	Amt
0.00		tartaric		
0.25		SO2		
0.50				
0.75				
1.00				

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Use gold standard lab testing for validation of in-house values

Cold stable, filtered box wine:

pH

TA

Malic acid

Acetic acid

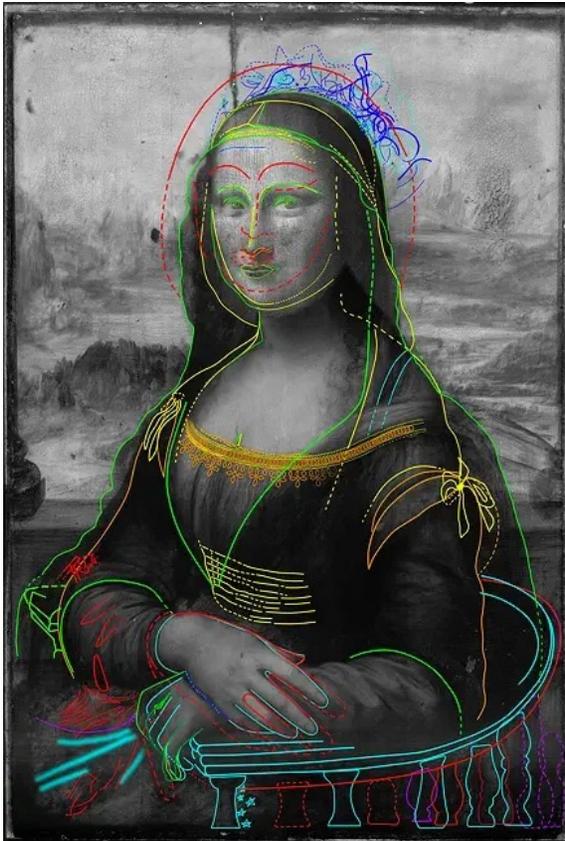
Residual Sugar

NOT

Free SO₂

Total SO₂





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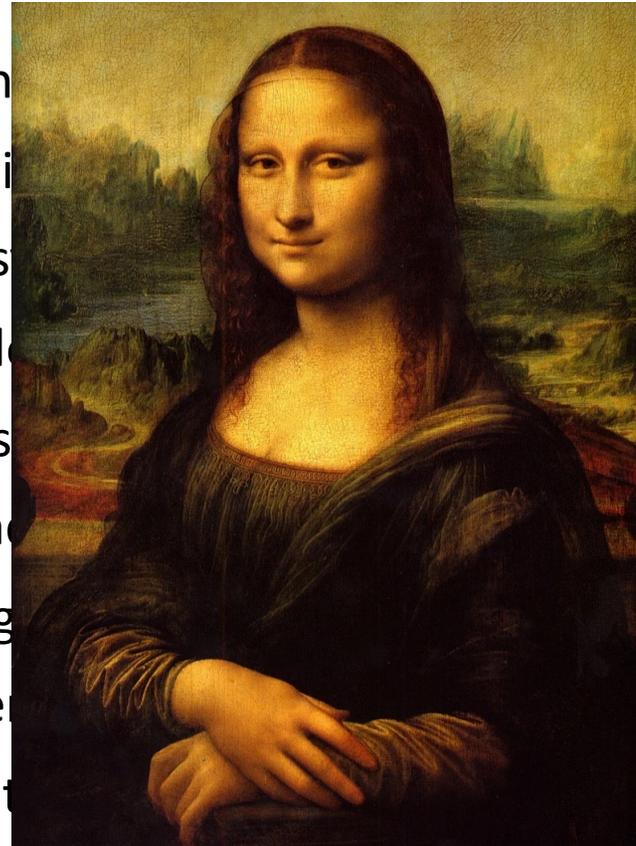
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Plan ahead

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For full reports and background:
www.winemakersresearchexchange.com

For questions/comments: VaWrex@gmail.com



Eastern Winery

EXPOSITION +
CONFERENCE

March 24-26, 2026 | Richmond, VA

Contact: Joy Ting

Joy Ting
Virginia Winemakers
Research Exchange
VaWREx@gmail.com



Pre-Harvest Record Keeping



sugar per berry (g/berry) = ($^{\circ}\text{Bx} / 100$) * berry weight (g)

