Winery Laboratory Requirements

TWGGA – Winery 101, 2026

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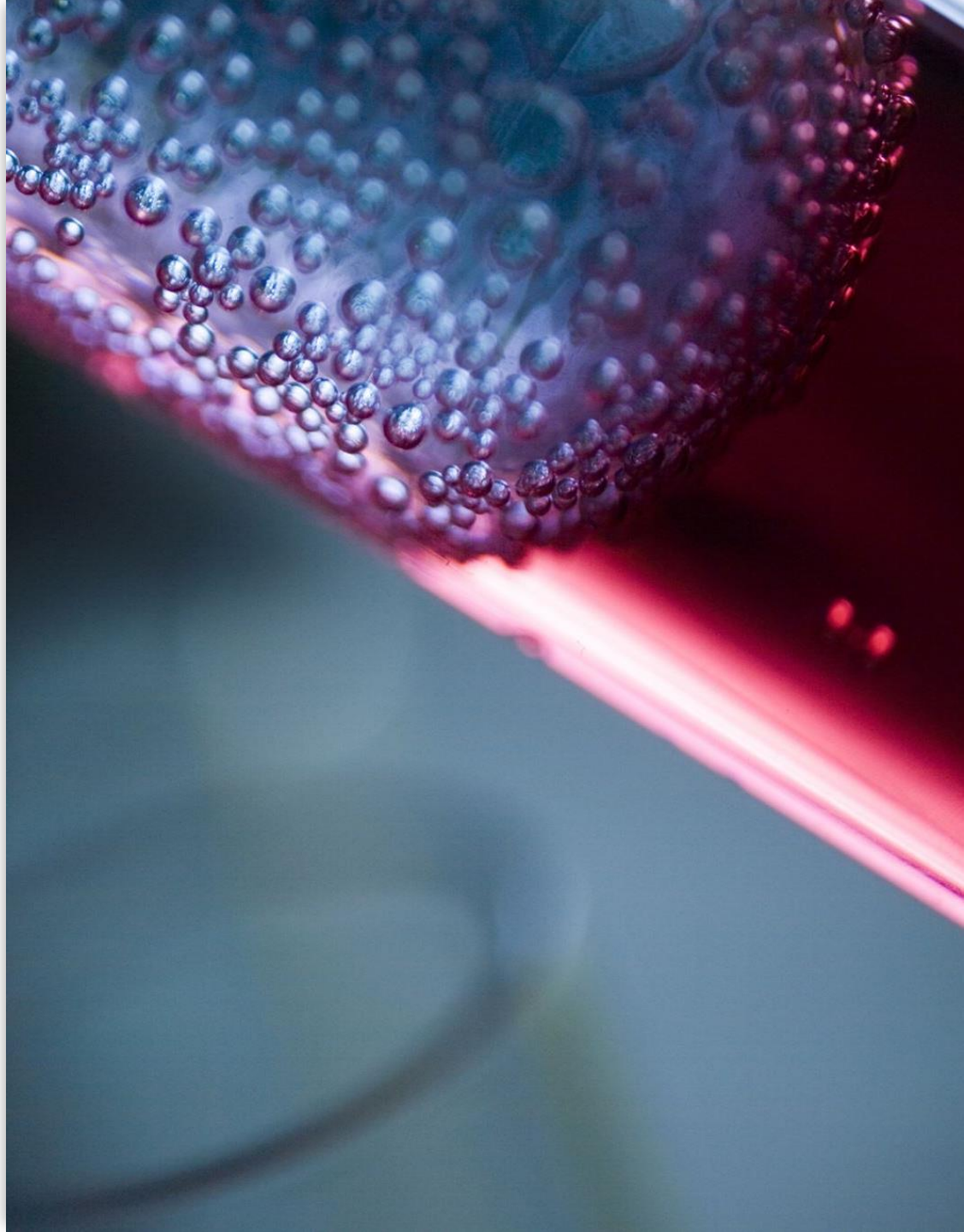
Introduction to Winery Lab Essentials

1. Discuss the importance of analytical testing in winemaking.
2. Identify the parameters that need to be measured at the grape and wine stage
3. List the equipment used to measure these parameters
4. Discuss pricing for a basic functional lab setup

Why a Winery Lab Matters

- Wine is chemistry in motion
- Fermentation is biological and dynamic
- Stability depends on measurable parameters
- Compliance requires analytical accuracy



Basic Analytical Needs for Harvest (Juice Analysis)

- Sugars (brix)
- pH
- TA
- YAN*
- Temperature

Core Parameters During Fermentation

- Temperature tracking
- Brix / density drop
- YAN adjustments
- pH monitoring
- Dissolved oxygen awareness

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Basic Analytical Needs for Wine

Alcohol

TA

pH

Free SO2

Total SO2

VA

MLF

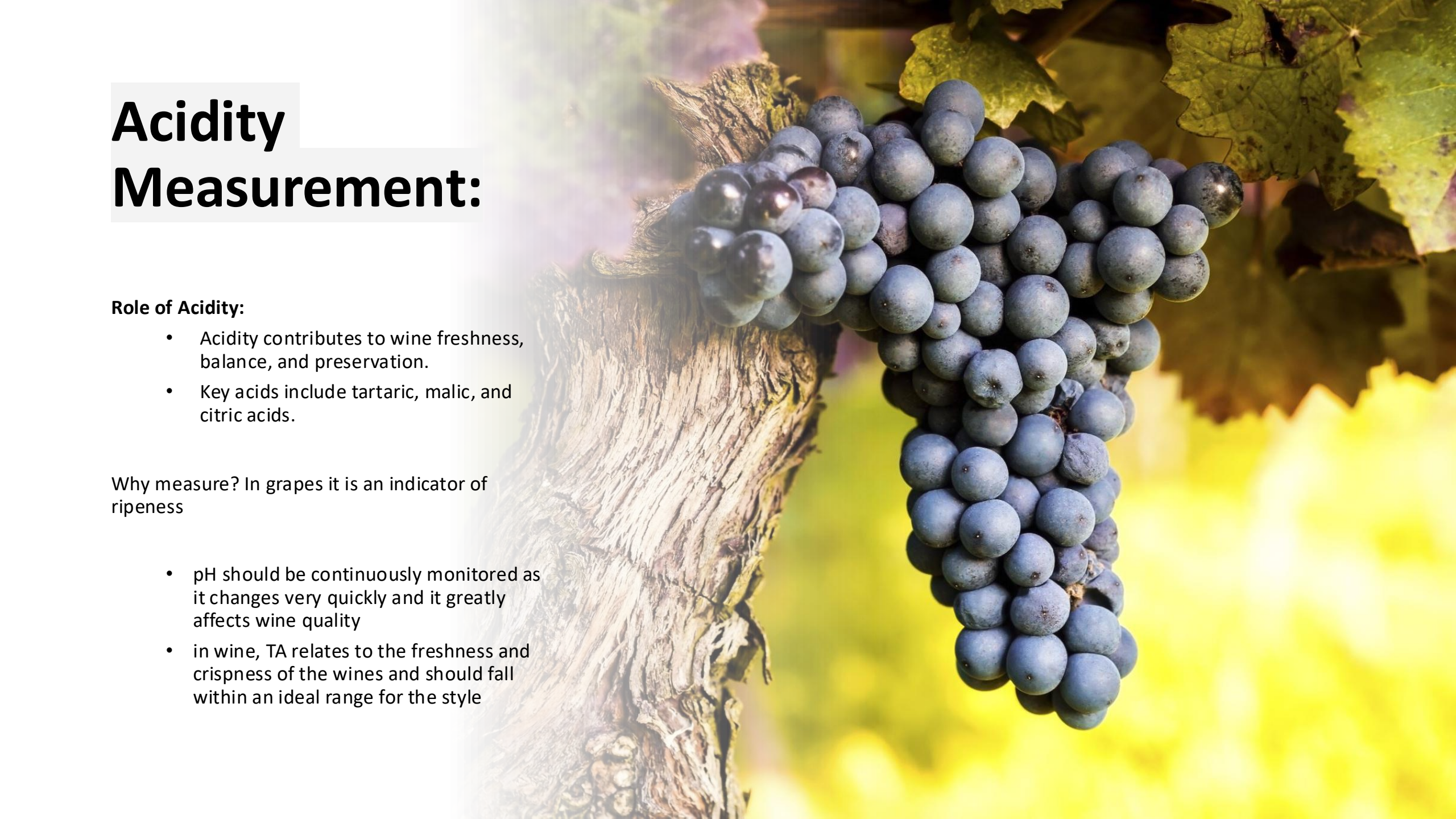
Sugars (Brix) Measurement:

- **Importance of Brix Measurement:**
  - Brix refers to the sugar content in grape juice or must.
  - It directly impacts potential alcohol content during fermentation – 17 g sugar/1% alcohol.
  - Winemakers use Brix readings to determine harvest timing.

Sugar Measurement

- **Measurement Tools:**
  - **Refractometer**: A handheld optical instrument that measures Brix by refracting light passing through a sample.
  - **Hydrometer**: A glass tube that floats in the juice and provides a Brix reading based on buoyancy.
  - **Density meters**

Acidity Measurement:



Role of Acidity:

- Acidity contributes to wine freshness, balance, and preservation.
- Key acids include tartaric, malic, and citric acids.

Why measure? In grapes it is an indicator of ripeness

- pH should be continuously monitored as it changes very quickly and it greatly affects wine quality
- in wine, TA relates to the freshness and crispness of the wines and should fall within an ideal range for the style

TA measurement

- **Measurement Tools:**
  - **Titration using a burette and reactants**: Titration-based method using a chemical indicator.
  - **Titralyzer – automatic acidity titrator**

Link to demo video:

TA manual titration demo

pH Measurement

pH and Wine Stability:

- pH affects color stability, microbial growth, and enzymatic reactions.
- Desired pH varies by wine type (e.g., red vs. white).

Measurement Tool:

- **pH meter**: measures hydrogen ion concentration.
- Combination analyzer with pH probe

Demo pH Analysis

YAN importance

Main nutrient for yeast metabolic activity

Too little:

- Stuck or sluggish fermentations
- H2S formation (rotten eggs smell)

Too much

- Hot/fast ferments
- Toxic compound formation
- VA

YAN Measurement

Enzymatic Kits (Most Common for Small/Medium Wineries)

1. Ammonium Enzymatic Kit

- Measures NH_4^+ specifically.
- **Equipment needed:**
  - Spectrophotometer (340 nm)
  - Glass cuvettes (or disposable plastic if compatible)
  - Micropipettes (100–1000 µL)
  - Timer
  - Vortex mixer (optional but helpful)

2. NOPA Assay (Primary Amino Nitrogen)

- Measures PAN.
- **Equipment needed:**
  - Same spectrophotometer (typically 335–340 nm)
  - Pipettors
  - Reaction tubes
  - Water bath (optional for temperature control)

Alcohol Measurement

- **Why Measure Alcohol Content?**
  - Alcohol percentage affects wine style, mouthfeel, and aging potential.
  - *There is a trend towards lower alcohol levels in wine*
  - Accurate alcohol levels are crucial for labeling compliance.
- **Measurement Tools:**
  - **Ebulliometer**: Measures boiling point depression due to alcohol content.
    - Classic or electronic
  - **Alcolyzer** – Near Infrared absorption (more expensive but much faster)

Classic ebuliometry video:

Demo ebuliometry

SO2 (Free Sulfur Dioxide) Measurement

- **Sulfur Dioxide in Winemaking:**
  - Preserves wine, inhibits oxidation, and prevents microbial spoilage.
  - Free SO2 is essential for wine quality. Total is important for legal requirements.
- **Measurement Tools:**
  - **The Ripper method** – burette, reagents, glassware – free and total
  - **SO2 Test Kit**: Colorimetric method using chemical reagents. – free SO2
  - **Enzymatic Method**: Quantifies **free** & total SO2 enzymatically.
  - **Aspiration** – oxidation apparatus – both free and bound/total
  - **Spectrophotometry** – free SO2

Volatile Acidity Measurement

- **Understanding Volatile Acidity:**
  - Volatile acids (e.g., acetic acid) impact wine aroma and taste.
  - Excessive volatile acidity indicates spoilage.
- **Measurement Tool:**
  - **Enzymatic kits plus spectrophotometer**
  - **Cash still apparatus**
  - **Voltametry**

Monitoring Malolactic Fermentation

What is MLF?

Bacterial process that transforms malic acid into lactic acid

Drops acidity, raises pH

Buttery, creamy notes

You may or may not want it – either way, important to monitor

Equipment

Paper chromatography – old school

Enzymatic malic acid kits ✓

Automated analyzers $$

Never bottle without confirmation

Dissolved Oxygen Awareness

- Impacts oxidation
  - Critical during racking and bottling
  - Advanced DO meters available

Lab QA/QC and Calibration

- pH meter calibration – fresh, clean buffer solutions
- SO2 standardization – standardized concentrations
- Probe maintenance – deposit free, no cracks
- Record keeping – lab books, physical or digital

Tier 1: Minimum Survival Lab (~$2–4K)

- Refractometer or
- Hydrometer
- Thermometers
- Manual TA titration
- pH meter
- Ripper SO2 kit
- Ebuliometer

Vinmetrica Analyzer

TA
pH
Free SO2
DO probe addition
YAN test kit
MLF kit
RS kit
ABV kit

Tier 2: Professional Small Winery (~$6–12K)

- Spectrophotometer
- Aeration-Oxidation
- VA still
- DO meter
- Analytical balance
- Centrifuge

Tier 3: Growth & Automation (~$20K++)

- Multi-parameter analyzer
- Electronic alcohol analyzer
- Automated titrators

Multi parameter analyzers

- Gallery Analyzer (Thermo Fisher) Gallery Analyzer
- Lyza Analyzer (Anton Paar) Lyza Analyzer
- SPICA Analyzer (Admeo) SPICA Analyzer
- OenoFoss Analyzer (Foss Analytical) FOSS Analyzer

Prices

- Refractometer $50-$150
- Hydrometer $10-$100
- Titration setup $100-$250
- pH meter $200 - $1500
- **Vinmetrica analyzer (TA, pH, SO2) - $400**
- SO2 aeration oxidation apparatus $350 - $450
- **Volatile acidity cash still $1000**
- Ebulliometer $1000 - $2500
- **Density meters (brix, specific gravity and alcohol) $400 - $800**
- Spectrophotometer (for enzymatic tests and YAN) - $300 - $3000
- Electronic alcoholyzer $10.000
- Centrifuge (for clarifying juice samples) $500 - $10.000

Prices

- Glassware (beakers, cylinders, etc)
- Pipettes
- Stir plates
- Other lab bits and pieces (stir bars, scoops, scales, wipes, gloves, etc)

- Other considerations
  - Lab should have a sink with running water, ventilation and a fridge/freezer
  - Computer for record keeping is also recommended

Winery Pitfalls

- Thinking winemaking is easy
- Not understanding and monitoring basic wine parameters throughout the process
- Sanitation! Contamination!
- Choosing the wrong equipment

Winery pitfalls

- Not **planning for equipment and storage** when designing the winery
- Not having enough **storage space**
- Not planning for **growth and expansion**
- **Overproduction**: Producing more wine than market demand can absorb can lead to excess inventory, storage costs, and potential devaluation of the product.
- **Inconsistent Quality Control**: Failing to maintain consistent quality standards throughout the winemaking process can result in variable tasting experiences for consumers, damaging brand reputation.

Winery Pitfalls

- **Failure to Adapt to Market Trends**: Neglecting to stay informed about evolving consumer preferences and market trends can result in products that are out of touch with current demand.
- **Ignoring Technology Advancements**: Failing to leverage technology for tasks such as inventory management, customer relationship management, and online sales can lead to inefficiencies and missed opportunities for growth.
- **Inattention to Sustainability**: Ignoring sustainability practices in vineyard management and winemaking processes can lead to environmental damage and negative public perception.
- **Ignoring Customer Feedback**: Failing to listen to customer feedback and adapt products or services accordingly can lead to decreased customer satisfaction and loyalty.
- **Lack of Marketing Strategy**: Neglecting to develop and execute a robust marketing strategy can lead to difficulties in attracting and retaining customers, especially in a competitive market.

Winery Pitfalls

- **Ignoring Regulatory Compliance**: Failure to comply with local, state, and federal regulations related to winemaking, labeling, and distribution can result in fines, legal issues, and reputational damage.
- **Underestimating Financial Planning**: Insufficient financial planning and budgeting can result in cash flow problems, hindering day-to-day operations and growth initiatives.
- **Neglecting Branding and Packaging**: Underestimating the importance of branding and packaging design can lead to products that fail to stand out on crowded shelves, resulting in lower sales.
- **Ineffective Distribution Strategies**: Poorly planned distribution channels or reliance on a single distribution partner can limit market reach and accessibility to consumers.

Thank you!

Questions and/or comments?

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Equipment photos:

Refractometer

Hydrometer

pH meter

SO2 aspiration oxidation

Volatile acidity cash still

Classic ebulliometer

Electronic ebulliometer

Vinmetrica analyzer for pH, TA, SO2

Titration setup for titratable acidity