

Winery Analysis Equipment for Small Wineries

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Overview

- Importance of winery laboratory
- General laboratory equipment
- Safety equipment
- Testing Equipment

Importance of Winery Laboratory

- Provide data to make informed wine processing decisions
- Quality of analysis
 - Precision vs. accuracy
 - Use of data
- Volume of data
 - Number of wines produced

Importance of Winery Laboratory

- Tests should be able to be standardized
 - Single use test items not acceptable for commercial wineries
 - Titrets, etc
 - Standards and calibrators should be a routine part of winery analysis

Importance of Winery Laboratory

- Precision and Accuracy



Importance of Winery Laboratory

- Data quality and decision making
 - Decisions are only as good as the data used to make them
 - Any adjustments to a product should be made using the best data available
 - Acid adjustments, sulfur adjustments
 - Replicate measurements should always be done

Importance of Winery Laboratory

- Bench Trials
 - Aside from sulfur, all other additions to a wine lot should be first bench tested
 - There are no rules of thumb on wine adjustments
 - Learn to appropriately conduct and analyze bench trials

General Equipment

- Glassware
 - Flasks, beakers, erlenmeyers, graduated cylinders, pipettes, burettes, etc
- Balance
 - At least 0.01 g accuracy
- Stir/Hot Plate
 - Sample mixing, de-gassing, yeast starter
- Ring Stand, clamps, centrifuge, DI water, lab fridge

Glassware

- Volumetric vs. graduated
 - Use volumetric glass ware for routine accurate measurements and dilutions
 - TA, sulfur
 - Reagent preparation
 - Sizes:
 - 5 mL for TA
 - 10, 20 mL for SO₂, reagent prep
 - 50 mL for reagent prep
 - Use graduated for less common measurements
 - Sizes: 1 mL, 10 mL, 25 mL

Glassware

- Graduated Cylinders
 - Sizes:
 - 10, 15, 50, 100, 500, 1000 mL



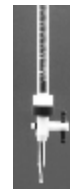
Glassware

- Keep a range of sizes on hand
 - Beakers, erlenmeyer flasks



Glassware

- Burets
 - 25 mL
 - 10 mL
 - PTFE Stopcock
 - Class A



Glassware

- Class A vs. Class B
 - Class A meets tolerances defined in ASTM E694, +/- 1% to +/- 0.1%
 - Class B has tolerances twice those of Class A
- TC vs. TC
 - TC, To Contain, contains amount specified when filled to graduation line
 - TD, To Deliver, delivers specified amount when filled and emptied

Balances

- Many producers
 - 0.01 g accuracy
 - Important for small additions and bench trials
 - Price depends on precision and load capacity
 - Calibration weights, proper installation

Balances



Stir/Hot Plate

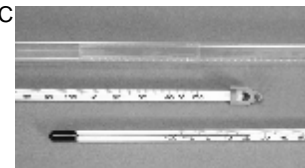
- Used for reagent prep, TA, inoculations
- Available in various styles, sizes
 - Minimum 7" surface area
 - Digital temperature helpful
- Stir bars
 - Hexagonal, stir ring, keep multiple sizes on hand

Stir/Hot Plate



Thermometer

- Food grade thermometer
- Must have at least one liquid thermometer
 - -20C to 110C



Safety Equipment

- Appropriate PPE
 - Safety glasses
 - Fire extinguisher
 - Apron, lab coat
 - Chemical resistant gloves
 - Eye wash station
 - First aid kit
 - MSDS
 - Chemical clean up kits
 - Check with local authorities for proper disposal of used reagents

Analysis Equipment

- pH
- Titratable Acidity
- Sulfur dioxide
- Ethanol
- Sugar
- Malic Acid
- Stability
- Minor components:
 - Nitrogen, CO₂, dissolved oxygen

Analysis Equipment

- Laboratory equipment is expensive
But, so is product loss
- Example:
 - 500 gallons wine
 - Grapes: \$0.75/lb, 13 lbs/gallon, ~\$5,000

Analysis Equipment

- Overall considerations:
 - Cost of unit
 - Technical difficulty
 - Cost per analysis
 - Frequency of use
 - Desired accuracy
 - Open vs. closed systems

pH

- Bench top model
- 0.01 pH unit sensitivity
- At least 2 point calibration
- Automatic temperature compensation (ATC)
- Meter cost increases with increasing sensitivity
- Probe cost increases with response speed and durability

pH

- Consumables
 - Buffer solutions, storage solution, electrode solution
- Multiple use
 - Ion selective electrode
 - Dissolved oxygen
- Cost
 - High unit cost, minimal cost per analysis

pH



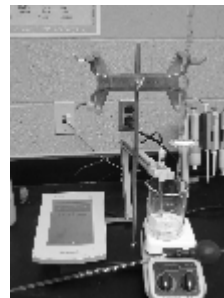
pH

- Manufacturers:
 - Hanna
 - Thermo
 - Fisher Scientific
 - Beckman Coulter
 - Mettler Toledo
 - Many more

Titration Acidity

- **Manual Method**
- 25 mL straight bore buret
 - PTFE stopcock, preferably class A
- pH meter
- Stir plate and stir bar
- Beaker
- Volumetric pipet
- NaOH
- Cost of Analysis:
 - Unit: Minimal
 - Per Analysis: Minimal

Titration Acidity



Titration Acidity

- **Automated Methods**
- Titrators
 - Convenient, less wet chemistry required
 - Consumables
- Cost of use:
 - Unit: High
 - Per analysis: Moderate

Titration Acidity



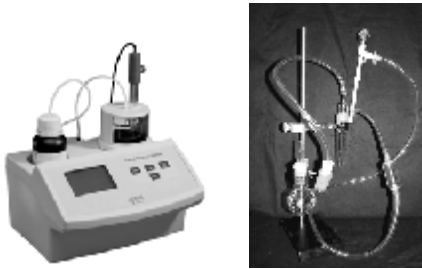
Sulfur Dioxide

- Manual Methods:
 - Ripper, A/O
- Ripper
 - Titration of acidified solution and iodine
 - Simple, but requires practice
 - Difficult to impossible for red wines
 - Cost
 - Unit: Minimal
 - Per Analysis: Minimal

Sulfur Dioxide

- Aeration Oxidation
 - Recommended method
 - Useful for all wines, including those with ascorbic acid
 - Cost
 - Unit: High
 - Per Analysis: Low
 - Phosphoric acid, indicator, hydrogen peroxide

Sulfur Dioxide



Sulfur Dioxide

- Automated Methods
 - Simple
 - More consumables
 - Cost:
 - Unit: High
 - Per Analysis: Moderate

Ethanol

- Ebulliometer
 - Preferred method
 - Simple
 - Limitations:
 - High or low alcohol
 - Sugar
 - Cost
 - Unit: High (~\$700)
 - Per analysis: Minimal



Ethanol

- Other methods:
 - Distillation
 - More glassware, calibrated hydrometers
 - Gas Chromatography
 - Independent of interfering substances
 - Expensive
 - NIR (Near Infra-Red Analyzer)
 - Fast
 - Expensive

Ethanol

- Potential alcohol and hydrometer use not acceptable

Sugar

- Harvest:
 - Refractometer
 - Handheld or digital
 - Which to use is dependent on need of accuracy
 - Sugar adjustments should be done according to digital results
 - ATC

Sugar



Sugar

- Hydrometers
 - 0-32 °Brix, +5/-5 °Brix
 - Useful for monitoring fermentation progress
 - Use refractometers for harvest measurements
 - Do not use as a measurement for residual sugar

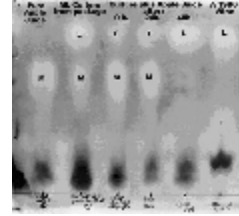
Sugar

- Post Fermentation
- Be aware of the difference between residual sugar and reducing sugar
 - Clinitest can be used to estimate reducing sugar
- Ultimately enzymatic tests are a reliable method for measuring final sugar content
- Several wet chemistry titration methods also available, Rebelein Method AKA Gold Coast

Malic Acid

- Paper chromatography most common in small wineries
 - Advantage:
 - Inexpensive, easy to use
 - Disadvantage:
 - Reliability
 - Does not indicate or guarantee that wine has finished MLF

Malic Acid



<http://www.vvva.net/winemaking-articles/graphics/acid2pic.jpg>

Malic Acid

- Enzymatic analysis
 - Fast
 - More accurate
 - More expensive
 - Spectrophotometer
 - Appropriate lab dispensing equipment
 - Enzymes, higher cost per analysis

Volatile Acidity

- Volatile Acid Still (Cash Still) most common
 - Very important analysis, but rarely done in-house or at all in small industry
 - Cost
 - Unit: High
 - Per analysis: Minimal
 - Technical difficulty: Moderate
- VA analysis is important
 - Indicate spoilage and acetate accumulation prior to sensory impact

Volatile Acidity



<http://www.adamschimenden.com/images/content/819.jpg>

Stability

- Cold Stability
 - Checking a wine for its propensity to form tartrate crystals
 - Easiest
 - Freeze a sample of wine and observe crystal formation when thawing
 - Better
 - Hold sample at -4C for 48 hours and observe presence of crystals
 - Best
 - Conductivity testing

Stability

- Heat Stability
 - Requires a way to heat samples consistently for a specified period of time
 - Multiple methods available, and decisions ideally would be made using results from more than one testing method
 - Samples for both heat and cold stability should be bench treated in a similar manner as final wine

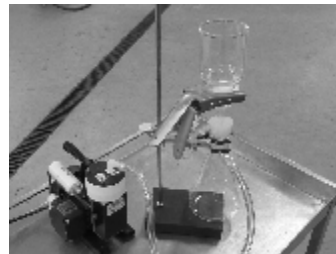
Stability

- Hot Box
 - Incubator, hold wine at 55C for 24-48 hours
- Water Bath
 - Water bath, hold wine at 80C for 6-8 hours
- TCA or boiling methods
 - Trichloroacetic acid

Stability

- Bench filter
 - Need to remove bentonite or other treatments
- Small volume sampling capability
 - Pipettors

Stability and Bench Trials



Bench Trials

- Graduated cylinders
 - 500 mL preferred, but 100 mL minimum
- Ability to weigh or measure small volumes
- Bench trials should, rather **MUST** be performed before modifying treatments are made to a lot of wine

Other Analysis

- Nitrogen
 - Ammonia, Primary Amino Acid, (YANC)
 - Enzymatic, ISE probe
- Dissolved Oxygen
 - DO probe
- Carbon Dioxide
 - Carbodosseur



Advanced Equipment

- Spectrophotometer
 - Highly versatile
 - Expensive, requires solid laboratory skills
 - Tests:
 - VA, malic acid, residual sugar, ammonia, primary amino nitrogen, ethanol, etc
 - Megazyme has handheld version
 - Less expensive, greater ease of use, visible range analysis

Advanced Equipment



<http://www.unitechscientific.com/1904+.htm>

Advanced Equipment



Books

- Chemical Analysis of Grapes and Wine, Patrick Iland (\$140)
- Wine Analysis and Production, Bruce Zoecklein
- <http://ucdavisbookstore.com/home.aspx>

Equipment Suppliers

- Cynmar, www.cynmar.com
- GW Kent, gwkent.com
- Fisher Scientific, www.fishersci.com
- Sigma Aldrich, www.sigmaaldrich.com
- Presque Isle: www.piwine.com

Questions?

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