WASHINGTON STATE UNIVERSITY EXTENSION

World Class. Face to Face.

Introduction to Winemaking
Part 1: Overview of Winemaking & Determining Ripeness

Dr. James F. Harbertson

Extension Enologist

Washington State University

Overview of winemaking

- Grapes are fermented by yeast and converted into wine.
- Winemaking procedure(s) differs at winemaker, winery, region, and country level.
- Many different techniques, recipes, outcomes.
- Desired wine style dictates much of winemaking techniques employed.
- Money, time and employees also important.

Winery Operations

- Harvest
- Crush
- Must Additions
- Pressing
- Settling/Racking
- Fermentation(s)
- Aging/Blending
- Filtering/Cold Stabilization
- Bottling

Harvest decisions

- How do we determine ripeness?
- Vineyard Sampling
- Berry Growth
- Sugar concentration (Brix)
- Titratable Acidity and pH

Vineyard Sampling

- Sample must represent entire vineyard (changes in topography, soil, etc.)
- Everything must be chosen randomly
  - I.E. different areas of cluster, canopy location, row orientation
- Berry Sample (100-200 berries)
  - Most Robust but must be meticulous and unbiased
- Cluster Sample (20-50)
  - Removes bias in berry sampling but requires more fruit
- Vine Sample (all clusters from 1 vine)
  - Only useful in vineyards where topography is uniform
- Most robust is Berry sampling

Berry Expansion During Ripening

- Berry Growth goes through 3 stages
  - Stage 1 Rapid Growth
  - Stage 2 Lag Phase
  - Stage 3 Resumed Growth and Maturation
- Growth pattern follows a double sigmoid
- During ripening the berry is expanding
  - 3 to 4 cell number ↑
  - cell volume ↑ 300 fold.
- Veraison (softening and coloration) begins at stage 3

Berry Growth During Ripening

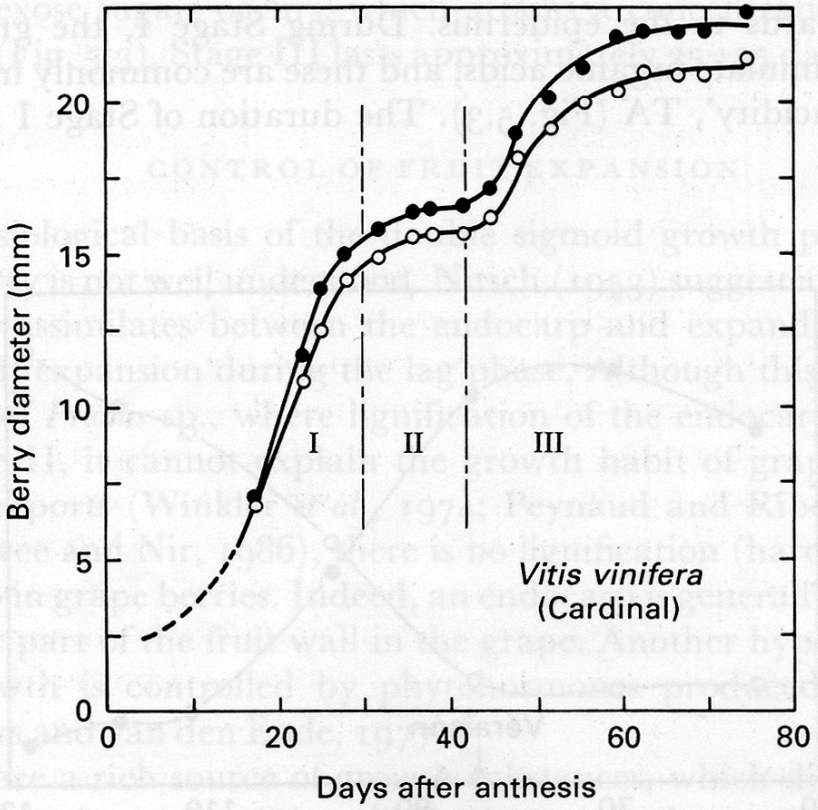

Fig. 5.2. The developmental pattern of fruit diameter (*V. vinifera* L. cv. Cardinal). Serial measurements of berry diameter were made on each of two berries (open and closed circles) for 70 days after anthesis. I, II and III refer to the three stages of berry growth (see text for details). From Matthews *et al.* (1987). Reproduced with permission

Sugar and Organic Acids

- Primary compounds of interest are sugar and organi acids (sweet and sour).
- As grape ripens it accumulates sugar
  - Rapid sugar accumulation starts at veraison
- Organic Acids decline during ripening
- Decline is due to dilution and respiration.
- Climatic Variation changes sugars and organic acids
- Hot Climate: High sugar Low Acid
- Cool Climate: Low sugar High Acid

Sugar and Organic Acids during Ripening

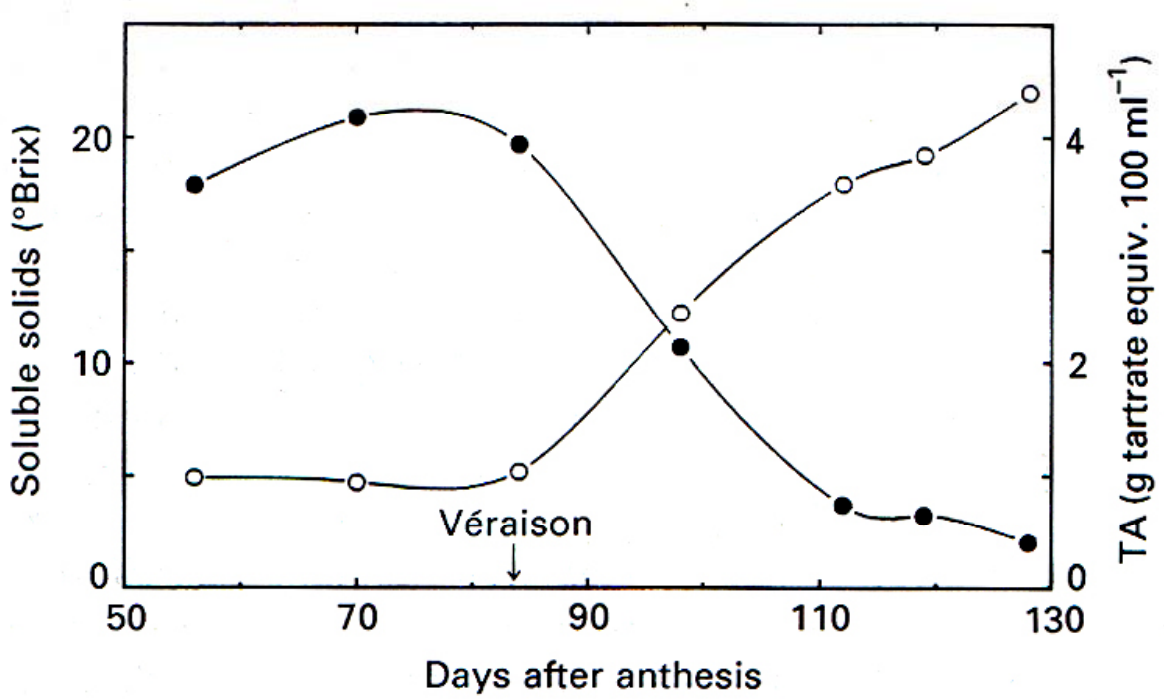

Fig. 5.3. Soluble solids (open circles) and titratable acidity (filled circles) of juice from berries of Cabernet franc. From Matthews and Anderson (1988). Reproduced with permission

Sugar Measurement

- Sugar (glucose and fructose) is the most abundant compound(s) found in berry.
- Other berry constituents are synthesized from it.
- Abundance allows indirect methodology for measurement (Unit Brix=% or g/100 mL)
- Hydrometer used in winery to monitor fermentation. (Based on Archimedes principal)
- Refractometer used in vineyard. (Uses refractive index of sugars)

Sugar and Ripeness

- Typically grapes will accumulate up to 25-26 Brix and after that increases are apparent and occur from dehydration.
- Winemakers often will allow crop to hang on vine and dehydrate waiting for flavors to develop.
- During this hang time the berries tend to shrivel and lose weight.
- Negotiation for grape prices can be based on tonnage and this reduces weight of clusters.
- Winemakers who like to develop flavors should negotiate an acreage contract to maintain grower relationship.

Ethanol Predictions

- Ethanol can be predicted from initial Brix in crusher.
- [EtOH]%v/v = (A)+(X)* Brix
- (X) ranges from 0.51 to 0.66 depending on variety and season.
- (A) ranges from -4.91 to 4.37 and is an attempt to compensate for other soluble solids measured by indirect Brix measurement.

Organic Acids

- Principal organic acids are tartaric acid and malic acid.
- Tartaric acid (most abundant) Stereochemistry was elucidated by Louis Pasteur in 1849.
- Stable to microbial fermentation but forms insoluble salts with potassium (K2Tar found on the bottom of the cork or bottle in aged wines, KHTar is cream of tartar)
- Malic acid (second abundant) can be metabolized by yeast and bacteria (discussed later).

Organic Acid Measurement

- Measured by titrating with a base of known concentration in the presence of a chemical indicator with a known pH end point.
- This measurement called titratable acidity (TA)
- pH is measured either with a meter or litmus paper.
- Concentrations range from 8.0 g/L to 6.5 g/L
- pH ranges from 2.8 to 4.0.
  - White wine 3.0-3.3 Red wine 3.2-3.4

Other Parameters?

- Anthocyanin and tannin content in red grapes
- Total phenols in white grapes.
- Grape and wine relationship not well established for either because of processing effects.
- Aroma compounds in grape difficult to measure.
- Methodology(s) for measurement tedious and not ready for production scale.

Tasting Grapes

- Contrary to myth no one can accurately estimate sugars and acid by taste.
- Tasting by panel (including winemaker and grower) with examination of sugar, acid, color, and flavor.
- Experience will provide perspective on varietal aroma, color and balance.
- Building a historical database with subjective and objective descriptions can help.

Harvesting Practices

- Primary objectives: Pick all of the grapes as fast as possible with minimum damage, cheaply.
- Sounds impossible?
- Condition of fruit at crush largely determines wine quality.
- Competition with birds (good ripeness indicator).
- Early morning harvest are good because it is easier to process cool fruit.

Manual vs. Machine Harvesting

- Manual harvesting can be quick, selective, thorough, with minimal damage but not cheap.
- Machine harvesting is cheaper but usually damages vines and reduces yield slightly.
- Vineyard topography and trellis design largely determine type of harvesting style.
- Hilly vineyards are difficult to machine harvest.
- Trellis design must be able to withstand machine damage and make fruit easily accessible to machine mechanism.
- Good manual labor is hard to find.