FRUIT COMPOSITION & QUALITY

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Wine Quality Potential

High quality fruit does not guarantee high quality wine, but low quality fruit guarantees low quality wine.

Linking Viticulture to Wine Flavor

Grapes ~ a few hundred odorants
Primary flavors

Wine ~ 1,000 odorants
Secondary flavors

What are the Chemical Components?

Component	Must (% by weight)	Wine (% by weight)
Water	75-85%	87-89%
Sugar	17-26%	--
Alcohol	--	8-14%
Organic Acids	0.4-1.2%	0.5%
Minerals	0.1-0.4%	0.05-0.3%
Polyphenolics	0.4-0.5%	0.02-0.2%
Aroma Compounds	<0.02%	<0.02%

Adopted from: Y. Margalit , Concepts in Wine Chemistry, 2012

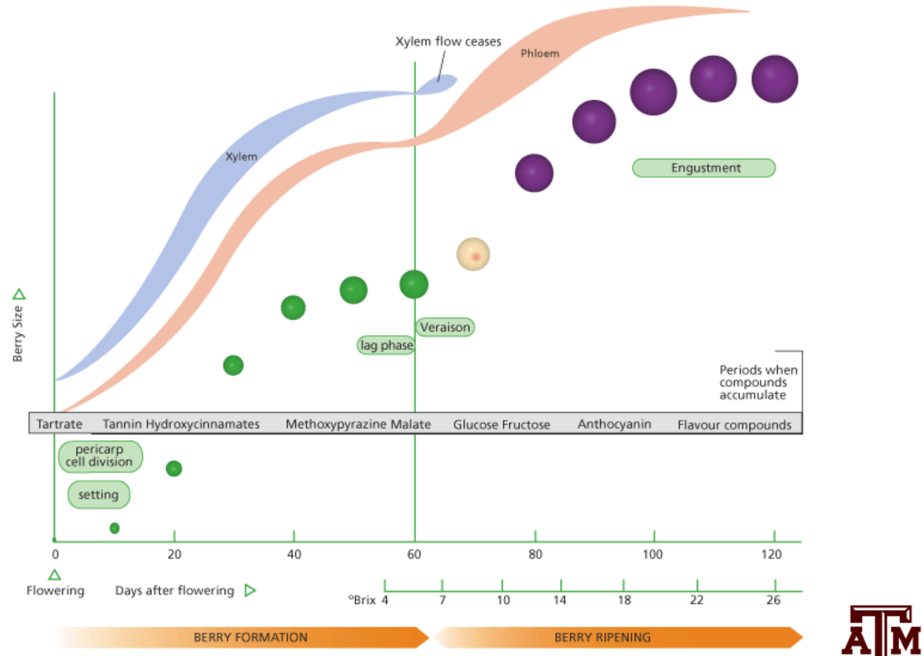
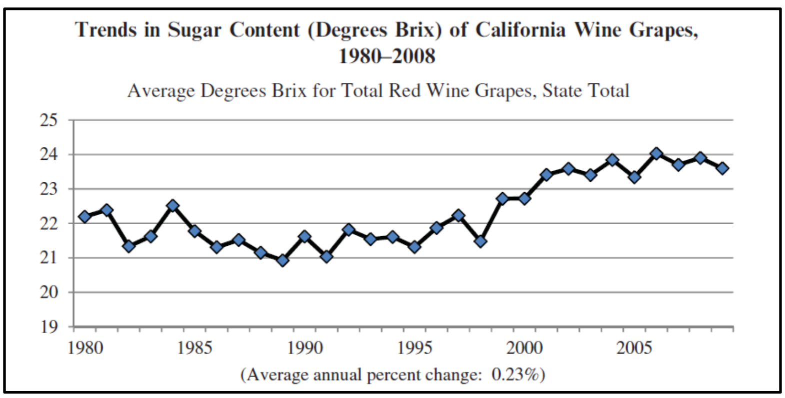


Illustration by J. Koutroumanidis, Winetitles

Consumer preference has been moving toward wines with "ripe" characteristics.



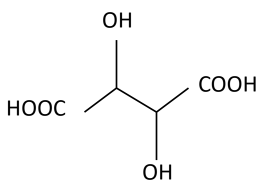
J. Alston et al. (JWE, 2011)

Metrics for Acidity

pH reflects molar concentration of free protons

– pH = -log [H^+] (e.g., a wine with a pH of 3 has 10x more free protons than a wine with pH of 4)

Titratable acidity (TA) reflects total concentration of titratable H^+ (pH + bound H^+)



Tartaric acid

Titratable acidity is an excellent predictor of perceived acidity

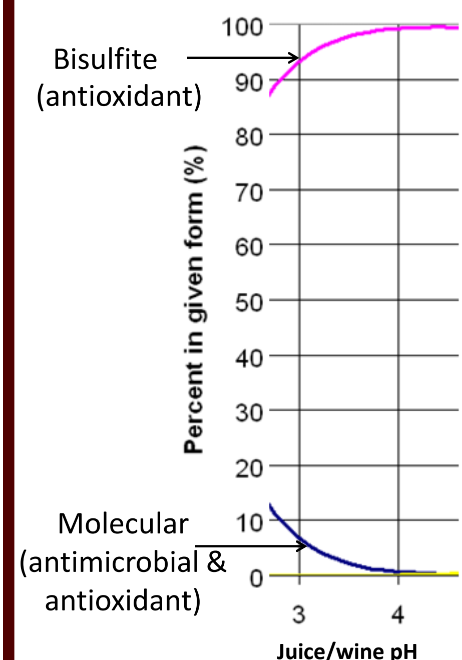
Malate plus tartrate (mmol/L)	pH	Total acid as tartaric (g/L)	Panel rank
40	3.64	3.80	least
40	3.46	4.21	3.0
40	3.26	4.67	3.4
50	3.57	5.05	3.7
50	3.38	5.58	4.8
40	3.08	5.10	5.2
60	3.59	6.06	6.0
50	3.20	6.02	6.1
60	3.41	6.71	7.4
50	2.99	6.57	8.0
60	3.20	7.33	8.2
60	3.02	7.63	most

From: Plane et al. 1980

Why do we care so much about pH?

pH is critical for:

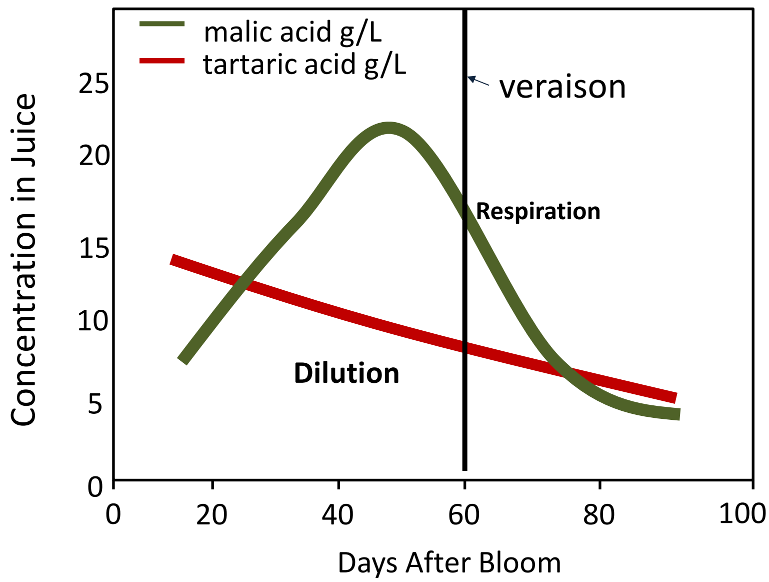
- microbial stability
- color
- malolactic fermentation
- preservatives (sulfur dioxide, sorbate)
- oxidation



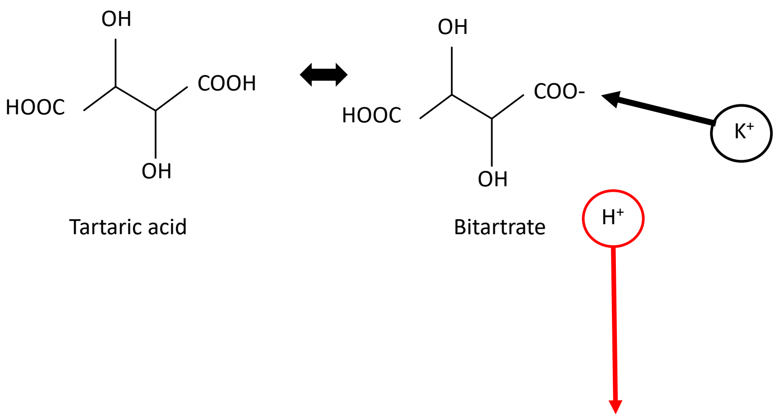
To achieve a "safe" level of molecular SO_2 a white wine would require:

13 ppm free at pH 3.0
40 ppm free at pH 3.5
125 ppm free at pH 4.0
200 ppm free at pH 4.3

Organic Acids During Berry Development

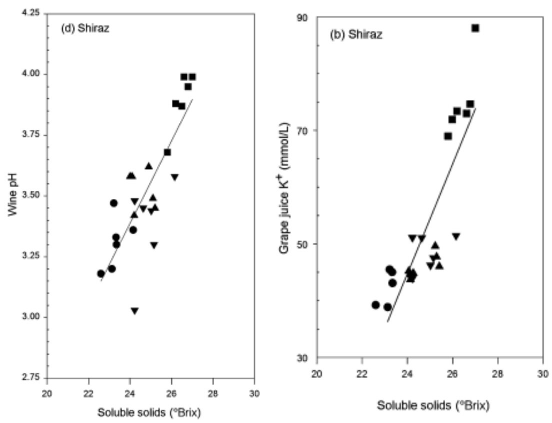


Tartaric Acid and Potassium



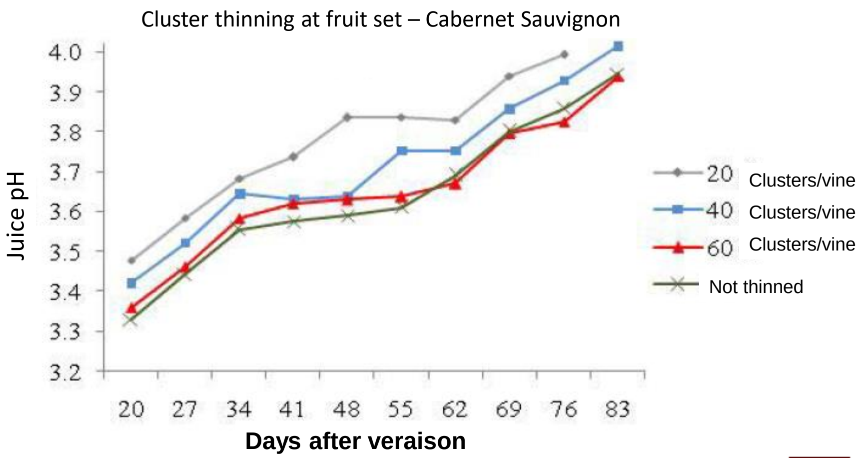
Factors Affecting K^+ Concentration

More K^+ with longer hang-time, high water availability and water stress, and dense shading, high soil K^+



From: Walker et al. 2012

Juice pH

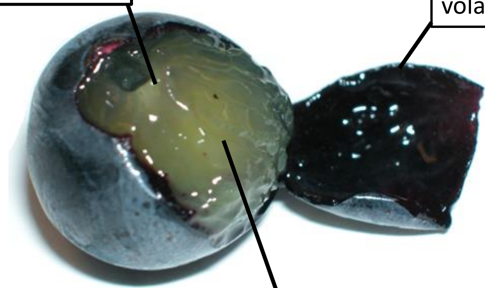


C. McDonnell Wood (Ph.D. Dissertation, 2011)

Components of Quality

Seeds:
89% of total tannin, short polymers

Skin:
11% total tannin, long polymers, all color, volatiles, potassium



Pulp: sugars, acids, potassium

Measuring Acidity

pH: ~~test strips~~, pH meter

- Calibrate meter regularly
- Proper storage
- Replace buffers annually
- Temperature correction

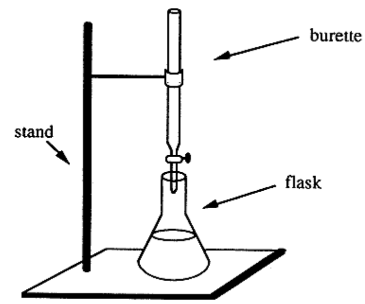
Measuring Titratable Acidity

Titratable acidity: acid/base titration

- Neutralize acid with a base (1:1 neutralization)

Source of error:

- 0.1 N sodium hydroxide (NaOH) loses strength with air contact – inflated TA value
- Check with 0.1 N HCl



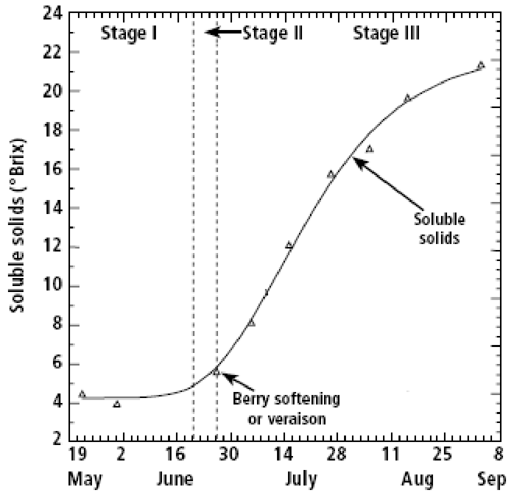
Yeast Assimilable Nitrogen

If you can measure TA then you can measure YAN

Formol titration

1. Wine acids are titrated with 0.1 N NaOH
2. Formaldehyde (37%) addition causes amino acids and ammonium to release acid (H^+)
3. Acids are titrated with 0.01 N NaOH

Sugars



From: N. Dokoozlian, Grape Berry Growth and Development

Measuring Sugars

Soluble solids: ≥90% in ripe grapes are sugars

Hydrometer: Specific gravity (density of juice / density of water)

- Calibrated at room temperature

Refractometer: refractive index

- Calibrated at room temperature

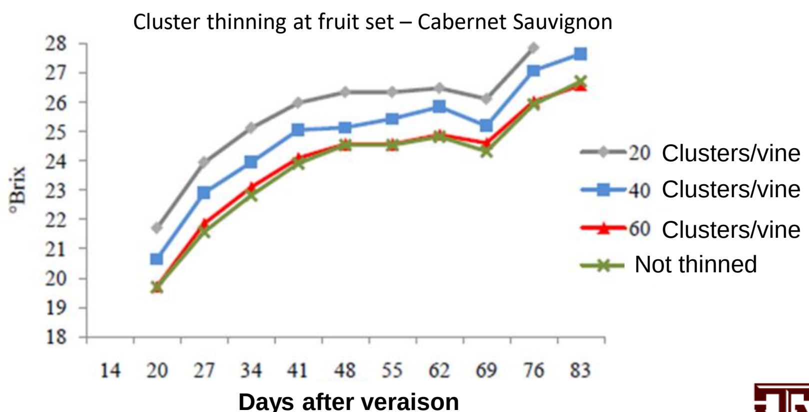
Use a Temperature Correcting Refractometer

Solutions are more dense at lower temperatures

Juice Temperature	Corrected value at 20°C	
°C / °F	°Brix	Specific gravity
16 / 60.8	- 0.24	- 0.0010
17 / 62.6	- 0.18	- 0.0008
18 / 64.4	- 0.12	- 0.0006
19 / 66.2	- 0.06	- 0.0004
20 / 68		
21 / 69.8	+ 0.06	+ 0.0010
22 / 71.6	+ 0.12	+ 0.0008
23 / 73.4	+ 0.18	+ 0.0006
24 / 75.2	+ 0.24	+ 0.0004
38 / 100	+ 1.0	

Rate of Maturation

Function of temperature, crop load, vine water status and health



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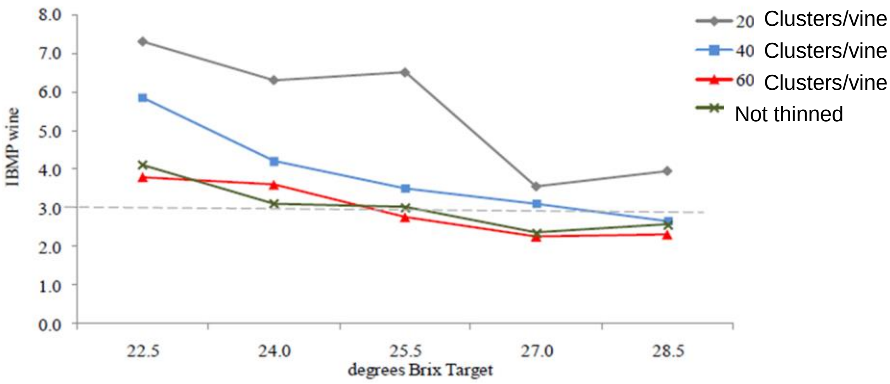
Methoxypyrazines



C. McDonnell Wood (Ph.D. Dissertation, 2011)

1-bud spurs

2-bud spurs

Under-Pruned

Divided canopy systems were developed for managing too much vigor

Cluster Thinning

Why: maintain balance, improve quality, reduce unevenness

When: before veraison (reduce yield), end of veraison (reduce unevenness)

- Target least advanced clusters, weak shoots

Hedging

When: after shoots clear the top of the trellis, but before they droop over and shade the fruiting zone

- At a minimum, leave 15 mature leaves per shoot

Shoot Positioning

Why: minimize shoot overlap, improve spray penetration, improve leaf sun exposure

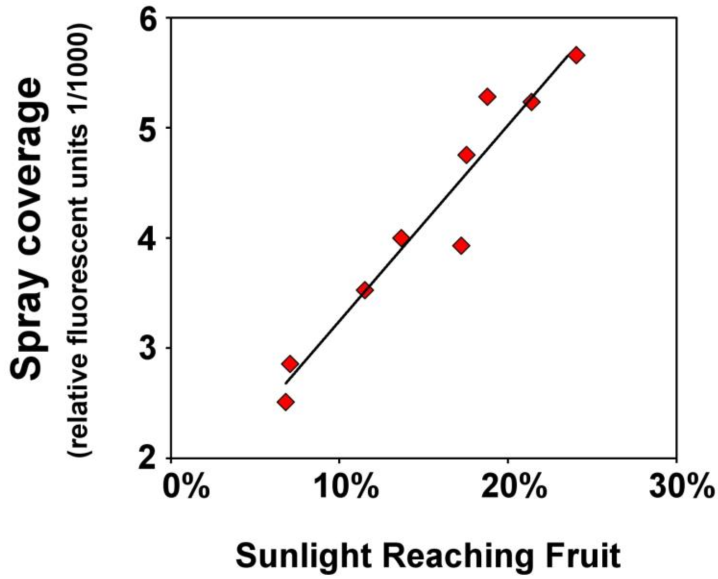
When: after thinning, when shoots reach first catch wire (for VSP systems), before tendrils become strongly attached

- Watch out for shoot breakage

Leaf & Lateral Removal

Why: improve cluster microclimate

When: within a few weeks of fruit set

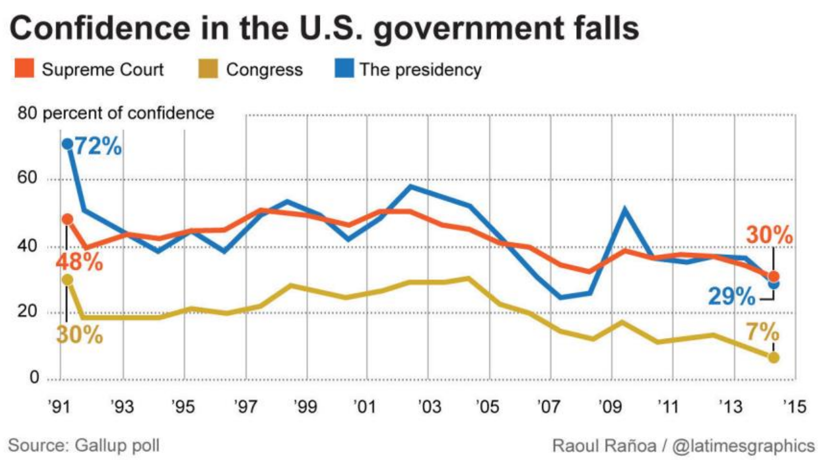


From: Austin et al.

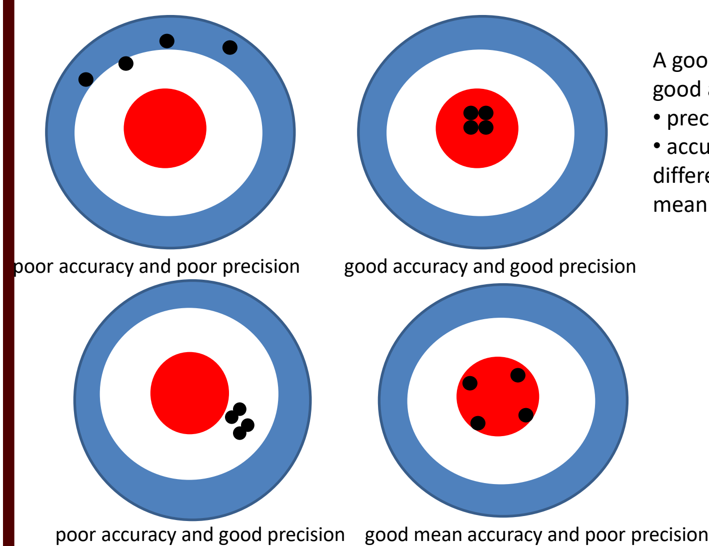
Fungal Disease Reduces Quality

Late Season Grape Berry Moth

Sampling



Accuracy Versus Precision



A good analyst should have good accuracy and precision.

- precision – random error
- accuracy – systematic error, difference between measured mean and true value

Vineyard Variability

- Vineyard variability leads to reduced quality

Between vines: soil, vine age, frost damage, disease, pruning

Between clusters on the same vine: cluster position, vine stress, disease, frost damage

Between berries on the same cluster: sun exposure, shot berries, poor weather at bloom, micronutrient deficiency, disease, insect infestation

Berry or Whole Cluster Samples?

Sample vines randomly or by a grid system

- Avoid sampling from exterior vines (border rows, end vines) or abnormal vines
- Keep records and compare to previous years and harvest data
- If results do not correlate with harvest data, adjust sampling procedure

Berry Sampling

Better suited for small vineyards and early sampling

- Avoid border rows and end vines

+/- 1 °Brix 200 berries (uniform vineyard)

+/- 0.5 °Brix 500 berries

  – 5 berries per cluster on one cluster per vine
  – One berry from each side of the shoulder, middle, and bottom of the cluster (randomize side where sample is taken)

Cluster Sampling

Accounts for within cluster variability (5-7 °Brix)

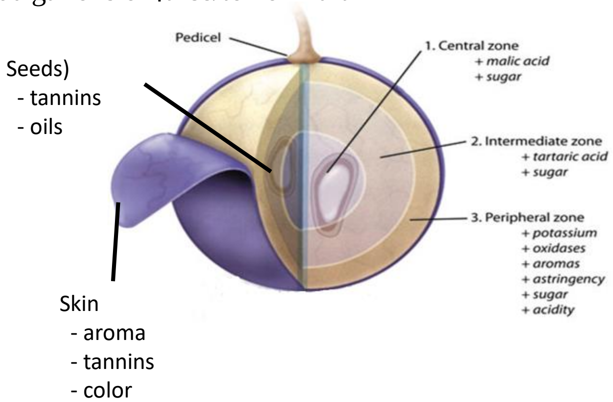
Sample size should be related to the size of the block and variability within the block

- A uniform block of ≤ 5 acres, sample 20-25 clusters
- A block with a high degree of variability, > 25 clusters
- One randomly selected cluster per vine
- Sample on both sides of the row

Do not determine maturity based on a single vine.

Processing Sample

- Process samples as soon as possible (within a few hours)
- Try to duplicate actual winery processing
  - 300 mL of juice from 1 lb of fruit is approximately equivalent to 160 gallons of juice/ton of fruit



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