GARAGE ENOLOGISTS
GENCO
SONOMA COUNTY

Key concepts in winemaking:

Winemaking: a subtle balance of science, nature, and artistry that varies from vintner to vintner. You can see, smell, taste, and feel the influence of the winemaker's approach in the glass.

The process (and variables)

- growing and harvesting
- crushing, sulfiting, chilling
- pressing and fermenting whites
- fermentation and pressing reds
- MLC
- sulfiting, maturation: clarification, stabilization
- alchemy: adjustments, fine-tuning
- and bottling

Every decision influences color, aroma/taste, intensity, mouth-feel, balance, stability, and overall sensory perception …

- AVA (region, climate, soil, slope, exposure, and environmental conditions,
- farming: crop thinning, canopy management
- ripeness at harvest
- skin-time (maceration): total time, including cold-soaking, fermentation, extended maceration
- Yeast: wild or cultured, fermentation speed, temperature (cool: 65 to 78°F) best for lighter and fruitier wines; (warm: to about 85, or hot >90°F) darker, more tannic, extracted, and earthier
- acid adjustments, watering-back
- number of punch-downs and rackings
- exposure to air
- oak vs. stainless steel
- time in barrel
- diligence

Harvest considerations:

- ripeness: defined by sugar, acid, phenolic maturity, and flavors
- indicators: taste, brown stems, and crunchy brown seeds, berries pull away easily, skin a bit slack
- uniformity of ripeness is key
- canopy management
- exceeding 25°B is an issue, e.g., low acidity and nutrient content, potential high alcohol, fruit is short-lived, and more port-like
- acidity: critical for balance, color, aromas/flavor, amount of SO_2 needed to prevent oxidation and microbial spoilage
- adjustments (before fermentation) is prudent: pH, TA, and °B (dilution)

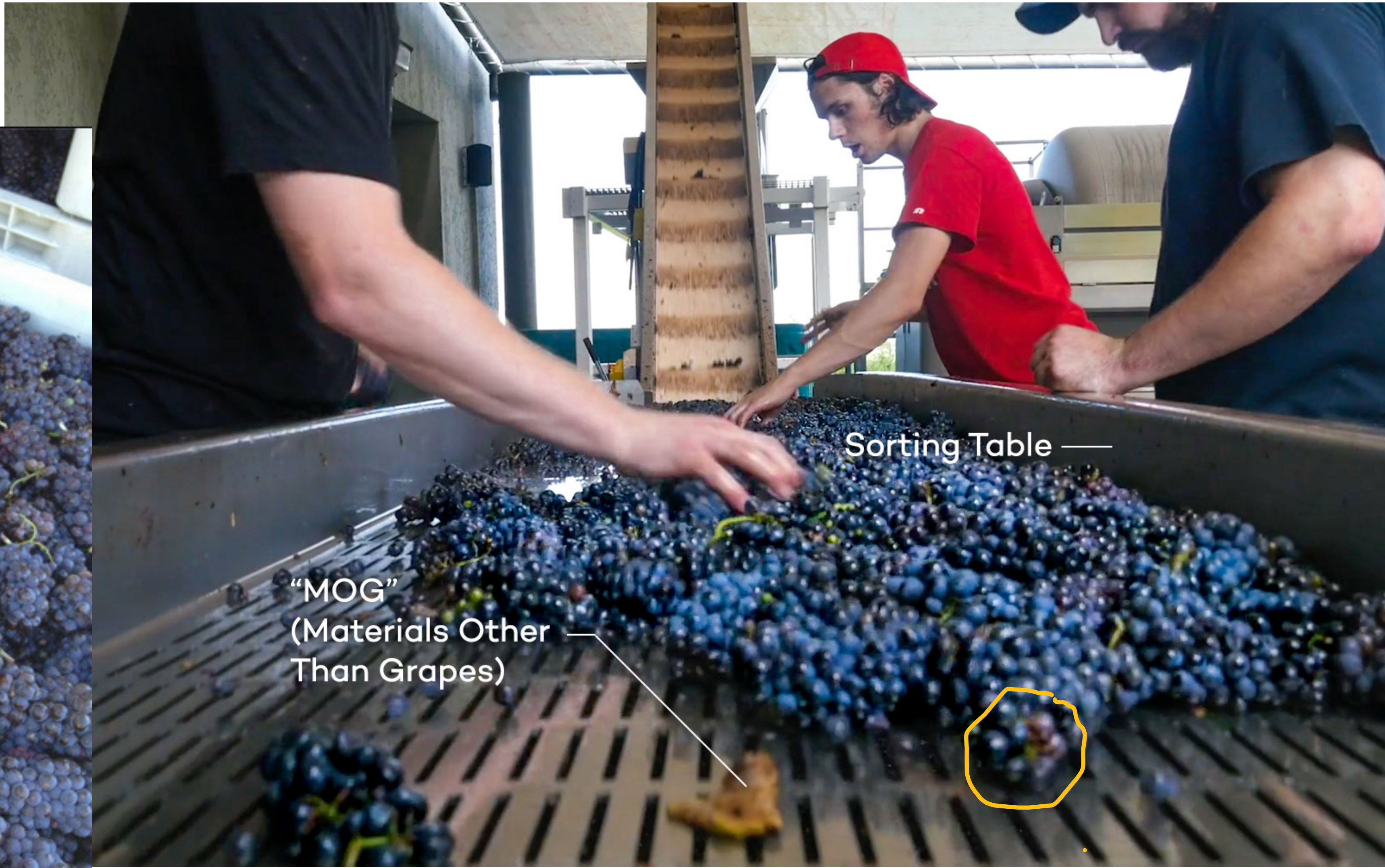
Winemaking and farming: inseparable

Sampling:

- taking a *representative* sample for testing is critical when assessing ripeness
- Brix, pH and YAN can change during skin contact
- grape skins contain a lot of K^+ ions that react with Tartaric acid reducing acidity
- let juice soak on the skins for at least a few hours in the fridge for more accurate pH values

Destemming/Crushing:

- eliminate majority of stems, don't sweat jacks
- sort out leaves, damaged grapes, etc.
- try to avoid shot-berries
- add clusters gradually at far-end, allowing cluster to move forward to the crushing rollers individually or small groups
- chill must
- whole-cluster fermentation
  - greater tannic structure, imparts fruity, spicy, and herbal notes, and overall balance seems improved
  - often used for Pinot Noir, Rhone varieties


Sorting Table
"MOG"
(Materials Other
Than Grapes)

Skin contact (maceration):

- chilling and sulfiting inhibits bacteria
- option to add non-*Saccharomyces* yeast (bio-protectant) or start fermenting
- whites: 2 to 8 hours, rosés less than 1 hour
- whole-cluster to minimize time on skins: more delicate and less astringent
- decoloring carbon to lighten rosés
- longer contacts up to 24 hrs. reduces acidity (pH)
- reds get more time if you cold-soak
- maceration time: big impact on style, extraction


Whole Bunch Fermentation

Whites: pressing and removal of gross lees

Rack, top-up, wait 2 weeks to sulfite

Enzymes facilitate:

- clarification, rapid settling, compact lees, easier pressing in whites
- Increase yield
- maceration: extraction of pigments and tannins, color stability
- mouthfeel, wine stability
- some favor yeast autolysis in whites aged surlie, releasing mannoproteins
- each formulation has a different mode of action

Cold-soak (maceration): reds

- a water extraction: up to 5 days (like cold-brewing tea)
- improves color and aromatics, tannins softer and round
- chill quickly <50°F for duration
- blanket with inert gas (dry-ice pellets)
- little value for big reds
- best for lighter bodied reds
- allows cooler ferments
- risk of bacterial spoilage if not cold enough, so higher level of SO_2 recommended, or can use a non-saccharomyces yeast as a 'bio-protector' to prevent spoilage bacteria
- warm to 55 to 60°F before inoculating

Benefits of cold soak?

- jury is still out …
- get an accurate reading of pH
- good color extraction in some varieties and flavor pre-cursors before fermentation
- some see it as frontloading the wine, allowing them to use a soft touch during fermentation and post-fermentation when alcohol is present — a more powerful solvent
- one to two ‘punch downs’ (mixing)
- fewer punch downs, rackings, cooler fermentation


32 Gallon

Sulfiting: why?

- SO_2: *antimicrobial* an *antioxidant* that binds with aldehydes, precursors to acetaldehyde (sherry-like), and prevents enzymatic browning
- when: at crush, post-fermentation, or after MLC, during maturation, and before bottling – its ongoing
- makes for a better wine
- **Potassium metabisulfite:** rate: 35 to 50 ppm: powder, stock-solution or foil porches
- ongoing process: some binds with oxidated substances, or spoilage bacteria, some precipitates, and some volatilizes
- alcohol, when exposed to oxygen, converts to VA (Vinegar, Ethyl acetate)

Most people aren’t fond of barnyard or other ‘funky’ aromas …

Sulfiting (continued)

- much of it rapidly binds with grape components, or oxidized chemicals and thus, referred to as ‘**bound’** SO_2
- what remains is called ‘**free-**SO_2’
- testing measures **free**, but can measure the ‘**total** (free and bound)
- some of the bound SO_2 may become available in time
- after fermentation and MLC, very little free-SO_2 remains, therefore wine is at risk
- best management practice: 60 ppm


enartis
SOLFITANTI
Prodotto effervescente granulare
EFFERBARRIQUE
IDEALE PER L'AGGIUNTA DI SOLFOROSA IN BARRIQUE
Quantità predosata - Solubilità immediata - Dispersione omogenea nel vino
SULPHUR CHEMISTRY
Prodotto effervescente granulare
EFFERGRAN DOSE 5
IDEALE PER L'AGGIUNTA DI SOLFOROSA IN PICCOLI CONTENITORI
GRANULAR EFFERVESCENT POTASSIUM METABISULPHITE
GRANULÉS EFFERVESCENTS DE MÉTABISULFITE DE POTASSIUM
Dose: 2 g of pure SO_2
Dose: 2 g de SO_2 pur
Composition:
E224 potassium metabisulphite: 75%
E501 potassium bicarbonate: 25%
Net: 5 g product - 2 g SO_2


LD Carlson COMPANY
POTASSIUM METABISULPHITE
TO KILL WILD YEAST: ADD 1/4 tsp. PER 6 GAL. OF MUST;
TO SANITIZE: ADD 2 oz. TO 1 GAL. OF WATER
NET WT. 1 LB (454 g)
Packaged by L.D. Carlson Kent, Ohio 44240


1000 ml

When PMBS added: dissolves (ionizes) into 3 forms: the *relative level* of each is determined by pH:

$K_2S_2O_5$ (PMBS) + H_2O (juice/wine) ↔ 2 K^+ + 2 HSO_3^- (***bisulfite*** ions)

HSO_3^- + H^+ ↔ SO_2 (***molecular***, gaseous form) + H_2O ↔

$2H^+$ + SO_3^{2-} (***sulfite*** ion)

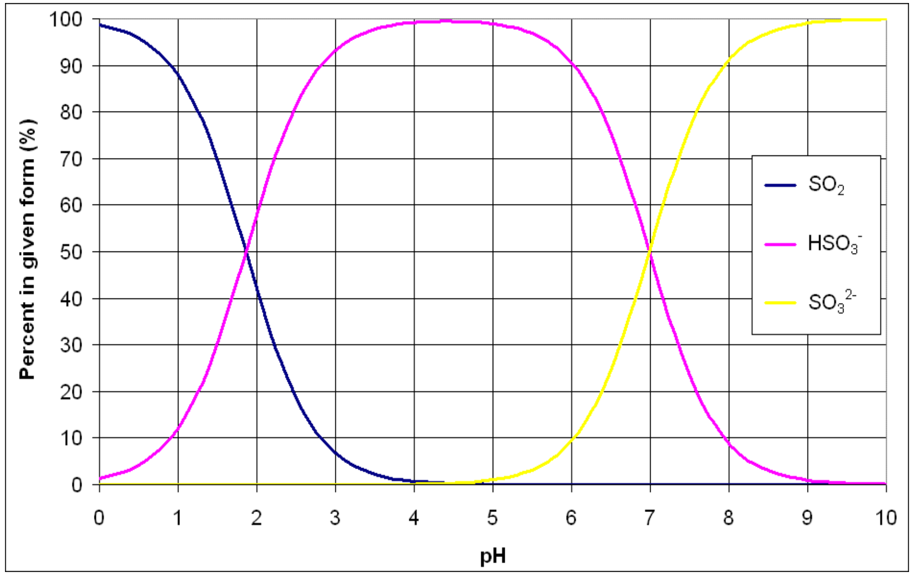
The reaction is dynamic and in equilibrium, depending on pH

Each form has a different of action:

- **Bisulfite ion**: predominates at normal wine pHs. It binds with acetaldehyde (precursor of Acetic acid) when alcohol is exposed to air

- SO_2 — the '**molecular**' (undissociated) form: It's a powerful antimicrobial, inhibits spoilage bacteria, wild yeasts, malolactic bacteria. The level at pH 3.0 (tart) is about 6% and 0.5 % at pH 4.0

- **Sulfite** ion: extremely low levels, but is important to deactivate enzymes that cause browning, and can remove free-oxygen



Recommended free-SO_2 (ppm) levels to ensure sufficient (molecular) SO_2:

pH	0.8 ppm	0.5 ppm
	White Wine	Red Wine
2.9	11 ppm	7 ppm
3.0	13	8
3.1	16	10
3.2	21	13
3.3	26	16
3.4	32	20
3.5	40	25
3.6	50	31*
3.7	63	39*
3.8	79	49*

Higher free-SO_2 levels are needed, as there is less molecular as pH increases.

Research done by the Australian Wine Research Institute demonstrated that adequate levels of free-SO_2 for whites was about the same, but levels for reds is less. Rankine, 1989, *Revisiting Sulfur Dioxide Use* (Note that mg/L is same as ppm).

Wine type	pH	Concentration mg/L (ppm)
White table wines	pH 3.00 to 3.20	0 to 20 mg/L free SO_2
	pH 3.21 to 3.40	20 to 30 mg/L free SO_2
	pH 3.41 to 3.50	30 to 50 mg/L free SO_2
	pH > 3.50	50 plus mg/L free SO_2
Red table wines	pH 3.40 to 3.60	10 to 20 mg/L 'apparent[1]' free SO_2 or 50 to 150 mg/L total SO_2
	pH > 3.60	> 20 mg/L 'apparent' free SO_2 or > 150 mg/L total SO_2

Some common chemical terms:

- **TA:** conc. of H^+ ions (dissociated and undissociated) in juice/wine (determines tartness)
- **pH:** a measure of the concentration of only ionized (free) H^+ ions in solution. The higher the conc., the lower the pH (responsible for wine stability)
- **acid:** a molecule that ionizes in solution, yielding free H^+ ions and a negatively charged ion
- **base:** a substance that typically releases hydroxide (OH^-) ions in solution, and that reacts with an acid to form a **salt** like Potassium Bicarbonate

What you should know about pH:

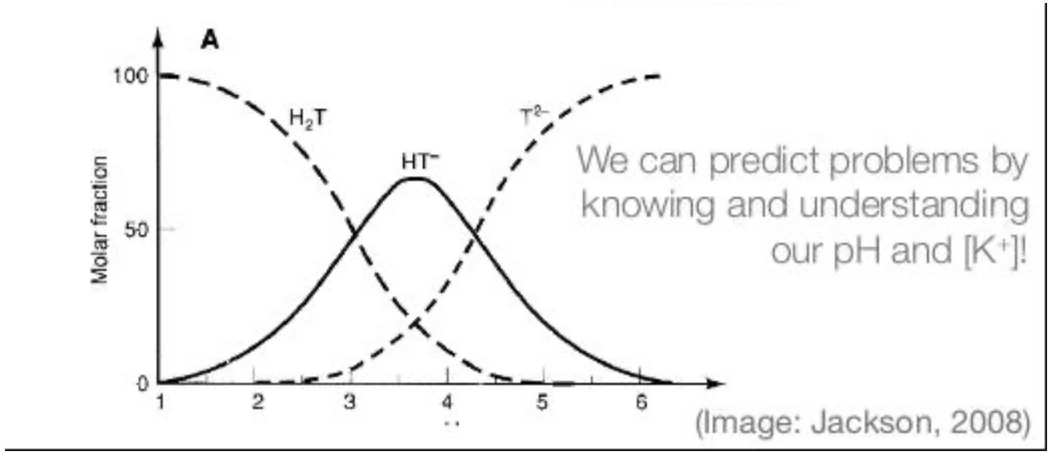
- expressed on a logarithmic scale and inversely
- the lower the number, the higher the acidity. Yes, confusing
- high acidity: high TA, and low pH
- low acidity: low TA and high pH values,
- **Important concept**:
- pH usually proportional to the amount of acid in grape juice or wine. How it changes when Tartaric is added, depends on how much is added

Why you can't ignore pH:

- its critical to winemaking
- influences flavor, aroma, color, susceptibility to oxidation and microbial spoilage, most chemical reactions, protein solubility, MLC, effectiveness of Bentonite
- determines how much free-SO_2 needed to protect wine
- controls relative levels of Tartaric acid and its ions
- determines how acidity changes when Potassium Bitartrate precipitates during fermentation, and later during cold-stabilization

How pH effects Tartaric acid ionization:

H_2Ta (Tartaric acid) ↔ $H^+ + HTa^-$ (Bitartrate) ↔ $2H^+ + Ta^{2-}$ (Tartrate)



At typical wine pH levels (about 3.4 to 3.7) most of the Tartaric acid consists of Bitrate. **The peak occurs at pH 3.65**

Testing and adjusting acidity (pH and TA):

- juice panel: Brix, TA, Malic, pH, YAN, VA (Home Wine Lab, Gusmer)
- whites: collect sample after pressing and settling
- reds: wait 24 to 48 hours to collect sample from a pooled source, preferably during cold-soak
- Brix (°B) may go up (soak-up)
- pH goes will up as well, (K^+ (Potassium) from skins, driving pH↑
- pH will go up 0.1 to 0.2 units during skin-contact, little change in TA

Adjustments:

- normal TA range: reds – 6 to 8 g/L
- normal pH range: reds – 3.4 to 3.9
- adjust pH to 3.5 or a bit less before fermentation: better color, aromas/flavors, and prevent pH from exceeding 3.8 by the end MLC
- °B: ideal range 23.5 to about 25, depending on variety and ripeness
- can dilute high sugar by adding water (bottled)
- water dilutes TA but not pH (add Tartaric acid: 23 g/gal)
- for example: to adjust 60 gal must at 27°B to 25°B, add ~4.75 gal – nearly 2 cases of wine! www.vinolab.hr/calculator/dilution

Most common acid problem:

- **Low acidity**: low TA <6g/L, high pH >3.5: mostly hot regions, and very ripe grapes (easy fix: acidify)

- **Moderate acidity**: TA 6-9g/L, and pH 3.4-3.5 (less for white and Rosés) (you're good!)

- **High acidity**: high TA >9g/L, and low pH <3.0. Cool areas/seasons (easy fix: deacidify)

- **Problematic**: high TA >9g/L, and high pH >3.5. (high Malic to Tartaric acid ratios (relatively rare in California), or **high** Potassium and salt levels.
  - such wines resist adjustment: adding acid drives up TA, but pH change is small, while deacidification drives pH up ☹. Seek technical advice.
  - large pH shifts can occur during malolactic fermentation (MLF) when malic acid content is high

Acidification/deacidification:

- **Tartaric acid: 3.8** g/gal will raise **TA** by **1g/L** (i.e. 6.0 to 7.0 g/L), and lowers **pH** roughly 0.1 unit, sometimes more

- **Potassium bicarbonate: 3.4 g**/gal lowers TA by 1g/L: (AWRI)

- According to Enartis, when using Potassium Carbonate: If the pH ≥3.45, use 3.5g/gal, or if the pH ≤ 3.45, use 1.75 g/gal. Note: Some people simply use 2.35 g/gal regardless of pH

- do bench trials or make additions gradually, and check after each addition

Some acid conditions are difficult to correct:

- if TA is **low** and pH is **high**, adding acid will increase TA, but pH often remains too high
- solution: continue adding acid until the **pH** is closer to 3.65
- at that point TA will be excessive, but as **pH** < 3.65, the ratio of Bitartrate to Tartrate ions increases.
- in this manner, KHTa formation increases, lowering **TA.** Yes!

How it works:

- adding Tartaric raises **TA**, but lowers pH. Why? more acid and some free H+

  H_2Ta (Tartaric acid) ↔ H^+ + HTa^- (Bitartrate)

- adding Potassium Bicarbonate ($KHCO_3$) drives TA down and pH up: Why? <u>less</u> acid due to the ppt. of Potassium Bitartrate, and 2 H^+ are neutralized in the process, so pH goes up)

  $KHCO_3$ + H_2Ta (Tartaric acid) → KHTa (Potassium Bitartrate)↓
  + H_2CO_3 → CO_2 (bubbles) + H_2O

- as Potassium Bitartrate ppt. pH will go up or down depending on pH of the juice/ wine when Tartaric acid is added and there is K^+ in solution

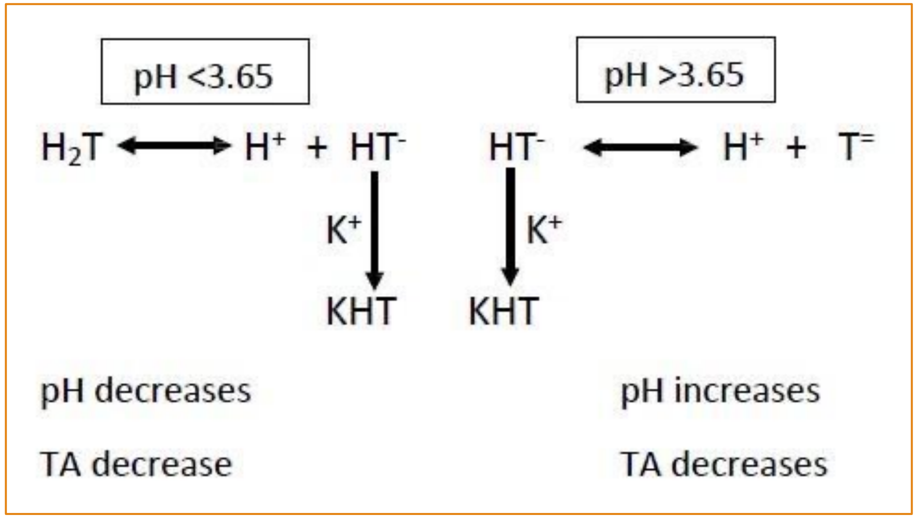
  H_2Ta → H^+ (gain of 1 H^+) + <u>HTa^-</u> ← Ta^{2-} + $2H^+$ (loss of 1 H^+)

How pH changes as KHTa precipitates:

- grapes contain lots of K^+ that react with HTa^-, forming Potassium Bitartrate
- maximum precipitation of KHTa is at pH 3.65
- always lowers TA, but when pH is:

  below 3.65, one H^+ ion is released,
  it goes down

  above 3.65, one H^+ ion is removed,
  it goes up
- useful when adjusting unusual acid problems
- pH 3.65 is the great divide



More free H+ Less free H+

Yeast and yeast selection:

- wild/spontaneous (low SO_2) or inoculate?
- start with ‘wild’ yeast and then inoculate with yeast of choice
- use a non-saccharomyces yeast, and then inoculate later
- some act as bio-protectants, other impart unique characteristics
- selection criteria: affinity for variety, sensory contributions, nutrient requirements, fermentation speed, temperature range, alcohol tolerance (to calculate final alcohol: 0.6 x °B)
- temperature key factor in yeast health

Native fermentation: ‘Pied du cuve’

Yeast hydration and acclimation:

- yeast: 1 g/gal mixed in 10 to 20 x its weight in bottled water
- heat to 100 to 104°F, add yeast, stir, wait 20 minutes
- consider a **rehydration nutrient**: Scott's **Go-Ferm Protect Evolution** this also adds 10mg N/L
- need to acclimate yeast mix to lower temp (add cold juice about 10% by volume—let stand for 15-20 min.
- repeat every 15-20 min. until the temp of the yeast mix is close to 70°F
- a temperature difference of more than 15°F is detrimental ☹

Test for Nitrogen availability (YAN):

- The range for most yeast: 150 to 250 for 21 to 23°B
- YAN: *Yeast Assimilable Nitrogen* (expressed as mg/liter same as ppm)
    - YAN <130: LOW
    - YAN >130 to 200: MODERATE
    - YAN >200 but <225: MODERATELY HIGH
    - YAN >250 -- generally sufficient
- the risk if you don't know: 💣 H_2S, a sluggish or stuck fermentation☹
- feeling lucky? assume its low or moderate (depending on °Brix), use a yeast with low nutrient needs, moderate fermentation speed, a cooler ferment, and add moderate nutrient levels
- more likely to avoid problems or add too much)

Yeast nutrition:

- yeast need N (amino acids), but readily absorb ammonium ions (DAP); fatty acids, sterols, vitamins, and trace minerals
- grapes often nutrient-deficient
- BMP: use a balanced, complex, organic (yeast-derived) nutrient
- amino acids in particular are precursors for aroma/flavors
- make additions early: first 12 to 24 hrs., and at 1/3 sugar depletion
- products containing DAP can be added after the 1/3 point (Fermaid K, Nutriferm Advance)
- don’t rely solely on DAP to supplement YAN, nutrients added after ½ to ⅔ not absorbed
- follow manufacture's protocols

Factors influencing yeast nutrition and outcome:

- yeast strain, speed, temperature
- high °B grapes typically low YAN
- excess DAP stimulates growth and nutrient-demand
- bacteria consume N during cold fermentations and cold-soaking
- Bentonite during fermentation decreases amino acids content
- amino acids uptake occurs in the absence of ammonium ions in the early stages of fermentation
- amino acids critical precursors for varietal aromas/flavors

Protocol - Enartis products (low YAN <130):

- At inoculation:
  - add 15 g/L *Nutriferm Energy,* or 30g/hL *Nutriferm Arom*
- 12 hours after inoculation:
  - add enough DAP to raise YAN to 150 (10 g of DAP/hL (~26 gal) of must will provide 20 mg N/hL
- ⅓ sugar depletion:
  - add 40 g/hL *Nutriferm Advance* (contains DAP).
  - Increase YAN for high B° grapes, add 15 g/L DAP when B° is 25 to 26, or 25g/hL if B° >26,
- ½ sugar depletion:
  - add 15 g/hL *Nutriferm No Stop*, regardless of YAN

Fermentation management:

- try split-batch fermentations – for complexity
- adequate head-space
- start **punch-downs** after cap forms – break up and re-submerge skins
  - promotes skin contact, aids tannin, color, and aroma extraction
  - releases heat and CO_2 and suspends sediment
- 1 to 3 times/day
- the more you punch – the greater the extraction – good or bad!
- enzymes, in general, increase maceration and extraction of tannin

Head-space:

Punch-downs: easy does it!

Pump-overs vs. punch-downs

Tannins: polyphenols and anthrocyanins

- from skins, pulp, seeds, stems, and oak
- give reds a dry, astringent, and sometimes bitter taste, or that ripe, soft, supple, velvety richness …
- the key is knowing how to manage them
- provide body, texture (mouthfeel)
- protect against oxidation and allow wine to age *gracefully*
- tannin extraction is promoted by enzymes, warmer fermentations, higher alcohol, and more frequency punching

Tannins (continued):

Fermentation tannins or untoasted oak chips:

- act as an antioxidant and remove unstable protein
- act sacrificially to preserve natural skin tannins, stabilize color, and improve aromas by masking green or herbaceous notes

Finishing tannins: add after fermentation impart desirable oaky flavors, improve body, and reduce astringency

Monitor for H_2S:

- commonly forms when grapes are nutrient deficient and/or oxygen levels are low
- the presence of H_2S in a wine leads to the formation of other smelly sulfides, such as Mercaptans and Disulfides (natural gas smell), especially during aging

- the term is 'reduced'
- aerate, nutrients, if detected early. No Stop, or Reskue later)
- spraying elemental sulfur too close to harvest results in H_2S
- treatment Cu or tannins, Disulfides treated with Ascorbic acid

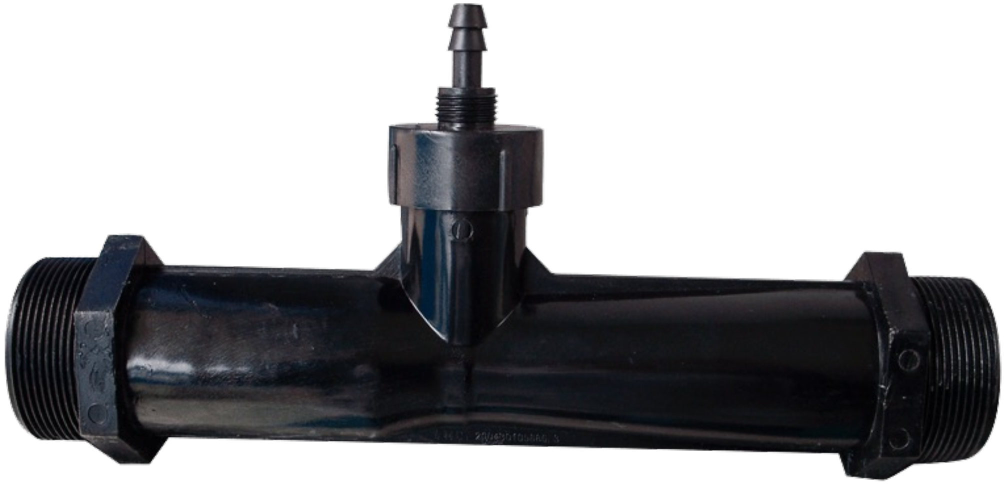
Aeration of red must:

- fermentation largely an ***anaerobic process***
- CO_2 largely prevents air from entering fermenter
- adding air during fermentation(day 2 and 3) helps yeast survive when alcohol levels rise
- O_2 needed by yeast to synthesize sterols and fatty-acids
- aeration releases CO_2 and provides O_2 and similar to pump-overs that promote oxidation of tannins and polymerization
- ‘bucket’ splash from one container to another or bubble air in wine (AWRI)
- minimizes stress on yeast, potential for reduction, and improves aromas and mouth-feel
- risk of oxidation low

Australian aeration studies:

- based on French practice of ‘rack and return’ (délestage)
- study looked at introducing air or O_2 during fermentation: time, methods varied
- aromas, flavors and mouthfeel improved, softer, fruitier
- no oxidation at any level of injecting air or O_2
- punch downs and pump-overs were shown to introduced little air
- what worked: inline venturi or sparging device for pump-over (4 times a day for 15 min.
- looked at standard punch downs, bubbling air/O_2 24 hours after inoculation, continuous low flow for 24 to 48 hours worked
- my take: use an aquarium pump 3 to 4 days? 8 hrs./day should work …
- splashing?

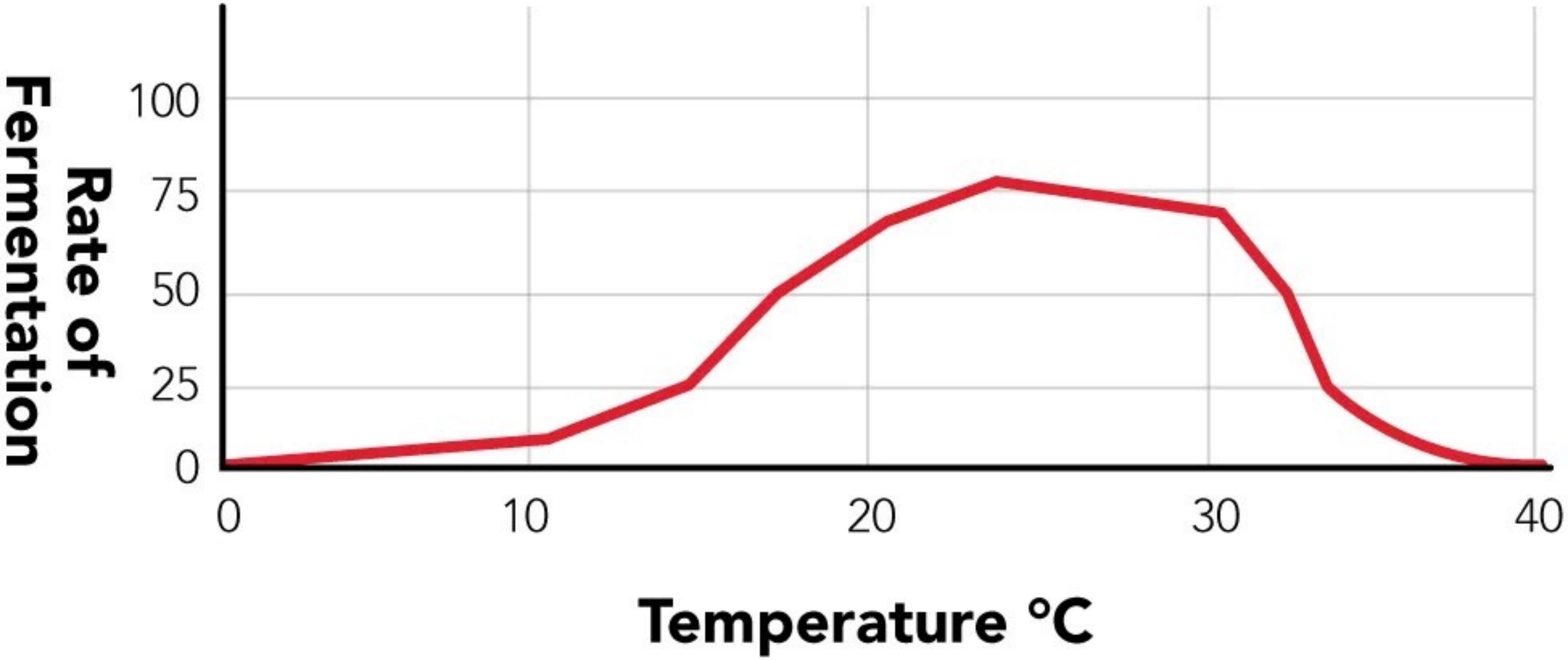
Seeds are particularly bitter: remove by bucketing to another container



Monitoring temperature:

- fermentation speed driven by temp
- typically range: 70 and 85°F
- middle range best for light-bodies reds
- cooler ferments moderate tannin extraction, and retain more fruit flavors
- reaching the upper range, briefly, will maximize tannin/color extraction
- exceeding the yeast’s upper limit, leads to sluggishness or a stuck ferment
- higher temps do increase color and tannins, but diminished fruit (volatiles driven off), wine is more earthy/savory character
- hot/fast fermentations can stress yeast, cooked flavors

Rate of fermentation and temperature:



20°C is 68°F, 25°C is 77°F and 30°C is 86°F

Temperature:

- measure under the cap in middle of container, or punch first, and then measure
- cap temp can be 10°F warmer
- in general, avoid exceeding 85°F
- nitrogen consumption increases with temp
- longer, cooler fermentations best: 14 days to dryness is something to shoot for
- getting a stuck ferment back on track is hard, and bacteria like Acetobacter or Brett can take off
- chill 'hot' fermentations
- monitor for off-odors and sluggishness

Early pressing: if tannin level is right

- around (3 to 5°B): to minimize astringency and bitterness, or tame tannic wines like Petite sirah (decision is often based on taste)
  - scoop up loose seeds and pass through a large sieve
  - settling the actively fermenting wine, rack to a barrel or container to finish
  - aeration toward end of fermentation is beneficial, O_2 binds with tannins and pigments, helping to stabilize color and build supple structure
- wine nearing competition can absorb a lot of O_2 with little risk of oxidizing

Post-fermentation: Pressing

- in general, press when specific gravity is -1.5° to-2°
- separate free-run and portion that flows under low pressure
- hard press has high pH acidity
- taste the moderate to hard-press for astringency
- stop when you taste obvious bitterness (‘fine’ it or discard)
- take your time, avoid hard cranking and fill basket presses press to about 80% capacity
- tannins are not necessarily the enemy
- how you manage them makes all the difference
- allow pressed wine to settle (gross lees) and rack cleanly into a closed container.

Surlie:

- white wines: adds polysaccharides (unfermentable sugars): improves mouth and complexity
- reds: heavy (gross) lees: sediment that forms during fermentation should be removed before MLC
  - the fine lees that settle more slowly, may be retained to enhance complexity
- can delay racking following MLC until following spring

Post-fermentation: extended maceration:

- leaving reds on their skins after fermentation increases tannins …
- seems counterintuitive, but the additional time on the skins, can soften the tannin structure and decrease bitterness for varieties that are typically tannic or astringent (Cab and Syrah, Malbec, Petite sirah, etc.)
- several weeks or longer
- inoculate with LAB at this point
- blanket with CO_2 or dry ice pellets and seal the container with plastic wrap
- keep it warm — 68°F to about 77°F ideal for MLC
- bear in mind that LAB also releases CO_2
- some risk involved

Check acidity at end of fermentation:

- adjust as needed
- if pH is above 3.7, reduce to ~3.6. helps with tartrate precipitation, which lowers both TA and pH. If it’s above 3.6, TA will drop, but pH will increase.
- you can dial-in pH later to suit your taste

Bladder presses:

- great time-saver, but shockingly pricey
- typically work using water pressure to expand a rubber bladder squeezing grapes against a perforated screen
- fill to capacity, but don’t pack
- partially inflate bladder to reduce space around the bladder if you don’t have enough grapes to fill the press
- bladder more likely to fail if press is not full
- work well fine at lower pressure


Charity Maness Photography



Better Bottle
www.better-bottle.com

Malolactic conversion (MLC)

- makes reds more palatable, less tart
- lactic acid bacteria (LAB) convert Malic acid to Lactic acid—a weaker acid, significantly reducing wine acidity
- TA may drop by 1 or more g/L, and pH may go up as much as 0.3 pH units, depending on @ of malic acid present
- best to inoculate
- LAB sensitive to low pH, and SO_2 (free and bound), in excess of 10 free and 50 total, and high alcohol, and inactive below 60°F
- use an air-lock.
- don't leave head-space

MLC continued:

- hydrate freeze-dried ML culture and use an ML nutrient
- keep warm, optimal range 68 to 77°F,
- time: 3 to 4 weeks, depending on temperature
- heat source: electric blanket, aquarium heater
- stir 1 to 2 times/week to keep the bacteria, spent yeast suspended.
- 2 approaches: sequential and simultaneous (co-fermentation)
- benefits: fruitier wines, with minimal buttery notes, and MLC finishes shortly after the alcoholic fermentation, and better yet, SO_2 can be added!!
- also less potential for oxidation and bacterial spoilage, such as Brett

MLC continued:

- signs of activity: fizzing or popping, and bubbling around edges
- CO_2 protects from oxidation, not when process is slowing,
- keep head-space to a bare minimum
- purge air every time you remove the airlock
- test when you no longer hear the bubbles popping
- if it doesn't finish, it will start again the following year
- MLC will restart in the bottle, carbonated wine with off-aromas.
- 30 ppm (mg/L) or less Malic indicates completion
- wait 2 weeks before adding SO_2 to avoid H_2S
- then add 60 ppm to kill/inhibit spoilage bacteria
- rack?

Racking: for clarity and to improve aromatics:

- in general, red are typically racked at least 3 times
- once – from the primary fermenter to the secondary
- twice – from the secondary fermenter to a maturation tank/barrel
- third – several weeks prior to bottling
- for light reds, some winemakers go directly from MLC to storage
- racking exposes wine to air and potentially spoilage organisms
- more frequent racking best for tannic reds
- surlie

Racking:

Maturation—time to resolve issues:

- large pH shifts can occur during (MLC) high malic acid content
- improve clarity, aroma, mouth-feel, or mitigate minor faults (astringency, bitterness, off-aromas)
- stability: cold-and heat stable, adjust pH and/or improve balance
- achieve balance: everything in harmony
- mitigate sensory problems by ‘fining’, but usually involves racking
- racking exposes wine to air, softening tannins, allowing CO_2 and off odors to escape, but some risk of oxidation
- wine can be moved using gas pressure with minimal air contact
- time frame: reds 14 to 24 months in oak, in stainless 8 to 12; whites up to 6 months- outliers

Protocol for Enartis products:

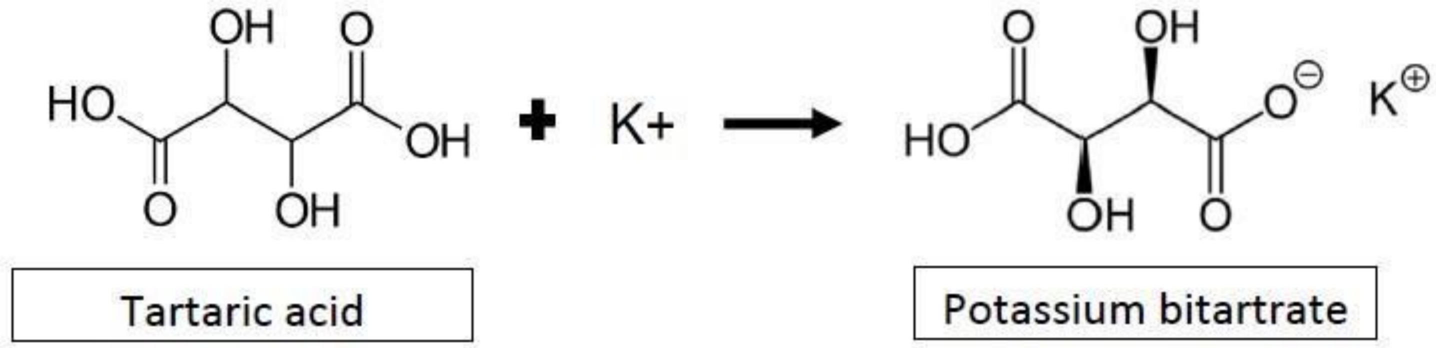
- YAN (g/hL) at inoculation:
  - <130: add 15 g/L *Nutriferm Energy*, or 30g/hL *Nutriferm Arom*
  - >130 to 200: add 15 g/hL *Nutriferm Energy*, or 25g/hL *Nutriferm Arom*
  - >200: add 10 g/hL *Nutriferm Energy*, or 20g/hL *Nutriferm Arom*

- 12 hours after inoculation, add enough DAP to adjust low YAN (<130) to 150 (10 g of DAP/hL (~26 gal) of must will provide 20 mg N/hL

- ⅓ sugar depletion: YAN <130: add 40 g/hL *Nutriferm Advance* (contains DAP); YAN >130 to 200: add 30 g/hL, YAN >200: add 20 g/hL.

  - High B° grapes with moderate YAN, add 10 g/L DAP when B° is 25 to 26 add: if B° >26, add 20g/hL

- ½ sugar depletion, add 15 g/hL *Nutriferm No Stop*, regardless of YAN



A hydrogen ion on tartaric acid can be substituted for a potassium ion (K^+), resulting in the formation of potassium bitartrate.