Principles and Practices of Fining Wines

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THANK YOU!

* 2015 Cold Climate Conference (CCC)
* Josie Boyle
  * Initial Contact
* Missy Machkhashvili & Amy Beckham
  * Organization and information contact
* Conference Organizing Committee

Outline

* Brief Description on Wine Stabilization
    * Chemical & Microbial
* Fining Definition, Goals and Steps
* Fining Agent Descriptions & Information
* Common Additives
* Cellar Applications

Wine Stabilization

* Chemical
  * Cold Stabilization
  * Heat Stability
  * Heavy Metals
* Microbial
  * Yeast
    * Fermentative
    * Film
    * Brettanomyces
  * Acetic Acid Bacteria
  * Lactic Acid Bacteria

Fining

Can help aid in wine stabilization

Fining: Definition & Goals

- Broad definition:
  - To become pure or clean
- In wine:
  - To add an absorptive or reactive substance to reduce or remove the concentration of one or more undesirable products
  - To aid in producing a product that is near perfect in terms of taste, color, bouquet and clarity

Fining: Definition & Goals

* The fining method should not take away from these attributes (taste, color, bouquet and clarity) but bring them together in expressing varietal character as much as possible
* Can be as simple as letting nature and time take its course or actively adding and assortment of fining agents at our exposure
  * This depends entirely on the individual must/wine and its components in addition to suspected time of bottling in meeting consumer demand

Reasons for Fining

- Aroma:
  - H_2S, oxidation, off varietal aroma, slightly flawed
- Color:
  - Intensity, browning
- Flavor:
  - Bitterness, astringency, off-balance
- Palate:
  - Harsh (round and soften, improve phenolic profile)
- Haze:
  - Protein, heavy metals
- Cold stabilize

Factors Improving Fining Action

* Low carbon dioxide (impedes fining and settling)
* Warm temperatures
  * Simply warming a wine up in some cases can help settle out and clarify a wine (except protein instability)
* Lower pH wines require less clarification time
* A high metal content can affect fining efficiency
* Young wines are more forgiving in protein fining
* Dry wines
* Clarified wines

Source: Zoecklein et al. 1995, Wine Analysis and Production

Essential Steps in Fining Wine

- Sensory evaluation
- Chemical Analysis
  - pH, TA, VA, SO_2, alcohol, heat stability, cold stability, % R.S. etc…
- Laboratory trials
- Cellar application

Sensory Evaluation

* Perform sensory evaluation in a clean aroma free atmosphere with good lighting and a white background
* Examine wine subjectively
  * Involve other evaluators
* Know the varietal or blend characteristics
* Identify shortcomings:
  * Taste alongside benchmark Wines

Chemical Analysis

* Many times chemical analysis will back up sensory results
* Help isolate or troubleshoot problem areas for fining treatments

Laboratory Trials

* Pipette, 5-10 ml graduated in 0.1 mls
* Several 100 ml graduated cylinders
* Numerous identical wine glasses
* Magic marker (Sharpie)
* Glassware – Beakers for fining tests
* Gram scales
* Calculator, pad and pencil
* Fining tech sheets and lab trial procedures

Laboratory Trials

- Prepare fining agents according to manufactures directions
- Use at least 200 ml of clarified wine
- Include a control sample with not treatment
- Evaluate wines blind in sensory room environment
  - Avoid any bias that treatment is or is not working

Classes of Fining Agents

* Earths: bentonite, Kaolin (-)
* Proteins: gelatin, isinglass, casein, albumin (+) & hydrogen bond activity
* Polysaccharides: Sparkalloid, Klear-mor (+) & repulsion
* Activated Carbons (adsorption)
* Synthetic polymers: PVPP, nylon – Hydrogen bond
* Silicon dioxide: Nalco 1072, Keiselsol (-)
* Others: metal chelators, enzymes, etc.

Source: Ellen Butz, 2001, Ohio Grape – Wine Short Course

Addition Preference of Fining Agents

- Copper and Iron treatments
- Aroma
- Acid adjustments (if necessary)
- Mouthfeel – tannin/phenolics
- Protein reduction
- Clarification and color
- Cold stability

Commonly Used Fining Agents

- Potassium Caseinate
- PVPP
- Yeast
- Activated Carbon
- $CuSO_4$
- Bentonite
- Isinglass
- Gelatins
- Egg Albumin

Commonly Used Additives

* Acids (tartaric, malic & citric)
* Deacidifying agents ($KHCO_3$ & $CaCO_3$)
* Tannins
* Oak
* Sugar
* Concentrates

General Activity of Various Fining Agents

Color	Aroma	Flavor	Texture
Casein	Copper	Acid	Tannins
PVPP	Casein	Sugar	Egg Albumins
Gelatin	Yeast	Conc.	Gelatin
Yeast	Isinglass	Carbon	Isinglass
Carbon	Carbon	Sugar	Yeast
Enzymes	Enzymes		Sugar
			PVPP
			Carbon

Adapted from: Chris Stamp, 2003 Ohio Grape-Wine Short Course Proceedings

Protein Precipitation

- Appearance:
  - Protein precipitation appears as an amorphous haze flocculation or deposit
- Cause:
  - Protein instability occurs predominately in white Vinifera wines
  - Red wines cause no concern due to tannins forming a complex with protein causing precipitation

Protein Precipitation

* Factors influencing protein precipitation
  * Protein instability is difficult to predict due to factors such as cultivar, maturity, climate, electrical charge and interaction with other wine components
  * Heat, shaking, heavy metals and ultraviolet light have been known to precipitate out proteins

Protein Precipitation

- Proteins present in wine ranging from 0–100 ppm
- The total protein concentration poorly correlates with instability
  - Not all proteins are unstable
- Proteins can be positive, negative and neutrally charged

Protein Precipitation

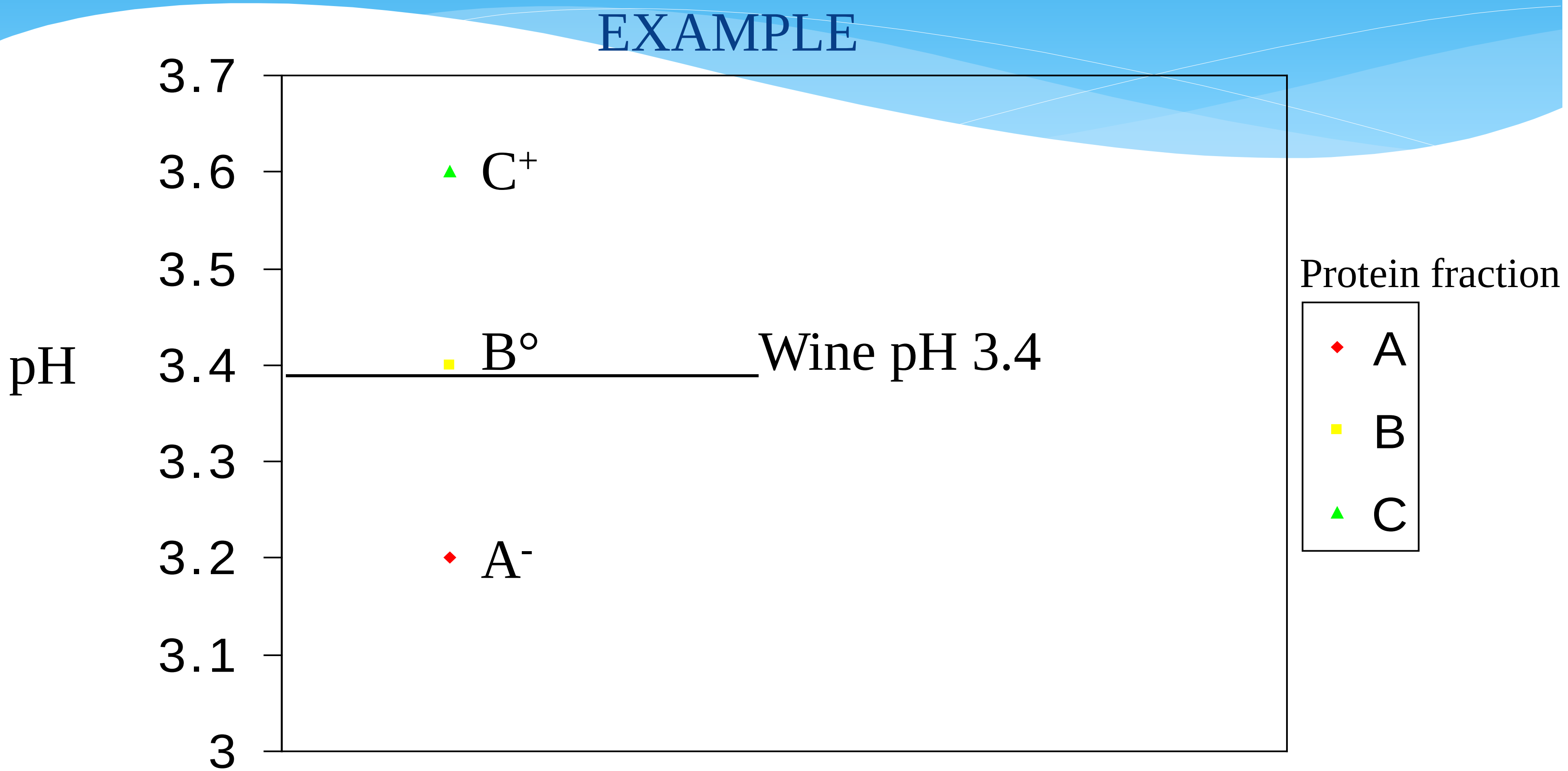
EXAMPLE

- Protein Fraction A
- Protein Fraction B
- Protein Fraction C

- Isoelectric Point 3.2
- Isoelectric Point 3.4
- Isoelectric Point 3.6

Source: Murli Dharmadhikari Vineyard and Vantage View March/April 1998

Protein Precipitation

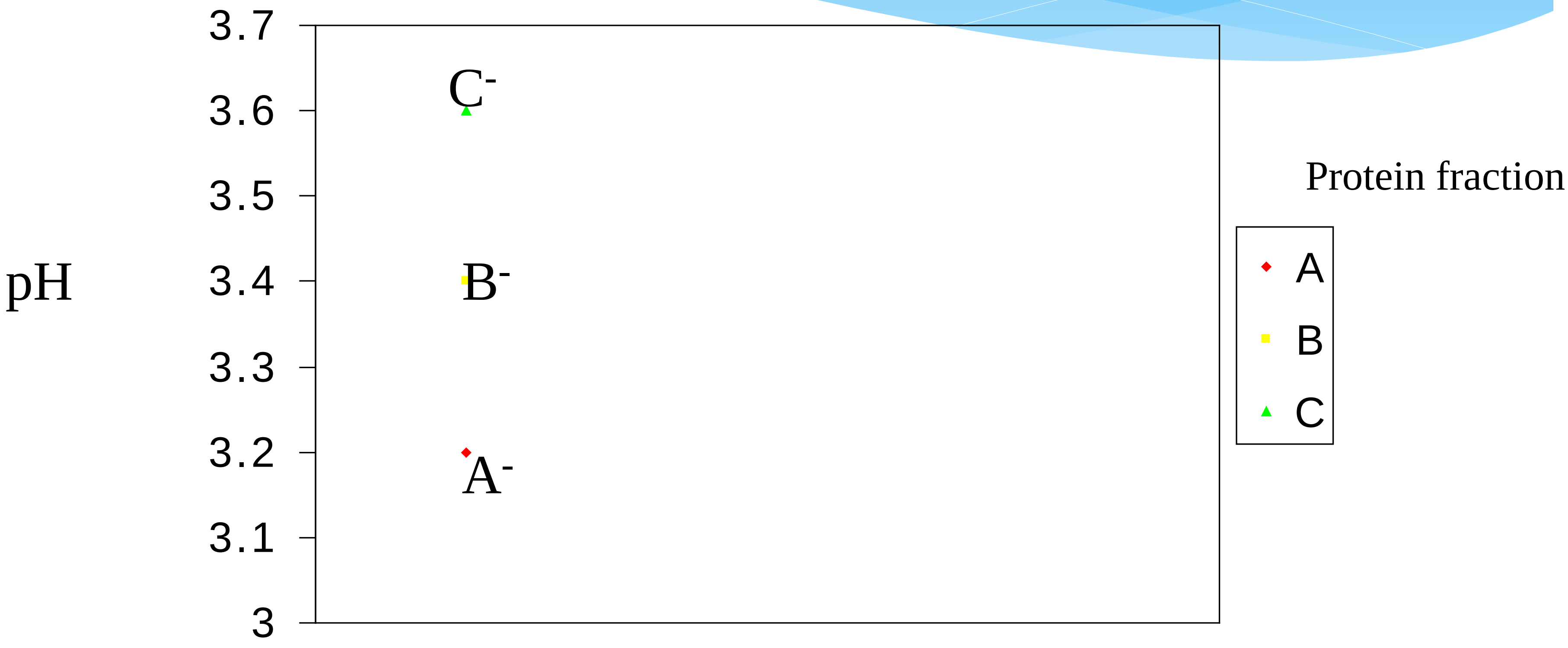


Source: Murli Dharmadhikari Vineyard and Vantage View March/April 1998

Protein Precipitation

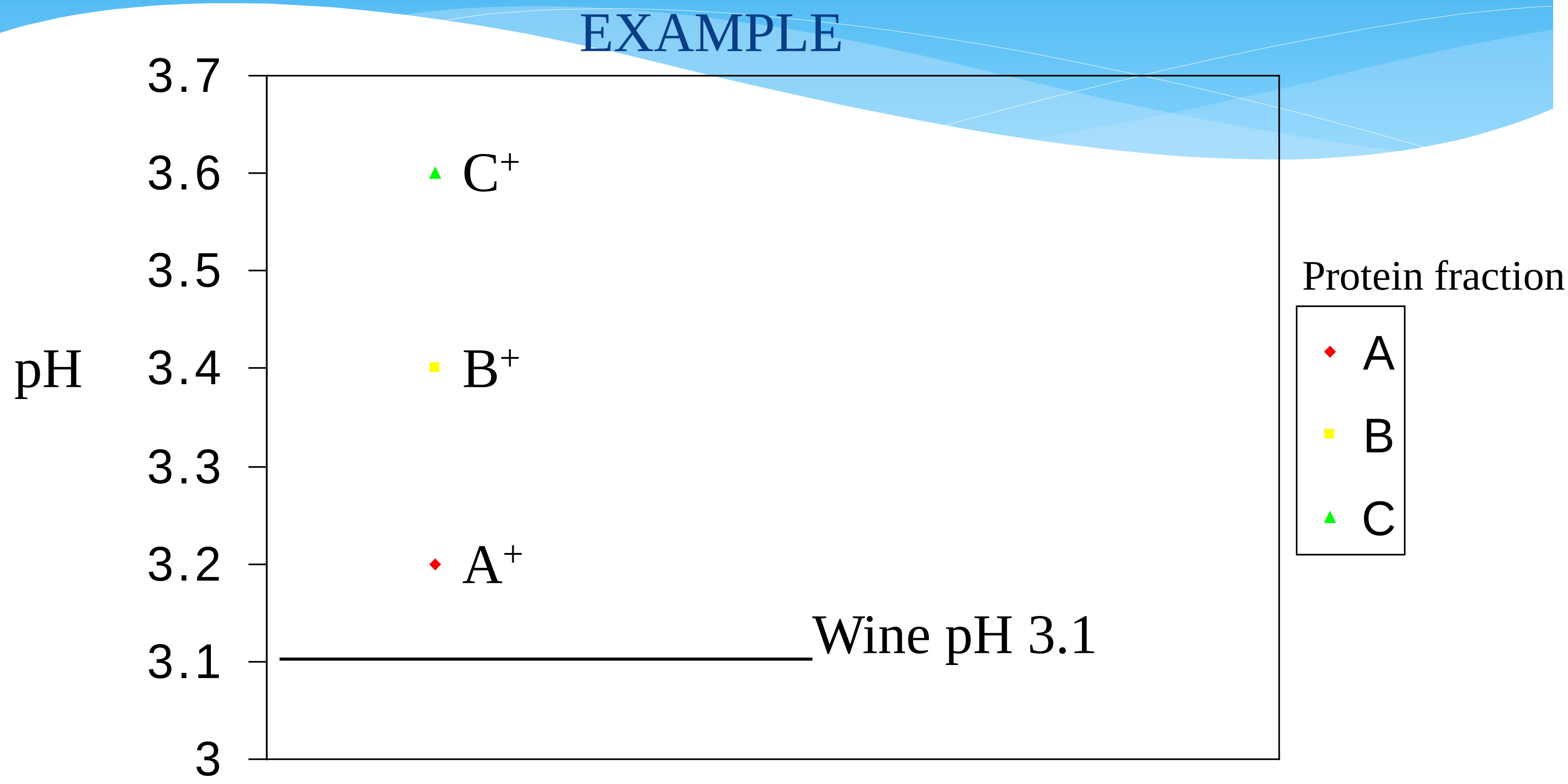
EXAMPLE

Wine pH 3.7



Source: Murli Dharmadhikari Vineyard and Vantage View March/April 1998

Protein Precipitation



Source: Murli Dharmadhikari Vineyard and Vantage View March/April 1998

Bentonite

- Claylike material of volcanic origin
  - Flat surface (-) charged attracts (+) charged proteins
  - Acts like a deck of cards
  - Come in both sodium and calcium for wine use
  - Sodium: hydrates best with more reactive sites making it more efficient (requires more time to settle)
  - Calcium: less efficient but compacts better
  - Combination of two a possibility

Bentonite

* Both hot and cold mix bentonite solutions available
* If adding to must/juice, determine YAN content prior to fermentation for correct nutrient additions since bentonite can strip some available nitrogen
* Bench trials should be performed to determine minimal levels required especially to post fermented wine
* Addition of 2 – 8 lbs / 1000 gallons can be added to the juice or wine

KHT Precipitation

- Appearance:
  - Formation of crystalline deposits
- Cause:
  - Tartaric acid and its salts potassium bitartrate (KHT) and calcium tartrate naturally occur in grape juice and wine
  - Newly fermented wines are supersaturated with cream of tarter and unless removed during the making of wine, the formation of crystalline deposits will form in bottled wine

KHT Precipitation

- Factors influencing KHT precipitation
  - Starts in the vineyard with the uptake of potassium in the soil through the roots
  - After veraison starts concentrating in the fruit including tartaric acid
  - The formation of potassium and tartaric acid depend on factors such as soil type, rootstock, irrigation, variety, etc…

KHT Precipitation

- Factors influencing KHT precipitation
  - The production of alcohol during fermentation lowers the solubility leading towards a supersaturated solution
  - Precipitation occurs in two stages with the formation of nuclei and the formation of a crystal lattice structure
  - The crystals have active binding sites
  - Solubility of KHT varies with temperature, pH, alcohol content, acids, ions, pigments, mannoproteins and tannins

KHT Precipitation

- Factors influencing KHT precipitation
  - These compounds can bind the active sites of the crystals and slow or stop crystal formation
  - Red wines generally require longer cold stabilization times then white wines
  - All acid adjustments, blending and fining trials should be made before cold stabilization
  - Wines settled, clarified with bentonite and filtered will typically have faster rates

KHT Precipitation

* The three most common methods of KHT removal
  * Mother Nature
  * Chilling
  * Contact seeding
* Additional methods
* Ion exchange
* Electrodialysis
* CMC & Mannoproteins

KHT Precipitation

* Chilling for KHT removal
  * Arguably the most common method for KHT removal
  * Subjecting wine to temperatures of 15 to 35°F for up to several weeks
  * Wine should be filtered cold after cold stabilization to prevent KHT from going back into solution

KHT Precipitation

- Chilling for KHT removal
  - Although this can be effective, fluctuations in temperature can have a significant impact on nuclei formation and slow crystal growth (Mother nature)
  - With increased time at lower temperatures oxygen will absorb more rapidly causing oxidation to be a concern

KHT Precipitation

- Contact Seeding for KHT Removal
  - An effective way of cold stabilization through seeding with KHT crystals
  - Addition of finely ground KHT powder providing more surface area in promoting faster nuclei formation and crystal growth
  - Can also speed up refrigeration time

KHT Precipitation

* Contact Seeding for KHT Removal
  * Add KHT crystals to chilled wine under a nitrogen or CO2 blanket
  * The addition of 2-10 lbs per 1000 gallons can reduce cold stabilization times to 3-5 days
  * The addition of 15-20 lbs per 1000 gallons can reduce cold stabilization times to 3-5 hours

KHT Precipitation

- Contact Seeding for KHT Removal
  - Benefits from lower energy costs in significantly shortening stabilization period
  - Cost effectiveness needs to be looked at when choosing higher amounts of KHT
  - KHT crystals can be recovered, washed and used again up to 5 times before grinding

KHT Precipitation

- CMC: Carboxymethyl Cellulose and Mannoproetein
- Fairly new procedures that do not require cold stabilization to work
- Both work on impeding further nuclei formation (CMC) or altering crystalline growth structure (mannoprotein) preventing it from occurring

Information complements of Maggie McBride, Scott Laboratories & Bertrand Robillard, R&D Manager, Institut Œnologique de Champagne

KHT Precipitation

- A few specific requirements prior to CMC or Mannoprotein use for KHT stabilization
  - Wine needs to be protein stable
  - conductivity checks essential to help determine KHT saturation temperature for correct dosage
  - Needs to be blend / bottle ready
    - No acid adjustments or additives
    - Was Lysozyme Used? (procedure dependent)
    - Pass filterability

Information complements of Maggie McBride, Scott Laboratories & Bertrand Robillard, R&D Manager, Institut Œnologique de Champagne

KHT Precipitation

- Other wine matrix specifics required
  - Check with manufacturer's requirements
- Combination with light cold stability procedures or lower amounts of contact seeding along with use of CMC or Mannoprotein may provide better stability results than cold stabilization itself

Information complements of Maggie McBride, Scott Laboratories & Bertrand Robillard, R&D Manager, Institut Œnologique de Champagne

KHT Laboratory Procedures

- Three tests for checking cold stability
  - Moderate refrigeration test
  - Severe refrigeration test
  - Conductivity test

Activated Carbon

* Removes color and aroma
* Oxidative – due to large quantity of air in carbon
    * Adjust free SO_2 levels prior to fining
* Add dry – Instant reaction
* Bentonite or PVPP counter fining recommended after carbon treatment, rack and filter
* Use as last resort
* Usage rate: 0.5 – 3 lbs/1000 gal (6-48 g/hL)

Albumen

- Fresh or frozen egg whites (fresh more effective)
  - Colloidal in nature with positively charged surface
- Reduces harsh and aggressive tannins (-) charged
- Soften mouthfeel
- Added directly to barreled red wines or more easily to same wine in SS tank
- Appears to remove less fruit (stripping) character than gelatin fining

Albumen

* Not typically used in white wines due to lack of tannin creating potential protein instability issues
* If egg whites are diluted with water, a pinch of salt is essential
* Standard practices of using from 1 – 8 egg whites per 60 gal barrel (2 – 4) being average
* Refer to TTB limitation on addition of working solution due to KCL and water

Casein (Milk Protein)

- Potassium Caseinate: Kolorfine, Vinpur
- White Powder easily dispersed in wine
- Flocculates , settles removing colloidal particles
- Binds to Leucoanthocyanidins
- Great for removing brown hues/tones
- Removes oxidative odors

Casein (Milk Protein)

- Reported to remove some copper as well
- Freshens overall fruit attributes
- May be used to soften tannins in red wines
- Usage rate .2 – 2 lbs/1000 gal
- Can also counter fine with Silica Dioxide
  - Kieselsol, Nalco
- Allow to settle, rack and filter after 2 – 4 hours or more depending on volume being fined

$CuSO_4$

- Reacts with H_2S (hydrogen sulfide) which can mask varietal character at low levels and contribute rotten egg to rubber type aromas at higher concentrations
- Reaction forms CuS (Copper Sulfide) as a precipitate
- Comes in blue powder or liquid ($CuSO_4$ x 5 H_2O)
- Determine lowest- effective concentration by performing bench trials
- Use 1% solution added directly to wine while mixing

$CuSO_4$

* Residual copper is a catalyst for oxidative reactions and haze formation
* Haze formation possible at levels > .3 ppm
* Use yeast, bentonite or potassium caseinate to fine excess copper
* TTB legal limit is 0.5 ppm (lab test)

Gelatin

- Prepared from collagen – structural protein derived from animal skin and bones
- Purchased as a granular powder or liquid
  - Exists in wine pH as (+) charged
- Removes astringency by reacting with tannins in red wines to soften mouthfeel
- Also used in white juice for removing phenols and brown color
- Can be used for clarification of white and red wines

Gelatin

* Commercial gelatin usually rated by bloom
  * Refers to the ability to absorb water
  * Higher the bloom number = greater absorbing capacity
    * Bloom of 75 – 100 acceptable for wine
* May desire to counterfine with silica dioxide
* Hydrate dry gelatin by stirring 1 lbs gelatin into 2 gal of water (112 °F)
* Usage level varies by preparation and purpose
  * 0.2 – 0.8 lbs/1000 gals – care taken not to over fine

Isinglass

- Complex protein collagen derived from fish bladders
- Comes in pre-hydrolyzed and fibrous form of flocced Isinglass (+)
  - Does not require tannin to act in wine
- Prepare in cold water (50 °F) and keep cold
- Affects phenolics and aromatics especially in whites

Isinglass

* Thought to have less stripping effect than gelatin or casein
* Also used as riddling aid in sparkling wine
* May benefit from being counter-fined with bentonite or silica to help reduce lees and speed settling
* Usage rate typically varies from 0.2 – 0.5 lbs/1000 gals
* Typically takes 1 – 2 weeks, rack and filter

Polysaccharides

* Alginates extracted from brown algae bound to diatomaceous earth (Sparkalloid, Kear-Mor)
* Positively charged and work best in wine pH < 3.5
* Primary function of enhancing clarity and filtration
  * Excellent clarification option when other fining agents have not worked efficiently
* Hot or cold mix preparations available
  * Hot more efficient in clarification of wines

Polysaccharides

* White granular material prepared by hydration in hot water (180 °F) addition rate of 1 - 8 lbs/ 1000 gal
* Add hot mix slowly to wine with continued stirring for 15 – 20 minutes
* Allow to settle from several days to a few weeks
    * Rack and filter
* Often added soon after bentonite addition as wine is being moved to cold stabilization

PVPP

* Synthetic protein - like material (fine granular)
  * Sold as Polyclar®
* Complexes with phenolic and polyphenolic components by absorption collecting low molecular weight catechins (hydrogen bond formation)
* Removes bitter compounds along with off colors
* Reduces potential for browning
  * Helps stabilize Rosé / Blush wines

PVPP

* Useful in helping to settle carbon treatments
* Usage rate ranges from 0.5 – 6 lbs/1000 gals
* Make 5 – 10% solution in wine or water and add directly to wine while stirring for approximately 30 minutes
* Settle, rack and must filter
* TTB legal limit of 6 lbs/1000 gallons

Silica Dioxide

- Silica Dioxide – silica gel and Kieselsol
- Use as a substitute for tannic acid addition in gelatin fining to initiate flocculation and settling of gelatin and protein – add prior to gelatin
- More commonly used for clarification in protein fining treatments (bentonite)

Silica Dioxide

* Limited shelf life of less then 2 years
* Dosage rate rarely exceeds 10 lbs/1000 gals
* Rack and filter all silica dioxide out of wine
* TTB legal limit equivalent of 20 lbs colloidal silicon dioxide at a 30% concentration /1000 gals

Yeast

- Reported to remove some copper and iron
- Reduces brown oxidative hues
- Can reverse some oxidation in aroma and on palate
  - Known to “freshen” up a wine
- Also indicated to remove herbaceousness and other off odors such as ethyl acetate
- Removes astringent tannins (especially oak tannin)

Yeast

* May use rehydrated yeast or freeze dried added directly to wine
  * Yeast high in mannoproteins good choice (D254)
* Usage rate ranges from 1.5 – 8 lbs/1000 gals
  * Average optimum concentration of 2-4 lbs/1000 gals
* Monitor effect, rack and filter once noticeable changes have been diagnosed
* May take several days to a couple of weeks

Additives

Additives

* Acids (tartaric, malic & citric)
* Deacidifying agents ($KHCO_3$ & $CaCO_3$)
* Tannins
* Oak
* Sugar
* Concentrates

Acid Additions

- Adjust acid perception on palate
- Adjust pH (important enological factor)
- Effects perception of tannin and astringency
- Effects cold stability
- Tartaric acid most commonly used
- Citric acid can be utilized at lower levels for enhanced fruit structure in aged white wines

Tartaric Acid Addition

- Preferred for addition to must over malic and citric acid.
- Tartaric acid is a stronger acid.
- Lowers the pH of must during fermentation.
- Excess citric acid may effect organoleptic profile.
- Malic and citric acid can be metabolically utilized by microorganisms.

Cool Climate Viticulture Areas

* Excess acidity at harvest may occur in cool climate viticultural areas requiring deacidification of the must or juice.

Excess Harvest Acidity

* Common for cool climate viticultural areas.
* Viticultural practices – over cropping, unorganized spray program, etc…
* Vine vigor – high vigorous vines typically produce higher acidities.
* Excess acidity may require deacidification.

Methods of Deacidification

* Amelioration
* Chemical neutralization and precipitation of tartrates
* Choosing an acid reducing yeast strain
* Anion exchange
* Performing a Malolactic Fermentation
* Blending
* Sugar Addition

Enological Tannins

- Many new tannins available on the market today with a broad range of action
  - Fermentation, cellaring and finishing
  - Especially good for hybrid red wines
- Can enhance mouthfeel, lower perceived astringency, help assist protein stability and aid in color extraction
- Can also be used with gelatin to enhance clarification
- Follow manufacturers suggested dosage rates

Oak

* Barrels – All types (species), options, toast levels and producer's available
* A plethora of oak alternatives and producer's on the market today with good results
* Enhance mouthfeel, provide subtle nuances and increase complexity to varietal aroma's and blend characteristics
  * Please do not over oak!!!
    * It takes expertise to integrate varietal character and oak nuance's correctly together

Concentrates

- Can add flavor, sweetness and enhance mouthfeel
- Good for fine tuning wines
- Also utilize juice reserve for these purposes
- Watch for Zygosaccharomyces in fruit concentrates which normal SO_2 levels are not effective
- TTB regulations indicate only using "like" fruit concentrates except formula wine

Sugar

* The power of a little sugar in finishing a dry wine goes along way!
* Add up to 0.5% residual sugar in balancing acid profile, smoothing out slightly harsh tannins and lowering perceived astringency
* Laboratory trials are critical in determining optimum concentration
* May need to follow sterile filtration protocols

Cellar Applications

* Commercial companies such as Scott Laboratories have nice laboratory size fining trial packets available with good directions for cellar applications
* Perform laboratory trials and cellar applications the same: Fining agent, preparation methods, temperature, mixing and timing are all critical
* The difference between mixing with a blender in the lab and a paddle mixer in the cellar results in over fining

Cellar Applications

* Effectiveness of fining can be reduced by 50% due to improper preparation methods
* Entire volume of wine must come into contact with fining agent as it is being added
* Limit contact time to minimum amount required to perform purpose efficiently
* Proteinaceous fining agents work better at colder temperatures (except bentonite)

THANK YOU!

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