

Lecture 5:

Juice and Must Treatments and Additions

Reading Assignment:

Chapter 3, pages 68-91

Appendix B, pages 551- 556

Juice/Must Treatments

- Skin contact
- Extended Maceration/Cold Soak
- Clarification
- Additions

Skin Contact

- Allowing juice to remain in contact with skins and seeds
- Increases extraction of material from skins
- Increases astringency
- May be done at varying temperatures
- Term used in white wine production

Extended Maceration/Cold Soak

- **Extended maceration** is a post fermentation “skin/grape lees contact” for red wines
- **Cold Soak** is holding red must at low temperatures for an extended period of time prior to fermentation to increase extraction of components
- Both impact microbial flora

Clarification

- Removal of suspended particles in juice
- Can facilitate downstream processing
- May be removing needed yeast nutrients (over-clarifying)

To Settle or Not Settle?

A Matter of Solids

Juice Clarification

- Natural (Gravity) Settling:
 - Rack Juice from lees: results in loss of volume
- Batch and Continuous Drainers
 - To separate juice from solids
 - Control size of particles removed
- Centrifugation
 - Can lead to aeration of wine
 - May strip too many solids

Juice Clarification

- Filtration
 - Usually a “rough” filtration
 - Juice may be difficult to filter
- Flotation
 - Use of fine suspension of gas (nitrogen) bubbles
 - Suspended pulp becomes attached to bubbles and floats to surface allowing removal

Juice/Must Additions

- Nutrient additions

Nutrient Additions

- Nitrogen as ammonium phosphate (8 lb/1000 gal or 0.96 g/L in USA)
- Yeast extract/nutrient mix (3 lb/1000 gal or 0.36 g/L in USA)
- Yeast “ghosts” (3 lb/1000 gal or 0.36 g/L in USA)
- Thiamine (0.005 lb/1000 gal or 0.6 mg/L in USA)
- Malic acid to stimulate malolactic bacteria
- Specific amino acids and other vitamins

Juice/Must Additions

- Nutrient additions
- Microorganisms

Microorganisms

- Yeast: *Saccharomyces cerevisiae* or *Saccharomyces bayanus*: No limit on addition, typically no more than 10^6 cells/mL.
- Bacteria: Malolactic bacteria, generally *Oenococcus oeni*: Also no limit on addition, can be as high as 10^8 cells/mL

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment

Acidity Adjustment (USA)

- Increase acidity
 - Tartaric and malic acid can be added to correct a natural deficiency
 - Ion exchange to a pH no less than 2.8
 - Lactic, citric and fumaric acid can be added to *wine* only
- Decrease acidity
 - Calcium carbonate (not below 6 g/L)
 - Ion Exchange to a pH no greater than 4.5

Definitions of Acidity

- Titratable acidity (TA)
- pH
- Volatile acidity (VA)
- Fixed acidity
- Total acidity

Titrateable Acidity (TA)

Defines the proton concentration of wine as measured by titration with a strong base to a specific end point, pH 8.2

Expressed as g/L tartaric acid equivalents in USA

pH

Defined as the “free” proton concentration

Not to be confused with the “titratable” proton concentration (dependent upon dissociation and concentration of organic acids)

Volatile Acidity (VA)

The portion of the acid species that are distillable away from the rest of the organic acids

Fixed Acidity

The portion of the organic acids that are not distillable.

Total Acidity

The summation of the organic acid species present in juice/wine

Total Acidity = Volatile Acidity + Fixed Acidity

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents

Defoaming Agents

- To prevent foaming and loss of wine volume
- Silicon dioxide, sorbitan monosterate, glycerol dioleate, polyoxyethylene 40 monosterate
- Not to exceed 0.15 lb/ 1000 gal or 0.0018 g/L in USA

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions

Enzyme Additions

- Amylases: breakdown complex polysaccharides
- Cellulases: breakdown complex polysaccharides
- Pectinase: breakdown pectins
- Protease: breakdown of proteins
- Glycosidase: release of terpenes

Purpose of Enzyme Additions

- Increase yield
- Facilitate settling
- Release flavors
- Prevent wine haze from forming later in processing

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids

Inert Solids

- Settling aids to increase clarification of juice
- Increase solids content to facilitate yeast fermentation

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color

Compounds Affecting Color

- Polyvinylpolypyrrolidone (PVPP): to remove color and “off-color-forming” potential (mostly whites); not to exceed 60 lb /1000 gal or 7.9 g/L
- Hydrogen peroxide: to bleach oxidizing color pigment, not to exceed 500 mg/L (ppm)

Juice/Must Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO₂)

Sulfur Dioxide

- Antioxidant
- Antimicrobial
- Stimulation of yeast
- Bleaches red wine color

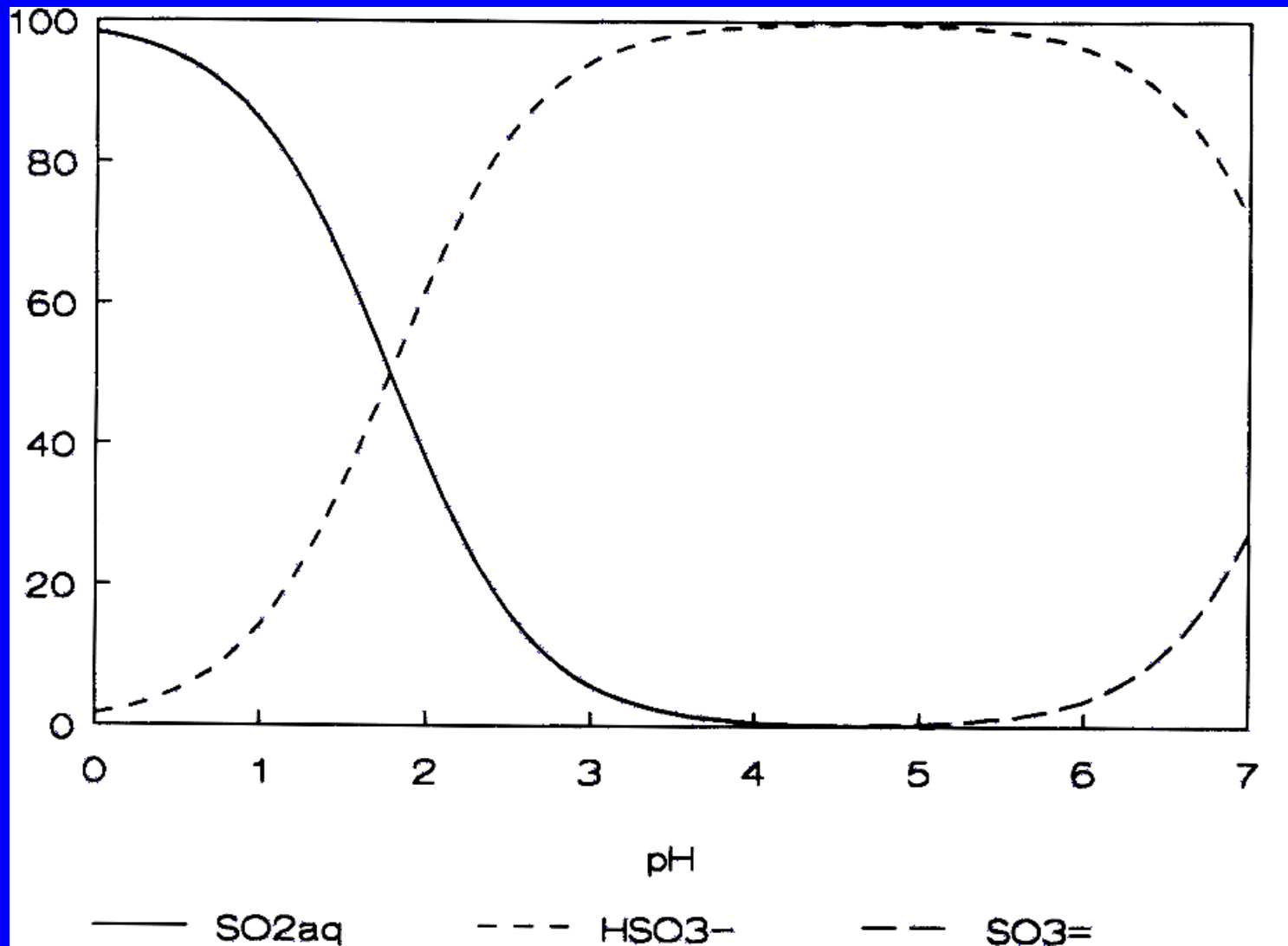
SO₂ as Antioxidant

- Blocks chemical oxidation reactions by reacting with oxygen radicals or with target compounds (not with O₂)
- Inhibits polyphenol oxidase (PPO) activity

SO₂ as Antimicrobial

- Inhibits both bacteria and yeast, less of an effect on yeast at low concentrations
- Effectiveness dependent upon pH
- “Detoxified” by *Saccharomyces* metabolic activity
- Will form addition compounds with acetaldehyde, sugars, phenols reducing effective concentration

Effect of pH on form of sulfur dioxide



SO₂ Stimulation of Yeast

- Inhibition of microbial competitors
- Elimination of competition with PPO for molecular oxygen

SO₂ Effects on Color

- Aids in extraction by killing grape skin cells
- Chemically bleaches color (reversible reaction)

SO₂ Health Concerns

- Wines must be labeled as “containing sulfites”
- Chronic asthmatics may be hypersensitive to SO₂
- Lack sulfite oxidase:
 - Normal: 0.75-3 units of activity
 - SO₂ sensitive: 0.2 or less units
- Lung tissue: lowest in sulfite oxidase
- Humans synthesize g/day of sulfite: natural antioxidant

Juice Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO₂)
- **Dimethyl Dicarbonate (DMDC)**

Dimethyl Dicarbonate

- Toxic to yeast, including *Saccharomyces*
- Rapidly hydrolyzed and inactivated
- Less toxic to bacteria especially in absence of sulfur dioxide

Juice Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO₂)
- Dimethyl Dicarbonate (DMDC)
- **Ascorbic Acid: Antioxidant**

Juice Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO₂)
- Dimethyl Dicarbonate (DMDC)
- Ascorbic Acid: Antioxidant
- Oxygen

Oxygen

- Stimulates microorganisms
- Required by yeast for optimal ethanol tolerance
- Stimulates oxidation reactions so oxidation products can be removed early (does not always work!)

Juice Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO₂)
- Dimethyl Dicarbonate (DMDC)
- Ascorbic Acid: Antioxidant
- Oxygen
- Sugar

Sugar

- Sugar addition not legal in California; is permitted in other wine-growing regions of the USA
- To correct a deficiency at time of harvest

Juice Additions

- Nutrient additions
- Microorganisms
- Acidity adjustment
- Defoaming agents
- Enzyme additions
- Inert solids
- Compounds affecting color
- Sulfur dioxide (SO_2)
- Dimethyl Dicarbonate (DMDC)
- Ascorbic Acid: Antioxidant
- Oxygen
- Sugar
- **Water**

Water

- Water can be legally added to correct a “high Brix” must or juice and to make wine from juice concentrate
- Water can be added with other addition if water solutions have been made
- Water cannot be added simply to increase volume of production

Additions which are fully permitted in one country might not be permitted in another. It is important to know the regulations of the country in which the wine is produced as well as of the country in which it will be sold.

Who Decides Which Additions Are Allowable?

- Tax and Trade Bureau (TTB) formerly the BATF
- State Alcohol Boards in USA
- Office International de la Vigne et du Vin (OIV)
- European Community