WASHINGTON STATE UNIVERSITY

Use of Tannin Additions in the Production of Red Wines

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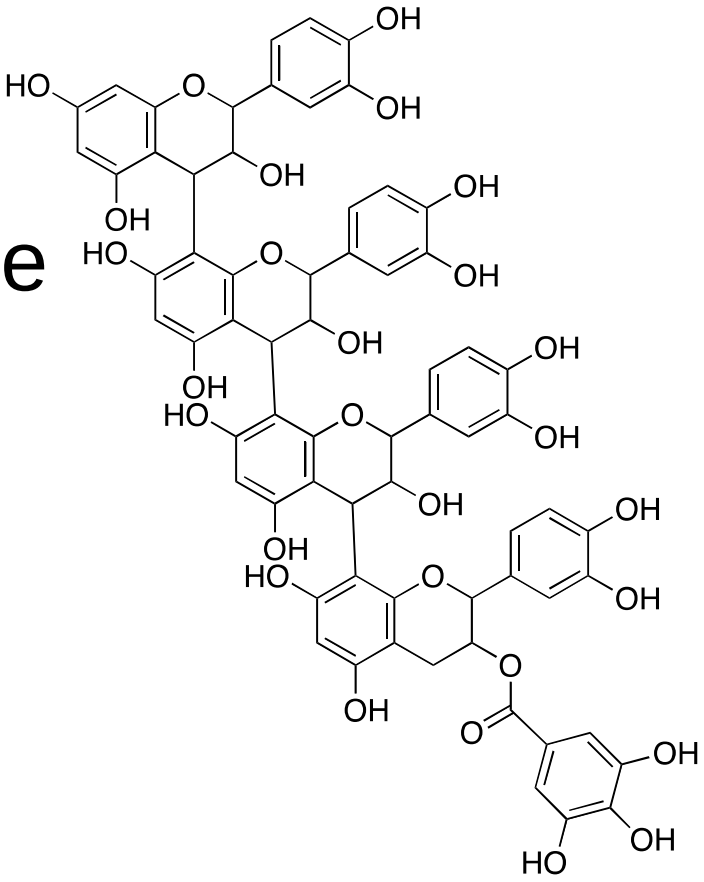
Tannins

- Importance
  - Sensory Attributes
    - Astringent
  - Antioxidant
  - Formation of Polymeric Pigments
- Condensed and Hydrolysable Tannins
  - Grapes contain Condensed in Skin, Seed, Stem
  - Oak Barrels contain Hydrolysable and Condensed (primarily Hydrolysable)
- Oenotannins
  - Extract dried into powder
  - Grapes, Barrels, Exotic Trees, Oak Galls

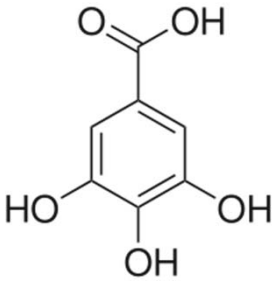
Grape Tannins

- Condensed Tannins
- Main Tannins found in Wine
- Origin
  - Skins (0.5-1.2 mg/berry)
  - Seeds (3.0-4.0 mg/berry)
  - Stems (?/racchis)

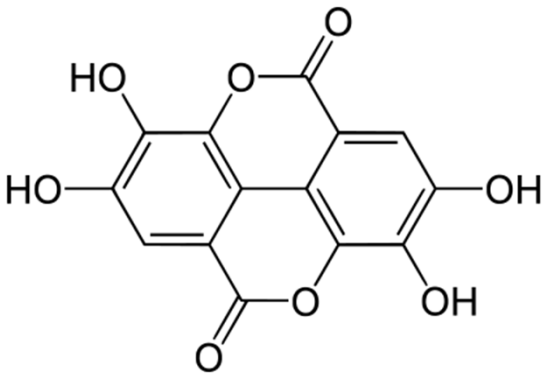


Oak Tannins

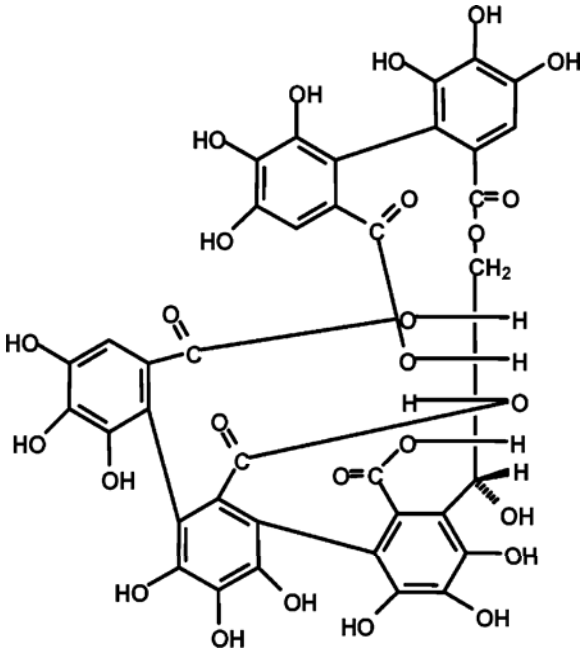
Gallic Acid



Ellagic Acid



Castalagin



- Ester linkages hydrolyze under acidic aqueous conditions of wine
- Castalagin may directly contribute to astringency of wine
- Syngeristic effect with wine tannins
  - Some evidence of direct impact

Oenological Tannins

- Removal of Protein Haze
- Deactivation of Laccase Enzyme
- Sulfide Removal
- Removal of Veggie Aroma
- Sacrificial Tannins
- *Color Stabilization*
- *Astringency Modification*

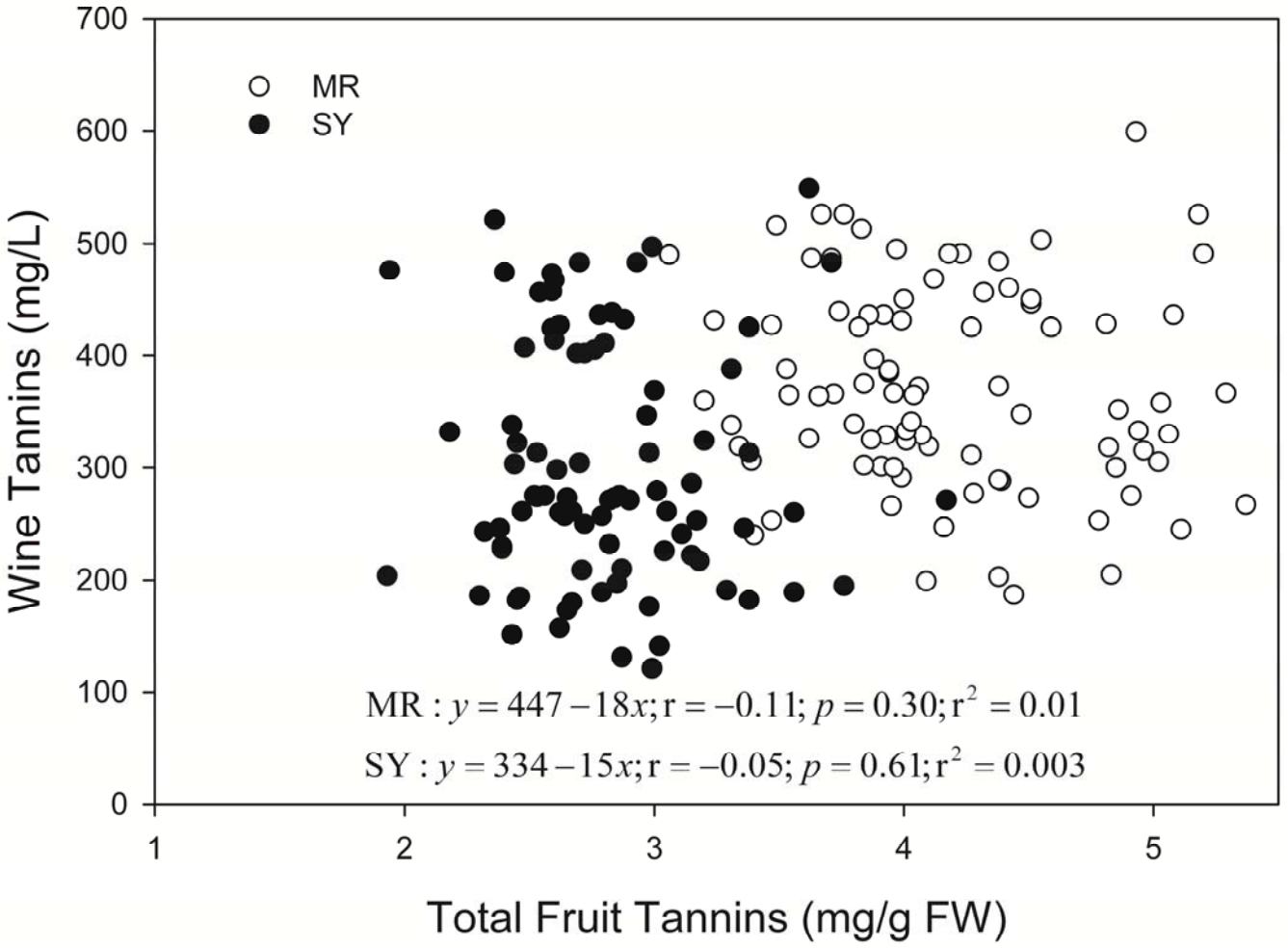
Protein Haze Removal

- Addition of tannin to remove proteins
  - Primarily used for protein stabilizing beer
  - Potential use for white wine production
    - Condensed tannins favored
      - Cross-linking mechanism linear relationship
  - Potential added bitterness or aroma
- Research Scale Immobilized Tannins
  - Reaction with metals and proteins

Laccase

- Tannins are well known enzyme inhibiters
  - Goldstein and Swain 1965
- Tannin Addition Friend or Foe?
- Impurity: monomeric phenolics (substrates for enzyme)
  - Residual bitterness
- Compete with Laccase for O_2?
  - Laccase affinity for oxygen is 0.16 -0.32 mg/L
  - Solubility of O_2 in water
    - 0°C – 15 mg/L O_2
    - 10°C – 11.4 mg/L O_2
    - 20°C – 9.1 mg/L O_2
    - 30°C- 7.7 mg/L O_2

Fruit & Wine Tannins



Sacrificial Tannins

- Fruit & Wine Tannins
  - Poor correlation
- Grape Fining Agent
  - Cell walls, polysaccharides
- Tannin Sponge Theory
  - Very large tannins occupy binding sites
  - Must occupy all binding sites for tannins to escape
    - Simplistic Idea
- No thorough examination of early additions
  - Canuti et al. 2012 added grape and gallnut tannins to Sangiovese primarily observed color change

Polymeric Pigments

- Heterogeneous mixture
  - HSO_3^- resistance (partial)
  - pH color shift small
  - Possible reduction in astringency
- Anthocyanins react with multiple classes
  - Aldehydes
  - Keto-Acids (Pyruvate)
  - Tannins
  - Hydrolysable tannins (in test tubes only)
- Some Data Supports Addition of Tannins
  - Primarily Excessive Additions
  - Small Additions provide temporary increase
    - Copigmentation or oxidation prevention?

Astringency

- Impact depends on target wine
  - Original amount of tannins
  - 100 mg/L added to 100 mg/L: 2-Fold Increase
  - 100 mg/L added to 1000 mg/L: 10% increase
- Additions of 200 mg/L – 400 mg/L
  - No improvement
    - Parker et al. 2007 (200 mg/L)
    - Bautista-Ortin et al. 2007 (400 mg/L)
- Change in Aroma Observed not Astringency
  - Parker et al. 2007
  - Diaz-Plaza et al. 2002

Purity: OIV CODEX

- Water extracts that are dried
  - Powder must be 98% water soluble
- International Oenological Codex (2013)
  - COEI-1-TANINS : 2009
- Not the most stringent set of rules
- Estimation of Total Phenolics in powder must be greater than 65% (gallic acid)
- Condensed tannins use (DMACH) 10 mg/g (1%)
- Ellagitannins use nitrous acid 20 mg/g (2%)
- Limits on yellow A_{420nm} and red color A_{520nm}
- Specific Definitions: Grape = 50 mg/g Catechin (5%)
  - 0.5 mg/g procyanindin

Purity: Literature

- Discrepancies in labeling and content
- Lack of relationship between total phenolics and tannins
  - Obreque-Slíer et al. 2009
- 12-48% of Total IRP is PPT (CE)
  - Harbertson et al. 2012
  - Keulder 2005 thesis
- Better purity than OIV requirements

Experimental

- Cabernet Sauvignon Wine from Columbia Valley WA
- Biotan by Laffort (Tanin VR Grape)
  - Grape Tannin: Information Confusing listed in units of non-flavonoid (coumaric acid)
  - Total phenolics > 65%
- Tanin Galacool by Laffort
  - Chestnut gall tannin
  - Hydrolysable tannins
  - Total phenolics > 80%
  - Used for deactivation of Laccase
- US: 150 mg/L Tannic Acid Addition is legal

Tannin Analysis

BIOTAN GRAPE TANIN

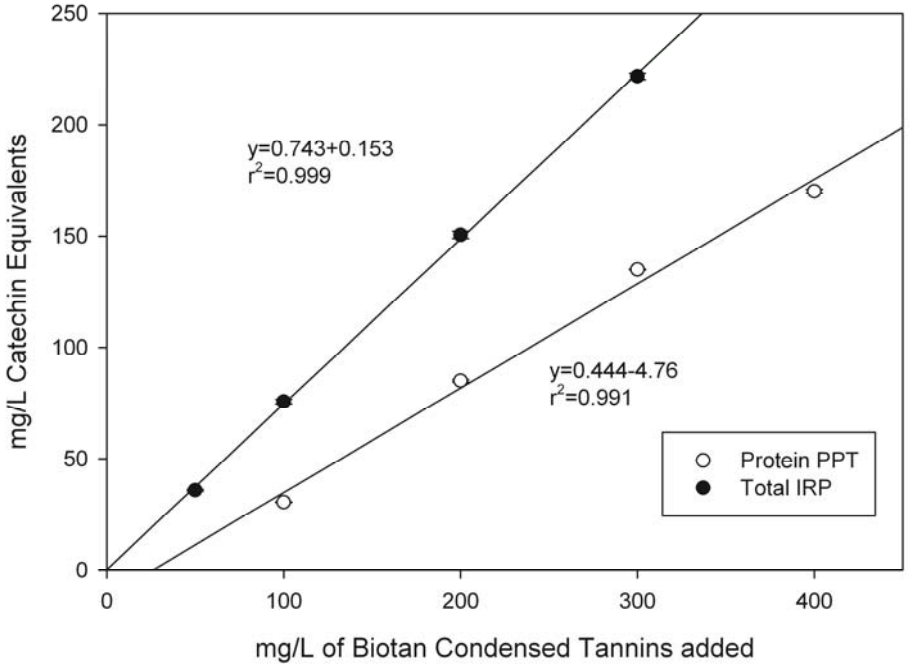


Figure 1.

Linear PPT: y=0.44x – 4.76

TANIN GALACOOL

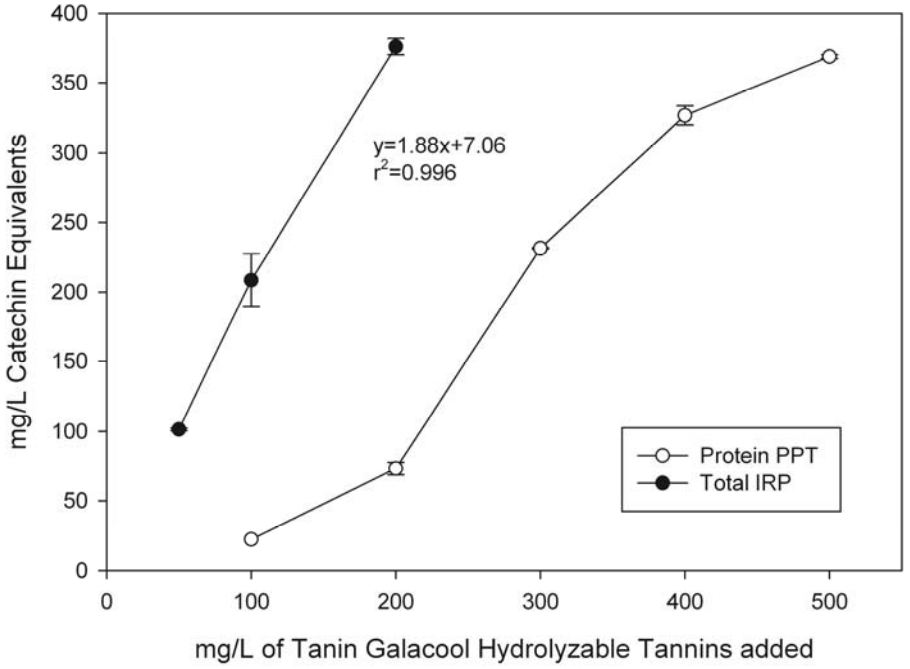


Figure 2.

Exponential PPT

Tannins and Total IRP

Predicted 85 and 350 mg/L Addition of Tannin for Biotan
Found 53 and 187 mg/L Addition for Biotan

Anthocyanins and Polymeric Pigments

Treatment	Anthocyanins (mg/L)	SPP (A_{520nm})	LPP (A_{520nm})
Control	330±3.5	1.75±0.06	1.99±0.04 ab
+ Biotan 200 mg/L	319±2.5	1.71±0.03	1.93±0.02 c
+ Biotan 800 mg/L	321±4.5	1.77±0.06	2.15±0.06 ab
+ GT 150 mg/L	322±3.5	1.71±0.02	2.03±0.08 abc
+ GT 600 mg/L	324±9.0	1.66±0.05	2.21±0.02 a

Sensory Evaluation

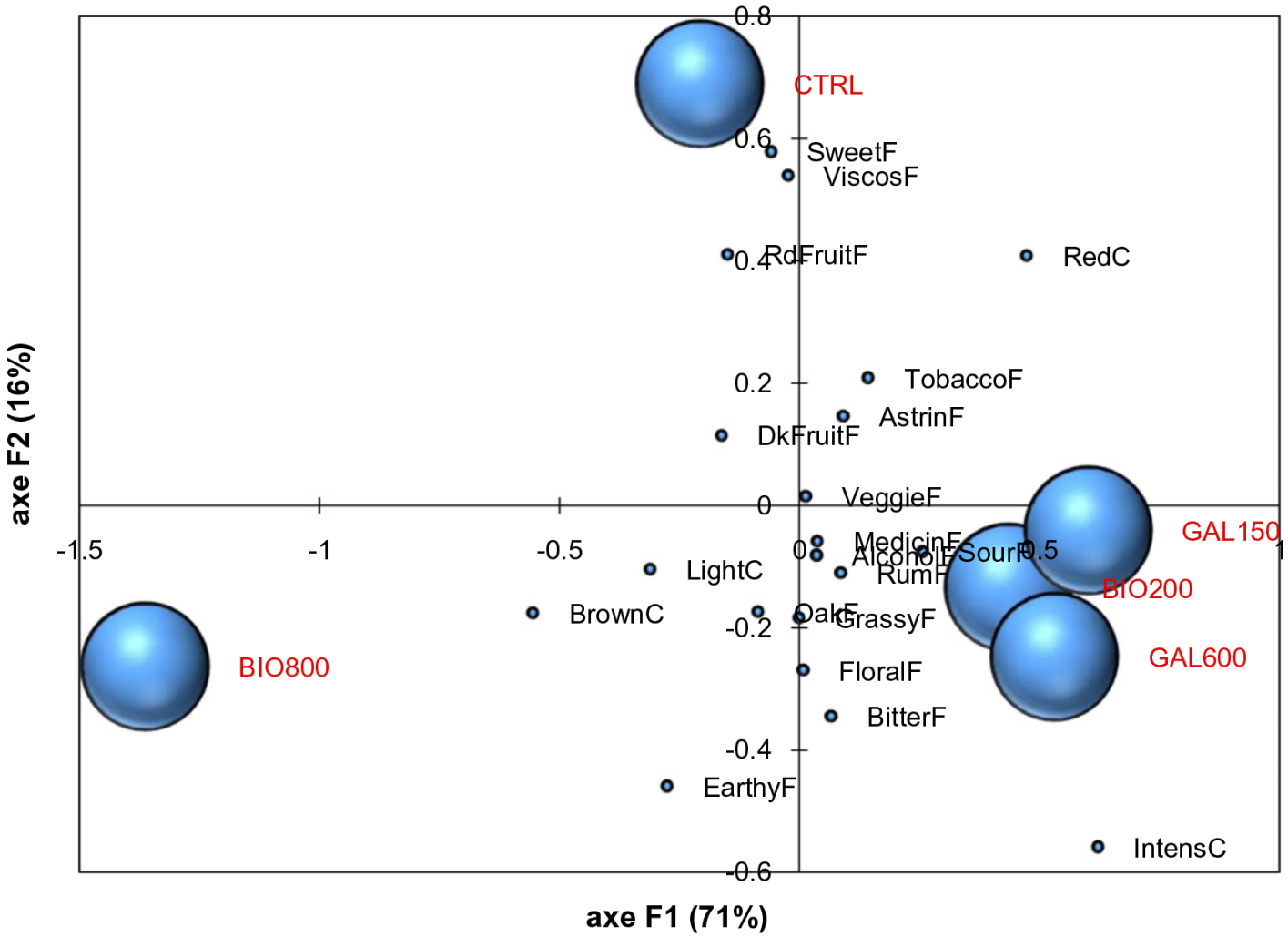


Fig. 4. Discriminant Analysis of the sensory data of the control wine (CTRL) and wines added with tannins (BIO200, BIO800, GAL150, GAL600).

Conclusions

- Significant Tannin, LPP and Total IRP impacts
- Sensory Evaluation
  - Tannin Addition Wines Characterized
  - Primarily Negative Attributes
    - Brown Color, Bitter Flavor and Earthy Aroma
      - BIOTAN 800 mg/L most Earthy
    - Bitterness Change consistent with greater Total IRP
  - Lower concentration additions had no detrimental impacts but small improvement in phenolics

Comments

- Purity Needs to Change
- Standard should be the same
  - Catechin Equivalents for Condensed Tannins
  - Gallic Acid for Hydrolysable Tannins
  - Use of Tannic Acid is confusing
    - Mixture of different compounds
- Legal Amount Allowable Needs to Change
- Many use tannins as flavorant
  - Tannins come with “friends”
  - Threshold for odorants ng/L, µg/L

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