WINE MOUTHEFEEL AND THE MOUTHEFEEL WHEEL

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WF101: Factors That Impact Wine Flavor and Mouthfeel

Introduction

- Tastes and tactile sensations
- Matrix influence on bitterness + astringency
- Phenol composition
- Sensory properties of phenolics
- Development of red wine mouthfeel wheel
- Use of RMFW
- Development of white wine mouthfeel wheel
Astringency Perception

- Astringency described as “roughing”, “drying” and “puckering"
- Tactile sensation
- Mechanism of astringency
  - Phenols bind with saliva proteins and precipitate
  - Stripping the mouth of lubrication “drying”
  - Texture effect of astringency could be due to precipitated complexes or those in solution
- Astringency is dynamic process
  - Changes during ingestion and expectoration

Matrix effects

- Astringency ↓ with increased EtOH
  - Impact on protein-tannin interactions
  - EtOH ↑ viscosity
- Bitterness ↑ with increased EtOH
- Astringency ↓ with polysaccharides and proteins
  - Binds with tannin
  - Polysaccharides ↑ viscosity
- Glycerol
  - Similar to polysaccharides ↑ viscosity

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**Matrix effects**

- **Astringency** increases with high acidity or high ionic strength (salt Na⁺)
  - Acid astringent in own right
  - Acid and salts reduce viscosity of saliva

- **Astringency** is roughly proportional to sugar content
  - Can be more difficult to perceive

- **Bitterness** decreases with increasing sugar


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**Variation within Tasters**

- **Different saliva flow rates**
  - Between people (gender, age)
  - Time of the day

- **Effect of variation in salivary flow rate on time-intensity scaling of bitterness and astringency**
  - **Low-flow**
    - Perceive max intensity later
    - More intense
    - Persistence longer

Oberholster (2008)
Astringency as a taste

- Average time-intensity curves for astringency in wine upon three successive ingestions: left 20s between ingestions; right 40s between ingestions. Sample uptake and swallowing are indicated by a star and arrow, respectively.

Guinard et. al., 1986

Wine non-volatiles: Phenolics

- Main phenols (flavonoids) in red wine
  - Anthocyanins responsible for red color
  - Flavonols in skins (copigmentation)
  - Hydroxycinnamic acids (skins/pulp)
  - Flavan-3-ols (ex. catechin, epicatechin, epigallocatechin, epicatechin gallate)
    - Oligomers and polymers of flavan-3-ols, so called proanthocyanidins (PA) or condensed tannins Fig.1

Anthocyanin
Proanthocyanidins

Phenols in wine

- Extraction during wine making
  - Anthocyanins from skins
    - Early during fermentation (3-5 days)
  - Hydroxycinnamic acids (skins/pulp)
  - Flavonols from the skins
  - Seed PA (mDP ~ 10), higher % galloylation
  - Skin PA (mDP ~ 30), also contain (epi)gallocatechin units
    - Increase extraction with temp, % EtOH
Sensory properties of phenols

- Tannins or proanthocyanidins
  - Main contributors to bitterness and astringency
  - Larger tannin more astringent and drying than smaller tannin
  - Ratio of astringency to bitterness increase with mDP


Bitterness and Astringency

- Monomers more bitter than astringent
- Ratio of astringency to bitterness ↑ with ↑ mDP

Sensory properties of phenols

- **Tannins or proanthocyanidins (PA)**
  - Main contributors to bitterness and astringency
  - Larger tannin more astringent and drying than smaller tannin
  - Ratio of astringency to bitterness increase with mDP
  - Seed tannin more astringent (coarse, dry) than skin tannin of equivalent size
  - Indicate – ‘coarseness’ and ‘dryness’ of astringency increase with galloylation


- Only above tetramer major contributor to astringency
- Hydroxycinnamic acids – astringent and bitter
- Flavonols – maybe bitter
- Ellagitannins – close to sensory threshold in wine
  - Small astringency contribution

Polymeric Phenols and Astringency

- During wine maturation and ageing
  - Anthocyanins and PA polymerise with each other by different mechanisms
  - Influenced by grape composition, presence of wood (hydrolyzable) tannins


Sensory properties of pigments

- Anthocyanins have no taste or mouthfeel
- How do you explain difference between white wine and red wine?
- New polymeric phenols/pigments – wine maturation
  - Methylmethine-bridged flavanols more bitter than similar tannins, lower astringency

Developing the Mouthfeel Wheel

- Panel of 14 tasters tasted 72 wines over 6 week period to derive a vocabulary
  - 6 months to 33 year old red wines (mean 4 yrs)
  - Mostly Australian Shiraz, Cab Sauv, Pinot noir, Grenache
- Another 75 red wines tasted to derive mouthfeel terms not astringent-like
  - Influence mouthfeel
- Investigate standards
  - Taste standards for astringency not practical

Standards for Mouthfeel

- Taste standards
  - Commercial tannins and other
    - Complex profiles
    - Tiring, influence subsequent perceptions
    - Carry-over effects
- Touch standards
  - Cutaneous sensations similar to those experienced in the mouth
- Terms not represented by physical standards – well defined

Mouthfeel Wheel


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Mouthfeel Wheel Astringency

Grouping | Distinguishing feature of the group
---|---
particulate | Feelings of particulate matter brushing against the surfaces of the mouth through the movement of the wine.
surface | Textures felt on mouth surfaces when the different surfaces come in contact with each other.
complex | A positive hedonic grouping consisting of an amalgam of pleasing astringency sensations, flavour and balanced acidity.
drying | Feelings of lack of lubrication or desiccation in the mouth.
dynamic | Sensations involving some form of mouth movement.
harsh | A negative hedonic grouping suggesting aspects of excessive unbalanced astringency, excessive roughness and/or bitterness.
sour | A negative hedonic grouping consisting of an astringent feel associated with excessive acidity and associated green flavour notes.

Touch Standards for Tactile Sensations

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Touch standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talc</td>
<td>Johnson baby powder</td>
</tr>
<tr>
<td>Satin</td>
<td>Satin cloth</td>
</tr>
<tr>
<td>Plaster</td>
<td>Gypsum powder</td>
</tr>
<tr>
<td>Chamois</td>
<td>Moistened chamois</td>
</tr>
<tr>
<td>Silk</td>
<td>High grade silk cloth</td>
</tr>
<tr>
<td>Velvet</td>
<td>Velvet felt in direction of the nap</td>
</tr>
<tr>
<td>Suede</td>
<td>Medium suede leather</td>
</tr>
<tr>
<td>Furry</td>
<td>Short velour cloth</td>
</tr>
<tr>
<td>Fine emery paper</td>
<td>1000 grade emery paper</td>
</tr>
<tr>
<td>Corduroy</td>
<td>Medium cord cloth</td>
</tr>
<tr>
<td>Abrasive</td>
<td>600 grade sandpaper</td>
</tr>
<tr>
<td>Hessian</td>
<td>Carpet backing</td>
</tr>
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Touch Standards for Tactile Sensations

Satin
Soft Suede (Chamois)
Silk
Suede
Velvet
Sandpaper
Corduroy
600 grade (Abrasive)
Burlap (Hessian)
### Definitions for Astringency Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>tannic</td>
<td>A reflex action of mouth surfaces being brought together and released in an attempt to lubricate mouth surfaces.</td>
</tr>
<tr>
<td>chewy</td>
<td>Gives the feeling that mouth movements (chewing) can displace the astringent sensation.</td>
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<tr>
<td>gummy</td>
<td>Distinct lack of slip between mouth surfaces resulting in the inability to easily move mouth surfaces across each other.</td>
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<tr>
<td>adhesive</td>
<td>The feeling that mouth surfaces are sticking or adhering to one another, yet can be pulled away from each other with slight pressure.</td>
</tr>
<tr>
<td>aggressive</td>
<td>Balance term indicating excessive astringency.</td>
</tr>
<tr>
<td>astringent</td>
<td>Excessive astringency of a strongly astringent nature.</td>
</tr>
<tr>
<td>soft</td>
<td>A light and finely textured astringency.</td>
</tr>
<tr>
<td>supple</td>
<td>Balance term indicating low to moderate astringency with an appropriate level of acidity and flavor concentration.</td>
</tr>
<tr>
<td>rich</td>
<td>High flavor concentration with balanced astringency.</td>
</tr>
<tr>
<td>Rudy</td>
<td>High flavor concentration with suppositories.</td>
</tr>
<tr>
<td>mouthfeel</td>
<td>Gives the impression of a moving film that adheres to mouth surfaces, and which falls from the mouth surfaces with time.</td>
</tr>
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### Non-astringent Mouthfeel Terms

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<tr>
<td>puckering</td>
<td>Drying with a background of alcohol bitterness.</td>
</tr>
<tr>
<td>green</td>
<td>Combined effect of excess acidity and astringency.</td>
</tr>
<tr>
<td>sappy</td>
<td>Astringency with high acid and slightly bitter. Reminiscent of the astringency elicited by chewing on a green grape stalk.</td>
</tr>
<tr>
<td>residual</td>
<td>Astringency elicited as if chewing on a piece of raw wood.</td>
</tr>
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Using the Mouthfeel Wheel (MFW)

- How do you explain changes in mouthfeel observed during aging?
  - Anthocyanins have no taste or tactile effect
  - Why is a white wine different to a red wine even when made similarly?
  - Could polymerization reactions explain changes in mouthfeel observed?
    - Formation of polymeric pigments?


Mouthfeel of different wine treatments

<table>
<thead>
<tr>
<th>W</th>
<th>WA</th>
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<th>WSA</th>
<th>WRS</th>
<th>RS</th>
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<tr>
<td>White free run juice</td>
<td>White free run juice + anth</td>
<td>White free run juice + white skins + seeds</td>
<td>White free run juice + white skins and seeds + anth</td>
<td>White free run juice + red skins and seeds</td>
<td>Red wine</td>
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Mouthfeel of different wine treatments

- **W**: white free run juice
- **WA**: white free run juice + anth
- **WS**: white free run juice + white skins and seeds
- **WRS**: white free run juice + red skins and seeds
- **RS**: red wine

Sensory properties of pigments

- DA of different ‘model wines’
  - Pol. Pigments add to astringency “dry”, “grippy”, “viscosity”, “fine emery”
- Using the MFW – small differences in phenol content could be related to mouthfeel differences
- But MFW is difficult to use – needs extensive training


Sensory properties of pigments according to non-MFW research

- Polymeric pigment fraction from wine
  - High molecular weight (HMW) less astringency
  - Incorporation of anthocyanins into polymers decrease astringency
  - Little impact of mDP and galloylation on astringency
  - These conclusions are based on “dry tannin” rating
  - Study can’t guarantee equal tannin conc – quantification methods not optimal
  - mDP of HMW fraction not known
  - Shown mDP decrease with wine aging

White Wine Mouthfeel Wheel

- White wine elicit wide range of taste and mouthfeel sensations
- Pickering et al. (2008) evaluated 136 wines
  - Table, sparkling, dessert and fortified white wines
  - Using hierarchical wheel structure
  - Developed definitions and reference standards
- Tool to aid training and communication between wine professionals
  - Help define influence of viticultural and enological variable on white wine quality
White Wine Mouthfeel Wheel

- Some major difference between the white and red mouthfeel wheel
  - Contains taste parameters
  - Avoided terms related to flavor even though observed retro-nasally
  - Inclusion of “time dimension” in the wheel
  - Descriptors are ordered clockwise starting at 12’ noon in approx order of perception and intensity perceived
  - RMFW has no intensity levels build in


White Wine Mouthfeel Wheel

- Discrete sensations
  - Surface smoothness terms have levels associated
  - Satin, silk and chamois are different levels of smoothness
  - Particulate terms are grouped under surface smoothness
Integrated sensations
- These products are associated with sparkling wines
- Seems body and weight related

Pressed foam, velvet, small marshmallow and large marshmallow

An overall sensation of smoothness, volume and depth. Pressed foam, velvet, small marshmallow and large marshmallow are listed in increasing order of volume and fullness.
White Wine Mouthfeel Wheel

- Usefulness of WMFW is still unknown
- Due to different WMFW and RMFW concepts
  - Using both wheels will be confusing
  - Too many complex or integrated terms which is not well defined
  - Both wheels can be adapted for personal use
  - Simplified and clarified further
Touch Standards

Satin
Soft Suede (Chamois)
Silk
Suede

Touch Standards for Tactile Sensations

Velvet
Sandpaper
Fury
Burlap (Hessian)

600-grade Abrasive
# Mouthfeel Standards and Definitions

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**Images:**
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- **Soft Suede (Chamois)**
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- **Burlap (Hessian)**