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

Oberholster (2008)
Influences on Astringency + Bitterness

- Ethanol %
  - Decrease astringency perception
  - Increase bitterness perception

- Sugar content
  - Decrease bitterness
  - No influence on astringency, but more difficult to perceive

- Other wine compounds such as acid have astringent sub-qualities themselves
Variation within Tasters

- 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)
• 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
Phenolics: Main Contributors to Astringency and Bitterness

• Main phenols (flavonoids) in red wine
  – Anthocyanins responsible for red color
  – Flavan-3-ols (ex. catechin, epicatechin)
    • Oligomers and polymers of flavan-3-ols, so called proanthocyanidins (PA) or condensed tannins Fig 1

• Extraction during wine making
  – Seed PA (mDP ~ 10)
  – Skin PA (mDP ~ 30)
  – Anthocyanins from skins
Sensory Properties of Flavanols

- Monomers more bitter than astringent

- Ratio of astringency to bitterness ↑ with ↑ mDP

Polymeric Phenols and Astringency

- Sensory properties of proanthocyanidins (PA)
  - Main contributors to bitterness and astringency
  - Ratio of astringency to bitterness increase with mDP
- During wine maturation and ageing
  - Anthocyanins and PA polymerise with each other by different mechanisms
  - Influenced by grape composition, presence of wood (hydrolyzable) tannins

Wine pigments

Flavan 3-ol-ethyl-anthocyanin

Flavanylpyranoanthocyanin

Flavanyl-vinyl-pyranoanthocyanin

Direct condensation

Chemical and sensory properties of red wine pigments

- Characterization of polymeric pigments
  - Comparing the polymeric pigment profile of 6 month old and 5 year old Syrah wine from the same vineyard
    - ↑ conc. of polymeric pigments, methylmethine and vinyl-linked pigments
    - mDP of wine 4 → 10
  - Development of the mouth-feel wheel

Oberholster (2008)
Developing the mouth-feel 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, Grenach
- Another 75 red wines tasted to derive mouth-feel terms not astringent-like
  - Influence mouth-feel
- Investigate standards
  - Taste standards for astringency not practical

Oberholster (2008)
Standards for Mouth-feel

• 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

Oberholster (2008)
## Mouth-feel Wheel Astringency

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

## Touch Standards Representing 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>
</tbody>
</table>
Touch Standards Representing Tactile Sensations

- Satin
- Soft Suede (Chamois)
- Silk
- Suede Velvet
- Sandpaper 1000 grade
- Fur (Furry)
- Corduroy
- Burlap (Hessian)
- Sandpaper 600 grade (Abrasive)
## Supplementary Definitions for Astringency Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>pucker</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>
</tr>
<tr>
<td>grippy</td>
<td>Distinct lack of slip between mouth surfaces resulting in the inability to easily move mouth surfaces across each other.</td>
</tr>
<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>hard</td>
<td>Combined effect of bitterness and astringency. Synonym 'harsh'.</td>
</tr>
<tr>
<td>aggressive</td>
<td>Balance term indicating excessive astringency.</td>
</tr>
<tr>
<td>abrasive</td>
<td>Excessive astringency of a strongly roughing 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 flavour concentration.</td>
</tr>
<tr>
<td>rich</td>
<td>High flavour concentration with balanced astringency.</td>
</tr>
<tr>
<td>fleshy</td>
<td>High flavour concentration with suppleness.</td>
</tr>
<tr>
<td>mouthcoat</td>
<td>Gives the impression of a coating film that adheres to mouth surfaces, and which falls from the mouth surfaces with time.</td>
</tr>
</tbody>
</table>

### Diagram

- A diagram illustrating various terms related to astringency, including 'parched', 'green', 'sappy', and 'resinous'.

<table>
<thead>
<tr>
<th>Term</th>
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<tbody>
<tr>
<td>parching</td>
<td>Drying with a background of alcohol hotness.</td>
</tr>
<tr>
<td>green</td>
<td>Astringency with 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>resinous</td>
<td>Astringency elicited as if chewing on a piece of raw wood.</td>
</tr>
</tbody>
</table>
### Non-astringent Mouth-feel Terms

<table>
<thead>
<tr>
<th>Terms</th>
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<tbody>
<tr>
<td><strong>hot</strong></td>
<td>A high degree of warmth.</td>
</tr>
<tr>
<td><strong>chill</strong></td>
<td>Hotness with a light chilli-like irritation.</td>
</tr>
<tr>
<td><strong>pepper</strong></td>
<td>Hotness with a black pepper-like irritation.</td>
</tr>
<tr>
<td><strong>tingle</strong></td>
<td>Irritation typified by mouth exposure to sherbet.</td>
</tr>
<tr>
<td><strong>prickle</strong></td>
<td>A coarse irritation typified by exposure to acetic acid.</td>
</tr>
<tr>
<td><strong>spritz</strong></td>
<td>An irritation typified by exposure to dissolved carbon dioxide.</td>
</tr>
<tr>
<td><strong>steely</strong></td>
<td>Sensation as if the mouth/tongue has contacted a stainless steel object.</td>
</tr>
<tr>
<td><strong>metallic</strong></td>
<td>Sensation of tasting a metal object. A low level of galvanic or electrical sensation.</td>
</tr>
<tr>
<td><strong>watery</strong></td>
<td>Low in body, viscosity and flavour.</td>
</tr>
<tr>
<td><strong>thin</strong></td>
<td>Low in body and flavour.</td>
</tr>
<tr>
<td><strong>full</strong></td>
<td>A feeling of a force pressing against the mouth surfaces and tongue.</td>
</tr>
<tr>
<td><strong>viscous</strong></td>
<td>An apparent thickness resulting in pressure required to move the wine around the mouth.</td>
</tr>
<tr>
<td><strong>syrup</strong></td>
<td>A high degree of viscosity.</td>
</tr>
<tr>
<td><strong>creamy</strong></td>
<td>A soft feel on the surfaces of the mouth, not unlike the feel of residual cream.</td>
</tr>
<tr>
<td><strong>warm</strong></td>
<td>Warming effect of the mouth surfaces primarily due to alcohol.</td>
</tr>
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</table>
• Vidal (2003, 2004) fractionated tannins from grape material – evaluate with MFW
  – Larger tannin more astringent and drying than smaller tannin
  – Seed tannin more astringent (coarse, drying) than skin tannin of equivalent size
  – Indicate → ‘Coarseness’ and ‘dryness’ of astringency increase with galloylation
  – Methylmethine-bridged flavanols more bitter than similar tannins

Using the Mouth-feel Wheel (MFW)

- Anthocyanins have no taste or tactile effect (*Singleton and Trousdale, 1992*)
- Anthocyanins ↑ perceived astringency and “fullness” of model wine (*Vidal et al., 2004b*)
- Anthocyanins – more pure – no significant contribution to mouth-feel (*Vidal et al., 2004a*)
- How do you explain differences between white wine and red wine?
Using the Mouth-feel Wheel (MFW)

• How do you explain changes in mouth-feel observed during aging?
  – Could polymerization reactions explain changes in mouth-feel observed?
  – Increase mDP proanthocyanidins $\uparrow$ astringency
  – Formation of polymeric pigments?

Singleton and Trousdale (1992) AJEV 43, 63-70
Vidal et al. (2004a) Food Qual. Pref. 15, 209-217
Vidat et al. (2004b) Food Chem. 85, 519-525
Mouth-feel of different white wine treatments

W: White free run juice
WA: White free run juice + anthocyanins
WS: White free run juice + white skins + seeds
WSA: White free run juice + white skins and seeds + anthocyanins
WRS: White free run juice + red skins and seeds
RS: Red wine

Mouth-feel Wheel

- Fine grain (Talcum powder)
- Medium grain (Bentonite)
- Coarse grain (Celite S45 filter aid)

Mouth-feel of different white wine treatments

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

• Using the MFW – small differences in phenol content could be related to mouth-feel differences
  – Anth increases astringency related terms, mainly fine grain sub-attributes
• But MFW is difficult to use – needs extensive training
• Doubt wine consumers will be able to use this wheel to communicate in meaningful way
Thank you

• Funding (GWRDC)
• Mouth-feel panel

Elizabeth Waters  Karen Block
Graham Jones  Linda Bisson
Patrick Iland  Lucy Joseph
Leigh Francis  Kay Bogart
Richard Gawel
Touch Standards Representing Tactile Sensations

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### Fabric Samples

- **Satin**
- **Soft Suede (Chamois)**
- **Silk**
- **Suede**
- **Velvet**
- **Sandpaper 1000 grade**
- **Fur (Furry)**
<table>
<thead>
<tr>
<th>Glass 1: Control</th>
<th>Glass 2: Control + 1.5 g/L V.R. Supra</th>
<th>Glass 2: Control + 1.5 g/L Biotan</th>
<th>Sphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powder → Fine Suede → Furry Emery → Furry Dry (Low) Adhesive (Low)</td>
<td>Plaster → Fine Suede → Fine Emery (High) Drying (High) Grippy (High)</td>
<td>Plaster → Fine Suede → Fine Emery (Very High) Drying (Very High) Grippy (Very High)</td>
<td></td>
</tr>
</tbody>
</table>