Understanding wine astringency sub-qualities by tribology – what is the role of saliva?

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What is astringency?

Think of your daily experience when taking a sip of black tea or red wine. Your mouth dries up with the feelings of Pucker, Drying or Rough. The changes in oral sensations could be caused by astringency, which is a complex of sensations due to shrinkage, drawing or puckering of the epithelium as a result of exposure to substances such as alums or tannins.

Astringency can be perceived in many foods and is usually characterised as the ‘backbone’ of food texture.

Examples of foods that induce astringency sensations

Astringency in wine

For wine, a balanced level of astringency is the requisite of high-quality wines; when in excess the astringency detracts from other components; while with too little, the wines may taste flat, insipid and uninteresting. Important contributors of wine astringency include:

- Tannin quantity and quality (concentration, degree of polymerisation, anthocyanin-tannin ratio, configuration, etc.)
- Wine matrix (acidity, polysaccharide, alcohol strength, etc.)

Various combinations of these factors shape the type of wine astringency perceived (termed astringency sub-qualities). Wine mouthfeel wheels have been developed to help tasters pick up these subtle sensory differences.

Measuring wine astringency

Sensory evaluations
- Straightforward, able to discern astringency sub-qualities
- Expensive
- Panel fatigue (build-up effect)
- Individual variation

Chemical assessments
- Tannin spectrophotometry: protein precipitation methods
- Unable to consider all the astringency contributors in the whole wine matrix
- Unable to explain astringency sub-qualities

Physical measures
The oral tribology is a physical measure simulating the development of astringency in mouth. This technique simultaneously considers all astringent stimuli and their interactions in a complex wine matrix.

In-mouth lubrication system (a) and tribometer lubrication system (b). (1) Tribometer monitors the friction change when the property of lubricant (saliva) is altered.

Experiments and results

Research aim: To develop appropriate tribological techniques, which consider salivary interactions, that allow the drivers for different wine astringency sub-qualities to be determined.

Study I: A model wine system with defined levels of tannin, pH and polysaccharide.

Mouthfeel profiling of red wine with modified matrix compositions

- Higher tannin → Higher Drying/Grippy/Rough
- Higher friction & sluggish lubricating speed of saliva + wine mixture
- Higher mannoprotein → Lower Drying/Grippy/Rough
- Lower dynamic friction coefficient of saliva + wine mixture
- Higher ethanolactility → Higher Pucker → Higher rate-of-increase of friction on salivary pellicle flushed by wine

Physically measured viscosity and sensorily perceived Fullness/Smoothness

Principle component analysis (a) and correlation matrix (b). Drying/Grippy/Rough mouthfeel sensations linking with instrumental measurements Yε, ε. A are parameters from modelled friction curves (μ = Yε + A·ε)

Conclusions

- Wine astringency sub-qualities can be driven by different matrix components.
- Linkages and independence exist among different sub-qualities.
- Saliva plays different roles in astringency sub-quality perception. High tannin resulting in poor lubricity of saliva + wine mixture is found to be a driver of Drying/Grippy/Rough.
- High acidity and high ethanol accelerate the collapse of salivary pellicle, which drive Pucker.
- Mannoprotein can reduce astringency by facilitating the lubrication of saliva + wine mixture.
- Sensorily perceived Fullness/Smoothness does not line up with physically measured wine viscosity. Saliva’s potential role in reshaping wine Fullness/Smoothness may need to be reconsidered.

References