Enhancing the Mouthfeel of De-alcoholised Wine: Sensory Interactions and Additive Strategies

Ineke Herholdt
Supervisor: Dr Jeanne Brand
Co-supervisor: Prof. Wessel du Toit

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SOUTH AFRICA WINE
discover diversity in a glass

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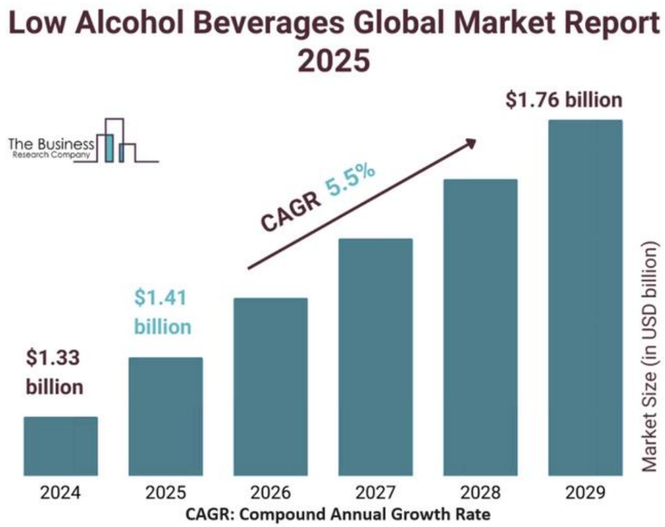
Growing demand for De-alcoholised Wine

- Global interest in low/no-alcohol beverages is rapidly increasing.
- Projected market growth (CAGR: 5.5%, reaching $1.76 billion by 2029).
- Driven by consumer trends:
  - Health and wellness
  - Moderation and mindful drinking
  - Expanding product availability and variety

What is De-alcoholised Wine?

- Wine with alcohol content significantly reduced (<0.5% ABV), aiming to preserve key sensory characteristics.

<0.5% Alcohol



Methods for Alcohol Reduction in Wine

Membrane-based Techniques:

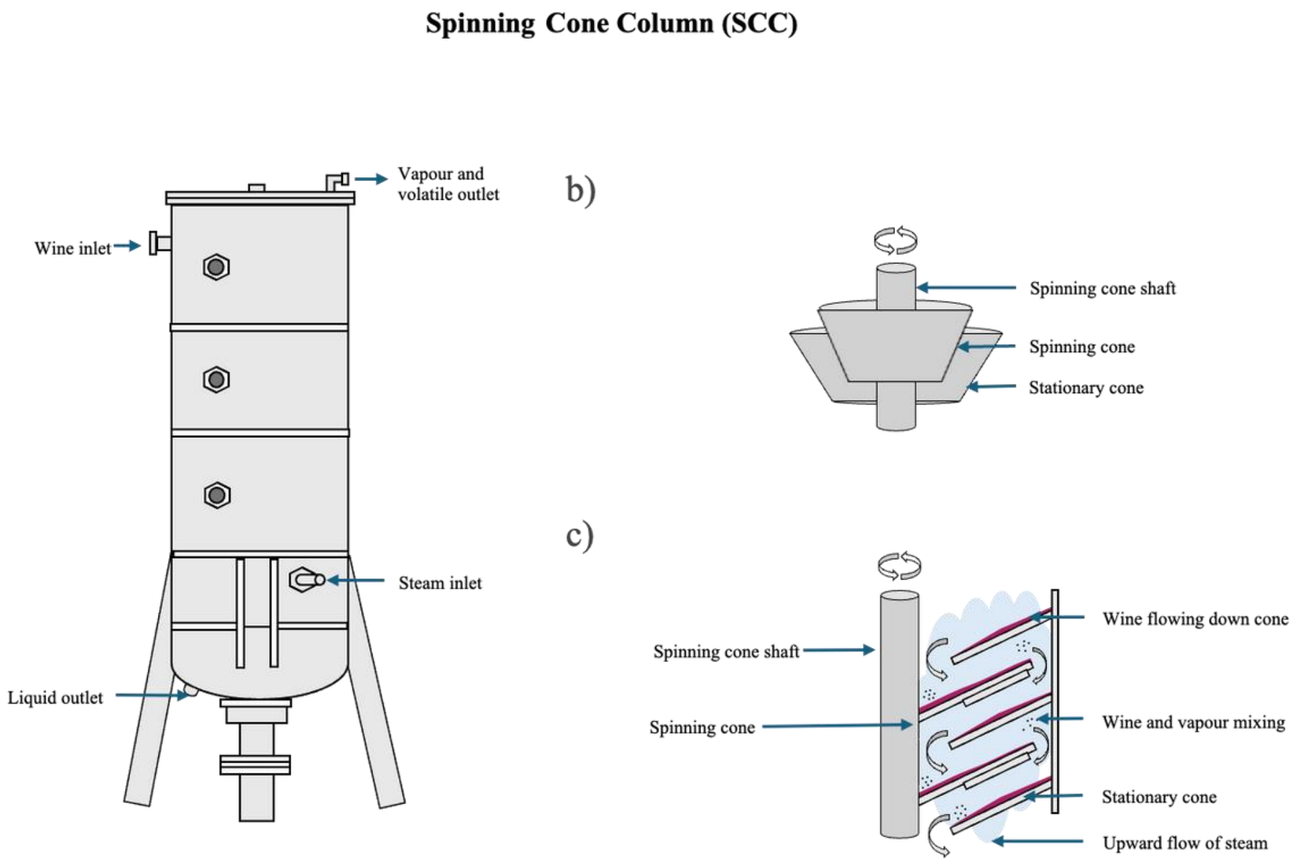
- Reverse Osmosis
- Pervaporation
- Osmotic Distillation

Thermal-based Techniques:

- Vacuum Distillation
- *Spinning Cone Column (SCC)*

Advantages of SCC:

- Gentle operating conditions (Low-temp, vacuum, rapid processing)
- Highly scalable, suitable for commercial volumes
- Selective and precise alcohol removal
- Robust, low maintenance



Sensory Challenges of De-alcoholised Wine

Sensory Challenges:

- **Reduced Mouthfeel:** Loss of alcohol-induced viscosity and fullness.
- **Altered Balance:** Increased perceived acidity and bitterness.
- **Loss of Complexity:** Simplified sensory profile, reduced consumer satisfaction.

Why is Mouthfeel Important?

- Crucial to consumer acceptance
- Influences perception of overall wine quality

How Can We Overcome These Sensory Challenges?

Oenological additives can be used to compensate for the loss of ethanol and improve sweetness, body, and balance.

- **Crystal grape must:** increases sweetness and suppresses acidity perception
- **Mannoproteins:** reduces astringency and increases body and smoothness
- **Arabic gum:** increases viscosity and reduces perceived astringency
- **Glycerol:** increases viscosity, sweetness, and body
- **Tannins:** enhances body and length, adds complexity

Objective 1

Experiment 1: Role of glycerol in de-alcoholised wine

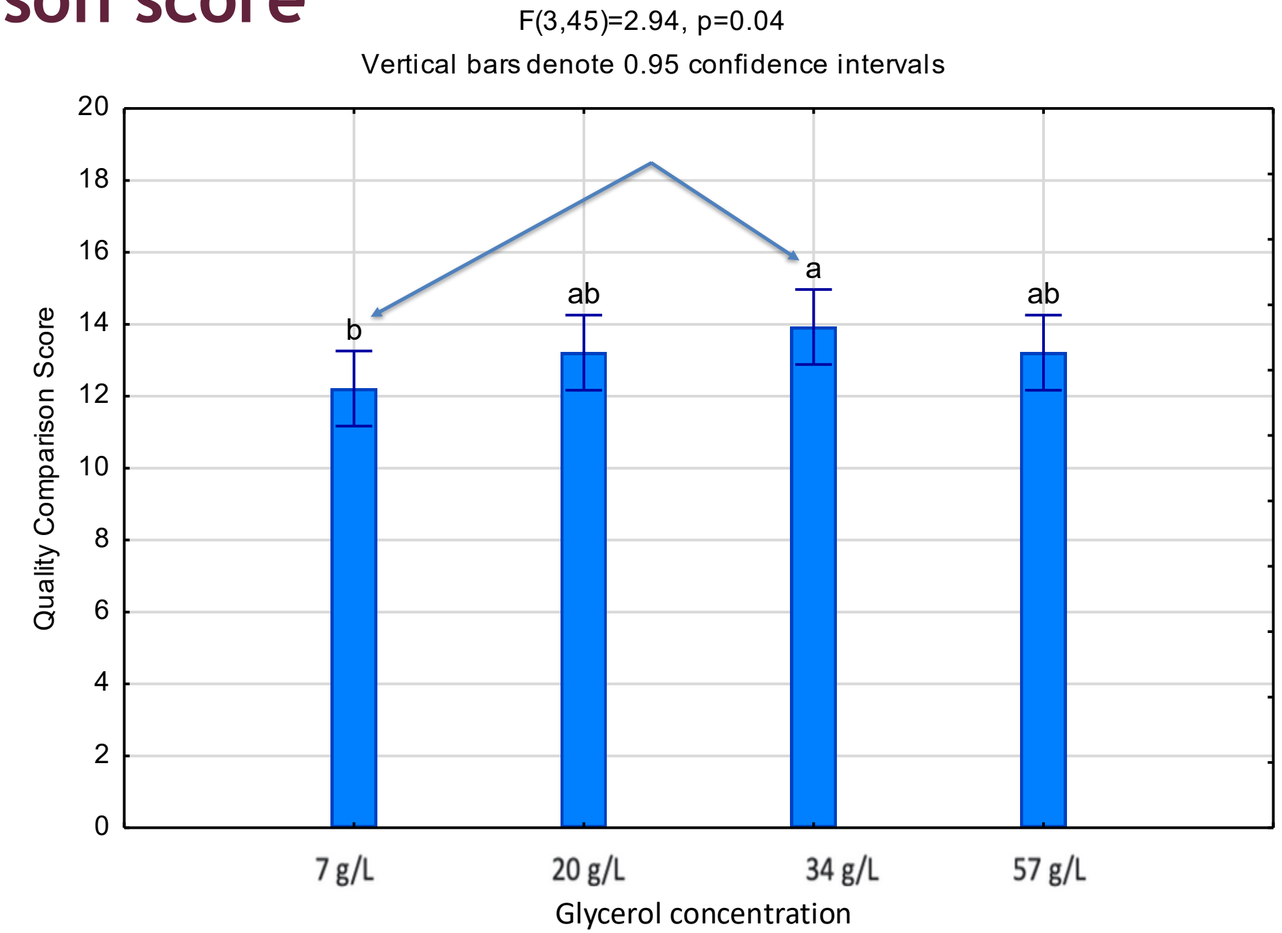
- 2024 Sauvignon blanc

- Treatments:
  - 7, 20 , 34 and 57 g/L glycerol concentrations (7 g/L control)
  - (0, 1%, 2% and 4% v/v additions)

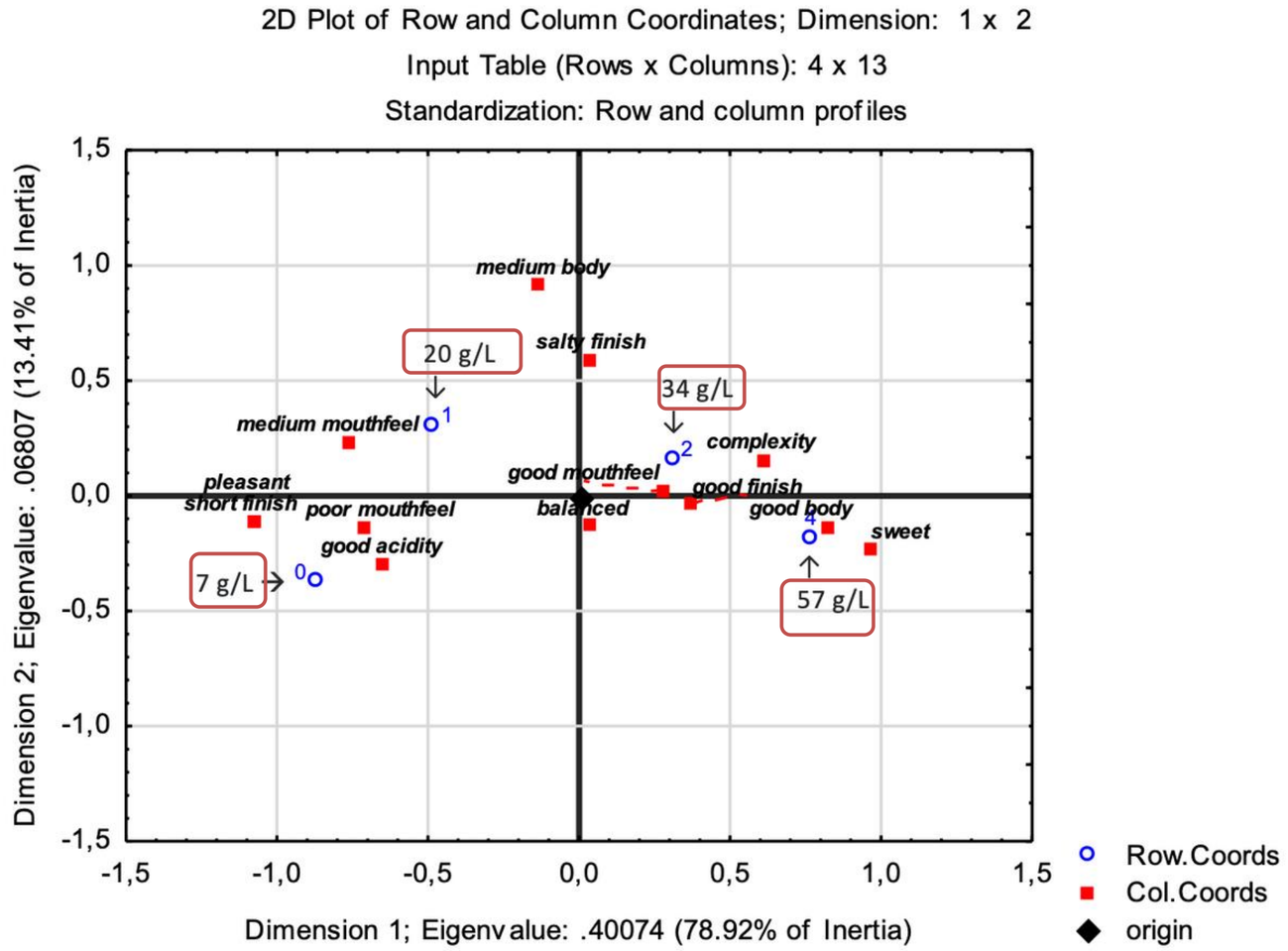
- Quality: 20-point scale
- Free description on taste and mouthfeel
- A panel of 16 wine industry professionals

Results

Quality comparison score



Correspondence Analysis for mouthfeel attributes and glycerol addition



Objective 1

Experiment 2: Impact of additives on mouthfeel

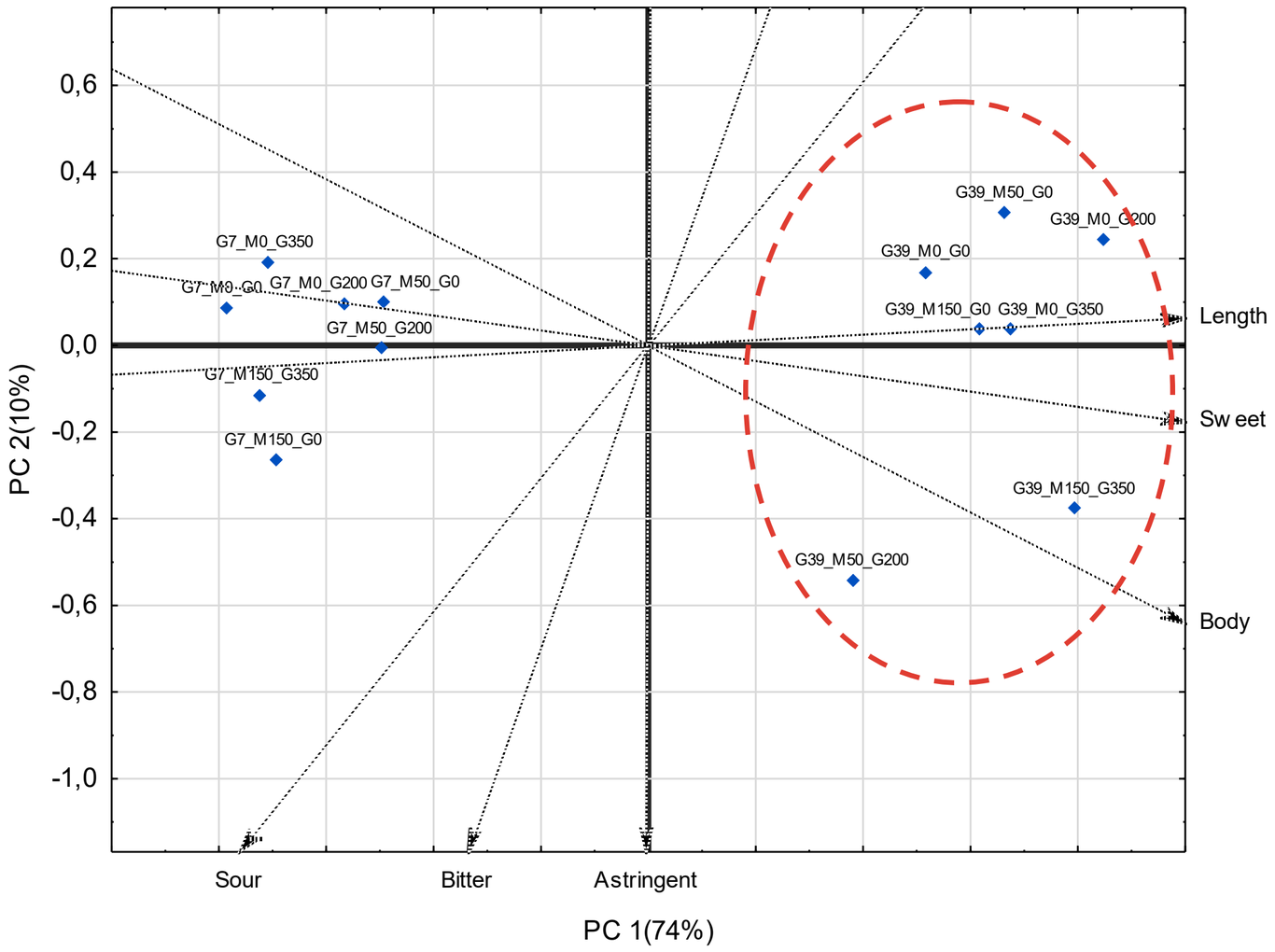
- 2024 de-alcoholised Chenin blanc (30 g/L Sugar)
- 2024 de-alcoholised Shiraz (30 g/L Sugar)

Treatments:

- 0 and 2% by volume glycerol additions
- Mannoproteins: 0, 50 and 150 mL/hL
- Gum Arabic: 0, 200 and 350 mL/hL

- RATA for 7 mouthfeel attributes using a 5-point scale
- 1= very low; 2= low; 3= medium; 4=high; 5= very high
- 15 Industry professionals

PCA plot for de-alcoholised Chenin blanc 2024



Glycerol Sensory Effects:

↑ Sweetness	↓ Sour
↑ Length	↓ Bitter
↑ Body	↓ Astringent

p<0.05: sweet, body, length

p>0.05: sour, bitter, astringent, balance

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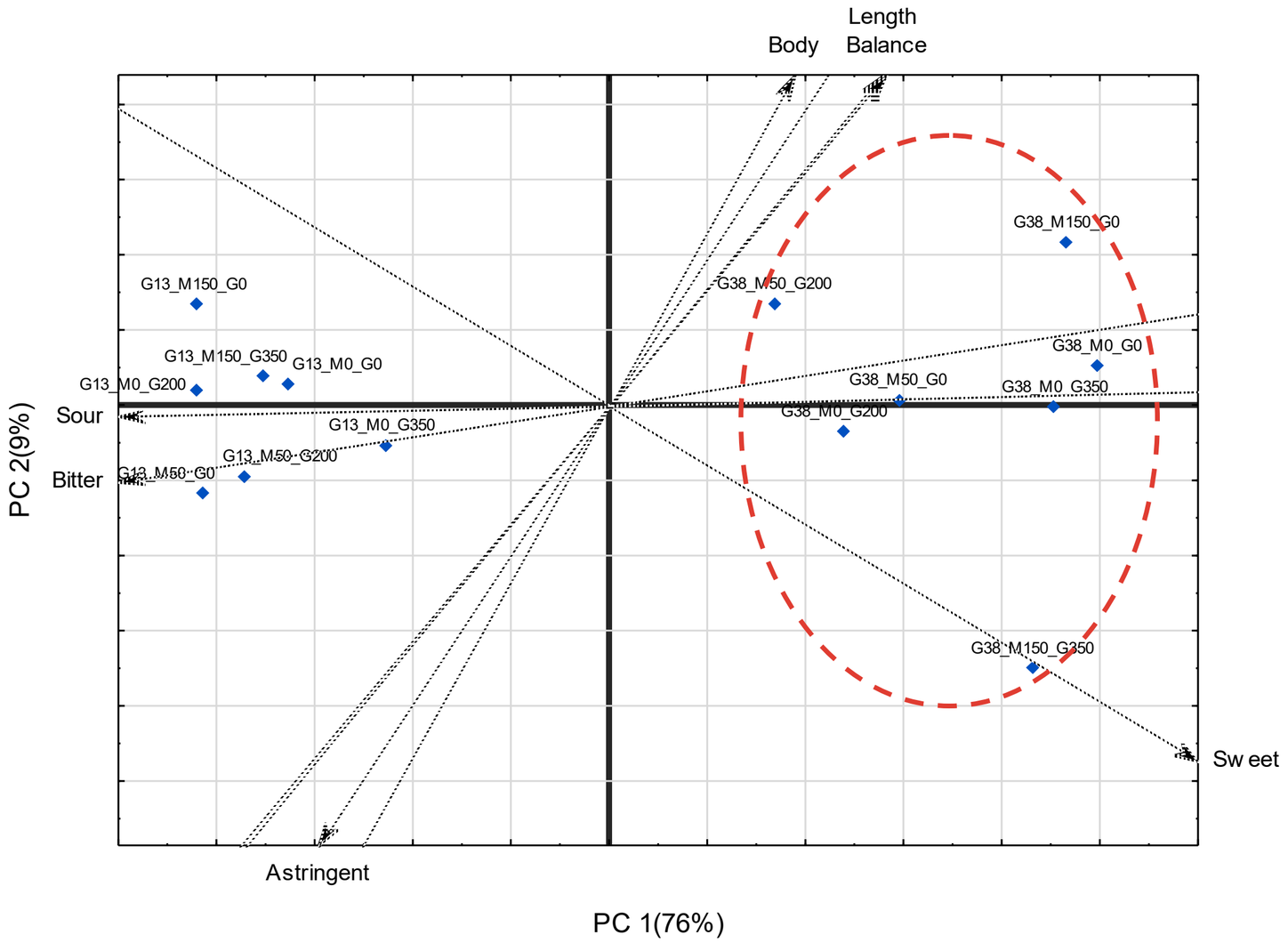
PCA plot for de-alcoholised Shiraz 2024



Glycerol Sensory Effects:

↑ Sweetness	↓ Sour
↑ Length	↓ Bitter
↑ Body	↓ Astringent
↑ Balance	

p<0.05: sweet, sour, bitter, body, balance

p>0.05: astringency, length

- Glycerol had a bigger effects compared to mannoproteins and gum arabic

Objective 1

Experiment 3: Central composite design

- 2024 Chenin blanc
- 2024 Shiraz

CCD analytes:

1. **Crystal grape must:** 15 and 30g/L
2. **Mannoproteins:** 0, 50 and 150 mL/hL
3. **Gum Arabic:** 0, 200 and 350 mL/hL
4. **Tannins:** 1.5g/hL and 5g/hL

- RATA for 7 mouthfeel attributes using a 5-point scale a overall 20-point quality score
- 15 Industry professionals

Results
Chenin Blanc Sensory Interactions and Additive Strategies

Sweetness	Astringency	Wine-like character
↑ Crystal grape must	↑ Tannins	↑ Crystal grape must
↑ Mannoproteins	↓ Crystal grape must	↑ Mannoproteins
	↓ Mannoproteins	↓ Tannins
	↓ Gum Arabic	

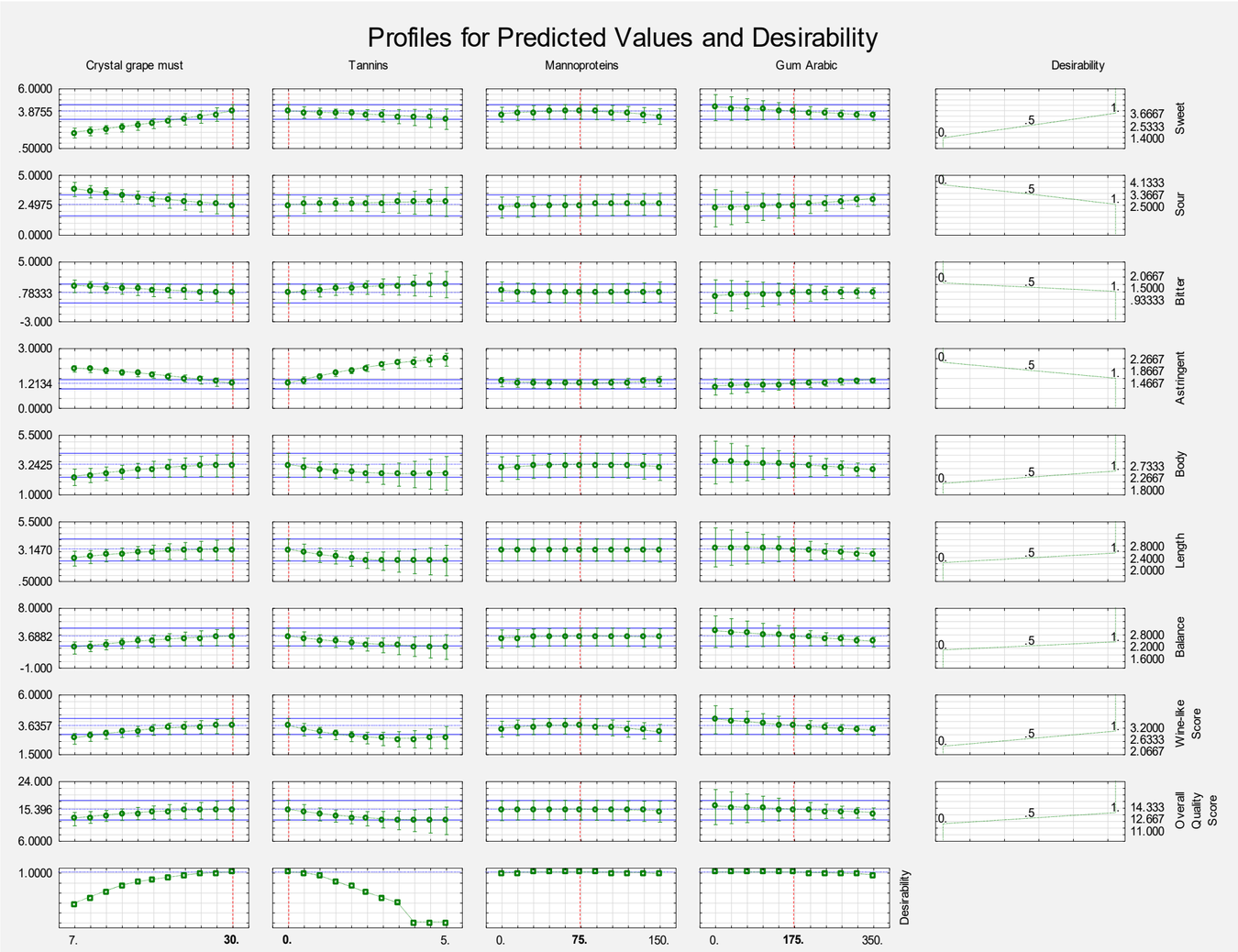
- Across all evaluated sensory attributes, only sweetness, astringent, and wine-like attributes exhibited significant effects ($p<0.05$)
- Crystal grape must, mannoproteins, and tannins showing significant interaction effects.

Overall desirability plot for de-alcoholised Chenin Blanc

- Maximising sweet, body, length, balance, wine-like, and overall quality
- Minimising bitter, astringent, and sour attributes

It was observed that the combination of these additives enhanced the mouthfeel of de-alcoholised Chenin Blanc:

- ***30 g/L*** crystal grape must
- ***75 mL/hL mannoproteins***
- ***175 mL/hL*** gum arabic
- No tannins



Results
Shiraz Sensory Interactions and Additive Strategies

Sweetness	Bitterness	Astringency
↑ Crystal grape must	↑ Tannins	↑ Tannins
	↓ Crystal grape must	↓ Crystal grape must
	↓ Gum Arabic	

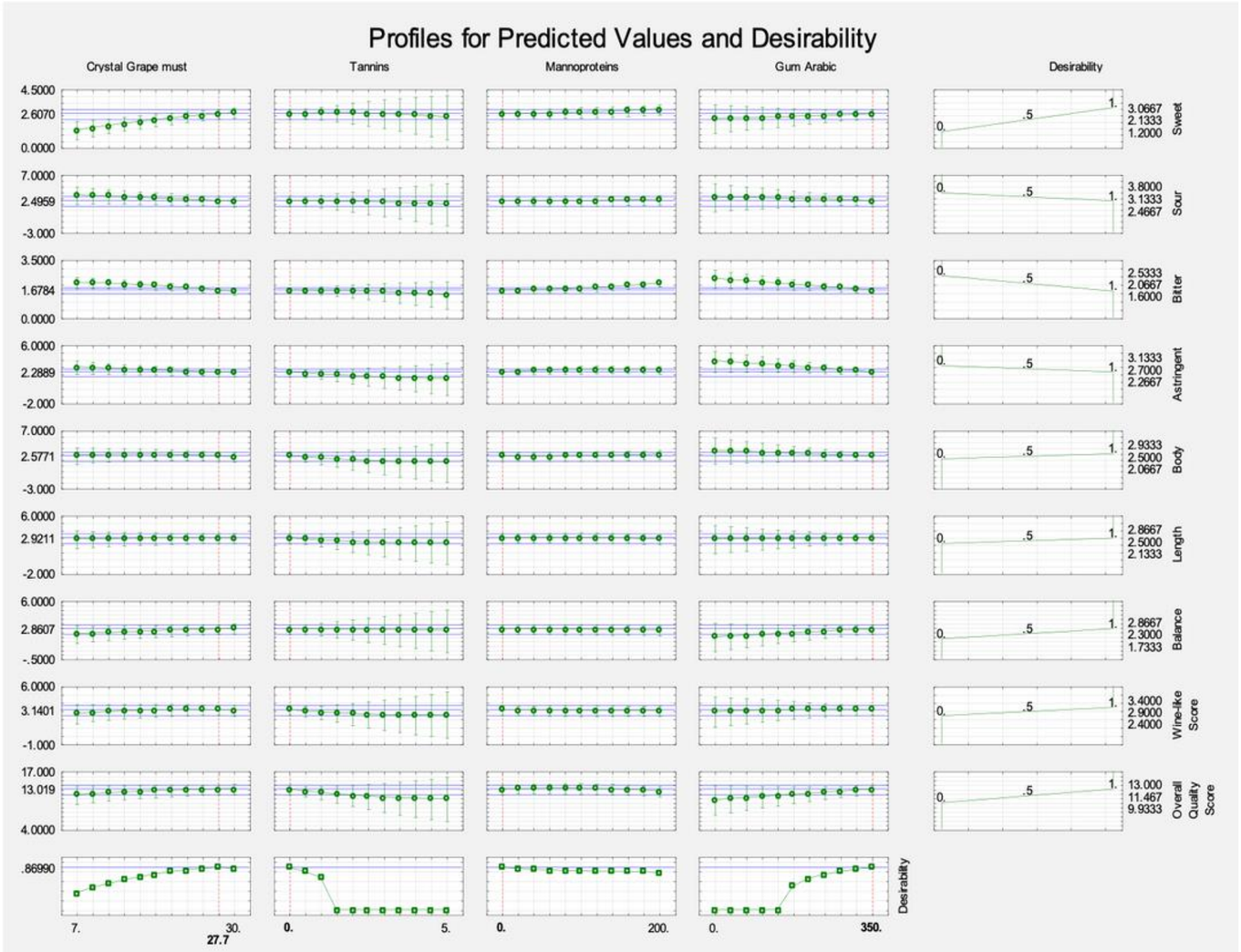
- Main effect observed with crystal grape must ($p<0.05$)
- Sweetness increases with increasing crystal grape must concentration
- Bitterness is modulated by crystal grape must and gum arabic
- Overall negligible effect of mannoproteins

Overall desirability plot for de-alcoholised Shiraz

- Maximising sweet, body, length, balance, wine-like, and overall quality
- Minimising bitter, astringent, and sour attributes

It was observed that the combination of these additives enhanced the mouthfeel of de-alcoholised Shiraz:

- ***27.7 g/L*** crystal grape must
- ***350 mL/hL*** gum arabic
- No mannoproteins
- No tannins



Conclusions

- Glycerol plays a significant effect in the sensory profile of de-alcoholised wine
- Maximum dosages of crystal grape must, and moderate gum arabic and mannoprotein additions enhanced the mouthfeel of de-alc Chenin Blanc
- Maximum dosages of crystal grape must and gum arabic enhanced the mouthfeel of de-alc Shiraz
- Overall, tannin addition had a negative contribution on the sensory profile of both wines

Limitations

- Panel composition bias
- Limited wine and additive diversity in mouthfeel trials
- We encourage producers to do own trials

Acknowledgements

- South Africa Wine
- BevZero
- Dr. Jeanne Brand
- Prof Wessel du Toit
- Helene Nuiwehoudt
- Producers and industry experts

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BEVZERO

SAGWRI South African Grape and Wine Research Institute

Thank you
Enkosi
Dankie

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Photo by Stefan Els

Results

Trial 3: Can glycerol be used as a sugar substitute?

- 2025 Shiraz (30 g/L Sugar)
- pH of 3.68 and TA of 6.44 g/L

Treatments:

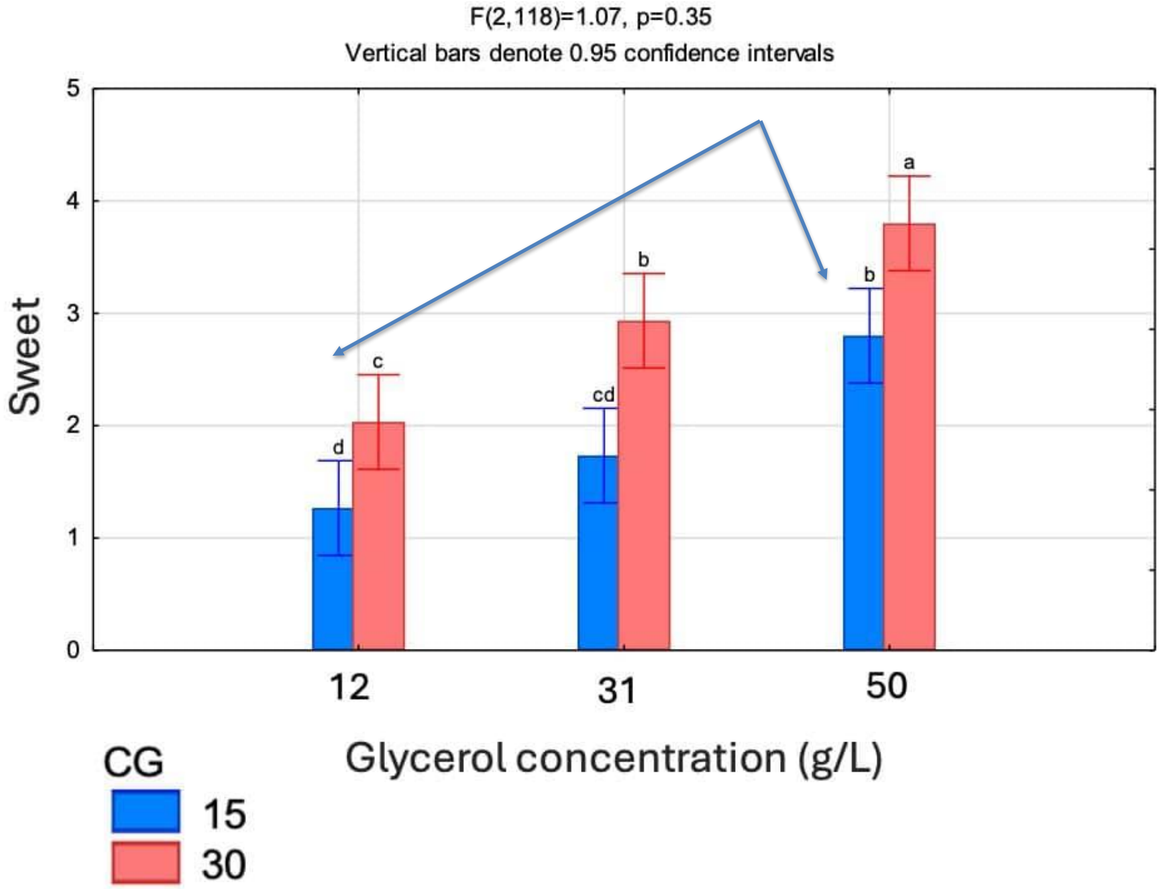
1. **Crystal grape must:** 15 and 30g/L
2. **Glycerol:** 11, 28 and 45 g/L

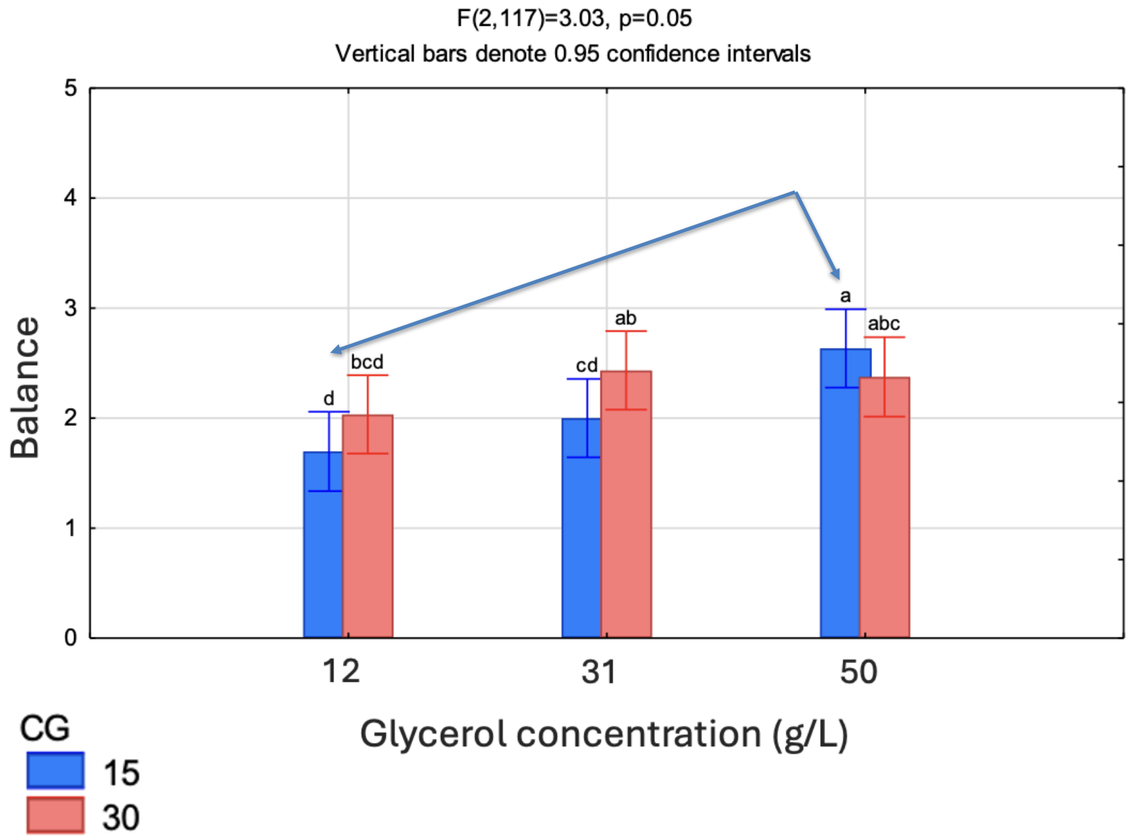
Sensory Evaluation

- RATA using a 5-point line scale for 7 mouthfeel attributes and overall 20-point quality score
- 15 Industry professionals

How can we reduce the sugar content of de-alcoholised wine?

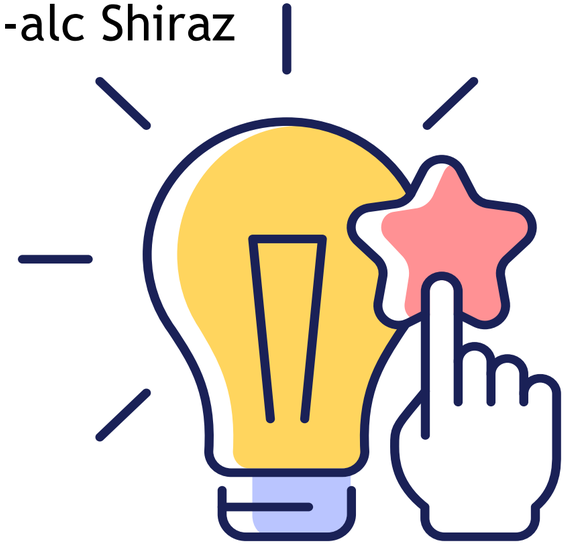
Results: Can glycerol be used as a sugar substitute?





Conclusions

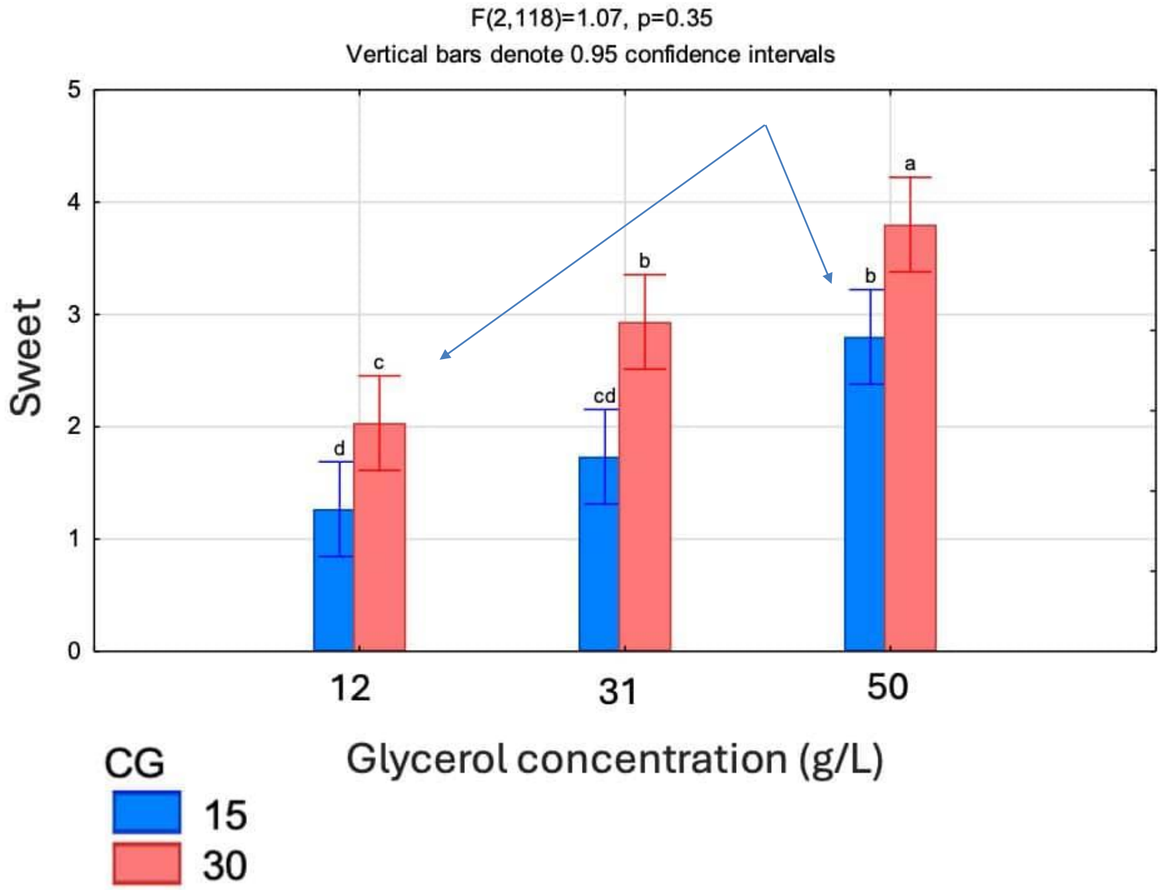
- Glycerol plays a significant effect in the sensory profile of de-alcoholised wine
- Maximum dosages of crystal grape must, and moderate gum arabic and mannoprotein additions can enhance the mouthfeel of de-alc Chenin Blanc
- Maximum dosages of crystal grape must and gum arabic can enhance the mouthfeel of de-alc Shiraz
- Overall, tannins had a negative contribution on the sensory profile of both wines
- Glycerol can increase sweetness and balance at lower sugar concentrations in de-alc Shiraz

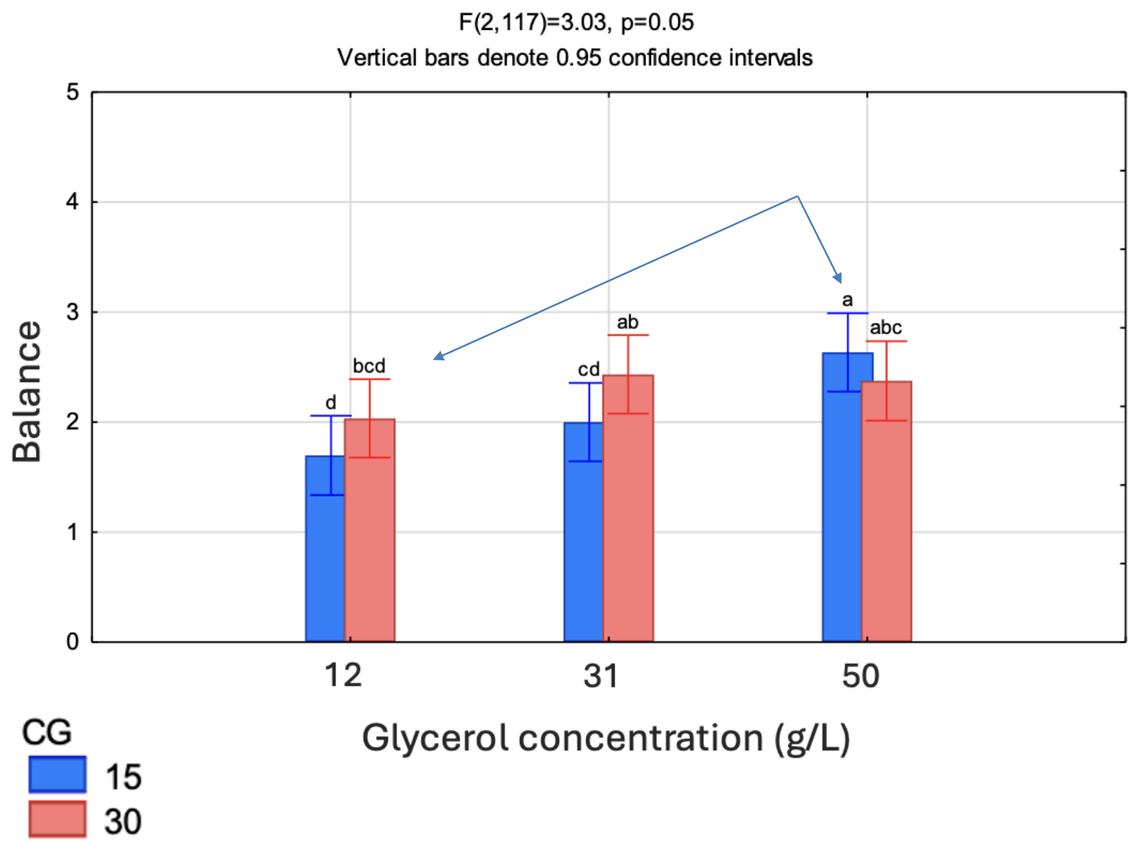


Limitations

- Panel composition bias
- Limited wine and additive diversity in mouthfeel trials
- We encourage producers to do own trials

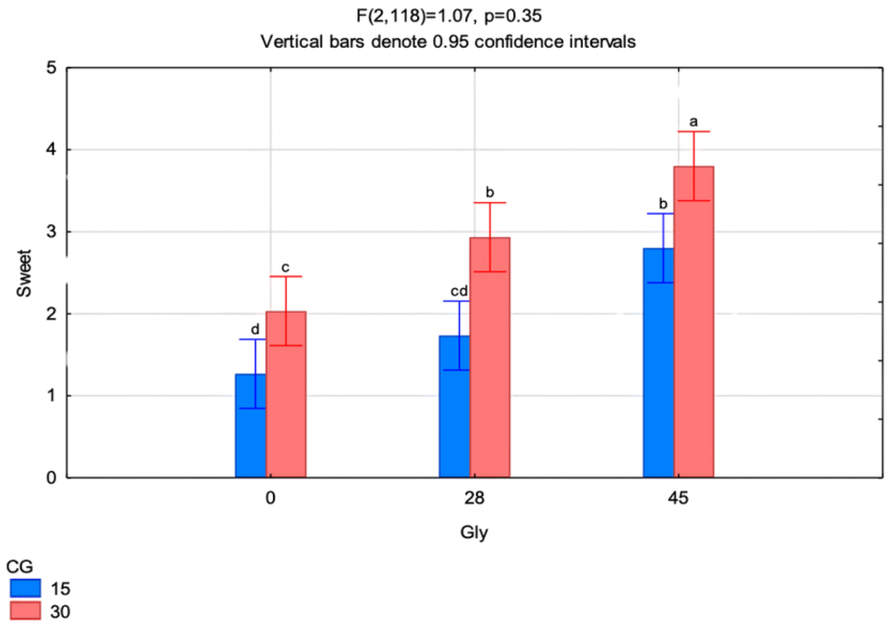
Results: Can glycerol be used as a sugar substitute?

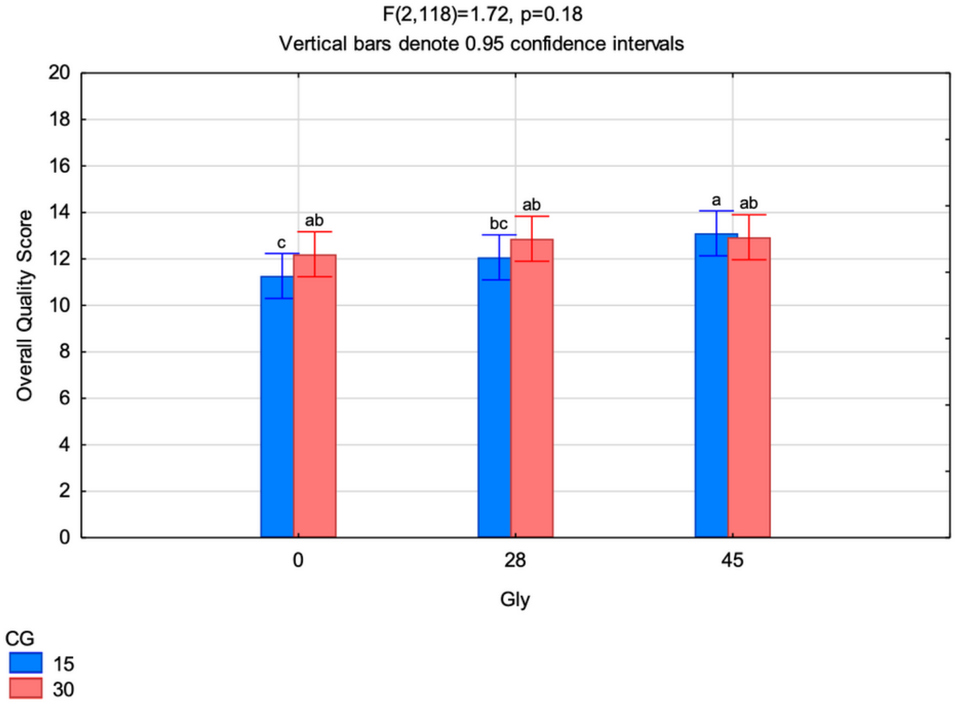




Results: Can glycerol be used as a sugar substitute?

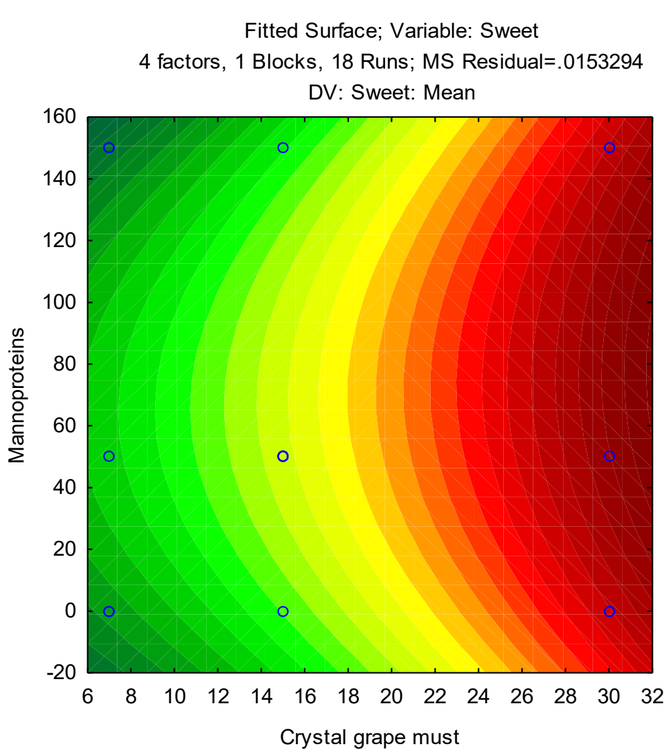
- Glycerol can be strategically used to reduce sugar
- While providing increased balance and comparable overall quality
- This highlights glycerol's contribution to perceived sweetness and balance

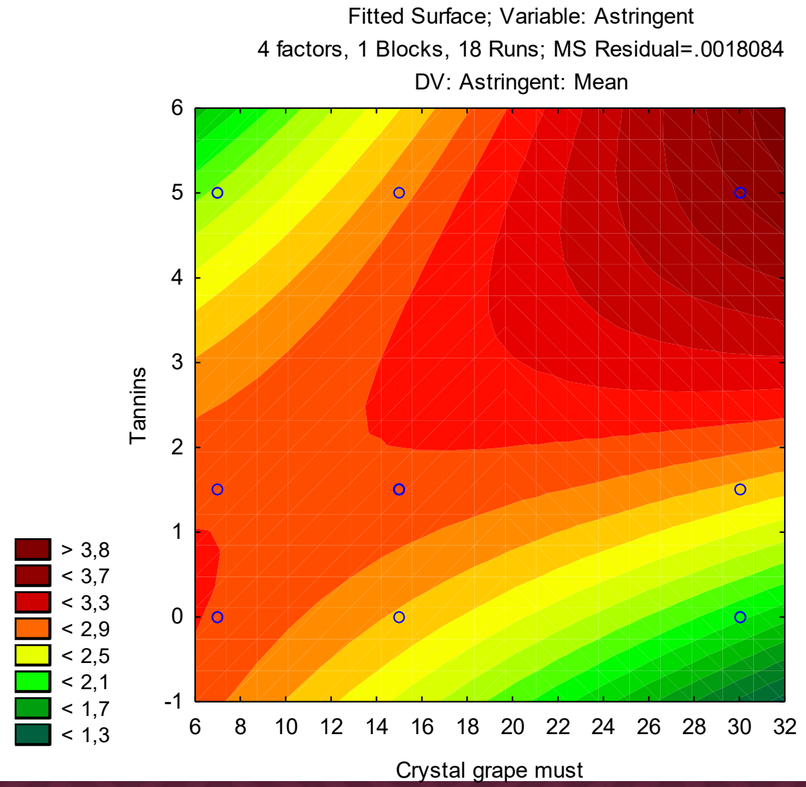




Results
Chenin Blanc Sensory Interactions and Additive Strategies

- Sweetness increases with increasing crystal grape must concentration, while mannoproteins contributes non-linearly
- Tannin addition significantly increased astringency perception, while crystal grape must modulated astringency





Crystal grape must

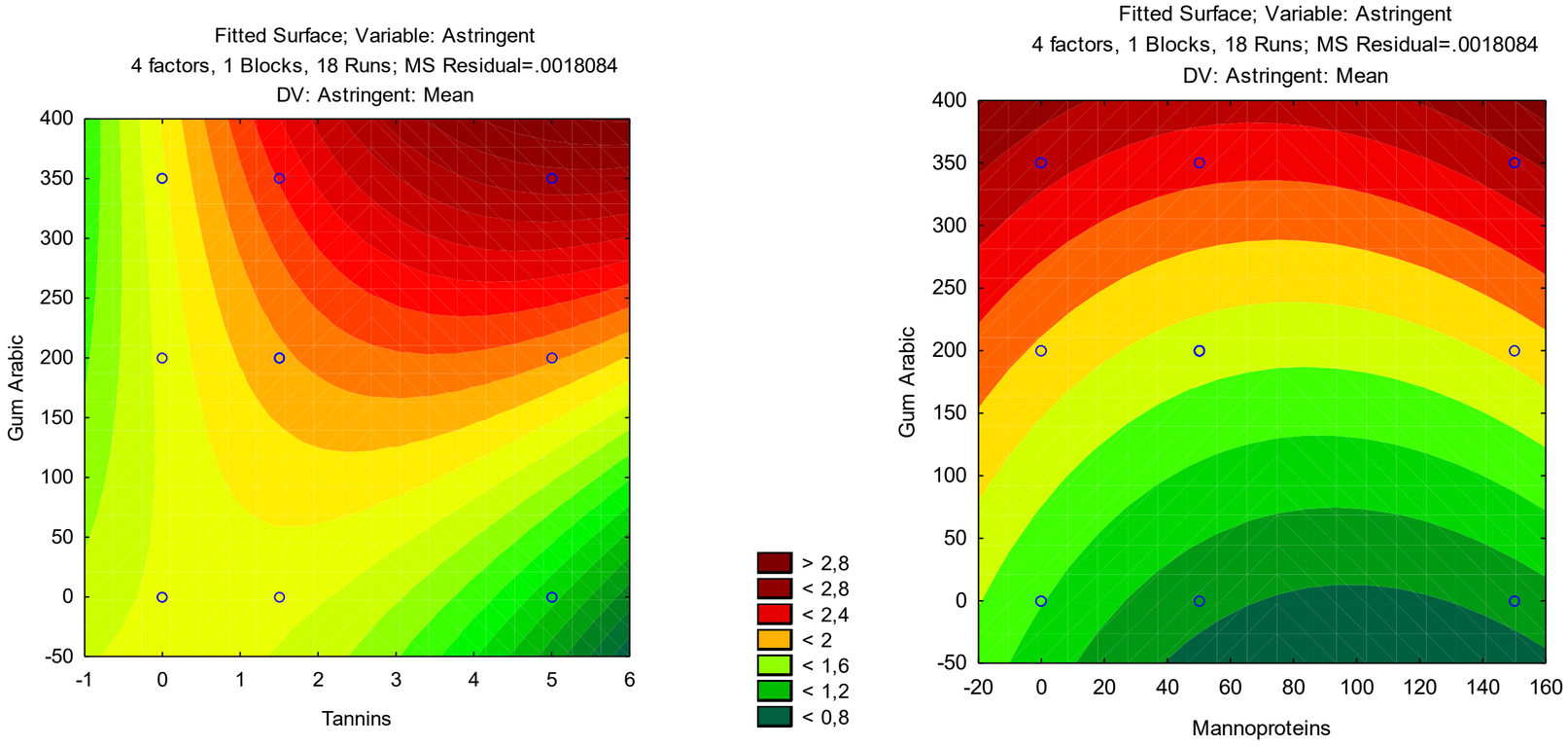
Sweetness ↑ Astringency ↓

Mannoproteins

Sweetness ↑ Astringency ↓

Results
Chenin Blanc Sensory Interactions and Additive Strategies

- Astringency is modulated by tannins, crystal grape must, gum arabic, and mannoproteins



Tannin

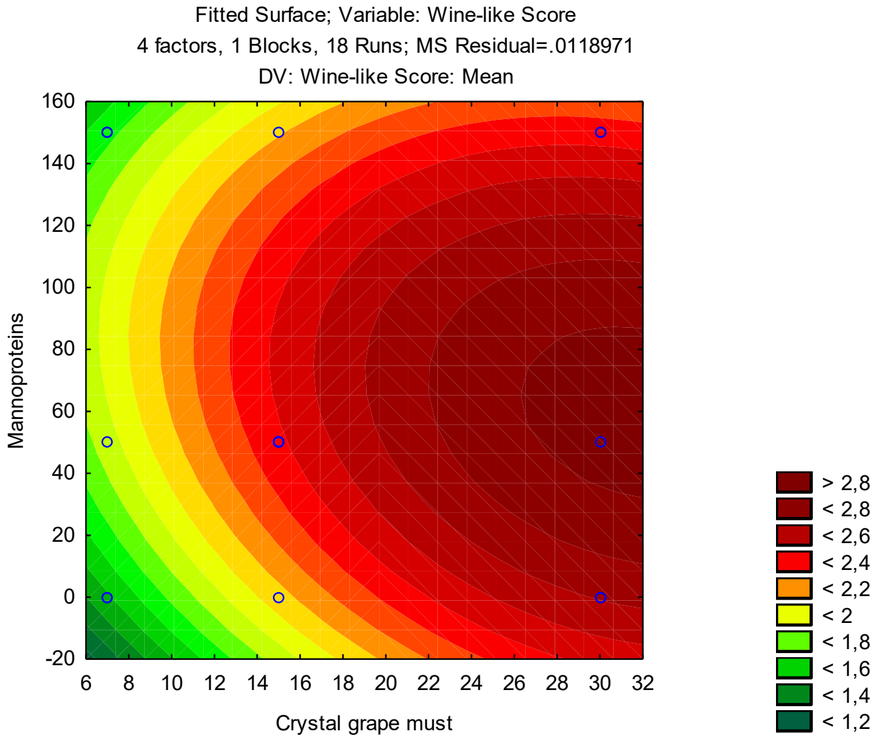
↑ **Astringency**

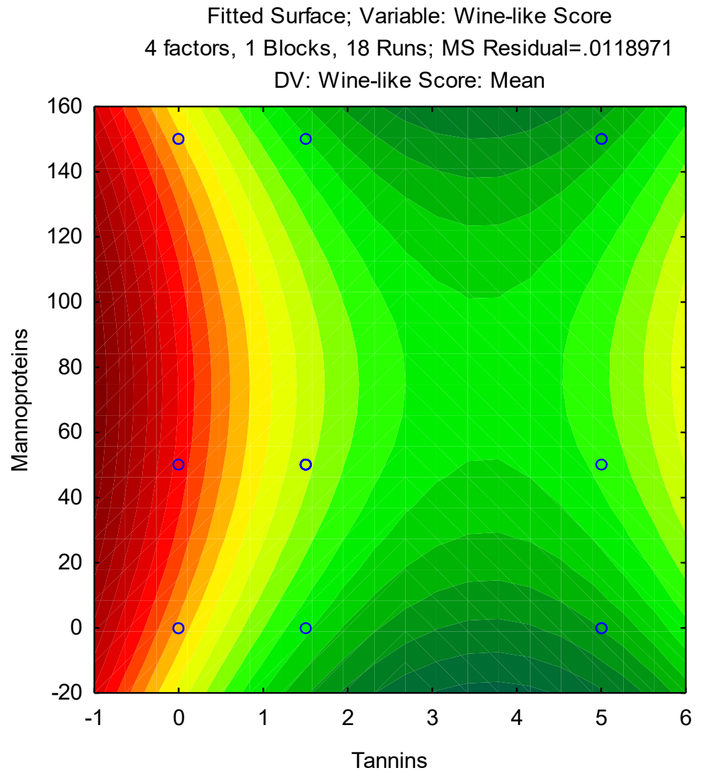
Arabic gum & Mannoproteins

↓ **Astringency at moderate levels**

Results
Chenin Blanc Sensory Interactions and Additive Strategies

- Crystal grape must increased wine-like character linearly, while mannoproteins increased moderately
- Tannins addition was negatively associated with wine-like score





Crystal grape must & Mannoproteins

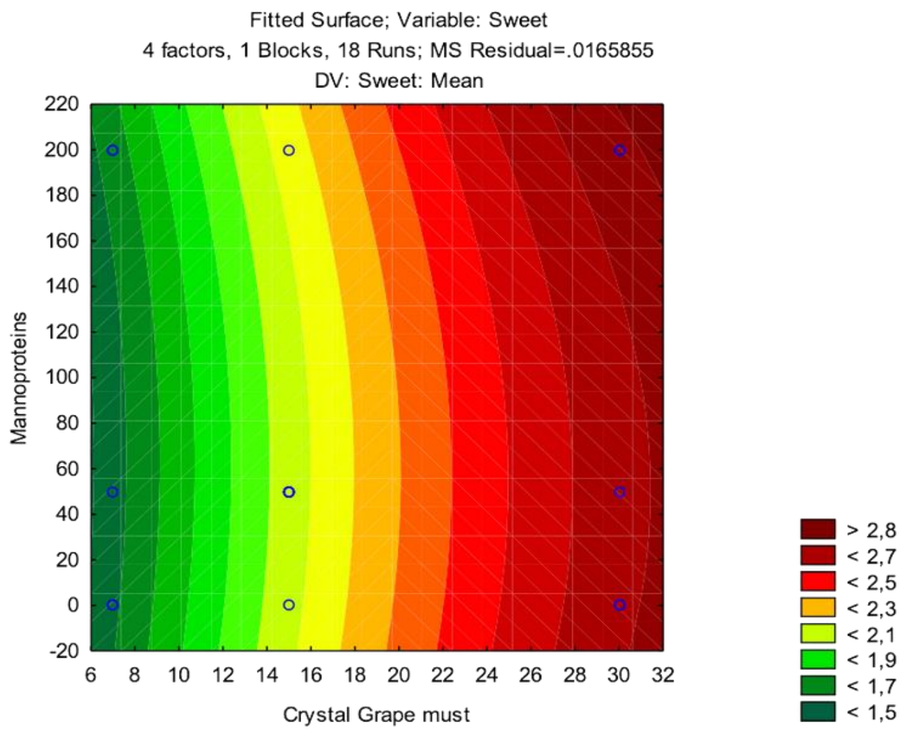
↑ **Wine-like character**

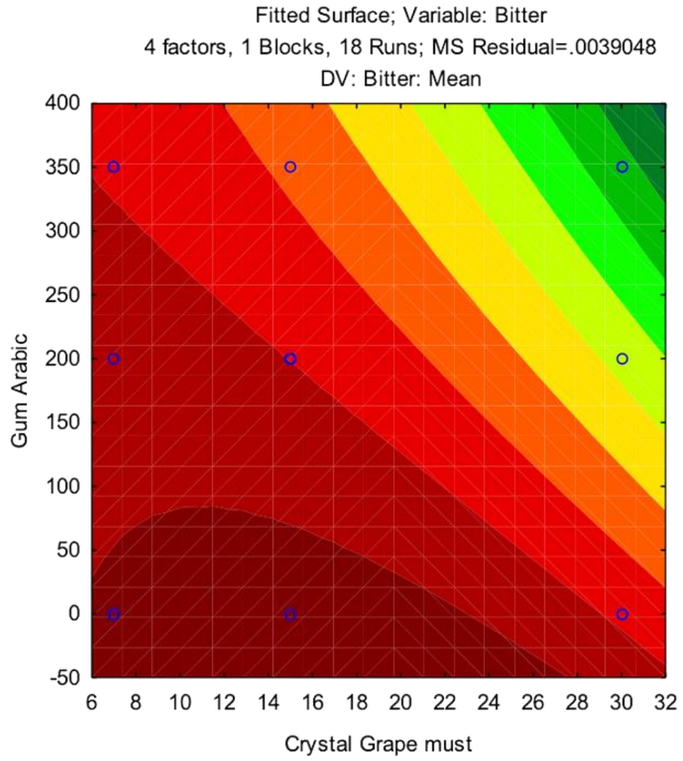
Tannins

↓ **Decreases wine-likeness**

Results
Shiraz Sensory Interactions and Additive Strategies

- Main effect observed with crystal grape must ($p<0.05$)
- Sweetness increases with increasing crystal grape must concentration
- Bitterness is modulated by crystal grape must and gum arabic





Crystal grape must

- ↑ Sweetness
- ↓ Bitterness
- ↓ Astringency

Arabic gum

- ↓ Bitterness