Influence of structural features of mannoproteins in white wine protein stabilization

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Introduction

Proteins are present in wine at low concentration, however these compounds could be responsible for colloidal instability and haze of wines [1, 2]. In white wine this issue is of great importance, since limpidity is an essential quality feature required by consumers. The most important proteins related with white wine instability are pathogenesis related proteins of *Vitis vinifera*, these include chitinases and thaumatin-like proteins [3, 4], that survive throughout the winemaking process, because they are highly resistant to proteolysis and to the low must and wines pH [5]. Protein instability is currently prevented by removing proteins using fining agents such as bentonite. However, bentonite fining could affect wine quality under some conditions, like the removal of colour, flavour and aroma compounds [6, 7] changing in this way wine sensory characteristics, thus alternatives for wine protein stabilization are important.

Objectives

The main objective of this study was to evaluate white wine protein stabilization effectiveness using different mannoproteins and to assess their effects on phenolic compounds.

Material and Methods

Wine sample

White wine from Douro Valley - 2011 vintage	
Alcohol content (% v/v)	14.2
Specific gravity (20 ºC) (g/mL)	0.9890
Titratable acidity (g/L tartaric acid)	5.5
pH	3.29
Volatile acidity (g/L acetic acid)	0.31
Protein stability heat test (NTU)	7.1

Protein stability experiments: Eleven types of mannoproteins (Mp1 - Mp11) were used at highest concentration according to the manufacture´s specifications (Table 1). Assays were done in 375 mL flasks at 20ºC for 7 days. Wine without any treatment was used as a control. Protein stability was assessed by heat test [8].

Table 1. Major commercial characteristics and recommended dosage of mannoproteins.

Characteristics	Codes	Dosage (g/hL)
Yeast cell wall	Mp1	30
Yeast cell wall polysaccharides/peptides	Mp2	1 – 5
Yeast cell wall	Mp3	5 – 10
Yeast cell wall	Mp4	10 – 40
Yeast cell wall (MW 150 KD)	Mp5	40
Yeast cell wall and mannoproteins	Mp6	5 – 10
Yeast cell wall	Mp7	5 – 40
Yeast cell wall (MW 20 KD)	Mp8	40
Specific yeast cell wall	Mp9	5 – 40
Polysaccharides from yeast cell wall	Mp10	0.5 – 5
Yeast cell wall	Mp11	40

Commercial mannoproteins characterization: Sequential acid hydrolysis was performed, with and without Saeman hydrolysis, in order to obtain the amount of insoluble polysaccharide. Sugar composition was obtained by anion-exchange chromatography with pulsed amperometric detection. Total nitrogen was determined by the Kjeldahl method and total protein content was determinate as Kjeldahl nitrogen multiplied by 6.25 [9, 10].

Browning potential and phenolic profile: The browning potential was determined according to the methodology proposed by Singleton and Kramling [11].

Results and Discussion

Protein stability test: Heat test, which provides information about protein thermal stability, showed that 9 onto 11 mannoproteins stabilized the wine, exceptions were Mp5 and Mp9.

Mannoproteins characterization: To understand previous results, mannoprotein composition, namely protein and sugar composition, was evaluated. Generally, results showed that total sugars accounted for major proportion, comparing to proteins (Figure 1A). Mannose and glucose were the most representative sugars, ranging from 17.4-41.9 g/100 g and from 6.8–41.4 g/100 g, respectively (Figure 1B). The different chemical composition observed among mannoproteins, could be related to industrial extraction process and/or different degrees of purity.

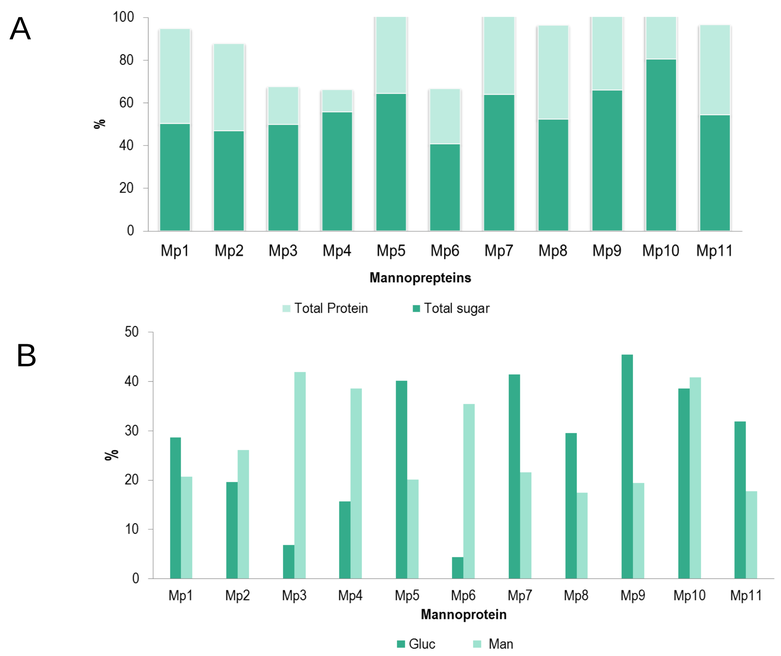

Figure 1. Mannoproteins composition (g/100g): A) total sugar and total protein; B) glucose and mannose content.

Mannose to glucose ratio allows us to access the relative amount of mannoproteins in each commercial preparations (Figure 2), and beside the different concentrations tested in this work, this ratio remains the same. Mannoproteins which are not able to stabilize wine against protein instability (Mp5 and Mp9) showed low mannose to glucose ratio, suggesting that this feature is implied to their effectiveness. These results are in accordance with Moine-Ledoux and Dubourdieu [12].

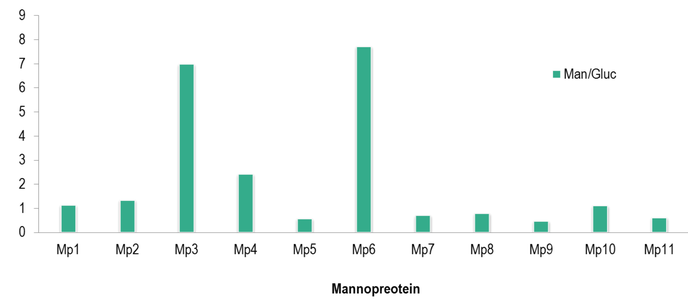

Figure 2. Ratio mannose to glucose (Man/Gluc) quantified in mannoproteins used in this study

All the mannoproteins decreased the wine browning potential; although total phenolic compounds diminished slightly. That could be explained by the fact that mannoproteins stays in solution and probably interacts with the phenolic compounds, preventing their oxidation.

Conclusion

The chemical composition of commercial mannoproteins affects wine protein stabilization. Mannoproteins with higher mannose to glucose ratio are more effective in achieving a thermal stability of white wine proteins. Additionally, some mannoproteins have a protective effect on the wine colour evolution by decreasing the browning potential. However, more detailed studies are needed to confirm our results.

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