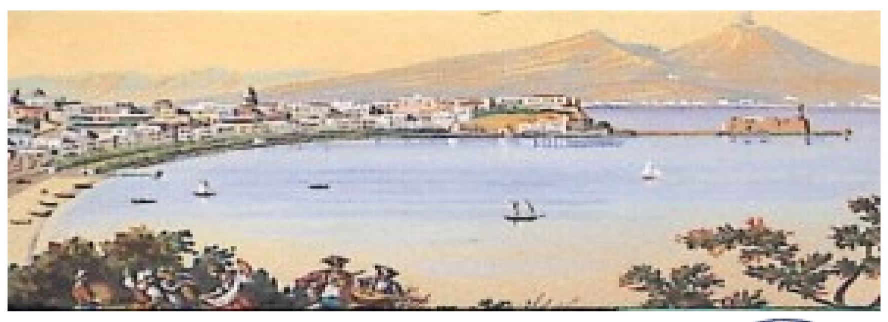

How to Improve the Mouthfeel and the Color of Wines Obtained by Excessive Tannin Extraction

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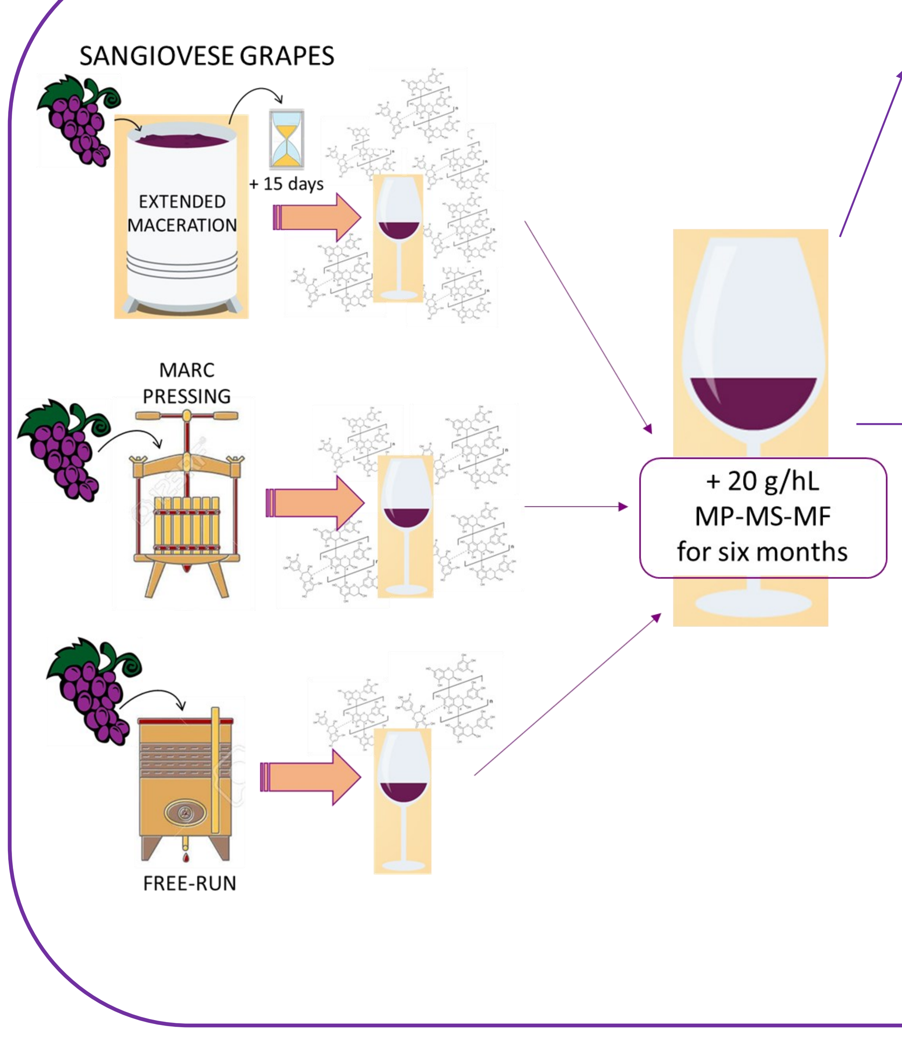
Introduction

The phenolic compounds constitute a wide group of compounds and, among them, the most important in winemaking are anthocyanins extractable from skins and proanthocyanidins (namely tannins) extractable from skins and seeds (Waterhouse, 2002). Grape maceration is a critical point of red wine production because an excessive extraction of tannins and/or a low extraction of anthocyanins, can determine an imbalanced ratio between these classes of phenolic compounds. This may cause defects as astringency and bitterness, depleting the commercial value of wines (Saenz-Navajas et al., 2010). One of the technological practices which often determine an excessive extraction of tannins is the prolonged maceration after the end of the alcoholic fermentation (Sacchi et al., 2005). This practice is often applied to obtain wines richer in phenolic compounds and with a higher shelf-life, but, sometimes, these wines are too rich in phenolic compounds responsible for bitterness and astringency (Frost, Blackman, Ebeler, & Heymann, 2018). Unbalanced red wines are also produced by marc pressing of wines just after the end of maceration. The correspondent marc pressed wines are lower quality wines because richer in bitter and astringent compounds, like flavanols and proanthocyanidins extracted from skin and seeds during the pressing of exhausted marcs (Rinaldi et al., 2020). Among different enological practices, mannoproteins have been shown to improve the mouthfeel of red wines positively. In this study, three commercial mannoproteins were tested to remediate the excessive astringency and bitterness of red wines produced by prolonged maceration and marc pressing, considering the contemporary effect on chromatic wine characteristics and aroma compounds.

Material and Methods



Color and Phenolic Analyses

Wine colorant intensity (CI), given by the sum of 420, 520, 620 Abs, and tonality (420/520 Abs) were analysed by Glories method (1984). CIELab coordinates L*, a*, b* were determined by the Panorama software (Shimadzu, Milan, Italy). The total color difference (ΔE) was calculated between treated wine and control wine. Vanillin reactive flavans were determined according to Di Stefano and Guidoni (1989). Total anthocyanins, pigmented polymers, BSA-reactive tannins were determined by Harbertson et al. (2003). All analyses were carried out in duplicate on each bottle for a total of four replicates.

Sensory Analysis

Sangiovese wines were evaluated in duplicate by trained assessors as previously described (Rinaldi and Moio, 2018; Rinaldi et al., 2021). They answer a check-all-that-apply (CATA) question with 16 sensory attributes of astringency (table 1). The panel also evaluated the taste (sweet, acid, bitter), odor, and aroma (floral, fruity, spicy, balsamic) of wines according to a 5-point scale.

Table 1: the astringency sub-qualities used in CATA questionnaire

Sub-quality term	Description	Grouping	Touch-standard
Silk	Tactile sensation like silk	surface smoothness	silk
Velvet	Tactile sensation like velvet	surface smoothness	velvet
Dry	Feeling of luck of lubrication in mouth	drying	-
Corduroy	Sensation of a light wrinkling of the soft palate that can be felt by tongue movements	surface smoothness	corduroy
Adhesive	The feeling that mouth surfaces are sticking, yet can be pulled away from each other with slight pressure	dynamic	double-sided scotch
Hard	Combined effect of astringency and bitterness	harsh	-
Aggressive	Excessive astringency of strong roughing nature	harsh	sand paper 600 grade
Soft	A light and finely textured astringency	complex	fur
Mouthcoat	Like a coating film that adheres to mouth surfaces	complex	suede
Rich	High flavour concentration with balanced astringency	complex	-
Green	Combined effect of excess of acidity and astringency	unripe	-
Grainy	Sensation of micro-particles in mouth	particulate	sand paper 1000 grade
Satin	A smooth and sliding astringency	surface smoothness	satin
Pucker	A reflex action of mouth surfaces being brought together and released in attempt to lubricate mouth surfaces	dynamic	burlap
Full-Body	Sensation of high viscosity	complex	-
Persistent	An overall sensation (flavour, tactile, taste) which lasts over time	complex	-

Results and Discussion

The content in high and low molecular weight proanthocyanidins

The prolonged contact between grape solids and wine in the extended maceration process extracted around 1500 mg/L of BSA-reactive tannins (E-t0), compared to 600 mg/L of marc pressed wine (P-t0) and 500 mg/L of free-run (F-t0) wine. After six months, the control wines E-C, P-C, and F-C, showed a significantly lower concentration of proanthocyanidins with respect to t0 (Figure 1a).

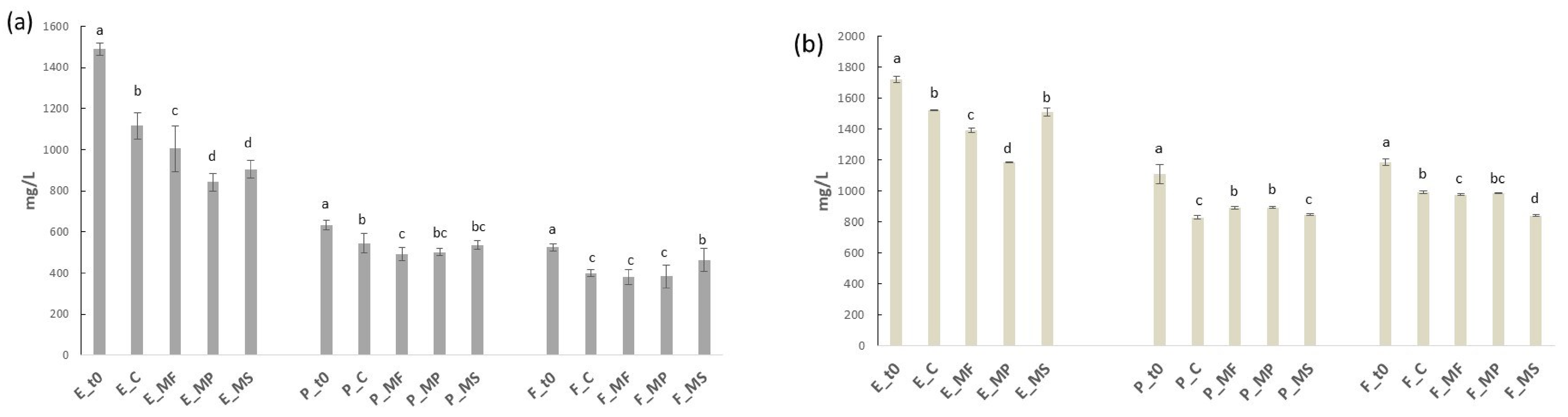


Figure 1: BSA-reactive tannins (a) and vanillin reactive flavans (b) after six months of aging on mannoproteins at 20 g/hL in extended macerated (E), marc pressed (P), and free-run (F) Sangiovese wines. C represents the control wine; MF, MP, MS the mannoprotein treatments. t0 represents the wine before aging.

In E wines, the treatments with MP and MS determined a greater lowering in BSA-reactive tannins; in P wines, only MF was efficient in reducing these compounds; in F wines, there were no differences between control and treated wines, except for MS that showed a high tannin concentration than control but lower than it before aging. Extended maceration also determined a high extraction of vanillin reactive flavans (Figure 1b). A decrease in flavans was also observed after the treatments with MF and MP in E, and MF and MS in F wines, being MS the most effective. In contrast, in the P-MF and P-MP wines, the content of flavans was higher than control, probably for lower precipitation during the time.

The effect of mannoproteins on the mouthfeel of wines

The mouthfeel profiles by CATA analysis permitted the samples' separation according to their subqualities. E-C was characterized principally by dry, hard, green terms, that is, a high astringency felt with bitterness and acidity. The primary sensation of E-MS was corduroy. E-MP wine resulted in soft and mouthcoating sensations, indicating that the MP represented the most suitable treatment to improve the mouthfeel of extended macerated wine (Figure 2a). The first and second dimensions explained 98.62 % of total inertia and allowed a clear separation between the P-C and P-MS from P-MP and P-MF. Green, dry, adhesive, and aggressive sensations characterized the control P-C (Figure 2b).

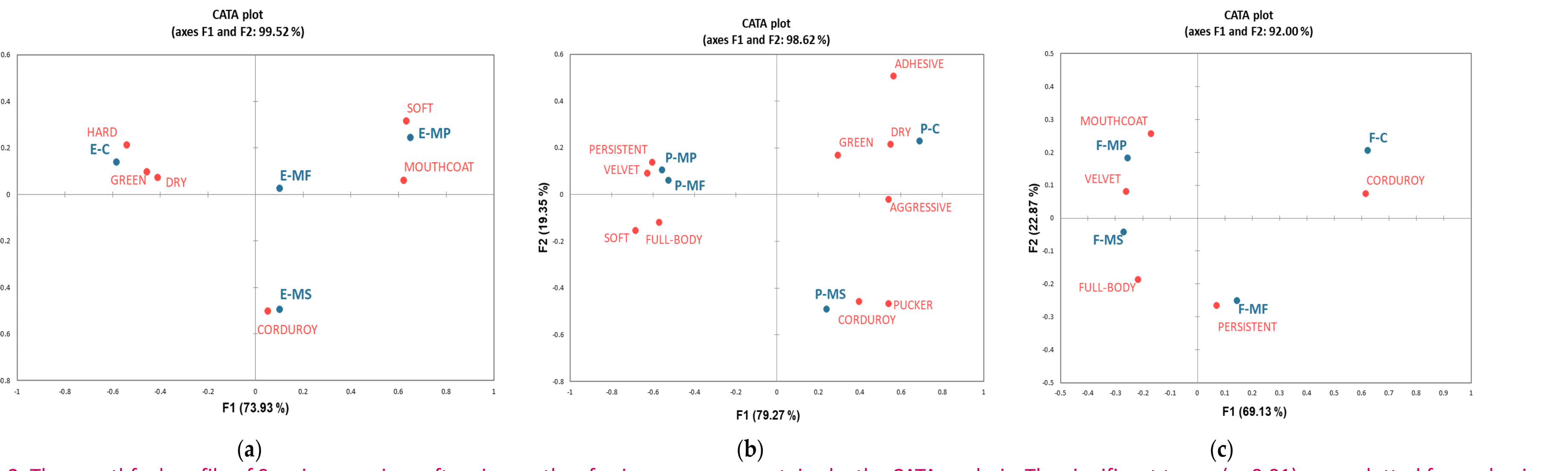


Figure 2. The mouthfeel profile of Sangiovese wines after six months of aging on mannoproteins by the CATA analysis. The significant terms (p<0.01) were plotted for each wine typology: (a) extended macerated (E), (b) marc pressed (P), and (c) free-run (F) wines. C represents the control wine; MF, MP, MS the mannoprotein treatments at 20 g/hL.

The treatment with MF and MP mannoproteins conferred positive subqualities to P wines: velvet, soft, full-body, and persistent. For the marc pressed wines, the most evident effect on mouthfeel was obtained with MP and MF mannoproteins similarly. Figure 2c showed the mouthfeel profile of Sangiovese free-run wines after six months of aging on mannoproteins. The corduroy term highly characterized F-C. Even if each wine showed a diversity from the control, treated wines were similar in their mouthfeel profile. In particular, F-MF was persistent, indicating that overall sensation related to aftertastes lasted in the mouth for a long time. F-MP was principally velvety and mouthcoating, while F-MS was felt full-bodied.

The effect of mannoproteins on color stability

In E wines, the total anthocyanins' content decreased after aging on mannoproteins, mainly by the MP treatment. Also, the colorant intensity and the redness (a*) were reduced in E-MP wine. However, a higher amount of pigmented polymers was formed (Figure 2), probably related to more bluish compounds, as shown by the b* coordinate (yellow-blue). Pigmented polymers were mainly formed in P-MF. The P-MP was the wine with a color difference (ΔE =2.98) detectable by inexperienced eye, probably due to the lower lightness and higher blue nuances than other wines.

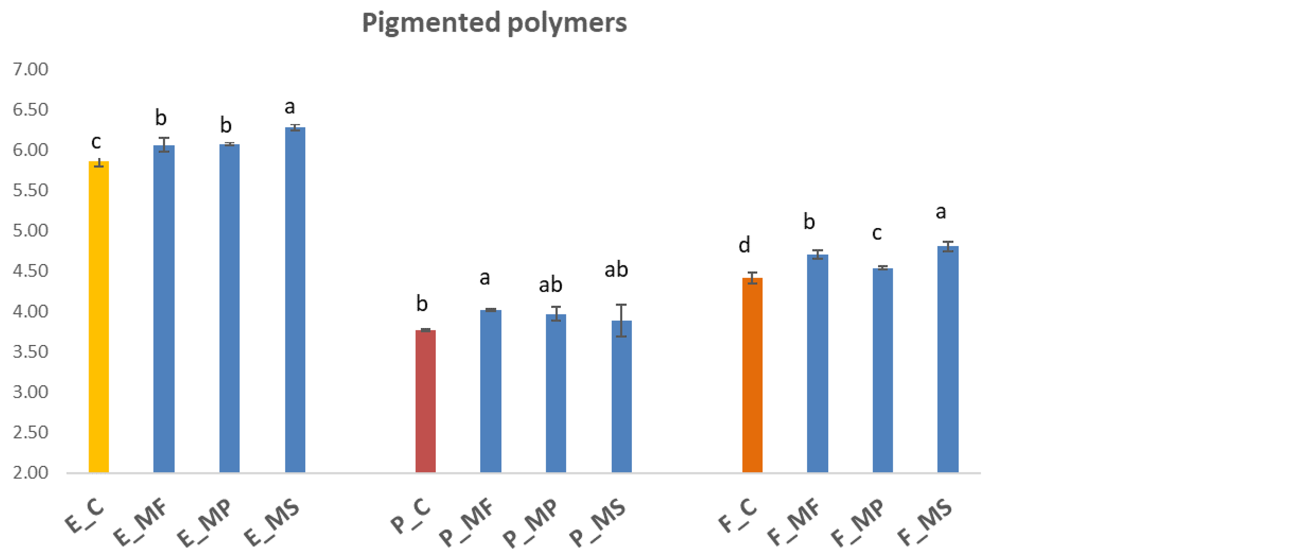


Figure 2. the pigmented polymers after six months of aging on mannoproteins at 20 g/hL in extended macerated (E), marc pressed (P), and free-run (F) Sangiovese wines. C represents the control wine; MF, MP, MS the mannoprotein treatments.

A different effect of mannoproteins can be observed in free-run wines on color parameters. The pigmented polymers were significantly increased after the treatment with all mannoproteins in free-run wines yet. Color stability of wines was promoted by mannoprotein, which may allow multiple interactions between proanthocyanidins and anthocyanins, as observed by others (Del Barrio-Galán et al., 2012; Escot, Feuillat, Dulau, & Charpentier, 2001).

Conclusions

Each Sangiovese wine typology necessitates a specific mannoprotein for mouthfeel and/or color improvement. When tannins are highly in excess (as in extended macerated wines) the aging with MP at 20 g/hL can be preferred because it conferred mouthcoating, soft and velvety sensations, and color stability to wine (higher pigmented polymers). In marc pressed wines, both MF and MP can improve the mouthfeel and color of Sangiovese. However, in free-run wine, the pigmented polymer formation was enabled by all treatments and correlated with an improved mouthfeel sensation. Besides, bitterness was also reduced by mannoproteins. For free-run wines, the ideal treatment can be represented by the MS because it also showed a significant effect on aroma revelation. In all cases, the formation or preservation of pigmented polymers by mannoproteins during aging can be associated with positive subqualities, like velvet, soft and mouthcoat. Mannoproteins can represent a way to improve the mouthfeel and color of wines highly rich in tannins.

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