The impact of different winemaking techniques on the mouthfeel of Shiraz wine (Part 5)



Keywords: Mouthfeel, Shiraz, tannin extraction.

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Introduction

The macromolecular fraction of red wine consists inter alia of polysaccharides and polyphenolic compounds such as procyanidins and anthocyanins (Vidal *et al.*, 2004a). It has been proposed that anthocyanins may impact on the astringency of wine, whether directly or in reaction to procyanidins (Gawel 1998; Vidal *et al.*, 2004a; Gawel *et al.*, 2007 & Oberholster *et al.*, 2009). Brossaud *et al.* (1999) realised that anthocyanins complement the grape's astringency and do not contribute to bitterness. Astringency is a tangible sensation and may be described as dry (the absence of lubrication in the mouth), coarse (uneven texture in the mouth) and puckering (pinching together of the mouth, lips and cheeks). Astringency occurs when tannins bind with the saliva and precipitate (Gawel *et al.*, 2001; Vidal *et al.*, 2004b & Landon *et al.*, 2008). It has also been found that seed tannins are more astringent than skin tannins (Oberholster *et al.*, 2009).

Gawel *et al.* described astringency as follows in 2001: "is a result from the cross-linking of polyphenols with glycoproteins found between and above the epidermal cells of the mucosal tissue in the mouth and/or from the binding and subsequent precipitation of salivary proteins by polyphenols. The polyphenol-protein interaction results in saliva with poorer lubricating properties and greater friction between mouth surfaces. The increased friction ultimately activates the mechano-receptors in the mouth, leading to the perception of astringency." From this description it is clear that astringency is a characteristic of unripe grapes (Vidal *et al.*, 2004b). Astringency of young red wines may be more intense and will gradually decrease as the red wine matures (Vidal *et al.*, 2004b).

Various other molecules in red wine may contribute to the perception of astringency or bitterness, such as polysaccharides that are responsible for softness and fluidity (Vidal *et al.*, 2004a). Acidity in red wine contributes to astringency by improving the binding between polyphenols and saliva (Gawel *et al.*, 2001). Furthermore, alcohol may reduce astringency in red wine (Gawel *et al.*, 2001 & Fontoin *et al.*, 2008). Gawel (1998) warns, however, that astringency in red wine may increase with the repeated swallowing of the red wine in question and that this sensation will occur more quickly if there is a short pause between different intakes.

The objective of this study was to investigate the mouthfeel of Shiraz wines with the accompanying chemical compounds. The difference between the mouthfeel of two wines from different climatic zones, as well as two different ripeness levels, was also investigated. The outcome of the investigation may shed light on the effect of different winemaking techniques on the mouthfeel of wine.

Material and methods

Grapes

Shiraz grapes were crushed on Plaisir de Merle, Simondium (Winkler scale IV) and Morgenster, Durbanville (Winkler scale III). The grapes were crushed at two different ripeness levels, namely before commercial harvest (LB) and after commercial harvest (HB).

Wine

Five different vinification treatments were used. The treatments are the following:

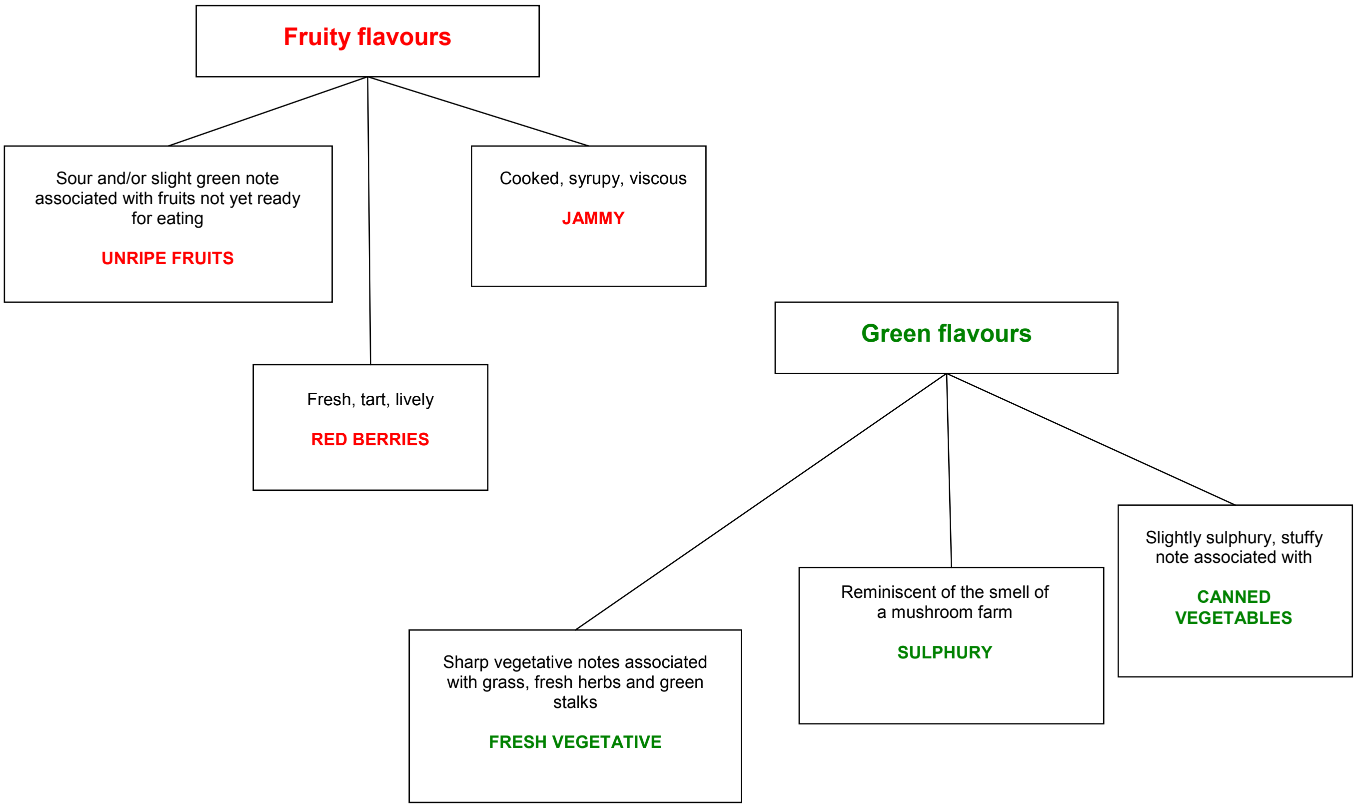
- Control (C) – the grapes were crushed, inoculated with WE372 and pressed at the end of fermentation.
- Enzyme treatment (E) – as for the control, except that a pectolytic enzyme preparation was used.
- Cold maceration (CM) – the crushed skins were held at 10°C for three days before the grapes were inoculated with WE372. After fermentation the grapes were pressed.
- Extended skin contact (PM) – crushed grapes were inoculated with WE372 and after fermentation the skins were left on the wine for a further two weeks before being pressed.
- Combination of cold maceration and post maceration (CM + PM) – crushed skins were kept at 10°C for three days before the grapes were inoculated with WE372. After fermentation the skins were left on the wine for a further two weeks before being pressed.

Tannins were measured by making use of the BSA and MCP methods.

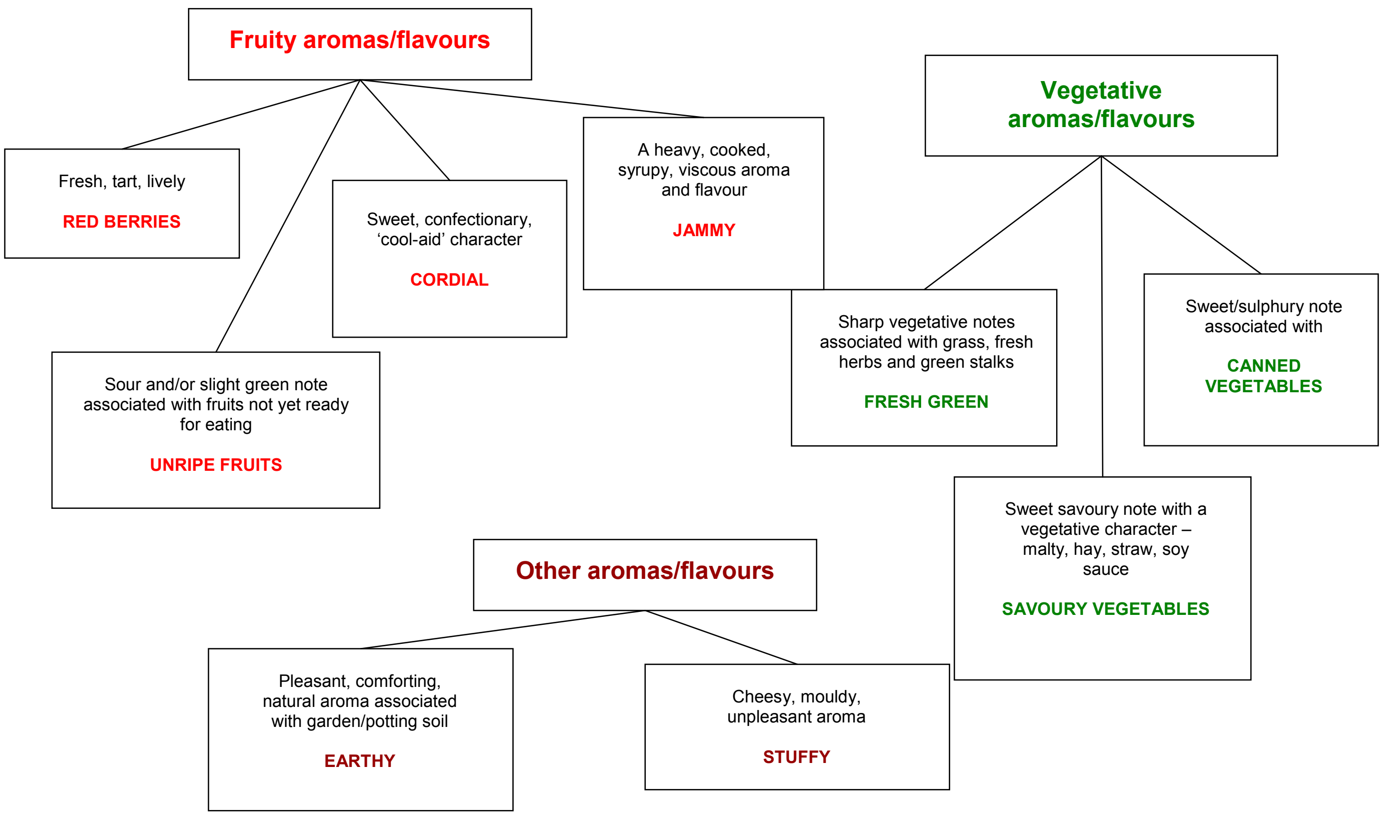
Panel

It was a very interesting experience for the panel comprising 11 well-trained members, all of whom are regularly used by the sensorial division of Distell. The panel trained for eight weeks (2 x 2 hour sessions per week) at which time they received representative samples of different wines and were tested to recognise the different mouthfeel characteristics in the wines and measure them in a repeatable way (Organogram 1 and 2). Panel members were also given tangible standards to help them distinguish between the different mouthfeel characteristics (Organogram 3).

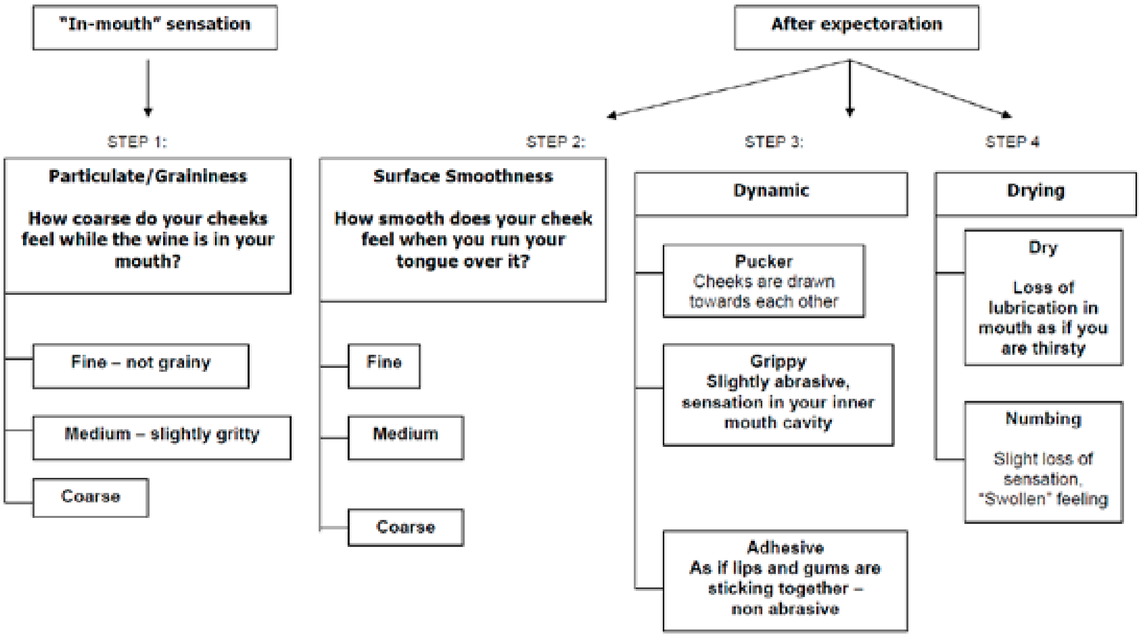
ORGANOGRAM 1. Aroma and flavour recognition guide – Phase 1.



ORGANOGRAM 2. Aroma and flavour recognition guide – Phase 2.



ORGANOGRAM 3. Mouthfeel evaluation guide – Phase 1 and Phase 2.



Statistics

ANOVA, PCA and AHC were performed on XLStat Version 2009.1.02 (Addinsoft, www.xlstat.com).

Results and discussion

The effects of climate on the mouthfeel of Shiraz wines

PCA of the mouthfeel characteristics was performed to investigate the effect of climate, ripeness levels and tannin extraction (Fig. 1). All the samples from the cooler farm had a positive count on PC2. Except for the enzyme treatment, all the samples from the warmer area had a negative count on PC2.

The overall impression of wines from the cooler area was strongly associated with "numbing" and "puckering" compared to wines from the warmer area. Wines from the warmer area were more associated with "grippy" and "drying", which are considered negative characteristics. The PCA also pointed out differences between wines from before the commercial harvest (LB – green) and wines from after the commercial harvest (HB – blue). Wines from grapes that

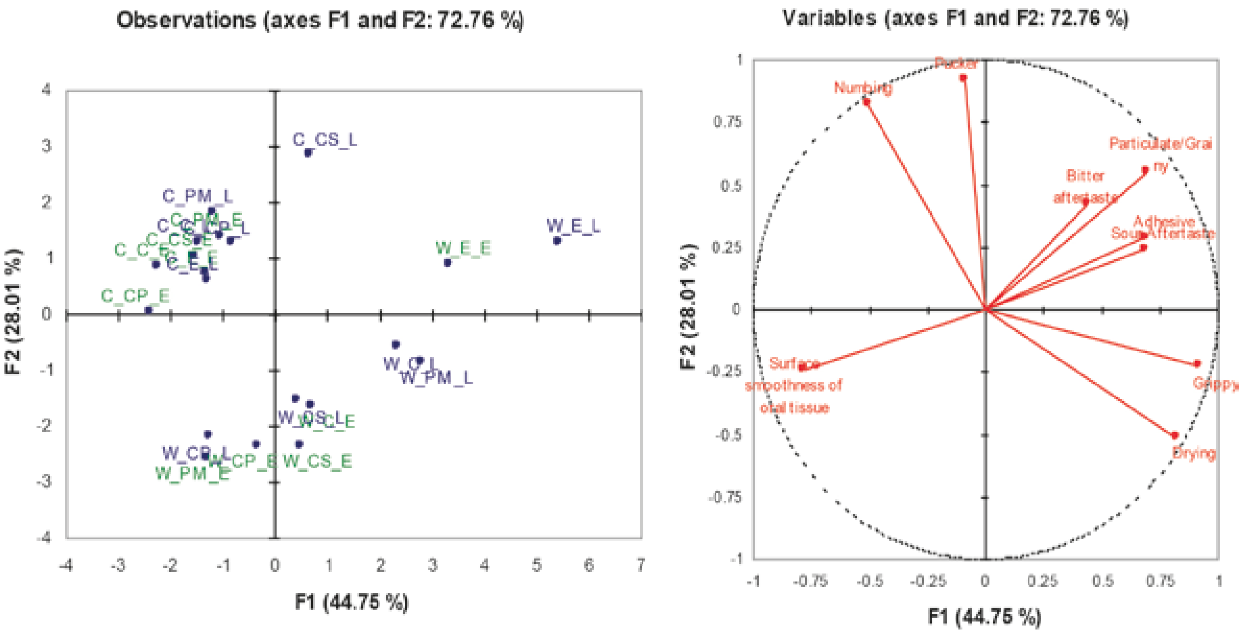


FIGURE 1. PCA that indicates the difference between warm and cold climates.

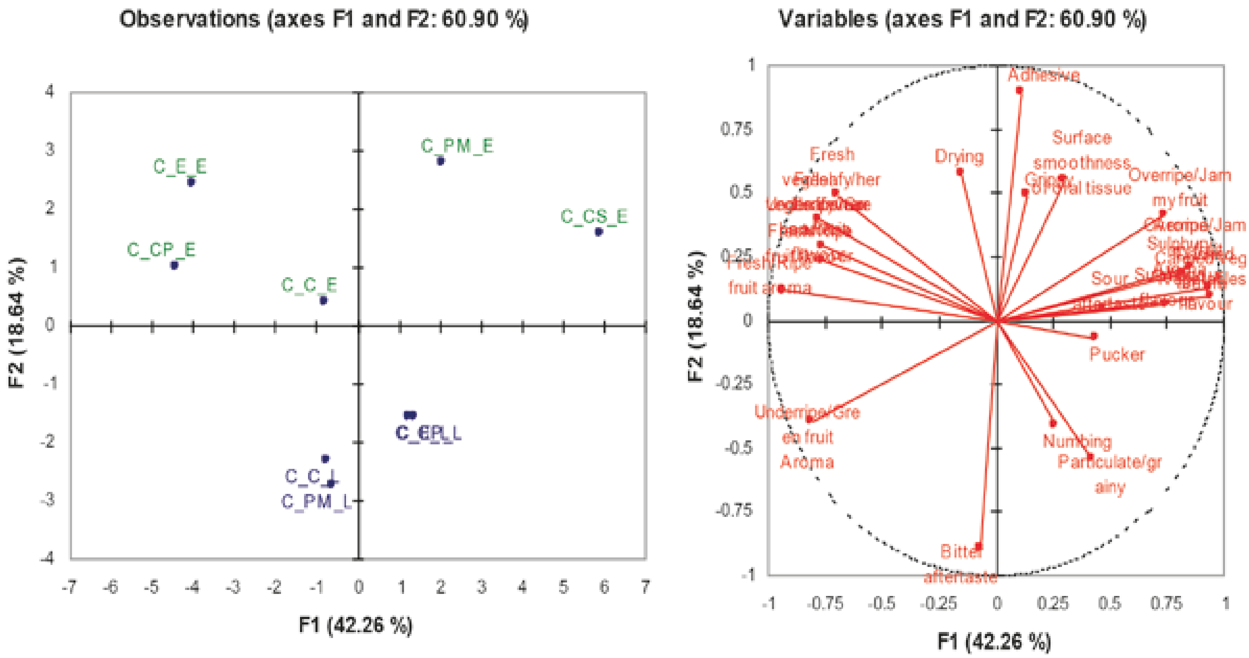


FIGURE 2. PCA of the effect of ripeness levels on the sensorial characteristics of the mouthfeel of Shiraz in the cooler area.

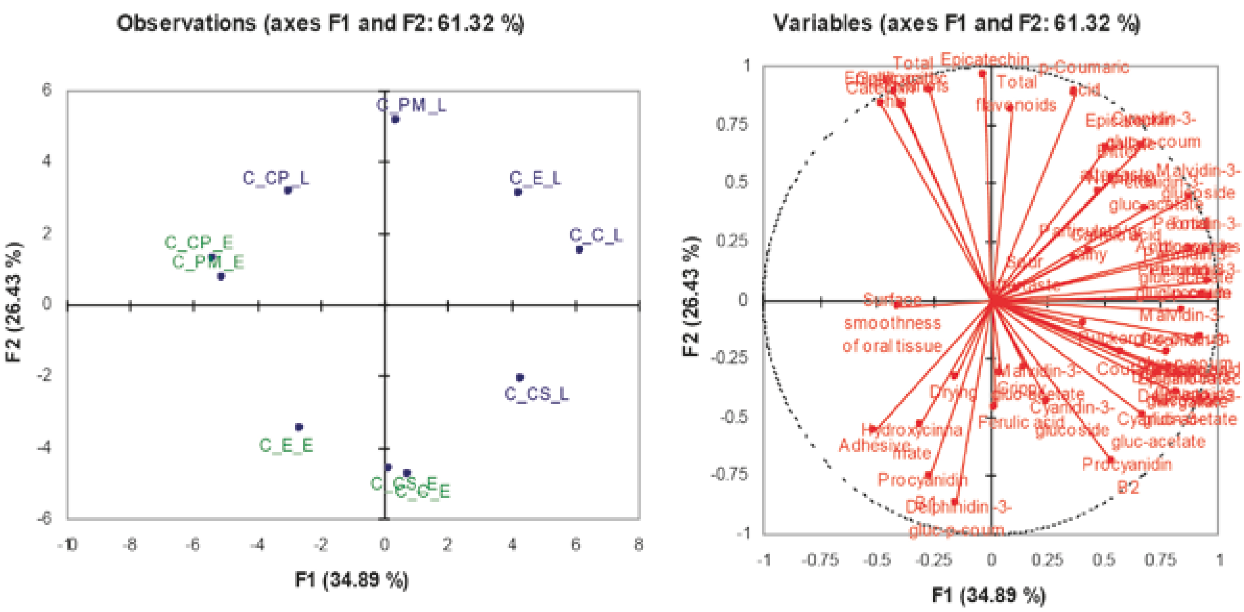


FIGURE 3. PCA of the effect of phenolic composition on the sensorial characteristics of the mouthfeel of Shiraz in the cooler area.

were harvested before the commercial harvest (LB) were associated with finer surface smoothness, whereas wines from grapes that were harvested after the commercial harvest (HB) were associated with a particulate/grainy mouthfeel, as well as a more bitter aftertaste.

The influence of different ripeness levels on the sensorial characteristics of Shiraz in a cooler area

The PCA graph was drawn to indicate the contribution of aroma, taste and mouthfeel relative to grapes harvested in a cooler environment. On the PCA graph (Fig. 2) there is an obvious difference between wines from grapes that were harvested before and after the commercial harvest. The wines from before the commercial harvest (LB) are associated with "drying, adhesive" characteristics, whereas the wines from after the commercial harvest (HB) are associated with a bitter aftertaste, as well as a "numbing, particulate grainy and puckering" mouthfeel.

The influence of phenolic composition on the different ripeness levels in a cooler area

The PCA graph (Fig. 3) shows that there is an obvious difference between mouthfeel and the different areas, as well as the different ripeness levels. Wines harvested before the commercial harvest (LB)

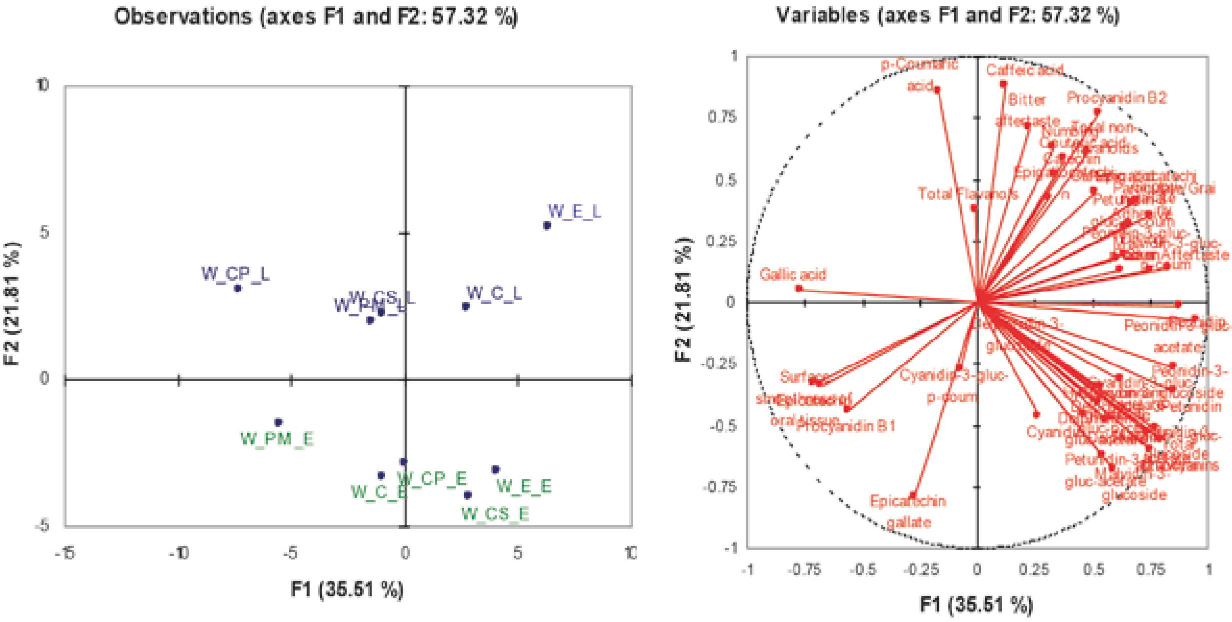


FIGURE 4. PCA of the effect of phenolic composition on the sensorial characteristics of the mouthfeel of Shiraz in the warmer area.

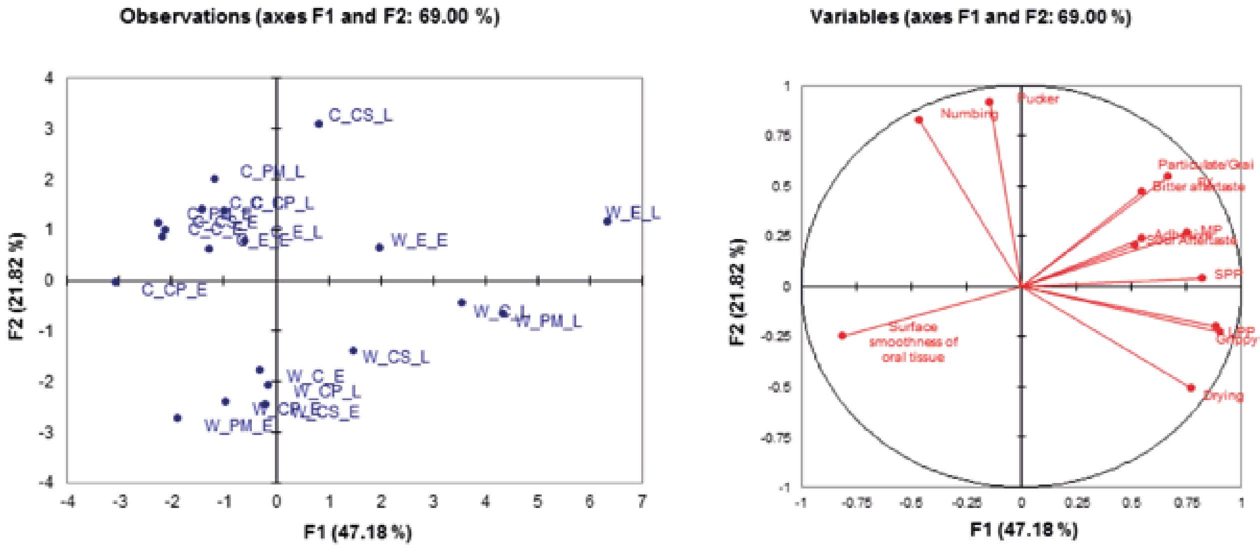


FIGURE 5. PCA of the influence of MP, SPP and LPP on the mouthfeel of Shiraz.

are associated with higher levels of hydroxycinnamate procyanidin B1, as well as delphinidin-3-glucoside-p-coumaric acid, "dryness", "surface smoothness" and "adhesiveness". Wines harvested after the commercial harvest (HB) are associated with the other anthocyanin derivatives, as well as epicatechin-gallate and p-coumaric acid.

The influence of phenolic composition on the various ripeness levels in a warmer area

On the PCA graph (Fig. 4) it is clear that the grapes which were harvested after the commercial harvest (HB) show a positive association with PC2, whereas the grapes that were harvested before the commercial harvest (LB) show a negative association with PC2. The former is associated with gallic acid, bitterness, caffeic acid and procyanidin B2, whereas the latter is associated with epicatechin-gallate and a "numbing" mouthfeel.

The influence of LP, SPP and LPP on the mouthfeel characteristics of Shiraz wine

A PCA (Fig. 5) was performed to investigate the relationship between the monomeric pigments (MP), short polymeric pigments (SPP) and long polymeric pigments (LPP) and the mouthfeel characteristics. LPP, MP and SPP are strongly correlated with each other and with PC1. Furthermore the compounds have a stronger relationship with the wines from the warm climatic region, after commercial harvest (HB) and the different winemaking treatments. SPP, LPP and MP also correlated with a bitter aftertaste, "particulate grainy", acidic aftertaste, “grippy” and a dry mouthfeel. The MP, SPP and LPP correlated negatively (Pearson’s correlation coefficient of $P < 0,05$) with procyanidin B1, epicatechin and gallic acid.

Conclusion

Three experimental factors were used in this study, namely climatic region, ripeness level and tannin extraction method. Of these three, the climatic region had the greatest effect on the mouthfeel and phenolic composition.

The wines from the cooler region were generally associated with higher levels of non-flavonoids and total anthocyanins and more intense “numbing” and “puckering” sensations. As a group the wines from the warmer region, on the other hand, were more readily associated with a dry and “grippy” mouthfeel, as well as total anthocyanins and non-flavonoids. It also transpired that a warmer climate is able to promote the compounds of p-coumaric acid and delphinidin-3-glucocide, although this has to be confirmed by further studies.

Among the wines that were harvested in a cooler climate, the ripeness level had a bigger impact on the mouthfeel and phenolic composition than the treatment. There was a tendency for the wines that were harvested before the commercial harvest (LB) to have more “adhesive”, “grippy” and “surface smoothness” characteristics, whereas the wines harvested after the commercial harvest (HB) were more bitter and “numbing”. In the cooler region the ripeness level also impacted on the phenolic composition of the wines. The wines harvested after the commercial harvest (HB) were associated with many of the anthocyanins/anthocyanin derivatives and were negatively associated with hydroxycinnamate, procyanidin B1 and delphinidin-3-glucocide and p-coumaric acid. The inverse relationship between p-coumaric acid and delphinidin-3-glucocide was observed where p-coumaric acid was associated with riper grapes. As with the wines from the cooler region, the ripe grapes are associated with a “particulate grainy” and a “numbing” sensation, bitter aftertaste and an “adhesive” mouthfeel. In terms of phenolic composition the riper grapes are associated with anthocyanins/anthocyanin derivatives, but here there is a strong relationship with procyanidin B2, caffeic acid, p-coumaric acid, catechin and non-flavonoids.

The effect of tannin extraction methods on the sensorial characteristics in the wines from the warmer region was more outspoken than in the wines from the cooler region. In both regions there was a bigger difference between treatments when ripe grapes were used, both in terms of mouthfeel and phenolic composition. In both regions the specific effect of the treatments on the mouth changed as the ripeness levels of the grapes increased. This was especially noticeable in wines from the cooler climate. In addition, the effect of the treatment on the phenolic composition of the wines was more outspoken in the riper grapes.

Generally the enzyme treatment was related to “dryness” and an “adhesive” character. Interestingly the enzyme treatment had a bigger effect on the mouthfeel than the phenolic composition, in the cooler climate especially. This is further proof that chemical composition is not always a direct indication of assumed sensorial characteristics.

It appears furthermore that the cold maceration (CM) treatment generally had the least effect on mouthfeel and phenolic composition, whereas the post-maceration (PM) treatment had the greatest effect, regardless of ripeness or region. The control (C) and cold maceration (CM) treatments were related to cyanidin-3-glucocide-acetate in grapes harvested before the commercial harvest (LB), whereas the post-maceration (PM) treatment was related to catechin, gallic acid and total flavonoids in riper grapes.

In conclusion, strong phenolic composition and mouthfeel are influenced by climatic region. In the warmer climate the effect of ripeness on mouthfeel was smaller than in the cooler climate. The effect of the five tannin extraction methods differs depending on climatic conditions and ripeness levels. At this stage it is not clear whether the specific way in which bitter mouthfeel occurs in wine may be manipulated by tannin extraction methods. SPP, LPP and MP also correlate with a bitter aftertaste, “particulate grainy”, acidic aftertaste, a “grippy” and dry mouthfeel.

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Literature references

Brossaud, F., Cheynier, V., Asselin, C. & Moutounet, M., 1999. Flavonoid compositional differences of grapes among site test plantings of Cabernet Franc. *Am. J. Enol. Vitic.* 50, 277 - 284.

Fontoin, H., Saucier, C., Teissedre, P-L. & Glories, Y., 2008. Effect of pH, ethanol and acidity on astringency and bitterness of grape seed tannin oligomers in model wine solution. *Food Qual. Pref.* 19, 286 - 291.

Gawel, R., 1998. Red wine astringency: a review. *Austr. J. Grape Wine Res.* 4, 74 - 95.

Gawel, R., Oberholster, A. & Francis, I.L., 2000. A “Mouth feel Wheel”: terminology for communicating the mouth feel characteristics of red wine. *Austr. J. Grape Wine Res.* 6, 203 - 207.

Gawel, R., Iland, P.G. & Francis, I.L., 2001. Characterizing the astringency of red wine: a case study. *Food Qual. Pref.* 12, 83 - 94.

Gawel, R., Francis, I.L. & Waters, E.J., 2007. Statistical correlations between the in-mouth textural characteristics and the chemical composition of Shiraz wines. *J. Agric. Food Chem.* 55, 2683 - 2687.

Landon, J.L., Weller, K., Harbertson, J.F. & Ross, C.F., 2008. Chemical and sensory evaluation of astringency in Washington State red wines. *Am. J. Enol. Vitic.* 59(2), 153 - 158.

Oberholster, A., Francis, I.L., Iland, P.G. & Waters, E.J., 2009. Mouth feel of white wines made with and without pomace contact and added anthocyanins. *Austr. J. Grape Wine Res.* 16, 59 - 69.

Vidal, S., Francis, I.L, Williams, P., Kwiatkowski, M., Gawel, R., Cheynier, V. & Waters, E., 2004a. The mouth feel properties of polysaccharides and anthocyanins in a wine like medium. *Food Chem.* 85, 519 - 525.

Vidal, S., Courcoux, P., Francis, I.L., Kwiatkowski, M., Gawel, R., Williams, P., Waters, E. & Cheynier, V., 2004b. Use of an experimental design approach for evaluation of key wine components on mouth feel perception. *Food Qual. Pref.* 15, 209 - 217.

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