

Study of the effect of irrigation on wines from Mavrotragano grapes in Santorini

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Abstract

The aim of this work was to investigate the influence of irrigation on the polyphenolic content of cv. Mavrotragano, an indigenous grape variety of Santorini. Three irrigation regimes were applied, full-irrigation, medium-irrigation, non-irrigated, on an experimental with vertical planting vineyard of Santorini. The study was carried out during three consecutive growing seasons 2010, 2011 and 2012. Several assays were used for the determination of the chemical composition of the wines. Total phenolic content, total anthocyanin, total tannins and astringency -protein precipitation assay by bovine serum albumin (BSA) - were determined. The results showed that irrigation affects the phenolic content of wines resulting in higher concentration of total anthocyanins and total phenols. Also, wines from non-irrigated vines showed the lowest concentration of total tannins but the highest content of astringent phenolic compounds precipitable by BSA. No significant differences were observed in %vol, colour intensity, hue, pH and titratable acidity (TA) for the first year, however for the next two years wines from non-irrigated vines showed higher TA.

Introduction

Phenolics are responsible for many important properties of wine including colour (Ribereau-Gayon 1982, Ribereau-Gayon et al. 1983), bitterness, astringency (Peleg et al. 1999) and the ageing potential of red wines (Ribereau-Gayon et al. 1999). Anthocyanins are important compounds in the skin of red grapes, due to their contribution to the colour of the respective wines. The anthocyanic profile of the grapes is characteristic for each variety and can vary significantly according to the conditions of the environment, determined by the climate, soil and management of the vineyard (González-Neves et al. 2004, Segade et al. 2009). Tannins are, by definition, substances capable of producing stable combinations with proteins and other plant polymers such as polysaccharides. Proanthocyanidins, or condensed tannins, are polymers composed of flavan-3-ols subunits. They are located in grape skins and seeds and are responsible for colour stabilization and the sensory characteristics of the wines due to their astringent and bitter properties (Ribereau-Gayon et al. 1999, Chira et al. 2009, Sun et al. 2013).

Astringency is the sensation that commonly described as drying, roughing and puckering and is an important mouth-feel character of most red wines and can enhance their complexity and palate length (Gawel, et al. 2001). The polyphenols in red wines believed to be more responsible for astringency are the polymeric flavan-3-ols (Peleg et al. 1999). The flavan-3-ols derive primarily from the seeds and skin of

the grape, and are extracted into red wine during fermentation (Somers & Verette 1988). Additionally, has been demonstrated that overall astringency intensity is associated with the degree of salivary protein-tannin interaction (Kallithraka et al. 1998).

Cultural practises such as training and pruning system (Segade et al. 2009, Downey et al. 2004), leaf removal (Tardaguila et al., 2010), irrigation (Esteban et al., 2001) and fertilization used to influence fruit zone microclimate and grape growing. Water conditions have been recognized as one of the most important factors that determine the phenolic composition of grapes associated with wine quality (Esteban et al., 2001) and wine sensory attributes (Matthews et al, 1990). Also, irrigation treatments were applied in warm climates and the results showed an influence on the phenolic composition of berries with a consequence for the style of the wine (Chacon et al, 2009).

The objective of this work was to characterize the not well known variety Mavrotragano from the Greek domain and the effect of irrigation treatment in a warm region (Santorini) on phenolic composition of the produced wines.

Materials and methods

Experimental conditions

Grapes of cv. Mavrotragano were sampled in triplicate at maturity for three consecutive years September 2010, 2011 and 2012 from a vertical planting vineyard in Santorini. Three different conditions were applied: Control-no irrigation (NI), 30% of crop evapotranspiration (Medium Irrigation- MI) and 60% of crop evapotranspiration (Full Irrigation- FI).

Wines were produced using the same vinification technique for each treatment, in triplicates.

Analyses of wines

In wines several classical analysis %vol, hue, color intensity, pH, total acidity (Ribereau-Gayon, et al. 1999) were carried out after bottling. In addition, total phenolic content Folin–Ciocalteu test (Waterman & Mole, 1994), total anthocyanin content, total tannins (Ribereau-Gayon, et al. 1999) and estimation of chemical astringency with protein precipitation assay by bovine serum albumin- BSA (Harbertson, et al. 2003) were determined. All analyses were performed in triplicate.

Statistics

Data were subjected to one-way analysis of variance (ANOVA), of Statistica V.7 Software (Statsoft InC., Tulsa, OK). Comparisons of mean values were performed using Tukey's HSD test when samples were significantly different after ANOVA ($p < 0.05$).

Results

The concentration of total phenolics and total anthocyanins are given in Figure 1. The highest anthocyanin and total phenolic concentration was observed in wines from the irrigated vines. However, no effect was observed in total phenolics between wines from non-irrigated and medium irrigated vines.

In addition, wines from irrigated (FI and MI) vines showed higher concentrations of total tannins in comparison to those from the non irrigated ones. However, irrigation decreased the content of astringent compounds that precipitate with BSA (Figure 2).

As we can see in Table 1, no significant effect of irrigation was observed in %vol, colour intensity, hue and pH. However titratable acidity (TA) was higher in wines from non-irrigated vines but this was observed only for the vintages 2011 & 2012.

Conclusions

This work demonstrates that irrigation of vines cv. Mavrotragano in the region of Santorini may affect wine quality by increasing total anthocyanin concentration and by decreasing the BSA precipitated tannin fraction (chemical astringency). Irrigation increased also the concentration of total tannins.

Acknowledgments

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Figure 1: total phenolics & total anthocyanins

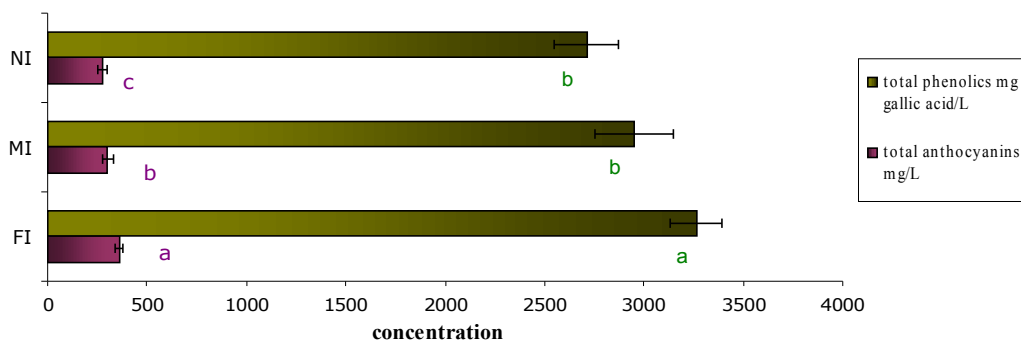


Figure 2 : total tannins & chemical astringency

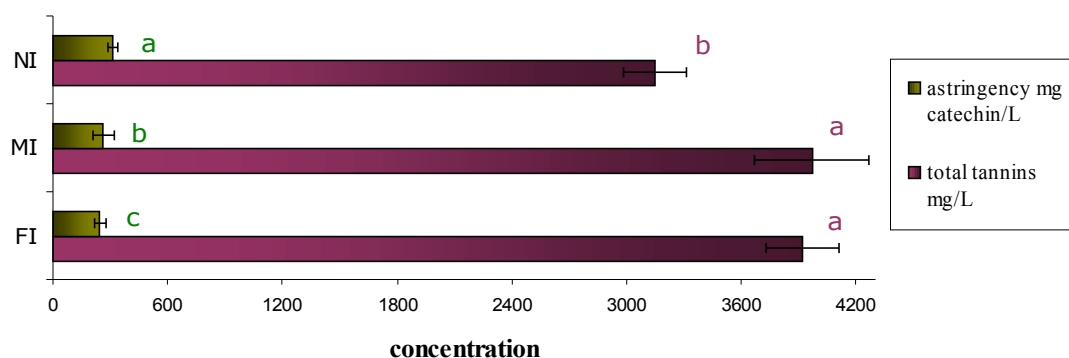


table 1 : Compositional parameters of the wines

	intensity	Hue	%vol	pH	titratable acidity (TA) *
FI	14,83 ± 0,52 ^a	0,61 ± 0,01 ^a	14,75 ± 0,34 ^a	3,61 ± 0,74 ^a	4,77 ± 0,28 ^b
MI	14,60 ± 0,76 ^a	0,64 ± 0,01 ^a	14,72 ± 0,45 ^a	3,64 ± 0,25 ^a	4,74 ± 0,32 ^b
NI	15,10 ± 0,39 ^a	0,61 ± 0,01 ^a	14,87 ± 0,43 ^a	3,57 ± 0,14 ^a	5,08 ± 0,69 ^a

* TA for the vintages 2011-2012

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