INFLUENCE OF SOME VITICULTURAL PRACTICES ON THE POLYPHENOLIC CONTENT OF GRAPES AND WINES PRODUCED FROM CV. AGIORGITIKO (*VITIS VINIFERA* L.)

INFLUENȚA UNOR PRACTICI VITICOLE ASUPRA CONȚINUTULUI DE POLIFENOLI AI STRUGURILOR ŞI VINURILOR DIN SOIUL AGIORGITIKO (*VITIS VINIFERA* L.)

PAVLIDIS M.[1], KYRALEOU Maria[1], KALLITHRAKA Stamatina[1], PROXENIA N.[1], KOUNDOURAS S.[2], KOTSERIDIS G.[1]

e-mail: stamatina@aua.gr

Abstract*: The aim of this work was to investigate the influences of some commonly applied viticultural practices on the polyphenolic content of cv. Agiorgitiko, an indigenous Greek grape variety. Two viticultural practices (leaf removal, irrigation as well as combination of both) were applied on cv. Agiorgitiko in the Nemea wine region and the phenolic content of the grapes and wines produced was compared. The results showed that when irrigation was combined with leaf removal a significant increase in the anthocyanin extractability was observed. Leaf removal caused a significant increase of the grape anthocyanin and tannin content. As far as the wines were concerned, color intensity, tannin content and antioxidant activity were increased due to leaf removal. The combination of irrigation and leaf removal resulted in wines with the highest individual anthocyanin concentration. The study showed that increasing bunch sun exposure of Agiorgitiko vines may be beneficial to the quality of the wine.*

Key words: cv. Agiorgitiko, poliphenols, tannin, leaf removal, irrigation

Rezumat*: Scopul studiului actual este evaluarea influenței unor practice viticole uzuale asupra conținutului de polifenoli din strugurii şi vinurile obținute din cv. Agiorgitiko, un soi tradițional greces, în regiunea viticolă Nemea. Rezultatele obținute au demonstrat că, atunci când, irigarea a fost combinată cu desfrunzirea, s-a remarcat o creştere semnificantă a extractibilității antocianilor. Desfrunzirea a dus la o creştere signifiantă a conținutului de antociani şi tanini din struguri. La vinuri, desfrunzitul a rezultat într-o creştere a intensității culorii, conținutului de tanin şi a activității antioxidante. Complexul de măsuri irigare şi desfrunzit a condus la obținerea de vinuri cu cea mai mare concentrație de antociani. Studiul a demonstrat că expunerea la soare a ciorchinilor de struguri din soiul Agiorgitiko influențează în mod pozitiv calitatea vinului obținut.*

Cuvinte cheie: cv. Agiorgitiko, polifenoli, tanin, desfrunzire, irigare

[1] Department of Food Science & Technology, Agricultural University of Athens, Greece
[2] Laboratory of Viticulture, School of Agriculture, Aristotle University of Thessaloniki, Greece

INTRODUCTION

Several strategies for increasing the content of phenolic compounds in wine have been made during the process of wine making and grape growing. Most of the viticultural practices applied in the vineyards are targeting on the increase of light penetration and air circulation into the canopy due to the benefits that they present: reducing humidity (Haselgrove et al., 2000), reducing the risk of fungal and bacterial infection (Emmett et al., 1992), increasing berry temperature and possibly increasing vine development and wine quality (Bordelon et al.,2008).

In cool climates, increased light penetration is related to enhanced anthocyanin and phenolic production (Ristic et al., 2007). However, it is under consideration whether this practice can be beneficial to wine quality in warm to hot and sunny climates, since extended bunch exposure could sharply increase bunch temperature and thus reduce the anthocyanin content of grapes (Lorrain et al., 2011).

Irrigation management seems to be another important factor in determining grape and wine quality, especially in arid and semi-arid areas, with the primary focus on grape phenolic compounds. However, limited data exist regarding the effect of vine water status on grape-derived metabolites. Moreover, water effects on berry components are often contrasting, mainly because of different irrigation volumes and environmental conditions, leading to variations in water availability.

The wine region of Nemea has a Mediterranean type climate, characterized by high temperatures and water deficiency during the summer season. There is a lack of information concerning the relationship between irrigation and leaf removal and wine quality due to the uniqueness of this grape variety.

In this study, the above practices were applied in the vineyard and the quality of the produced wines was determined based on two quality parameters of red wines; anthocyanin content and tannin composition.

MATERIAL AND METHOD

Grapes of cv. Agiorgitiko were sampled in triplicate at maturity in September 2010 from Nemea region. Four different conditions were applied:

- Control (C10),
- Irrigation (I10),
- Leaf Removal (LR10),
- Combination of Irrigation & Leaf removal (I/LR10).

Wines were produced using the classical red vinification technique, in triplicates.

Berries were homogenized and Ribereau Gayon & Stonestreet, (1966) and Iland, (2004) methods were applied for the quantification of total anthocyanins, tannins and anthocyanin extractability.

Seeds and skins were extracted using acetone-water (80:20, v/v) followed by methanol-water (60:40, v/v) and the residue was diluted in model wine for the quantification of total phenols (Follin-Ciocalteau), antioxidant activity (DPPH) and tannin content.

In wines color intensity, total tannins, total anthocyanins and antioxidant activity (DPPH) were determined.

Determination of individual anthocyanins by High-Performance Liquid Chromatography (HPLC):

A lot of 100 berries from each plot was weighted and manually skinned, and the skins were weighed and freeze-dried.

The freeze-dried tissues were then extracted with 100 mL of 1% HCl in Methanol.

Extraction was carried out under stirring for 48 h and repeated 3 times in triplicate.

Anthocyanin analysis was carried out according to Arnous et al. (2002).

RESULTS AND DISCUSSION

Total anthocyanins, total phenolics and anthocyanin extractability of berries are given in table 1.

Table 1

Total phenolic content, anthocyanin concentration and extractability in homogenized berries

Specification	C10	I10	LR10	I/LR10
Anthocyanins (mg/bery)	1,553± 0,02[b]	1,472± 0,04[b]	1,714± 0,05[a]	1,558±0,04[b]
Total phenols (au/bery)	2,27± 0,05[b]	2,32± 0,06[b]	2,60± 0,078[a]	2,43±0,05[a,b]
Anthocyanin extractability (AE%)	27,012±0,89[b,c]	35,966±1,37[a]	30,969±1,03[b]	24,84±0,76[c]

When irrigation was combined with leaf removal, grapes exibited a higher "cellular maturity'' expressed as anthocyanin extractability (AE%). On the contrary, when only leaf removal was applied, total athocyanin concentration (table 1) and malvidin-3-O-glucoside content of skin extracts (0,1%HCl/Methanol) were increased (figure 1).

No significant effect of these practices was observed regarding antioxidant activity and phenolic composition of skin extracts (results not appear). The concentration of total phenols (results not appear) in seed extracts was higher when irrigation was applied while when irrigation was combined with leaf removal resulted in higher antioxidant activity (figure 2).

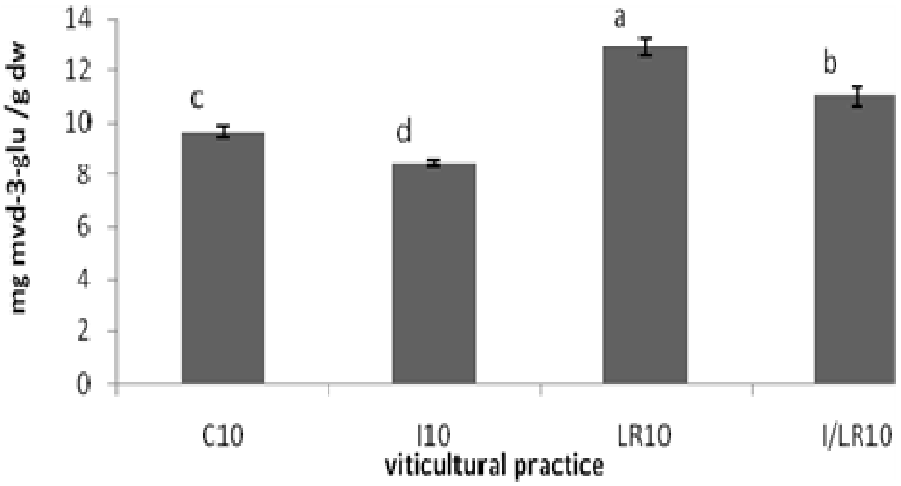

Fig. 1 - Concentration of malvidin-3-glucoside (mg/g dry weight) in skin extracts

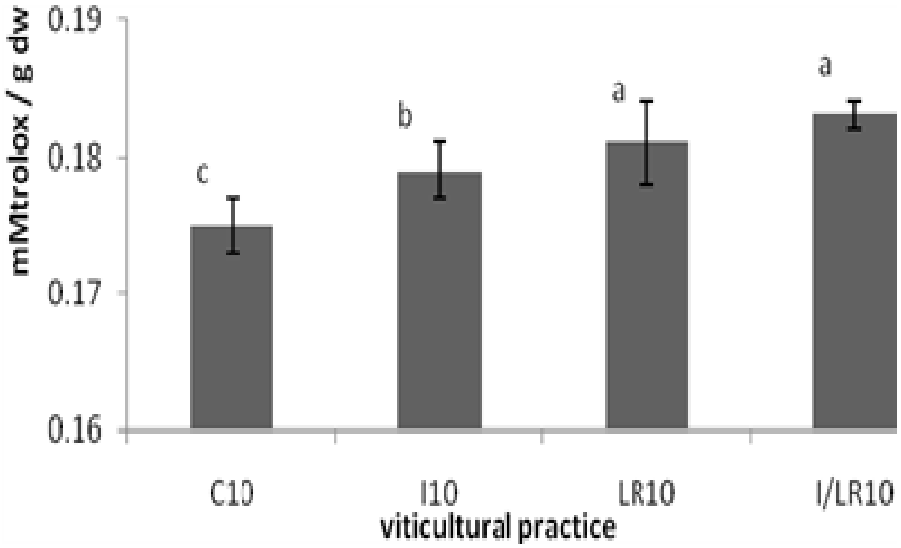

Fig. 2 - Antioxidant activity of seed extracts (mM trolox/ g dry weight)

Regarding wines, the applied practices did not affect significantly total anthocyanin content. However, leaf removal resulted in wines with higher color intensity. Since these wines also contained higher concentrations of tannins, this observation might be attributed to the tannin-anthocyanin complexes which are known to increase color intensity and stability. In

addition, leaf removal increased wine antioxidant activity possibly due to the elevated tannin content.

Table 2

Phenolic composition and antioxidant activity of wines

Specification	C10	I10	LR10	I/LR10
Total anthocyanins (mg/L)	306,92±11,34[a]	301,70±4,84[a]	337,32±11,67[a]	336,96±4,93[a]
Color intensity	4,71± 0,08[c]	4,74± 0,02[c]	7,73± 0,34[a]	5,83± 0,12[b]
Malv-3-glu (mg/L)	68,08± 2,77[b]	79,34±0,58[a,b]	77,94±4,58[a,b]	83,69±1,03[a]
Total tannins (g/L)	1,432± 0,03[c]	1,414±0,03[c]	2,027± 0,06[a]	1,862±0,09[b]
Antioxidant activity (mMtrolox)	5,97± 0,21[c]	5,785± 0,1[c]	8,012± 0,09[a]	7,213± 0,02[b]

CONCLUSIONS

This work demonstrates that the leaf removal of vines cv. Agiorgitiko resulted in higher color intensity, antioxidant activity and total tannin concentration in the produced wines. In addition, when irrigation was combined with leaf removal anthocyanin extractability increased significantly.

REFERENCES

1. **Bordelon B.P., Skinkis P.A., Howard, P.H., 2008** - *Impact of training system on vine performance and fruit composition of Traminette*, Am. J. Enol. Vitic., 59, 1, p. 39-46.
2. **Brand-Williams W., Cuvelier M. E., Berset E.**, **1994** - *Use of a Free Radical Method to Evaluate Antioxidant Activity*, Lebensmittel-Wissenschaft Technology, 28, p. 25–30
3. **Haselgrove L., Botting D., Van Heeswijck R., Hoj P.B., Dry P.R., Ford C., Iland P.G.**, **2000** - *Canopy microclimate and berry composition: The effect of bunch exposure on the phenolic composition of Vitis vinifera L cv. Shiraz grape berries*, *Austr. J. Grape Wine Res.*, 6 (2), p. 141-149.
4. **Iland P.G., Bruer N., Edwards G., Weeks S., Wilkes, E., 2004** - *Chemical analysis of grapes and wine: techniques and concepts*, P. Iland Wine Promotions PTY LTD, Campbelltown, Australia.

5. **Lorrain B., Chira K., Teissedre, P.L.**, **2011** - *Phenolic composition of Merlot and Cabernet-Sauvignon grapes from Bordeaux vineyard for the 2009-vintage: Comparison to 2006, 2007 and 2008 vintages*, Food Chem., 126, 4, p. 1991-1999.
6. **Ribéreau-Gayon P., Stonestreet E**., **1965** - *Bull. Soc. Chim.*, vol. 9, p. 2649-2652.
7. **Ristic R., Downey M., Iland P., Bindon K., Francis L., Henderich M., Robinson S., 2007** - *Exclusion of sunlight from Shiraz grapes alters wine colour, tannin and sensory properties*, Austr. J. Grape Wine Res., 13, 2, p. 53-65.
8. **Waterman P.G., Mole S.**, **1994** - *Analysis of phenolic plant metabolites*, Oxford: Blackwell Scientific Publ., p. 83-91.