Impact of mash maceration duration and temperature on non-flavonoid phenolics in Malvazija istarska wines

Ena Bestulić[1], Sara Rossi[1], Fumica Orbanić[1], Ivana Horvat[1], Igor Lukić[1], Tomislav Plavša[1], Ana Jeromel[2], Sanja Radeka[1]

[1]*Institute of Agriculture and Tourism, Karla Huguesa 8, 52440 Poreč, Croatia (ena@iptpo.hr)*
[2]*University of Zagreb Faculty of Agriculture, Department of viticulture and Enology, Svetošimunska 25, 10000 Zagreb, Croatia*

INTRODUCTION

Phenolic acids and stilbenes are important groups of non-flavonoid phenolic compounds present in grapes and wine. Their content in wine may be modulated by the vinification technique applied.
The present study aimed to determine the impact of the application of different grape mash maceration treatments on the composition of hydroxycinnamic (HCA) and hydroxybenzoic acids (HBA) and stilbenes in Malvazija istarska wines.

RESULTS

- Prolonged post-fermentative maceration treatment M42 – the highest concentrations of total HBAs
- Gallic acid - significantly the highest concentrations among all HBAs
- HCAs, the total content was significantly the highest in seven days maceration treatment (M7), while in longer maceration treatments (M14, M21, M42) total HCA content gradually decreased as maceration progressed
- individual HCAs, *trans*-caftaric acid had the highest concentrations, especially in M7 treatment wine, while caffeic and ferulic acids reached the highest concentrations in pre-fermentative two days (CRYO) treatment
- Total stilbene content – M7, M14, and M21 obtained the highest concentrations, but did not significantly differ between each other, and when observing individual stilbenes *cis*-piceid concentrations were the highest in those treatments and among all identified stilbenes

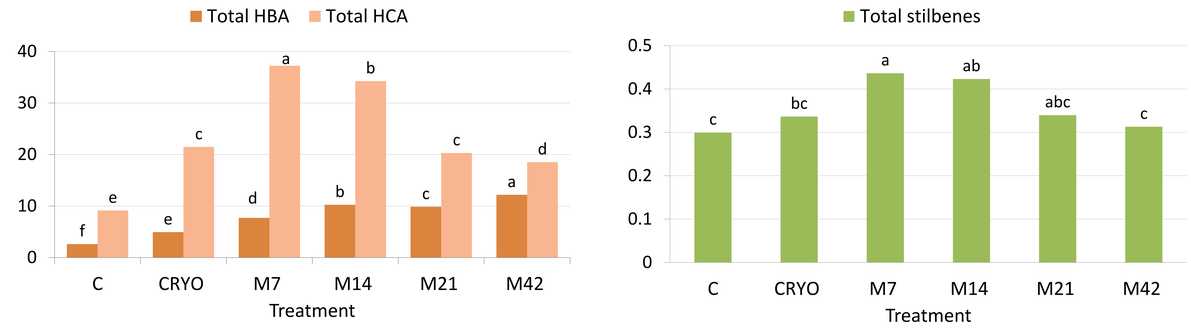
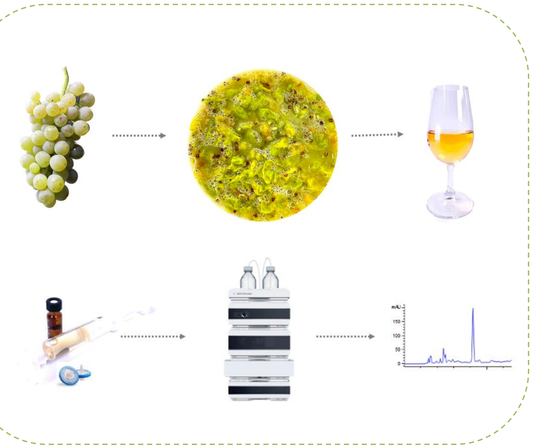


Figure 1. A) Total HBA and HCA concentrations (mg/L) in different Malvazija istarska wine treatments, and **B)** Total stilbene concentrations (mg/L) in different Malvazija istarska wine treatments. Different lowercase superscript letters represent statistically significant differences between treatments at $p < 0.05$ obtained by one-way ANOVA and least significant difference (LSD) test.

MATERIALS AND METHODS

- Institute of Agriculture and Tourism (Poreč, Croatia)
- **Malvazija istarska** (*Vitis vinifera* L.), an autochthonous Croatian white grape variety
- six vinification treatments: two days maceration treatment at 8 °C (**CRYO**, and seven (**M7**), 14 (**M14**), 21 (**M21**), and 42 days (**M42**) maceration treatments at 16 °C, compared with the control treatment without maceration (**C**)
- Identification and quantification of phenolic acids (HBA and HCA) and stilbenes – high performance liquid chromatography **HPLC-DAD**
- One-way analysis of variance (ANOVA) and Fisher's test of least significant differences (LSD)



Non-flavonoid phenolics (mg/L)	Treatment					
	C	CRYO	M7	M14	M21	M42
HBA						
Gallic acid	0.82 ± 0.21^{f}	1.88 ± 0.11^{e}	4.16 ± 0.07^{d}	6.66 ± 0.19^{b}	6.27 ± 0.14^{c}	$\mathbf{8.63 \pm 0.37^{a}}$
Protocatechuic acid	1.12 ± 0.02^{c}	2.04 ± 0.19^{b}	2.47 ± 0.15^{a}	2.47 ± 0.08^{a}	2.49 ± 0.04^{a}	2.4 ± 0.10^{a}
p-Hydroxybenzoic acid	0.35 ± 0.01^{d}	0.51 ± 0.01^{b}	0.38 ± 0.03^{c}	0.49 ± 0.01^{b}	0.51 ± 0.02^{b}	0.57 ± 0.01^{a}
Syringic acid	0.32 ± 0.01^{e}	0.51 ± 0.01^{d}	0.68 ± 0.01^{a}	0.63 ± 0.01^{b}	0.58 ± 0.00^{c}	0.59 ± 0.00^{c}
HCA						
cis-Caftaric acid	0.30 ± 0.04^{c}	0.64 ± 0.04^{a}	0.49 ± 0.12^{b}	0.41 ± 0.12^{bc}	0.39 ± 0.11^{bc}	0.30 ± 0.06^{c}
trans-Caftaric acid	3.84 ± 0.32^{e}	13.87 ± 0.54^{d}	$\mathbf{31.25 \pm 0.34^{a}}$	28.21 ± 1.19^{b}	15.94 ± 0.92^{c}	13.28 ± 0.49^{d}
Caffeic acid	2.59 ± 0.05^{c}	3.96 ± 0.09^{a}	2.68 ± 0.04^{bc}	2.9 ± 0.09^{b}	2.00 ± 0.23^{d}	2.86 ± 0.15^{b}
p-Coumaric acid	1.41 ± 0.06^{b}	1.80 ± 0.04^{a}	1.70 ± 0.11^{a}	1.64 ± 0.16^{a}	1.07 ± 0.05^{c}	1.18 ± 0.02^{c}
Ferulic acid	1.00 ± 0.03^{c}	1.18 ± 0.01^{a}	1.1 ± 0.03^{b}	1.09 ± 0.06^{b}	0.89 ± 0.01^{d}	0.91 ± 0.01^{d}
Stilbenes						
trans-Piceid	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Piceatannol	0.07 ± 0.01^{c}	0.08 ± 0.02^{c}	0.11 ± 0.00^{a}	0.10 ± 0.01^{ab}	0.08 ± 0.02^{bc}	0.07 ± 0.01^{c}
Resveratrol	0.08 ± 0.00	0.09 ± 0.00	0.16 ± 0.1	0.14 ± 0.05	0.09 ± 0.01	0.1 ± 0.02
cis-Piceid	0.15 ± 0.00^{c}	0.16 ± 0.00^{b}	$\mathbf{0.16 \pm 0.00^{ab}}$	$\mathbf{0.17 \pm 0.00^{a}}$	$\mathbf{0.17 \pm 0.01^{ab}}$	0.15 ± 0.01^{c}

Table 1. The concentration of individual HPLC non-flavonoid phenolic compounds in different Malvazija istarska wine treatments. Different lowercase superscript letters represent statistically significant differences between treatments at $p < 0.05$ obtained by one-way ANOVA and least significant difference (LSD) test; n.d. – not detected.

CONCLUSION

Obtained results show that HBA content benefits from the prolonged maceration, while for the most HCAs and stilbenes concentrations increase up to seven days of maceration and then decrease during prolonged maceration, possibly due to oxidation and other reactions.

ACKNOWLEDGEMENTS

The study was funded by the Croatian Scientific Foundation under the projects VINUM SANUM (IP 2018-5049) and DOK-2020-01-1901