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How does the foliar application of vine-shoot extract onto grapevine affect white must composition?

Sourced from the research article "Effect of vine-shoot and oak extract foliar grapevine applications on oenological parameters, phenolic acids and glutathione content of white musts and wines" (OENO One, 2020)[1].

>>> Nowadays, agronomic practices are evolving towards *"Sustainable Agriculture"* using environmentally friendly systems. Modern viticulture aims to reduce inputs without reducing grape yield and wine quality. As a result of pruning, vine-shoots are generated as vineyard waste. However, their aqueous extracts have been shown to have significant contents of bioactive compounds and, therefore, biostimulant activity. Foliar applications of vine-shoot extracts onto a white grapevine variety caused a reduction in sugar content, and an effect on the content in grape reaction product (*trans*-GRP) was observed. <<<

■ Study context

The wine industry is actively looking for new ways to reuse waste and turn it into by-products with high added value in order to be more competitive, innovative and sustainable.
In the vineyard, the most important waste products are pruned vine-shoots[2]. Although this kind of waste has long been used for different purposes (organic fertilisers, food additives, paper pulp production or to obtain solid biofuels, among others), recent studies on the chemical composition (phenolic, volatile, and mineral compounds) of their aqueous extracts[3] have shown that they have great potential for being assimilated by plants; for example, Airén and Moscatel vine-shoot extracts applied foliarly to the grapevines have been shown to have a biostimulant effect, improving the phenolic and volatile composition of wines[4, 5].
Colour is considered to be one of the most important properties of must and wines coming from white varieties, the oxidation process of such wines being well-known. Glutathione, a naturally occurring antioxidant, is a tripeptide formed by three amino acids (cysteine, glutamate and glycine) present in grape, must and wine. It has the ability to regenerate the o-diphenol group of enzymatically oxidized trans-caftaric acid, giving rise to 2-S-glutathionyl-trans-caftaric acid (also known as grape reaction product, GRP), which inhibits the browning of wine. The amount of GRP present in a wine provides information about its oxidation history throughout its production and aging.

■ Trials

The aim was to study how foliar application in the vineyard of aqueous extracts from vine-shoots directly affects white grape composition. In order to do this, must composition was studied for °Baumé, glutathione and trans-GRP content during two consecutive vintages (2013 and 2014). The study took different variables into account: pruned vine-shoot variety (Airén and Moscatel), pruned vine-shoot toasting effect (non-toasted and toasted) and extract formulation effect (applied once or twice).

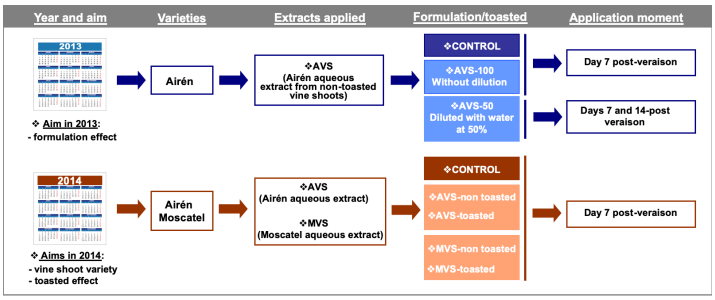


Figure 1. Aqueous extracts tested in the study with different aims.

The prepared[3] aqueous extracts were:
➔ AVS: Airén aqueous extract from non-toasted pruned vine-shoots: from 2013 (AVS_{2013}) and 2014 (AVS_{2014}).
➔ $AVS_{Toasted}$: Airén aqueous extract from toasted pruned vine-shoots.
➔ MVS_{2014}: Moscatel aqueous extract from non-toasted pruned vine-shoots.
➔ $MVS_{Toasted}$: Moscatel aqueous extract from toasted pruned vine-shoots.

In previous applications, a superficial wetting agent typically used for foliar treatments was added at a dose of 0.05 % (v/v). Treatments (Figure 1) were sprayed on the leaves[6]. Airén vines (*Vitis vinifera L.*) grown in O.D. Jumilla, in Southwest Spain, were used.
In 2013, the formulation effect of pruned vine-shoot extracts was tested: the AVS_{2013} extract was applied once on day 7 post-veraison (AVS_{2013}-100), and the second application was carried out with AVS_{2013} diluted with water at 50 %, which was applied twice on days 7 and 14 post-veraison (AVS_{2013}-50). In 2014, the vine-shoot variety and toasted procedure effects were tested. All treatments (AVS_{2014}, $AVS_{Toasted}$, MVS_{2014} and $MVS_{Toasted}$) were applied once (on day 7 post-veraison). Moreover, plants treated with water were selected each year for the Control.

■ Effects on must sugar content and on wine alcohol strength

The sugar content (measured as °Baumé) of the must from the treated vines, was lower than the Control ones in both seasons (Figure 2). Although vintage variability was observed, the foliar applications seemed to have clearly affected sugar accumulation in the berries. Additionally, while the wood toasting procedure (studied in the 2014 season) did not seem to follow any pattern, the formulation effect (studied in the 2013 season) showed

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an influence on the °Baumé content; the same dose was given, but when diluted and applied twice it seemed to have a greater effect on the accumulation of sugars. The phenomenon of the decrease in sugar content was observed in musts (probable alcohol) and in the wines they produced (alcohol content).
All grapes in both vintages and from all treatments were harvested considering the optimum maturation time of the Control sample. Therefore, the delay in grape ripening could be due to the application of the vegetal extracts; the extracts may have caused a stress on the grapevine, further decreasing the photosynthesis process. Hence, the sugar content of the treated berries decreased[7]. This fact would be a very interesting alternative for the wine industry given the consumer demand for wines with low alcohol content and the current global warming/climate change scenario.

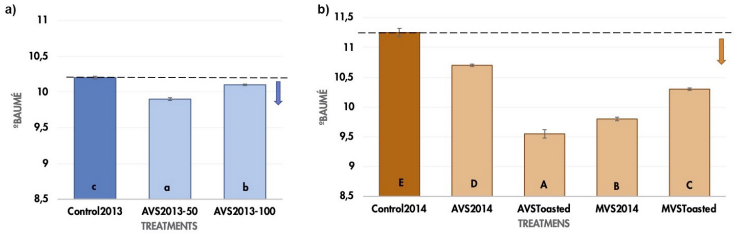


Figure 2. °Baumé of musts after vines treated with different vine-shoots extracts: a) 2013 vintage; b) 2014 vintage. Small letters indicate significant differences for musts in 2013 vintage and capital letters for musts in 2014 vintage according to the Tukey test ($p \leq 0.05$).

■ Effects on glutathione and *trans*-GRP content of musts

During the 2013 and 2014 vintages, the treatment of Airén vine-shoot extract (AVS and AVSToasted) did not affect the glutathione concentration in the must from the Control vines. In relation to the Moscatel vine-shoot extracts (MVS and MVSToasted), the glutathione concentration in must decreased compared to the Control samples[1]. Such differences could mainly be related to climatic conditions and to the biosynthetic pathways that modify or activate vine secondary mechanisms depending on the different extract applications.
With regards to the trans-GRP content, must from vines treated with the different vine-shoot aqueous extracts showed a significantly higher content compared to the Control ones, except for those from the AVSToasted (Figure 3). This means that the must had a greater amount of glutathione adducts and orthodiphenol compounds, which are not polyphenoloxidase substrates, hence reducing the well-known browning problem in white wines. After alcoholic fermentation, trans-GRP concentration decreased, but to a lesser extent than the glutathione. In wines, the vintage effect was higher than the vine-shoot extract, since the differences were maintained in the 2013 vintage, but not in 2014[1].

■ Final remarks

The foliar applications of pruned vine-shoots on Airén grapevines clearly reduced the sugar content in grapes, but no effect was observed for glutathione content. Moreover, higher values for *trans*-GRP formation were recorded in must from treated vines in both studied vintages.

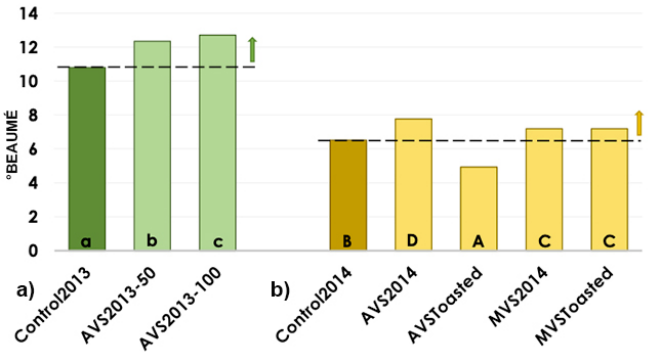


Figure 3. Grape reaction product (*trans*-GRP) content (mg/L) in musts after different vine-shoot extract applications: a) 2013 vintage; b) 2014 vintage. Small letters indicate significant differences for musts from the 2013 vintage and capital letters for musts from the 2014 vintage according to the Tukey test ($p \leq 0.05$).

■ Significance and impact of the study

These findings are important in relation to making the most of vineyard waste, as well as improving the quality of white must as a result of effects on oxidation processes, by using alternative more sustainable and intrinsic products from the vineyard. ■

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