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An ethanol spray at veraison enhances colour in red wines

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Abstract

Aqueous ethanol (5% v/v) was sprayed onto bunches of *Vitis vinifera* L. cv. Cabernet Sauvignon 8–9 weeks following full flowering (controls were sprayed with water). Internal ethylene concentration in treated berries increased to a maximum within 6 hours, and berry colour subsequently increased substantially (maximum attained 2–3 weeks after spraying). Berry fresh weight at harvest was unaffected by ethanol treatment, but wine made from treated grapes showed greater colour intensity compared with control grapes.

Keywords: grapes, ripening, *Vitis vinifera*, Cabernet Sauvignon, ethanol spray, ethylene, berry colour, wine colour

Introduction

Studying the effects of an ethanol spray on grapes may seem counter-intuitive, but positive results can follow. Indeed, ethanol has recently been shown to stimulate ethylene synthesis in tomatoes (Beaulieu and Salveit 1997). In turn, this plant hormone is also known to enhance synthesis of anthocyanins, the main pigments of red grape (Weaver and Montgomery 1974, Mazza 1995). Pigmentation in ripe grapes might be similarly affected. Moreover, increasing pigment levels in ripe grapes by using ethanol instead of synthetic chemicals (including ethylene precursors, as used widely in horticulture) is consistent with sustainable viticulture.

Accordingly, we studied the effect of an ethanol spraying program at veraison because this stage is recognised as one of the best times to apply ethylene precursors in order to boost anthocyanin synthesis (Weaver and Montgomery 1974, Schulman et al. 1985). According to one study on tomatoes (Beaulieu and Salveit 1997) only low doses of ethanol (< 2 mg/g fresh wt) stimulate ethylene synthesis, while high doses (> 6 mg/g fresh wt) actually inhibit synthesis. Our application rates were adjusted to stimulate, rather than inhibit *in vivo* synthesis of grape berry ethylene.

Material and methods

Ethanol, 5% in water (v/v), was sprayed onto Cabernet Sauvignon (*Vitis vinifera* L.) bunches at a rate equivalent to 200 L/ha, 8 to 9 weeks after full flowering. Approximately 50% of berries had turned purple by that stage. Controls were sprayed with water. Internal ethylene assay was carried out within two hours of picking whole clusters (n = 6 clusters, each from a different vine, vintage 2000). Internal gases were obtained from grape berries under partial vacuum in a saline solution and the

ethylene was measured by gas chromatography according to Alleweldt and Koch (1977). The colour of berry skins was assessed in acidified methanolic extracts and expressed as OD_{520nm} per gram of berry skin fresh weight, as outlined previously by Boss et al. (1996). Spectrophotometric data were obtained from n = 6 clusters (skins of 10 berries per cluster), each from a different vine over 2 combined vintages, 3 replicates in 1999 and 3 replicates in 2000. Finally wines were made in triplicate for each treatment (n = 3 wines made separately, each from 10 kg of the vintage 1999 grapes). The wines were stored for one year and the colour intensity was expressed as the sum of OD_{420nm} + OD_{520nm} + OD_{620nm} according to OIV standards (Anonymous 1999).

Results and discussion

Ethanol spray did not change berry weight significantly. At harvest the weight of 50 control berries was 22.17 ± 0.55 g compared with 21.93 ± 1.16 g for ethanol-treated fruit (mean \pm SE, n = 3). By contrast, we observed that 5% ethanol rapidly stimulated internal ethylene concentration in grapes (Figure 1a). We also observed that grapes sprayed with ethanol accumulated higher levels of red pigments in berry skin (Figure 1b). Similar results were obtained over two consecutive years with different vines and different weather over the month prior to harvest. Optical density (OD) at 520 nm is a good indicator of anthocyanin concentration, although other factors influencing colour, including co-pigments, may have been altered by the ethanol spray. While acknowledging that issue, we note that the colour intensity of one-year-old wines made from ethanol-treated grapes was greater than that from controls (Figure 1c). This is an important outcome because colour stability is a major quality factor of red wines.

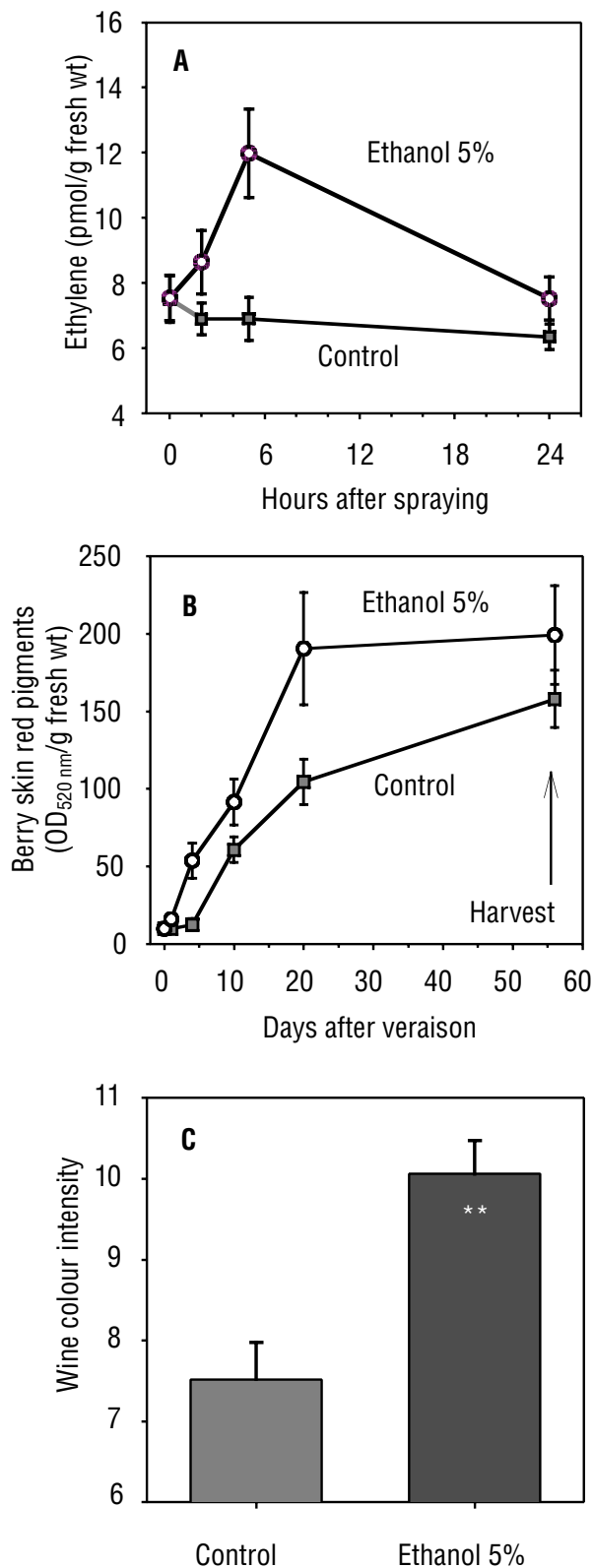


Figure 1. Effects of spraying ethanol at veraison on (a) internal ethylene of Cabernet Sauvignon grape clusters, (b) OD at 520 nm of acidified methanolic extracts of grape berry skins and (c) resulting one-year-old wine colour intensity. Values are means of (a) $n = 6$ clusters, (b) $n = 6$ clusters (10 berries per cluster), and (c) $n = 3$ wines. Error bars show mean values \pm SE; t -test results in comparison to controls are shown by ** for $P = 0.01$.

Two additional findings warrant comment. Firstly, over our two-season study, we found that the ethanol effect was more pronounced, in comparison to the control, when the end of summer was partly cloudy and temperate as in 1999, than when the ripening season was very sunny and warm as in 2000. Thus, an ethanol spray might be of particular value in cool climate viticulture areas. Secondly, as ethanol-treated grapes reached their maximum colour within two to three weeks after spraying, it may be interesting to test a spray program at a date closer to harvest than veraison.

Finally, we are presently studying the stimulation by ethanol of gene transcription corresponding to proteins involved in anthocyanin synthesis. Our main question is whether ethanol acts on anthocyanin synthesis through an ethylene signal exclusively, or via other signals as well.

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