HIGH AND EXTREME HIGH TEMPERATURE EFFECTS ON SHIRAZ BERRY COMPOSITION

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Abstract:

Context and purpose of the study – Climate change is leading to a rise in average temperature and in the frequency and severity of heatwaves, and is already significantly disturbing grapevine phenology and berry composition. With the evolution of the weather of Australian grape growing regions that are already warm and hot, flavonoids, for which biosynthesis depends on bunch microclimate, are expected to be impacted. These compounds include anthocyanins and tannins which contribute substantially to grape and wine quality. The goals of this project were to determine if berry tannin accumulation is sensitive to high temperature and to enhance knowledge on upper temperature limits for viable wine production, in turn informing critical timing for mitigation strategies.

Material and methods – Temperature-related parameters (duration, intensity, day/night, phenological stages, levels and berry acclimation) were investigated across five glasshouse experiments, conducted on well-irrigated potted Shiraz grapevines, during the 2016-17 and 2018-19 seasons. The research focused on high (>35 °C) and extreme high (>45 °C) temperatures impact on berry physiology, survival and detailed tannin composition. Berries were sampled at regular intervals, peeled, ground, and skin and seed flavonoid composition individually analysed by LC-MS/MS. Primary and other secondary metabolites were also analysed by gas and liquid chromatography-mass spectrometry on key samples to provide a more comprehensive picture.

Results – Tannin accumulation experienced just a short delay following high temperature exposure during early berry development, providing berries were not damaged. Differences were likely due to a combination of berry development disruption as well as a deregulation of some genes involved in tannin biosynthesis. Most differences were no longer evident by harvest, but if any, tannin extractability was increased compensating for the decrease in berry phenolics. To complement compositional responses, berry survival thresholds were identified with green Shiraz berries exhibiting visual damage for temperatures above 42-44 °C while red berries only started to necrose above 50 °C. In damaged berries, skin flavonoids were dramatically reduced while seeds were mostly preserved. With the experimental system used for this study, tannin accumulation showed an elastic response to high temperature and if berries were not shrivelled, quality was not impaired at harvest by the sole effect of temperature.

Keywords: Berry composition, Bunch heating, Composition, Heatwave, High temperature, Tannins.