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Cultivar diversity of grape polyphenol composition and changes in response to drought investigated by LC-MS based metabolomics

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Phenolic compounds are essential for the quality of grape and wine and play a major role in plant defense against biotic and abiotic stresses. Grape phenolic composition is genetically driven and greatly affected by environmental factors, including water stress. A major challenge for breeding of grapevine cultivars adapted to climate change and with high potential for wine-making is to dissect the complex plant metabolic response involved in adaptation mechanisms.

A targeted metabolomics approach based on ultra high-performance liquid chromatography coupled to triple quadrupole mass spectrometry (UHPLC-QqQ-MS) analysis in the Multiple Reaction Monitoring (MRM) mode enabling rapid, selective, and sensitive quantification of 96 phenolic compounds (anthocyanins, phenolic acids, stilbenoids, flavonols, dihydroflavonols, flavan-3-ol monomers and oligomers…, and of the constitutive units of proanthocyanidins (i.e. condensed tannins), has been developed for high throughput profiling of the phenolic composition of grape skins.

This method has been applied for analysis of the phenolic composition of mature grape berries from a core-collection of 279 V. vinifera cultivars grown with or without watering, in two successive vintages (2014-2015). Chemometrics analysis of the data showed large differences in polyphenol composition related to genetic factors and water deficit. Correlation networks gave insight on the relationships between the different phenolic metabolites and related biosynthetic pathways. In addition, detailed polyphenomics analysis showed that polyphenol reactions described in wine take place in the berries. Finally, cultivar differences in the types and extents of drought responses, with different molecules affected either positively or negatively, potentially impacting grape and wine quality, were also established.

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