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A METABOLOMIC VIEW OF WINE MICRO-OXYGENATION

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Sangiovese, UPLC, mass spectrometry, iron, oxygen

Contribution

Oxygen plays a fundamental, and often controversial role, during winemaking. Luis Pasteur was the first to raise the idea, conflicting against the belief of his time, that "It's the oxygen that makes the wine. By its influence the wine matures" [1]. To date is widely accepted that a well controlled, limited exposure to oxygen, is indispensable for the optimal aging of premium red wines. When oxygen is in contact with wine, the metal catalysed Fenton reaction have been shown to be a major route to ethanol oxidation [2, 3]. Strong oxidant species are produced, which have been suggested to react directly with the wine constituents, bypassing the pool of polyphenols [3].

We report here the first results of an experience of micro-oxygenation of a Sangiovese wine of the vintage 2009, performed at the Tuscania experimental winery. The micro-oxygenation was carried on during the early phases of winemaking, just after the alcoholic fermentation and prior

to the malo-lactic fermentation. The wine (240 hl) was divided in 24 stainless-steel tanks and subjected to 7-weeks of controlled micro-oxygenation under 8 different conditions, in triplicate. The variables investigated were the amount of oxygen (four levels, 0-5-10-15 mg per litre per month) and the iron concentration (two levels, 1.5 and 2.0 mg/L), while all other conditions were strictly standardized and monitored. During and after the micro-oxygenation trials, the wine composition, antioxidant and sensorial properties were measured. A data-driven experiment, aimed at measuring the effect of the treatments on all measurable low-molecular weight organic compounds in wine, was performed by Synapt UPLC-Q-TOF (Waters), with ESI interface operating under both positive and negative conditions. A number of >1000 and >3000 features (i.e. unique couple of retention time and exact mass) were measured in the experimental wines, respectively by direct injection or after SPE preparation. After data alignment and processing with the s/w MarkerLynx (Waters), a preliminary list of the biomarkers of wine micro-oxygenation in presence of variable levels of iron and oxygen were extracted. This experiment confirmed that both factors influence in a complex manner the wine composition during wine ageing. The effects induced from both iron and oxygen during the treatments involved a very large number of wine constituents. This experiment, now in progress with a second phase of micro-oxygenation after the FML fermentation, highlights the feasibility of unbiased, non-target metabolomic experiments, for improving our understanding of wine chemistry.

REFERENCE LIST

[1] Pasteur L. Etudes sur le vin. Librairie F. Savy, Paris, 1873, 344pp.
[2] Singleton V.L., Am. J. Enol. Vitic., 1987, 38, 69-77.
[3] Elias R.J., Andersen M.L., Skibsted L.H., Waterhouse A.L., Am. J. Enol. Vitic., 2009, 60, 471-475