Chemical markers in wine related to low levels of yeast available nitrogen in the grape

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Contribution

Nitrogen is an important nutrient of yeast and its low content in grape must is a major cause for sluggish fermentations. To prevent problems during fermentation, a supplementation of the must with ammonium salts or more complex nitrogen mixtures is practiced in the cellar. However this correction seems to improve only partially the quality of wine [1]. In fact, yeast is using nitrogen in many of its metabolic pathways and depending of the sort of the nitrogen source (ammonium or amino acids) it produces different flavor active compounds. A limitation in amino acids can lead to a change in the metabolic pathways of yeast and consequently alter wine quality. A better management of nitrogen fertilization of vineyards can significantly increase the quantity of yeast available nitrogen (YAN) in the grape and consequently the wine quality. A metabolomics study comparing Chasselas and Doral wines produced from grapes of two variants, nitrogen deficient culture versus supplemented with foliar urea, indicated several markers related to nitrogen supplementation of grapes [2]. Four substances from these potential markers were chosen for the present study: 2-phenylethanol, 2- plus 3-methylbutanol, succinic acid and prolin. The production of these compounds is known to be influenced by the nitrogen content of the must and they are in easily measurable concentrations in the wine.

The objective of this work is to study the correlation between the concentration of YAN in must and the concentration of the four potential chemical markers in the wine using a significant number of samples (>130) including different grape varieties (13), harvests (2009-2014) and yeast types. The goal is to create a model for the retro-prediction of YAN concentration in the original must based on the chemical analysis of the wine. This information can be used by winemakers to optimize nitrogen fertilization of their vineyards.

Wines produced in the cellar of AGROSCOPE using a standard protocol without addition of ammonium salt were used for this study. The concentration of YAN in the must was determined before the fermentation. The concentrations of the potential markers in the wine were measured for: the higher alcohols (2-phenylethanol, 2- and 3-methylbutanol) by GC-FID, for succinic acid by enzymatic method and for prolin by HPLC-MS.

The four markers show a good correlation ($R^2 > 0.7$) with YAN content in must. Grape variety and yeast variety strongly influence these correlations whereas harvest is less important. The distribution of YAN between ammonium and different individual amino acids explains the major part of the effect from the grape varieties.

Reference
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