



Grape yield to soil N-NO₃⁻ ratio can explain the different levels of biogenic amines in wine from two vineyards in the AOC Rioja (Spain)

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Plant N status may affect the grape amino acid concentration, which act as precursors in the formation of biogenic amines in wine. Biogenic amines have negative effects on human health and so they reduce the wine quality. The objective of this study was to analyze, at bloom (when the vine N demand peaks) if both the available soil N and the N concentration in the leaf could explain the amino acid concentration in the must as well as the biogenic amines in wines from AOC Rioja.

Two plots with cv. *Tempranillo* (*Vitis vinifera* L.) vines grafted on R-110 rootstock were chosen: "La Grajera" (2,998 plants ha⁻¹) and "Nájera" (2,849 plants ha⁻¹), both plots with a traditional soil tillage management system and classified according to the American Soil Taxonomy as *Typic Haloxerepts* and *Oxyaquic Xerorthent*, respectively. Both soils had a pH higher than 7, a silty loam texture and organic matter values lower than 2%. The climatic conditions were described as semiarid Mediterranean according to the UNESCO aridity index.

In each vineyard, three non-adjacent experimental plots with 3 rows of 30 vines each, were set out. No fertilizer was applied during the project. Each plot was sampled in 2009, 2010 and 2011 seasons at bloom, analyzing the available soil N-NO₃⁻ at 0-15 and 15-45 cm depth and expressing the results in kg ha⁻¹ by means of the bulk density of soil and the coarse elements content. Also at bloom, 30 leaves per experimental plot were collected and their N concentration was analyzed. At harvest, 200 berries were taken from each plot and the amino acid content in the musts was determined by HPLC. In addition, 100 kg of grapes from each plot were taken in order to elaborate wine according to the AOC Rioja common winemaking practices. When the winemaking process was finished, the concentration of biogenic amines in the wine (histamine, methylamine, ethylamine, tyramine, putrescine, cadaverine, phenylethylamine and isoamylamine) was determined by HPLC. Our results showed that both the total amino acid content in the must and the sum of biogenic amines in the wine were higher in "La Grajera" than "Nájera". Positive correlations were observed between the total biogenic amine content and leaf N ($R^2=0.33$, $p=0.007$), soil N-NO₃⁻ ($R^2=0.43$, $p<0.001$), and the yield to soil N-NO₃⁻ ratio ($R^2=0.71$, $p<0.001$).

These results indicate that the higher biogenic amines concentration in "La Grajera" wines could be caused by the higher soil N availability as well as the lower yield thus leading to a higher concentration in both amino acids and biogenic amines.

Therefore, in order to determine which conditions could increase the amino acid concentration in the must and cause high levels of biogenic amines in wine, it would be more convenient to consider the ratio between yield and soil N-NO₃⁻ instead of carrying out either a soil N-NO₃⁻ determination or analyzing the leaf N concentration.