

Is geology or soil which produces the terroir effect? An experimental study in representative Chianti Classico terroirs during three contrasting vintages

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The influence of terroir on the style of wine obtained an international acknowledgement in the context of the International Organisation of Vine and Wine (OIV) in 2010.

Although it is known that geology, morphology and microclimate influence and diversify the wine characters, it is not studied in detail the real effect of soil features, namely soil hydrology, limiting horizons, secondary precipitation of salts and carbonates, etc.

Aim of this work was to demonstrate and quantify the effect of geology-morphology-climate (macro-terroirs) and of the soil features (Basic Terroir Units, BTUs) on wine quality.

The study was conducted during three different vintages (2012, '13 and '14) in vineyards belonging to one of the biggest farm of Chianti Classico and characterized by four different macro-terroirs, which are representative of the most common viticultural environments of the Chianti Classico wine district. In particular, the macro-terroirs were :

- Agresto: developed on clayey-calcareous rocks situated in slopes between 400 and 450 m a.s.l. and characterized by clay-loamy, calcareous, and stony soils.
- Fattoio: developed on feldspathic sandstone, situated at elevated altitude for vineyard (430-500 m a.s.l.). The soil was characterized by sandy or loamy-sandy texture, high stoniness and very low content of calcium carbonate (< 1%).
- Leccio: developed on marine sands and gravelly-sands of early Pliocene period, situated in slopes around 300-350 m a.s.l. The soils are loamy or clay-loamy with variable content of rounded cobbles and pebbles and medium content of calcium carbonate (10-15%).
- Ceni: This terroir was situated at lower altitude (250-320 m a.s.l.) than the others, and it was characterized by loamy soils developed on ancient fluvial deposits (Pliocene-Quaternary), with medium content of calcium carbonate (10-15%).

The vineyards were surveyed by proximal sensors, namely electromagnetic induction sensor (EMI) and gamma-ray spectroscopy to study soil spatial variability and to individuate two homogeneous areas (BTUs) of about 1.5-2 hectares, for each terroir. BTUs were harvested separately and the grapes were wine-made in separated tanks and then aged for 6 months in separated barrels, using the same methodology.

The three vintages had very different climate during growing season, which was very dry and hot in 2012, moderately wet and warm in 2013 and chilly and very wet in 2014.

Taking into account all the three vintages, discriminant analysis demonstrated that the wines produced in the four macro-terroirs were significantly different ($p < 0.05$) for colour intensity, total acidity and glycerine. T-test analysis did not show statistical difference between the couples of BTUs within each macro-terroir.

Blind wine sensory analysis was also performed by 10 wine tasters for all the three vintages. Fisher LSD test showed several significant differences among the wines produced in the different BTUs. In particular, Agresto and Ceni terroir provided wines with stronger colour intensity, whereas the wines produced in Fattoio terroir showed higher flavour intensity and lower acidity. Summers with high precipitation, like 2014, tend to hide the soil effect on wine features, whereas drier summer highlight the soil effect.