



Stand-alone LED sensors for future field monitoring of grape (*Vitis vinifera* L.) ripeness

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Abstract.

In the winemaking industry, the grape maturation control is a complex process that is critical to produce high-quality wines, but currently, maturation control is cumbersome and inefficient. This inefficient control of the maturation is related to a reduced value of the wine. This work aims to develop of a fully integrated stand-alone optical devices for grape quality monitoring directly in field. Ergo, during the sampling campaign 2019 a first prototype version of a fully integrated optical device was developed by INL following a “stripe” design in which the spectrometric components were mounted on a long, flexible substrate which can be placed onto or inside the grape bunch. The multiple spectrometers were placed along the stripe enabling simultaneous measurements at different parts of the grape bunch to have more representative information of the entire bunch. Four optical bands associated to the evolution of the maturation parameters of the grapes such as the development of anthocyanins and sugars, chlorophyll degradation, and decrease of water content were integrated. Four light-emitting diodes (LEDs) in the Vis and SW-NIR range were used for illumination of the grape. Placed close to these, but optically isolated using an opaque barrier, four photodiodes (with an active area of 520 × 520 μm²) assembled with spectral filters to allow intensity measurements at the desired wavelengths have been used. Four PLS models were developed for the prediction of the total solids soluble and for the potential alcohol (R^2 about 0.90 and RMSEP of 2.22 and 1.54, respectively). A very promising model was also obtained concerning the prediction of the titratable acidity (R^2 of 0.93 and RMSEP of 1.39) while a pH predictive model (using 4 LVs) was developed showing a lower performance than previous parameters (R^2 of 0.76 and RMSEP 0.15) but still with potential for being used with further improvements.