



Environmental performance comparison between optical and wet-chem analyses to assess quality parameters of grape (*Vitis vinifera* L.)

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Abstract.

Grape quality composition at harvest is one of the most important factors that determine the future quality of the wine. By measuring certain grape quality parameters (sugars content, total acidity and pH-value), it's possible to determine the optimum harvest timing ensuring the production of high-quality wines. These parameters are usually obtained through traditional analytical methods, the wet-chem analyses, which require samples to be sent to geographically distant laboratories and waiting long time before achieving results. All these procedures imply also the use of chemicals. As a solution to destructiveness and slowness problems, optical methods can be suitable alternatives to monitor the technological maturation of grapes.

In this context, the work aimed to evaluate and compare the environmental impact of three different analyses carried out to determine technological parameters (sugars, pH, and total acidity) using three different approaches: the wet-chem method, the optical method using benchtop devices and the optical method using innovative, smart, and cost-effective devices. The Life Cycle Assessment (LCA) methodology was used to identify the most sustainable solution and propose actions to reduce the impact along wine supply chain in a “from-cradle-to-grave” approach. The functional unit was identified by the execution of the analyses necessary to obtain the three technological parameters.

Results demonstrate how firstly the wet-chem analyses should be carried out in triplet to obtain technological parameters while for the benchtop and the innovative ones the three quality parameters can be obtained with only one single analysis. Moreover, the optical analysis results the most suitable and green solution resulting 3.2 times more sustainable respect the wet-chem analyses. If innovative optical method can be identified as the best solution, its performance may not be so reliable in obtaining precise and trustworthy results. For this reason, the performance factor was included in the evaluation and results have been normalized confirming what obtained in the previous scenario. Results obtained demonstrate how innovations in agriculture and the development of smart solutions could represent advantages in managing and monitoring agri-food products quality in an industry 4.0 approach by proposing green solutions.