**Environmental Performance Comparison Between Optical and Wet-chem Analyses to Assess Quality Parameters of Grape (Vitis vinifera L.)**

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Grape quality composition at harvest is one of the most important factors that determine the future quality of the wine (Dambergs et al., 2000; R.G. Xiao et al., 2019). Sugars content, total acidity and pH-value are some of the main grape quality parameters which are obtained through the wet-chem analyses implying the use of chemicals, the destruction of the samples and time-consuming procedures. To overcome these technical 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 these three different analyses by considering 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 methodology used to identify the most convenient solution in terms of environmental impact was the Life Cycle Assessment (LCA). The functional unit was identified by the execution of the analyses necessary to obtain the three technological parameters and a “from-cradle-to-grave” approach was used for the evaluation.

Results demonstrate the advantages of the benchtop and the innovative solutions to obtain the three quality parameters with only one single analysis. Among the alternatives, the innovative optical method seems to be the greenest solution resulting 3.2 times more sustainable respect to the wet-chem analyses. Nonetheless, the performance of the innovative optical solution may be not so reliable in obtaining precise and trustworthy results. For this reason, they were adjusted considering a performance factor confirming once again what obtained in the previous scenario. This work demonstrates how innovations in agriculture, like the development of smart optical solutions, could generate advantages in managing and monitoring agri-food products quality in an industry 4.0 approach.

**Keywords.** Optical technique, prototype, chemometrics, technological maturation, sustainability, LCA.

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