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19.3 LIFE CYCLE THINKING APPLIED TO THE ANALYSES SECTOR: A CASE STUDY ON OLIVE OIL ANALYSES USING E-LCA AND LCC APPROACH

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Abstract

The Life Cycle Thinking (LCT) is an approach that aims to evaluate the sustainability profile of a process, a product or a service, and takes in account all the steps involved in the life cycle.

In the olive oil production chain, the activities related to the analyses of olives maturity index and of the quality parameters of the olive oils were neglected by LCT studies so far. Therefore, the aim of the work was to evaluate the sustainability of the analyses performed on olives and olive oils, comparing the chemical methods with the optical one base on visible and near infrared spectroscopy (vis/NIR).

The assessment considers the different ways to perform the analyses. The chemical one consists in a destructive approach using reagents, different devices and with high energy consumption for some steps; vis/NIR does not need any sample-preparation, reagents and requires less time.

The Environmental Life Cycle Assessment (E-LCA) was applied to evaluate the environmental sustainability. Moreover, the Life Cycle Cost (LCC) analysis was carried out to quantify the economic sustainability of the two method of analyses. The functional unit was defined as one analysis and for both the two methods a “from cradle to grave” approach was used identifying all the inputs (data, amount of resources or raw materials, devices or chemicals that enter in one process) and outputs (final materials and waste materials) of the chemical and optical analyses. The environmental profile comparison allows to identify that the vis/NIR analysis is sharply better, 38 times than the chemical one.

Regarding the LCC evaluation, the single analysis has quite the same price and the variation is due to the chemicals and analytical tools used. Even for the LCC evaluation, the optical analysis is preferable and cheaper, showing costs 60% less compared to the chemical analysis.

In conclusion, considering the E-LCA and the LCC methods, the optical analyses are more sustainable than the chemical ones. Optical analyses as vis/NIR spectroscopy can be properly defined as green technologies.

Keywords: sustainability, vis/NIR spectroscopy, olives, laboratory, LCT