Development of a cost-effective prototype to monitor the must fermentation process: first tests in lab-scale

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Abstract (presented for Oral)

The correct management of alcoholic fermentation within the oenological process is a fundamental aspect for quality control. The current management of this operation has wide room for improvement both in terms of optimization of production factors and in terms of potential energy and economic savings.

Systems that can help the winemaker to feed the yeast during the fermentative process according to predetermined nutritional profiles are already available on the market. However, to optimize such feeding operation and to further control the fermentation process by refining the dosage of nutrients, an objective evaluation of qualitative parameters like must solids soluble content, density and developed alcohol is needed.

Therefore, this work aimed to design, build and test a monitoring system (dedicated to fermentation processes) using cost-effective sensors based on vis/NIR spectroscopy. A first prototype version for lab-scale measurements was developed. The module has been designed in-house and built using resin 3D printers (Figure 1). The structure has been equipped with a halogen lamp (20W, 12V, MR11) and a cooling system managed with a microcontroller (Arduino Nano, A000005). The spectral measurements were performed using two ultra-compact spectrometer heads taking optical signs from 340 nm to 850 nm (Hamamatsu, C12880MA) and from 640 nm to 1050 nm (Hamamatsu, C14384MA-01), respectively.

Such sensing architecture will be combined and/or used in a joint cooperation with chemical-physical sensors (temperature, time, pressure, CO2 etc.) to develop a real-time multiparameter system to be used as a PAT in yeast feeding machines to develop a quality by design approach for an enology 4.0.

Keywords: Industry 4.0, winemaking process, multivariate process monitoring, quality by design

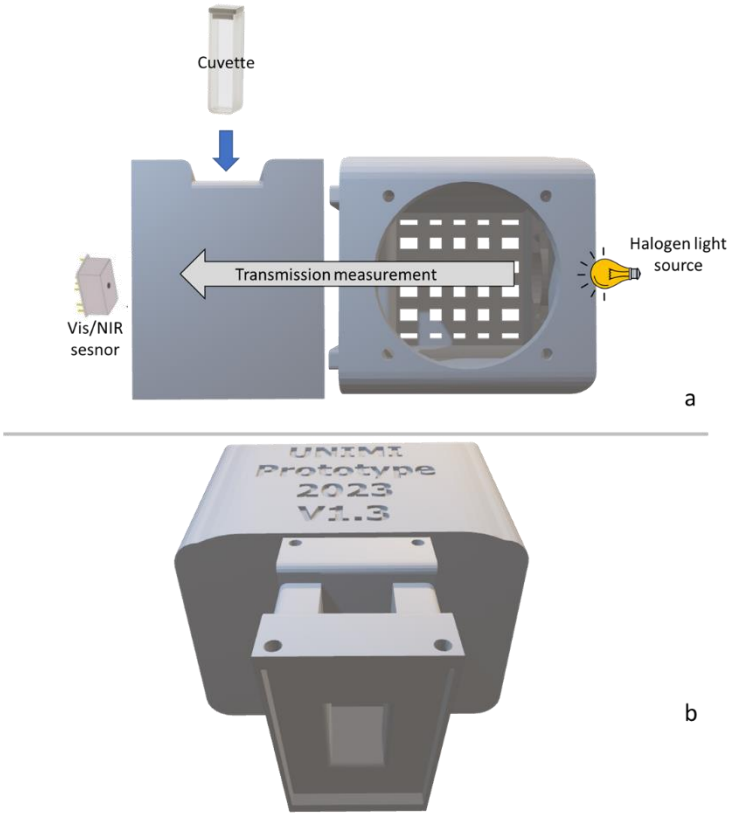

Figure 1. Prototype setup for lab-scale measurements.