Rapid assessment of wine yeast viability and vitality during fermentation using flow cytometry

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Background

- The health of a wine fermentation is largely determined by the vitality of the yeast population.
- Current methods employed in the wine industry focus on measuring cell mass, and sometimes viability, but not yeast vitality.
- Flow cytometry is a tool that allows physical and chemical parameters of microbial cell populations to be quantified (Figure 1).

Methods

- This pilot study aimed to investigate if flow cytometry could be used to rapidly assess wine yeast viability and vitality during fermentation.
- The effect of two different yeast preparation techniques on yeast health during fermentation was assessed.
- Yeast samples, taken at different time-points throughout fermentation, were treated with two fluorescent probes: propidium iodine (PI) and Bis-(1,3-dibutylbarbituric acid) trimethine oxonol (BOX), and analysed using a flow cytometer.

Results

- Yeast cells could be segregated into sub-populations of ‘viable’, ‘non-viable’ and ‘stressed’ based on fluorescence (Figure 2A).
- The fermentations with a higher percentage of yeast cells classified as ‘stressed’ in the later stages of fermentation (85% fermented) were also slower to finish. This illustrated a correlation of flow cytometry results with fermentation kinetics (Figure 2B).

Conclusion

This study illustrates the potential for flow cytometry to be used as a tool to assess not just yeast viability but also yeast vitality of cultures and fermentations within a winery.

Figure 1. A) Diagrammatic explanation of how flow cytometry works. B) Example of graphical output obtained from using flow cytometry and PI and BOX fluorescent dyes to separate yeast populations based on their viability and vitality.

Figure 2. A) Percentage of yeast cells classified as ‘viable’, ‘non-viable’ or ‘stressed’ based on flow cytometry of dual-stained yeast (PI/BOX) sampled from ferment at 85% completion. B) Graph showing ferment kinetics of fermentations by total weight loss over time. Ferments were inoculated with yeast prepared in two different ways (prep 1 and prep 2).