Reduction of wine volatile acidity by immobilized *S. cerevisiae* cells in alginate-chitosan beads

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One major issue for wine quality is volatile acidity. Above certain limits and depending on the wine, acetic acid may confer an undesirable sour taste and unpleasant vinegar aroma, which makes the wines unfit for consumption and translates into economic losses for the producer. In this context the removal of acetic acid from wine is an important issue for the wine industry.
Biological removal of acetic acid from wines by *Saccharomyces cerevisiae* yeasts is an enological practice that has been studied [1] since the pioneer work of Peynaud in 1938 [2]. However, this deacidification process is inadequate for wines with high ethanol content and low pH [3].
Cell immobilization by entrapment in beads has been increasingly applied in the last years, due to numerous advantages such as continuous cell utilization and protection from inhibitory substances in the fermentative medium and from shear forces, as well as increased fermentation and production rates [3].
The aim of this work was to study the efficiency of acetic acid removal by immobilized cells of a previously characterized commercial strain of *S. cerevisiae*. In order to exploit its application in the reduction of volatile acidity of wines we evaluated two cell immobilization processes, one-layer Ca-alginate beads or double-layer alginate-chitosan beads, which have already been used in alcoholic fermentations by *S. cerevisiae* [4]. Furthermore, the effect of different parameters (cell concentration, initial pH and number of bead layers) on the deacidification process efficiency was also determined.
The results showed that the outer chitosan layer improved the stability of the beads during fermentation, preventing cell leakage from the beads into the medium. In fact, immobilized cells in double layer alginate-chitosan beads ($8.0x10^7$ cell ml^{-1}alginate) were able to reduce 61.8% of the initial volatile acidity of an acidic wine (1.1 g l^{-1} acetic acid) with 12.5% (v/v) ethanol and pH 3.12, after 72 h. Under these conditions beads maintained their integrity and no cell leakage occurred as confirmed by Scanning Electron Microscopy. Thus, immobilized *S. cerevisiae* cells in double-layer alginate-chitosan beads appear as an efficient alternative for the reduction of excessive volatile acidity of wines with low pH and high ethanol.

[1] Vilela-Moura, A.; Schuller, D.; Mendes-Faia, A.; Côrte-Real, M. (2008) Reduction of volatile acidity of wines by selected yeast strains. *Appl. Microbiol. Biotechnol*., *80*, 881-890.

[2] Ribéreau-Gayon J, Peynaud E, Ribéreau-Gayon P, Sudraud P (1975) Les mécanismes des fermentations. In: Chez Dunod (eds.) Traité d`oenologie, sciences et techniques du vin, Tome 2, Dunod, Paris. pp 511–556.

[3] Vilela-Moura, A.; Schuller, D.; Mendes-Faia, A.; Côrte-Real, M. (2010) Effects of acetic acid, ethanol and SO_2 on the removal of volatile acidity from acidic wines by two *Saccharomyces cerevisiae* commercial strains. *Appl. Microbiol. Biotechnol., 87,* 1317–1326.

[4] Liouni, M.; Drichoutis, P.; Nerantzis, E.T. (2008) Studies of the mechanical properties and the fermentation behavior of double layer alginate–chitosan beads, using *Saccharomyces cerevisiae* entrapped cells. *World J. Microbiol. Biotechnol., 24,* 281-288.

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