

Minyi Xu, Dr. Joey Talbert

A Study of Grape Skins as Support Material for Whole-Cell Immobilization during Malolactic Fermentation in Model Wine

Introduction¹⁻³

Malolactic fermentation (MLF): desirable for most red wine and certain types of white wine. However, **MLF** process is usually done by batch process in wine industry, which is not very efficient.

***Oenococcus oeni*:** a type of **MLF** bacteria that converts malic acid to lactic acid to reduce the tartness and acidity in wine.

Grape skins: the outer layer of grapes. In this study, the grape skins were obtained after the crush process in winemaking.

Whole-cell immobilization: an alternative to enzyme immobilization. It is defined as “the physical confinement or localization of intact cells to a certain region of space with preservation of some desired catalytic activity”.

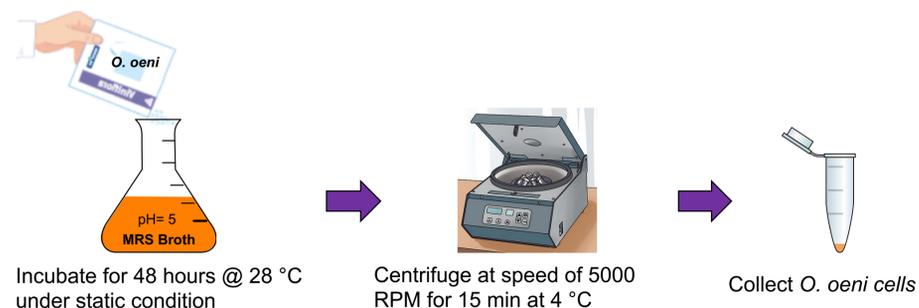
Objectives

- Determine a good concentration of **grape skins** for efficient **whole-cell immobilization** with ***Oenococcus oeni***
- Study **malolactic fermentation** using immobilized cells in **model wine**

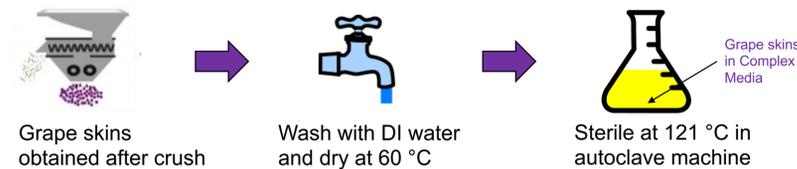
Methods and Materials⁴

- HPLC analysis was done after 8 and 17 days MLF
- The amount of immobilized cell on grape skin was determined by weight

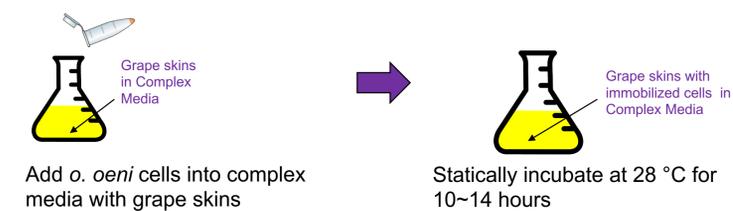
- Microorganism Preparation



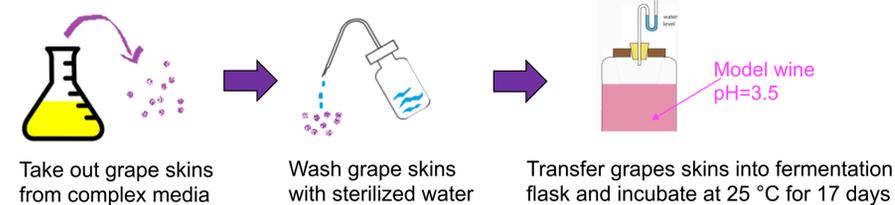
- Grape Skins Preparation



- Cell Immobilization



- Malolactic Fermentation



Results

- The results for 10g/l grape skins were **not determined**.
- As the **concentration** of grape skin **increased** from 20 g/l to 30 g/l, the quantity of immobilized cells (per gram of grape skins) at least **doubled**

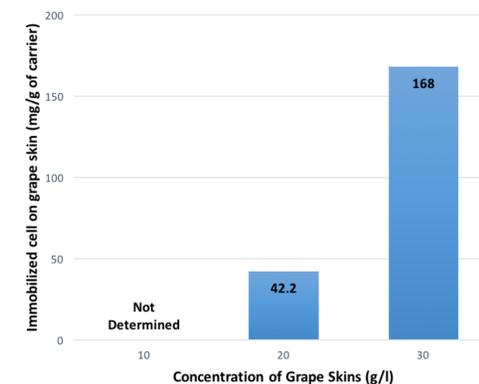


Figure 1. Comparisons of *O. oeni* Cell Immobilization Efficiency on Different Concentrations of Grape Skins

- Due to the high affinity of *O. oeni* cells to 30 g/l grape skins, the *O. oeni* cells previously immobilized on 30 g/l grape skins were used for conducting malolactic fermentation in model wine.

- The immobilized *O. oeni* cells were alive and had the ability to consume malic acid in model wine.

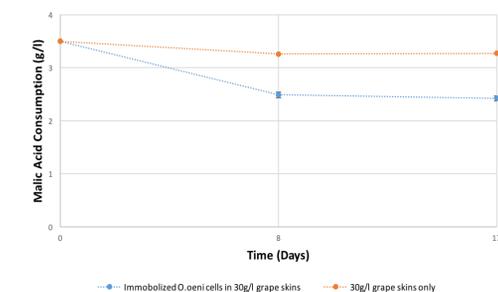


Figure 2. Malic Acid Consumption after 8 and 17 days of MLF with 30g/l Grape Skins Compared with Controls

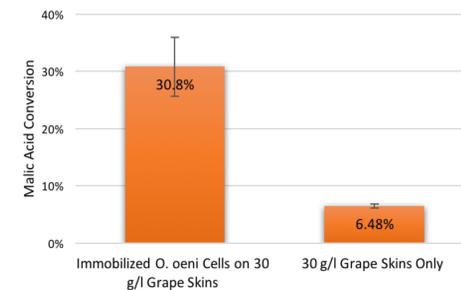


Figure 3. Malic Acid Conversion in Malolactic Fermentation after 17 Days in Model Wine

Conclusions and Future Work⁵

- Grape skins, at the concentration of 30 g/l was the optimized concentration for *O. oeni* immobilization.
- The maximum malic acid conversion was 30.8% ± 5.1 % for *O. oeni* immobilization during MLF in model wine.
- Grape skins are natural products and they are often taken out after grape juice extraction in winemaking process, therefore, it is a very environmental friendly approach and it can also improve economic efficiency.
- Further study on higher concentration of grape skins can be performed to test the maximum limit of affinity.
- More detailed investigation on HPLC analysis of residual sugar, lactic and malic acids are needed for sound winemaking practices.

References

- [1] Costello, Peter J, et al. (2015) Malolactic Fermentation Importance of Wine Lactic Acid Bacteria in Winemaking. *Lallemand Inc.*, pp. 49-51
- [2] Genisheva Z, Mussatto S, Oliveira J, Teixeira J (2013) Malolactic fermentation of wines with immobilised lactic acid bacteria – Influence of concentration, type of support material and storage conditions. *Food Chemistry* 138:1510–1514. doi: 10.1016/j.foodchem.2012.11.058
- [3] Karel SF, Libicki SB, Robertson CR (1985) The immobilization of whole cells: Engineering principles. *Chemical Engineering Science* 40:1321–1354. doi: 10.1016/0009-2509(85)80074-9
- [4] Sudano, Alison M. (2013) Composition of Enological Nutrients and Their Effect on Malolactic Fermentation. Cornell University, MS thesis.
- [5] Vieth, W. R., & Venkatsubramanian, K. (1979) Immobilized Microbial Cells in Complex Biocatalysis. *Immobilized Microbial Cells*, 1-11. doi:10.1021/bk-1979-0106.ch001