Federal University of Santa Catarina
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# Fluid Flow Modeling in a Bioreactor Applied to Wine Production

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# Introduction


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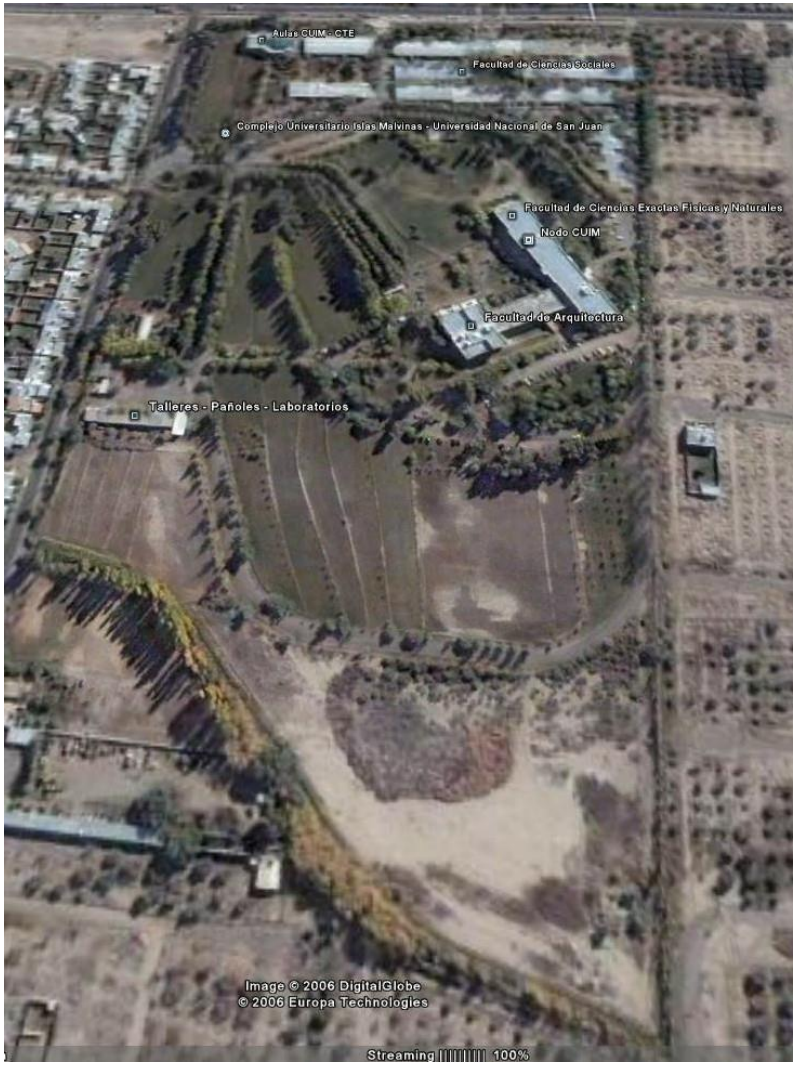
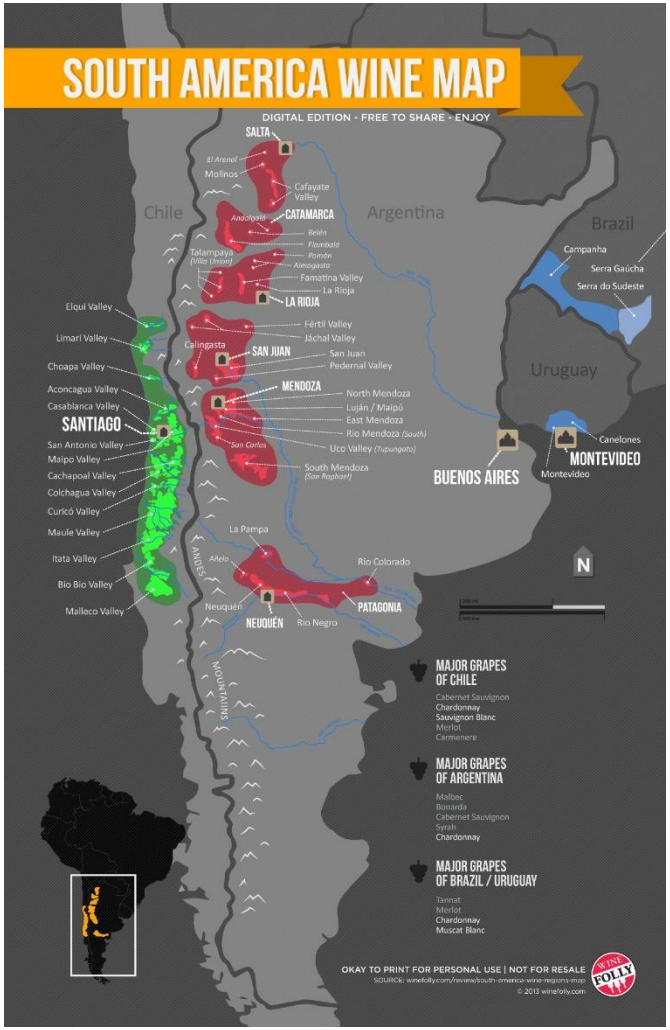


# Introduction

## Research Overview

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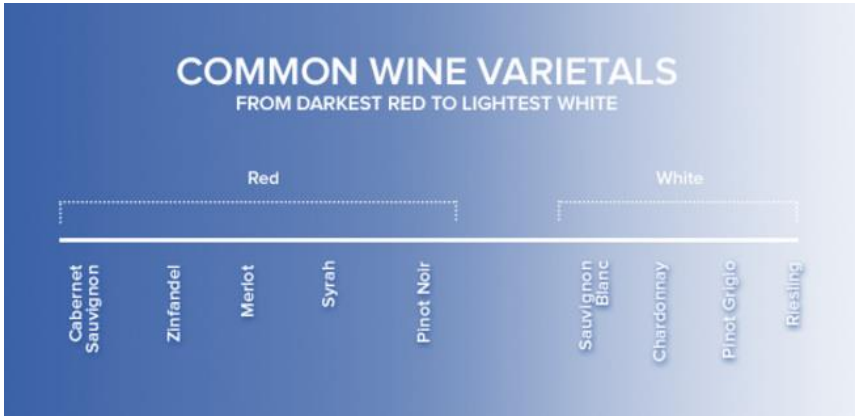


Wine quality is strongly dependent on the operation paramenters of the production process

In batch or fed batch bioreactors, the rotating velocity should be carefully controlled

# Introduction

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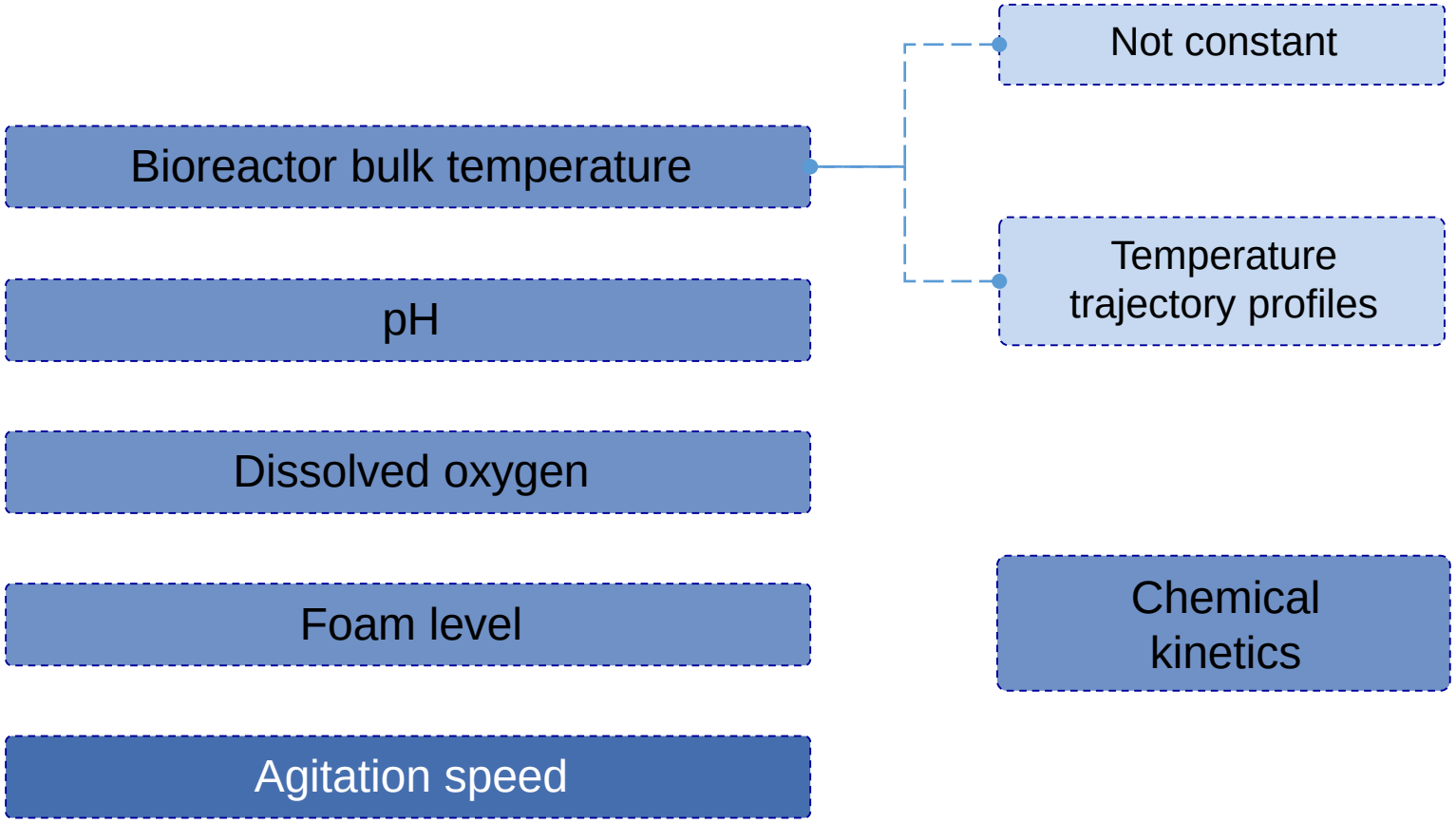

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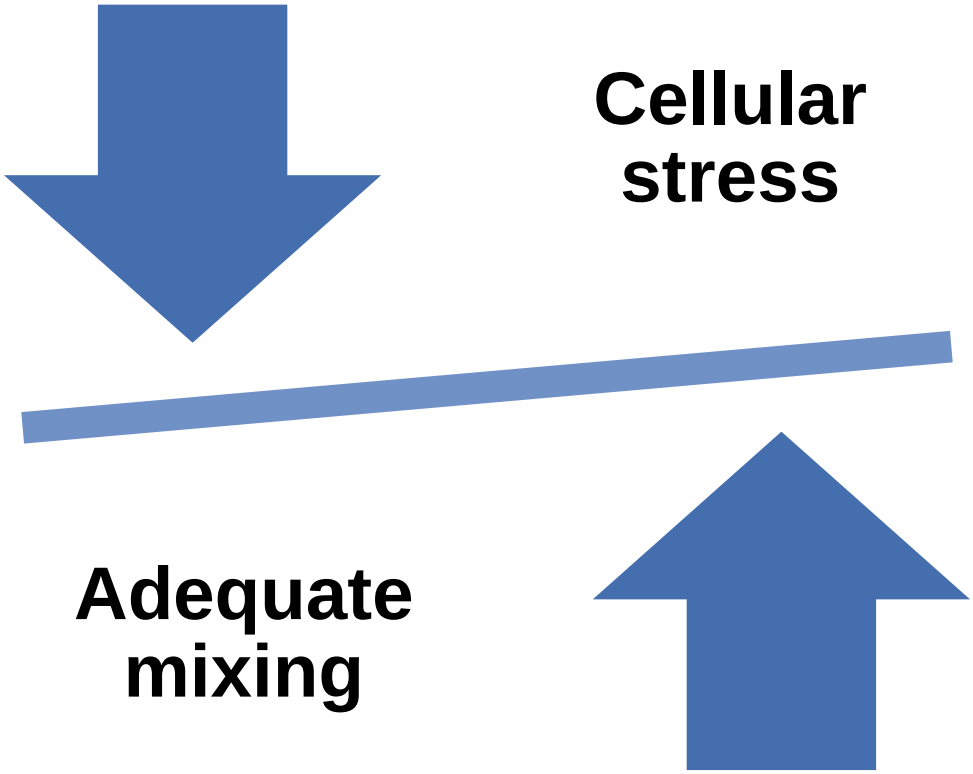


# Introduction

## Research Overview

### Objective

Investigate fluid flow in a batch bioreactor applied to varietal wine production

# Method

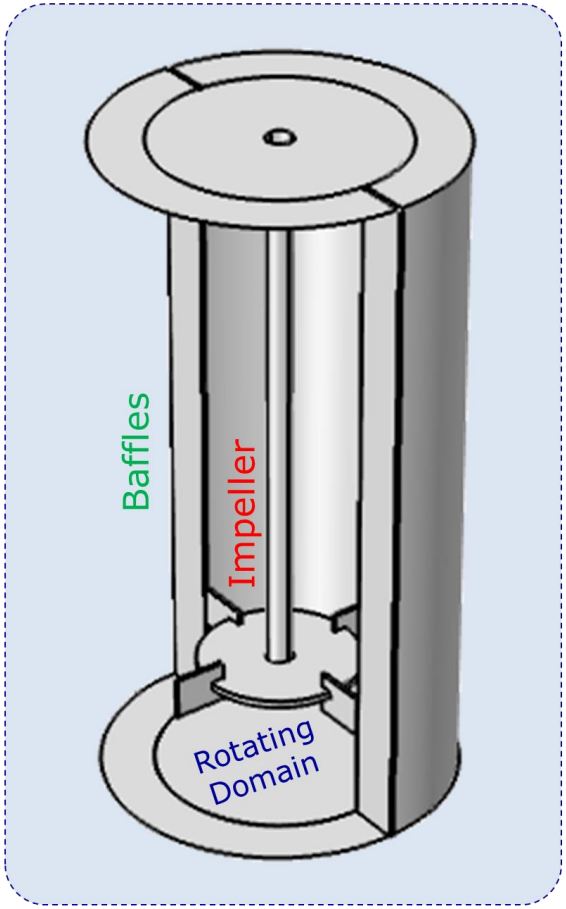
## Experimental Setup (UNSJ)

# Method

## Numerical Setup

A 3D geometry representing the real equipment installed at UNSJ was built using COMSOL CAD

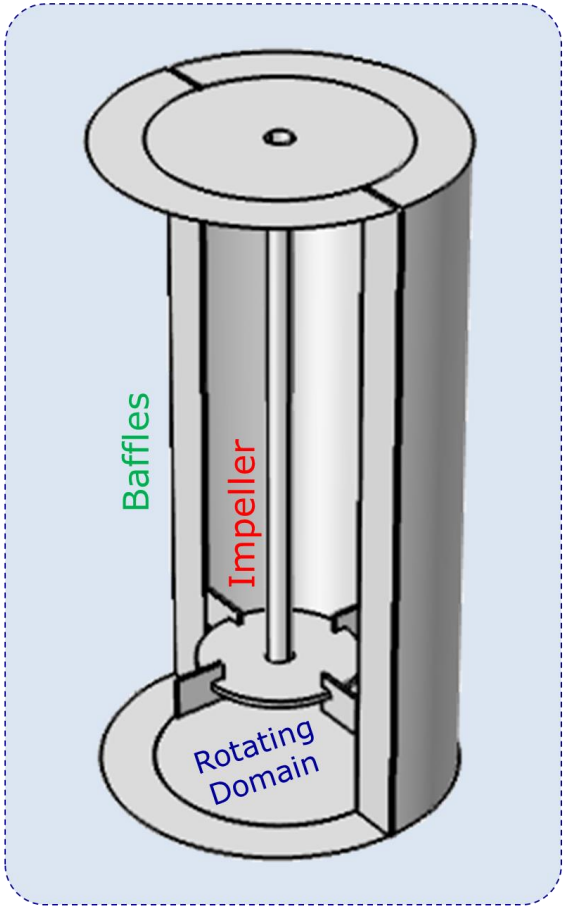
The 10 L stainless-steel tank has an inner diameter of 0.26 m and height of 0.5 m. Two baffles and an impeller ensure the mixture. A cooling-water jacket and, air supply, stirring, pH, and temperature controls are included



# Method

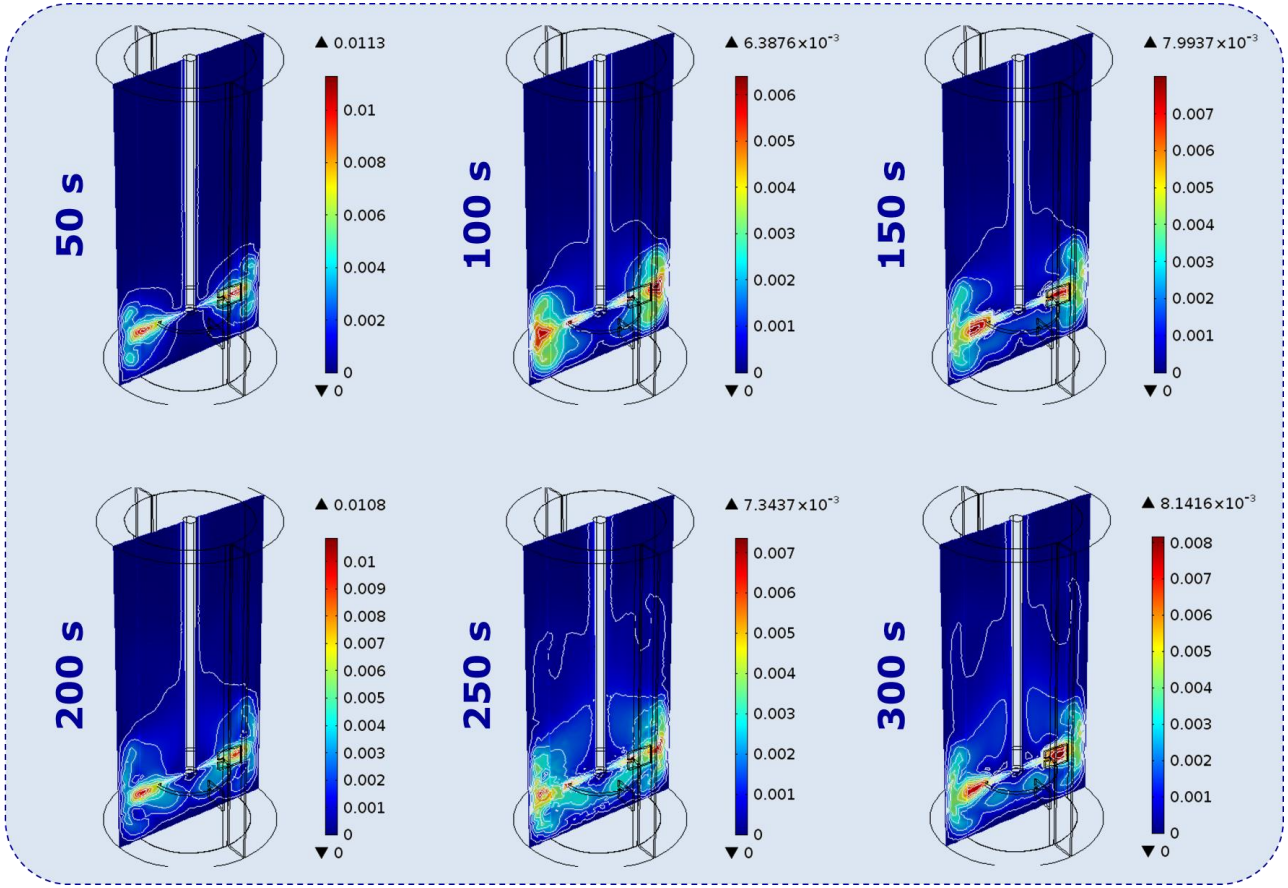
## Numerical Setup

- Pure water flow.
- Rotating velocity of 1 rpm.
- Total simulation time of 5 min (300 s).
- Mesh consisting of ~$7 \times 10^5$ elements.
- Segregated solver; time-stepping through BDF algorithm.



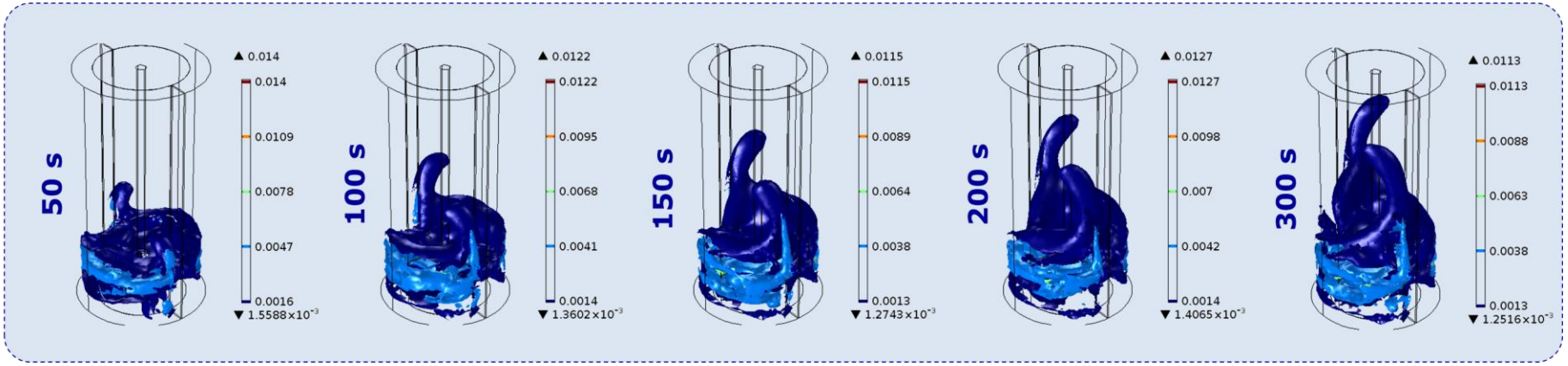
# Results

## Velocity Contours



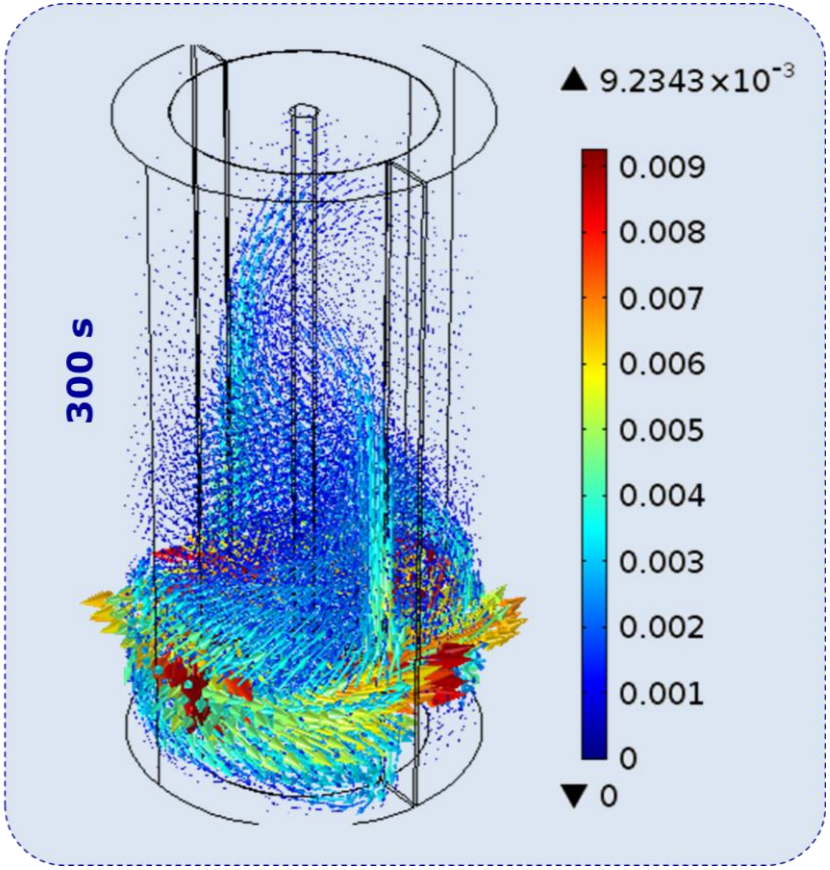
# Results

## Velocity Isosurfaces



# Results

## Velocity Vectors



# Conclusions

Wine production is a complex process and optimizing operation parameters is essential for enhancing varietal wine quality

In particular, optimizing hydrodynamics in these devices allow for reducing cell stress, while maintaining adequate mixing level

Further modeling of chemical reaction kinetics and heat transfer in the vessel will allow for a complete description of the system with COMSOL

# References


- COMSOL Inc., Laminar flow in a baffled stirred mixer (Application Gallery). Available at: https://br.comsol.com/model/laminar-flow-in-a-baffled-stirred-mixer-8559.

- G. J. E. Scaglia, P. M. Aballay, C. A. Mengual, M. D. Vallejo, O. A. Ortiz. **Improved Phenomenological Model for an Isothermal Winemaking Fermentation**. Food Control 20 (2009) 887–895.

- P. M. Aballay, G. J. E. Scaglia, M. D. Vallejo, O. A. Ortiz, M. E. Serrano, C. A. Mengual, S. Rómoli. **Validation of a Phenomenological Model for the State Variables in the Non-Isothermal Wine Fermentation**. VII CAIQ 2013.

# Acknowledgements



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# Thank You!

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