

**ABSTRACT – D7 Weinakademiker Thesis**

Non-conventional yeasts: microscopic heroes helping to tackle the wine industry's current challenges

Candidate: Renato Leal Binati

*Motivation*

Among the many different disciplines covered in the study of wines, microbiology is at the core of the transformation of grapes into wine. However, in most wine courses and certifications, even the most advanced ones, the role of microorganisms in vineyards and wineries is only briefly discussed. Motivated by the complexity and relevance of this subject, the growing interest among wine experts, the scarcity of previous theses dealing with it, the potential of microbial innovations for the future of winemaking, and my background carrying out research with wine yeasts and bacteria for the past ten years, I decided to choose alternative wine yeasts as the topic to develop the Weinakademiker thesis.

*Problem/objective*

Innovative solutions embracing non-conventional yeasts are being proposed by microbiologists and food scientists to some of the many challenges faced in vineyards and wineries. The number of starters commercially available, although growing, is just a tiny part of the strains selected in studies worldwide. More discussions about wine microbiology may help to increase the interest of consumers and producers and stimulate new research to improve products and processes, in a virtuous cycle.

In this context, the aim of this thesis was to demonstrate the current use and future perspectives of non-*Saccharomyces* yeasts to diversify and improve wine fermentations. In particular, the strategies that take advantage of antioxidant and antimicrobial activities were discussed in further detail, with a view to reduce the addition of sulphur dioxide (SO<sub>2</sub>) in grape must and wine.

*Methodology*

This thesis can be divided in two main parts: a review of the literature and an experimental work conducted in winery and laboratory. The bibliographical review targeted the most recent scientific articles dealing with non-*Saccharomyces* yeasts in oenology, besides further technical information from books, online publications, and industry magazines. More importantly, a critical assessment of my own track record of the past years as PhD student and postdoctoral research fellow allowed me

to put together for the first time some publications that have in common the use of alternative yeasts to complement or improve SO<sub>2</sub> efficacy. Finally, an original experiment was set up as a proof of concept: a non-*Saccharomyces* commercial strain was sprayed on the grape bunches at the beginning of post-harvest withering to test its potential biological control against mould infection, and then the same yeast was inoculated in a multistarter fermentation strategy to diversify the wine profile.

### *Content*

The most common applications of non-*Saccharomyces* yeasts regard their contribution to the organoleptic profile of wines, which were summarised and illustrated in the first two sections. These yeasts give further important inputs, improving other aspects related to the wine quality along the winemaking process. Special attention was given in section 3 to the ability of specific yeast strains to produce lactic acid, lowering the alcohol level and modulating the acidity; to produce less acetaldehyde, increasing the proportion of more effective free SO<sub>2</sub>; to produce more glutathione, partially replacing the antioxidant effect of SO<sub>2</sub>; and to suppress the growth of spoilage organisms.

Biocontrol and bioprotection with selected yeasts were discussed with greater detail in section 4, as a tool to reduce microbial diseases in the grapevines and contaminations in the fermentation. The selection of yeasts with this activity that can also positively modulate the wine profile is an innovative approach still little explored. In the case-study described in the fifth section, withered grapes treated with a bioprotective yeast showed a remarkably lower presence of moulds in the surface and a faster dehydration rate than control grapes, achieving different concentrations of sugars, acids, and aromas. Multistarter inoculation with the non-*Saccharomyces* strain further distinguished the wines.

### *Conclusion*

The potential of exploring yeasts, especially species of non-*Saccharomyces*, to address some challenges of winemaking is already well-established among the scientific community, with multiple examples exhaustively discussed in the literature in the last decades and many new applications being proposed every year. Besides their contributions to wine aroma, these species can help to achieve more sustainable and fresher wines, with less alcohol, less sulphites added, and more stable. The case-study showed that a commercial strain of *Metschnikowia pulcherrima*, marketed as a bioprotective yeast for the early stages of fermentation, could be successfully adapted for the biocontrol application during post-harvest withering and the modulation of fermentation through multistarter inoculation, as already hypothesized by some laboratory trials with this species.