Starmerella bacillaris and *Saccharomyces cerevisiae* Interactions During Alcoholic and Malolactic Fermentations

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The diversity and complexity of wine environment during alcoholic and malolactic fermentation limits the successful prediction of wine characteristics. The use of selected starter cultures has allowed a better control of the fermentation process and the production of wines with established characteristics. Among them, the use of mixed fermentations with *Starmerella bacillaris* and *Saccharomyces cerevisiae* yeasts have gained attention in recent years due to the fructophylic nature of the first and the ability of this inoculation protocol to reduce the acetic and ethanol content of the wines. Both yeast species interact throughout the alcoholic fermentation and influence the chemical and aromatic composition of the wines. Many studies have been carried out to gain an insight to the nature of these interactions, with the aim to better control the wine fermentation.

Generally, successful inoculation protocol is considered the fermentation that enables *Starm. bacillaris* to dominate in the early stages of the fermentation process and demonstrate its peculiar characteristics, which are absent in *S. cerevisiae*. Inoculation delay between *Starm. bacillaris* and *S. cerevisiae* and combination of strains plays an important role to achieve this objective. Attention must be paid also to numerous winemaking variables, like nitrogen and oxygen availability and the presence of inhibitory or stimulator substances produced by the growth of yeasts. Among them, oxygen has positive impact on *Starm. bacillaris* by increasing its survival time and sugar consumption, while nitrogen sources could modulate the functional characteristics of the inoculated yeast strains to better control the fermentation process. Concerning the co-existence of both species during the fermentation process, we recently demonstrate that the early death of *Starm. bacillaris* in mixed fermentations with *S. cerevisiae* is not due to the depletion of nutrients not due to the production of toxic metabolites by the yeasts but rather to cell-to-cell contact mechanism, depend on the presence of viable cells of the last. Concerning malolactic fermentation, the consumption of nutrients by the above-mentioned yeast species and their produced metabolites may inhibit or stimulate the growth (and malolactic activity) of lactic acid bacteria (LAB), such as Lactobacillus plantarum and Oenococcus oeni. Specifically, yeast inoculation protocol and the combination of tested species/strains influenced LAB population dynamics, malic acid consumption and wine characteristics.

All these information's contributes to further understand *Starm. bacillaris* and *S. cerevisiae* interactions occurring during alcoholic and/or malolactic fermentations and allows a greater management of the production of specific metabolites to improve wine quality.

Keywords: Mixed cultures, interactions