

# Circular microbial biotechnology for improving colour and aroma in rosé wines produced in warm climates

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## Abstract

Global rosé wine production is on the increase, but high temperatures in warm climates influence colour intensity and aromatic freshness, ultimately affecting sensory quality [1,2]. Applying non-*Saccharomyces* yeasts and lactic acid bacteria in combination with *Saccharomyces cerevisiae* in sequential inoculations offers a promising strategy to enhance colour expression and aromatic complexity during fermentation [3]. In this study, six pilot-scale fermentations (500 L each) were carried out using Nero d'Avola grape must, with co-inoculations of either *Starmerella lactis-condensi* MN412 or *Candida oleophila* YS209, with or without *Lactiplantibacillus plantarum* MLPKH45™, followed by sequential inoculation with *S. cerevisiae* NF213. Fermentation kinetics, microbial dynamics, CIELab colour parameters, and sensory profiles were monitored. Sequential inoculation accelerated fermentation compared to the control with *S. cerevisiae*, showing positive microbial interactions. All mixed fermentation trials showed significantly higher *L* values (up to 67.20 vs 57.67) and lower *C* values (17 vs 24.52), suggesting lighter hues and lower colour saturation. Total colour differences ( $\Delta E$ ) between treatments and the control reached up to 12.2, well above the visual perception threshold ( $\Delta E > 2.7$ ) [4]. Sensory analysis showed that sequential inoculations enhanced floral (up to 6.7) and red fruit notes (up to 6.5). The combination of *C. oleophila* YS209 + *L. plantarum* MLPKH45™, followed by *S. cerevisiae*, provided the best balance between colour intensity and sensory quality, achieving the highest overall score (7.5 vs 6.5 for the control). Overall, the results demonstrate that co-inoculation of non-*Saccharomyces* yeasts and lactic acid bacteria, coupled with sequential inoculation of *S. cerevisiae*, is an effective tool for modulating colour and aroma in rosé wines produced in warm climates. This approach supports more sustainable winemaking practices with reduced reliance on chemical additives.

## Reference

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