

Impact of *Metschnikowia pulcherrima* and *Saccharomyces cerevisiae* in mixed fermentation on volatile compounds and energy sustainability in Lugana wine

Giulia Bertazzoli, Emma Pelizza*, Giovanni Luzzini, Giovanna E. Felis, Maurizio Ugliano, Sandra Torriani

*Presenting author: emma.pelizza@univr.it

Department of Biotechnology, University of Verona, Verona (VR), Italy

Background

Temperature control during fermentation is a key factor in wineries' energy consumption and significantly influences the aroma of white wine [1]. The use of selected strains of non-*Saccharomyces* yeasts, such as *Metschnikowia pulcherrima*, has the potential to enhance both sustainability and aromatic quality in winemaking [2] [3] [4].

Aim: Evaluate the impact of temperature ($16^{\circ}\text{C} \pm 1^{\circ}\text{C}$ vs $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$) and sequential fermentations with *M. pulcherrima* and *Saccharomyces cerevisiae* on the volatile and aromatic profile of Lugana wine, focusing on sustainable practices.

Material & Methods

➤ Must: Natural thiol-rich white must from *Trebbiano* grapes

➤ Yeast strains:

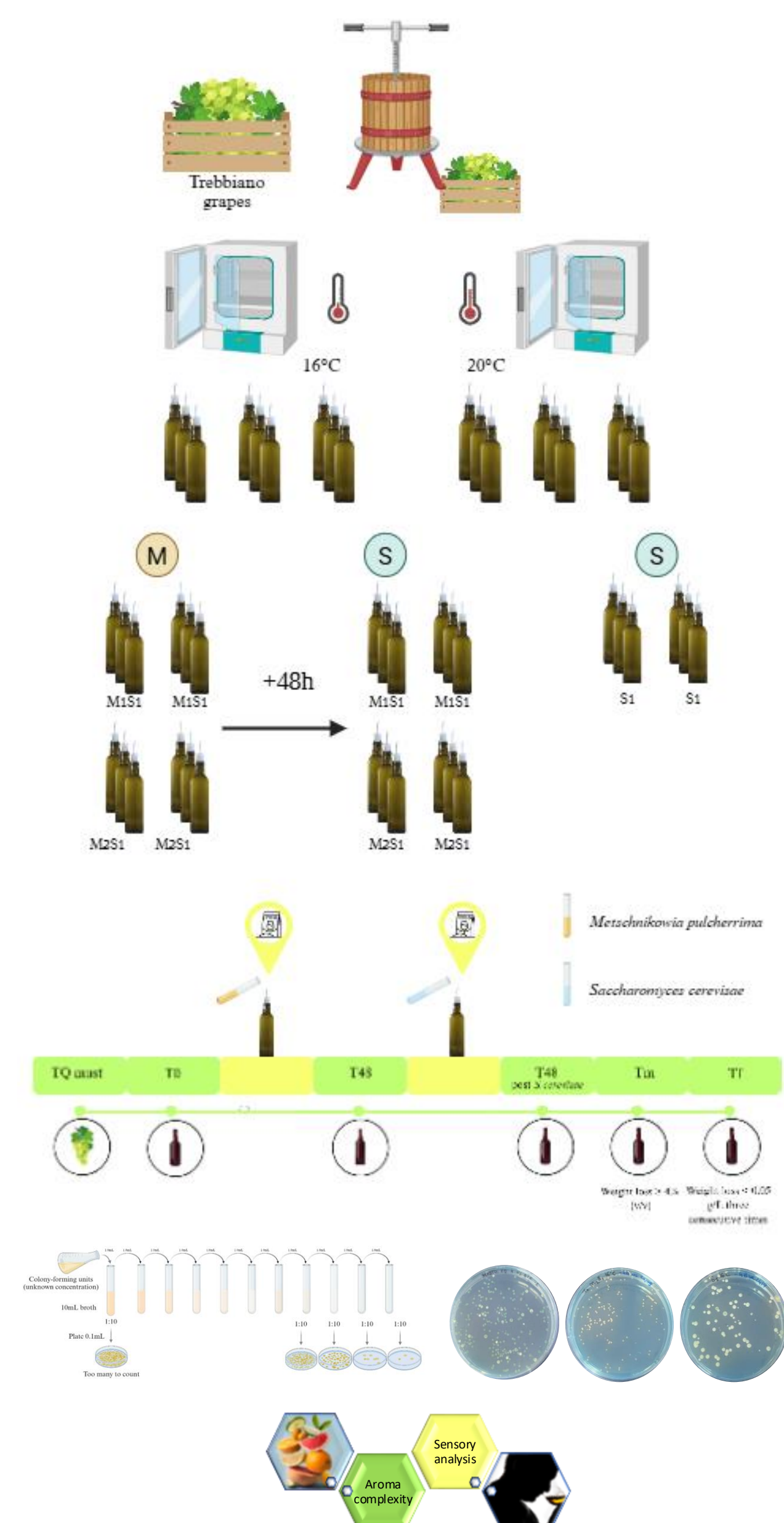
- *Metschnikowia pulcherrima* Level² Flavia (M1)
- Level² Initia (M2)
- *Saccharomyces cerevisiae* EC 1118 (S1-control)

➤ Fermentation design

- Sequential fermentations
M. pulcherrima (M1 or M2) at time 0
S. cerevisiae (S1) added after 48 h
- Control
Single inoculation with *S. cerevisiae* at time 0

➤ Analyses:

- Fermentation kinetics (g CO₂/100 g and Log₁₀ CFU/mL)
- Volatile compound analysis (GC-MS)
- Sensory evaluation (Sorting Task and PCA)



Conclusions

This study shows that **sequential fermentations** with *M. pulcherrima* and *S. cerevisiae* at $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ enhance the **thiol** content and aromatic complexity of Lugana wine, leading to faster fermentations and improved energy efficiency. The results highlight the potential of non-*Saccharomyces* yeasts in sustainable winemaking.

Take-home Message

Using *M. pulcherrima* in **sequential fermentations** at higher, non-traditional temperatures can **improve** wine production's **aromatic profile** and **energy efficiency**, offering a sustainable approach to winemaking.

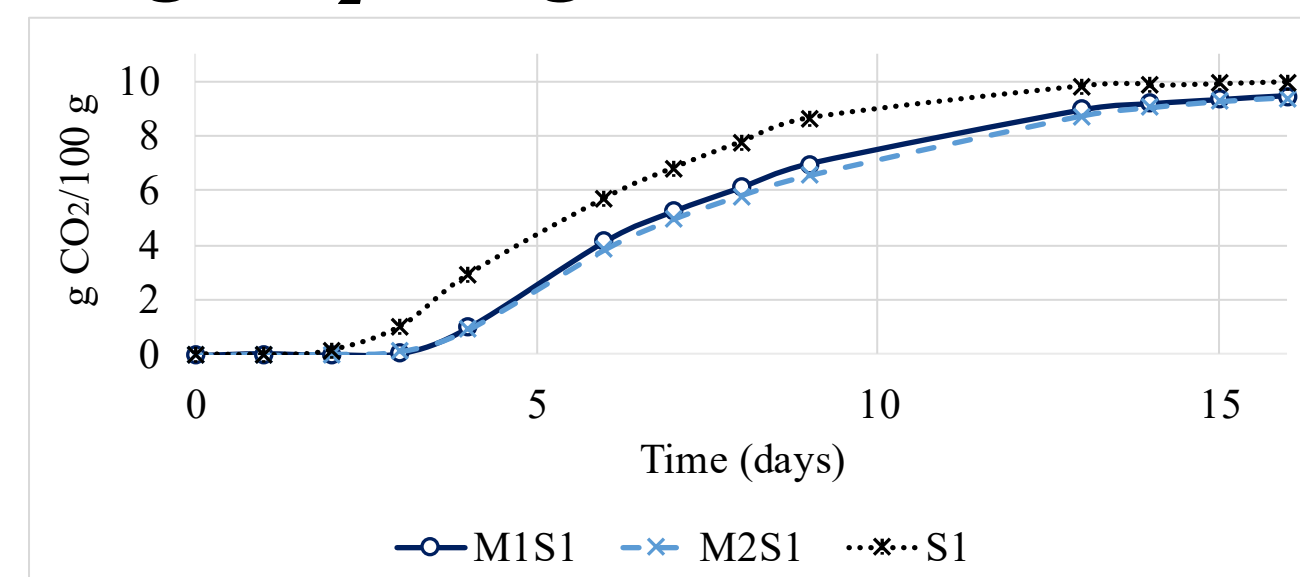
This study was financially supported by the Italian Ministry of Agriculture, Food Sovereignty and Forestry (MASAF), project WINERED - Innovative interdisciplinary approaches for the reduction of the environmental impact of vinification.

References

- [1] Giovenzana, V.; Beghi, R.; Vagnoli, P.; Iacono, F.; Guidetti, R.; Nardi, T. Evaluation of energy saving using a new yeast combined with temperature management in sparkling base wine fermentation. *American Journal of Enology and Viticulture* 2016, 67, 308 doi:10.5344/ajev.2016.15115.
- [2] Castrillo, D.; Rabuñal, E.; Neira, N.; Blanco, P. Oenological potential of non-*Saccharomyces* yeasts to mitigate effects of climate change in winemaking: impact on aroma and sensory profiles of Treixadura wines. *FEMS Yeast Research* 2019, 19, foz065 doi:10.1093/femsyr/foz065.
- [3] de Castro, M.; Baptista, J.; Matos, C.; Valente, A.; Briga-Sá, A. Energy efficiency in winemaking industry: Challenges and opportunities. *Science of The Total Environment*, 2024, 930, 172383, doi:10.1016/j.scitotenv.2024.
- [4] Binati, R.L.; Lemos Junior, W.J.F.; Luzzini, G.; Slaghenaufl, D.; Ugliano, M.; Torriani, S. Contribution of non-*Saccharomyces* yeasts to wine volatile and sensory diversity: a study on *Lachancea thermotolerans*, *Metschnikowia* spp. and *Starmerella bacillaris* strains isolated in Italy. *International Journal of Food Microbiology* 2020, 318, 108470 doi:10.1016/j.ijfoodmicro.2019.108470.

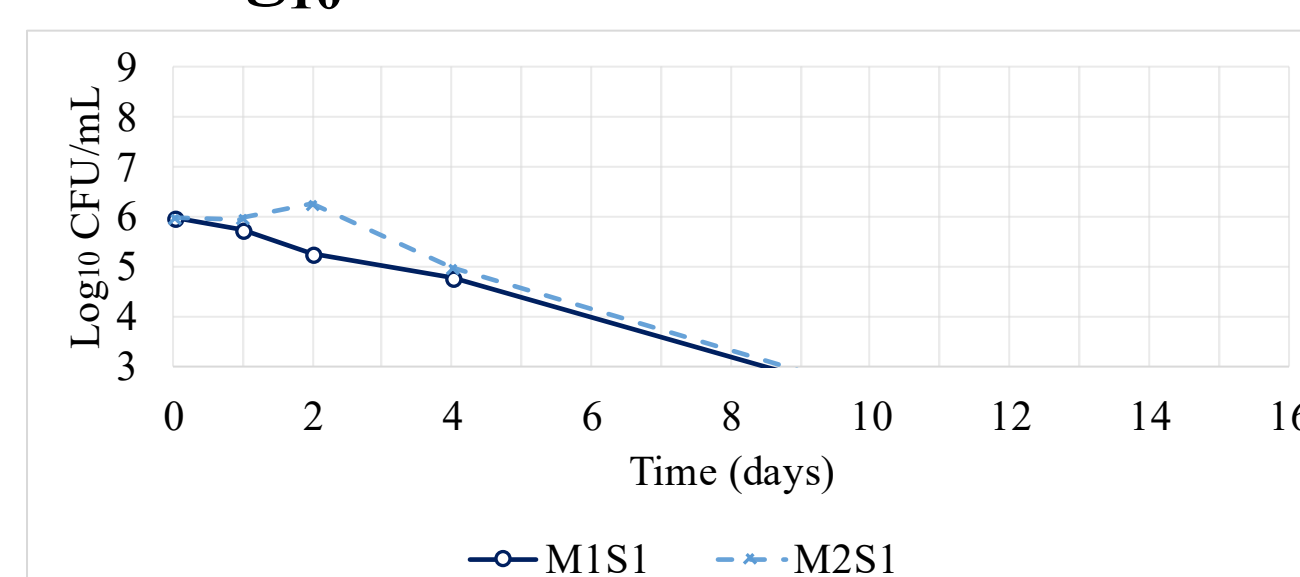
Results

• g CO₂/100 g

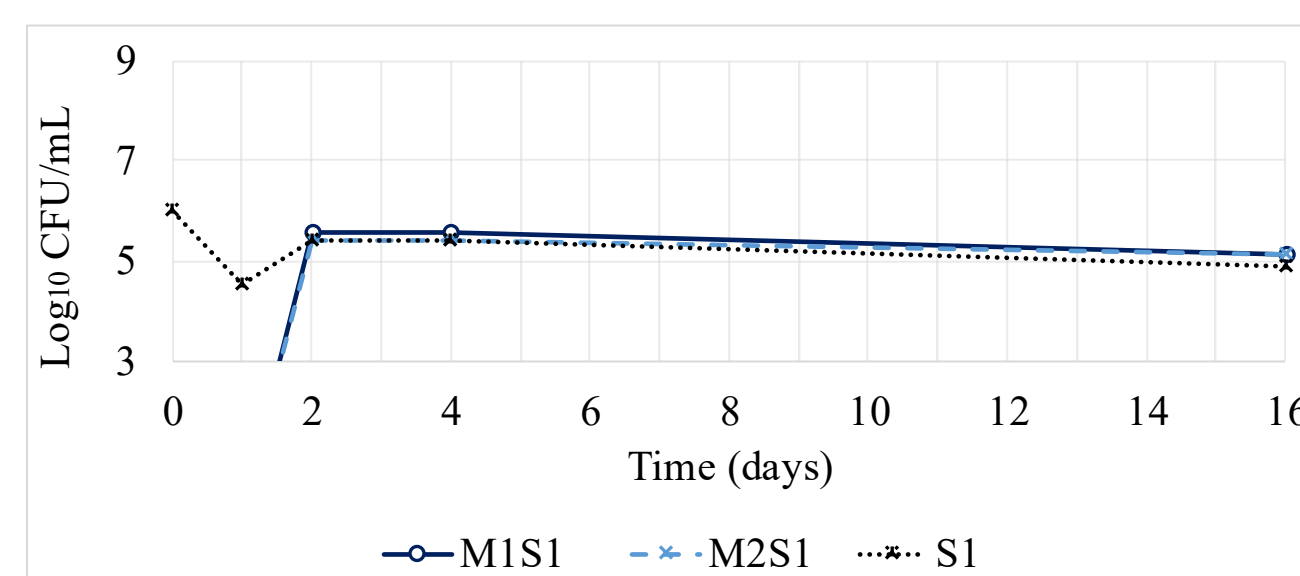


$16^{\circ}\text{C} \pm 1^{\circ}\text{C}$: completed in 16 days

• Log₁₀ CFU/mL

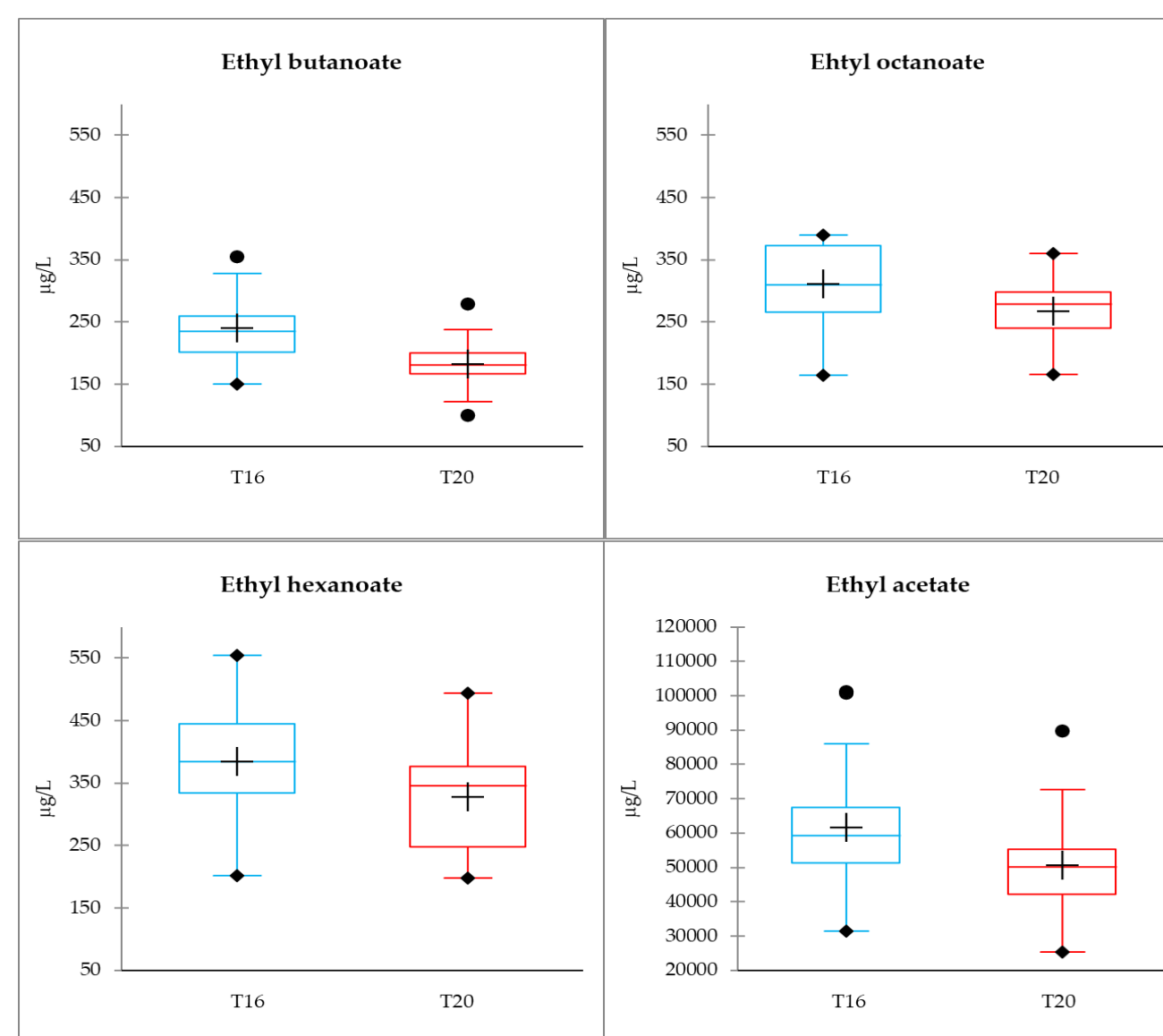


At $16^{\circ}\text{C} \pm 1^{\circ}\text{C}$, only *M. pulcherrima* M2 showed initial growth, indicating better low-temperature adaptability



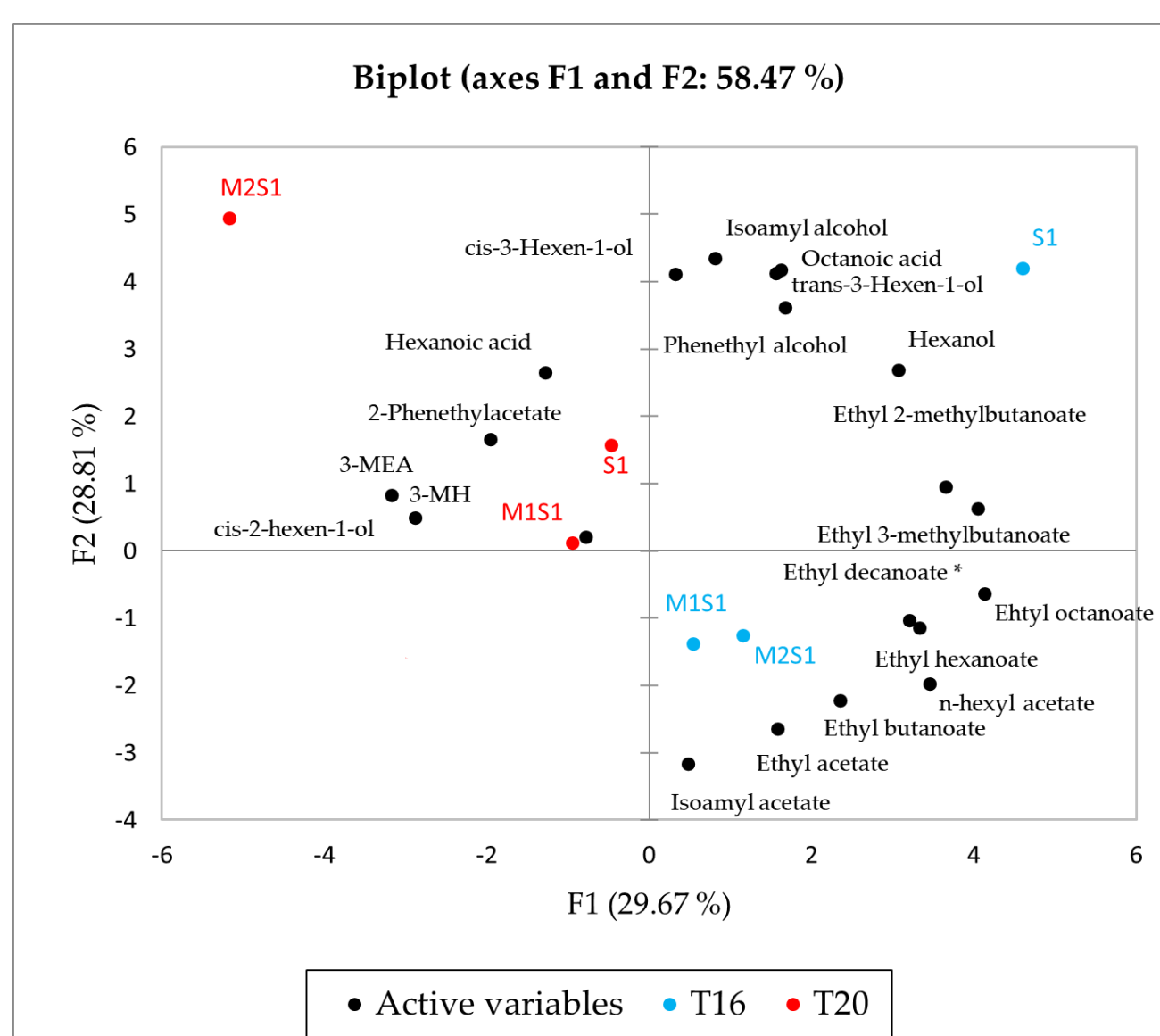
At $16^{\circ}\text{C} \pm 1^{\circ}\text{C}$, *S. cerevisiae* exhibited limited growth in sequential fermentations, maintaining low final cell counts.

• GC-MS

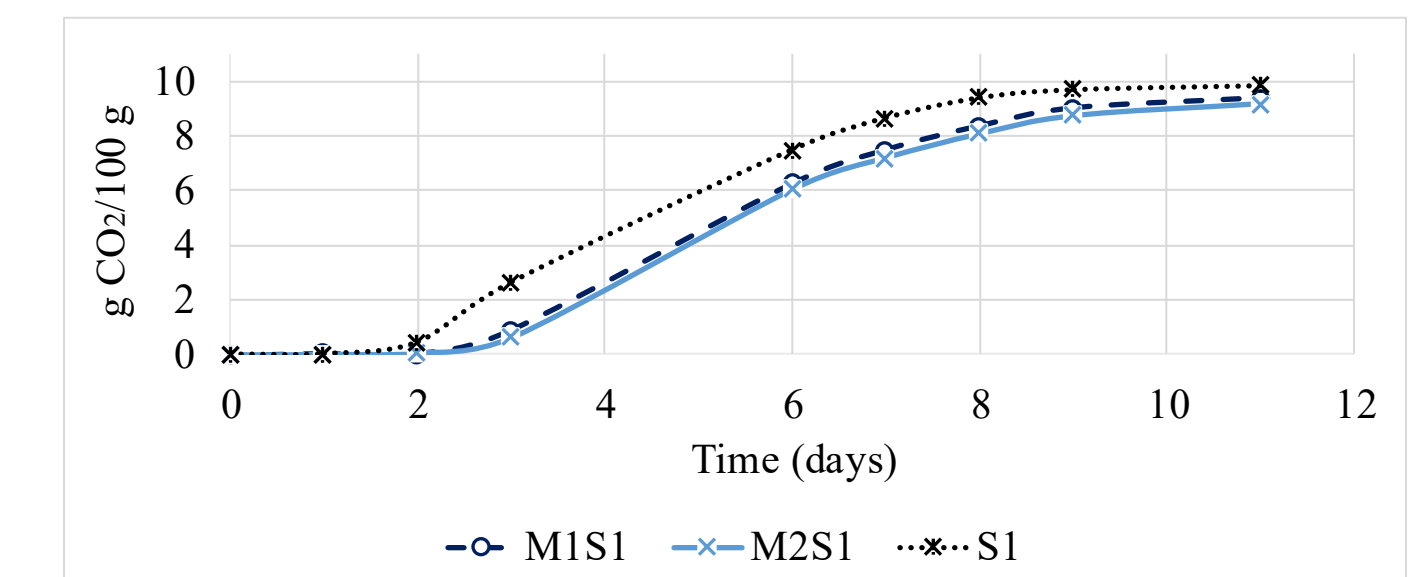


$16^{\circ}\text{C} \pm 1^{\circ}\text{C}$ wines: ↑ Ethyl esters and fatty acids → different aromatic expression

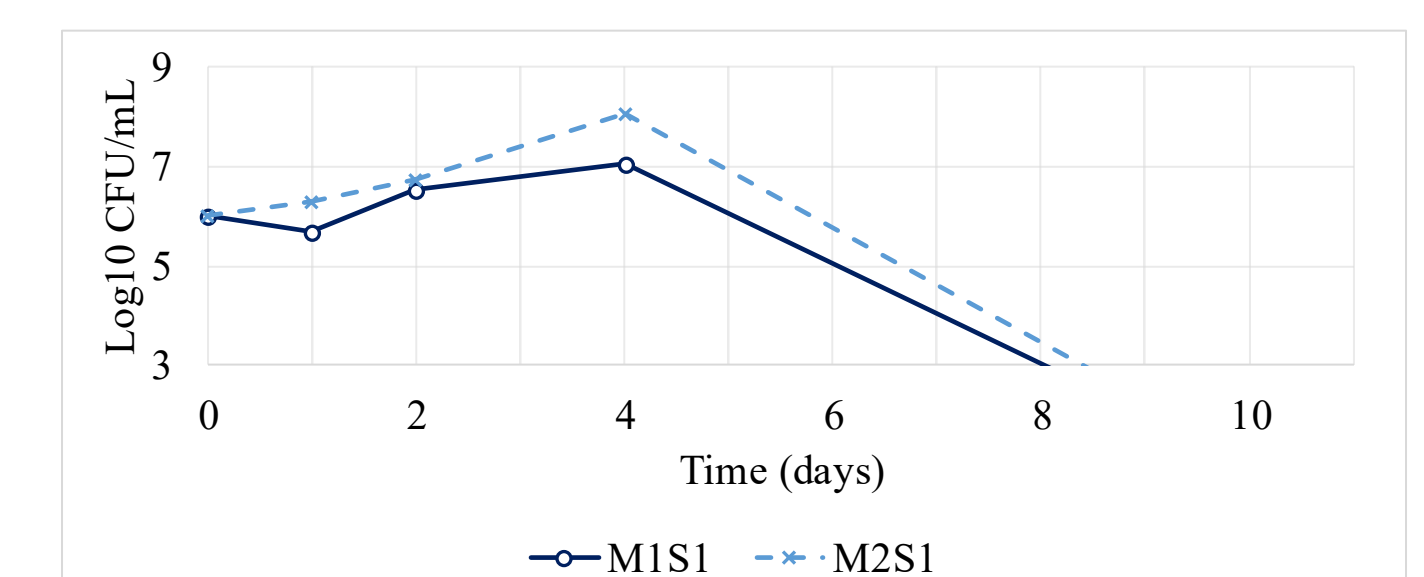
• PCA



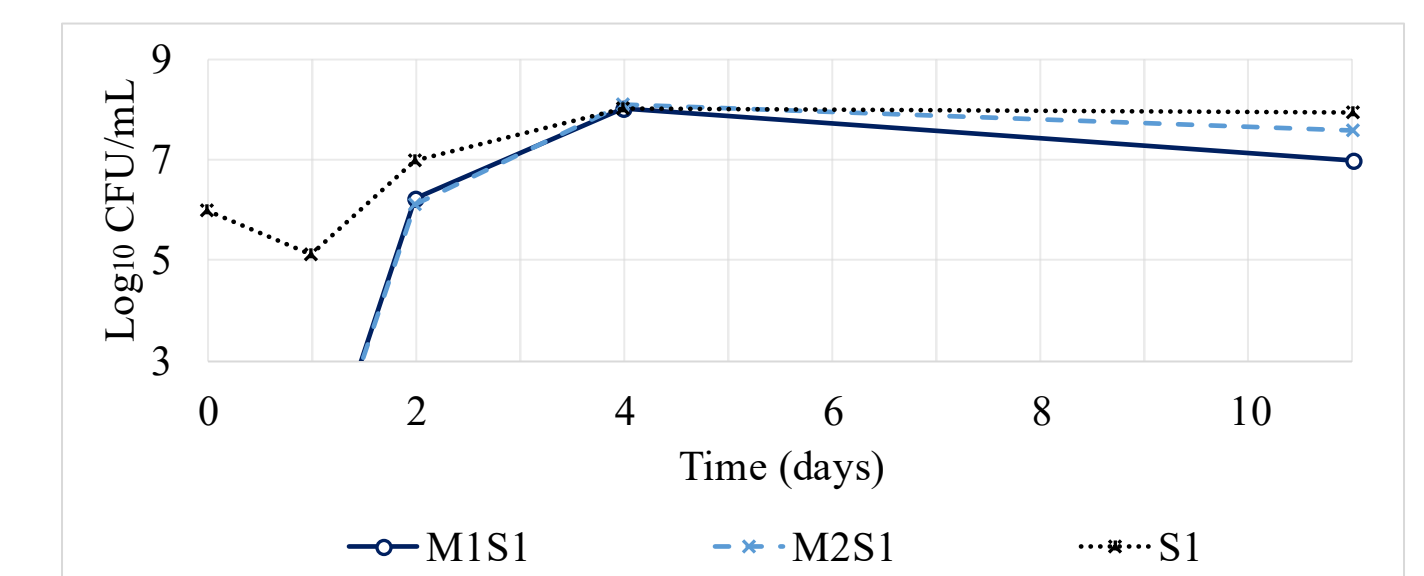
Temperature substantially impacted volatile composition more than the specific *M. pulcherrima* strain.



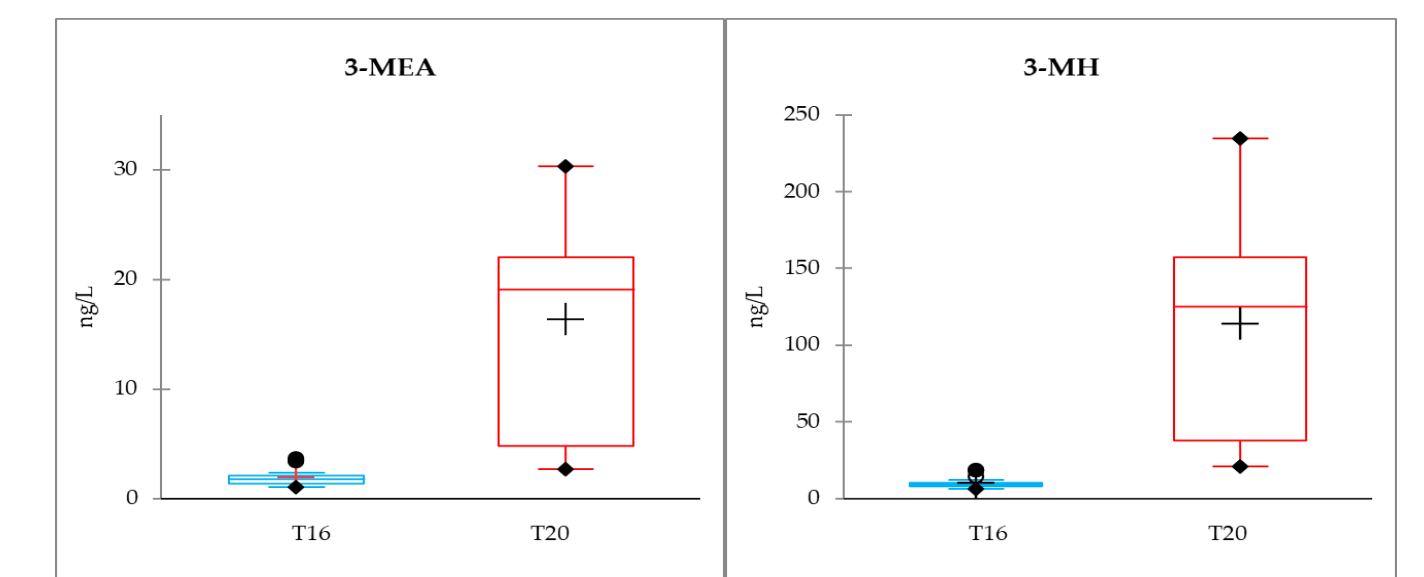
$20^{\circ}\text{C} \pm 1^{\circ}\text{C}$: completed in 11 days



At $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$, M2S1 reached the highest level (8 log CFU/mL).

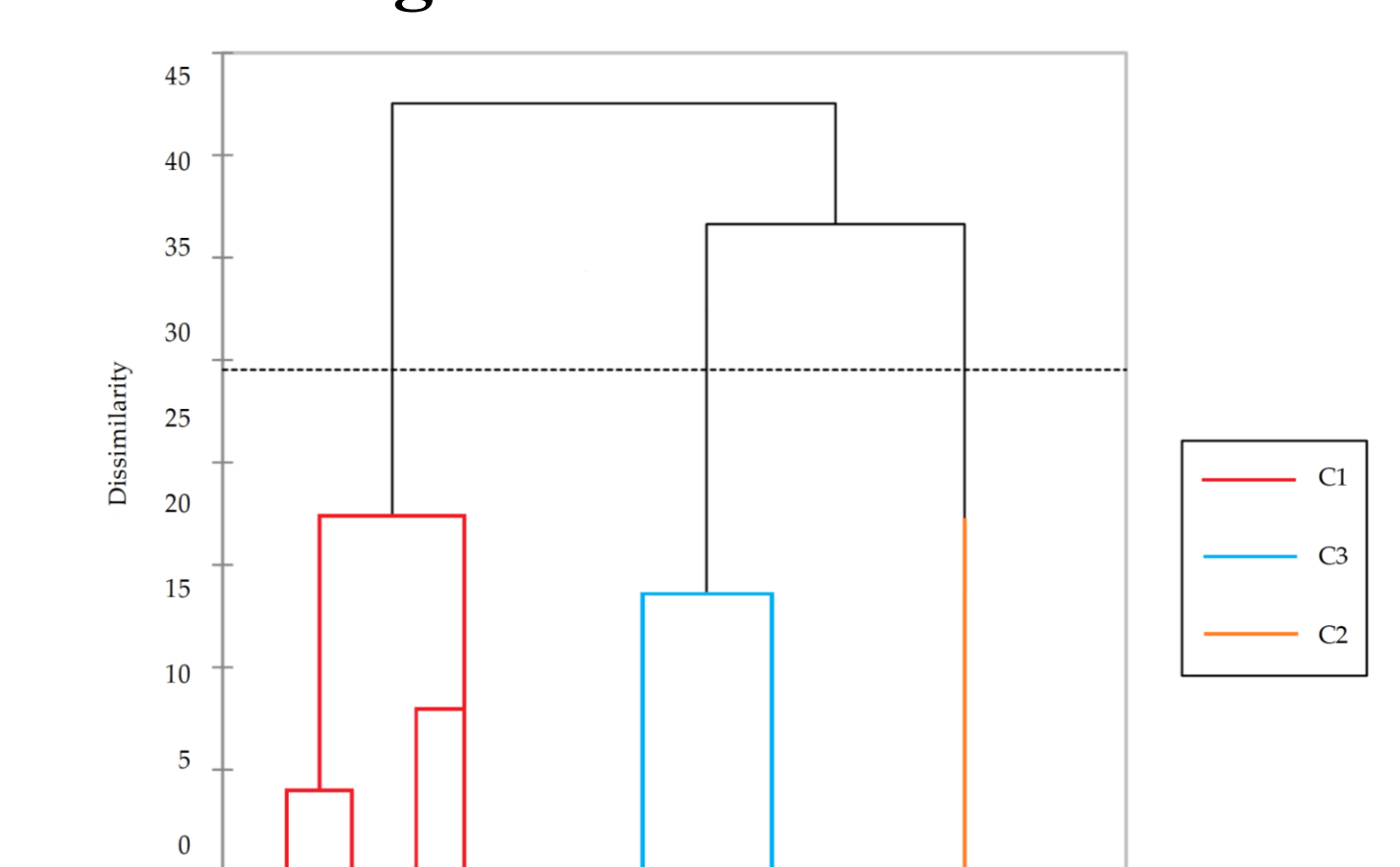


At $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$, *S. cerevisiae* showed marked growth in all trials until day 4, except for M1S1, which declined thereafter.

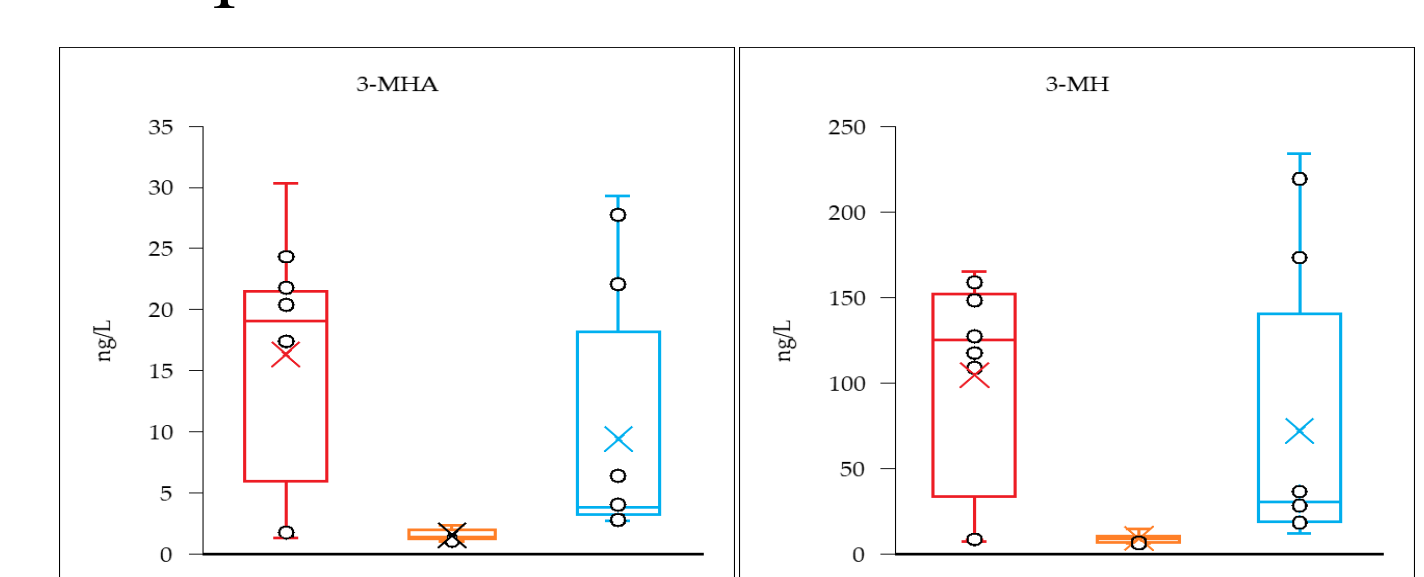


$20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ wines: ↑ Thiols → more tropical and fruity aromas

• Sorting Task



Clear distinction between wines fermented at different temperatures.



Thiol concentrations were 2- to 6-fold higher than in the control.