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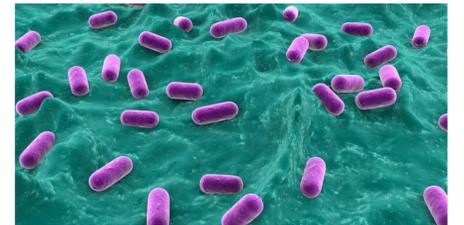
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## INTRODUCTION

Malolactic fermentation is a key biological deacidification process in winemaking, in which L-malic acid, naturally present in grapes, is converted into L-lactic acid and carbon dioxide, resulting in a reduction of wine acidity. Lactic acid bacteria can be introduced at various stages of production, before alcoholic fermentation, during co-inoculation, or through sequential inoculation with yeasts (after 24, 48, or 72 hours). Previous studies have shown that early bacterial inoculation improves acclimatisation to stress factors such as ethanol and sulphur dioxide, bacterial resilience and accelerating fermentation

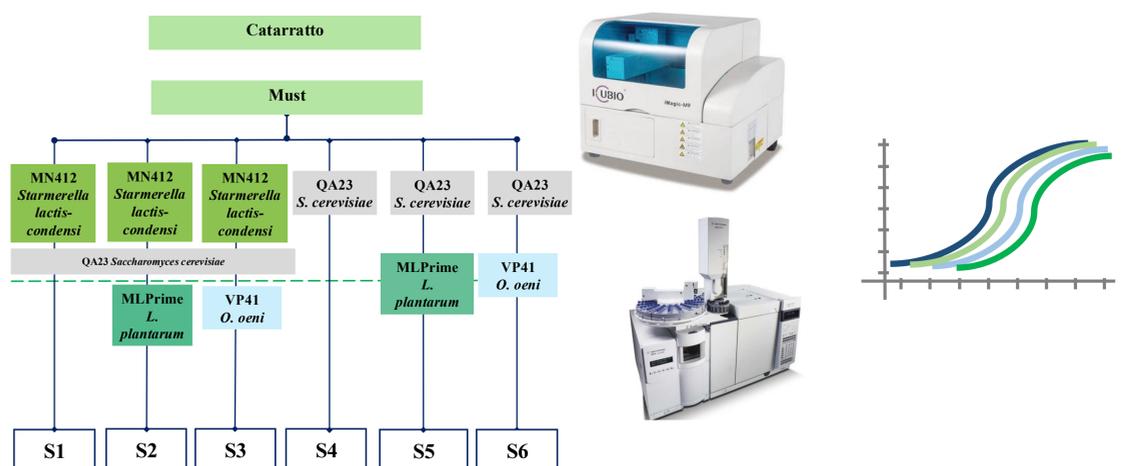
This study comparative six fermentation protocols and their respective controls to assess the impact of:

- *Starmerella lactis-condensi* MN412;
  - *Saccharomyces cerevisiae* QA23;
  - the lactic acid bacteria *Oenococcus oeni* and *Lactiplantibacillus plantarum*;
- on fermentation kinetics and the volatile organic compounds (VOC) profile of Catarratto wines.



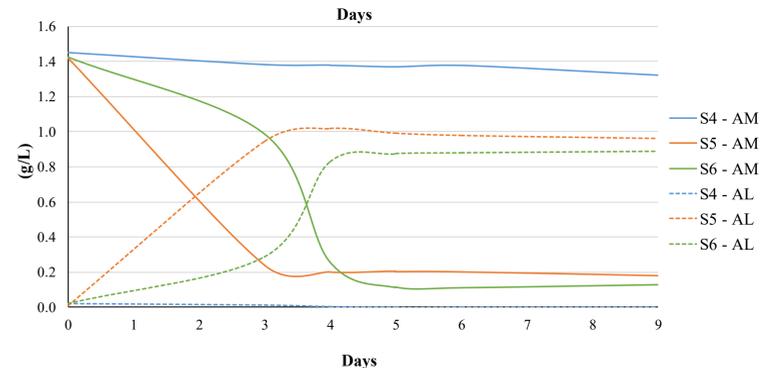
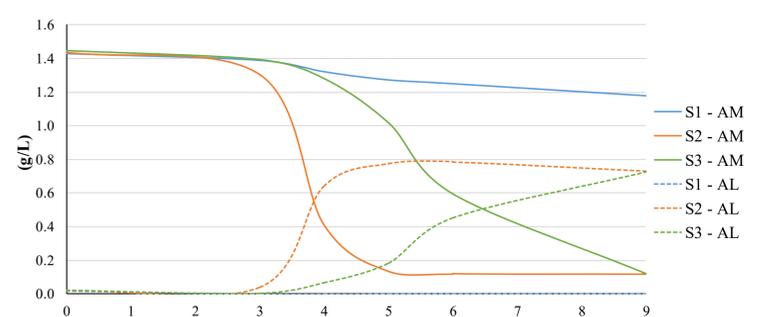
## METHODOLOGY

- ❖ Analysis of **volatile compounds**: wines obtained from different combinations of yeast/bacteria starters were analysed using **SPME/GC-MS** to identify and quantify alcohols, aldehydes, ketones, carboxylic acids, esters and other volatile compounds.
- ❖ **Malolactic fermentation**: monitored by evaluating the conversion of malic acid to lactic acid (g/L).



## RESULTS

- ❖ Malic acid degradation was closely correlated with **cell density**, leading to final **lactic acid** concentrations of up to **0.96 g/L**.
- ❖ **Alcohols** are the most abundant compounds
- ❖ **Aromatic esters** (e.g., ethyl acetate, ethyl lactate), enhancing **fruity notes** and **aromatic complexity**.



Compounds	Trials					
	S1	S2	S3	S4	S5	S6
ΣAlcohols	192.49±9.79ab	215.85±14.1a	141.74±11.96cd	86.20±5.62f	124.34±8.4de	146.27±8.19cd
ΣAldehydes	4.9±0.36b	7.15±0.96a	2.46±0.36de	2.08±0.25def	3.12±0.44cd	4.29±0.54bc
ΣKetones	7.29±0.94a	2.97±0.34bc	3.04±0.35b	1.49±0.14de	2.47±0.28bcd	3.22±0.36b
ΣCarboxylic acids	4.6±0.51de	32.68±3.71a	18.14±2.14b	5.17±0.67de	8.03±0.72cd	3.87±0.59de
Acetic acid	0.00±0.00d	23.41±2.54a	11.59±1.34b	3.21±0.47c	3.23±0.24c	0.00±0.00d
ΣEsters	14.49±1.58b	15.74±1.80ab	20.2±2.44a	8.51±0.99c	7.89±0.92cd	19.21±2.28ab
Ethyl acetate	10.54±1.16a	11.00±1.34a	9.74±1.12a	5.99±0.64b	3.53±0.45c	10.21±1.15a
Ethyl lactate	0.00±0.00e	0.00±0.00e	5.93±0.68a	0.27±0.03de	1.28±0.14de	3.99±0.57b
3-Methyl-butyl acetate	0.61±0.08cd	0.61±0.09cd	1.87±0.24b	0.58±0.07d	0.93±0.11cd	1.51±0.17be
2-Phenylethyl acetate	0.52±0.04de	0.57±0.03cd	0.43±0.08de	0.36±0.04e	0.52±0.06de	0.87±0.09b

## ACKNOWLEDGMENTS