# Enzyme treatments during pre-fermentative maceration of white winegrapes: EFFECT ON VOLATILE ORGANIC COMPOUNDS AND CHROMATIC TRAITS

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## Introduction & Aims

Pellicular maceration and the use of enzymes enhance the release of the compounds present in the skin, such as phenolic and volatile compounds [1], being it influenced by the cell wall composition [2,3]. In this study, the effect of different enzyme preparations with single activity was evaluated on the chromatic characteristics and volatile composition of pre-fermentative macerated musts from four white winegrape varieties.

## Materials & Methods

Independent replicates of 500 g each of *Vitis vinifera* L. cv. Chardonnay, Arneis, Greco and Falanghina grape berries were manually and individually crushed for 1 min, and then 1 g/100 kg of enzyme were singularly added (PL: pectin lyase; PG: polygalacturonase; PE: pectin methylesterase; XY: xylanase; AR: arabinose; three independent replicates for each treatment). Control samples (CT) without enzyme addition were also prepared. Pre-fermentative maceration was conducted for 13 h at 12 °C and then berries were pressed for 2 min. The resulting must was centrifuged and the following analyses were carried out:

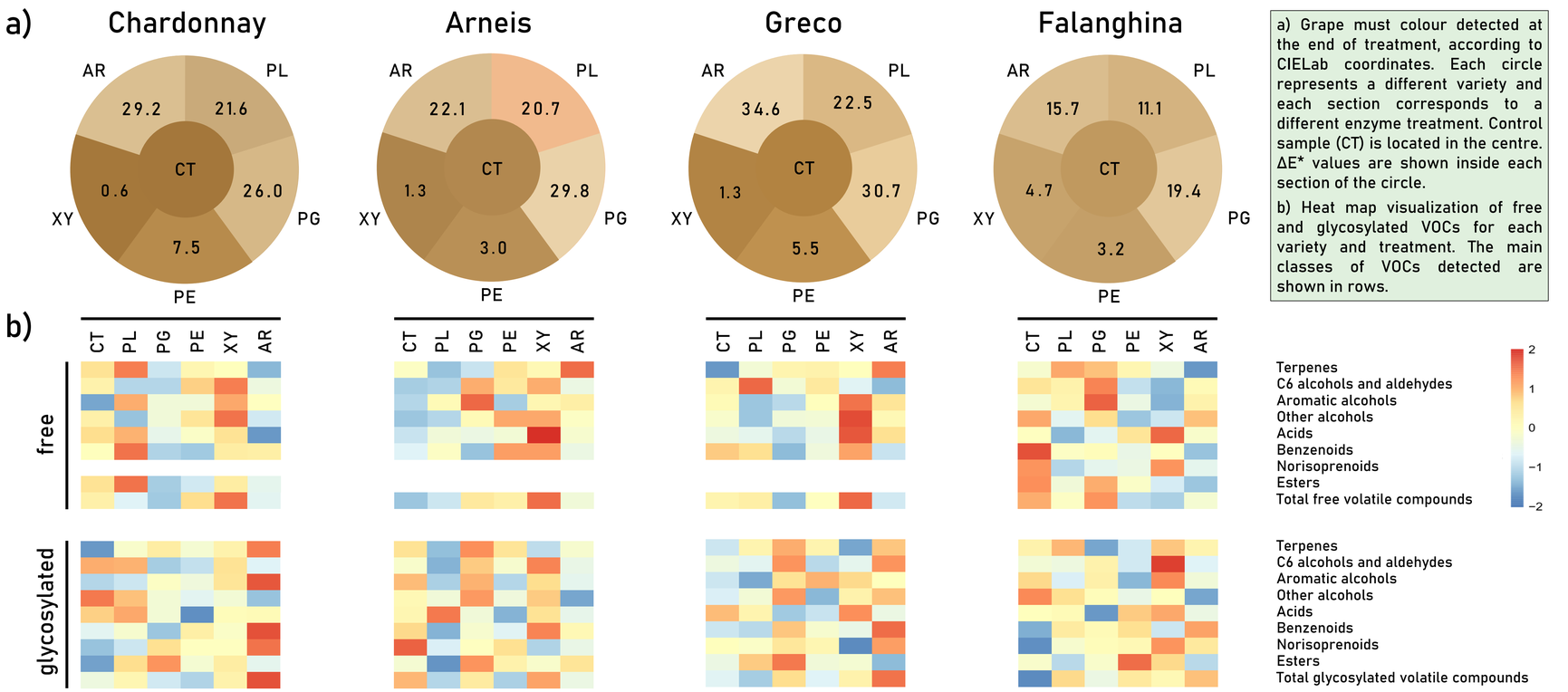
- Technological parameters;
- Total polyphenol index (TPI), CIELab colour coordinates and ΔE* (colour difference between control and treated samples) [4,5];
- Free and glycosylated volatile compounds by solid-phase extraction and GC-MS [6].

## Results

Technological parameters, chromatic characteristics and total polyphenol index of untreated (CT) and enzyme-treated (PL, PG, PE, XY and AR) Chardonnay, Arneis, Greco and Falanghina grape musts.

| | CT | PL | PG | PE | XY | AR | sign. |
|---|---|---|---|---|---|---|---|
| *Chardonnay* | | | | | | | |
| Must yield (%) | 57.9 ± 1.3 d | 62.9 ± 1.4 bc | 68.2 ± 1.6 a | 59.3 ± 1.2 cd | 58.7 ± 1.5 d | 64.5 ± 1.5 ab | *** |
| Sugars (g/L) | 198 ± 4 | 200 ± 1 | 200 ± 2 | 200 ± 9 | 200 ± 16 | 199 ± 1 | ns |
| pH | 3.57 ± 0.01 ab | 3.55 ± 0.01 b | 3.58 ± 0.01 ab | 3.57 ± 0.01 ab | 3.58 ± 0.01 a | 3.55 ± 0.01 ab | * |
| Total acidity (g/L) | 5.20 ± 0.04 a | 5.30 ± 0.04 a | 5.30 ± 0.04 a | 5.23 ± 0.04 a | 5.00 ± 0.04 b | 5.23 ± 0.11 a | *** |
| L* | 53.4 ± 1.5 d | 71.4 ± 2.7 b | 76.3 ± 2.3 ab | 60.8 ± 1.1 c | 53.9 ± 1.8 d | 78.5 ± 0.3 a | *** |
| a* | 10.97 ± 0.89 a | 4.69 ± 0.51 b | 3.94 ± 0.74 bc | 9.73 ± 0.25 a | 11.13 ± 0.30 a | 3.20 ± 0.07 c | *** |
| b* | 39.29 ± 1.37 a | 29.06 ± 0.89 b | 28.95 ± 1.58 b | 39.49 ± 0.03 a | 39.71 ± 0.05 a | 26.51 ± 0.42 b | *** |
| TPI | 13.07 ± 0.32 ab | 10.72 ± 0.77 cd | 11.83 ± 0.77 bc | 12.24 ± 0.11 ab | 13.18 ± 0.13 a | 9.49 ± 0.20 d | *** |
| *Arneis* | | | | | | | |
| Must yield (%) | 54.6 ± 0.6 b | 63.6 ± 2.1 a | 64.2 ± 2.7 a | 54.7 ± 1.7 b | 54.2 ± 0.7 b | 65.6 ± 1.1 a | *** |
| Sugars (g/L) | 232 ± 3 | 230 ± 5 | 234 ± 4 | 232 ± 3 | 231 ± 2 | 232 ± 5 | ns |
| pH | 3.45 ± 0.01 a | 3.40 ± 0.01 b | 3.46 ± 0.01 a | 3.42 ± 0.03 ab | 3.45 ± 0.01 a | 3.45 ± 0.01 a | ** |
| Total acidity (g/L) | 3.83 ± 0.04 b | 4.14 ± 0.02 a | 3.93 ± 0.13 b | 3.94 ± 0.07 b | 3.89 ± 0.02 b | 3.88 ± 0.02 b | ** |
| L* | 59.6 ± 0.8 d | 76.8 ± 1.3 b | 85.4 ± 0.5 a | 62.6 ± 1.6 c | 58.3 ± 0.9 d | 78.3 ± 1.0 b | *** |
| a* | 8.83 ± 0.01 ab | 3.58 ± 0.27 c | 2.05 ± 0.13 d | 8.32 ± 0.24 b | 8.98 ± 0.32 a | 3.34 ± 0.16 c | *** |
| b* | 36.77 ± 0.30 a | 26.38 ± 0.54 b | 23.47 ± 0.68 c | 36.64 ± 0.22 a | 36.61 ± 0.61 a | 26.36 ± 0.76 b | *** |
| TPI | 10.57 ± 0.22 a | 7.81 ± 0.26 b | 7.73 ± 0.31 b | 10.25 ± 0.53 a | 10.87 ± 0.19 a | 7.81 ± 0.34 b | *** |
| *Greco* | | | | | | | |
| Must yield (%) | 69.1 ± 0.9 a | 72.5 ± 1.5 a | 72.7 ± 1.4 a | 68.8 ± 1.6 a | 68.9 ± 1.9 a | 71.3 ± 2.0 a | * |
| Sugars (g/L) | 211 ± 1 | 220 ± 9 | 215 ± 3 | 217 ± 1 | 210 ± 2 | 213 ± 2 | ns |
| pH | 3.18 ± 0.03 | 3.17 ± 0.01 | 3.17 ± 0.01 | 3.19 ± 0.02 | 3.17 ± 0.01 | 3.19 ± 0.01 | ns |
| Total acidity (g/L) | 7.02 ± 0.31 | 7.27 ± 0.09 | 7.03 ± 0.14 | 6.76 ± 0.31 | 7.11 ± 0.16 | 7.05 ± 0.29 | ns |
| L* | 58.0 ± 1.3 c | 76.7 ± 4.0 b | 84.0 ± 0.6 a | 63.3 ± 2.4 c | 58.4 ± 2.0 c | 86.0 ± 1.1 a | *** |
| a* | 11.40 ± 0.47 a | 4.90 ± 1.47 b | 3.23 ± 0.15 bc | 9.90 ± 1.01 a | 10.79 ± 0.22 a | 2.09 ± 0.35 c | *** |
| b* | 41.89 ± 0.66 a | 31.16 ± 3.48 b | 27.70 ± 0.30 bc | 41.04 ± 1.74 a | 40.80 ± 0.58 a | 23.71 ± 0.91 c | *** |
| TPI | 13.73 ± 0.43 a | 11.31 ± 0.35 b | 10.23 ± 0.21 c | 13.42 ± 0.46 a | 13.90 ± 0.12 a | 9.89 ± 0.43 c | *** |
| *Falanghina* | | | | | | | |
| Must yield (%) | 64.2 ± 2.6 b | 71.2 ± 0.8 a | 71.0 ± 0.7 a | 64.4 ± 1.9 b | 67.2 ± 0.7 ab | 69.7 ± 1.3 a | *** |
| Sugars (g/L) | 219 ± 16 | 219 ± 22 | 233 ± 7 | 228 ± 8 | 232 ± 2 | 230 ± 7 | ns |
| pH | 3.43 ± 0.01 | 3.43 ± 0.02 | 3.43 ± 0.01 | 3.43 ± 0.01 | 3.44 ± 0.01 | 3.44 ± 0.01 | ns |
| Total acidity (g/L) | 4.93 ± 0.08 b | 5.15 ± 0.08 a | 5.03 ± 0.11 ab | 4.93 ± 0.04 b | 4.86 ± 0.04 b | 5.00 ± 0.04 ab | ** |
| L* | 65.6 ± 1.7 c | 74.7 ± 1.0 b | 81.6 ± 1.1 a | 67.5 ± 1.9 c | 68.9 ± 0.3 c | 78.2 ± 2.1 ab | *** |
| a* | 7.71 ± 0.71 a | 4.78 ± 0.21 c | 2.94 ± 0.26 d | 6.67 ± 0.57 ab | 6.33 ± 0.14 b | 3.63 ± 0.73 cd | *** |
| b* | 36.07 ± 1.47 a | 30.45 ± 0.56 bc | 26.05 ± 0.77 d | 33.70 ± 0.88 ab | 33.13 ± 0.44 ab | 27.51 ± 2.28 cd | *** |
| TPI | 11.09 ± 0.29 a | 10.93 ± 0.86 a | 9.12 ± 0.16 b | 10.97 ± 0.51 a | 10.84 ± 0.15 a | 9.39 ± 0.26 b | *** |

All data are expressed as average value ± standard deviation (n=3). Different Latin letters within the same row indicate significant differences among treatments according to Tukey test ($p < 0.05$). Sign: *, **, *** and "ns" indicate significance at $p < 0.05$, 0.01, 0.001 and not significant, respectively. L*: lightness, a*: red/green colour coordinate, b*: yellow/blue colour coordinate, TPI: total polyphenol index.




a) Grape must colour detected at the end of treatment, according to CIELab coordinates. Each circle represents a different variety and each section corresponds to a different enzyme treatment. Control sample (CT) is located in the centre. ΔE* values are shown inside each section of the circle.

b) Heat map visualization of free and glycosylated VOCs for each variety and treatment. The main classes of VOCs detected are shown in rows.

## Main findings

- PL, PG and AR enzymes increased must yield in Chardonnay, Arneis and Falanghina;
- PL-treated Arneis and Falanghina musts showed higher total acidity values, when compared to the respective CT, whereas XY-treated Chardonnay musts showed the opposite effect;
- In all varieties the addition of PL, PG and AR enzymes led to musts with a lighter colour (higher L* values) able to be visually perceived (ΔE* > 5) and with lower TPI values than CT;
- XY enzyme caused a greater release of free volatile compounds in Chardonnay, Arneis and Greco musts, while PG did in Falanghina must;
- Glycosylated volatile compounds were found in higher amounts in AR-treated Chardonnay, Greco and Falanghina musts, while XY enzyme was the most efficient in Arneis must.

## References

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