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New insights into the fate of markers involved in fresh mushroom off-flavour during alcoholic fermentation

Léa Delcros^{1,2,3}, Sylvie Collas², Marion Hervé¹, Bruno Blondin³ & Aurélie Roland^{3*}

¹MHCS, Epernay, France

²Comité Champagne, Epernay, France

³SPO, Univ Montpellier, INRAE, Institut Agro, Montpellier, France

Context

The fresh mushroom off-flavour (FMOFF) appeared in wines since the 2000s. Some C8 compounds such as 1-octen-3-one, 1-octen-3-ol, 1-hydroxyoctan-3-one, 3-octanol and others are involved in this specific off-flavour [1-3] (Figure 1). At the same time, glycosidic precursors of some FMOFF compounds have been identified in musts contaminated by *Crustomyces subabruptus* [4], highlighting the role of aroma precursors in this specific taint. However, the fate of these volatile molecules and glycosidic fractions during fermentation is not well known. The aim of this work was to study the effects of alcoholic fermentation by *Saccharomyces cerevisiae* (Levuline CHP® strain) on FMOFF glycosidic precursors and free volatile compounds present in healthy and contaminated Pinot noir musts, using *Crustomyces subabruptus* as fungal infection.

7 CARBONS	8 CARBONS	9 CARBONS
2-heptanol <chem>CCCCC(O)C</chem> Identified in Semillon Must pt: 100 µg/L La Guerche et al., 2006	1-hydroxyoctan-3-one <chem>CCCCC(O)C(=O)C</chem> pt: 0.1 mg/L Identified in musts and wines Pt: perception threshold in water	1-nonen-3-ol <chem>CCCCC(O)C=CC</chem> Only identified in wines pt: 0,04 ng/L in air
2-octen-1-ol <chem>CCCCC=CCO</chem> pt: 50 µg/L Identified in musts and wines	3-octanone <chem>CCCCC(=O)CC</chem> pt: 23 µg/L Came from 1-octen-3-one during AF Brander et al., 1980; La Guerche et al., 2006; Xu et al., 2019; Darriet et al., 2002; Ribereau-Gayon et al., 2012; Delcros et al., 2023	1-octen-3-ol <chem>CCCCC(O)C=CC</chem> pt: 7 µg/L Identified in musts and wines
3-octanol <chem>CCCCC(O)CC</chem> pt: 0,25 µg/L Identified in Pinot noir wines	1-octen-3-one <chem>CCCCC(=O)C=CC</chem> pt: 3 ng/L Identified in musts and wines	1-nonen-3-one <chem>CCCCC(=O)C=CC</chem> pt: 1 ng/L Pons et al., 2011; Baiano et al., 2016

Figure 1: Main aroma compounds involved in fresh-mushroom off-flavour

MAIN RESULTS

Methodology

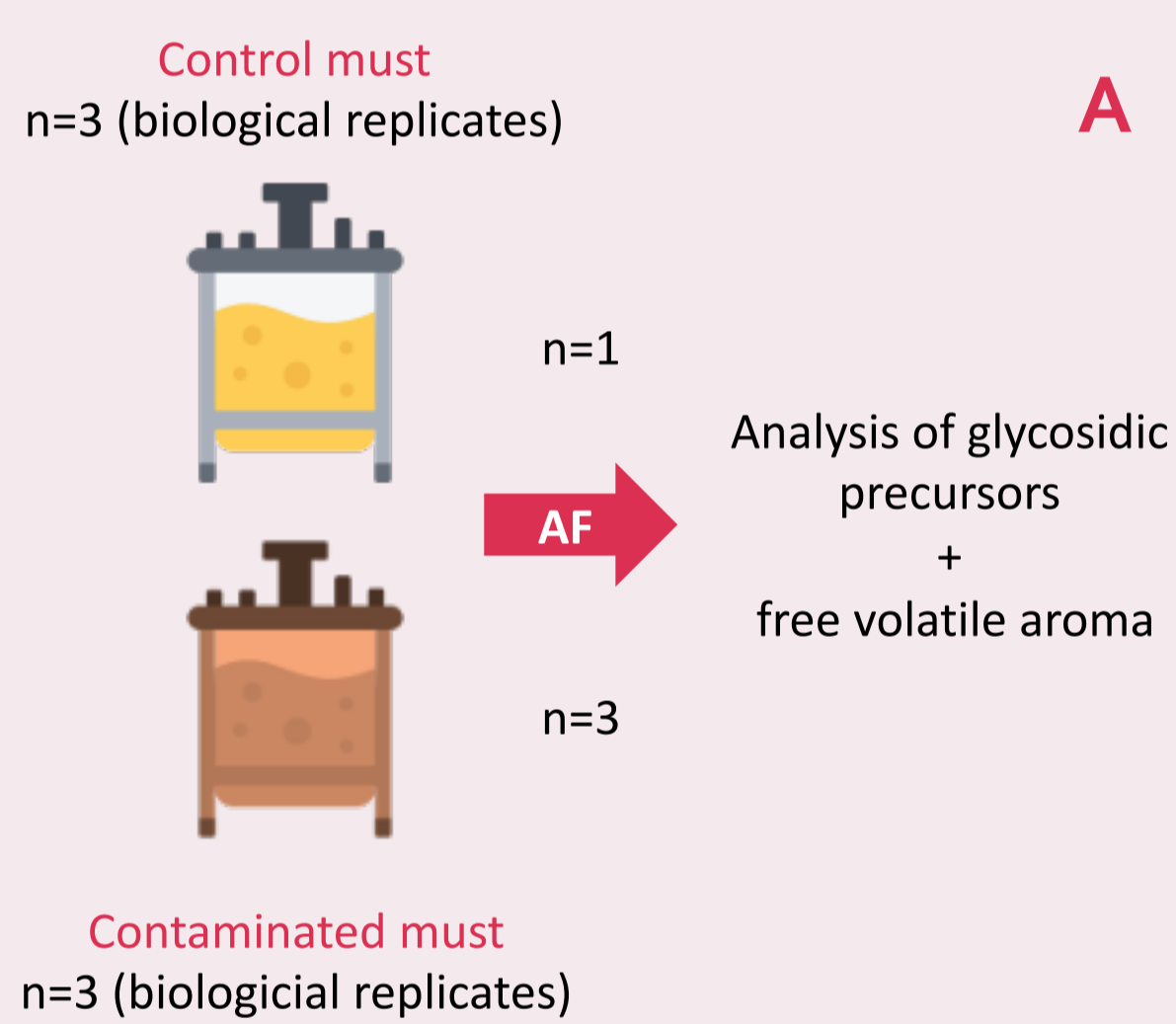
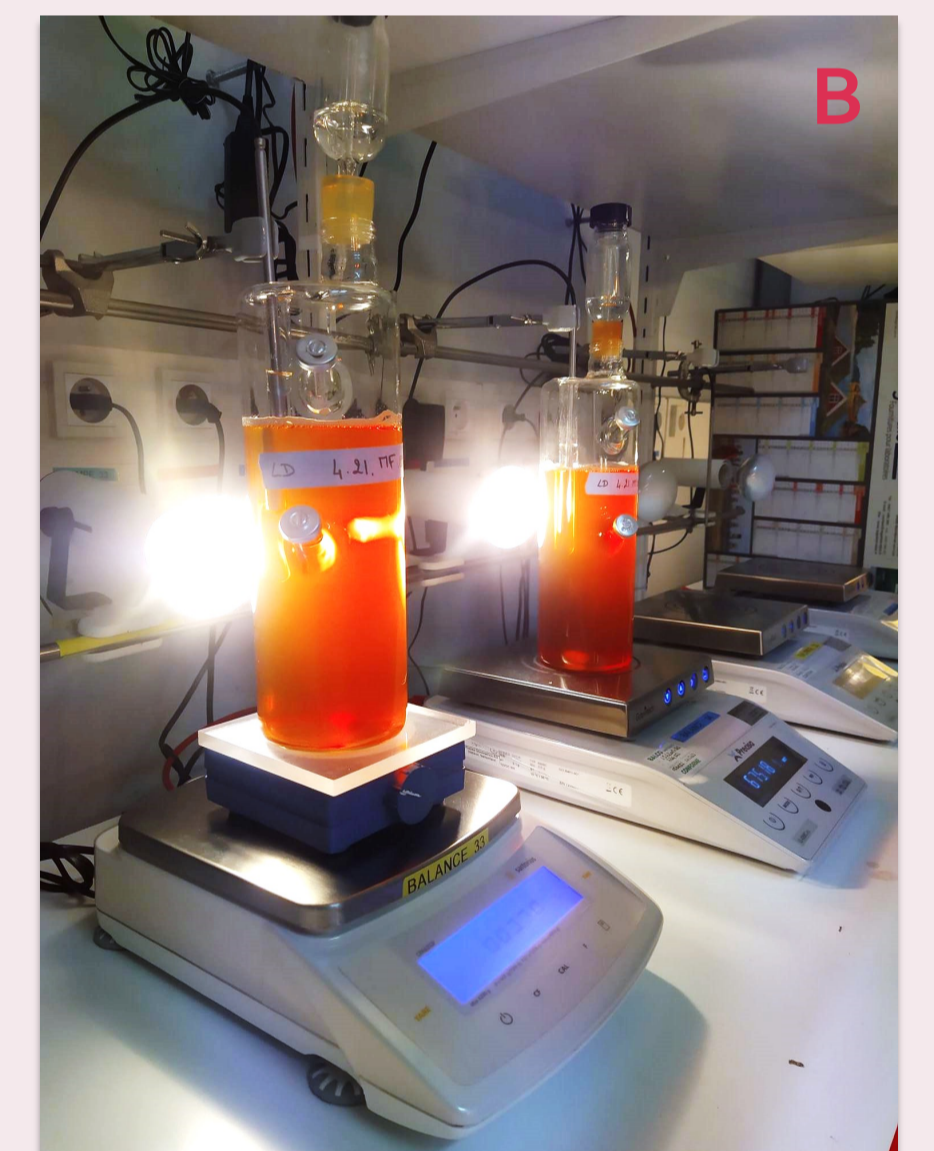


Figure 2: (A) Experimental workflow and (B) standardized alcoholic fermentations (AF)
(3 musts of Pinot noir coming from Champagne and contaminated at laboratory by *Crustomyces Subabruptus* according to Meistermann et al., 2021 protocol)

Methodology



- The **1-hydroxyoctan-3-one** reached an identical threshold concentration at the end of AF (around 100-150 µg/L).
- The **1-hydroxyoctan-3-one** plays a dual role as substrate and product for the yeast.

Results

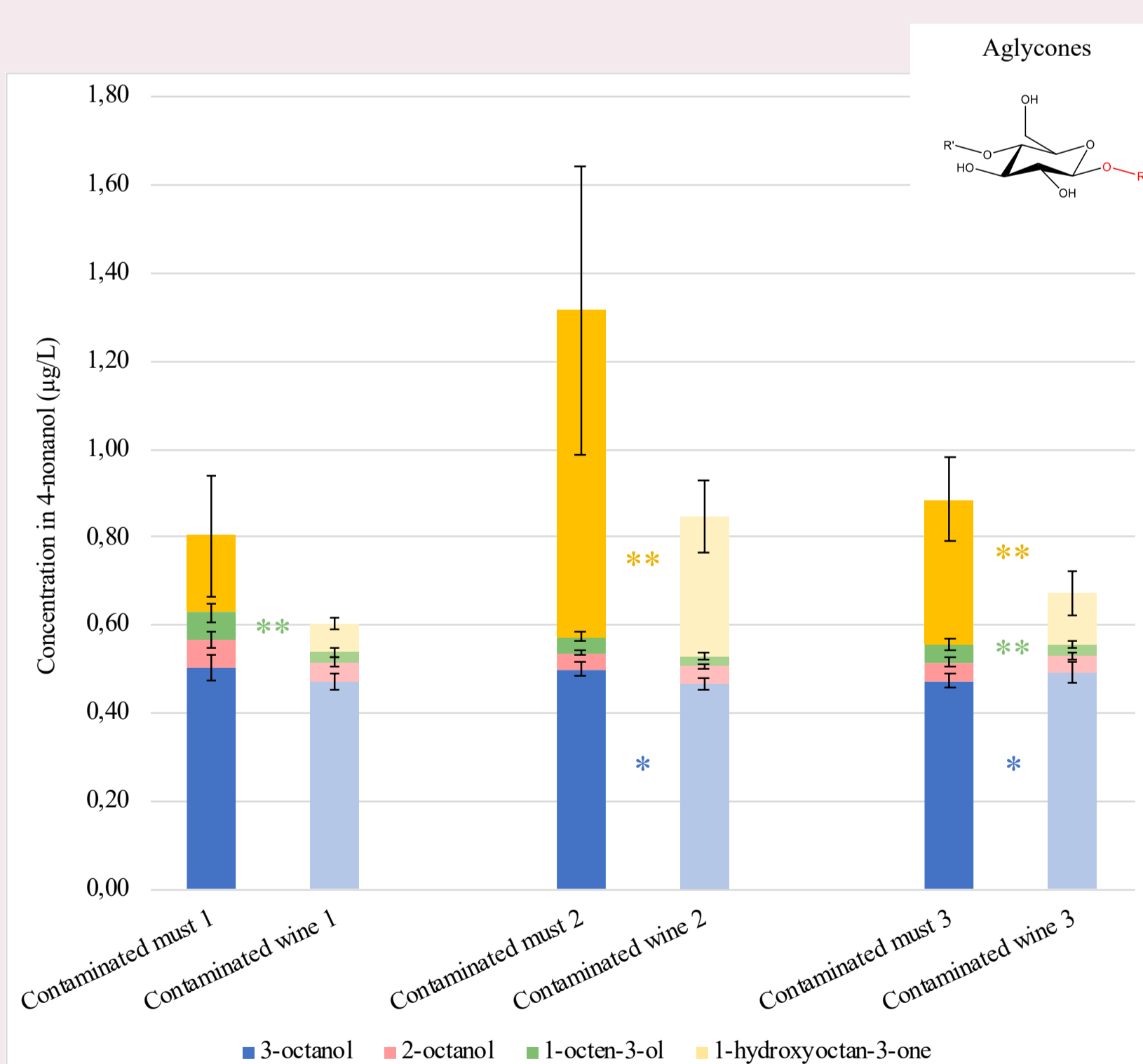


Figure 3: Concentration of aglycones in *Crustomyces subabruptus* contaminated Pinot noir musts and associated wines after treatment with β -glucosidase. Must: Dark color, Wine: Light color. Analyses were done in triplicate, error bars represented analytical standard deviation (n=3). Differences obtained by Student's t-test ($\alpha=0.05$) between each aglycone concentration in contaminated musts and associated wines. * Significant ($p < 0.05$), ** Highly significant ($p < 0.01$).

Glycosidic precursor analysis:

- First identification of 1-hydroxyoctan-3-one glycosides in the laboratory contaminated musts
- The FMOFF glycosidic fraction decreased and even more in the case of 1-hydroxyoctan-3-one precursors during AF.

Free volatile compounds analysis: →

- Evolutions both compound and matrix dependent except for 1-hydroxyoctan-3-one
- 1-hydroxyoctan-3-one reached an identical threshold concentration in wine regardless of its initial level in contaminated musts.

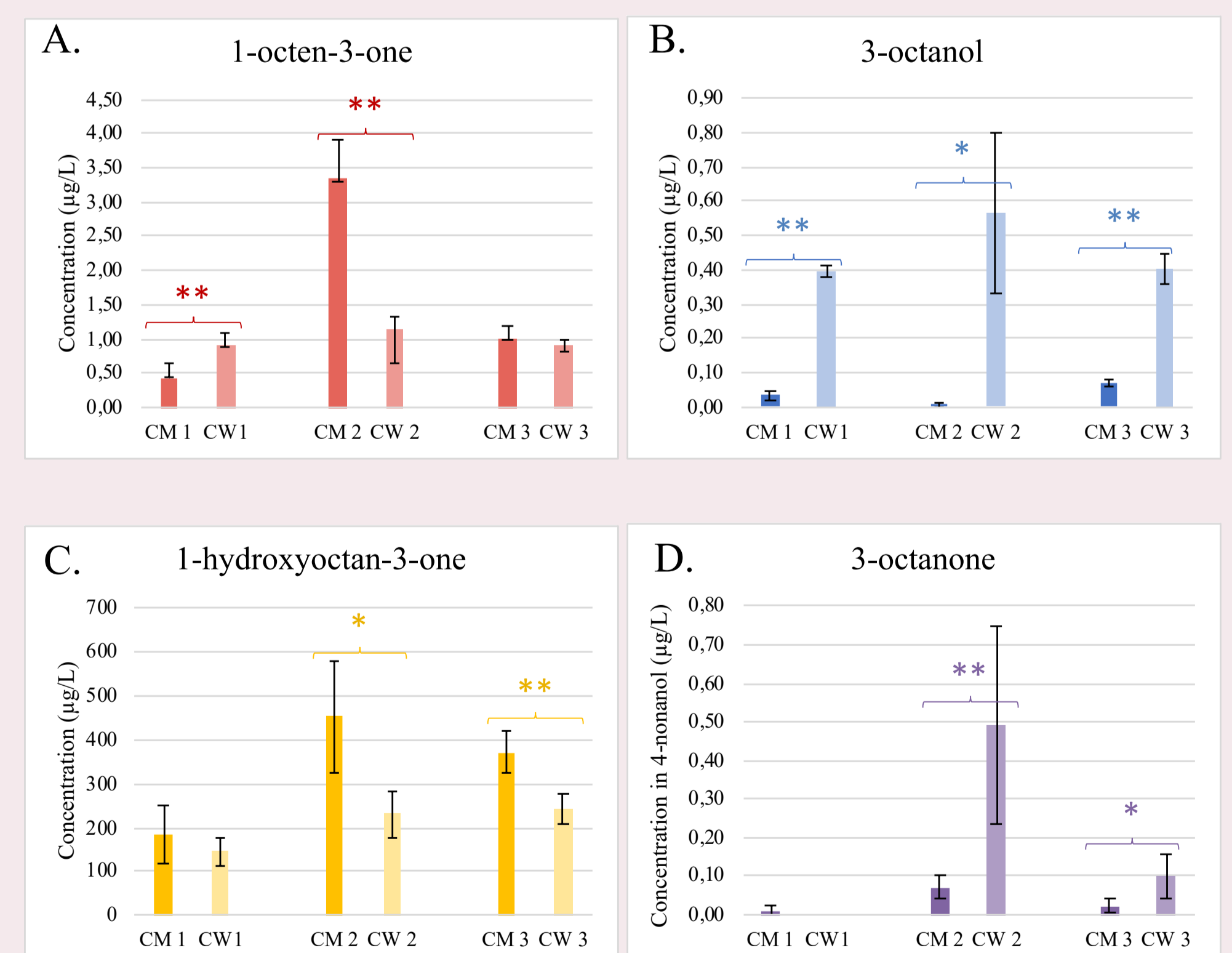


Figure 4: Concentration of free volatile compounds in *Crustomyces subabruptus* contaminated Pinot noir musts and associated wines. (CM: Contaminated must (dark color), CW: Contaminated wine (light color)). Analyses were done in triplicate, error bars represented analytical standard deviation (n=3). Differences obtained by Student's t-test ($\alpha=0.05$) between each compound concentration in contaminated musts and associated wines. * Significant ($p < 0.05$), ** Highly significant ($p < 0.01$)

Conclusions and Perspectives

- Identification of glycosidic fractions of 1-hydroxyoctan-3-one at significant levels in a *Crustomyces subabruptus*, allowing the differentiation of a healthy must from a spoiled one.
- With regard to volatile compounds, 1-hydroxyoctan-3-one and 1-octen-3-one reached higher levels in contaminated matrices.