PTR-ToF-MS for the study of VOCs associate with different interactions between *Saccharomyces* and *non-Saccharomyces* strains in commercial grape juice and in grape must

Carmen BERBEGAL[a], Iuliia KHOMENKO[b] Pasquale RUSSO[a], Vittorio CAPOZZI[a], Franco BIASIOLI[b], Giuseppe SPANO[a]

[a] *University of Foggia, Department of the Sciences of Agriculture, Food and Environment, Foggia, Italy.*
[b] *Research and Innovation Centre, Fondazione Edmund Mach, San Michele all'Adige, Italy.*
E-mail: vittorio.capozzi@unifg.it

INTRODUCTION

A consistent part of Volatile Organic Compounds (VOCs) responsible for wine aroma quality, belong to yeast metabolic activities. The model organism for Alcoholic Fermentation (AF) in wine is *Saccharomyces cerevisiae* and the most part of commercial starter culture for AF in wine are designed on the basis of well characterized strains belonging to this species. However, an increasing interest has been deserved to non-*Saccharomyces* yeasts used in combination with *S. cerevisiae* strains in order to differentiate the quality of final wines (Capozzi *et al*. 2015). The interactions among microbial resources in wine are among the main lever susceptible to influence the content of VOCs associated with fermentations (Li *et al*. 2016). PTR-ToF-MS analysis of VOCs associated with wine headspace has been recently optimized for experimental setup in order to reduce fragmentation and formation of ethanol clusters (Campbell-Sills *et al*. 2016). In this study, we used this analytical approach to explore the interactions among two *Saccharomyces* strains (one commercial isolate and one autochthonous Apulian biotype) and two non-*Saccharomyces* strains (two commercial isolates belonging to the species *Metschnikowia pulcherrima* and *Torulaspora delbrueckii*).

MATERIAL AND METHODS

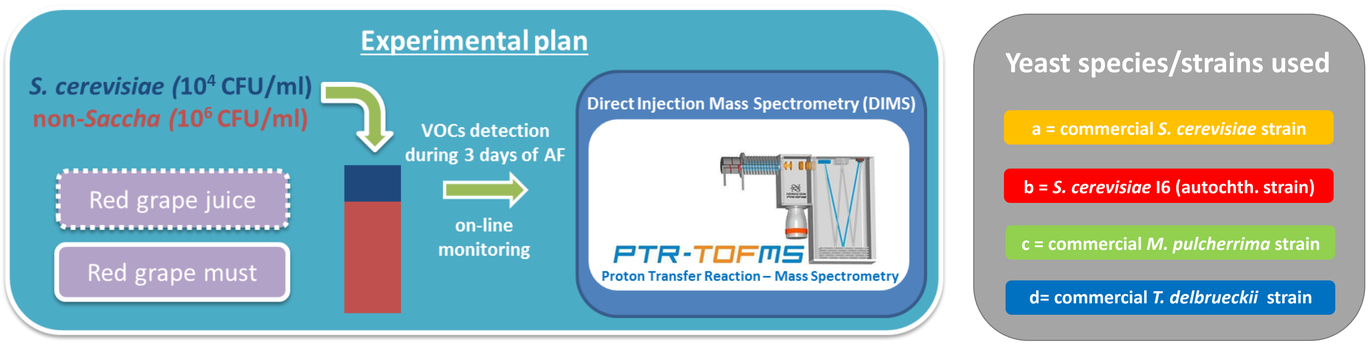

Figure 1. Nano-vinifications were performed in the vials using commercial red grape juice (Vitafit) and red grape must from Apulian autochthonous grape varieties (pH 3.5, 18º babo). Nitrogen flux in the vial headspace assured the maintaining the conditions comparable with those present in vinification. Commercial grape juice was sterilized. The must was not sterilized. When present in the same experimental mode, yeasts were co-inoculated in the juice/must.

Experimental Modes			
1 - a	2 - b	3 - g	4 - e
5 - ab	6 - ag	7 - ae	8 - bg
9 - be	10 - abg	11 - abe	12 - age
13 - bge	14 - abge	15 - uninoc.	

Table 1. Number corresponding to the different yeast managements we tested in this study. The letters correspond to the yeast species/strains reported in Figure 1. The trial number 15 corresponds to the uninoculated samples (control).

RESULTS

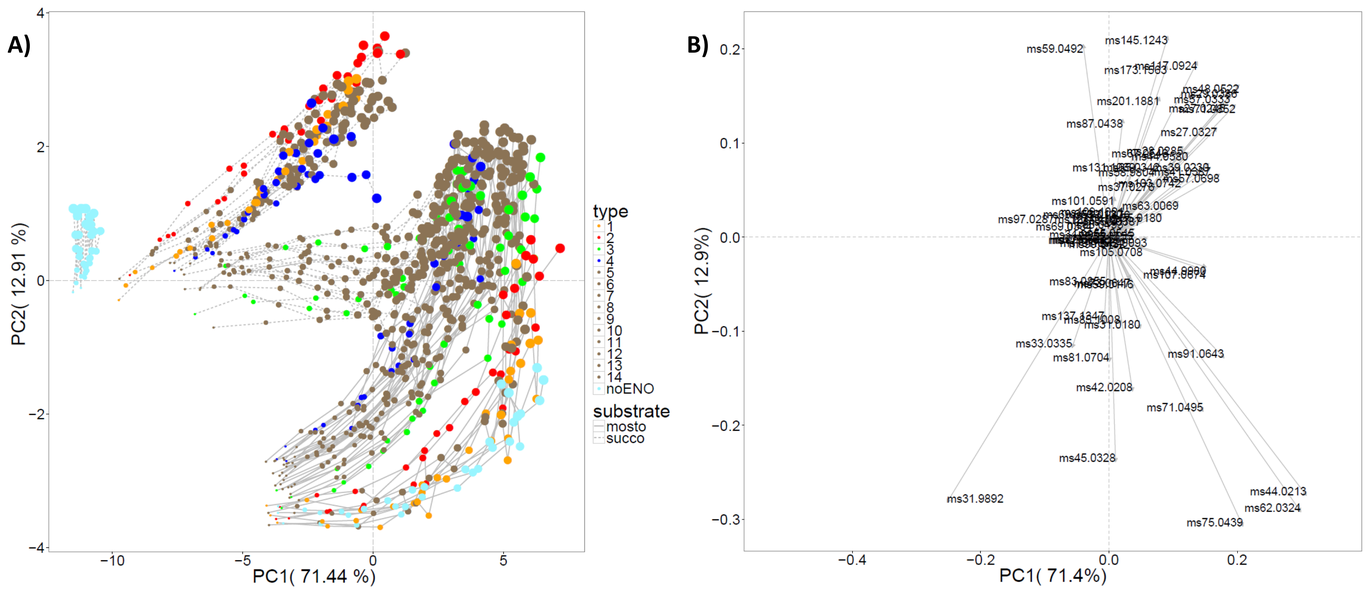

Figure 2. Score plot (A) and loading plot (B) of principal component analysis of VOC emission evolution associated with the first three days of alcoholic fermentation for each experimental modes we tested in this study. Data are logarithmically transformed and centered. Different colors indicate different yeast managements , medium and blank samples. The size of points grows with time of measurements.

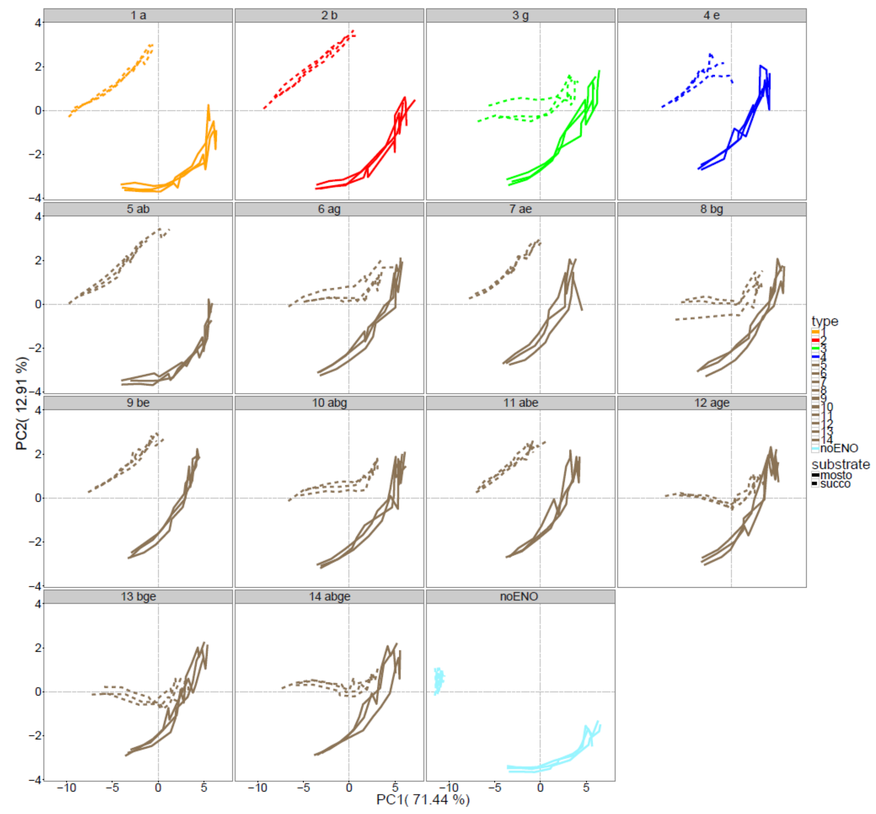

Figure 3. Score plot of principal component analysis of VOC emission evolution associated with the first three days of alcoholic fermentation separately represented for each experimental modes we tested in this study.

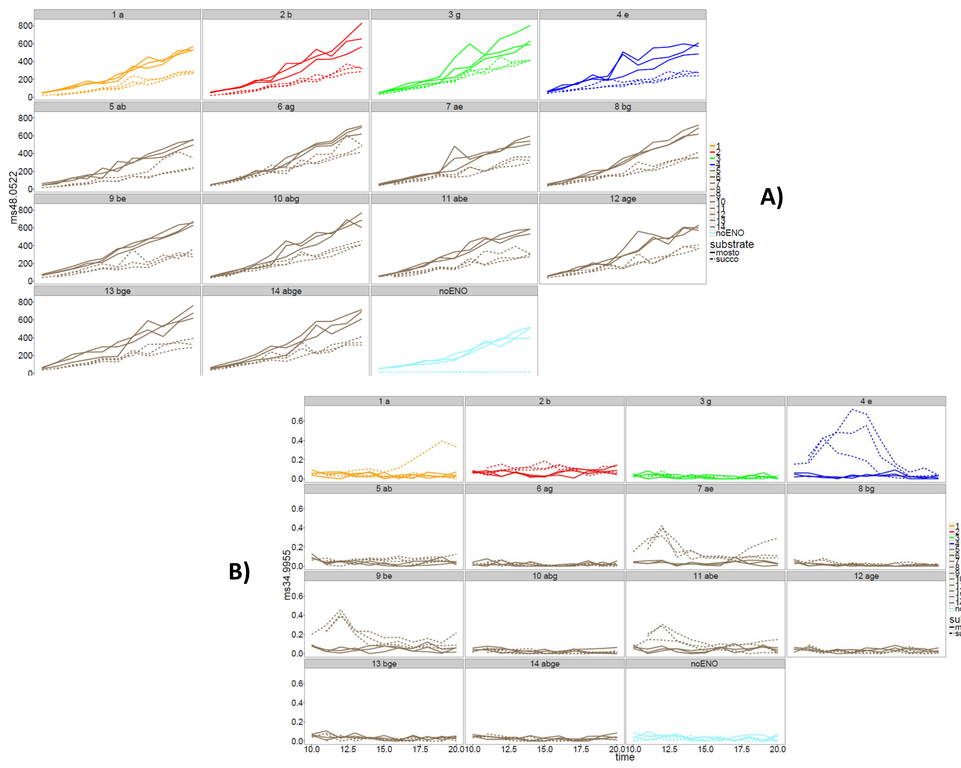

Figure 4. Curves of selected mass peaks (ms48.0522 and ms34.9955) tentatively identified as an isotope of ethanol (A) and hydrogen sulfide (B), respectively. The profiles show the evolution of VOCs associated to the two mass peaks during the first three days of alcoholic fermentation. Curves of each sample represent mean value of each yeast management for each time point.

In this study, we on-line monitored for three days the VOCs (more than 70 mass peaks) associated with all the possible different combinations (of enological significance) of the four yeast strains, when inoculated in both commercial grape juice and grape must. Our results i) underlined the presence of different behaviors on grape juice and on must, respectively; ii) highlighted differences among the single yeast strains 'volatomes'; iii) provided interesting information important to select combinations of *Saccharomyces*/non-*Saccharomyces* strains susceptible to maximize the content of desired VOCs in wine and minimize the presence of those undesired.

This research was supported by the Apulian Region Project cod. QCBRAJ6 "Biotecnologie degli alimenti per l'innovazione e la competitività delle principali filiere regionali: estensione della conservabilità e aspetti funzionali - BIOTECA". V.C. is supported by a grant by the Apulian Region in the framework of 'FutureInResearch' program (practice code 9OJ4W81). C.B. is grateful to The Division of Mass Spectrometry of the Italian Chemical Society for Fellowships for participation, as young researcher, to the 2nd MS WineDay Conference.

- Campbell-Sills, H., Capozzi, V., Romano, A., Cappellin, L., Spano, G., Breniaux, M., Lucas, P., Biasioli, F., 2016. Advances in wine analysis by PTR-ToF-MS: Optimization of the method and discrimination of wines from different geographical origins and fermented with different malolactic starters. International Journal of Mass Spectrometry 397–398, 42–51. doi:10.1016/j.ijms.2016.02.001
- Capozzi, V., Garofalo, C., Chiriatti, M.A., Grieco, F., Spano, G., 2015. Microbial terroir and food innovation: The case of yeast biodiversity in wine. Microbiol. Res. 181, 75–83. doi:10.1016/j.micres.2015.10.005
- Lu, Y., Huang, D., Lee, P.-R., Liu, S.-Q., 2016. Assessment of volatile and non-volatile compounds in durian wines fermented with four commercial non-*Saccharomyces* yeasts. J. Sci. Food Agric. 96, 1511–1521. doi:10.1002/jsfa.7253

2nd MS-Wine Day