



Sciences pour
l'œnologie



LALLEMAND



Potentialities of wine yeasts to produce unusual aromas during fermentation

Guillaume BERGLER, PhD Student

Audrey BLOEM, Carole CAMARASA,

Anne ORTIZ-JULIEN

Benoît COLONNA-CECCALDI, Michel BRULFERT



International Congress on Grapevine and Wine Sciences

Logroño, Spain

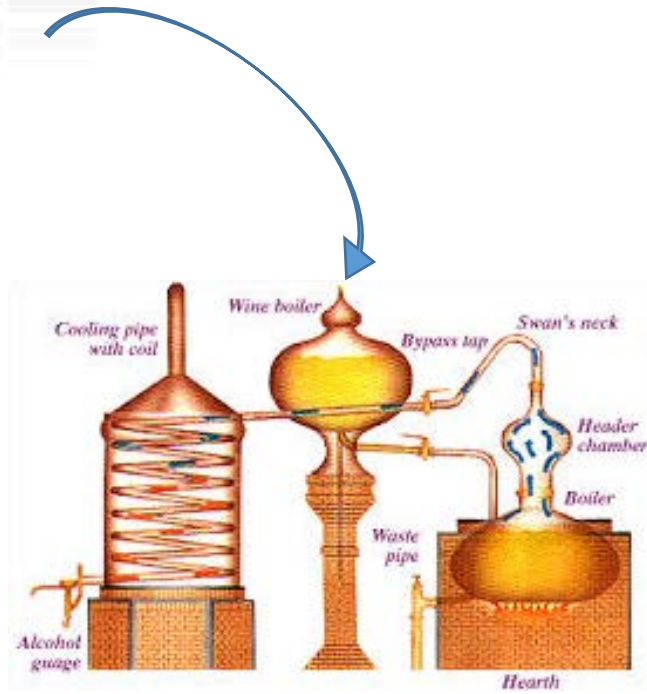
7-9 November 2018

Three-step Cognac making process

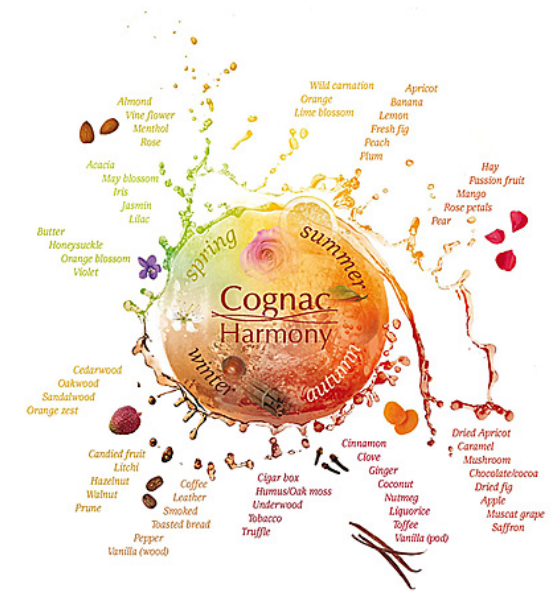
Fermentation



Double distillation



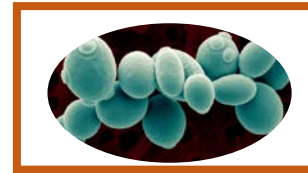
Ageing



Wine fermentation



Carbohydrates (Glucose, Fructose)
Nitrogen
Lipids
Precursors



Ethanol
CO₂
Volatile compounds

Grape juice: availability of nutrients, composition, ...

Management of fermentation:

Yeasts: species/strains

Technological parameters: O₂, inoculation procedure, temperature, ...



Diversifying wine flavor and aroma: a current challenge in oenology



Increasingly competitive global market of wines and spirits



Control the quality of wines and offer products with character



Unusual aromas

Low production during fermentation

Less studied

Terpen derivatives



Benzene derivatives



Norisoprenoids

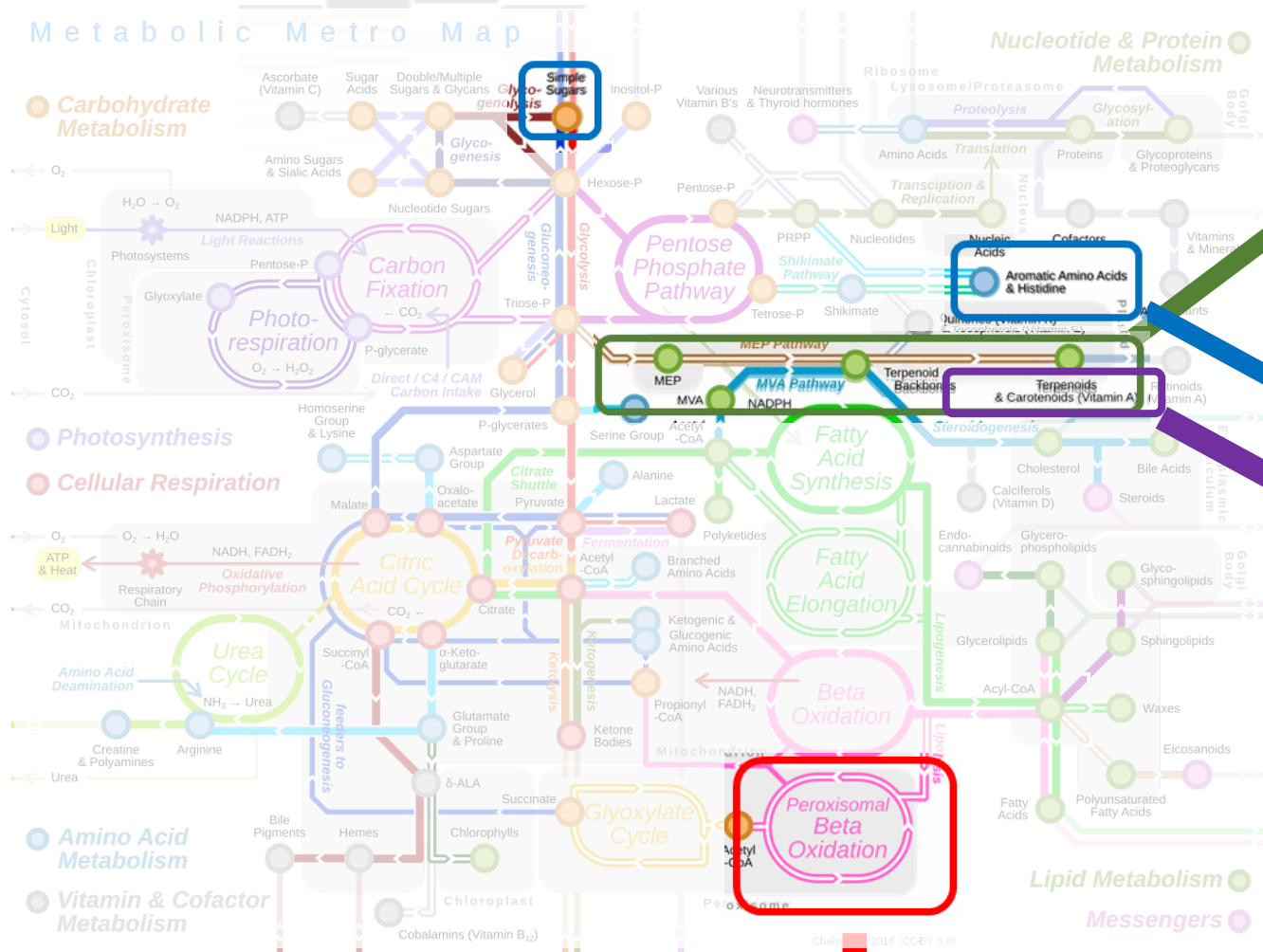


Lactones

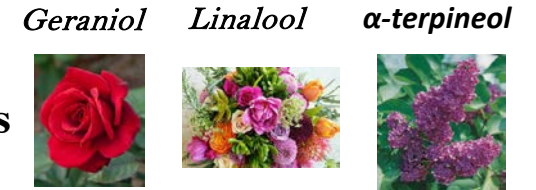


Metabolic pathways ?

Metabolic pathways related to the synthesis of unusual aromas



Terpen derivatives



Benzene derivatives



Norisoprenoids



Lactones

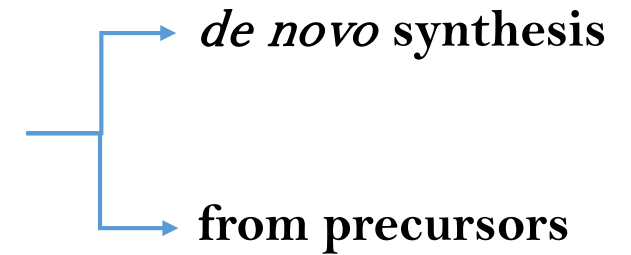


Aims of the study



✓ Study the ability of wine yeasts to produce unusual aromas

✓ Investigate the effects of environmental conditions and yeast genetic background on the production of aromas



Experimental design



41 yeast strains

31 *Saccharomyces cerevisiae*

10 non- *Saccharomyces*

2 *L. thermotolerans*

2 *T. delbrueckii*

2 *S. bacillaris*

1 *H. osmophila*

1 *Z. florentina*

2 commercial strains

(L28 and L31)

PhenOFerm
device



Fermentations (in duplicate) :

- 3 natural musts
- 1 synthetic must

328 fermentations

Must	Sugars (g/L)	pH	YAN (mgN/L)	NTU
Ugni blanc 2016	160.5	2.95	92	1150
Maccabeu 2016	215.8	3.38	134	20
Chardonnay 2016	227.5	3.42	192	20 + 4mg/L of phytosterols
Synthetic Must	228	3.4	192	4mg/L of phytosterols

Experimental design



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PhenOFerm device



Fermentations (in duplicate):

- 3 natural musts
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328 fermentations

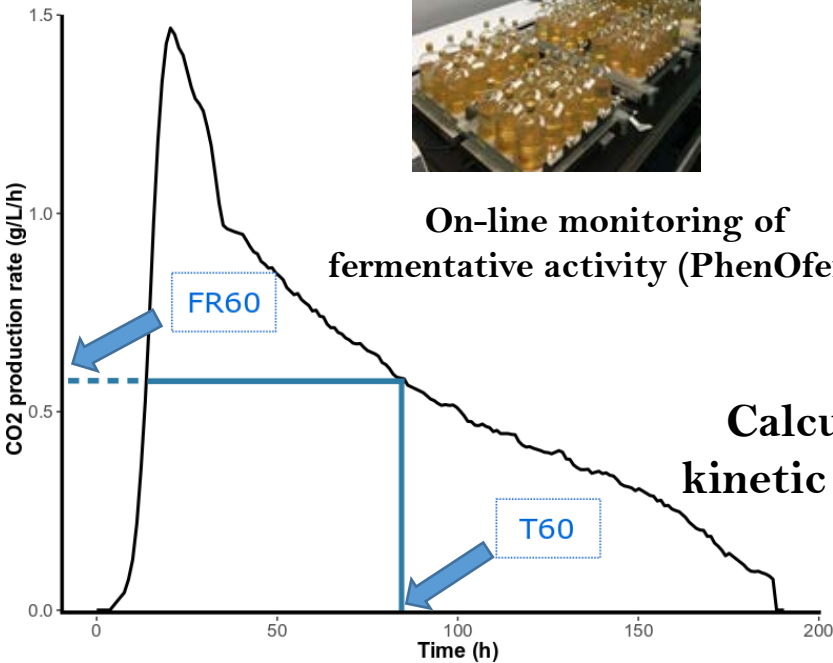
Dispersive Liquid-Liquid MicroExtraction & GC-MS

- Terpen derivatives
- Benzene derivatives
- Norisoprenoids
- Lactones

23 analysed compounds

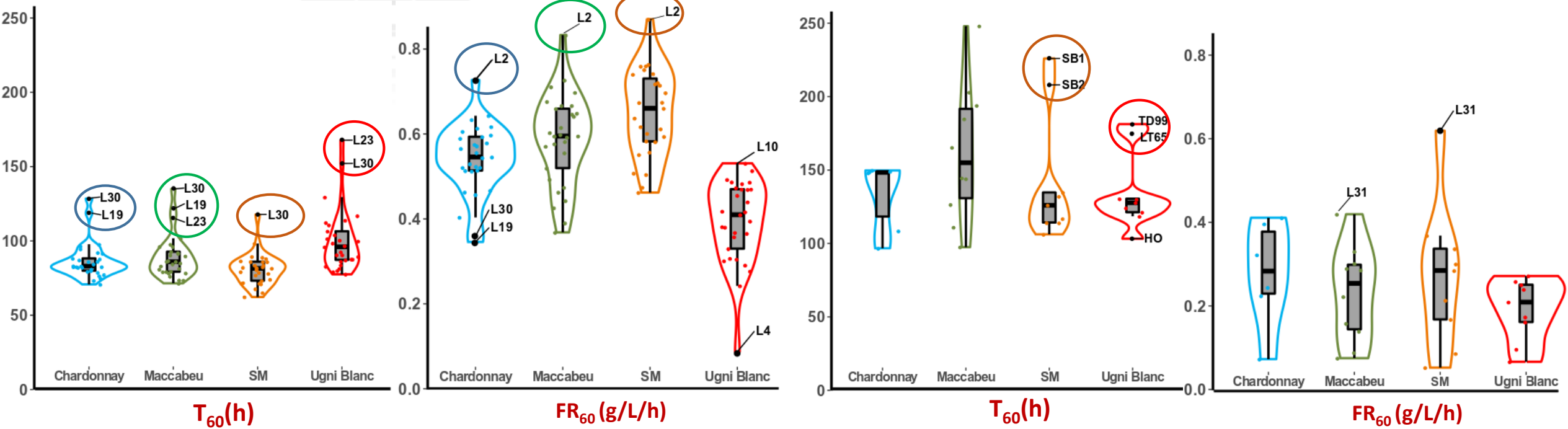
Calculation of kinetic parameters

Quantification of volatile compounds



On-line monitoring of fermentative activity (PhenOFerm)

Variability between strains in kinetic parameters



Saccharomyces cerevisiae strains

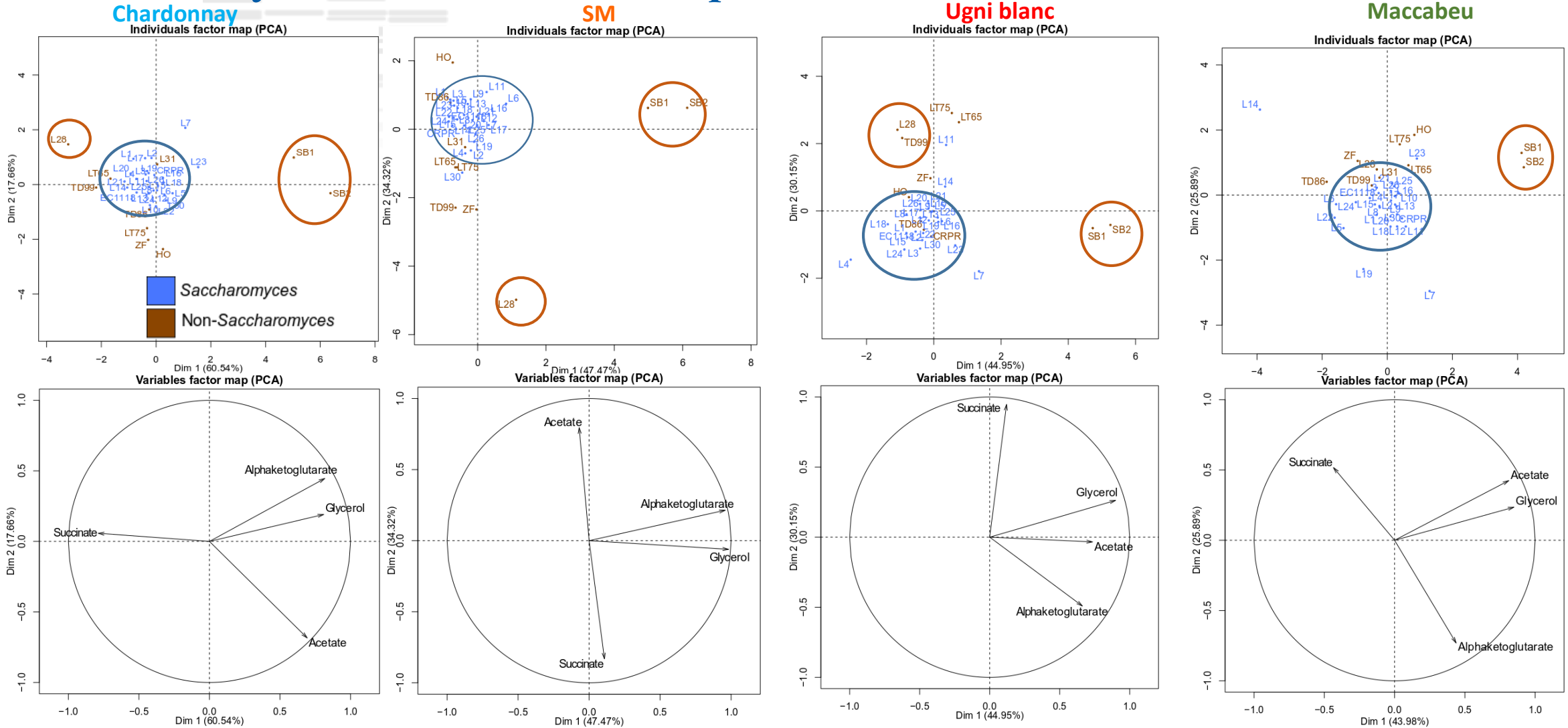
- Low incidence of the medium composition
- Substantial variability between strains (fermentation rates)

Non-Saccharomyces strains

- Incidence of the medium composition
- Substantial variability between strains



Variability between strains in the production central carbon metabolites



Similar behaviour of *Saccharomyces cerevisiae* strains

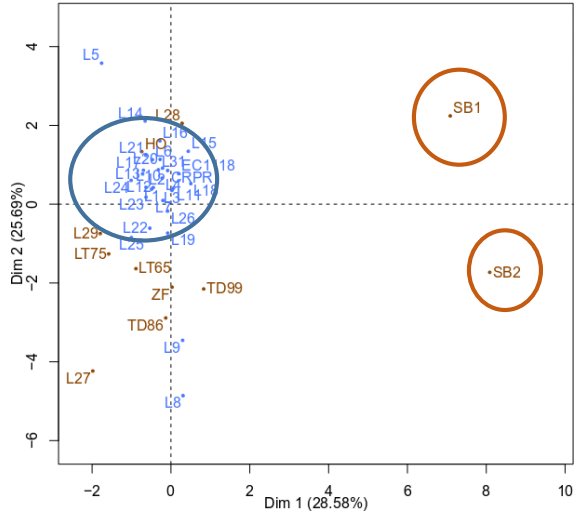
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Important diversity within the non-*Saccharomyces* strains

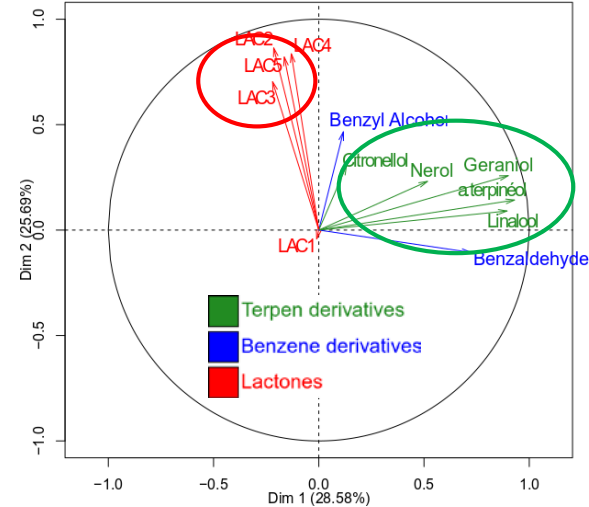
Diversity on the production of unusual aromas ?

SM

Individuals factor map (PCA)

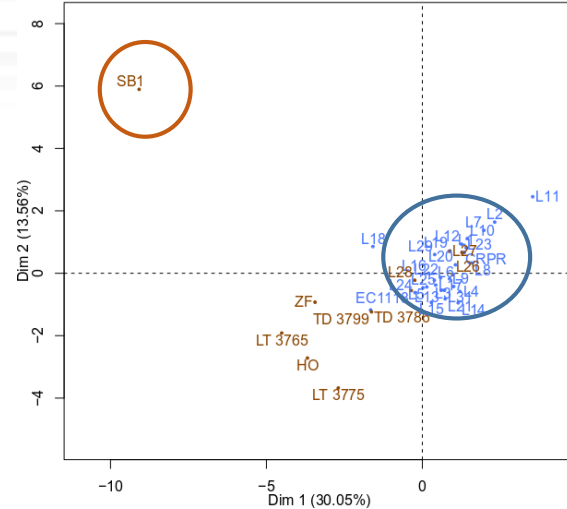


Variables factor map (PCA)

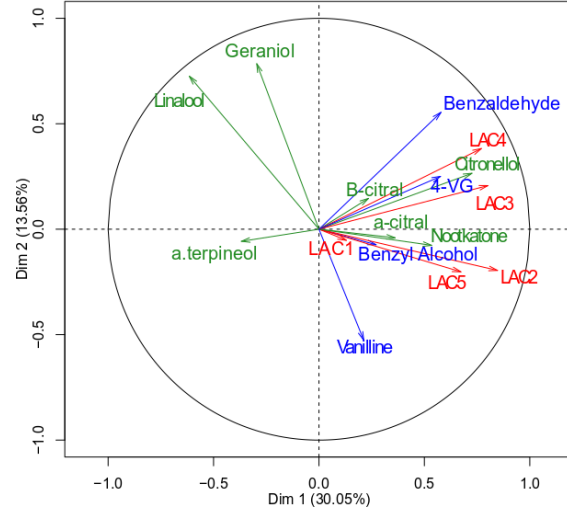


Chardonnay

Individuals factor map (PCA)

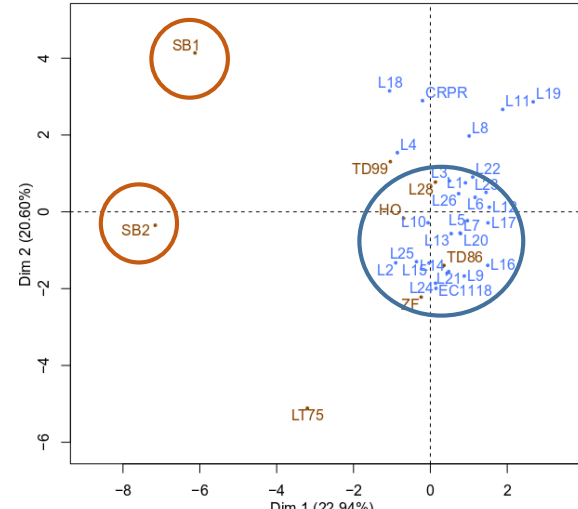


Variables factor map (PCA)

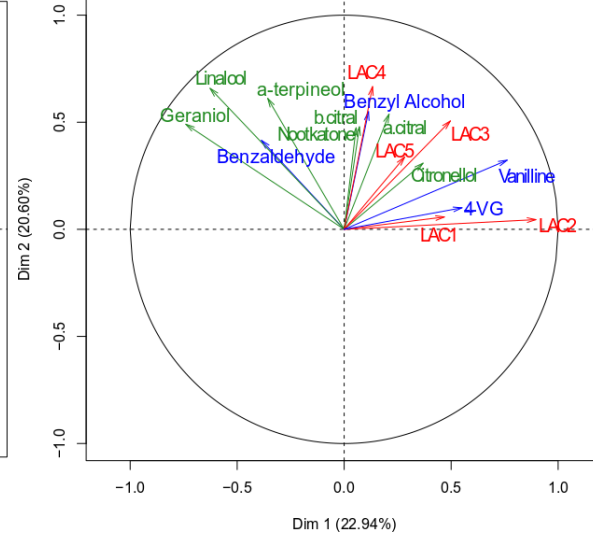


Ugni blanc

Individuals factor map (PCA)

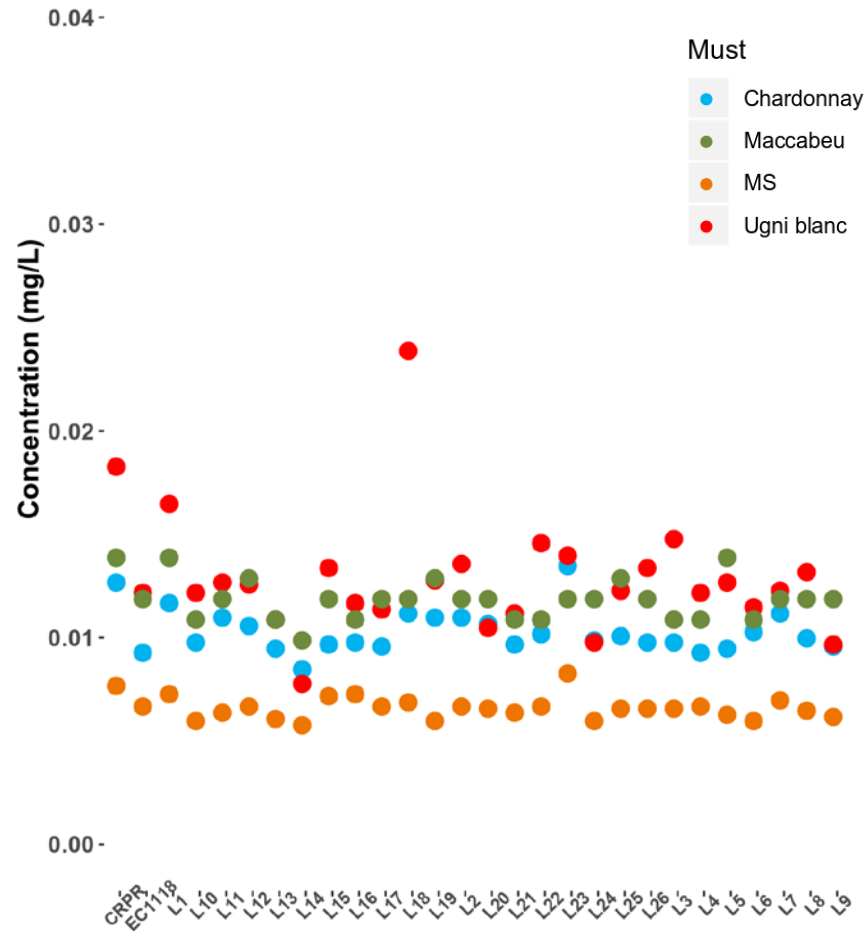


Variables factor map (PCA)

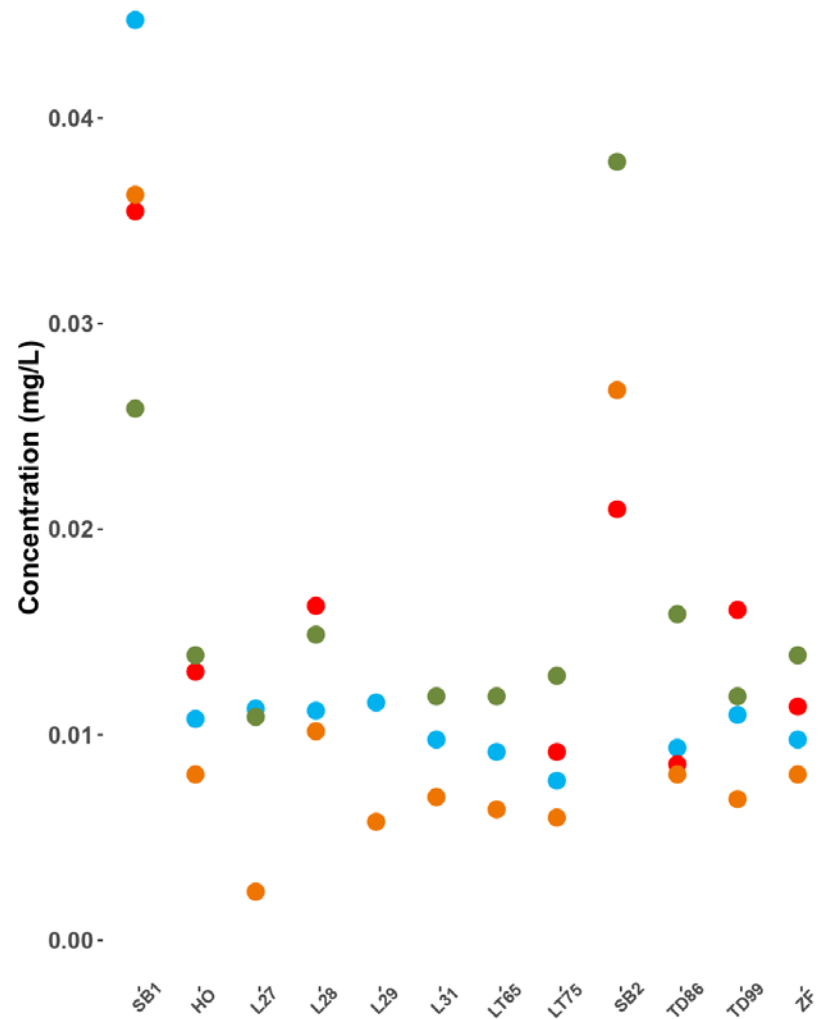


- Cluster of *Saccharomyces cerevisiae* strains
- Non-*Saccharomyces* strains generally lower producers ...
- ... except *S. bacillaris* strains that produce the highest amounts of linalool and geraniol
- Intrinsic ability to produce the majority of the studied compounds
- Terpen derivatives correlated with each other, as well as the lactones (only on SM)

Production of unusual aromas : Example of linalool



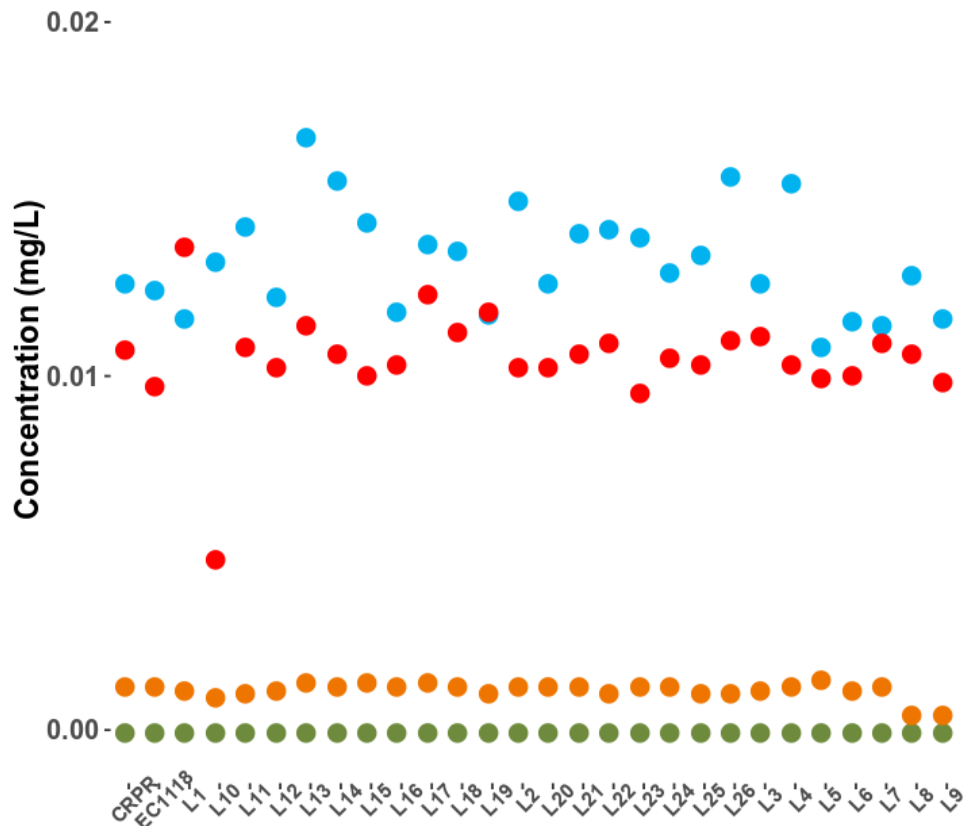
Saccharomyces cerevisiae strains



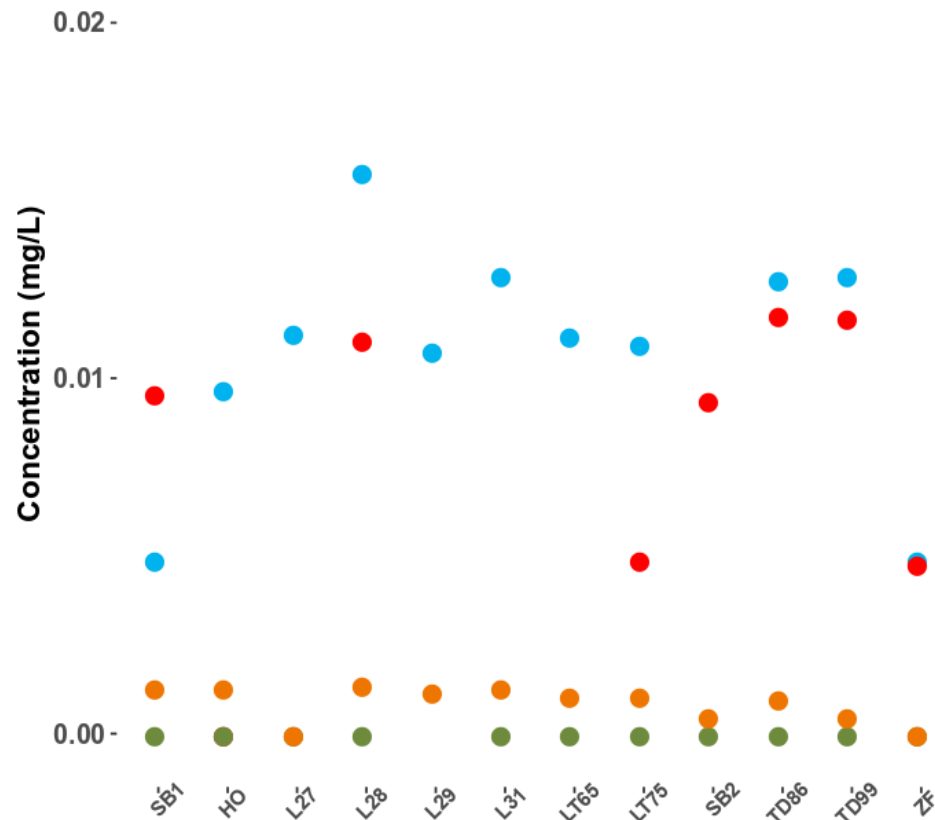
Non-Saccharomyces strains

- Substantial production on SM
- Species-dependant production
- Higher production on natural musts

Production of unusual aromas : Example of δ -decalactone



Saccharomyces cerevisiae strains



Non-Saccharomyces strains

- Must-dependant production
- Very limited production on SM
- Strain-dependant production



Conclusion ...

- Ability of yeasts strains to produce a panel of unusual aromas
- Strain-dependant production for most of the compounds
- Must-dependant production for specific compounds
- Few differences between *Saccharomyces cerevisiae* strains in their volatile profiles
- Some undetected compounds : γ -nonalactone, β -ionone

... & Perspectives

- Further investigation of the involved metabolisms
- *de novo* biosynthesis or precursor-related synthesis

Acknowledgements



Academic supervisors :

- Carole CAMARASA
- Audrey BLOEM

Industrial supervisors :

- Benoît COLONNA-CECCALDI / Michel BRULFERT
- Anne ORTIZ-JULIEN

Technical team:

- Christian PICOU
- Marc PEREZ

