

How to adapt winemaking practices to modified grape composition under climate change conditions?

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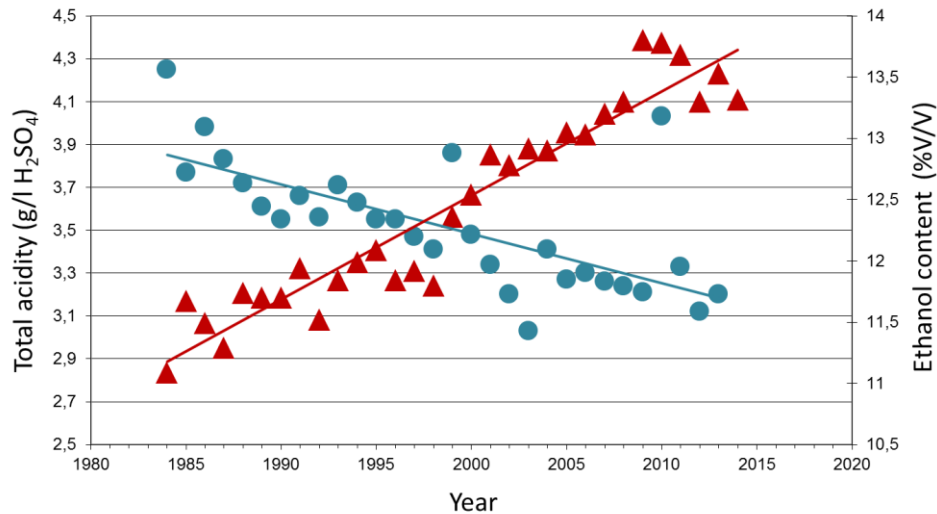
J. Noble



P. Marullo

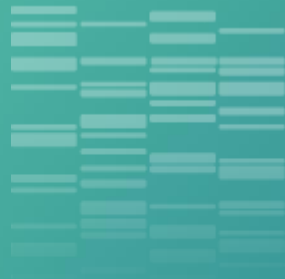


Consequences of climate change



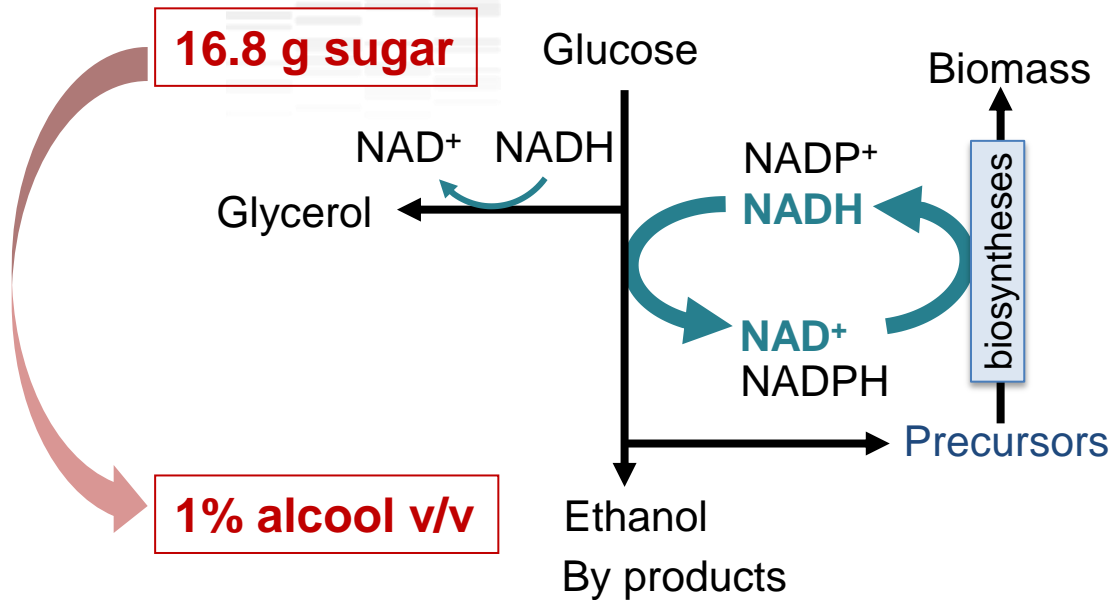
Source: Dubernet laboratory

- How to adapt winemaking practices ?
- Which new tools ?
- Research subjects of our groups



Microbiological strategies

How to reduce the alcohol yield of wine yeast?



Decrease ethanol production
↕
Divert high amounts of sugar to the production of other metabolites

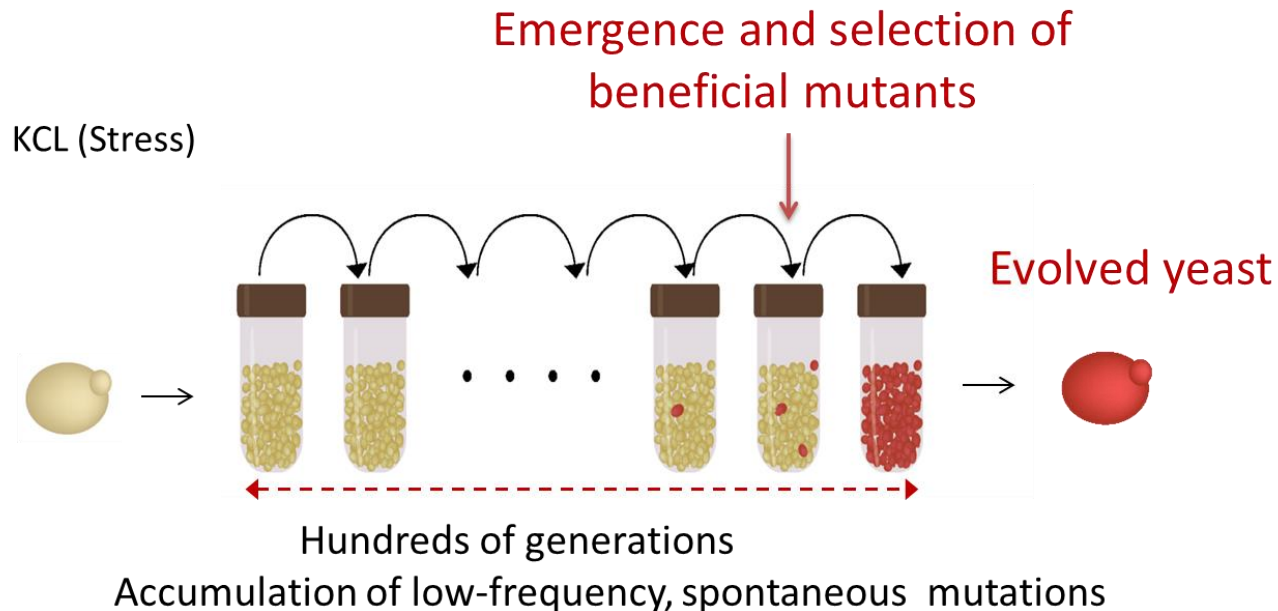
Strong constraints

- Avoiding the accumulation of undesirable by-products
- Preserving strains performances
- Maintaining carbon and redox balances

Glycerol : a good candidate

Adaptive evolution: a GM free approach

Glycerol production : a cell response to osmotic stress (KCL)



Strains overproducing glycerol obtained after 200 generations
Backcrosses between the most performant strains → Strain H2

Pilot-scale trials (1 hL)

	Syrah 1 28°C		Merlot 25°C		Syrah 2 Low sugar		Syrah 2 High sugar	
Ethanol (%)	15.1	13.7	14.3	13.4	13.3	12.8	16.1	15.3
Glycerol (g/l)	11.2	17.1	7.1	13.0	8.1	13.1	10.1	17.2
Total acidity (g/l)	2.65	3.65	1.55	2.05	4.85	6	4.75	5.95
Volatile acidity (g/l)	0.4	0.05	0.29	0.21	0.14	0.09	0.28	0.11

- . Decrease of ethanol : **0.6 – 1.3%** / Effect of θ , S
- . Increase of glycerol
- . Increase of total acidity / Decrease of volatile acidity
- . Potentially of industrial interest

Tilloy et al., 2015



Hybrids and Non Saccharomyces strains

- Increase of genetic and phenotypic variability
- Incomplete understanding of the metabolism
- Hybrids

Intra or interspecific level : *S. uvarum*, *S. kudriavzevii*...
Differences in glycerol and redox metabolism

- Non Saccharomyces

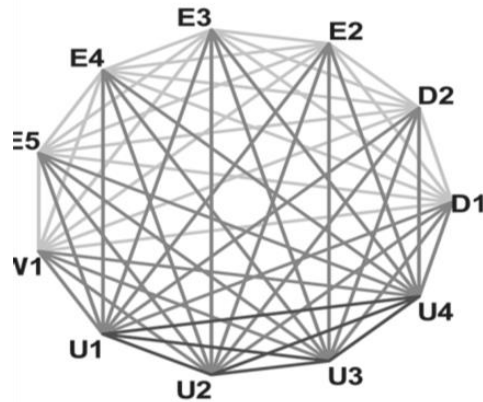
Many species

Necessity of mixed or sequential cultures



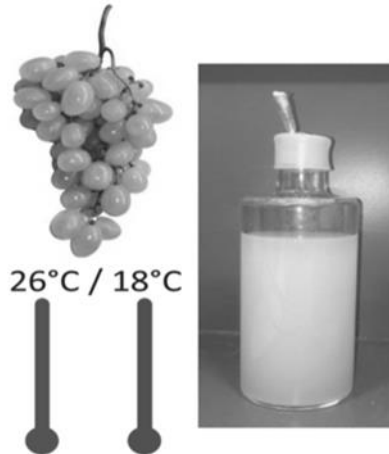
Hybrids

Yeast diallel:
55 hybrids

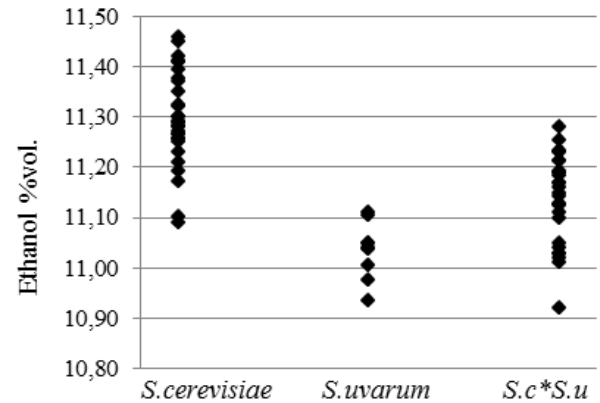


7 *S. cerevisiae* parental strains,
4 *S. uvarum* parental strains
= 28 interspecific and
27 intraspecific hybrids

396 grape must
fermentations



Sauvignon blanc
Two temperatures
125mL bioreactors



Decrease of ethanol yield (less than 0.5 %)

Adaptative evolution experiments carried out to improve the best hybrid

Da Silva et al., 2015

Non Saccharomyces

Candida zemplinina

48 isolates

- . stuck fermentations
- . sequential cultures
- . ethanol decrease : 0,4-0,9 %

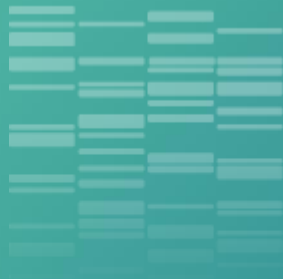
	<i>S. cerevisiae</i>	<i>S. cerevisiae</i> <i>C. zemplinina</i> *
Ethanol (%)	13.91 ± 0.00	13.16 ± 0.07
Yield (g/g)	0.46 ± 0.00	0.43 ± 0.00
Glycerol (g/l)	7.30 ± 0.48	13.03 ± 0.87

* : Sequential culture : 10^7 C.z. + $2 \cdot 10^6$ S.c. (24h)

High sulfur off-flavor
Need for additional research



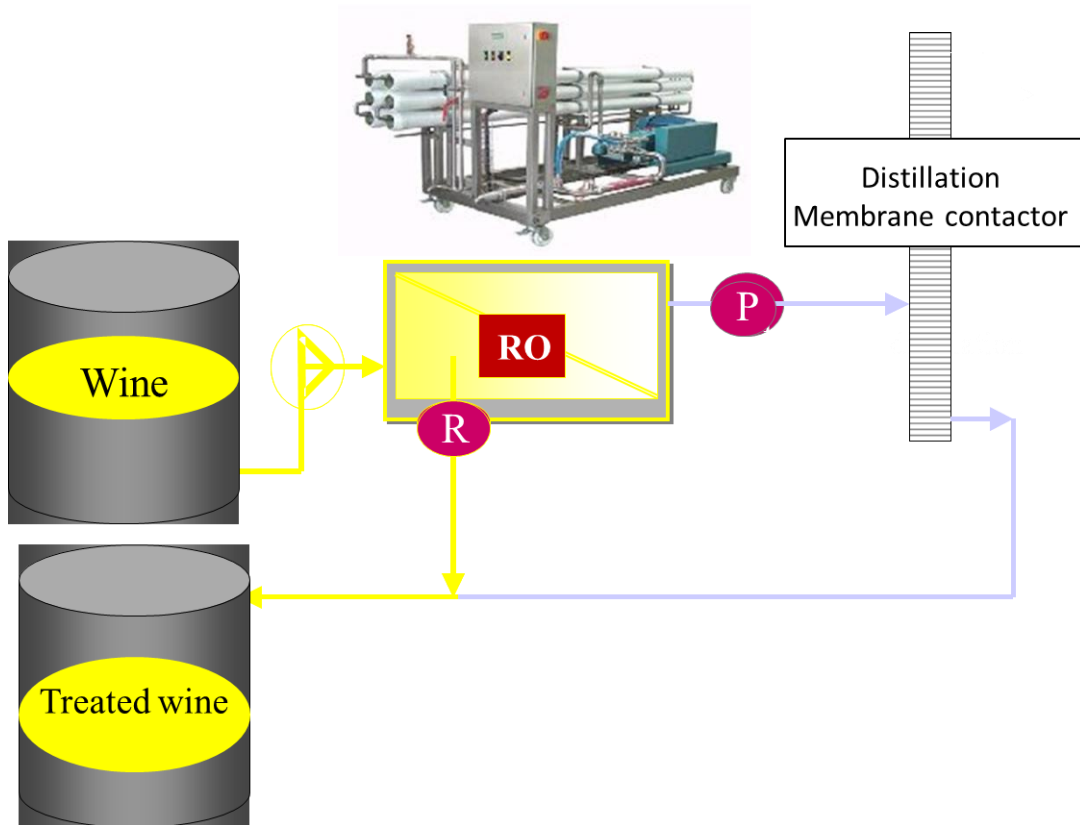
Bely et al., 2012



Technological strategies

Reducing ethanol

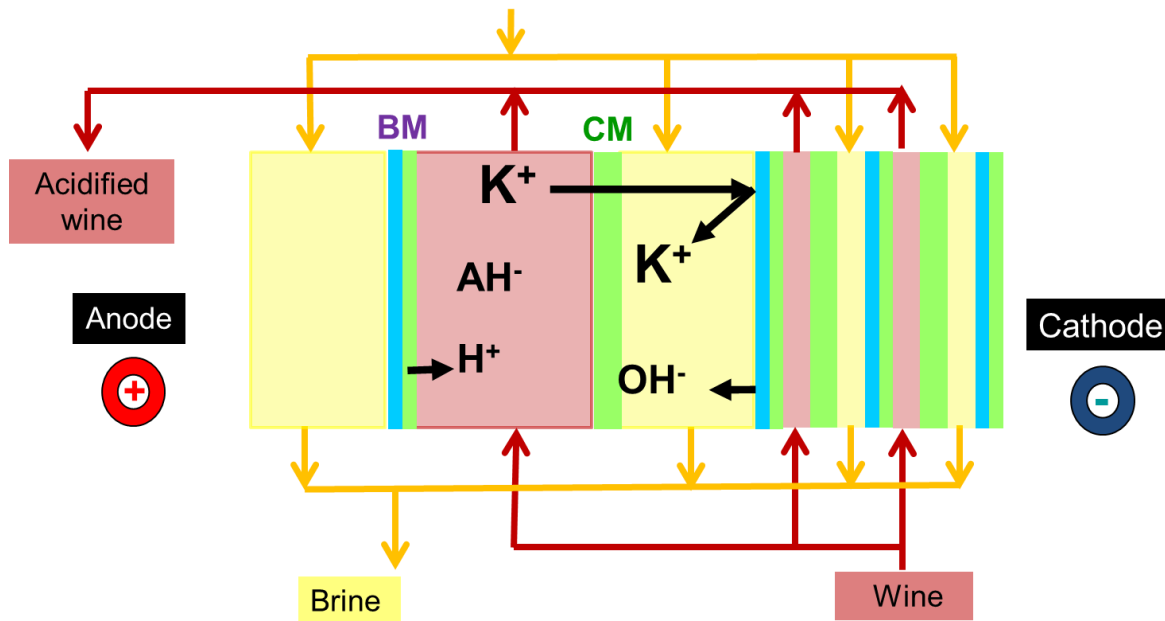
- Several techniques authorized– OIV recommendation
- Interest of semi permeable membranes



Industrial equipments
Few impact on sensory
properties

Adjusting pH

- Electrodialysis – authorized
- Cationic membrane \searrow $[K^+] \leftrightarrow$ PH



From 3.9 to 3.5 (red wine)

- \nearrow acidity
- \searrow bitterness
- no effect on astringency

Samson et al., 2009
Caillé et al., 2011

Control of key winemaking operations

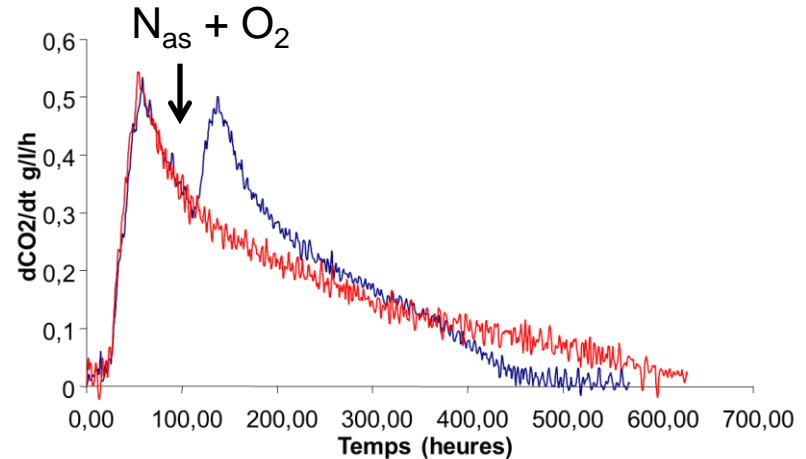
Fermentation

- . Nutrients (N_{as} , O_2 , lipids)
- . Protectors (rehydration phase)

Blateyron et al., 2000

Casalta et al., 2016

Salmon and Julien, 2007



Oxydation

- . Decrease of SO₂ effectiveness (pH, doses)
- . Alternatives :
 - Low temperature during key steps
 - Inactivated yeasts during aging

Aguera et al., 2012

Sieczkowski et al., 2016



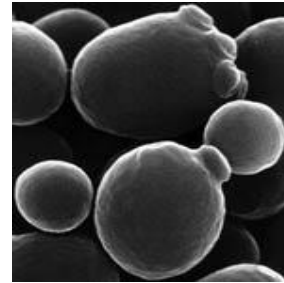
Conclusion

- Many different strategies

Functional



Subject of research



- Correction of defaults → Integrated approaches to optimize quality

