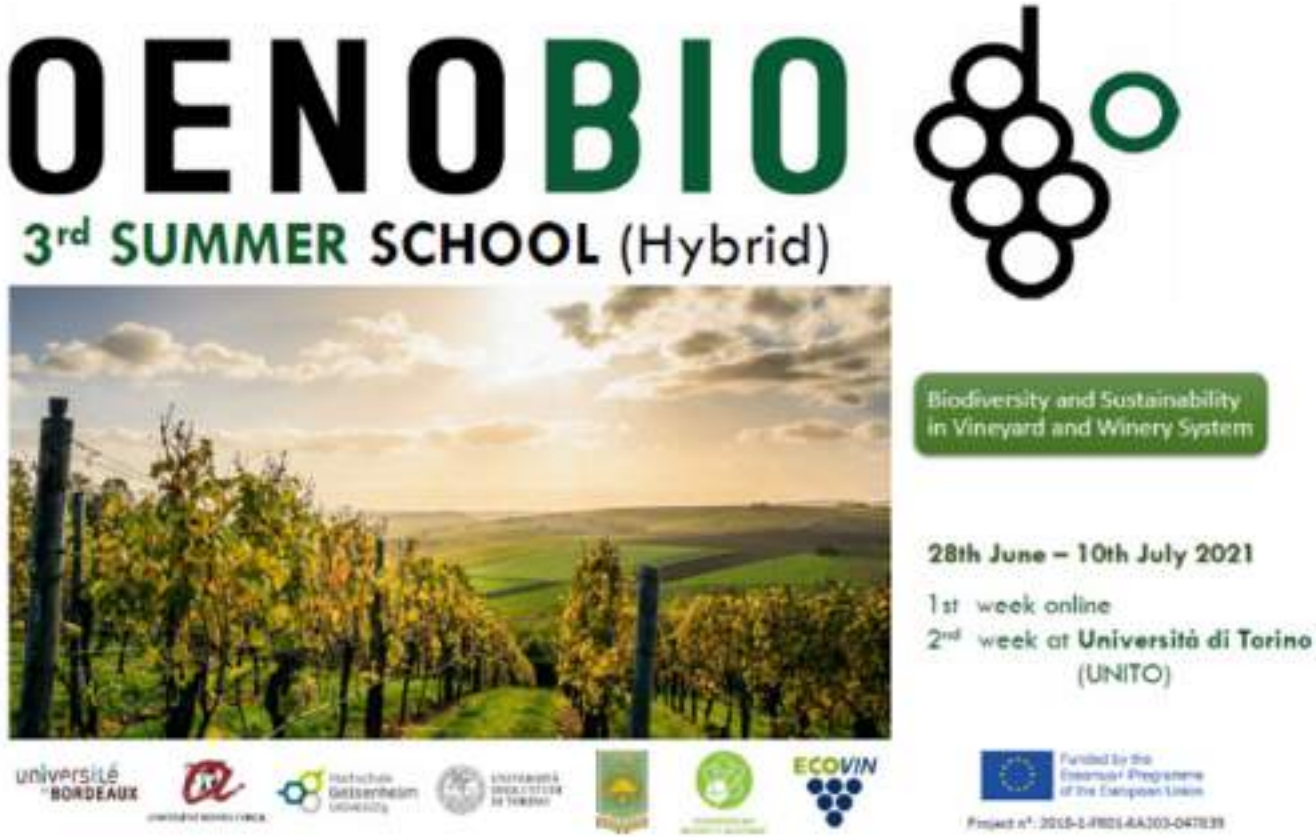


Barrel ageing of organic wines

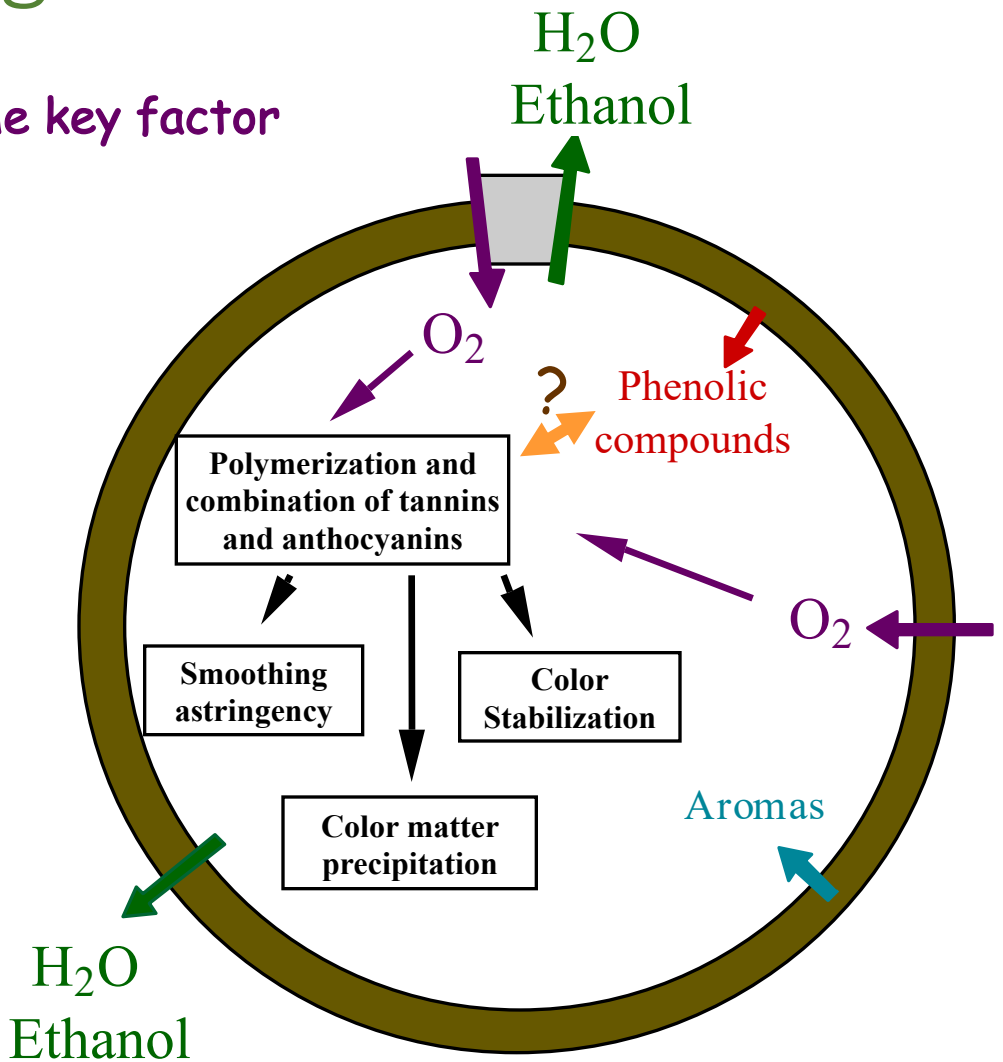
JM Canals and F Zamora

Summer School hybrid June-July 2021.

Torino

Why ageing wines?

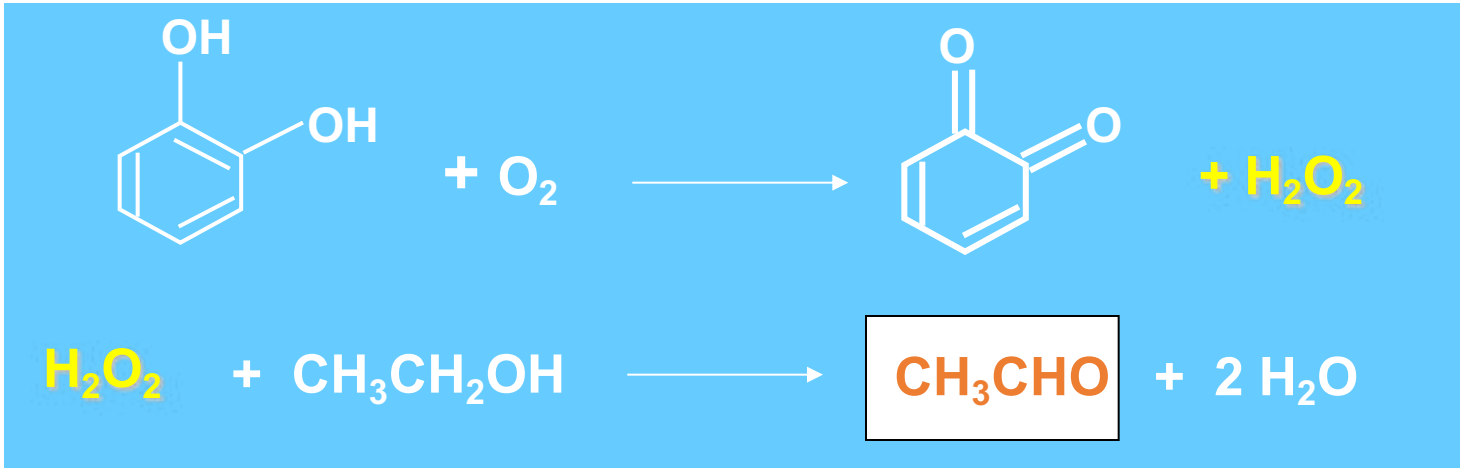
Oxygen is the key factor



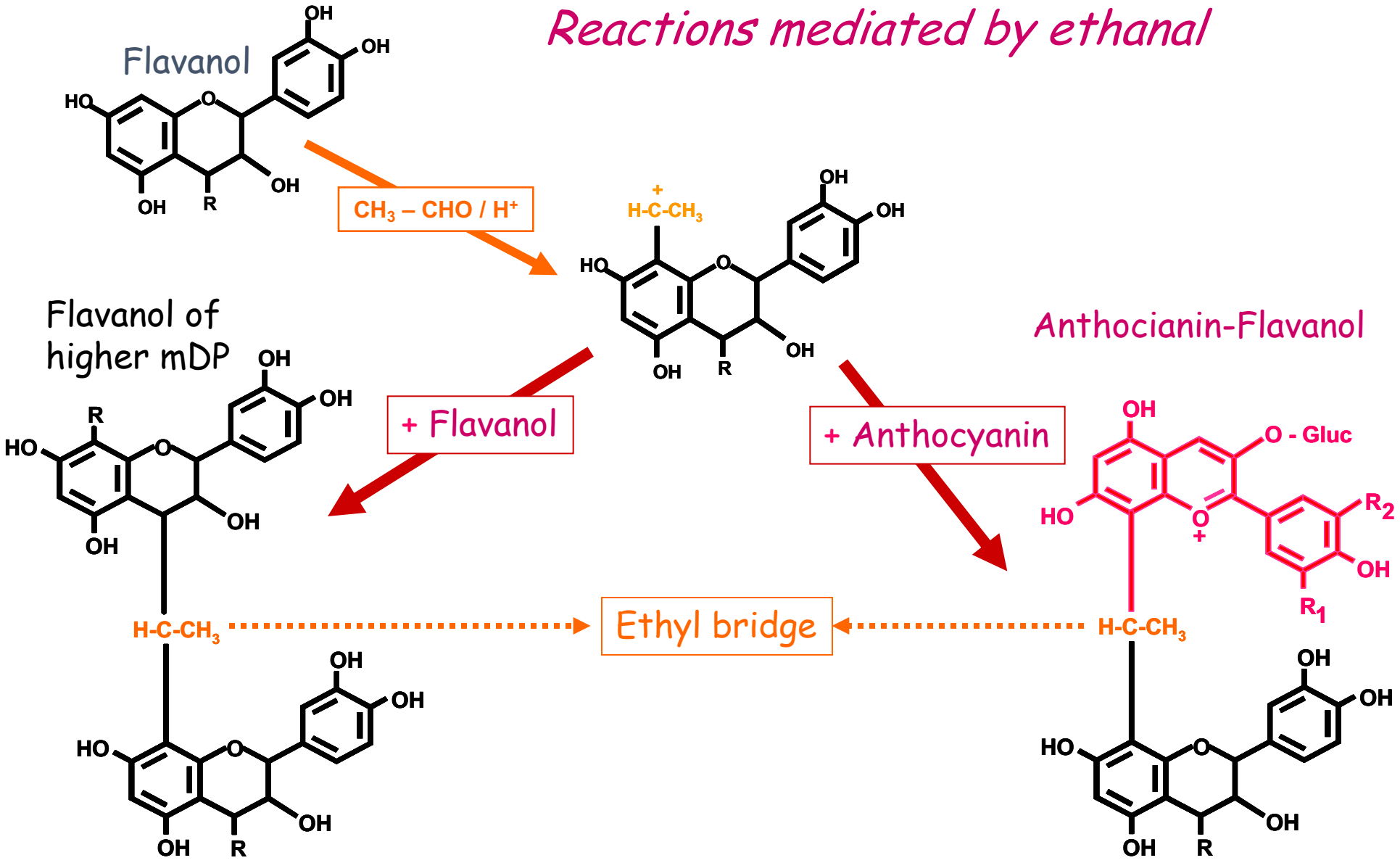
¿How acts the oxygen?

Formation of ethanal from ethanol

Singleton, 1987

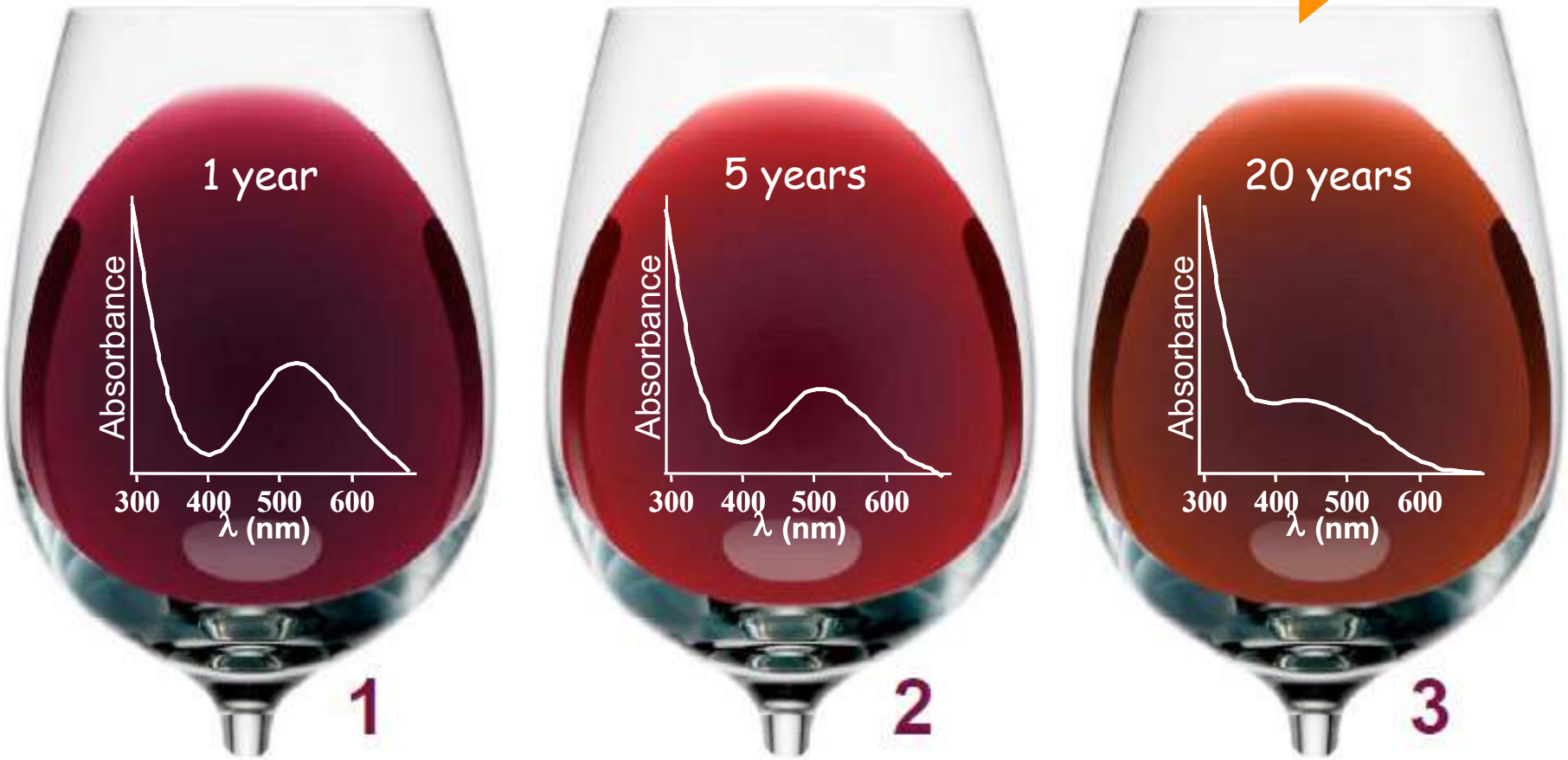


Reactions mediated by ethanal



The color of red wine

The inevitable evolution of wine color



However, aging of wine in barrels also involves some risks:

- *Oxidation of aromas*
- *The development of some spoilage microorganisms*

For that reason, winemakers use to employ sulfur dioxide to avoid this problems

Sulfur dioxide is employed during oak ageing in different forms

- Potassium metabisulfite
- Aqueous solution

- Gas bottles

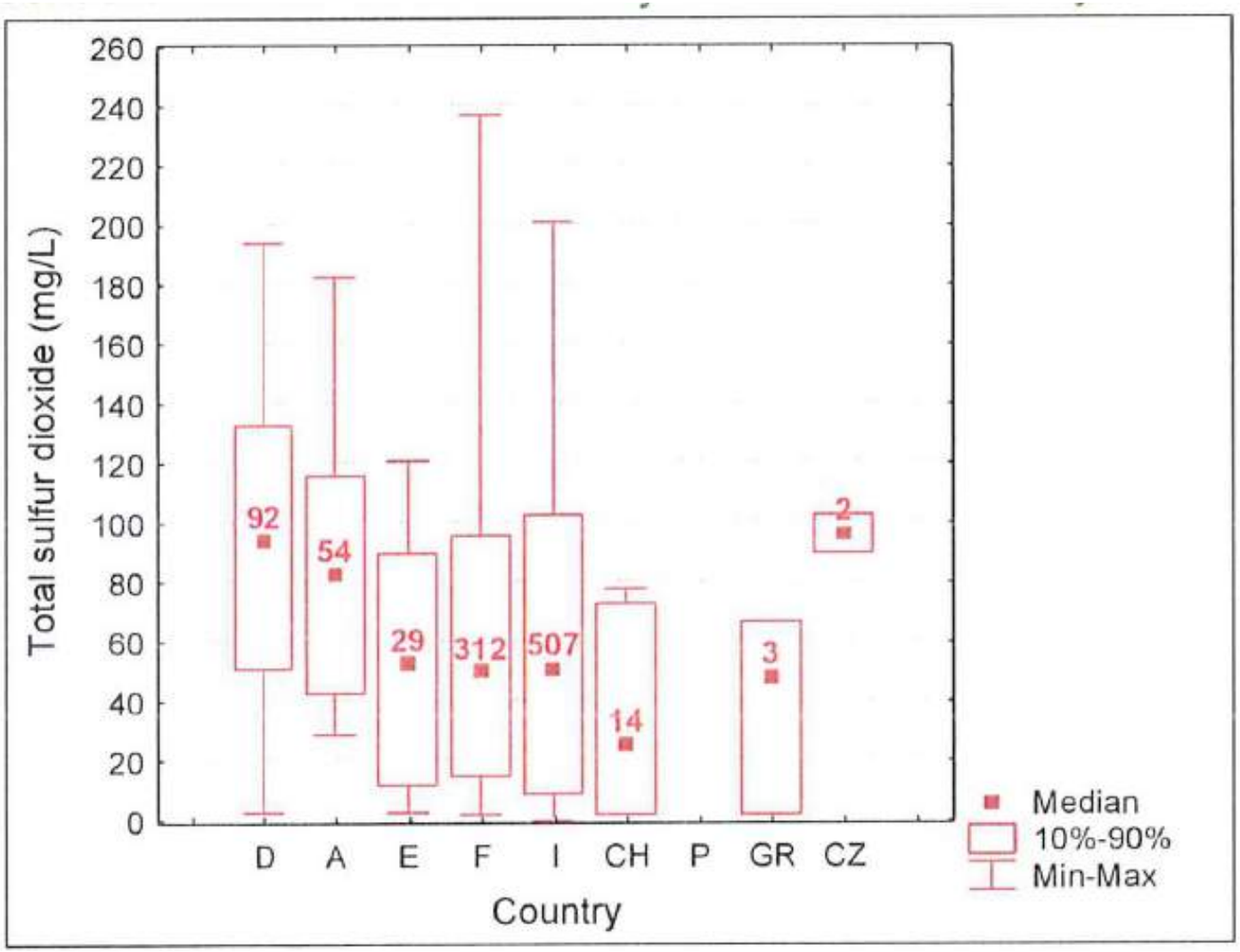
- Effervescent tablets
- Burning sulfur in barrels

But in any case, the levels of sulfur dioxide are limited by law:

Maximum levels of total SO_2 in different type of wines

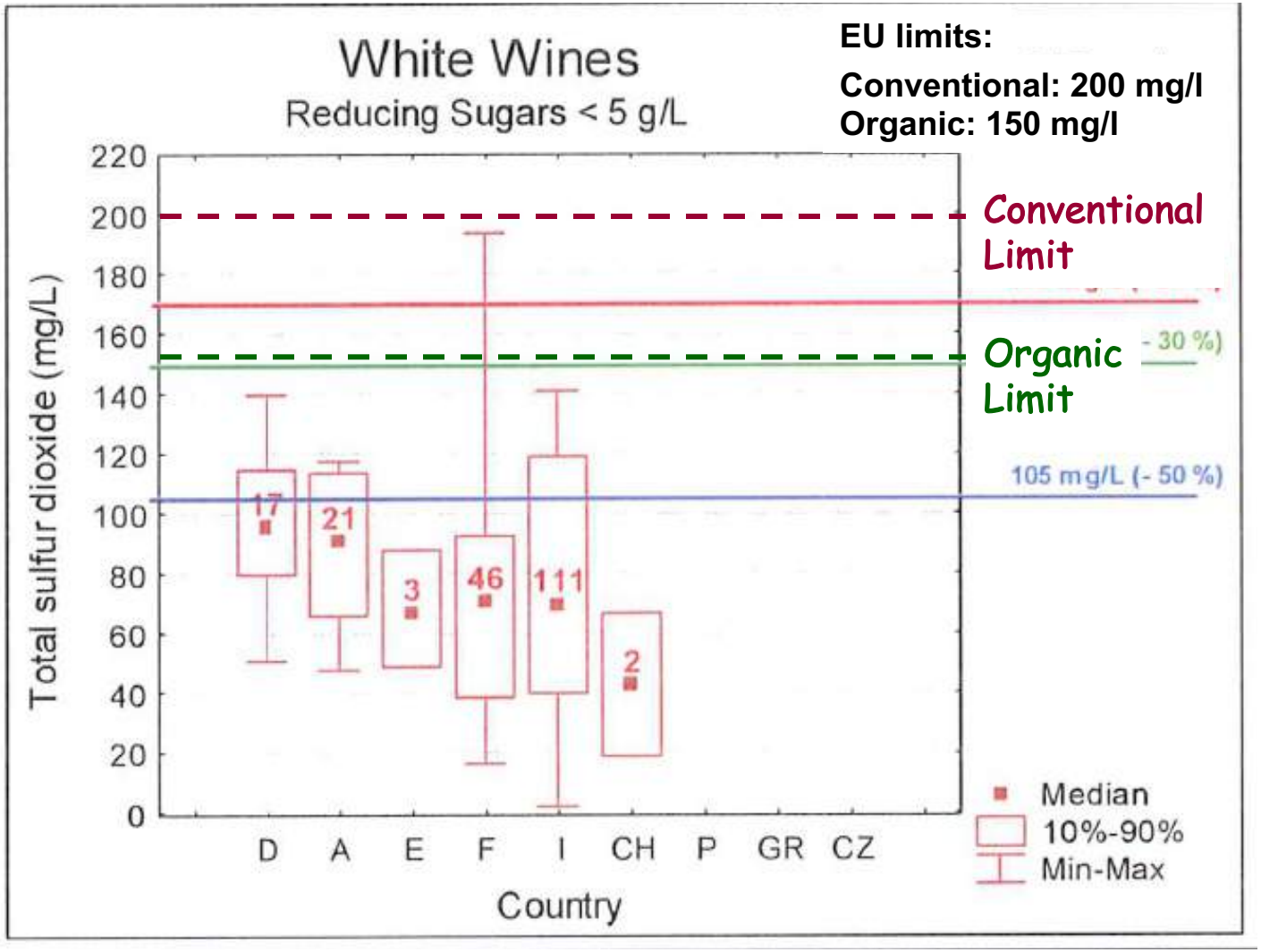
Type of wine		Total [SO_2] (mg/l)		
		(according with EC Reg. 606/09)		(Certificate Demeter)
		Conventional wines	Ecological/Organic Wines	Biodynamic wine
Red Wines	[glucose + fructose] < 5 g/l	150	120	110
	[glucose + fructose] > 5 g/l	200	150	140
White & Rosé Wines	[glucose + fructose] < 5 g/l	200	150	140
	[glucose + fructose] > 5 g/l	250	220	180
Sparkling Wines		185	155	120
Special wines	Paragrah 2 c	300	270	250-360
	Paragrah 2 d	350	320	
	Paragrah 2 e	400	370	

SO_2 levels detected in organic wines (1014 wines)



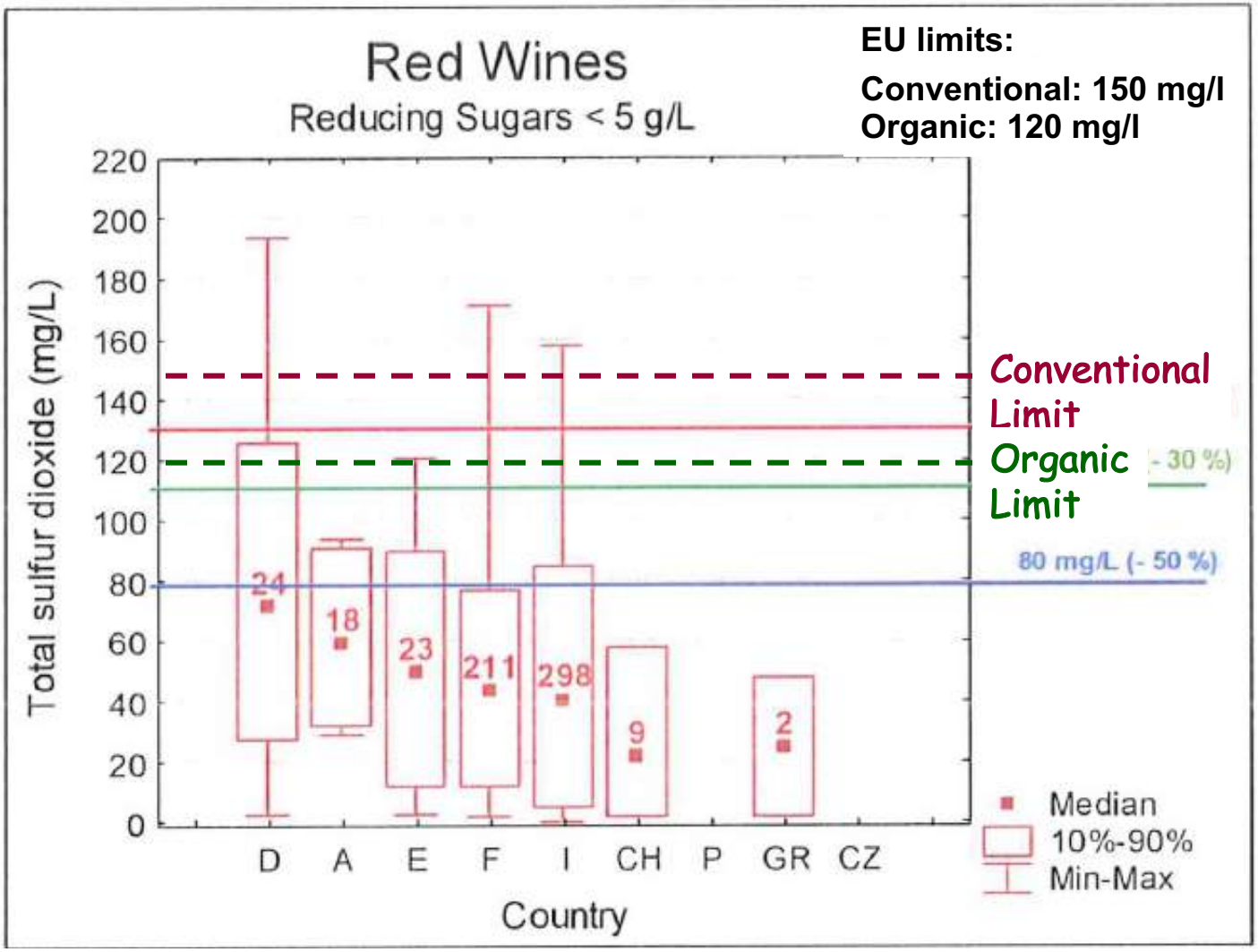
Extracted from Rauhut, Zironi, Comuzzo, Cotterau, Salmon (2009) Winemaking techniques to reduce sulfites and other additives. **WORKSHOP ORWINE**: Scientific Basis for European Rules on Organic Wines. Brussels, April 2009

SO_2 levels detected in organic white wines (200 wines)



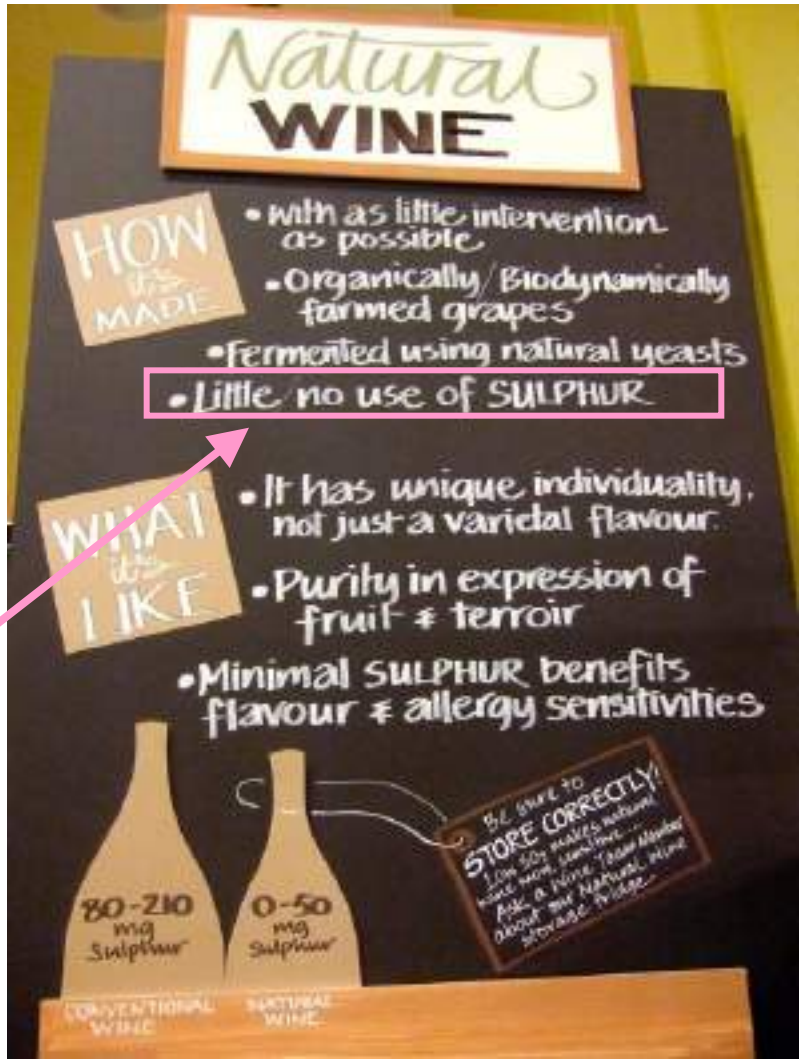
Extracted from Rauhut, Zironi, Comuzzo, Cotterau, Salmon (2009) Winemaking techniques to reduce sulfites and other additives. **WORKSHOP ORWINE**: Scientific Basis for European Rules on Organic Wines. Brussels, April 2009

SO_2 levels detected in organic white wines (585 wines)



Extracted from Rauhut, Zironi, Comuzzo, Cotterau, Salmon (2009) Winemaking techniques to reduce sulfites and other additives. **WORKSHOP ORWINE**: Scientific Basis for European Rules on Organic Wines. Brussels, April 2009

Types of wines according to the degree of engagement with environmental / health

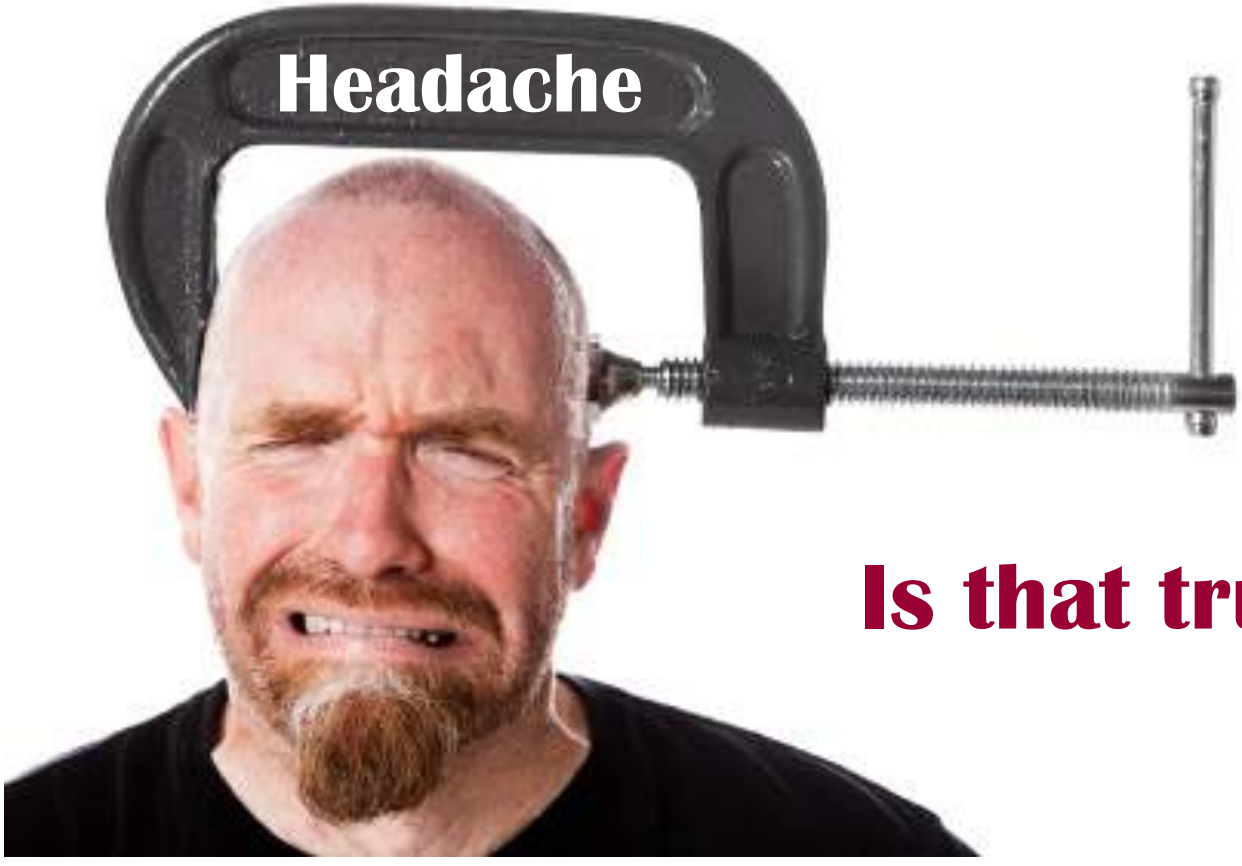


What's the reason?

Their Health and Environmental Effects

The increasing trend of minimal intervention

The myth: Sulfites provoke



Is that true?


Wait...
This wine **doesn't** give me headaches,
yet it says here
that **it has sulfites**!
Maybe sulfites **weren't**
actually the problem?
OrganicWineCompany™

Biogenic amines

- From Lactic Acid Bacteria (LAB) metabolism
- *Histamines*: found in fermented & processed foods, as well as in some vegetables.

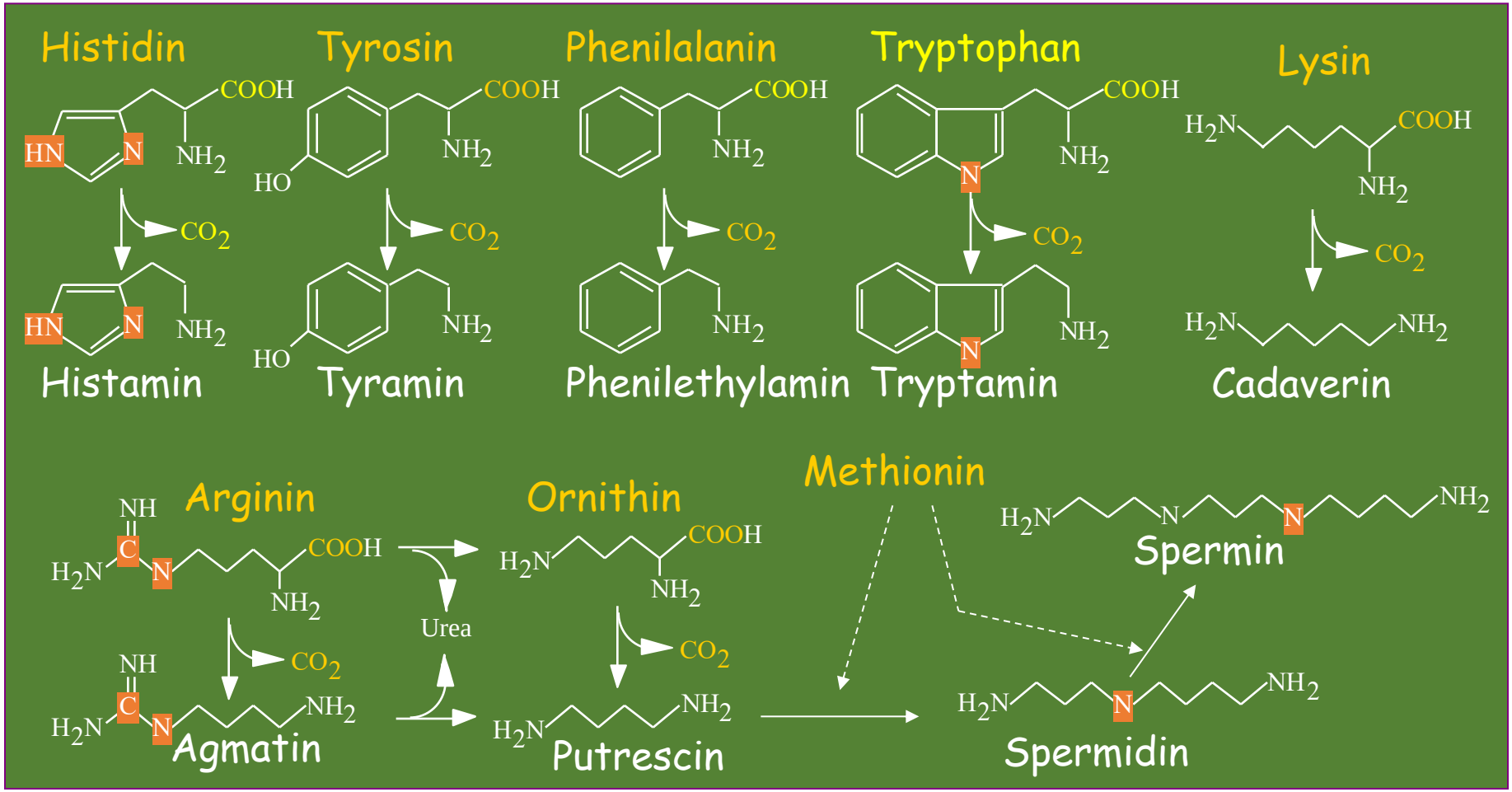



- *Tyramines*: found in fermented & foods, as well as in over-ripened fruits, smoked & cured meats, and soy.

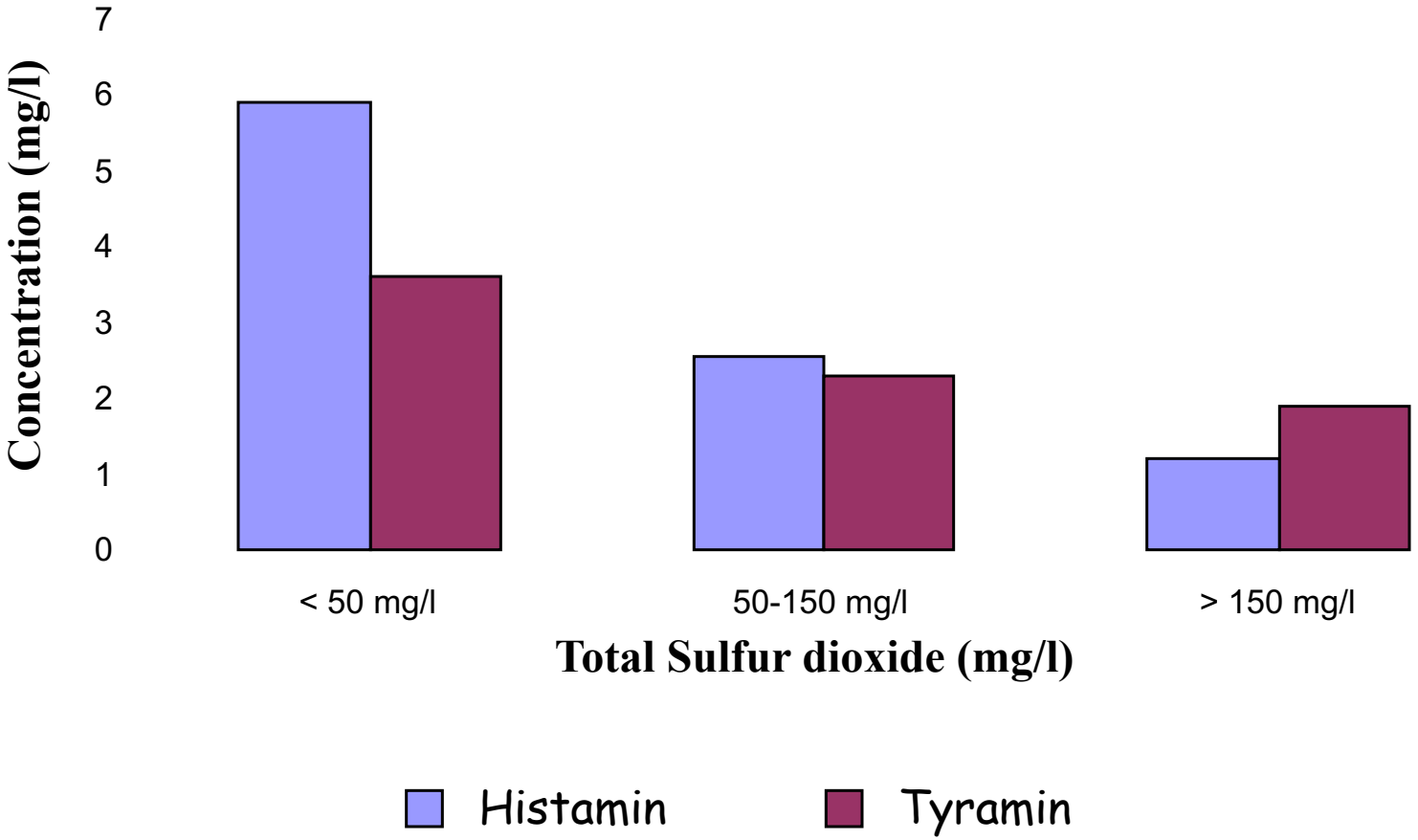



Origin of the main biogenic amines

Lactic Acid Bacteria can decarboxylate amino acids



Adapted from Halasz et al. (1994) and Vidal & Bover (2001)

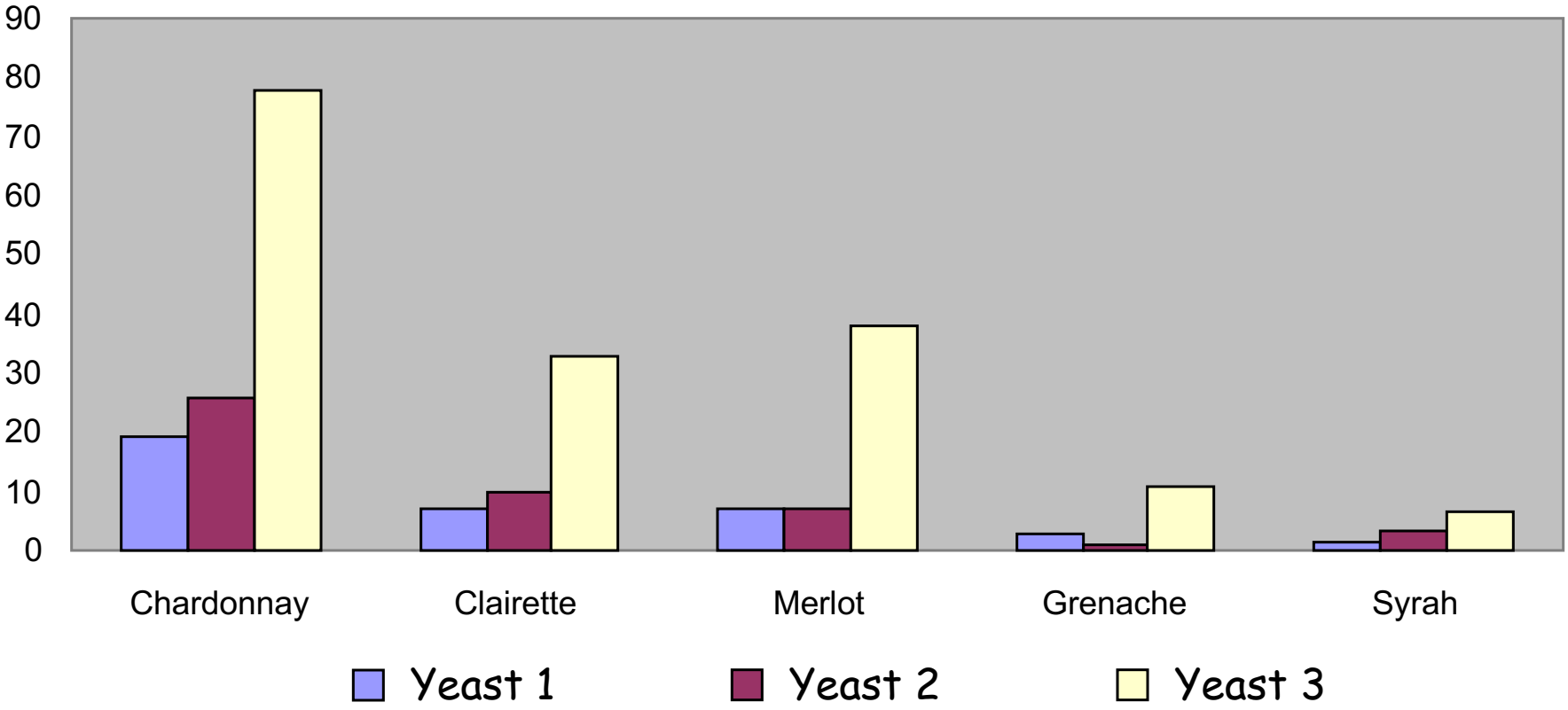


Vidal-Carou et al. (1990) Food Chemistry, 35, 217-227

Headache

Or maybe, just too much alcohol!

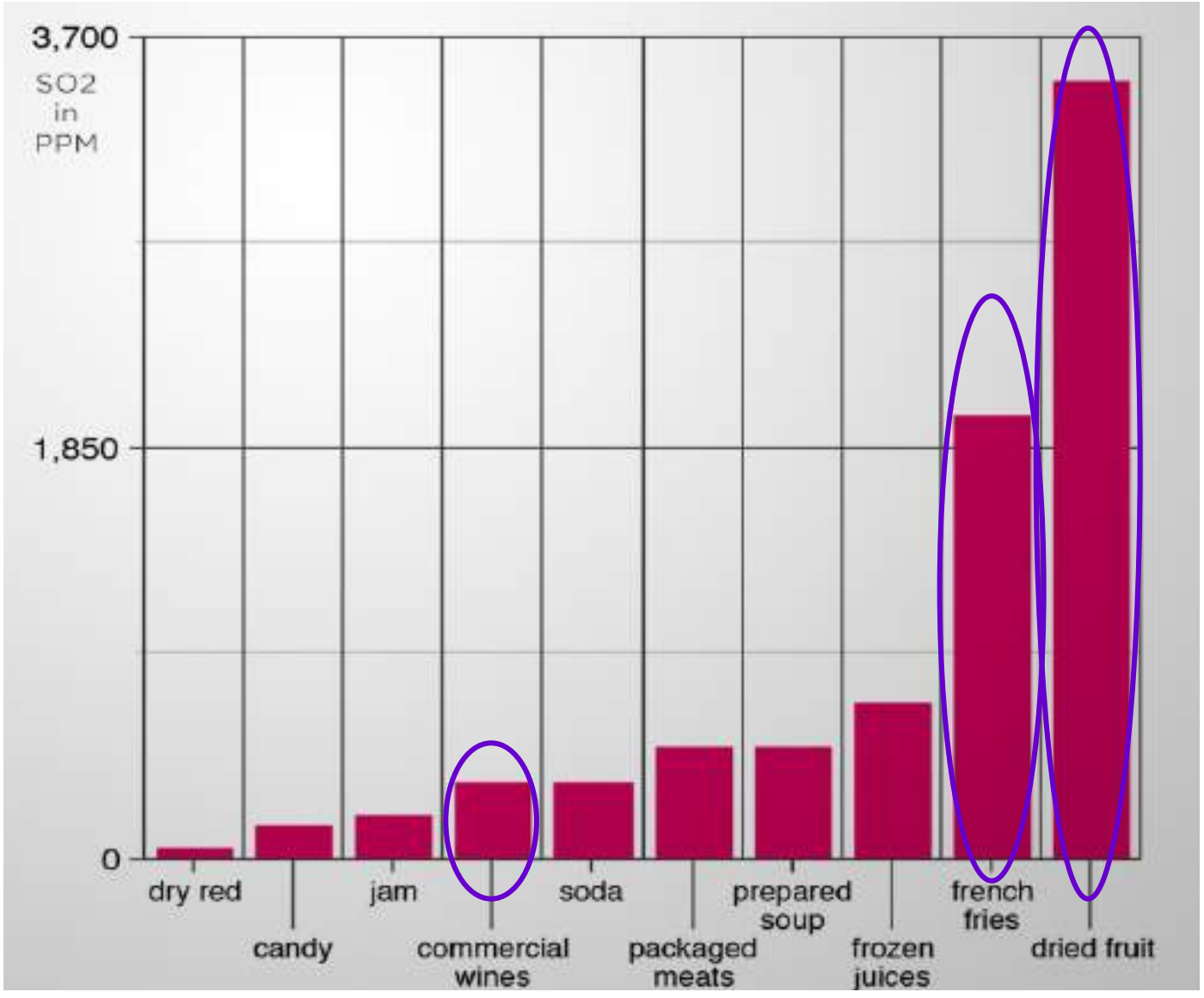
Natural SO_2 produced by yeasts



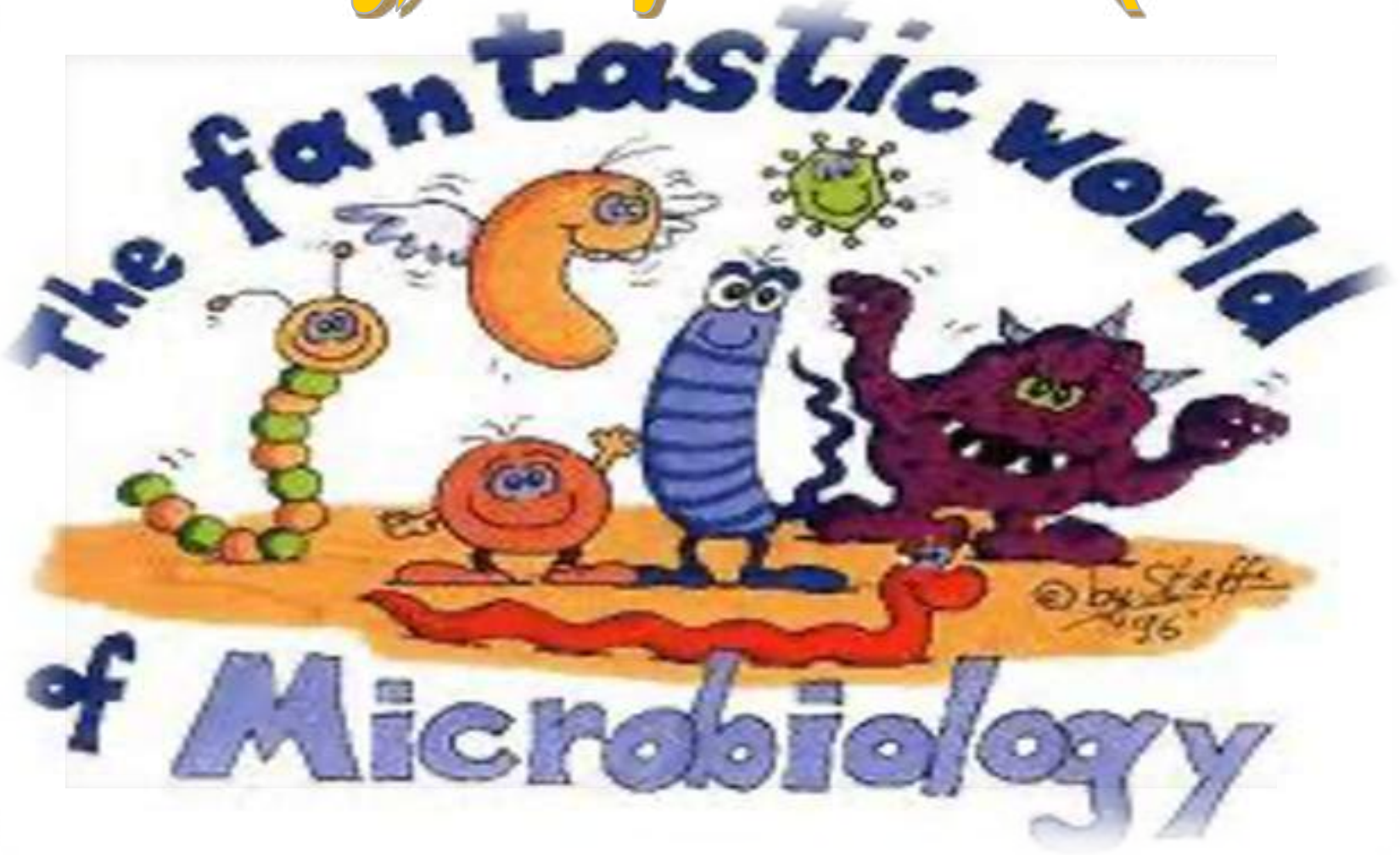
Important differences in SO_2 production depending on grape variety and yeast strain

Extracted from Rauhut, Zironi, Comuzzo, Cotterau, Salmon (2009) Winemaking techniques to reduce sulfites and other additives. **WORKSHOP ORWINE**: Scientific Basis for European Rules on Organic Wines. Brussels, April 2009

SO_2 in other foods



Winemaking: a very traditional process



Particularities on maintenance of wood barrels

1 m^2 of stainless steel after polishing= 1,1 m^2 of developed surface

1 m^2 of stainless steel after brushing= 2 m^2 of developed surface

1 m^2 of wood = 5 up to 8 m^2 of developed surface

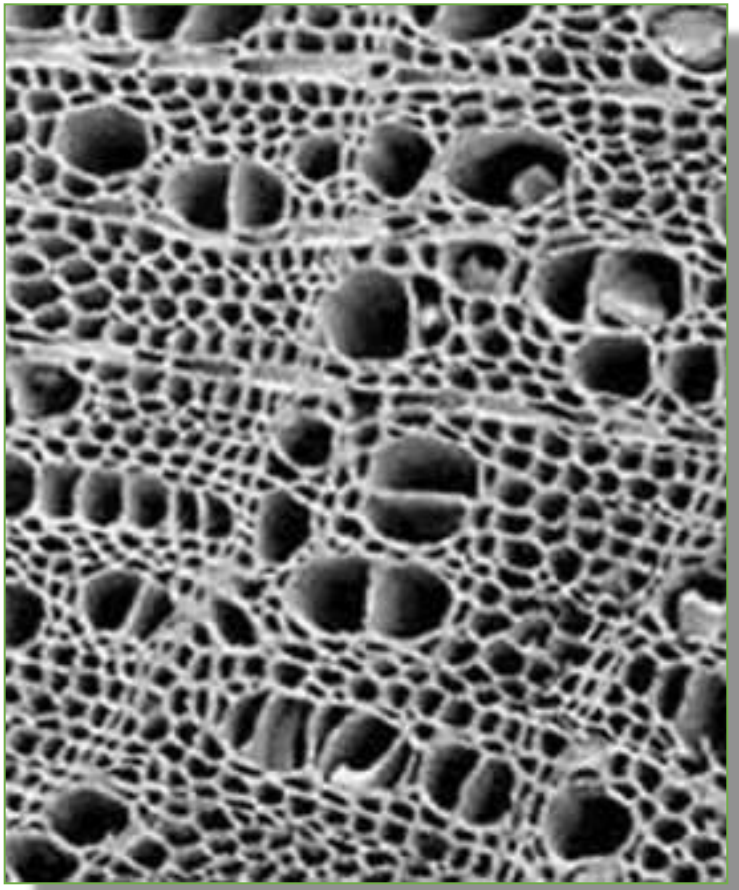
Oak barrels after 2 years with white wine

After rinsing
(rinsing at 15°C
3 bar, 5 min.)

After cleaning
(High-pressure 110 bar;,
65°C, 5 min. + detergents)

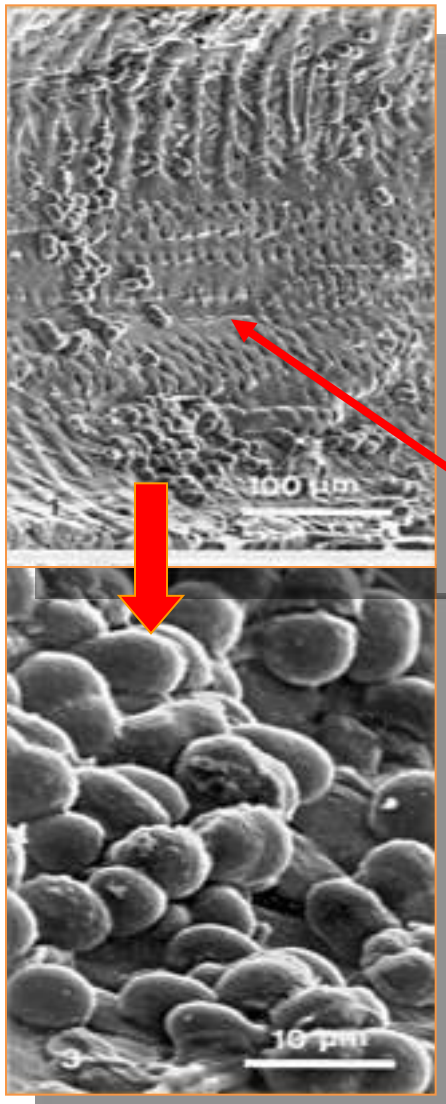
Particularities on maintenance of wood barrels

stainless steel

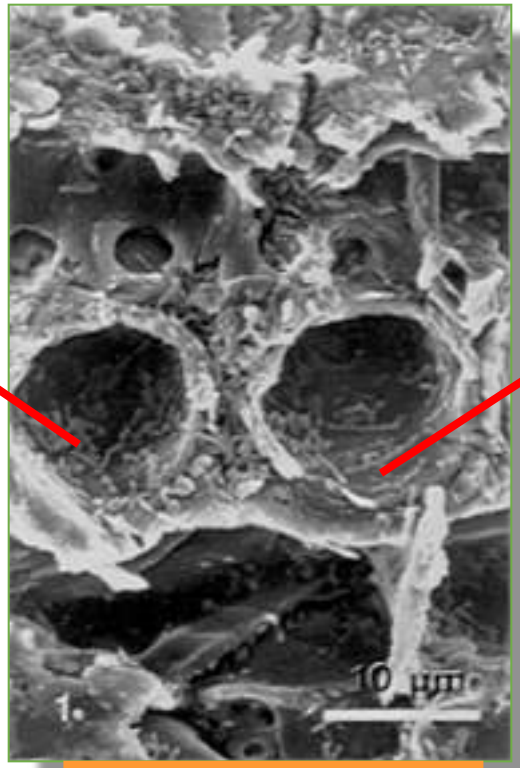


Wood

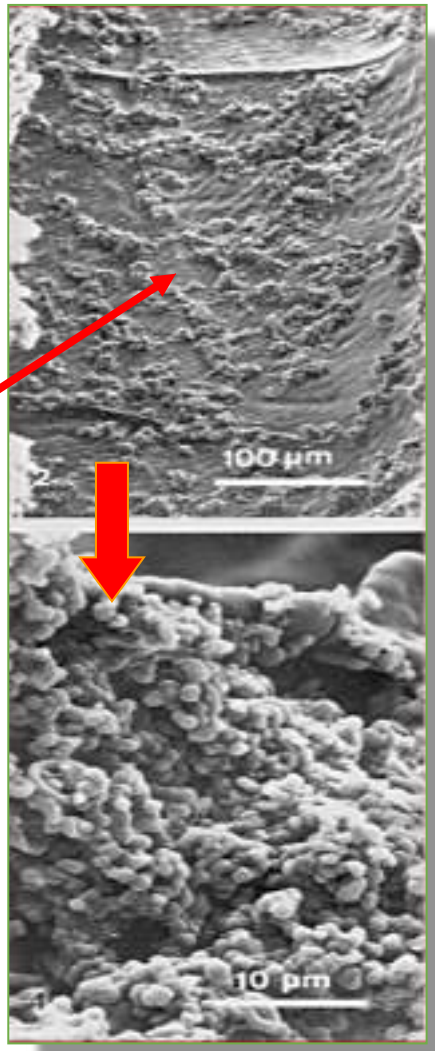
The microporosity of wood; an ideal refuge



Yeasts : *Brettanomyces sp.*



Surface of a stave after rinsing



Bacterias : *Acetobacter aceti*

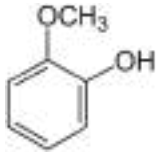
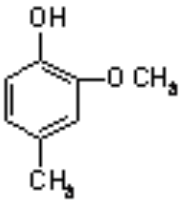
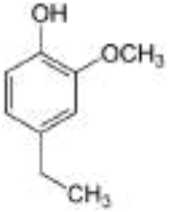
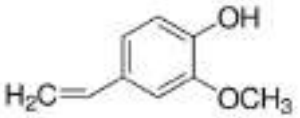
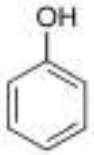
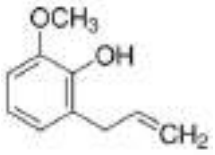
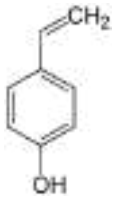
The volatile phenols

Phenolic and / or pharmaceutical odors

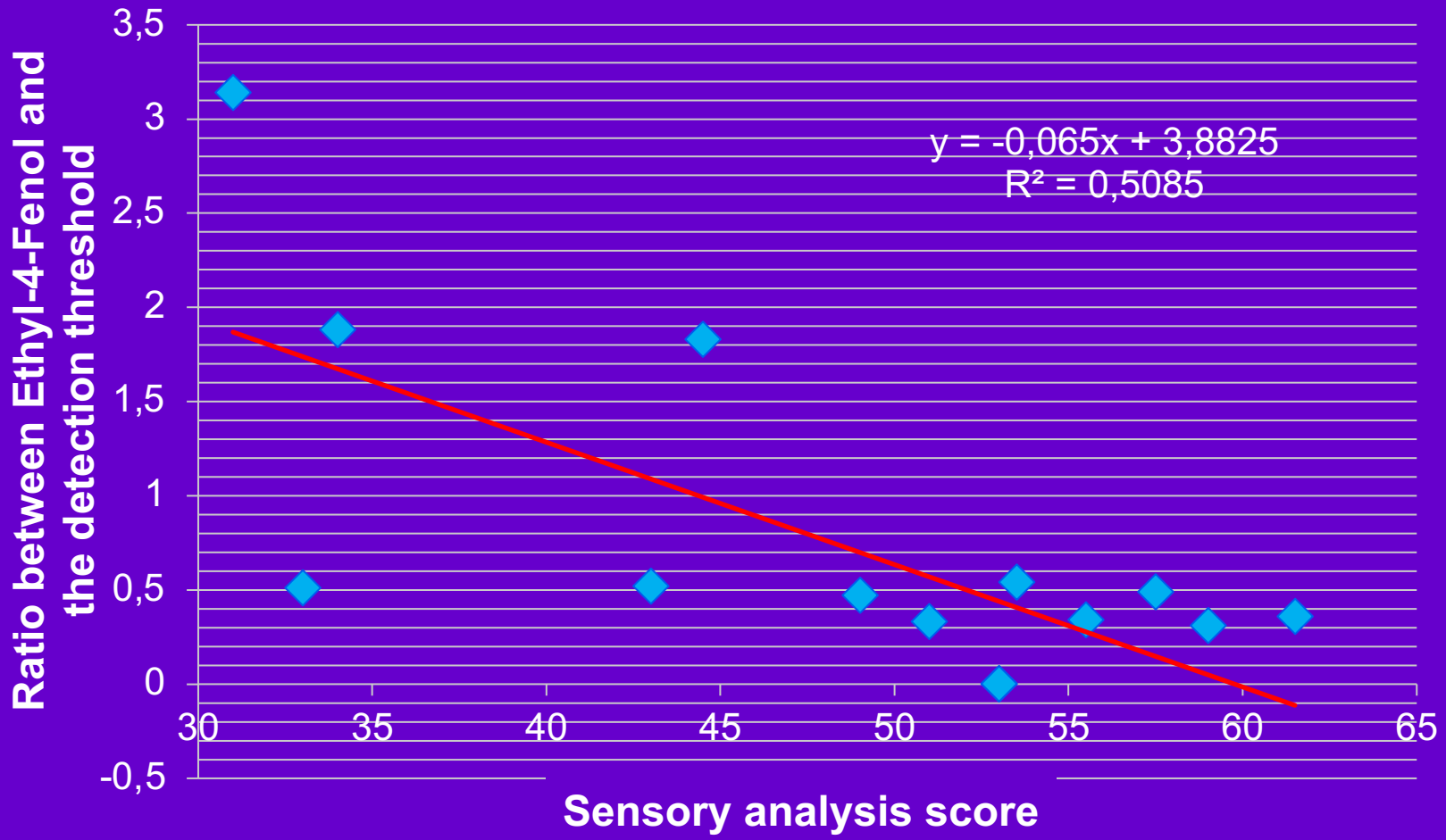




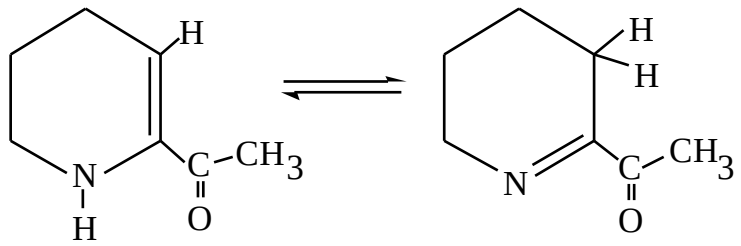



Guaiacol	Methyl-4 -guaiacol	Ethyl-4 -guaiacol	Vinyl-4 -guaiacol
			
20 µg/l	30 µg/l	47 µg/l	130 µg/l
Toasted	Burned wood	Burned wood	Burned wood
Phenol	Eugenol	Vinyl-4-phenol	Ethyl-4-phenol
			
15 mg/l	15 µg/l	180 µg/l	440 µg/l
Ink	Clove	Phenolic Pharmaceutical	Horse sweat Leather

Organoleptic damage of Brett character



Molecules responsible for mouse taint

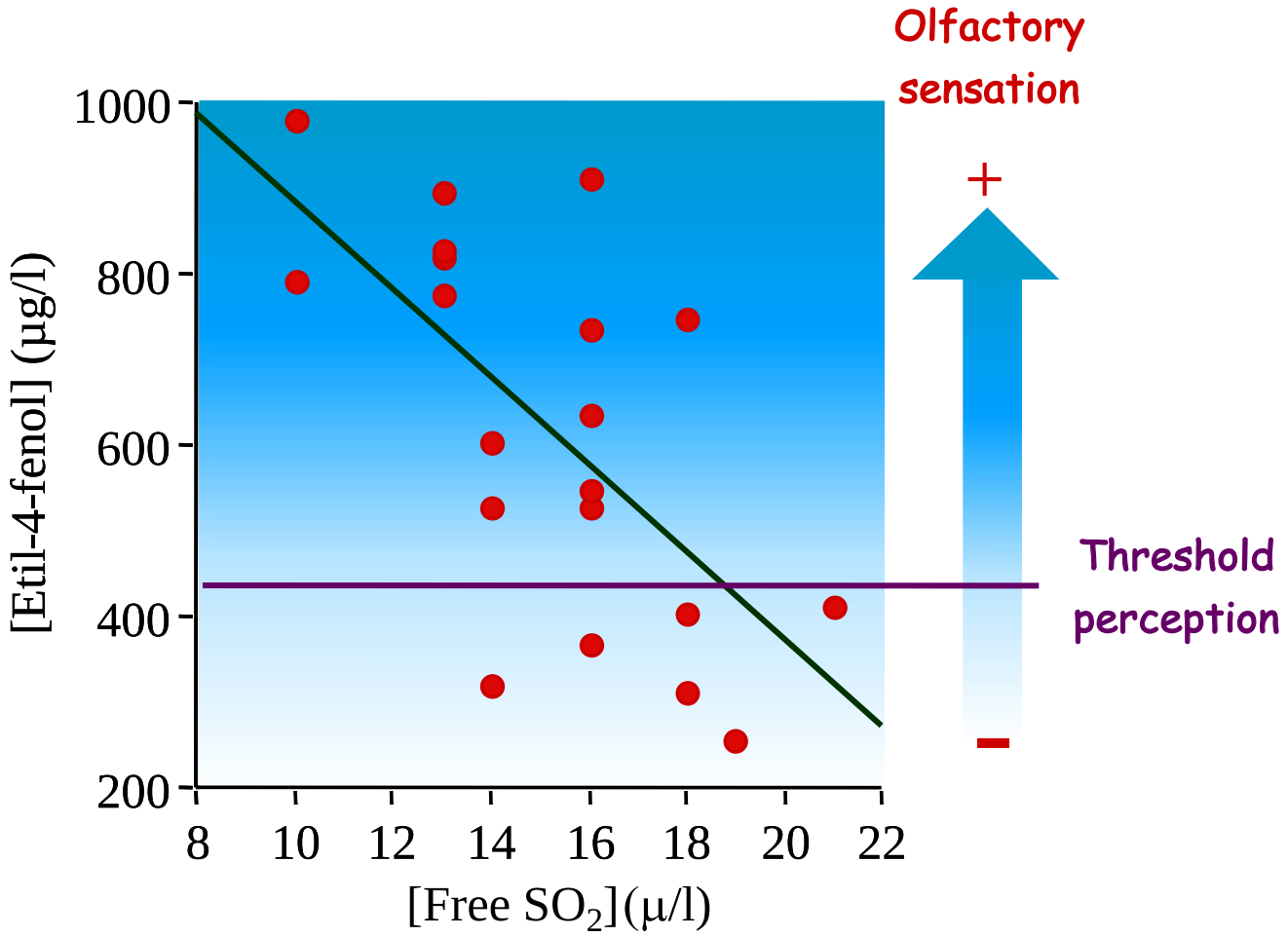


Tautomèriques forms of 2-acetiltetrahidropiridina
Perception threshold: 1.6 ng / l

1. Microbial origin: LAB in high pH, solids, nutrient load and oxygen exposure
2. Chemical origin: hyperoxydation or H2O2 is used to remove SO2 or Maillard reaction in situation of solids presence (lees) and low sulphur dioxide.

https://www.awri.com.au/wp-content/uploads/2018/04/s1694.pdf

Relationship between the concentration of free SO_2 and the level of Ethyl-4-phenol of the different barrels of a same winery

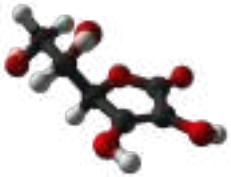


Adapted from Chatonnet (2000)

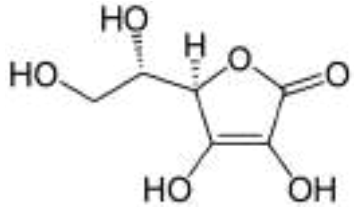
Molecular SO_2 concentration in function of Free SO_2 concentration and pH

SO2 libre (mg/l)	pH												
	2,8	2,9	3,0	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	4,0
5	0,46	0,38	0,33	0,24	0,19	0,16	0,12	0,10	0,08	0,06	0,05	0,04	0,03
10	0,93	0,75	0,61	0,49	0,39	0,31	0,25	0,20	0,16	0,13	0,10	0,08	0,06
15	1,39	1,13	0,91	0,73	0,59	0,47	0,38	0,30	0,24	0,19	0,15	0,12	0,10
20	1,86	1,50	1,21	0,98	0,78	0,62	0,50	0,40	0,32	0,25	0,20	0,16	0,13
25	2,32	1,88	1,52	1,22	0,98	0,78	0,63	0,50	0,40	0,32	0,25	0,20	0,16
30	2,78	2,26	1,82	1,46	1,17	0,94	0,75	0,60	0,47	0,38	0,30	0,24	0,19
35	3,25	2,63	2,12	1,71	1,37	1,09	0,88	0,70	0,55	0,44	0,35	0,28	0,22
40	3,71	3,01	2,42	1,95	1,56	1,25	1,00	0,80	0,63	0,50	0,40	0,32	0,26
45	4,18	3,38	2,73	2,20	1,76	1,40	1,13	0,90	0,71	0,57	0,45	0,36	0,29
50	4,64	3,76	3,03	2,44	1,95	1,56	1,25	1,00	0,79	0,63	0,50	0,40	0,32


Alternatives to SO_2
Ascorbic acid
Inert gases
Dry ice
Glutathione
Ellagitannins
Chitosan
Lisozyme
Others

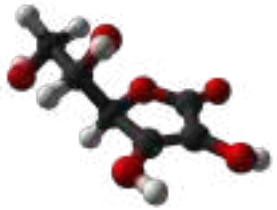


The Ascorbic Acid

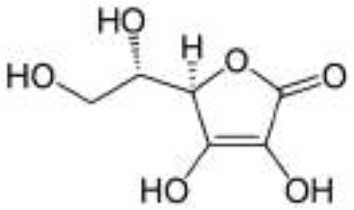


- **Vitamin C; Optical isomer – Erythorbic acid**
- **Permitted in wine since the 1950s; up to 200 mg/l**
- **No antimicrobial properties**
- **No aldehyde binding properties**
- **Does not denature oxidative enzymes**
- **Cannot act alone as protective antioxidant**

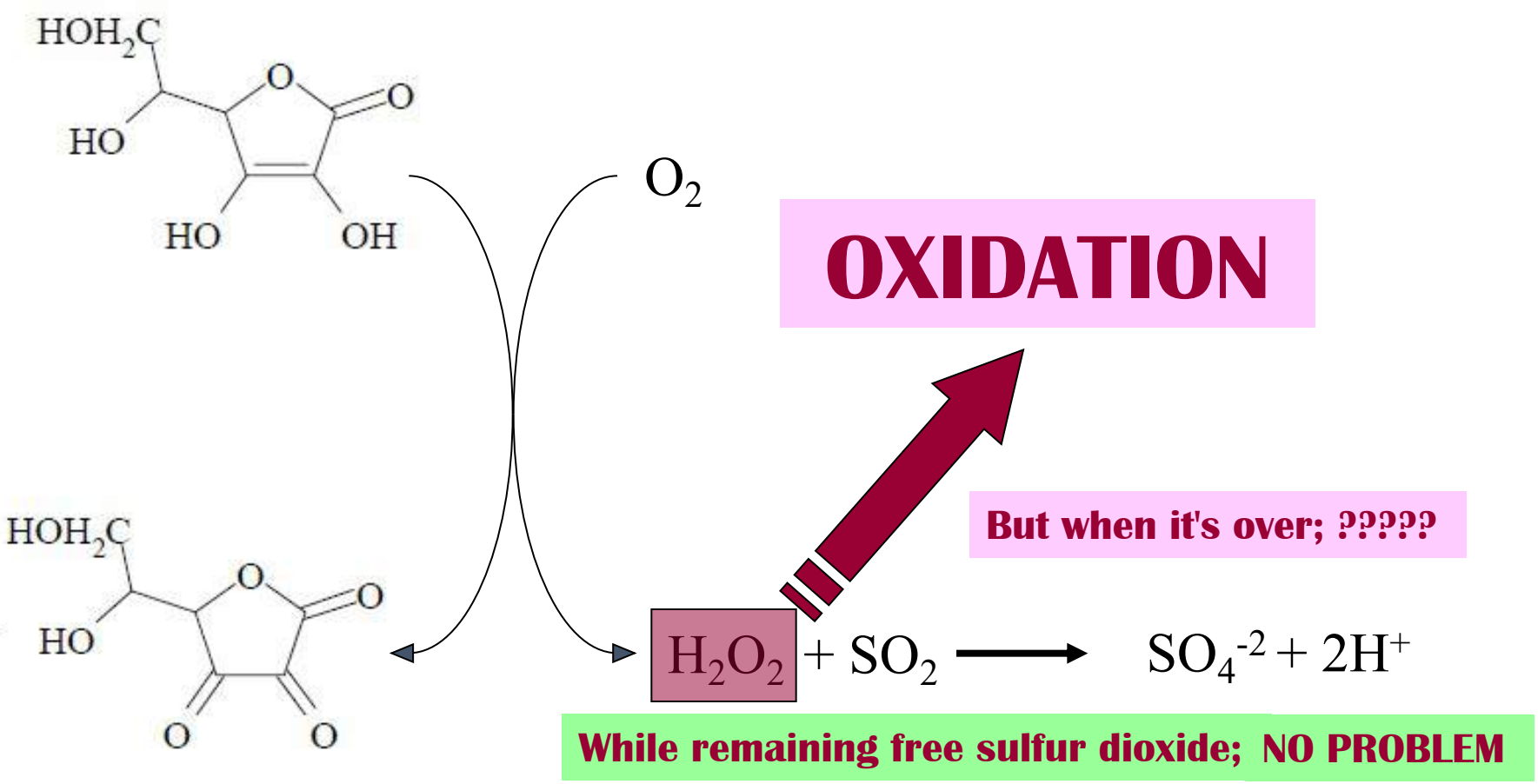
Complementary adjunct to sulfur dioxide, not a substitute…….



The Ascorbic Acid

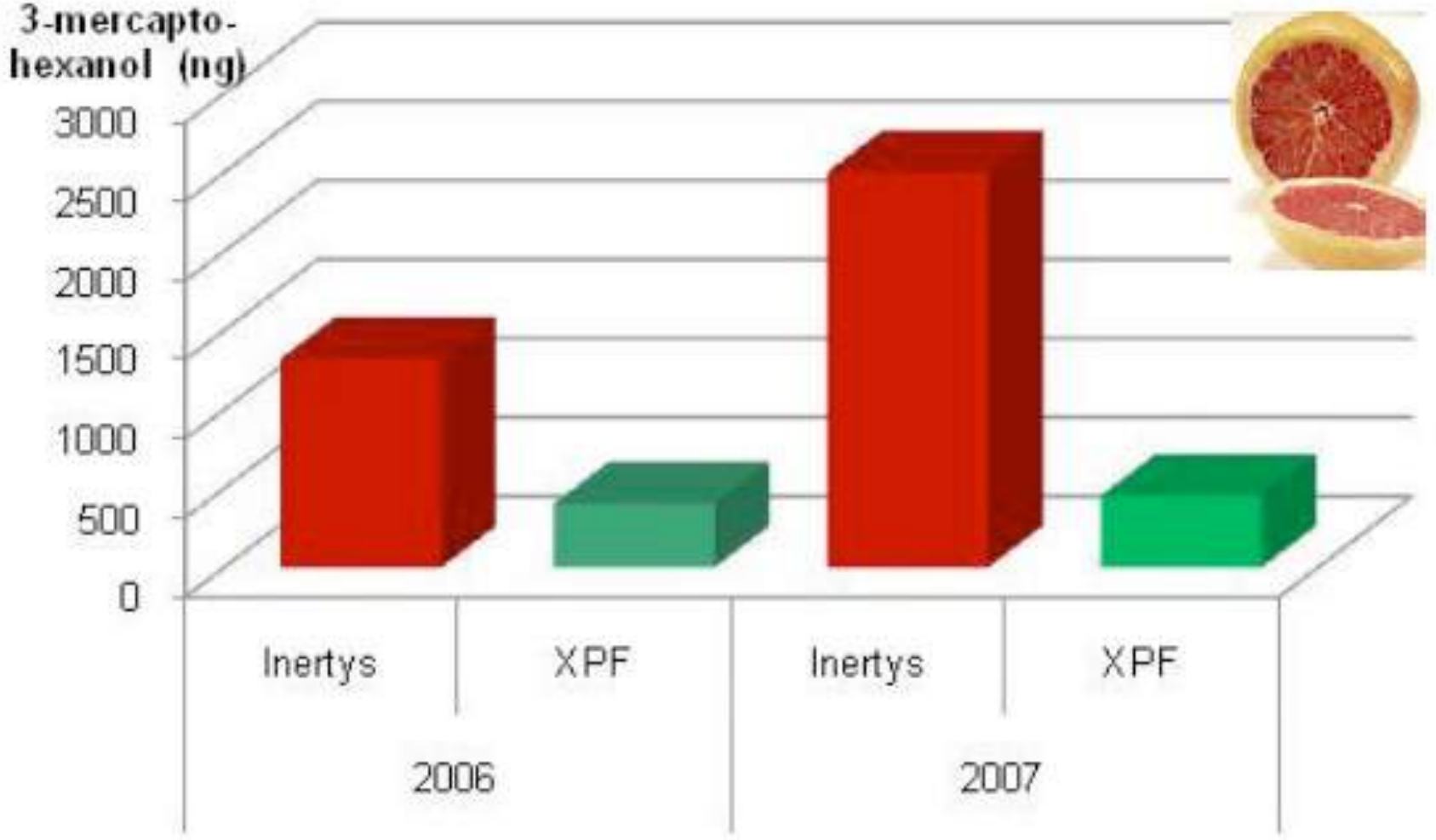


A friend or an enemy?

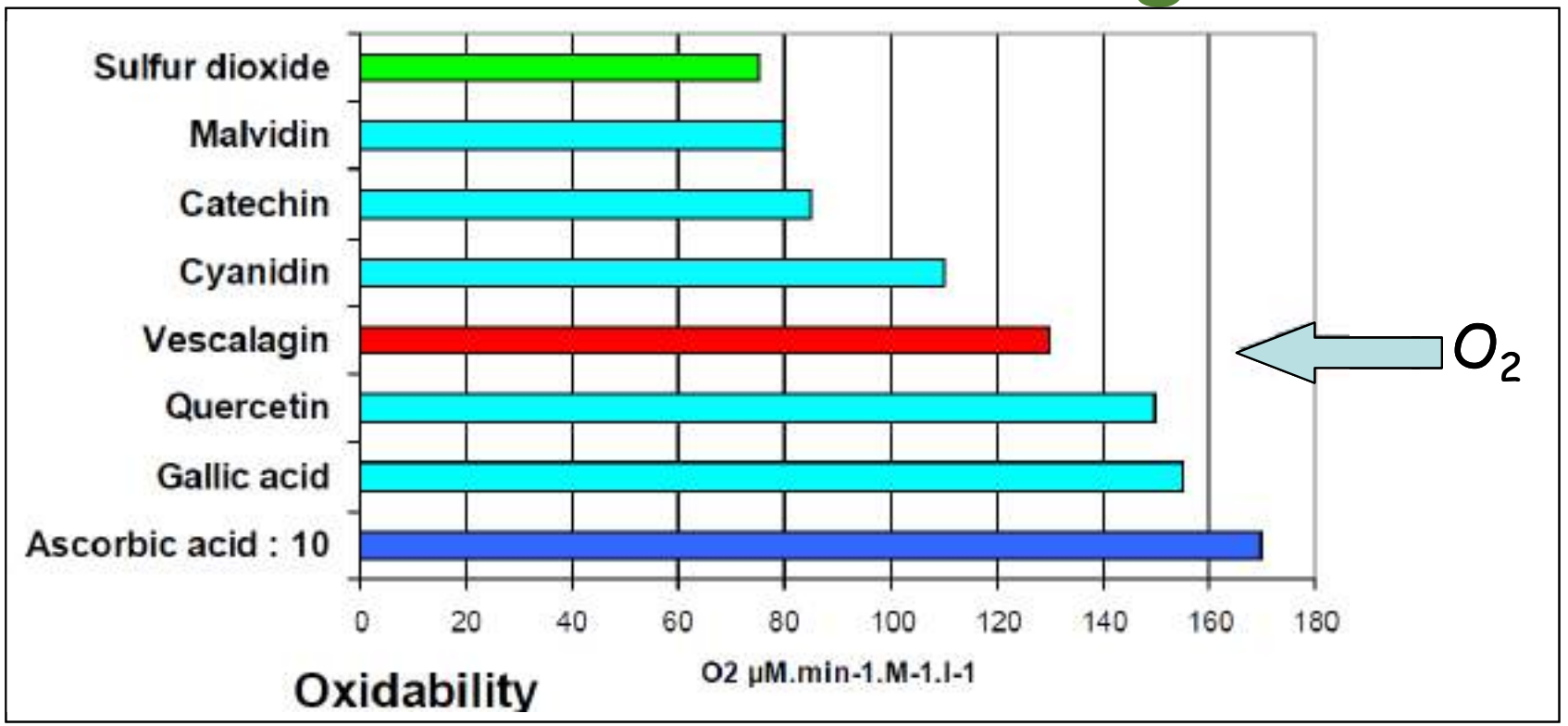


Inert gases

Inert gases


3-mercapto-hexanol (ng)
3000
2500
2000
1500
1000
500
0
Inertys
XPF
Inertys
XPF
2006
2007

Antioxidant effect of Ellagitannins



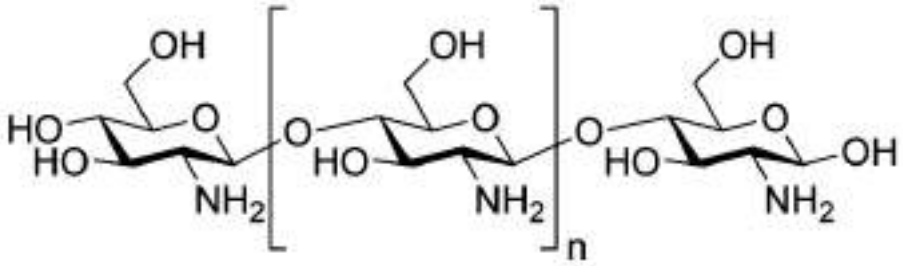
Ellagic tannins from oak aremuch more reactive than most of the polyphenols of white an red wines with dissolved oxygen
Oxygen is quickly trapped by these tannins

Courtesy from

RADOUX

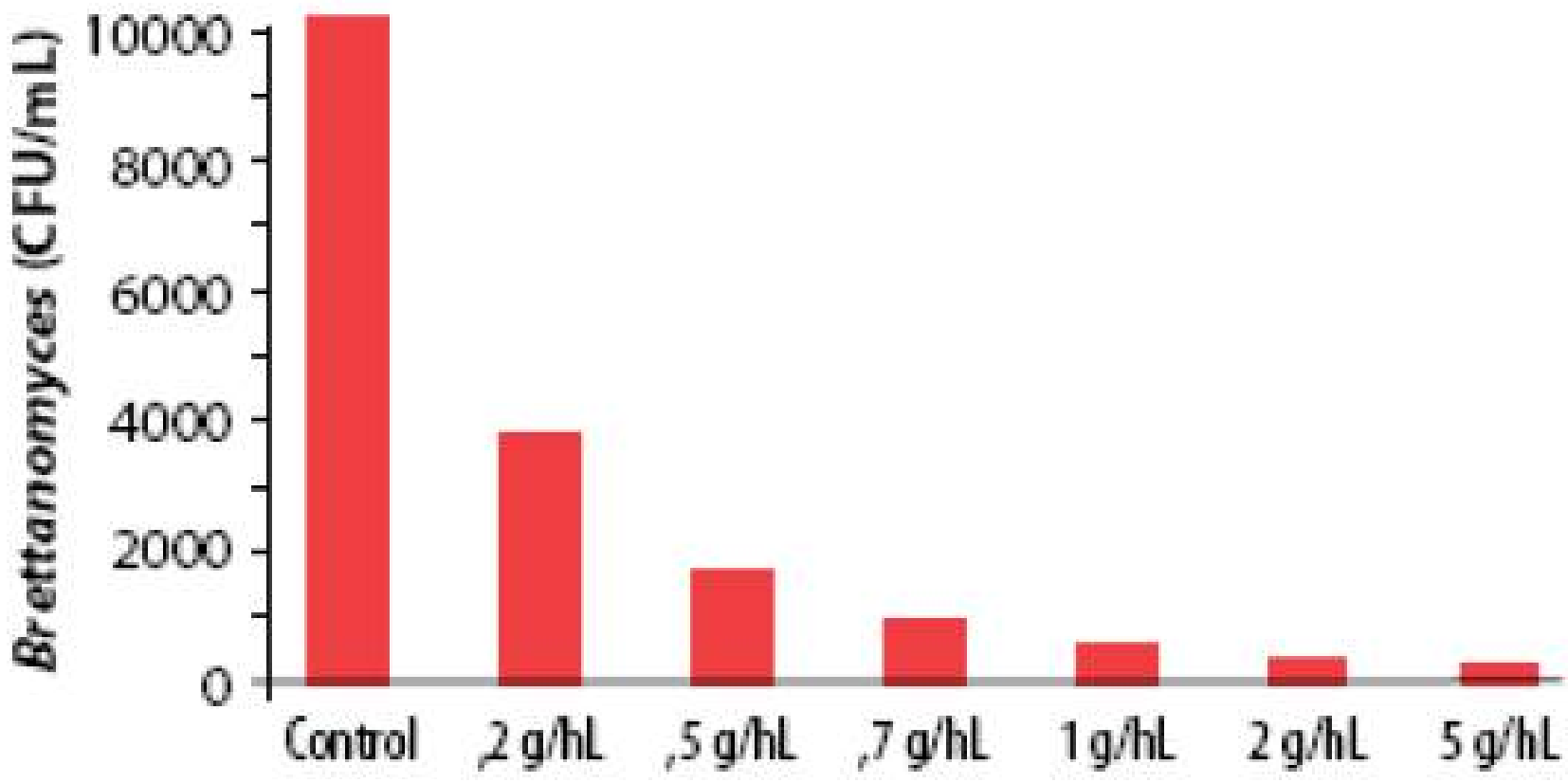
Pronektar

Alternatives to sulfur dioxide
Chitosan

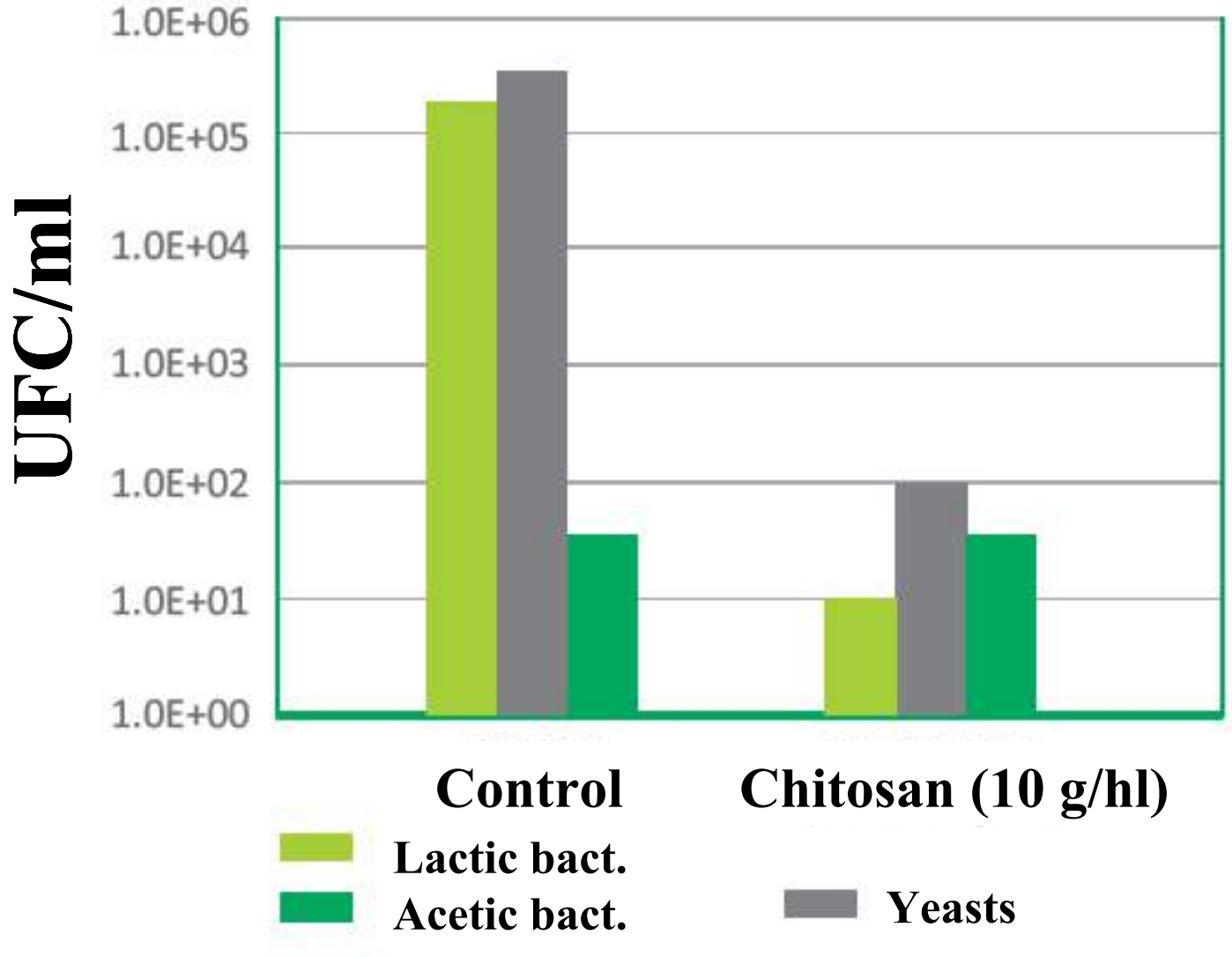


- **Chitosan is a linear polysaccharide composed of β-(1-4)-D-glucosamine and N-acetyl glucosamine**
- **Chitosan form part of the exoskeleton of crustaceans (shrimp, lobsters,...) and of fungal structures**
- **It has several interesting properties for winemaking**
- **It acts as antimicrobilogical agent, especially against *Brettanomyces***
- **Permitted by EU in wine since 2010**

Alternatives to sulfur dioxide
Quitosane

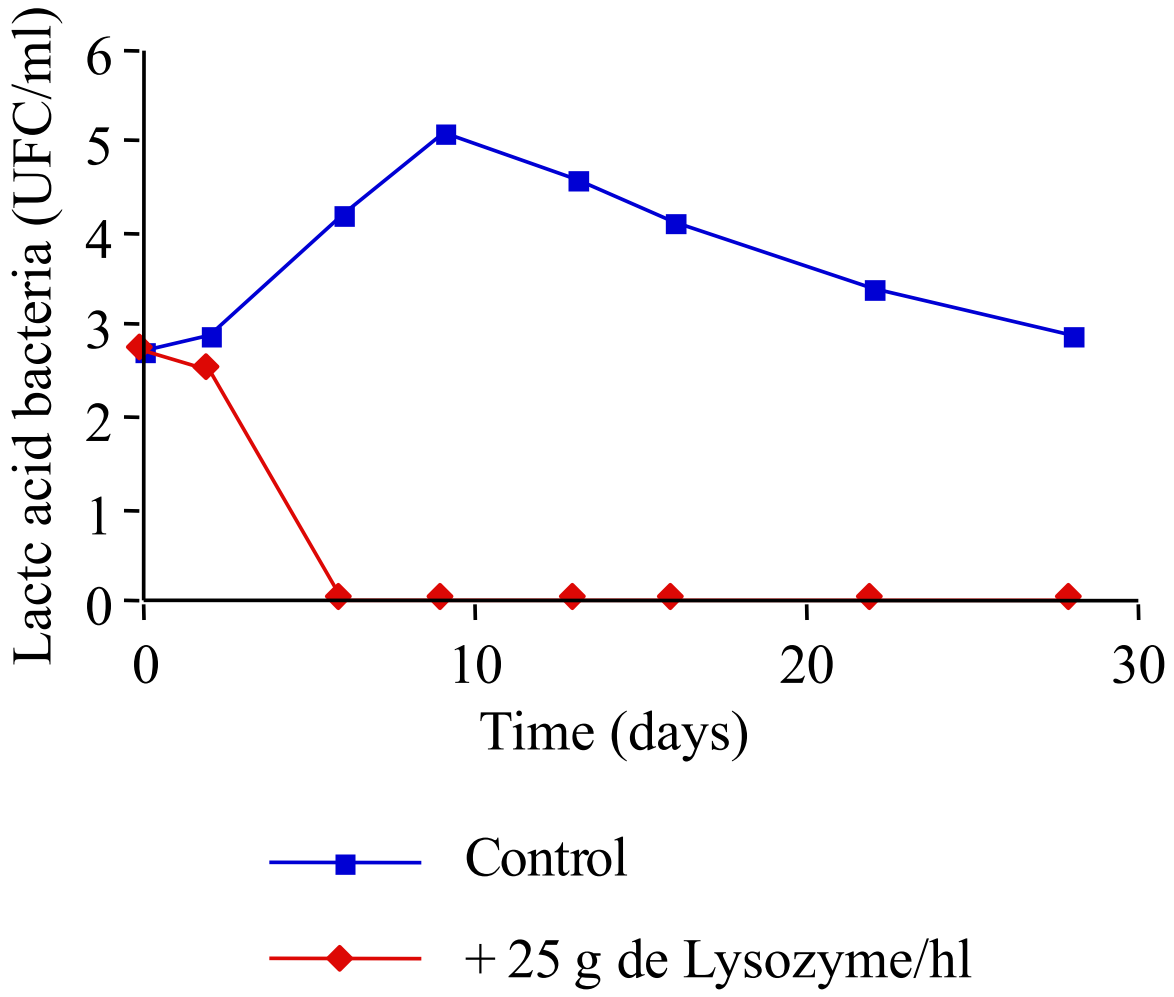


Alternatives to sulfur dioxide
Quitosane

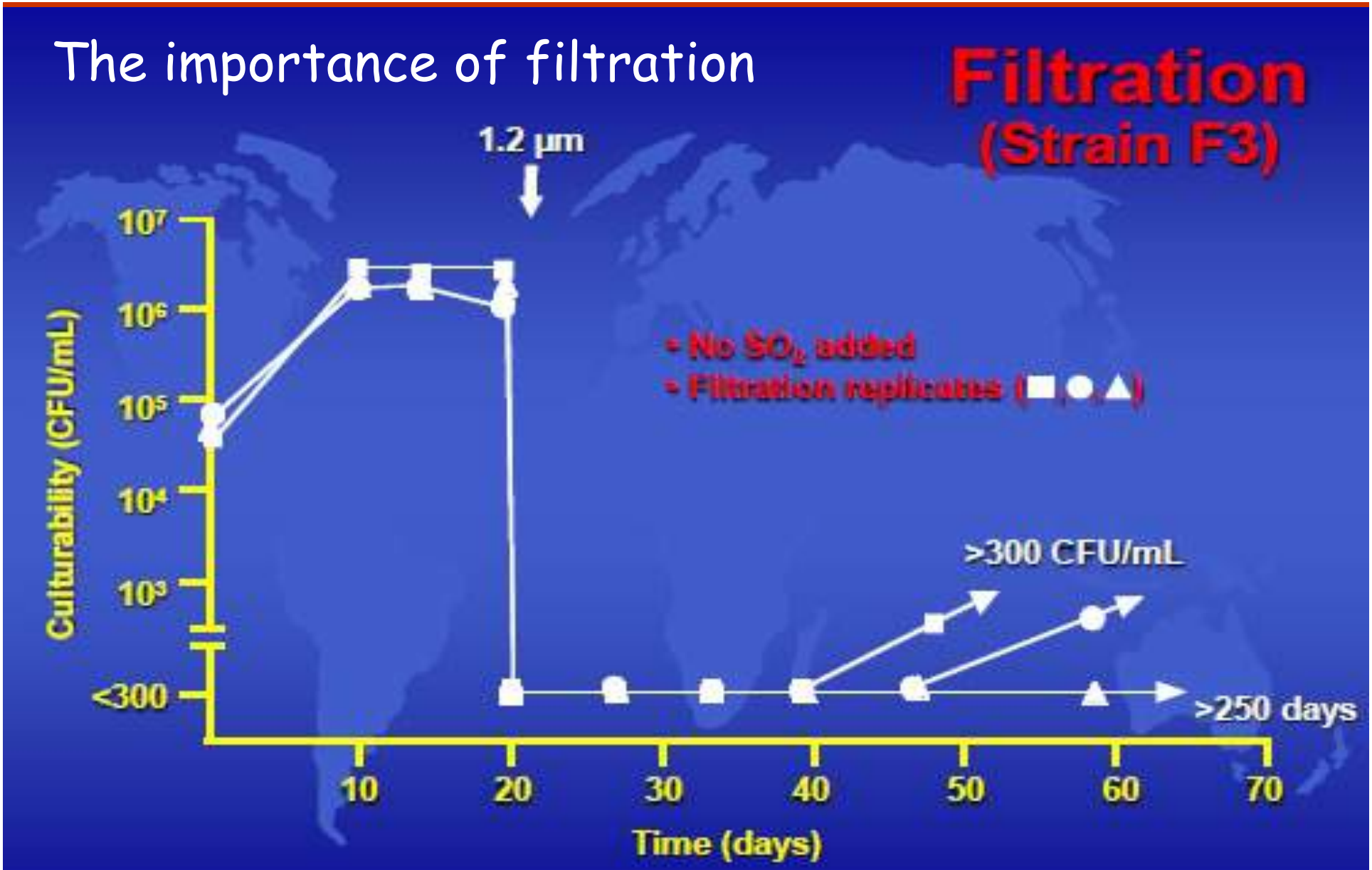


Effect of lysozyme on populations of wine lactic acid bacteria.

Adapted from Gao et al. (2002)

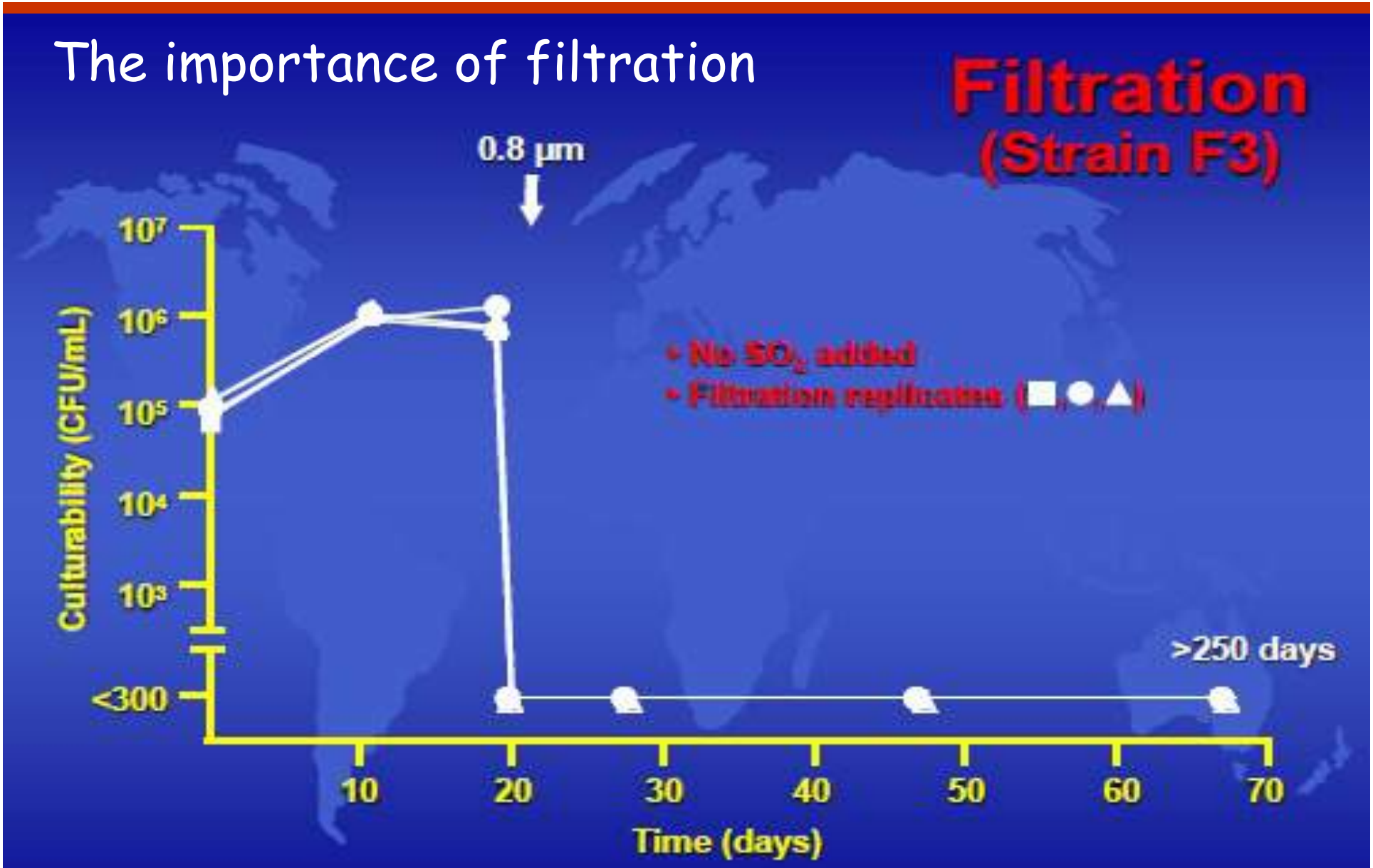


The importance of filtration



Adapted from Charles Edwards

The importance of filtration



Adapted from Charles Edwards

Ageing organic wines implies working with less SO_2 which increase the risk of oxidation and microbiological taints.

In that conditions wine control and hygiene must be strictly controlled

Small oversights that in a conventional wines would not matter can generate big problems in organic wines

Some possibilities exists to mitigate the risks although some of them do not are already authorized