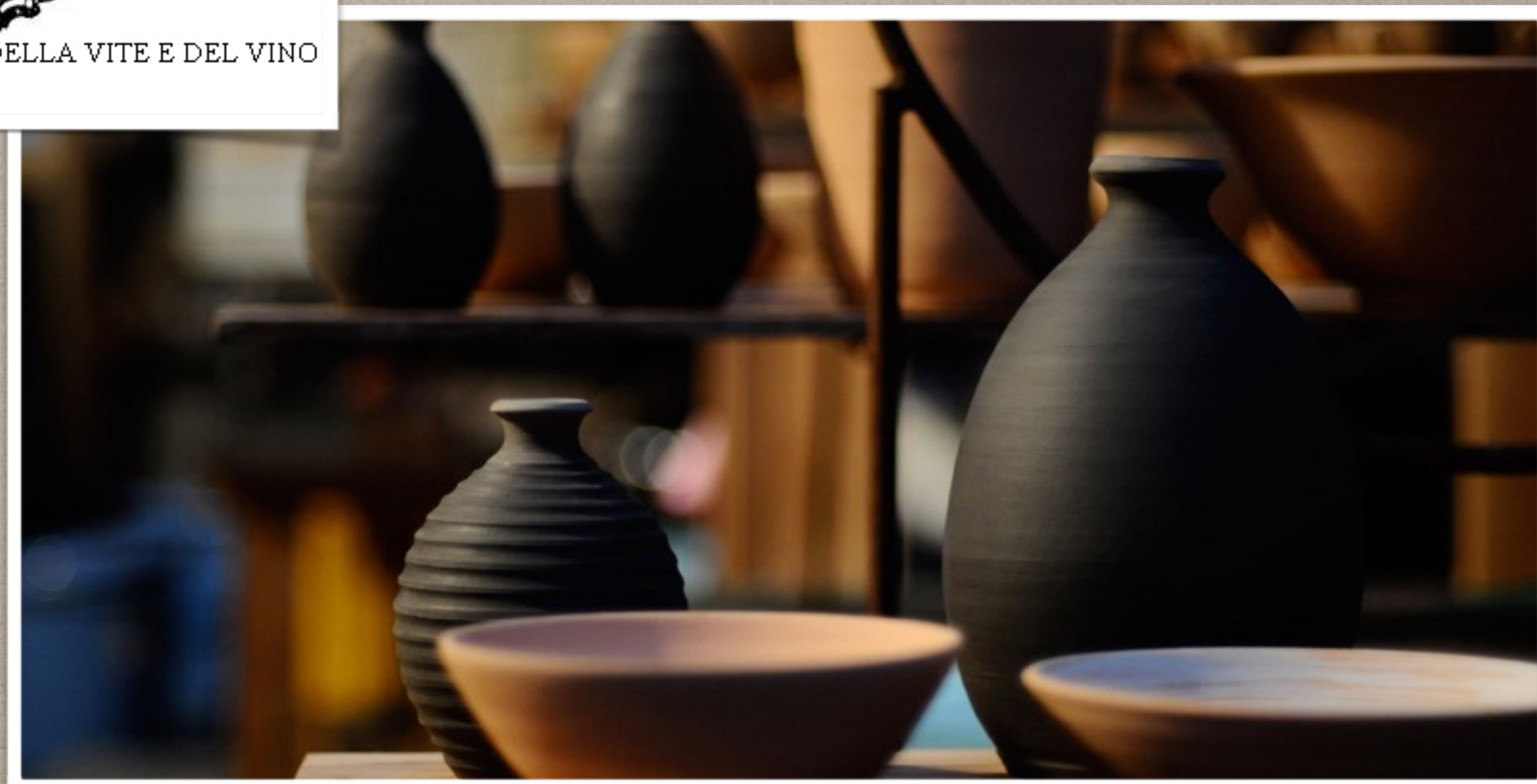
ACCADEMIA ITALIANA DELLA VITE E DEL VINO

Piacenza, 22 ottobre 2016

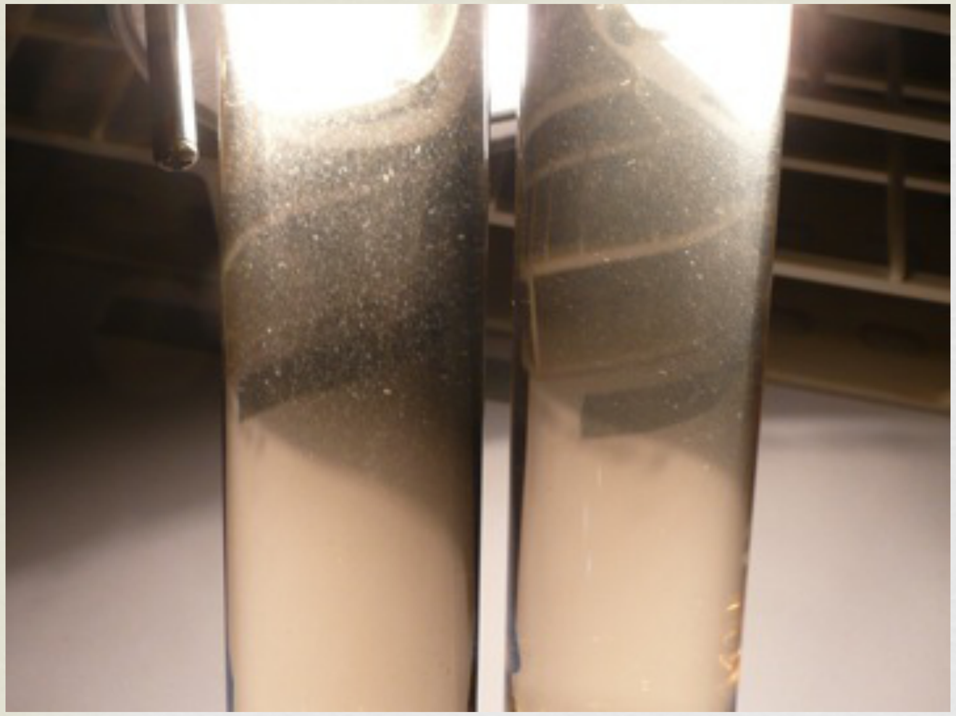


STABILIZZAZIONE SOSTENIBILE DEI VINI

MILENA LAMBRI, FABRIZIO TORCHIO, LUCA ROLLE

Resilience

- the power or ability to return to the original form, position, etc., after being bent, compressed, or stretched; elasticity.
- the ability to recover readily from illness, depression, adversity, or the like; buoyancy.
- the physical property of a material that can return to its original shape or position after deformation that does not exceed its elastic limit.



Protein / Polyphenols
aggregation
with inclusions
→clouding
→haze

Tartrate / Salts / Cristalline precipitations with inclusions

Examples of colloidal systems from daily life

Wine colloids mainly affect wine resilience

Grape and Wine Proteins

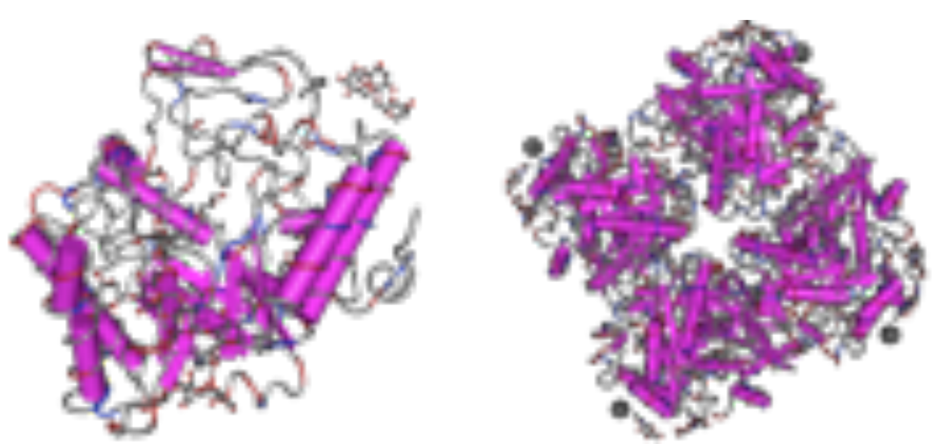
- Protein concentration
- Unfolding, aggregation, coagulation
- pH, Ethanol, Heat
- Interaction with tannins
- Stabilized by polysaccharides

Chitinase & Thaumatine – Unfolding T > 50°C

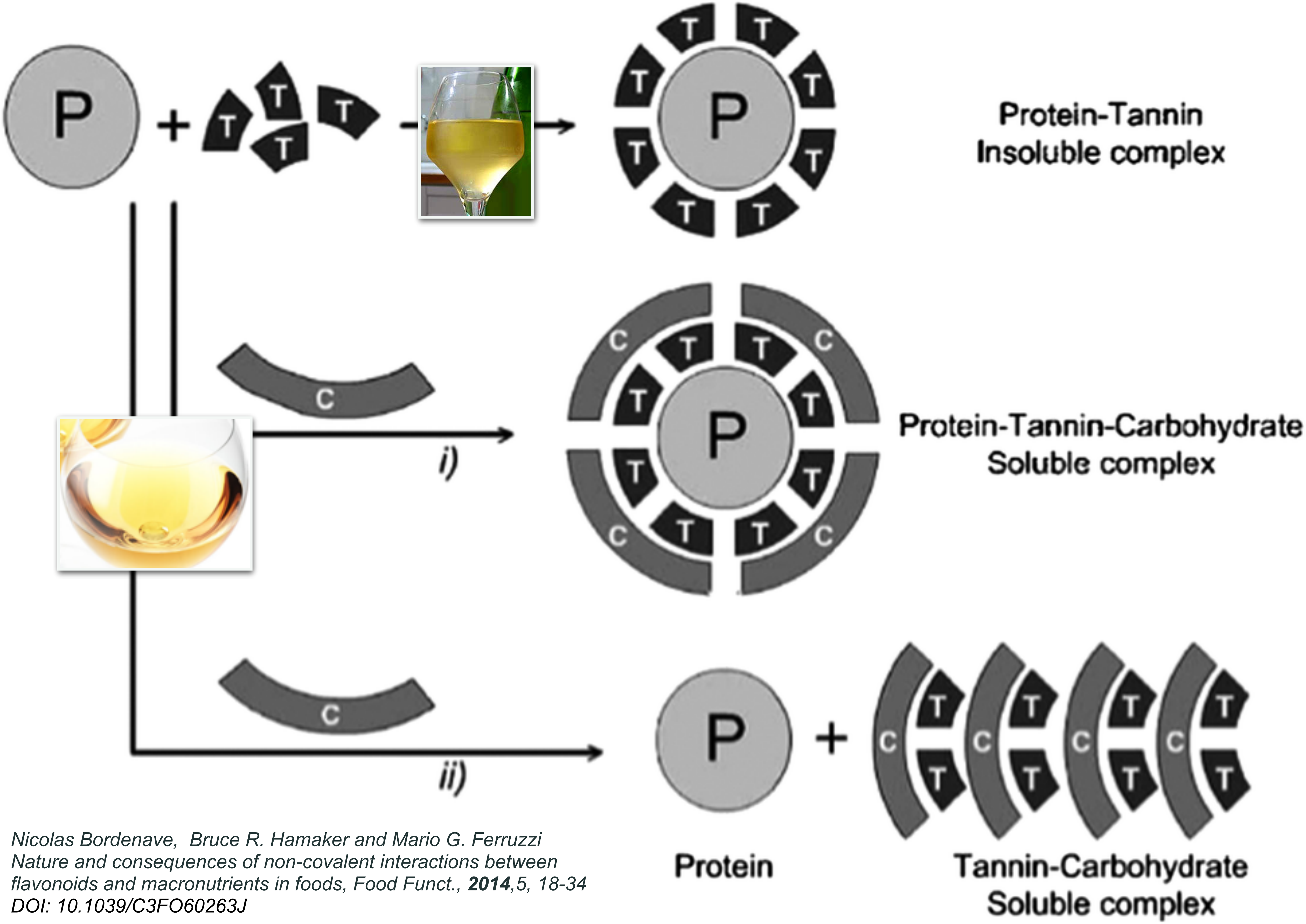
Invertase GIN 1 – Unfolding T > 70°C

FROM GRAPE
more heat unstable

FROM YEAST
less heat unstable

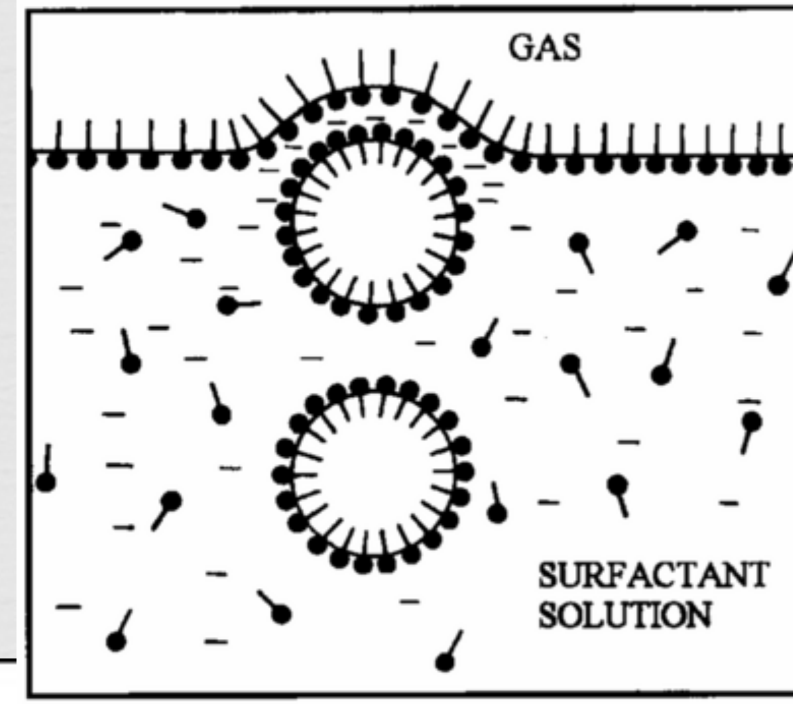


Exo-β-glucanase e Crh1p from *S. cerevisiae*

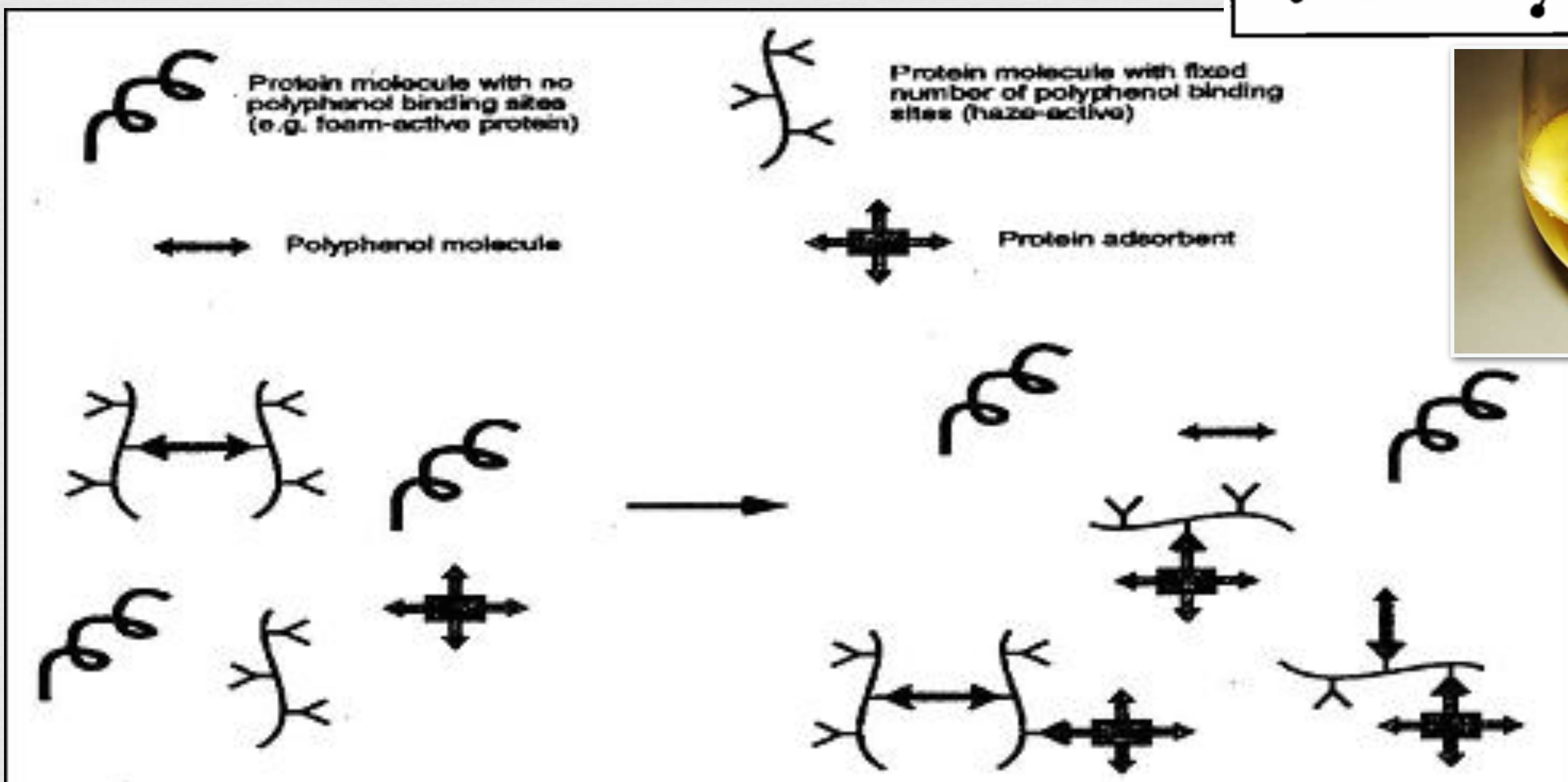


Nicolas Bordenave, Bruce R. Hamaker and Mario G. Ferruzzi
Nature and consequences of non-covalent interactions between flavonoids and macronutrients in foods, Food Funct., ***2014***, *5, 18-34*
DOI: 10.1039/C3FO60263J

Polypeptide / Polyphenol binding
→ foaming properties
→ stabilizing bubble surface
→ sparkling wines

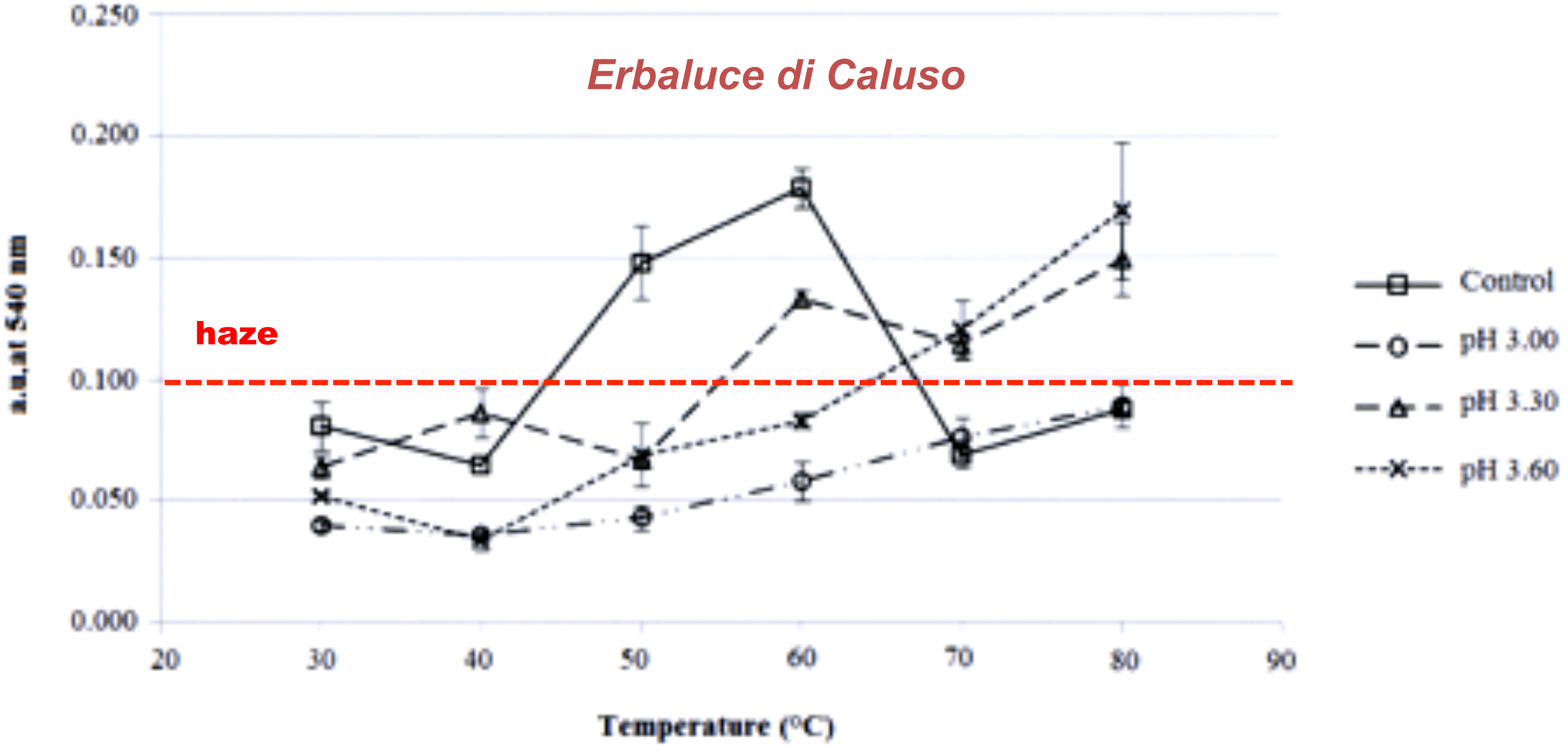


http://soft-matter.seas.harvard.edu/index.php/Foams

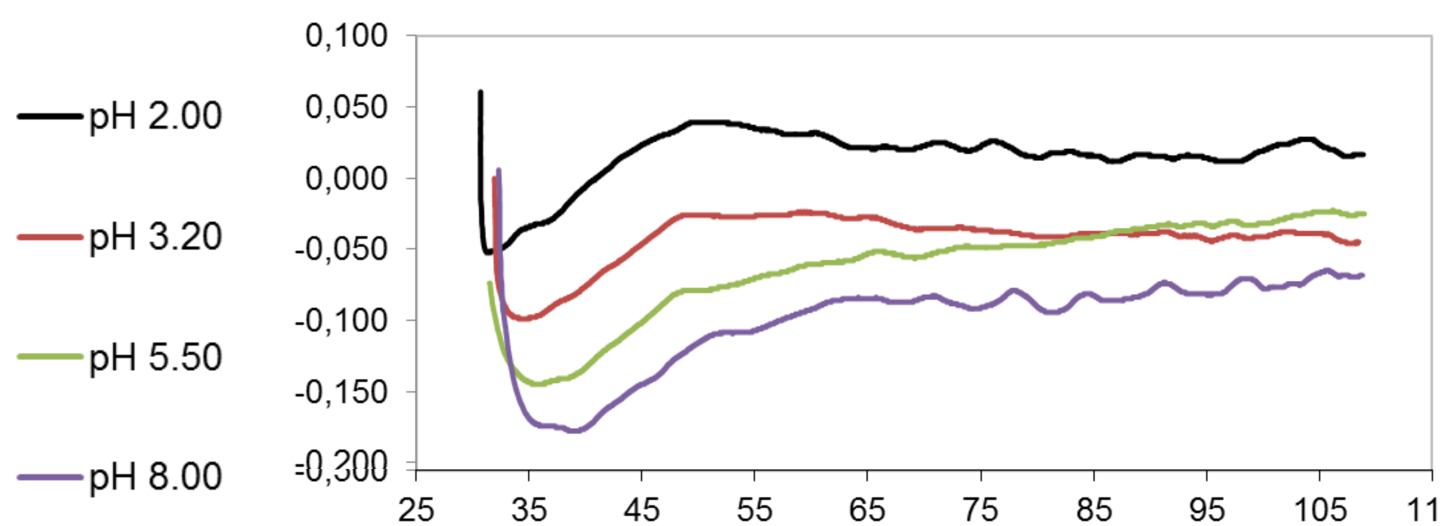


http://wwwcourses.sens.buffalo.edu/ce457_527/ce457_pro/g5_doc.htm

Colloidal stability (under heating)



*Lambri M., Dordoni R, Giribaldi M., Riva Violetta M., Giuffrida G. (**2013**). "Effect of pH on the protein profile and heat stability of an Italian white wine", Food Research International, 54, 2, 1178-1186. ISSN 0963-9969. DOI:10.1016/j.foodres.2013.09.038.*



Turbidity scale

FINING AGENTS

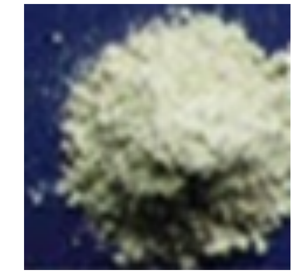
Wine	Agent	Dose rate (mg/l)	Properties	Clarity
White	Bentonite	250-500	Reduces protein	C+
	Gelatine	15-150	Reduces bitterness, astringency & off-tastes	C++
	Casein	50-500	Reduces colour & oxidative taints	C+
	Isinglass	10-100	Very good clarification, removes astringency	C+++
	PVPP	200-600	Reduces bitterness & easily-oxidised subs.	
	Milk	2 - 4 ml/l	Deodorises, removes colour	C+
	Carbon	max. 1 g/l	Reduces colour, removes aroma & flavour (both good and bad)	
	Silica sol	30-300	Reduces proteins, enhances other fining agents	C
Red	Gelatine	30-300	Reduces astringency, off-tastes & colour	C++
	Egg albumin	60-100	Reduces astringency	C+

http://www.wineskills.co.uk/winemaking/winemaking-knowledge-base/fining-agents

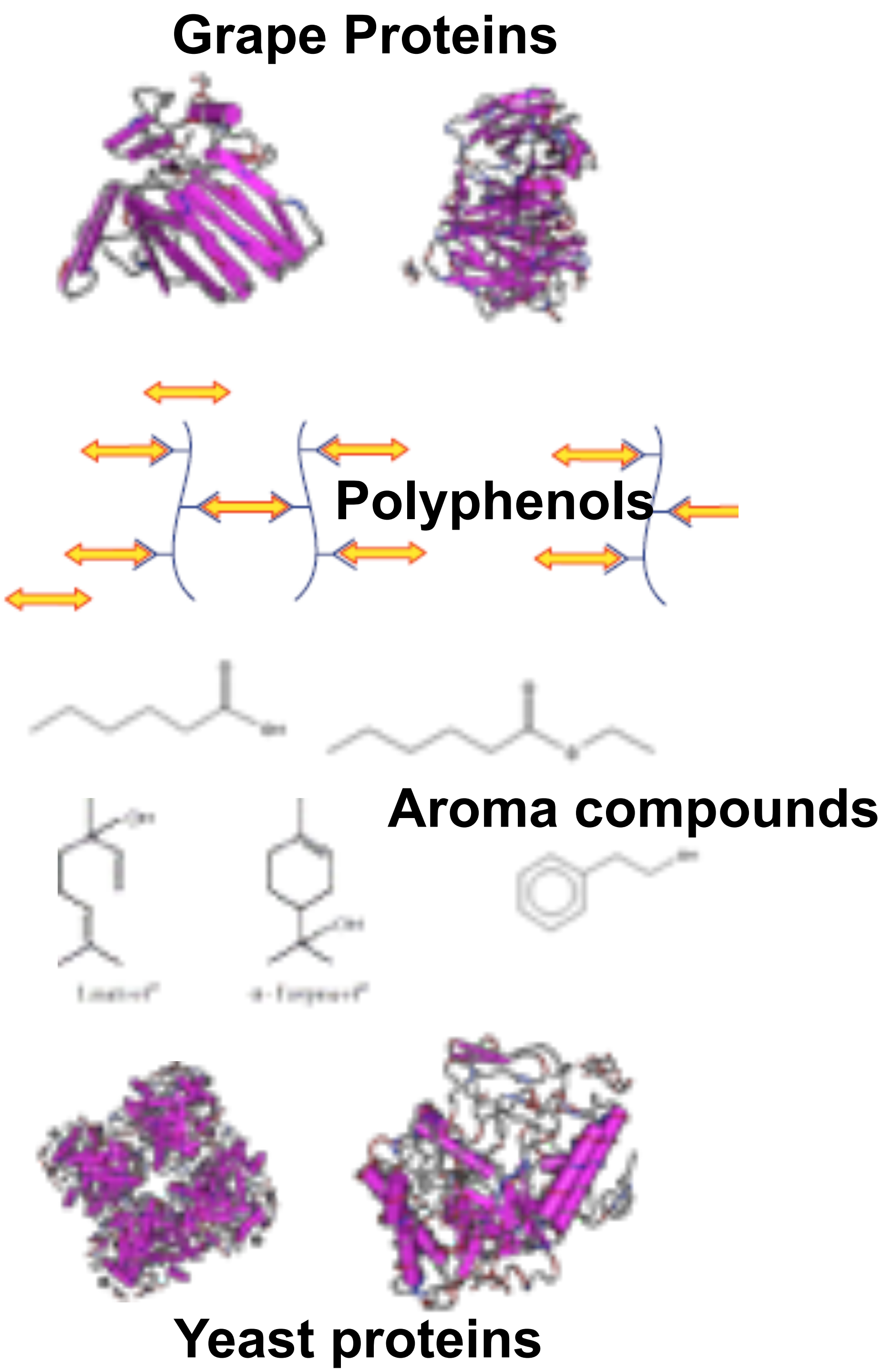
Bentonite & Wine colloids

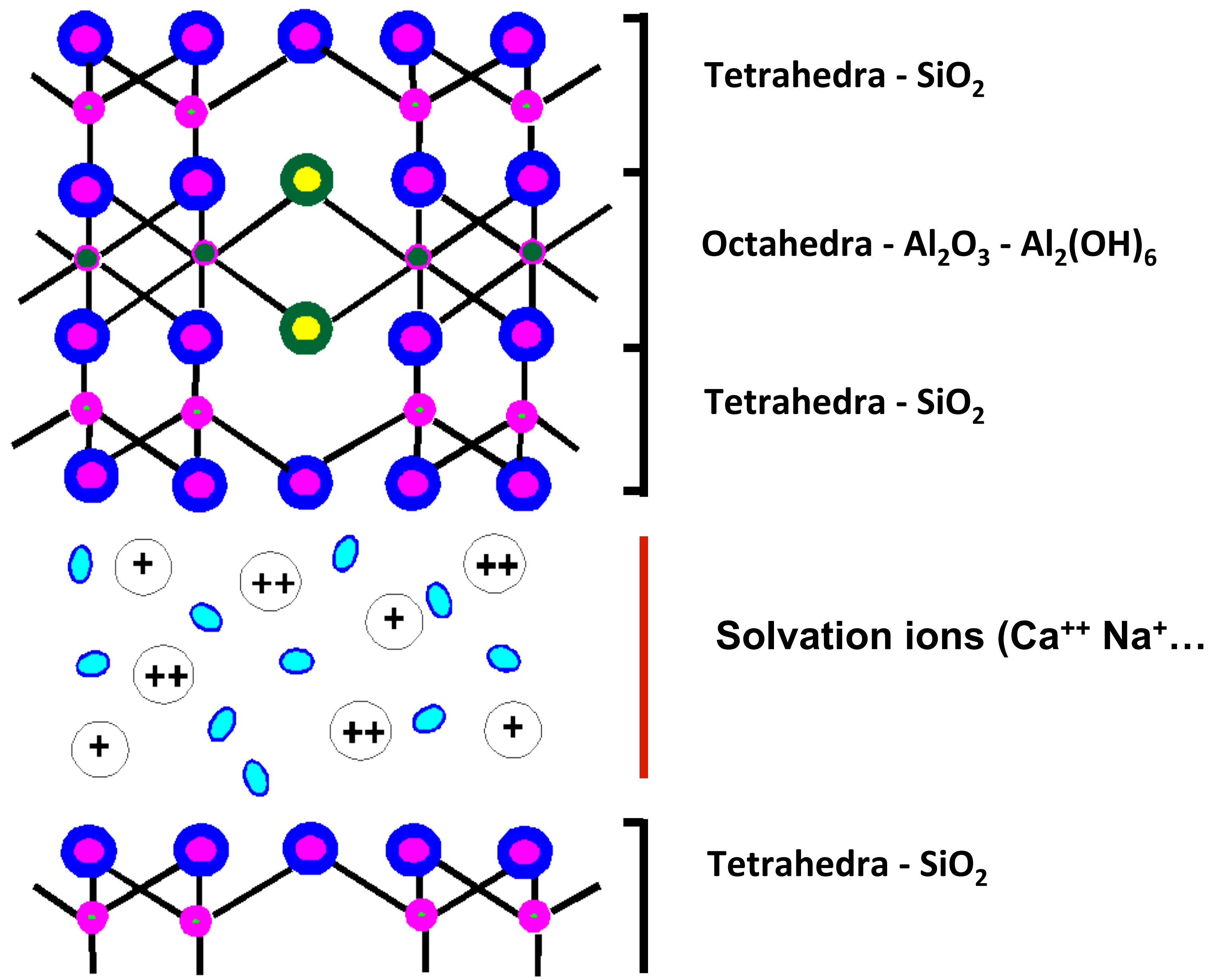
Short spaghetti

Granules



Dust





Card-house structure

Bentonite properties

Lambri M., Dordoni R. (**2014**). "Aggiornamenti sull'uso della bentonite in enologia", Il Corriere Vinicolo n.21, 7 luglio 2014, 24-25.

Sample	SSA (m^2 g^{-1})	Na/Ca Interlayer charge	SCD [meq $(100g)^{-1}$]	SCD/SSA [(meq m^{-2}) 10^{-2}]	Swell index (mL g^{-1})	pH
1	80.0 g	1.04 d	32.1 c	0.40 ab	9.5 ab	10.05 a
2	82.7 g	1.47 c	30.6 d	0.37 b	4.1 f	9.86 b
3	87.9 g	1.00 d	43.5 b	0.50 a	4.3 f	10.10 a
4	101.7 f	1.39 c	32.3 c	0.32 b	6.1 de	9.49 c
5	102.3 f	1.05 d	35.2 c	0.34 b	5.8 e	9.74 b
6	271.6 e	1.17 d	47.3 b	0.17 c	11.0 a	8.13 d
7	396.2 d	0.71 e	35.7 c	0.09 d	6.2 d	9.45 c
8	405.8 cd	1.44 c	43.1 b	0.11 c	6.7 cd	9.65 b
9	406.4 cd	1.11 d	36.2 c	0.09 d	7.3 c	9.72 b
10	409.9 cd	1.14 d	30.6 d	0.07 d	11.5 a	9.69 b
11	443.5 b	2.41 b	26.2 e	0.06 d	10.0 ab	9.72 b
12	487.2 b	2.41 b	68.5 a	0.14 c	11.0 a	9.77 b
13	519.4ab	3.20 a	43.0 b	0.08 d	11.3 a	10.53 a
14	530.3 a	2.75 b	16.3 f	0.03 d	8.1 b	10.24 a

HPLC
Maldi TOF MS

Chardonnay
Proteins: 100.6 ± 3.2 mg/L
Bentonite: 100 g/hL

Sauvignon blanc
Proteins: 65.8 ± 1.5 mg/L
Bentonite: 50 g/hL

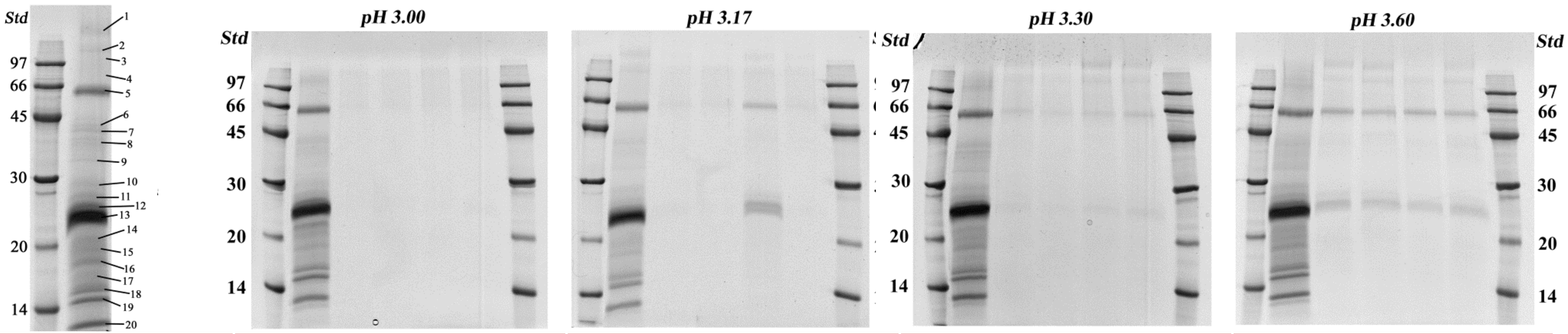
*Lambri M., Dordoni R, Giribaldi M., Riva Violetta M., Giuffrida G. (**2012**). "Heat-unstable protein removal by different bentonite labels on white wines", LWT - Food Science and Technology, 46, 2, 460-467. ISSN 0023-6438. DOI:10.1016/j.lwt.2011.11.022.*

Band	*Chardonnay*				*Sauvignon*			
	Sign. diff.	Identified protein	Hyp. Mw	Exp. Mw	Sign. diff.	Identified protein	Hyp. Mw	Exp. Mw
b	406 – 1.11 82 – 1.47 101 – 1.39	Vacuolar invertase 1	71.5	58.0	406 – 1.11 82 – 1.47	Vacuolar invertase 1	71.5	58.0
e	All	Class IV endochitinase/ Thaumatin like protein 1	27.4/ 24	27.0				
f	All	Thaumatin like protein 1	24.0	24.0	All	Thaumatin like protein 1	24.0	24.0
g	All	Thaumatin like protein 1	24.0	21.0				
h	406 – 1.11	Thaumatin like protein 1	24.0	18.0	396 – 0.71	Thaumatin like protein 1	24.0	18.0
m					All	Thaumatin like protein 1	24.0	14.5
o	All	Non-specific lipid-transfer protein	11.6	11.0	All	Non-specific lipid-transfer protein	11.6	11.0

More efficient bentonites → natural pH < 10 ; high Na/Ca ; large SSA

Bentonite - Proteins - pH

Erbaluce di Caluso



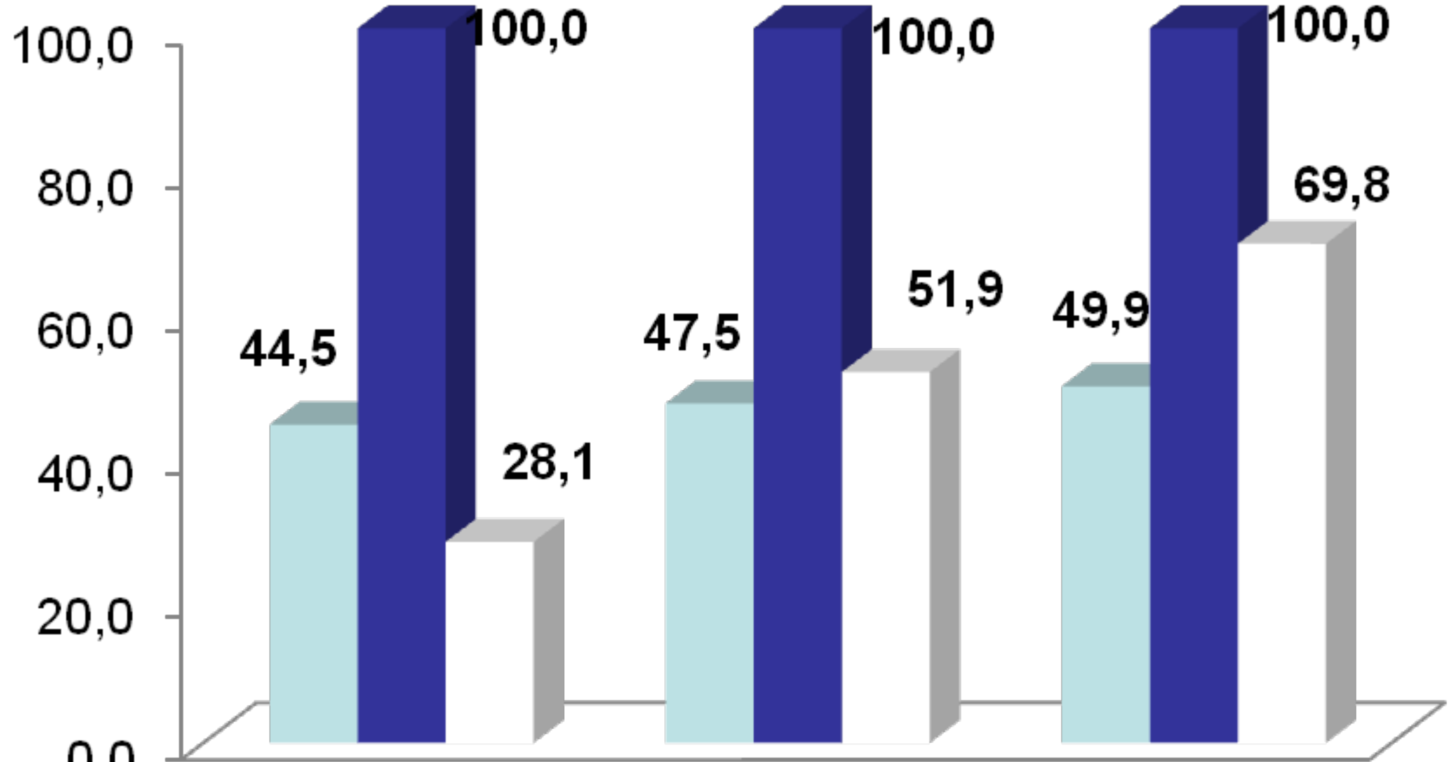
	pH 3.00	pH 3.17	pH 3.30	pH 3.60
Untreated	$99.32\pm2.01^{a}_{a}$	$96.00\pm2.00^{a}_{a}$	$100.95\pm10.2^{a}_{a}$	$105.05\pm10.61^{a}_{a}$
443 – 2.41	$72.86\pm1.72^{ab}_{b}$	$82.27\pm0.54^{a}_{b}$	$67.79\pm4.86^{b}_{b}$	$79.53\pm5.94^{a}_{b}$
409 – 1.14	$74.08\pm3.00^{a}_{b}$	$88.76\pm10.75^{a}_{ab}$	$80.05\pm10.02^{a}_{ab}$	$83.31\pm7.00^{a}_{b}$
80 – 1.03	$74.42\pm8.74^{a}_{b}$	$80.50\pm1.91^{a}_{b}$	$91.16\pm8.64^{a}_{ab}$	$88.38\pm4.02^{a}_{ab}$

*Dordoni R, Colangelo D., Giribaldi M., Giuffrida G., De Faveri D.M., Lambri M., (**2015**). "Effect of bentonite characteristics on wine proteins, polyphenols, and metals under different pH conditions", American Journal of Enology and Viticulture, 66 (4), 518-530. ISSN 0002-9254. DOI: 10.5344/ajev.2015.15009*

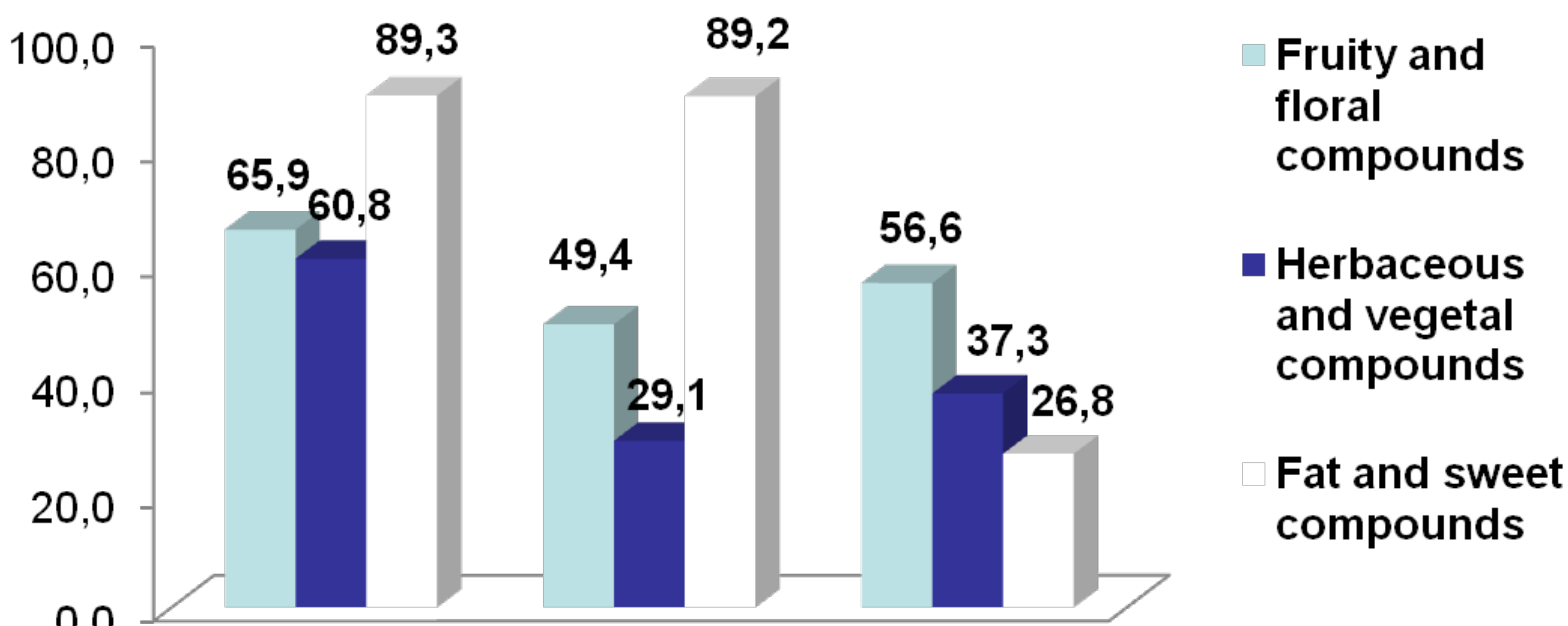
Less efficacy of bentonites at pH ≥ 3.30

Fermentative Aroma and Bentonite

*Lambri M., Dordoni R., Silva A., De Faveri D.M. (**2010**). "Effect of bentonite fining on odor active compounds in two different white wine styles", American Journal of Enology and Viticulture, 61, 2, 225-233.*



Chardonnay without any aging



Chardonnay aged on lees

Bentonite - Fermentative Aroma Compounds

Significance of bentonite sample, dose e wine style (aged / young) on fermentative aroma compounds

	Bentonite dose	Bentonite sample	Wine style
Ethyl butyrate	***	n.s.	***
Ethyl hexanoate	n.s.	*	**
Ethyl octanoate	*	n.s.	n.s.
Isoamyl acetate	n.s.	n.s.	n.s.
Phenylethyl acetate	*	n.s.	***
β-Phenylethanol	**	n.s.	n.s.
1-Hexanol	*	*	n.s.
Hexanoic acid	**	n.s.	**
Octanoic acid	n.s.	n.s.	n.s.

n.s., not significant
** significant differences ($p < 0.01$)
* significant differences ($p < 0.05$)
*** significant differences ($p < 0.001$)

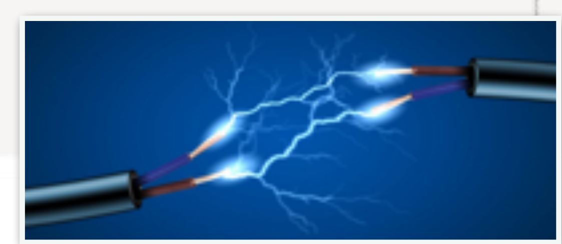
*Lambri M., Dordoni R., Silva A., De Faveri D.M. (**2010**). "Effect of bentonite fining on odor active compounds in two different white wine styles", American Journal of Enology and Viticulture, 61, 2, 225-233.*

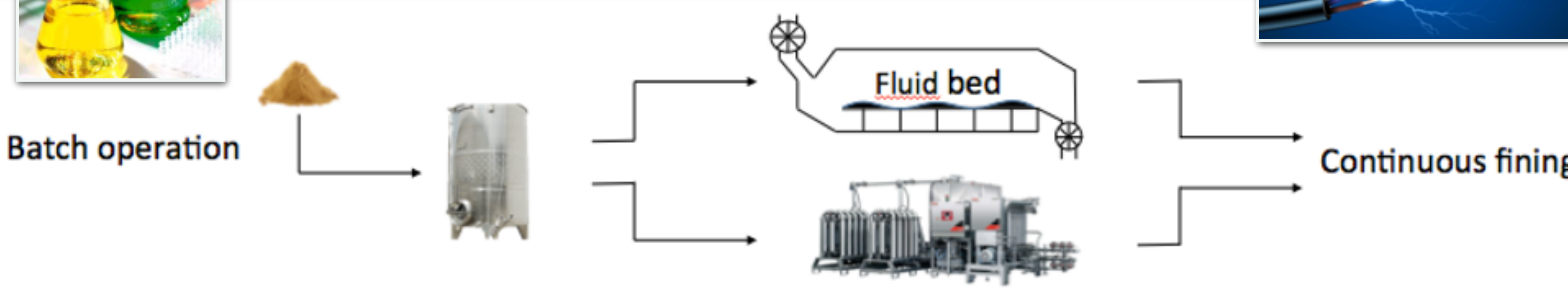
Wine practice, safety and sustainability

Wine Spectator

BEST OF AWARD OF EXCELLENCE

Chemistry and batch operations with adjuvant to be substituted by physical steps

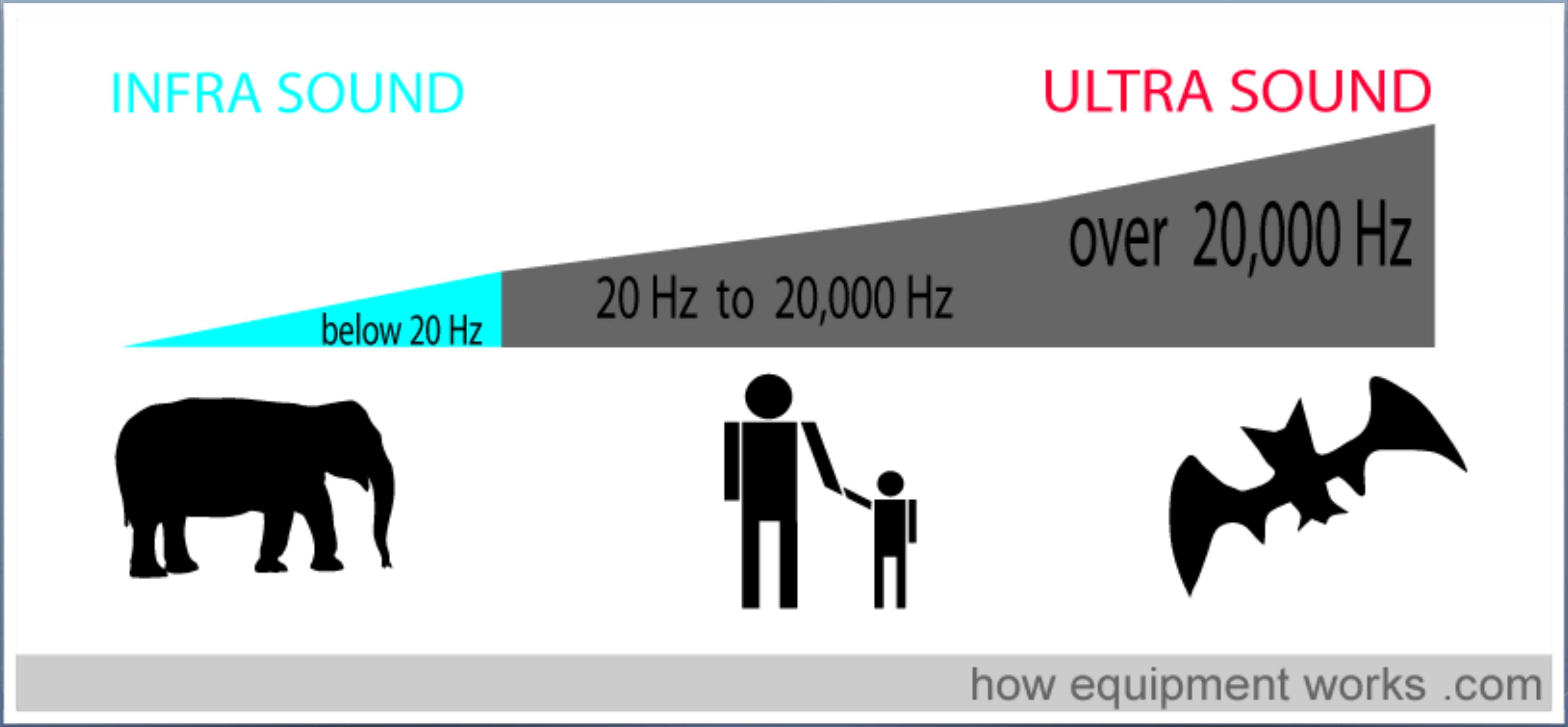




ULTRASOUNDS

Tecnologia ad ultrasuoni in vinificazione
Di Emilio Celotti e Paola Ferraretto - Vitenda ***2015***
Si illustrano le possibili applicazioni degli ultrasuoni in vinificazione, in particolare in merito alla loro capacità di indurre cavitazione.

- **In the last decade, ultrasounds have emerged as an alter- native processing option to conventional thermal treatments for pasteurization and sterilization of food products.**



How can Ultrasound be applied in Food ?

Ultrasound when propagated through a biological structure induces compressions and depressions of the particles and a high amount of energy is imparted.

In food industry, the application of ultrasound can be divided based on range of frequency:

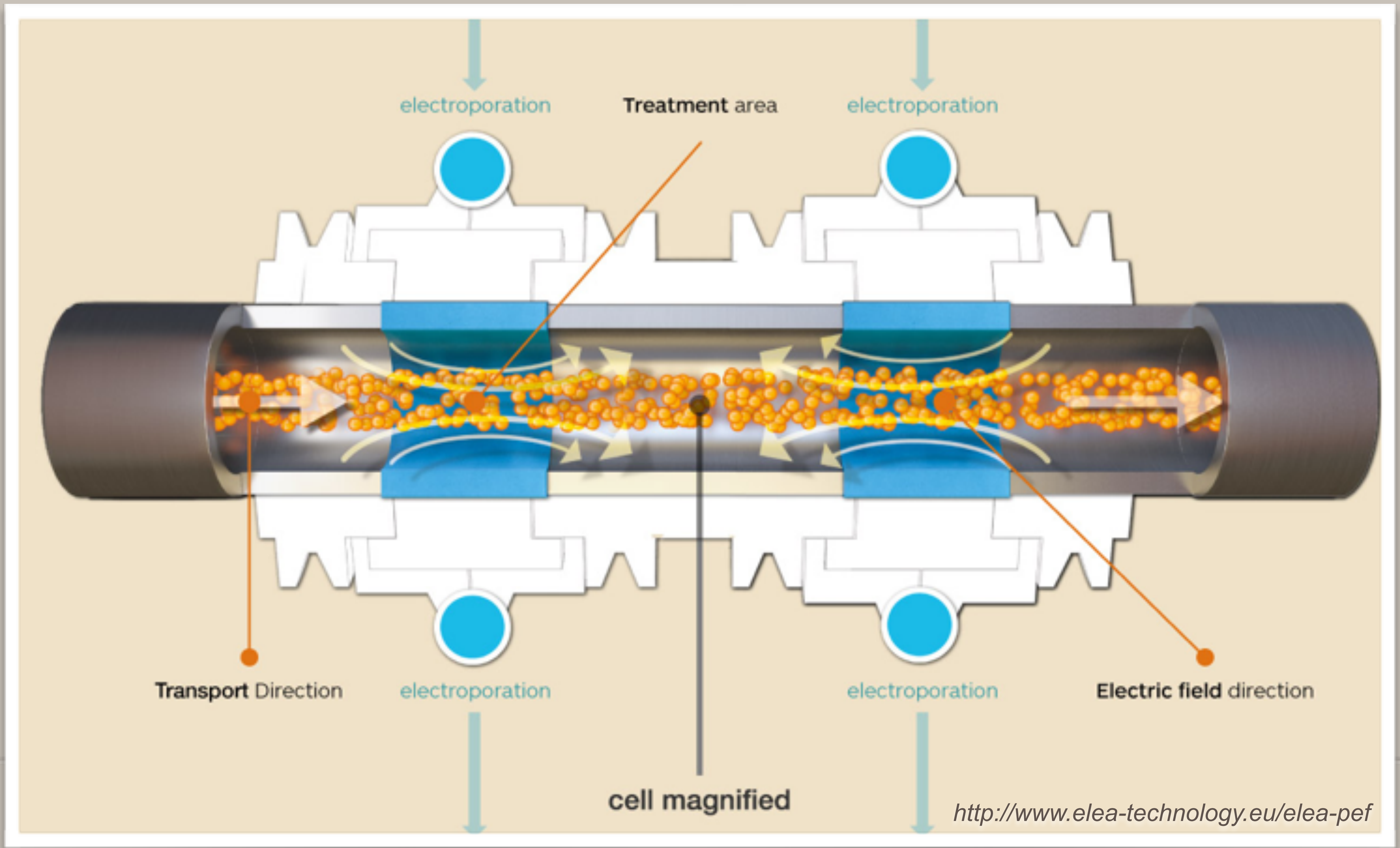
- ❑ *low power ultrasound*
- ❑ *high power ultrasound*

The advantages of ultrasound Quality control techniques for food safety
Jithin Mj, Food Science Technology
*Published on April 11, **2014**.*

- When high power ultrasound propagates in a liquid, cavitation bubbles are generated due to pressure changes.
- These micro bubbles collapse violently in the succeeding compression cycles of a propagated ultrasonic wave.
- This results in regions of high localized temperatures resulting in high shearing effects. Consequently, intense local energy and high pressure bring about a localized pasteurization effect without causing a significant rise in macro-temperature.

PULSED ELECTRIC FIELDS

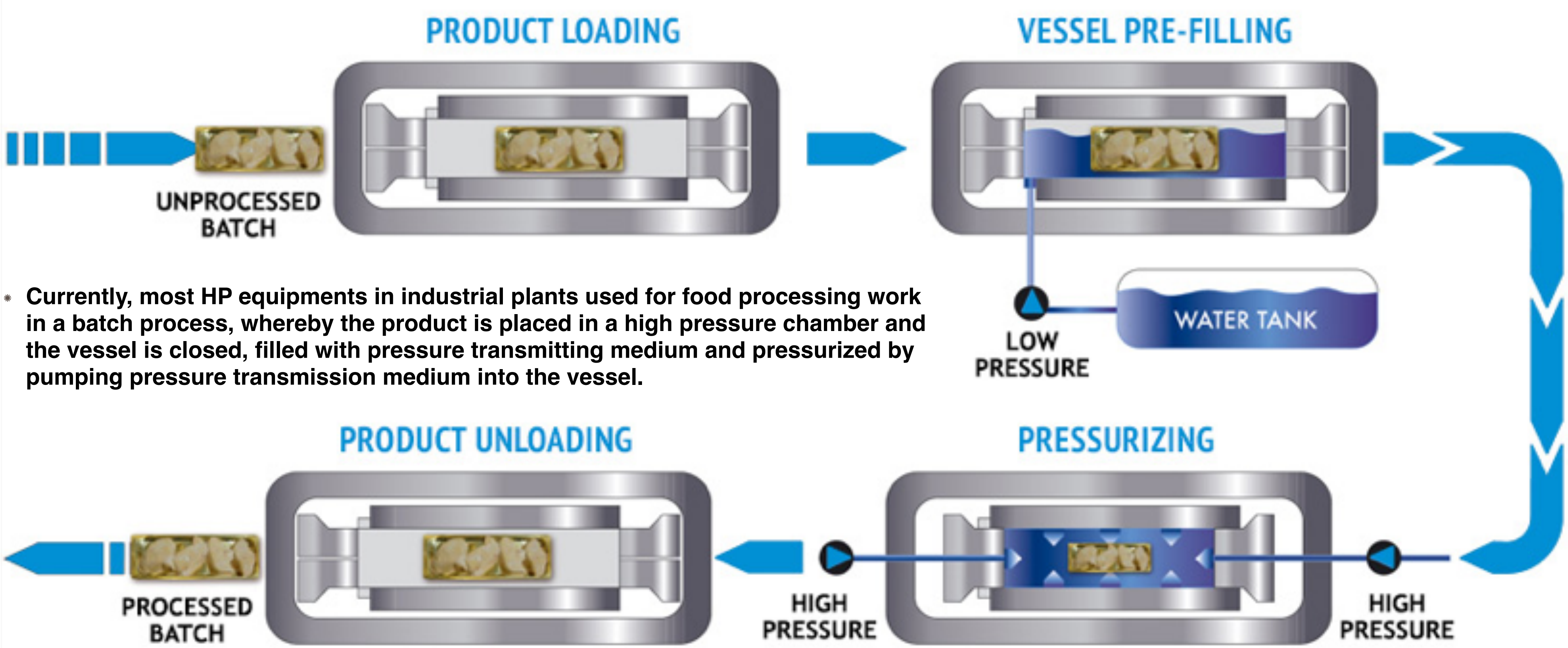
- Pulsed electric fields (PEF) technology constitutes a fast, non-thermal, and highly effective technique for the inactivation of pathogenic microorganisms in foods without modifying food quality.
- This technology involves the application of short pulses of high electric field strengths (up to 70 kV/cm) to products placed between 2 electrodes.



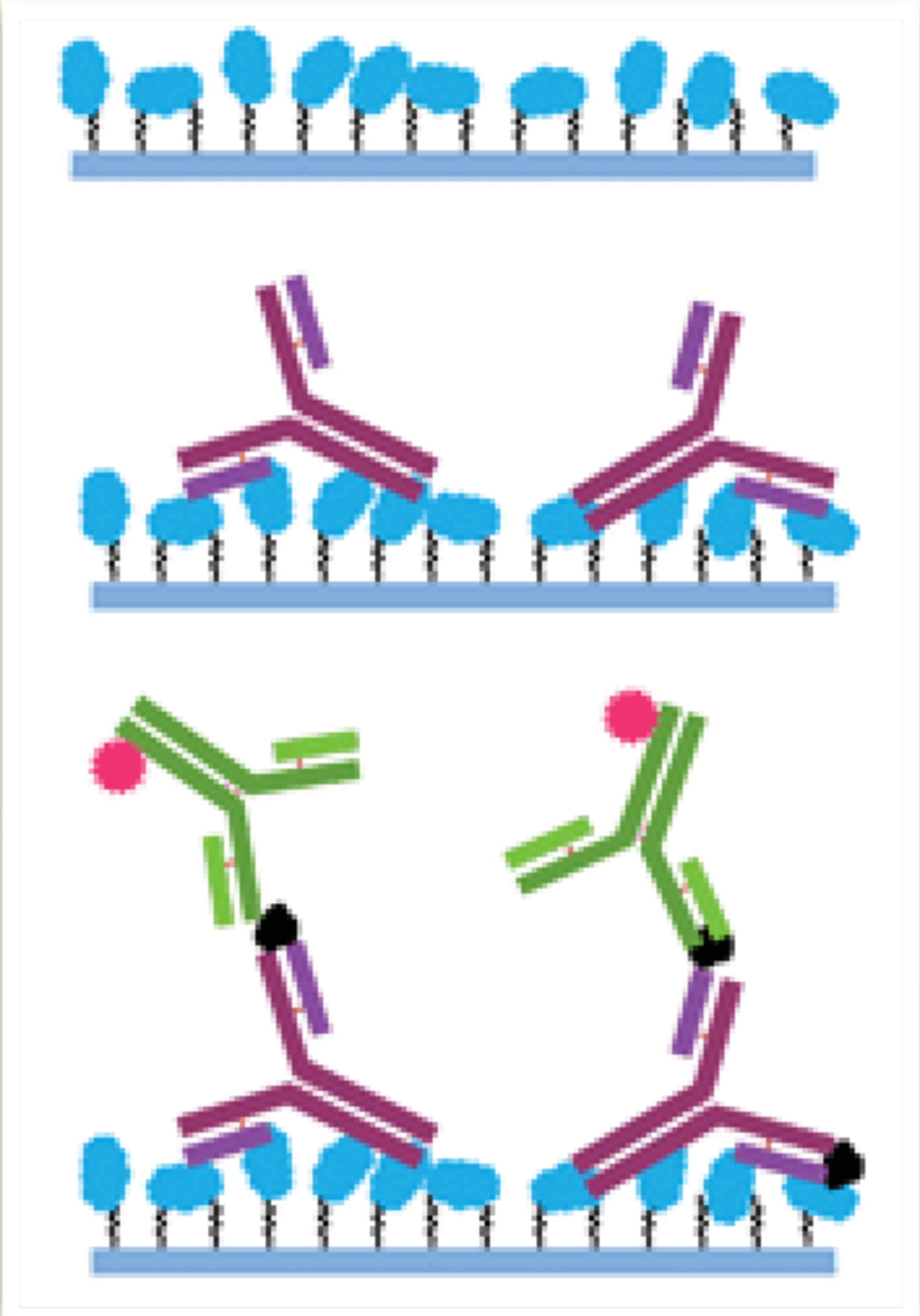
HIGH PRESSURE

- High (hydrostatic) pressure (HP) is a non-thermal processing technique which subjects products to pressures between 1000 and 10000 Bars instantly and uniformly, independently of the product size and geometry.
- HP is considered a green technology, since it uses water as a compression media and is energetically very efficient.

http://www.hiperbaric.com/en/high-pressure



- **Currently, most HP equipments in industrial plants used for food processing work in a batch process, whereby the product is placed in a high pressure chamber and the vessel is closed, filled with pressure transmitting medium and pressurized by pumping pressure transmission medium into the vessel.**



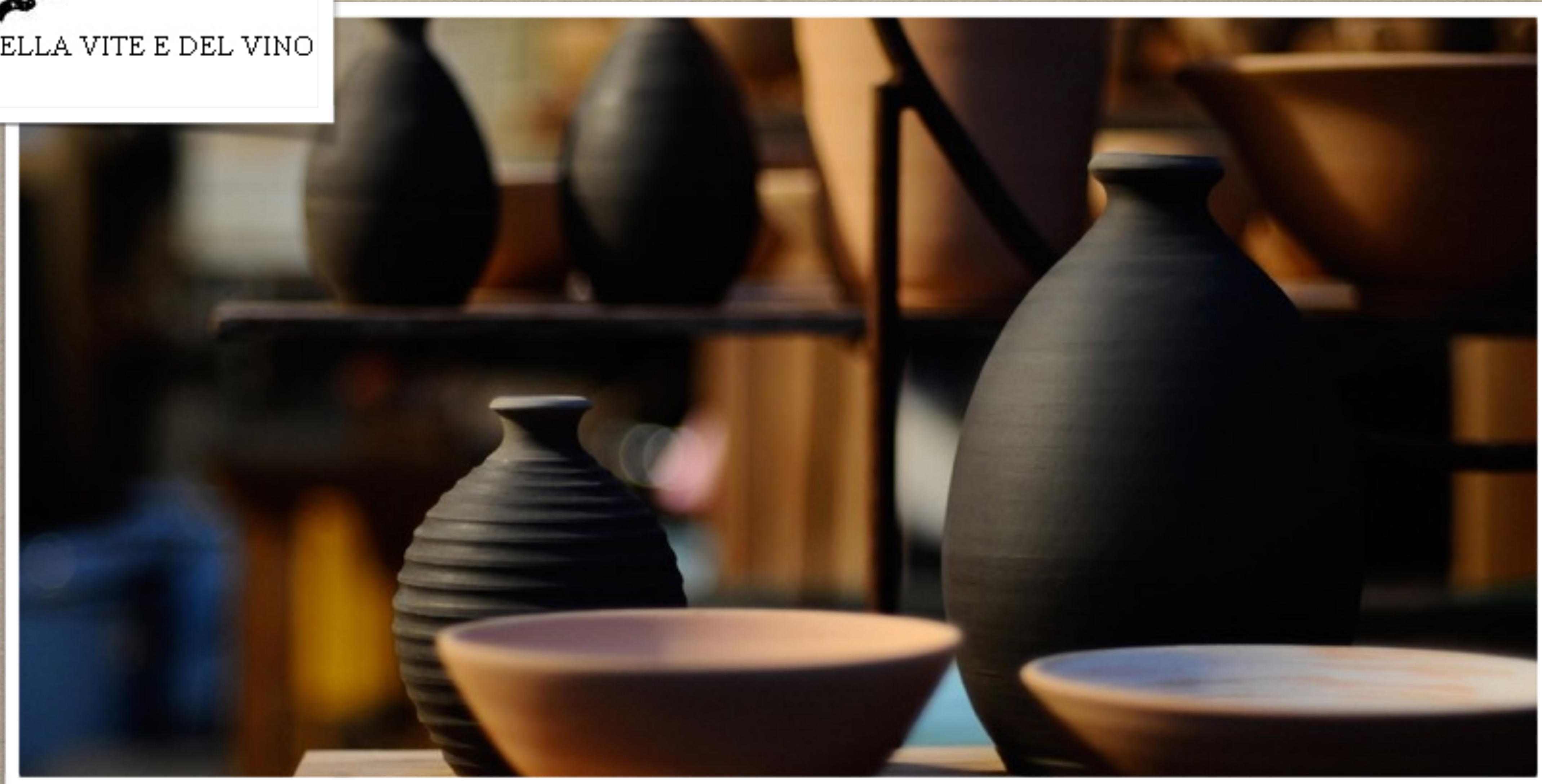
Donato Colangelo "Innovazioni nella stabilizzazione colloidale di mosti e vini" (2015-2018)
PhD in Food Science Technology and Biotechnology
Agrisystem School - Università Cattolica del Sacro Cuore
Tutors: Milena Lambri & Fabrizio Torchio

IMMOBILIZATION OF ADJUVANT (CHITOSAN)

- hydrogel between chitosan with other large molecules (tannic acid, CMC, alginate)
- binding sites free for interaction with thermally unstable proteins (chitinases)
- selective and precise colloidal stability of must and wine
- from batch to continuous fining process

ACCADEMIA ITALIANA DELLA VITE E DEL VINO

Piacenza, 22 ottobre 2016



STABILIZZAZIONE SOSTENIBILE DEI VINI

GRAZIE