Influence of specific inactive dry yeast treatments during grape ripening on postharvest berry skin texture parameters and phenolic compounds extractability

UNIVERSITÀ DEGLI STUDI DI TORINO

LALLEMAND

Susana Río Segade[1#*], Simone Giacosa[1#], Maria Alessandra Paissoni[1], Carolina Ossola[1], Vincenzo Gerbi[1], Carlos Suárez Martínez[2], Fabrizio Battista[2], Javier Téllez Quemada[2], Paola Vagnoli[2], Luca Rolle[1]

* susana.riosegade@unito.it

[1] Università degli Studi di Torino, Dipartimento di Scienze Agrarie, Forestali e Alimentari. Largo Paolo Braccini 2, 10095 Grugliasco (TO), Italy.

[2] Lallemand Inc., 1620 rue Prefontaine, H1W 2N8 Montreal, Quebec, Canada.

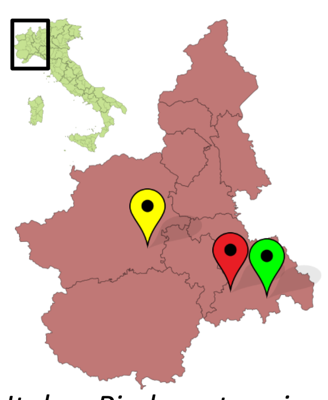
 # These authors contributed equally to the study.

Introduction

Grape phenolic accumulation and ripeness are important factors for the production of quality wines. In addition, an increased berry skin thickness was seen to be correlated with higher resistance of grapes to pests (Gabler et al. 2003). Innovative vineyard practices could be aimed at the improvement of these characteristics (Villango et al. 2015; Portu et al. 2016; Šuklje et al. 2016).

To this purpose, a foliar spraying treatment with specific yeast derivatives (specifically designed to be used with the patent pending application technology of Lallemand Inc., Montreal Canada) was tested on *Vitis vinifera* L. cv. Chardonnay, Cortese, Nebbiolo, and Barbera winegrapes grown in south Piedmont (Italy).

Samples



Italy – Piedmont region

Vitis vinifera L. cultivar	Location	Vineyard age	Vine spacing
Chardonnay	Chieri	6	2.8 × 0.9 m
Cortese	Novi Ligure	40	2.4 × 1.2 m
Barbera	Acqui Terme	40	2.2 × 0.9 m
Nebbiolo	Acqui Terme	12	2.4 × 0.9 m

Calcareous soils. Vertical trellis and Guyot-type pruning. Fertilization in 2014/15 for Cortese with 250 kg/ha Emonatural NPK 8.5.15 (Fertben, Poggio Rusco, IT). For all the analysis, the grapes were sampled at harvest on the treated parcels, and compared with grapes harvested from “not treated” parcels (control) in the same vineyard, with adequate buffer space between them.

LalVign™ treatment in vineyard

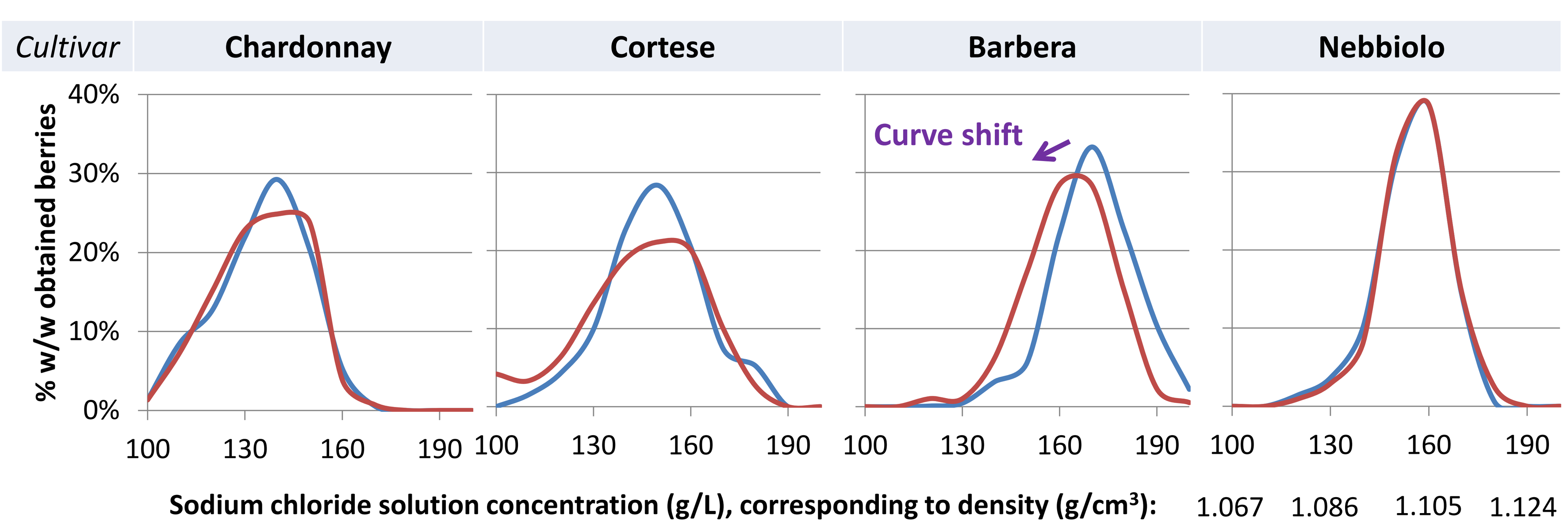
Two products were tested:
- LalVigne™Aroma on white varieties (3 kg/ha for each application)
- LalVigne™Mature on red varieties (1 kg/ha for each application)

The products formulation is based on ***Saccharomyces cerevisiae* specific inactive dry yeast derivatives** (Lallemand Inc., Montreal, Canada). For each variety, two applications of the product were done in the vineyard: at 5% véraison and 10 days later.

PATENT PENDING TECHNOLOGY WO/2014/024039

Analysis at harvest

Color key: CONTROL TREATED



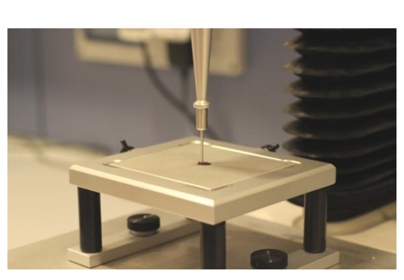
Samples were sorted by densimetric flotation in saline solutions to obtain **berry density distribution curves** by weight percentage (Fournand et al. 2006; Kontoudakis et al. 2011; Rolle et al. 2011).

For white varieties, the treatment seemed to have induced a less-narrower Gaussian-shape curve. In Barbera, a shift towards lower density values was found, while Nebbiolo distribution was not affected.

Cultivar	Sample	Average berry weight g	Must composition (whole sample, not densimetrically sorted)					
			°Brix	pH	Titr. acidity g tartaric acid/L	Citric acid g/L (HPLC)	Tartaric acid g/L (HPLC)	Malic acid g/L (HPLC)
Chardonnay	Control	1.70	21.7	3.35	5.18	nd	6.91	1.17
	Treated	1.60	21.7	3.32	5.48	nd	7.11	1.25
	Sign.	ns	ns	ns	ns	-	ns	ns
Cortese	Control	2.38	22.5	**3.21**	**5.08**	0.11	7.19	0.95
	Treated	2.24	22.5	**3.13**	**6.04**	0.11	7.23	0.97
	Sign.	ns	ns	*	*	ns	ns	ns
Barbera	Control	2.61	**26.5**	3.14	8.18	0.25	9.01	2.51
	Treated	2.70	**25.8**	3.18	8.36	0.25	8.95	2.74
	Sign.	ns	*	ns	-	ns	ns	ns
Nebbiolo	Control	2.20	**23.8**	**3.19**	**5.33**	0.11	6.70	0.90
	Treated	2.17	**24.6**	**3.28**	**4.61**	0.11	6.99	0.91
	Sign.	ns	*	*	**	ns	ns	ns

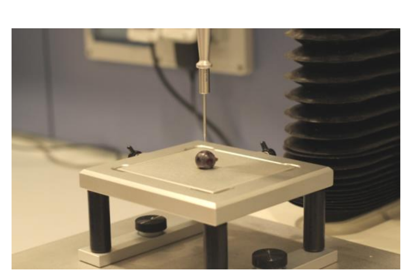
No significant effect on average berry weight was found. The **must composition**, shown in the above table, reported **no effect on sugars accumulation on white varieties**, and a different trend for Barbera and Nebbiolo, with the ripeness of Nebbiolo improved. Due to the abnormal ripeness shift previously seen, which might have caused by external factors, the **Barbera experiment is not included in the next results**; the behavior will be investigated with new trials.

Berry skin thickness and break force

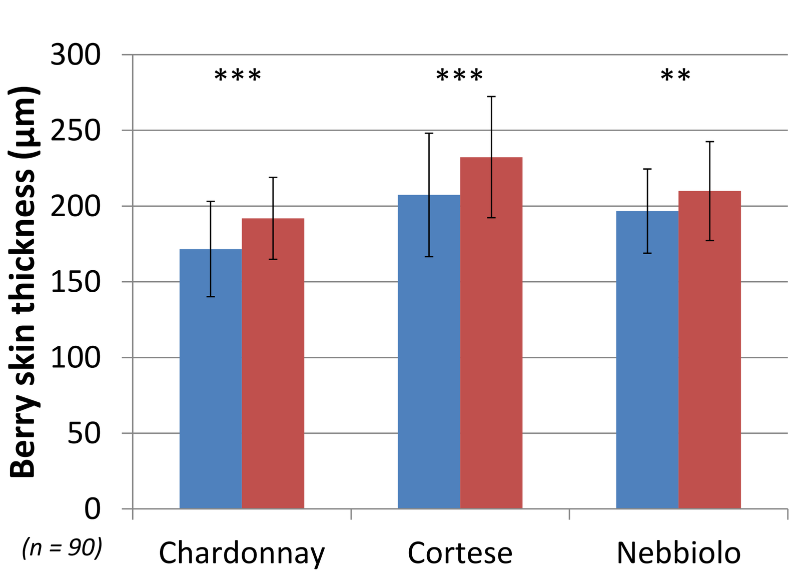


BERRY SKIN THICKNESS

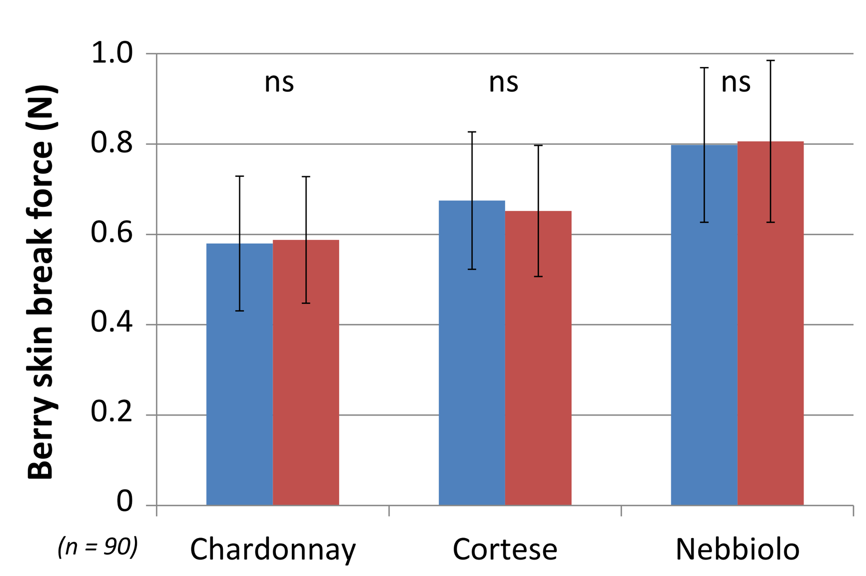
Berry skin mechanical properties were evaluated using a TA.XTplus instrument (Stable Micro Systems, Godalming, UK) according to the methods proposed by Letaief et al. (2008) and Rolle et al. (2013). The analyses were carried out on the three most represented density classes for each variety, on both control and treated samples. For each test combination 30 randomly-taken berries were tested.



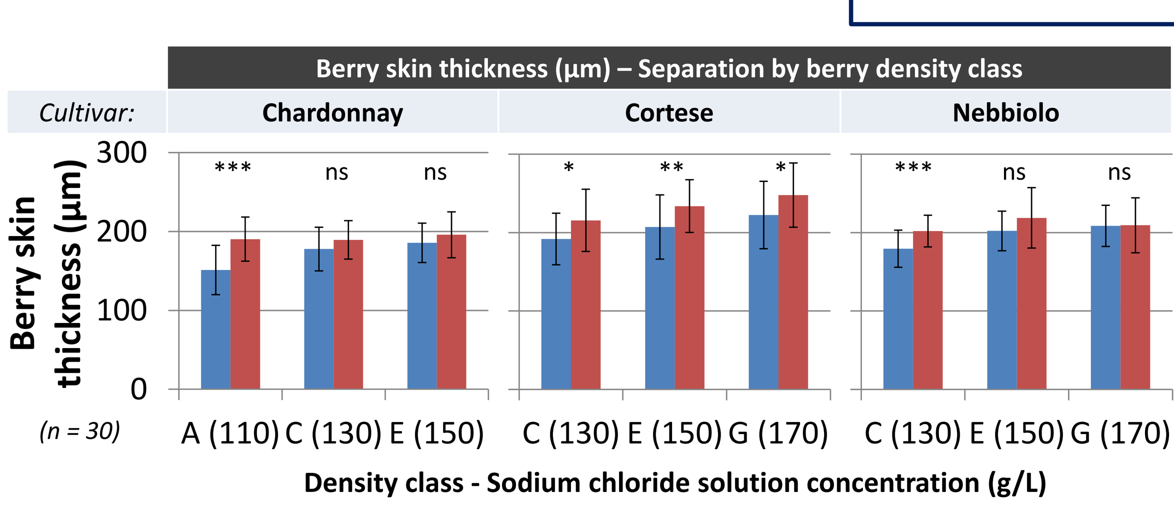
BERRY SKIN BREAK FORCE



Treatment effect on berry skin thickness
Positive influence



No treatment effect on berry skin break force
No significant differences



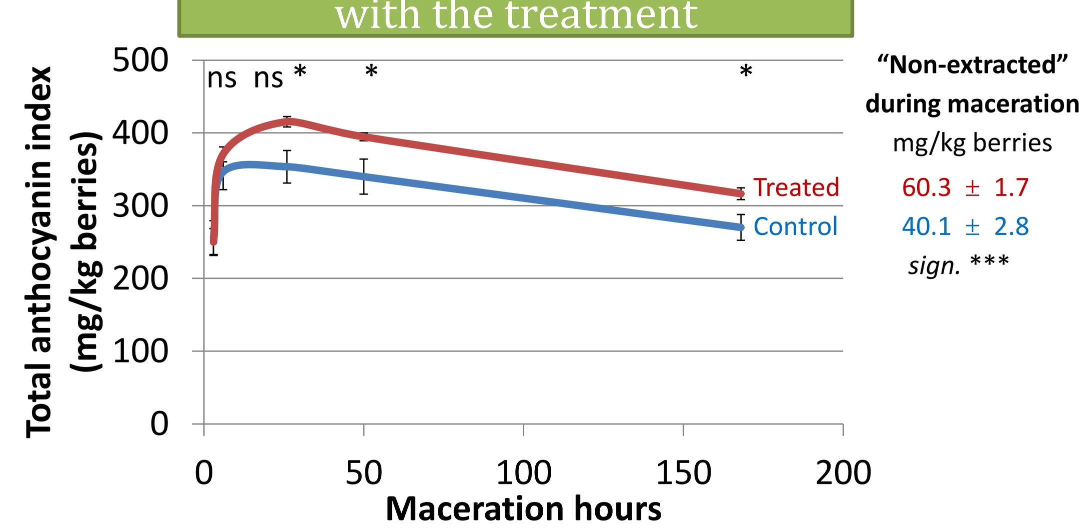
Higher positive variations between control and treated samples were found in lower density classes (less ripe berries).

Anthocyanin extractability

Phenolic extractability was evaluated on berries belonging to the most represented density class, and on control and treated samples, according to the method proposed by Río Segade et al. (2015). Extracts were taken during a 7-days skin maceration in model wine solution (12% ethanol, 50 mg/L SO_2, pH 3.20).

At the end of the maceration, the skins were further extracted in a similar solution with the SO_2 content increased to 2 g/L, homogenized and centrifuged, to evaluate the “non-extracted” fraction. Spectrophotometric (total anthocyanin index, proanthocyanidins and vanillin assays; Di Stefano and Cravero, 1991) and HPLC (anthocyanin profile; Rolle and Guidoni, 2007) analyses were carried out (*n* = 3).

Nebbiolo: significant increase with the treatment

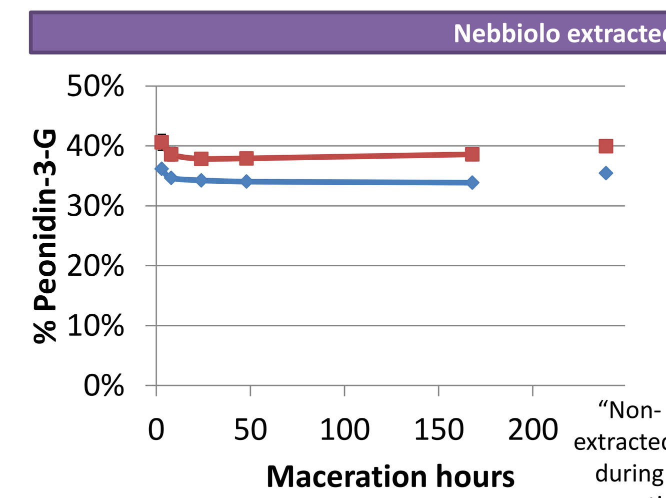


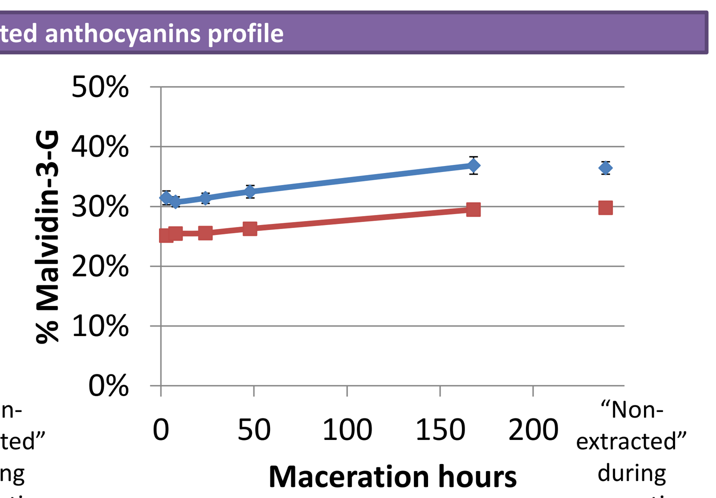
With respect to control, in the treated grapes it was found:
+ a higher anthocyanin value extracted after 48h and at the end of the 7-day maceration
+ a higher anthocyanin content “non-extracted” during maceration

= **a higher anthocyanin content in grapes from treated samples**

Nebbiolo extracted anthocyanins profile

A percentage increase in peonidin and cyanidin forms was found in the Nebbiolo treated sample, which contributed to the higher total anthocyanin content.

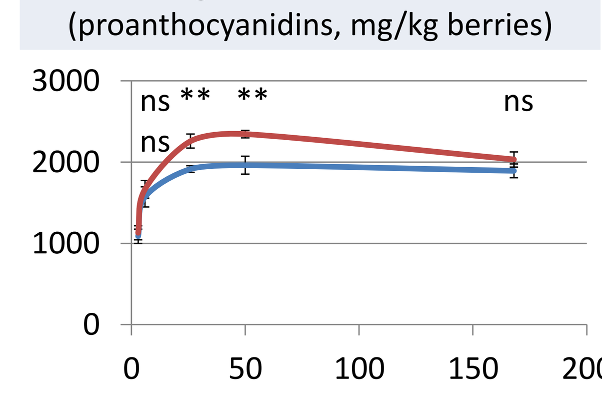




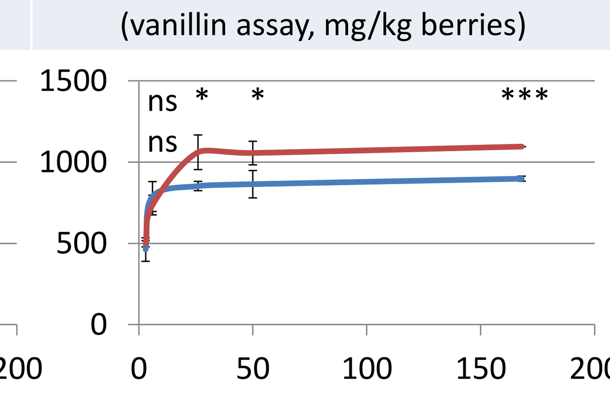
Tannin extraction

A **significant increase in both high- and low-mass flavanols** extracted was found during the simulated maceration in the treated samples, except after 7 days for proanthocyanidins assay.

High mass flavanols (proanthocyanidins, mg/kg berries)



Low mass flavanols (vanillin assay, mg/kg berries)



Conclusions

The tested **specific inactive dry yeast treatment enhanced the berry quality**:
- The average berry skin thickness increased on Chardonnay, Cortese, and Nebbiolo. *The trend found on Shiraz by Villango et al. (2015) was confirmed also on the tested varieties.*
- Berry anthocyanin content and extraction on Nebbiolo was found higher after a 7-days maceration, mainly for di-substituted forms. Also tannin extraction improved.

Barbera grapes in this trial presented an abnormal shift of the berry density distribution. To understand if the behavior was caused by external factors the experiment will be repeated. For other varieties, further experiments could be aimed to confirm these results.

References

Di Stefano R., Cravero M.C. (1991). Riv. Vitic. Enol. **44**, 37-45.

Fournand D., Vicens A., Sidhoum L., Souquet J.-M., Moutounet M., Cheynier V. (2006). J. Agric. Food Chem. **54**, 7331-7338.

Gabler F.M., Smilanick J.L., Mansour M., Ramming D.W., Mackey B.E. (2003). Phytopathology **93**, 1263-1273.

Kontoudakis N., Esteruelas M., Fort F., Canals J.M., De Freitas V., Zamora F. (2011) Food Chem. **124**, 767-774.

Letaief H., Rolle L., Gerbi V. (2008). Am. J. Enol. Vitic. **59**, 323-329.

Portu J., López R., Baroja E., Santamaría P., Garde-Cerdán T. (2016). Food Chem. **201**, 213-221.

Río Segade S., Pace C., Torchio F., Giacosa S., Gerbi V., Rolle L. (2015). Food Res. Int. **71**, 50-57.

Rolle L., Guidoni S. (2007). J. Int. Sci. Vigne Vin **41**, 193-201.

Rolle L., Río Segade S., Torchio F., Giacosa S., Cagnasso E., Marengo F., Gerbi V. (2011). J. Agric. Food Chem. **59**, 8796-8805.

Rolle, L., Giacosa, S., Río Segade, S., Ferrarini, R., Torchio, F., Gerbi, V. (2013). *Drying Technology*, **31**, 549-564.

Šuklje K., Antalick G., Buica A., Coetzee Z.A. Brand J., Schmidtke L.M., Vivier M.A. (2016). Food Chem. **197**, 1073-1084.

Villangó Sz., Pásti Gy., Kállay M., Leskó A., Balga I., Donkó A., Ladányi M., Pálfi Z., Zsófi Zs. (2015). S. Afr. J. Enol. Vitic. **36**, 304-315.