Improving the grape pressing for a sustainable wine production chain (GrapePress 4.0)

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The first three activities of the PhD thesis project are described. Chardonnay grape samples (vintage 2022) were collected from different vineyards. Firstly, lab-scale must samples were obtained simulating different pressing conditions. Secondly, industrial-scale musts were sampled to investigate the impact of different pressing processes on must composition. Thirdly, winemaking trials were carried out to evaluate the impact of pressing on the characteristics of the resulting wines.

**Perfezionamento della fase di pressatura dell’uva per implementare la sostenibilità della filiera enologica (GrapePress 4.0)**

Sono descritte le prime tre attività del progetto di tesi di dottorato. Campioni di uva Chardonnay (annata 2022) sono stati raccolti in diversi vigneti. In primo luogo, mosti sperimentali sono stati ottenuti in scala di laboratorio simulando diversi processi di pressatura. In secondo luogo, mosti prodotti in scala industriale sono stati campionati per indagare l’impatto di diversi processi di pressatura sulla composizione del mosto. In terzo luogo, sono state effettuate prove di microvinificazione per valutare l'impatto della pressatura sulle caratteristiche del vino ottenuto.

**Key words**: Pressing, white grape, base wine, phenols, antioxidant capacity

# **1. Introduction**

In accordance with the PhD thesis project previously (Shanshiashvili, 2022), this poster reports the main results of the first three activities concerning:

A1) Identification of chemical/physical parameters of wine grape.

*A1.1* Pressing under lab conditions simulating different pressing processes for the production of musts.

A2) Investigation of the relationship between the pressing cycle on must.

*A2.1* Sampling of must on an industrial scale according to pressing conditions adopted by wineries.

A3) Evaluation of the relationship between pressing cycle and wine characteristics.

*A3.1* Winemaking trials with minimal intervention approach.

# **2. Materials and Methods**

*A1.1.* Six Chardonnay grape samples were collected from different vineyards in vintage 2022 in the Franciacorta area (Lombardy, Italy). Lab-scale musts were produced by different pressing conditions: manual press, vacuum press (grape pressing under anoxic condition in vacuum plastic bags), juicer, and small screw press. Moreover, aliquots of whole grape berries were homogenized by an ultra-turrax; for these samples, total and extractable flavonoids were also determined following the procedure described by Di Stefano *et al.* (1989).

*A2.1.* Must samples were collected at industrial scale following the pressing conditions applied by the winery in terms of both equipment used and pressing cycle applied. The musts were sampled at different extraction yields: free-run juice, 20, 30 [1st fraction], 40, 50 [2nd fraction], 60, and 70 [3rd fraction] % must yields.

*A3.1.* Experimental base wines were produced from 1st and 2nd fractions following the minimal intervention approach. Musts were inoculated with *Saccharomyces cerevisiae* EC1118 strain (20 g/hL) after the adjustment of readily assimilable nitrogen (RAN) up to 200 mg/L with diammonium phosphate, if required. The fermentations were carried out at 20 ± 2°C in triplicate and daily monitored by weight. At the end of fermentation, wines were racked and stored at 4℃ degrees until the in-bottle fermentation. Carbon dioxide (CO2) release and fermentation efficiency were calculated. The tirage was carried out by inoculating *S. cerevisiae* IOC18-2007 strain (on-going).

The parameters determined in both must (lab- and industrial scales) and wine samples were sugars, pH, titrable acidity (TA), tartaric and malic acids, color index (absorbance reading at 420 nm), total phenol index (TPI, Folin-Ciocalteau method), total flavonoids (FLVs). RAN, polyphenol oxidase (PPO), antioxidant capacity (AC), and turbidity units (NTU) were assessed for the must samples. Ethanolic strength, volatile acidity, lactic acid, free and total sulfur dioxide, total dry, and reduced extracts were determined in base wine samples.

# **3. Results and Discussion**

**3.1 Lab-scale pressing (A1.1)**

Different methods for the production of lab-scale musts were investigated in order to identify the must preparation mostly representative of the industrial must production. Among the conditions adopted, no difference was found for the major technological parameters usually considered (sugars, pH, TA) (Dumas *et al.,* 2020). On the contrary, the method for must preparation strongly affected the color, AC and phenolic indexes, the latter being compared with the overall quantity determined by means of the homogenized samples. In particular, the highest content of TPI and FLVs were determined in the must samples produced by the juicer, followed by vacuum condition, manual pressing and by small screw press (Table 1). These results suggest the small screw press could be best condition for simulating the industrial pressing.

***Table 1*** *Chemical parameters of lab-scale must samples*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Samples | **pH** | **Titrable Acidity**  (g/L of tartaric acid) | **Color**  (AU 420 nm) | **Total phenol index**  (mg/L gallic acid) | **Total flavonoids**  (mg/L catechin) | **Antioxidant activity**  (mM Trolox/L) |
| Manual press | 3.25-3.43 | 4.68-6.69 | 0.36-0.72 | 492-771 | 46-235 | 2.26-3.65 |
| Juicer press | 3.24-3.57 | 4.80-6.96 | 0.98-2.47 | 915-2169 | 188-620 | 5.83-15.0 |
| Vacuum press | 3.27-3.55 | 4.88-6.95 | 0.40-0.70 | 366-971 | 140-343 | 3.21-3.96 |
| Small screw press | 3.18-3.38 | 4.88-6.91 | 0.40-0.60 | 155-342 | 38-129 | 1.96-3.69 |
| Homogenized sample | 3.34-3.56 | N/A | 0.54-1.28 | 629-2195 | 216-800 | 7.16-12.0 |

## **3.2 Industrial scale pressing (A2.1)**

The impact of pressing conditions on must composition was investigated by evaluating the chemical parameters in musts collected at different extraction yields. The content of the phenol-related indexes, NTU, pH, and the color index increased at higher extraction yields, while TA decreased (Table 2). For most of the samples, RAN were lower for increased extraction yields and PPO seemed to be unaffected by the must extraction yield (data not shown). These results can indicate a relevant relationship exists between the different pressing conditions and must characteristics. The phenol-related indexes should be considered in addition to chemical parameters to make the proper decision of the pressing condition being adopted related to the specific characteristics of grape, as well.

***Table 2*** *Chemical parameters of industrial-scale must samples*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Samples | **pH** | **Titrable acidity**  (g/L of tartaric acid) | **Color**  (AU 420 nm) | **Total phenol index**  (mg/L gallic acid) | **Total flavonoids**  (mg/L catechin) | **Antioxidant activity**  (mM Trolox/L) |
| Free-run juice | 2.64-3.46 | 4.9-6.9 | 0.138-0.389 | 150-333 | 32-106 | 1.8-5.35 |
| 20 % yield | 3.21-3.51 | 5.2-7.0 | 0.214-0.490 | 143-394 | 19-119 | 1.74-5.48 |
| 1st fraction | 3.02-3.51 | 5.1-8.6 | 0.212-0.891 | 181-314 | 26-117 | 1.46-2.91 |
| 40 % yield | 3.28-3.45 | 3.37-6.7 | 0.367-0.760 | 164-267 | 35-126 | 1.88-2.09 |
| 2nd fraction | 3.29-3.52 | 5.2-6.0 | 0.279-0.811 | 207-483 | 50-236 | 1.40-7.80 |
| 60 % yield | 3.31-3.70 | 3.8-6.8 | 0.250-0.856 | 124-361 | 26-134 | 2.07-3.33 |
| 3rd fraction | 3.53-3.63 | 4.5-5.8 | 0.956-1.580 | 293-470 | 52-277 | 3.11-6.20 |

## **3.3 Winemaking trials (A3.1)**

Alcoholic fermentation (AF) was completed in all the must samples within 8-9 days. CO2 release and fermentation efficiency differed between the two must fractions fermented. Lower amount of CO2 was released from AF of the 1st fraction musts and a slight difference in fermentation efficiency was observed (Table 3). The base wines from 1st fractions had higher TA and tartaric acid content, while the base wine from 2nd fraction showed a higher pH and color index (Table 3). Negligible difference was found in TPI content among the base wines from the two must fractions (Table 3).

***Table 3*** *Fermentation parameters (CO2 release and efficiency) and chemical parameters of experimental base wines*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Samples | **CO2 release** (moles/4 L) | **Fermentation efficiency** | **pH** | **Titrable acidity**  (g/L of tartaric  acid) | **Tartaric acid**  (g/L) | **Color**  (AU 420 nm) | **Total phenol index**  (mg/L gallic acid) |
| 1st fraction | 53.3-97.4 | 57-146 | 3.00-3.47 | 5.9-8.4 | 2.13-4.59 | 0.11-0.16 | 7.45-14.0 |
| 2nd fraction | 43.6-131.3 | 42-140 | 3.19-3.72 | 4.4-6.3 | 1.92-2.64 | 0.11-0.81 | 5.60-14.5 |

# **4. References**

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