



Dipartimento di Scienze Agrarie
Forestali e Alimentari
Sede di Alba
Ampelion – corso Enotria 2c – 12051 ALBA (CN)



UNIVERSITÀ
DEGLI STUDI
DI TORINO



Gruppo di Ricerche Avanzate Per
l'Enologia
Ampelion – corso Enotria 2c – 12051
ALBA (CN)

GOfermentor trials in Piedmont

2016 harvest

SUPPLEMENTAL REPORT

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Introduction

This supplemental report describes the characteristics of the wines obtained from the GOfermentor trials during the 2016 harvest. An additional point of analytical and sensory analysis were performed one year after bottling, in May 2018. The analytical protocols are the same as previously described in Table 4 of the Final Report. Table S1 shows the identification codes of the trials.

After bottling, the wines have been bottle stored in a cellar at a temperature ranging from 12 to 18 °C. For this trial no oak aging was carried out.

Table S1 – Trials samples and sample codes

| Grape cultivar | Vineyard | GOfermentor | Control (traditional vinification) |
|----------------|-----------------------|-------------|------------------------------------|
| Barbera | B1 -Santo Stefano SC | B1F | B1C |
| | B2 – Santo Stefano AP | B2F | B2C |
| Nebbiolo | N1 – Santo Stefano VV | N1F | N1C |
| | N2 – Val Torta N | N2F | N2C |

Wine characteristics after 1 year from bottling

The analytical characteristics of the Barbera (B1 and B2) test wines before stabilization and bottling (V2) and one year after bottling (V3) are summarized in Table S2.1. The same analysis for Nebbiolo wines (N1 and N2) are shown in Table S2.2.

Barbera wines are characterized by a high alcohol strength and a high total acidity with respect to Nebbiolo, in line with the general characteristics of the cultivar. All samples show a high glycerol concentration (> 10 g/L) except for B2FV3 (9.7 g/L). The volatile acidity content after one year from bottling is into 0.53–0.90 g/L range.

In the Nebbiolo wines (N1 and N2) we notice the typical alcohol values of the variety, while the sugar fermentation produced a good level of glycerol (7.7–8.5 g/L). Titratable acid values of the Nebbiolo wines are less than 5 g/L after cold stabilization. The volatile acidity of Nebbiolo wines is similar to these found in Barbera wines.

Table S2.1 Chemical parameters of of Barbera wines: control (C) and GOfermentor (F), and before stabilization and bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|---------------------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | B1CV2 | B1FV2 | B2CV2 | B2FV2 | B1CV3 | B1FV3 | B2CV3 | B2FV3 |
| Alcohol % by vol. | 15.73 | 15.55 | 15.29 | 14.95 | 15.48 | 15.35 | 15.20 | 14.63 |
| Dry matter g/L | 32.9 | 32.5 | 30.1 | 29.4 | 26.8 | 27.1 | 24.8 | 25.0 |
| Glucose and fructose g/L | 1.4 | 1.2 | 1.2 | 0.6 | 0.7 | 1.2 | 0.5 | 0.4 |
| Glycerol g/L | = | = | = | = | 10.3 | 10.9 | 10.0 | 9.7 |
| Total acidity g/L (as tartaric acid) | 8.03 | 7.80 | 7.50 | 8.63 | 6.86 | 7.38 | 6.34 | 7.20 |
| Volatile acidity g/L (as acetic acid) | 0.49 | 0.53 | 0.63 | 0.85 | 0.51 | 0.53 | 0.65 | 0.90 |
| Total SO ₂ mg/L | 43 | 34 | 31 | 41 | 55 | 58 | 53 | 50 |
| pH | 3.26 | 3.22 | 3.33 | 3.30 | 3.27 | 3.22 | 3.35 | 3.30 |
| Tartaric acid g/L | 3.7 | 3.7 | 3.1 | 3.9 | 2.5 | 2.5 | 2.2 | 2.4 |
| Malic acid g/L | nd | 0.9 | nd | nd | nd | 0.65 | nd | nd |
| Lactic acid g/L | 0.83 | 0.18 | 1.10 | 1.18 | 0.84 | 0.18 | 1.14 | 1.15 |

nd: not detectable

Table S2.2 Chemical parameters of of Nebbiolo wines: control (C) and GOfermentor (F), and before stabilization and bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|---------------------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | N1CV2 | N1FV2 | N2CV2 | N2FV2 | N1CV3 | N1FV3 | N2CV3 | N2FV3 |
| Alcohol % by vol. | 14.46 | 14.80 | 14.20 | 14.57 | 14.32 | 14.61 | 14.02 | 14.20 |
| Dry matter g/L | 26.5 | 26.8 | 24.6 | 26.6 | 23.9 | 24.1 | 22.1 | 23.5 |
| Glucose and fructose g/L | 0.6 | 0.7 | 0.7 | 1.0 | 0.6 | 0.6 | 0.7 | 0.5 |
| Glycerol g/L | = | = | = | = | 8.4 | 8.5 | 7.7 | 8.1 |
| Total acidity g/L (as tartaric acid) | 6.75 | 7.95 | 8.10 | 7.65 | 4.7 | 4.8 | 4.6 | 5.0 |
| Volatile acidity g/L (as acetic acid) | 0.60 | 0.73 | 0.51 | 0.80 | 0.65 | 0.82 | 0.60 | 0.90 |
| Total SO ₂ mg/L | 33 | 47 | 43 | 40 | 65 | 70 | 65 | 72 |
| pH | 3.57 | 3.48 | 3.57 | 3.44 | 3.60 | 3.58 | 3.62 | 3.59 |
| Tartaric acid g/L | 2.6 | 2.4 | 2.5 | 2.3 | 1.1 | 1.1 | 1.1 | 1.3 |
| Malic acid g/L | nd | 0.6 | nd | 0.7 | nd | nd | nd | nd |
| Lactic acid g/L | 0.83 | 0.37 | 0.91 | 0.46 | 0.84 | 0.83 | 1.2 | 1.1 |

nd: not detectable

Phenolic Profile

Tables S3.1 (Barbera) and S3.2 (Nebbiolo) show the relative analyzed parameters to polyphenolic substances after one year from bottling. In particular, a normal but significant decrease in total anthocyanins (TA) is observed after one year (V3 vs V2) in all Barbera and Nebbiolo trials. By contrast, the good combination level of anthocyanins is confirmed by a low concentration of monomeric anthocyanins.

In the case of Barbera, we can observe that tannins polymerization increases, as shown the higher values of the PRO/VAN ratio, above all in GOfermentor tests.

The PRO/VAN ratio of Nebbiolo wines, correlated with the average degree of polymerization of tannins, is low (always less than 2) with limited differences between the control and GOfermentor tests. This ratio grows

slightly over time (see V3 vs V2). The evolution of tannins is indispensable for a well-balanced wine, and the improvement of this parameter requires aging in wooden barrels with permeation of micro-doses of oxygen.

Table S3.1 Phenolic parameters of Barbera wines: control (C) and GOfermentor (F), and before stabilization and bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|------------------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | B1CV2 | B1FV2 | B2CV2 | B2FV3 | B1CV3 | B1FV3 | B2CV3 | B2FV3 |
| Total anthocyanins (TA) mg/L | 507 | 449 | 513 | 303 | 330 | 311 | 325 | 190 |
| Monomeric anthocyanins (MA) mg/L | = | = | = | = | 88 | 52 | 98 | 31 |
| Total polyphenols (FC) mg/L | 2803 | 2500 | 2634 | 1984 | 2294 | 1889 | 2174 | 1412 |
| Total flavonoids (TF) mg/L | 1967 | 1451 | 1849 | 1111 | 1985 | 1578 | 1812 | 1182 |
| Absorbance at 280 nm | 74.25 | 66.75 | 68.15 | 52.5 | | | | |
| Proanthocyanidins (PRO) mg/L | 2638 | 2478 | 2620 | 1670 | 2495 | 2102 | 2467 | 1477 |
| Flavanol Vanillin Assay (VAN) mg/L | 999 | 711 | 1051 | 518 | 898 | 455 | 848 | 323 |
| PRO/VAN ratio | 2.64 | 3.48 | 2.49 | 3.22 | 2.78 | 4.62 | 2.91 | 4.57 |

Table S3.2 Phenolic parameters of Nebbiolo wines: control (C) and GOfermentor (F), and before stabilization and bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|------------------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | N1CV2 | N1FV2 | N2CV2 | N2FV2 | N1CV3 | N1FV3 | N2CV3 | N2FV3 |
| Total anthocyanins (TA) mg/L | 121 | 82 | 121 | 100 | 95.4 | 69.5 | 88.9 | 80.0 |
| Monomeric anthocyanins (MA) mg/L | = | = | = | = | 19.4 | 12.9 | 23.9 | 16.8 |
| Total polyphenols (FC) mg/L | 3583 | 2981 | 3189 | 2955 | 2946 | 2557 | 2651 | 2346 |
| Total flavonoids (TF) mg/L | 2956 | 2477 | 2606 | 2429 | 2760 | 2286 | 2414 | 2278 |
| Absorbance at 280 nm | 67.6 | 57.55 | 59.7 | 56.05 | | | | |
| Proanthocyanidines (PRO) mg/L | 4858 | 3858 | 4288 | 4371 | 4084 | 3738 | 3738 | 3374 |
| Flavanol Vanillin Assay (VAN) mg/L | 2873 | 2393 | 2690 | 2532 | 2749 | 2026 | 2224 | 2086 |
| PRO/VAN ratio | 1.69 | 1.61 | 1.59 | 1.73 | 1.48 | 1.84 | 1.68 | 1.62 |

Color parameters

The color parameters are shown in Tables S4.1 (Barbera) and S4.2 (Nebbiolo).

The Barbera wines show a color density greater than Nebbiolo wines, but all values in V3 point (one year after bottling) are lower than which at V2 point. Instead, Barbera color hue increased in last year with slightly differences between control and GOfermentor samples, although the values show still a clear predominance of the red component compared to the yellow component. Over time the color tint grows but less for the control tests.

Table S4.1 Color parameters of Barbera wines control (C) and GOfermentor (F), and before stabilization and bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|--------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | B1CV2 | B1FV2 | B2CV2 | B2FV2 | B1CV3 | B1FV3 | B2CV3 | B2FV3 |
| Color indices | | | | | | | | |
| Color tone | 0.56 | 0.54 | 0.52 | 0.59 | 0.64 | 0.60 | 0.64 | 0.62 |
| Color density (OP=10 mm) | 27.0 | 30.0 | 23.7 | 19.8 | 18.5 | 21.8 | 16.5 | 13.9 |
| L* | 2.06 | 1.63 | 4.19 | 2.23 | 6.29 | 4.25 | 7.05 | 8.00 |
| a* | 14.6 | 11.8 | 48.9 | 15.7 | 35.2 | 28.6 | 36.9 | 38.5 |
| b* | 3.5 | 2.8 | 7.2 | 3.8 | 10.8 | 7.3 | 12.1 | 13.8 |
| C* | 15.0 | 12.1 | 49.4 | 16.2 | 36.9 | 29.6 | 38.8 | 40.9 |
| H* / rad | 0.24 | 0.23 | 0.15 | 0.24 | 0.30 | 0.25 | 0.32 | 0.34 |

The color parameters of Nebbiolo wines confirm much lower color density than the corresponding Barbera wines. These differences derive from the lower content of anthocyanins of Nebbiolo wines. CD values show slightly differences between GOfermentor and control after one year from bottling. Color tone shows higher values than those of the respective Barbera wines close to 1. This color tone parameter tendency is typical of Nebbiolo wines.

Table S4.2 Color parameters of Nebbiolo wines: control (C) and GOfermentor (F), and before bottling (V2) and after one year from bottling (V3).

| Parameters | Wine Samples | | | | | | | |
|--------------------------|--------------|-------|-------|-------|-------|-------|-------|-------|
| | N1CV2 | N1FV2 | N2CV2 | N2FV2 | N1CV3 | N1FV3 | N2CV3 | N2FV3 |
| Color indices | | | | | | | | |
| Color tone | 0.87 | 0.88 | 0.79 | 0.80 | 1.02 | 1.03 | 0.96 | 1.02 |
| Color density (OP=10 mm) | 12.7 | 13.1 | 13.0 | 11.2 | 4.8 | 4.3 | 4.4 | 4.4 |
| L* | 7.84 | 9.16 | 8.94 | 14.39 | 32.6 | 35.3 | 34.6 | 34.0 |
| a* | 36.9 | 38.9 | 39.2 | 46.2 | 53.6 | 52.1 | 53.8 | 52.7 |
| b* | 21.8 | 24.1 | 23.7 | 33.1 | 45.8 | 40.3 | 42.6 | 40.2 |
| C* | 42.9 | 45.7 | 45.8 | 56.8 | 70.5 | 65.9 | 68.6 | 66.3 |
| H* /rad | 0.53 | 0.55 | 0.54 | 0.62 | 0.71 | 0.66 | 0.67 | 0.65 |

Sensorial Evaluation

After one year from bottling the wines were tasted by a panel of 15 people carried out the sensorial evaluation using the same descriptors of second tasting (V2 point). Each parameter was evaluated on a scale from 0 to 5 (with increasing intensity of the descriptor). It should be remembered that all wines have a composition and aptitude for long-aging wines and, consequently, sensory assessments express only partial judgment.

Barbera Profile

The results of the sensory analysis of Barbera wines at V2 e V3 time are shown in Figures S1.1 and S1.2 (B1 trial), S2.1 and S2.2 (B2 trial). After one year the use of GOfermentor has confirmed to obtain Barbera wines with a color similar to control in B1 vinification, whereas color appears less intense in the B2 trial. Wines obtained with the GOfermentor system appear less astringent (B2) and with more intense floral notes and less herbaceous notes.

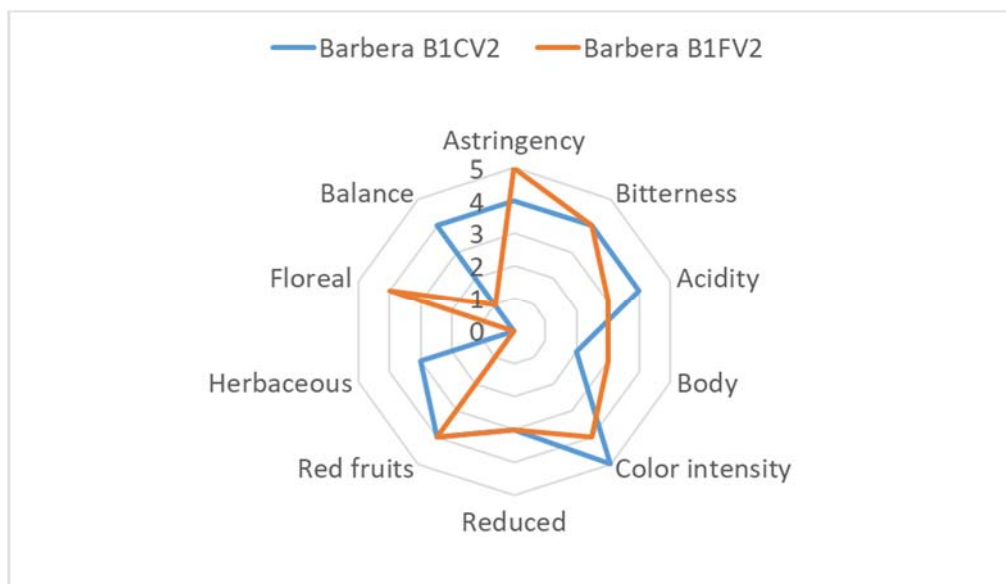


Figure S1.1 Sensorial profile of Barbera wines (B1) before stabilization and bottling (V2).

Significance level: * = 0.05; ** = 0.01.

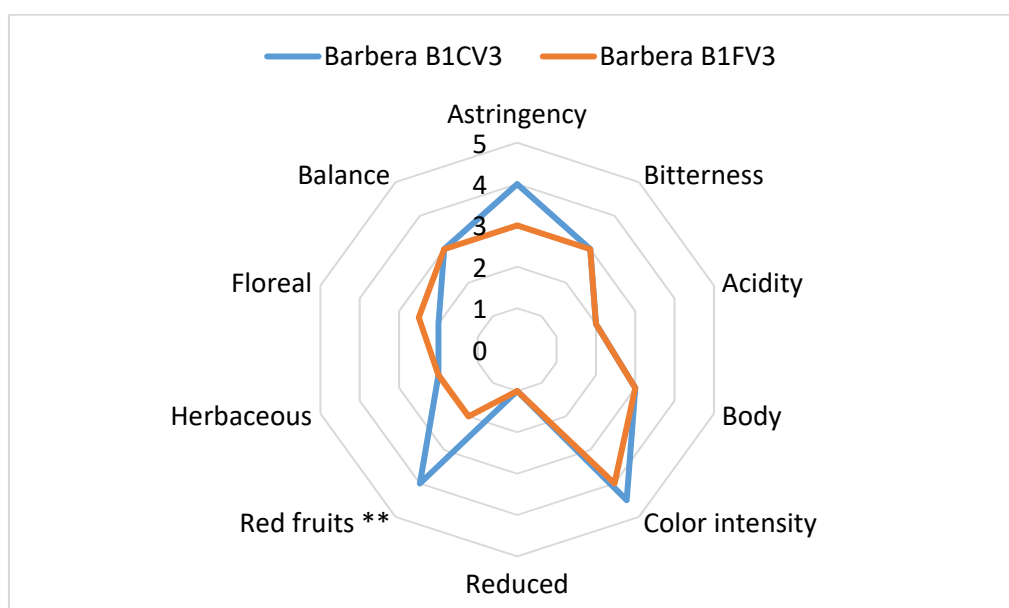


Figure S1.2 Sensorial profile of Barbera wines (B1) after one year from bottling (V3).

Significance level: * = 0.05; ** = 0.01.

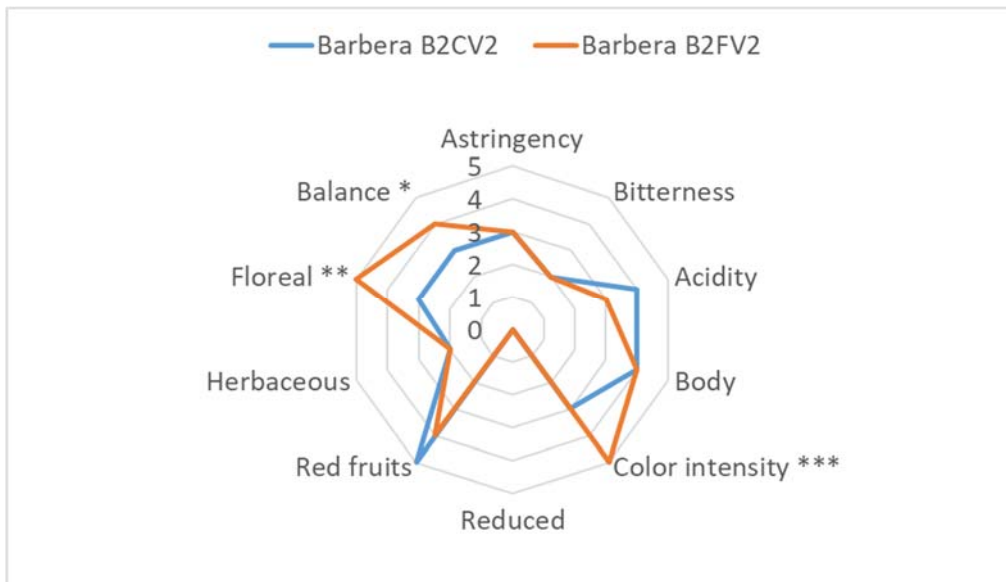


Figure S2.1 Sensorial profile of Barbera wines (B2) before stabilization and bottling (V2).

Significance level: * = 0.05; ** = 0.01.

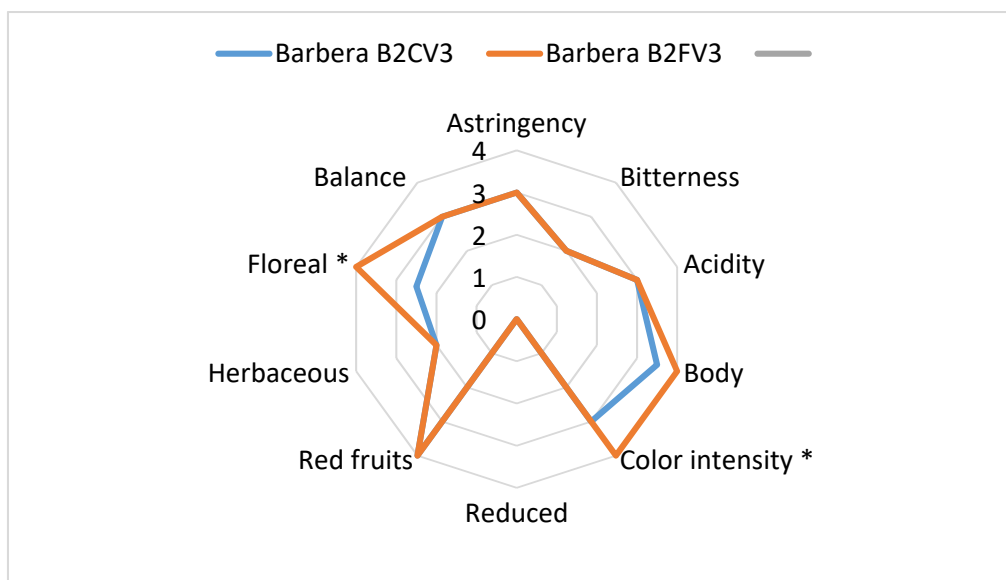


Figure S2.2 Sensorial profile of Barbera wines (B2) after one year from bottling (V3).

Significance level: * = 0.05; ** = 0.01.

Nebbiolo Profile

The results of the sensory analysis of Nebbiolo wines are shown in Figures S3.1 and S3.2 (N1 trials) and S4.1 and S4.2 (N2 trial). The tasting after one year from bottling confirm that the GOfermentor system of vinification has led to more balanced, less astringent and less bitter Nebbiolo wines. The color, not particularly intense in all Nebbiolo wines because of the variety characteristics, is slightly lower in both GOfermentor trials.

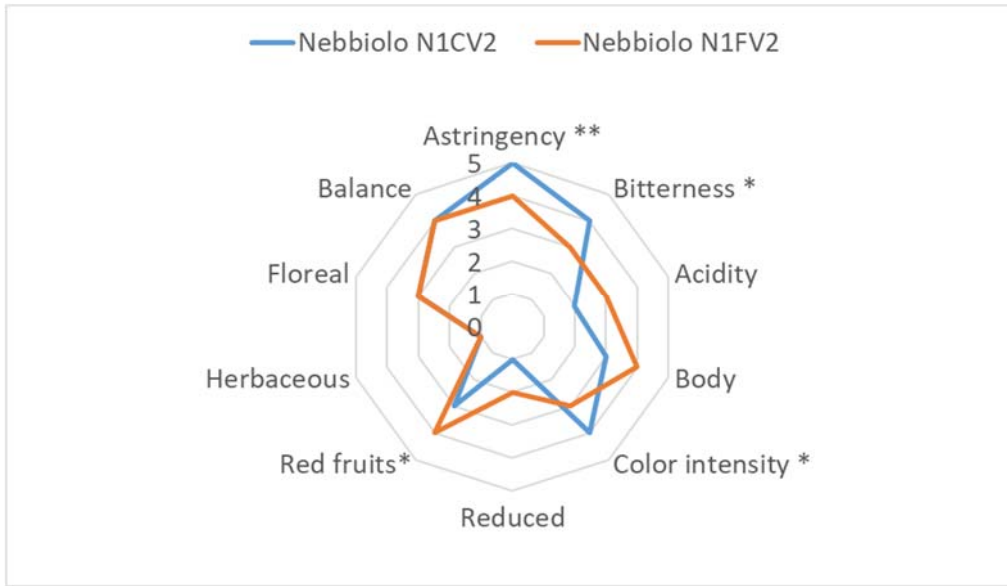


Figure S3.1 Sensorial profile of Nebbiolo wines (N1) before stabilization and bottling (V2).

Significance level: * = 0.05; ** = 0.01.

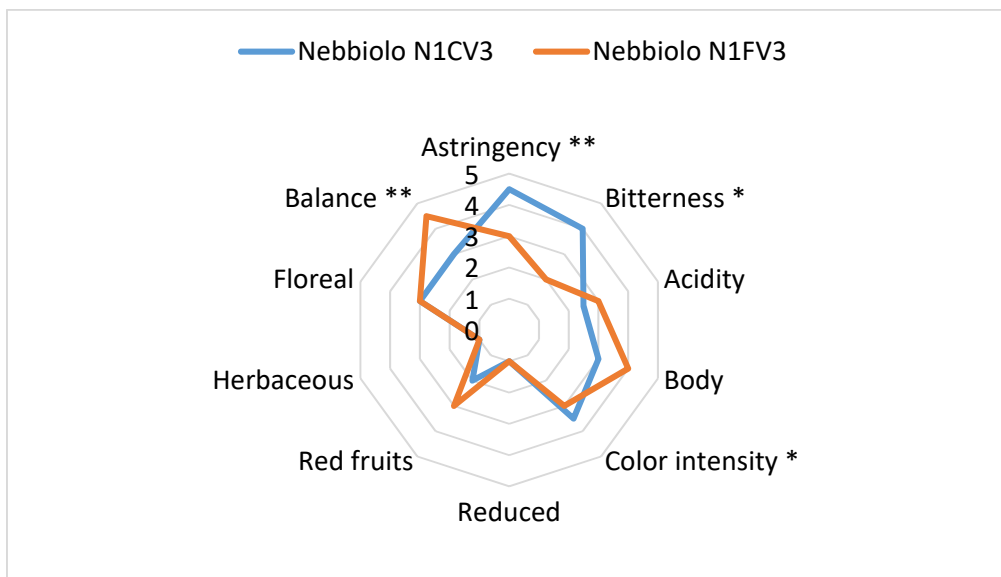


Figure S3.2 Sensorial profile of Nebbiolo wines (N1) after one year from bottling (V3).

Significance level: * = 0.05; ** = 0.01.

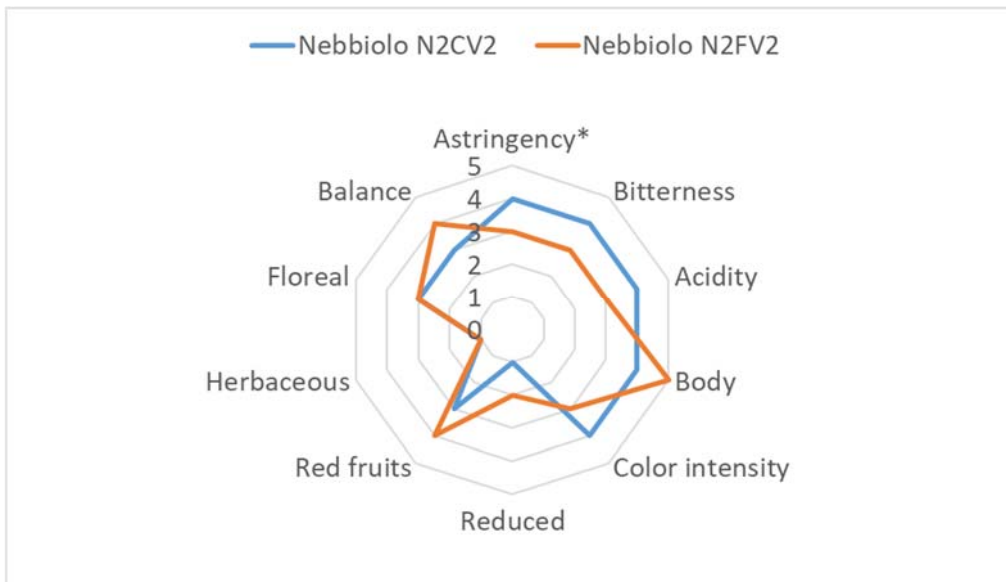


Figure S4.1 Sensorial profile of Nebbiolo wines (N2) before stabilization and bottling (V2).
Significance level: * = 0.05; ** = 0.01.

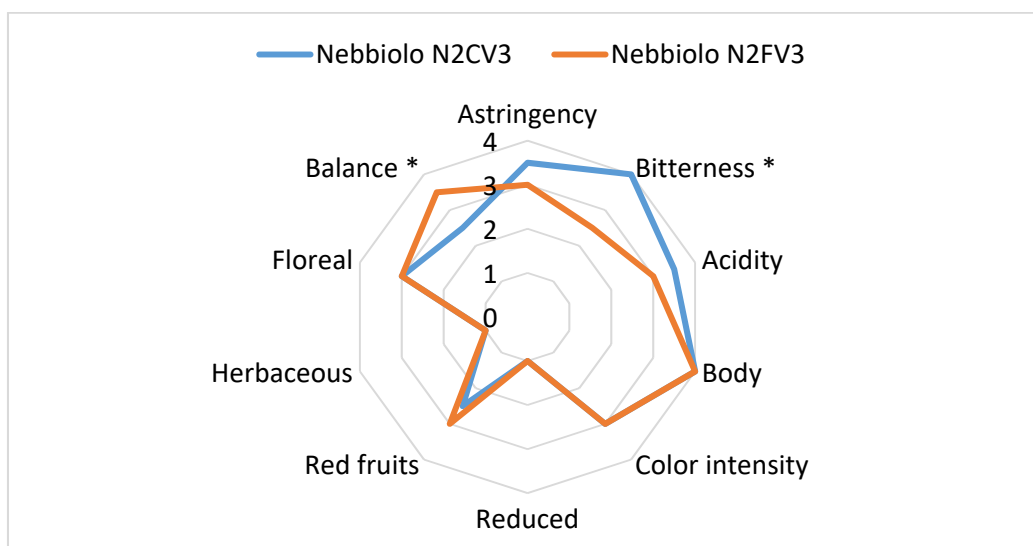


Figure S4.2 Sensorial profile of Nebbiolo wines (N2) after one year from bottling (V3).
Significance level: * = 0.05; ** = 0.01.

Conclusion

The evaluation of wines, after one year from bottling, obtained by winemaking experiences with the GOfermentor system conducted in the 2016's harvest, confirm some our considerations related to possible uses of this system. Particularly, all wines produced in the experiments using GOfermentor, after about 18 months (12 months in bottle) of aging, evidenced a good color intensity at sensory level with slightly differences respect to control.

About flavour, GOfermentor has proven to be particularly effective in favoring the production of floral and fruity aroma wines with respect to control wines. Moreover, the GOfermentor winemaking system has led to more balanced, less astringent and less bitter wines above all for Nebbiolo wines.

In conclusion, the GOfermentor system can express the best potential in the production of young red wines, or aged wines from grapes which not require an intense (hard) extraction process. The system is useful also when conducting winemaking processes using moderate amounts of grapes (less than 900 kg). In addition, the GOfermentor system can be a valuable tool for experimental winemaking thanks to the high automation that makes the technological effects reproducible, and to the single-use bag that allows a clean production environment for each batch.