Effects of ethanol removal techniques on Nero d'Avola wine

Denis ALLIERI[1], Leonardo LA CORTE[2], Iklima ODABASI[1], Alessio ALTOMARE[1], Giulio STAFFIERI[1], Marta BAVIERA[1], Gvantsa SHANSHIASHVILI[1], Carmen Cris DE OLIVEIRA NOBRE BEZERRA[3], Nicholas BONACINA[3], Ileana VIGENTINI[3], Daniela FRACASSETTI[1,*]

[1]Department of Food, Environmental and Nutritional Sciences (DeFENS), Università degli Studi di Milano, Via Celoria 2, 20133 Milano, Italy.
[2]ISVEA S.r.l., Via Basilicata Loc. Fosci, 53036 Poggibonsi (SI), Italy.
[3]Department of Biomedical, Surgical and Dental Sciences (DSBCO), Università degli Studi di Milano, Via della Commenda 10, 20122 Milan, Italy.

* Corresponding author. Email: daniela.fracassetti@unimi.it

Over the past two decades, climate change has contributed to an increase in sugar content in grape must, and consequently, in the ethanol levels of wines. This trend contrasts with the growing consumer demand for wines with lower alcohol content or alcohol-free, a market segment that has continued to expand. Various technologies are currently available to partially or completely remove ethanol from wine, including distillation, vacuum evaporation, and membrane-based systems. However, the effects of these processes on wine composition vary depending on the technique used, the degree of ethanol removal, and the characteristics of the wine itself. Therefore, further research is necessary to deepen our understanding of how dealcoholisation influences different wine profiles.
This study aimed to assess the impact of removing ethanol on the chemical and sensory properties of Nero d'Avola wine.
Nero d'Avola wines (vintage 2024, Sicily, Italy) were collected from four different wineries after malolactic transformation. These wines underwent dealcoholisation using a combined membrane technology based on nanofiltration and reverse osmosis, with ethanol reduction of -2% and -4% (v/v). Moreover, one of these wines was also dealcoholised by a contactor membrane system. The low-alcohol wines were bottled and stored at 15±1°C for up to six months, with additional sampling conducted one-month post-bottling. Untreated wines were bottled as controls under the same conditions. The wines were analysed for general chemical composition, phenolic content, colour intensity, procyanidins, and tannins.
The results showed that a -2% (v/v) ethanol reduction caused moderate decreases in titratable acidity (up to -14%) and tartaric acid (up to -10%). However, a -4% (v/v) reduction resulted in more significant losses (up to -31% and -34%, respectively for titratable acidity and tartaric acid). Acetaldehyde content dropped notably (up to -68%) at the -4% ethanol level in most samples. A -4% ethanol reduction led to a significant drop in flavonoids (up to -46%) and anthocyanins (about 50%) compared to control wines. Nevertheless, two wines showed only minimal decreases (flavonoids -11%, anthocyanins -13%), suggesting that the response to dealcoholisation may depend on wine-specific characteristics. Colour intensity decreased consistently with anthocyanin loss. The use of contactor membrane system led to only limited changes in wine composition. Sensory analysis revealed that wines with -2% ethanol were perceived as fruitier and more floral, with greater aromatic intensity than those with a -4% reduction.
This research provides new insights into the impact of membrane-based dealcoholisation on Nero d'Avola wine, a grape variety not previously studied in this context, to the best of our knowledge. Further investigations are ongoing to monitor the evolution of partially dealcoholised Nero d'Avola wines, a key variety in Sicilian viticulture.

Keywords: dealcoholisation, Nero d'Avola, phenolics, wine evolution

Funding
InnoNDA project is funded by Regione Sicilia, PROGRAMMA DI SVILUPPO RURALE SICILIA 2014-2022, SOTTOMISURA 16.1 "Sostegno per la costituzione e la gestione dei gruppi operativi del PEI in materia di produttività e sostenibilità dell'agricoltura"

References
[1] Sam et al., 2021. DOI: 10.3390/foods10102498.