Impact of different filtration treatments on genetic traceability in red wine

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The wine industry involves a complex supply chain with various intermediaries, including producers, distributors, retailers, and collectors. This complexity can make it challenging to track the authenticity of a wine, providing opportunities for fraudsters to adulterate or falsify its geographical origin, grape variety, and vintage. Nowadays, DNA based methods are valuable techniques to identify grape varieties, due to their independence from external conditions. Indeed, DNA markers, including simple sequence repeats (SSRs) and single nucleotide polymorphism (SNPs) are tested for DNA authentication of wine. The limiting factors are the low quality and quantity of DNA that can be influenced by winemaking practices. Among them, filtration treatments can reduce the content of aroma, phenolic compounds, pesticides residues and others owing to the adsorption properties of filters.

The purpose of the study was to evaluate the effect of eleven different filtration treatments, using SNP-based methods, on traceability of 'Nebbiolo' wine. Four membrane filter materials, including cellulose, PES, PVDF and PTFE, with different pore sizes (0.22 and 0.45 µm), were tested on wine, also compared to kieselguhr and perlite used alone and in combination with a cellulose membrane. The treatments were carried out in triplicate through a vacuum filtration system. Chemical-physical parameters, phenolics and color were determined. For DNA extraction, a CTAB based method was used. Quantitative PCR (qPCR) was used for grapevine DNA quantification and two specific 'Nebbiolo' markers, SNP_15082 and SNP_14783, were analyzed in extracted DNA.

Wine filtration treatments decreased the turbidity compared to control, although total phenolics, flavonoids and non-flavonoids were not affected. Membrane filters resulted in a significant reduction of anthocyanins and color intensity due to the adsorption of filters aids and membrane. Regarding extracted DNA, all treatments reduced DNA ranging from 37.2% (Cellulose) to 99.7% (PVDF, 0.22 µm), suggesting that DNA molecules could be adsorbed and eliminated by filtration treatment. SNP_15082 and SNP_14783 were detected in all treated wines, except for PDVF filters with 0.22 µm pore size due to the low DNA yield (<0.5 pg/mL). In conclusion, wine filtration can hinder genetic traceability, depending on pore size and material characteristics, confirming that the traceability of wine DNA is affected by the adopted oenological practices.

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