

Strategies to increase sustainability in wine production

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Introduction

The change in production and consumption mindset toward a sustainable approach has also involved the wine sector (Flores, 2018). The last decade has seen a growing awareness both of companies, driven by strategic, economic, and ethical reasons (De Steur et al., 2020), and of consumers who are more sensitive to the matter and willing to pay more for a product identified as sustainable (Schäufele & Hamm, 2017). Focusing on **quality** and **food safety** issues, the project aims to obtain tangible results through whose dissemination they can be a valuable **support** to producers' **decisions** during **winemaking** to get **sustainable** and **high-quality products**. To this end, a perfect knowledge of the musts and wines composition is crucial, especially since it is evolving considerably due to climate change (Mouret et al., 2021), as well as the modifications caused by winemaking practices is advisable. In this sense, **timely** and **precise oenological practices** can be taken, only when **necessary** and with **awareness**. Even if for grape composition much has been studied concerning the effects of climate change (Ollat & Touzard, 2014; Rogiers et al., 2022; Markopoulos et al., 2023], for musts and wines few publications are intent on elucidating the issue.

Therefore, there is a need to deepen the knowledge. In light of what is stated above, this PhD thesis project will be directed to deepen the understanding of some crucial dynamics of wine production. In particular, the project will focus on two main aspects:

- the **implications of wine fining**, e.g. **bentonite** treatment and **potential alternatives** to its usage. The research has described the issues related to bentonite in terms of quality, environmental, health, and safety aspects (Sommer & Tondini, 2021)
- the role of **must** and **wine acidification** as the effects of climate change has made this practice essential (Chidi et al., 2018). The OIV has recently raised the legal limit underlying this new **necessity**. However, the wine's acidic properties influence many other important wine characteristics, such as the **phenolic extraction** during maceration (Forino et al., 2019), the **color** (Escribano-Bailón et al., 2019), and the **sensory attributes** Gawel et al., 2001), thus there is a need to elucidate whether is better to acidify musts or wines according to the variety vinified and the type of acid applied.

Objectives and milestones



Writing a comprehensive literature review on the role of bentonite in the wine industry, including the potential for enhancing its usage by examining the dynamics of protein instability and predictive tests, used to determine the required dose for achieving final product stability, as well as exploring possible alternatives (A1.1). Investigation of the scientific literature concerning the acidic profile of wine, its impact on organoleptic and sensory characteristics, and the modification of pH and titratable acidity aim to prepare an experimental plan to explore the possibility of improving the acidification practice, which is becoming increasingly critical in the context of climate change (A1.2).



Evaluation of potential new alternatives in wine protein stabilization: more sustainable, and less affecting the wine's quality and organoleptic characteristics. Investigation on the effect of pH on bentonite treatment. Is it more effective to stabilize the wine before or after acidification or malolactic fermentation? (A2.1).

Study of the efficiency of acidification at different stages of winemaking: pre-, during, and post-fermentation. The contextual effect on the extraction dynamics from the skins, on the color, on the aromatic compounds, and on the final sensory profile (A2.2).



Follow up of the previous experiments based on newly acquired knowledge, mainly focusing on the correlation between the predicted dose by the different heat tests and wine storage trials to identify the less drastic heat test conditions able to stabilize the wine, avoiding over-fining and limiting the drawbacks associated with bentonite treatment (A3.1). Evaluating the effects of the acidification practice, mainly focusing on its effects on the sensory quality and attributes of red and white wines (A3.2).



Data and information collected will provide new insights into the winemaking process allowing to obtain high-quality and sustainable products in an increasingly competitive and challenging context given the effects of climate change. The results will be disseminated through the writing of the PhD thesis, scientific papers, and oral or poster communication (A4)

Activity/Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A1) Overview of the literature																								
1) Bentonite treatment																								
2) Wine's acidity																								
A2) Experimental plan																								
1) Bentonite and alternative																								
2) Must/Wine acidification																								
A3) Process optimization																								
1) Bentonite																								
2) Acidification																								
A4) Thesis/papers preparation																								

Selected References

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