fermentation

Editorial

Enological Repercussions of Non-*Saccharomyces* Species 3.0

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Citation: Morata, A. Enological Repercussions of Non-*Saccharomyces* Species 3.0. *Fermentation* **2022**, *8*, 613. https://doi.org/10.3390/fermentation8110613

Received: 21 October 2022
Accepted: 3 November 2022
Published: 8 November 2022

Innovations Using Non-*Saccharomyces* Species in Wine Biotechnology

The use of non-*Saccharomyces* in wine production has increased steadily since the commercial introduction of the first non-*Saccharomyces* strains produced as dry active yeasts at the beginning of the century by CHR Hansen and Lallemand (2004–2007) [1,2]. This is due to the development of the sensory profile and the complexity of the wines produced with these new species, as well as the commercial success of the first non-*Saccharomyces* strains. This third issue of the 'Enological Repercussions of Non-*Saccharomyces* Species' Special Issue in *Fermentation* features research from scientists from Europe, the United States, Australia, South Africa, Uruguay, Argentina, and Peru. Currently, the fourth edition is being held. Thank you to all the researchers and professors participating in these successful SIs.

The impact of non-*Saccharomyces* yeasts is based on the possibilities that they offer to modulate wine aroma [3,4], acidity and freshness [5], mouth feel [4,6], color [4], stability and bioprotection/biocontrol [6]. Moreover, they even facilitate an improvement in wine stability, a reduction in SO_2, the control of off-flavors [7] and biological ageing [4]. About 42 commercial products based on non-*Saccharomyces* are currently available, the majority of which are dried yeasts, primarily from the species *Torulaspora delbrueckii*, *Lachancea thermotolerans*, and *Metschnikowia pulcherrima* [3]. The selection of new non-*Saccharomyces* strains is increasing in these traditional species, but also in others with new potential applications, opening new opportunities in winemaking [8]. Some of them are now in use for special products such as sparkling wines [9] or for wines made from hybrid varieties [10].

Several publications in this SI on the modulation of wine scent have concentrated on the formation and release of fermentative esters [4,5,10,11], the effect of yeast enzymes on varietal aroma [5,12] and the protection of varietal compounds [10]. Some interesting volatiles with a positive impact on wine aroma include ethoxy-1-propanol [5], 2-phenylethyl, tryptophol and tyrosol acetates [4,11]. Particularly, when *Hanseniaspora* spp. are utilized, the increased content of these fermentative volatiles, as well as free terpenes, has been correlated with fruitier and more flowery sensory profiles [4,10,11].

The use of *L. thermotolerans* is a trend in current enology, and this species' generation of lactic acid from carbohydrates is a powerful tool for regulating pH during fermentation [13]. It has been proven as a powerful biotechnology to substitute the use of chemical acidification in warm areas, while also having a favorable effect on wine aroma [5].

Many non-*Saccharomyces* have an influence on mouthfeel, producing full-bodied wines, even with low-structure white varieties. The use of apiculate yeast from *Hanseniaspora* spp. frequently produces better roundness and density in the mouth, which can be clearly observed when tasting after fermentation [4]. Furthermore, it has been noted that sparkling wines with base wines made from *Metschnikowia pulcherrima* have greater foamability and foam stability [9]. Glycerol is another component whose viscosity has an impact on the volume and softness of wine. The concentration of this polyalcohol is increased when non-*Saccharomyces* such as *Starmerella bacillaris* are used, which enhances the structure and mouthfeel of the wine [6]. Furthermore, as the production of glycerol is performed with sugars, some reduction in alcoholic degree can be expected, which is advantageous for warm-climate wines. The effects of stress such as osmotic pressure, ethanol and pH conditions in non-*Saccharomyces* have also been studied [14]. The better prepared species to grow under stress conditions are *Lachancea fermentati*, *L. thermotolerans*, and *S. pombe* [14], opening new applications for overripe grapes in warm areas.

The use of metagenomic tools is also a powerful and interesting way to map the microbial community that can be found in a winery, identify areas with a higher concentration of spoilage microorganisms, and manage specific sanitization procedures to eradicate these threats and their associated issues, such as wine alteration and off flavors [15]. With regard to *Brettanomyces*—a typical spoilage yeast—a very low relative abundance has been detected. The populations of *Brettanomyces* and *Zygosaccharomyces* that can be persistent in cellars can be reduced and controlled with the aid of these procedures. Bioprotection is another way of controlling yeasts in grapes or must fermentations that is a trend in current enology. Because of their interesting abilities in bioprotection, *Picchia kluyveri* and *Candida pyralidae* are two non-*Saccharomyces* yeasts that are frequently utilized [16]. Biochemical and engineering parameters have been studied to build stoichiometric models that aid in understanding yeast's biochemical conversion when we are working with specific growth media derived from grape bioproducts.

As a summary, non-*Saccharomyces* offer new ways to improve wine quality and manage enological problems. This SI contains numerous advantageous applications for a number of non-*Saccharomyces* species.

Funding: This research received no external funding.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Carlos Escott for the revision of the MS. Project ENOINNOVAPRESS—MICINN AEI-PID2021-124250OB-I00.

Conflicts of Interest: The authors declare no conflict of interest.

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