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Editorial

Yeast Biotechnology

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Yeasts are truly fascinating microorganisms. Due to their diverse and dynamic activities, they have been used for the production of many interesting products, such as beer, wine, bread, biofuels, and biopharmaceuticals. *Saccharomyces cerevisiae* (brewers' or bakers' yeast) is the yeast species that is surely the most exploited by man. *Saccharomyces* is a top choice organism for industrial applications, although its use for producing beer dates back to at least the 6th millennium BC. Bakers' yeast has been a cornerstone of modern biotechnology, enabling the development of efficient production processes. Today, diverse yeast species are explored for industrial applications. This Special Issue is focused on some recent developments of yeast biotechnology, i.e., bioethanol, wine and beer, and enzyme production. Additionally, the new field of yeast nanobiotechnology is introduced and reviewed.

New developments in efficient bio-ethanol production. Due to its low costs and wide distribution, lignocellulosic biomass is the most promising feedstock to be used in biorefineries and lignocellulose-derived fuels. The fermentation of sugars from lignocelluloses has been proposed as a viable pathway for the production of renewable biofuels. However, the feedstock is a major cost factor. Therefore, the use of low cost and underutilised feedstocks, such as harvest forest residues, to produce ethanol could be an interesting route. Yang and colleagues [1] evaluated several batch fermentation approaches under various conditions for ethanol production from softwood forest residues. Ranges of liquefaction time, cellulase, and yeast loadings were all evaluated in this study to improve ethanol production. A pretreatment of the lignocellulose feedstock is necessary to improve the saccharification and fermentation processes, but the current physical and/or chemical pretreatment procedures have several drawbacks. The use of laccases has been developed as an environmentally friendly alternative for improving the saccharification and fermentation stages of lignocellulosic biomass. Moreno et al. [2] evaluated a novel bacterial laccase for enhancing the hydrolysability and fermentability of steam-exploded wheat straw. To increase the productivity of the ethanol fermentation, new bioreactor designs and operation modes have been introduced. A novel textile bioreactor for improved ethanol production was developed by Osadolor and colleagues [3]. Due to the efficient mixing, this fluidised-bed bioreactor allowed the procurement of a high cell density of flocculating yeast cells, resulting in a high ethanol productivity.

Wine and beer yeasts. The increasing economic interest in the sector of sparkling wine has stimulated a renewed interest in microbial resource management. Starter cultures for sparkling wine production need to be selected in order to produce either quality base wine or to vigorously promote secondary fermentation. Garofalo and coworkers [4] reviewed the main characterisation for selecting *Saccharomyces cerevisiae* strains suitable as starter cultures and analysed the possible uses of selected

non-*Saccharomyces* and malolactic strains in order to differentiate specific productions, and highlighted the main safety aspects related to microbes of enological interest. In spontaneous wine fermentations, more than one *Saccharomyces cerevisiae* strain ferments the wine must. These strains affect flavour and aroma properties differently. Therefore, Gustafsson et al. [5] investigated the interaction of two *S. cerevisiae* strains. The results showed that the co-inoculation of strains creates a new chemical profile not seen in the pure cultures, which have implications for winemakers that are looking to control wine aroma and flavour profiles through strain selection. Wine quality can be improved by using locally-selected *S. cerevisiae* strains as starter cultures. Cordero-Bueso and coworkers [6] could improve the fruity and fresh character of Malvar wines by selecting two local strains. Non-*Saccharomyces* ("wild") yeasts are found on the grapes and are also present on cellar equipment. This wealth of yeast biodiversity with hidden potential, especially for oenology, is largely untapped. In this Special Issue, the applications of non-*Saccharomyces* yeasts to the wine-making process were reviewed by Mateo and Maicas [7]. Schlander and coworkers [8] characterised acid proteases isolated from the wild yeasts *Metschnikovia pulcherrima* and *Wickerhamomyces anomalus*. These enzymes are of significant importance for medicine and biotechnology.

Yeast strains that flocculate are of particular interest to brewers, since it simplifies the yeast removal at the end of the primary fermentation considerably. Conjaerts and Willaert [9] performed adaptive laboratory evolution with gravity imposed as selective pressure for evolving a weak flocculating industrial strain towards a more flocculent phenotype. They used 3D printing to construct a suitable mini tower fermenter.

Yeast nanobiotechnology, which is a recent field where nanotechniques are used to manipulate and analyse yeast cells and cell constituents at the nanoscale, was reviewed by Willaert and coworkers [10]. An overview and discussion of nanobiotechnological analysis and manipulation techniques that have been particularly applied to yeast cells, is given; i.e., nanoscale imaging techniques, single-molecule and single cell force spectroscopy, AFM (Atomic Force Microscopy)-cantilever-based nanomotion analysis of living cells, nano/microtechniques to pattern and manipulate yeast cells, and direct contact and non-contact cell manipulation methods were reviewed.

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References

1. Yang, M.; Ji, H.; Zhu, J. Batch Fermentation Options for High Titer Bioethanol Production from a SPORL Pretreated Douglas-Fir Forest Residue without Detoxification. *Fermentation* **2016**. [CrossRef]
2. Moreno, A.; Ibarra, D.; Mialon, A.; Ballesteros, M. A Bacterial Laccase for Enhancing Saccharification and Ethanol Fermentation of Steam-Pretreated Biomass. *Fermentation* **2016**. [CrossRef]
3. Osadolor, O.; Lennartsson, P.; Taherzadeh, M. Development of Novel Textile Bioreactor for Anaerobic Utilization of Flocculating Yeast for Ethanol Production. *Fermentation* **2015**. [CrossRef]
4. Garofalo, C.; Arena, M.; Laddomada, B.; Cappello, M.; Bleve, G.; Grieco, F.; Beneduce, L.; Berbegal, C.; Spano, G.; Capozzi, V. Starter Cultures for Sparkling Wine. *Fermentation* **2016**. [CrossRef]
5. Gustafsson, F.; Jiranek, V.; Neuner, M.; Scholl, C.; Morgan, S.; Durall, D. The Interaction of Two *Saccharomyces cerevisiae* Strains Affects Fermentation-Derived Compounds in Wine. *Fermentation* **2016**. [CrossRef]
6. Cordero-Bueso, G.; Esteve-Zarzoso, B.; Gil-Díaz, M.; García, M.; Cabellos, J.; Arroyo, T. Improvement of Malvar Wine Quality by Use of Locally-Selected *Saccharomyces cerevisiae* Strains. *Fermentation* **2016**. [CrossRef]
7. Mateo, J.; Maicas, S. Application of Non-Saccharomyces Yeasts to Wine-Making Process. *Fermentation* **2016**. [CrossRef]

8. Schlander, M.; Distler, U.; Tenzer, S.; Thines, E.; Claus, H. Purification and Properties of Yeast Proteases Secreted by *Wickerhamomyces anomalus* 227 and *Metschnikovia pulcherrima* 446 during Growth in a White Grape Juice. *Fermentation* **2017**. [CrossRef]
9. Conjaerts, A.; Willaert, R. Gravity-Driven Adaptive Evolution of an Industrial Brewer's Yeast Strain towards a Snowflake Phenotype in a 3D-Printed Mini Tower Fermentor. *Fermentation* **2017**. [CrossRef]
10. Willaert, R.; Kasas, S.; Devreese, B.; Dietler, G. Yeast Nanobiotechnology. *Fermentation* **2016**. [CrossRef]