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Concept for A Multi-Feedstock Bio-refinery that uses Engineered Yeast to value winery waste

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Abstract

Without proper management, the wine industry produces a lot of byproducts and residues, which are bad for the environment. Vine shoots, wine lees, and surplus grape must have the potential to be utilized as renewable resources for the production of chemicals and energy. Saccharomyces cerevisiae is now recognized as an effective microbial cell factory for biorefneries thanks to efforts in metabolic engineering. The bioeconomy would clearly benefit if these biorefneries could effectively convert multiple feedstocks, but the current biorefneries designed for producing multiple products frequently rely on just one feedstock. Additionally, a biorefnery ought to be able to supplement the production of biofuel with the production of high-value products in order to maximize production economics and minimize the impact on the environment of fossil fuel consumption [1]. Through the biosynthesis of xylitol and ethanol, this study proposes an integrated strategy for the valorization of various wastes from winemaking processes. The xylose-rich hemicellulosic fraction of hydrothermally pretreated vine shoots was turned into xylitol with genetically modifed S. cerevisiae strains, and the cellulosic fraction was used to make bioethanol. Additionally, sugar-rich grape must was successfully utilized as a low-cost source for yeast propagation. In a Simultaneous Saccharifcation and Fermentation process configuration, the inoculum size and enzyme loading were adjusted to optimize xylitol production. Bioethanol was also produced from the glucan-rich cellulosic using a yeast strain with cellulases on the cell surface. High ethanol concentrations were achieved with the addition of wine lees or grape must, which are essential for the economic viability of distillation [2]. A synergistic alternative for reducing the amount of waste released into the environment while simultaneously converting a variety of winery wastes and by-products into biofuel and an added-value chemical is this integrated multi-feedstock valorization.

Keywords: Winery residues; Bioethanol; Xylitol; Engineered Saccharomyces cerevisiae; Integrated biorefnery

Introduction

A signi cant portion of global agriculture is dedicated to the wine industry, which has cultural and commercial signi cance. One of the most widely grown fruit crops is grapes, with an estimated 7.3 million hectares of vineyard land in 2021. e top six countries that grow vines are Spain (13%), France (11%), China (11%), Italy (10%), Turkey (6%), and the United States (5%)—each of which accounts for 56% of the total area planted with vines. Over the past few years, global wine production has remained relatively stable. It is anticipated to be 260 million hectoliters (mhL) in 2021, a decrease of approximately 3 mhL (1 percent) from 2020 [3].

Vine shoots, grape pomace (seeds, stalks, and skins), and wine lees are all byproducts of viticulture and winemaking. Wineries also produce an excessive amount of grapes and a signi cant amount of wastewater in addition to these waste products. Up to 93% of winery le overs are made up of vine shoots (VS) from pruning, an agronomic practice. Xylitol, cellulose, hemicellulose, and lignin make up VS, which can be thought of as a platform for the synthesis of numerous biobased products like proteins, oligosaccharides, lactic acid, bioactive compounds, biosurfactants, and biofuels like ethanol and biogas. erefore, utilizing VS as a source of energy and value-added products rather than burning it or dumping it on the ground where it will decompose is more environmentally friendly and cost-e ective [4].

Wine dregs (WL) are a typical winery squander that structures at the

Material and Method

For cloning and plasmid maintenance, Escherichia coli DH5/NZY5 (Nzytech, Portugal) strains, plasmids, and engineered strain construction were utilized. For transformant selection, E. coli cells

evaluated for supplementation of culture media in biotechnological processes [5].

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were added to the YPD media, which contained 10 g/L yeast extract, 20 g/L peptone, and 20 g/L glucose, to select the transformants. A er that, the constructed integrative vector (p2909_TEF-1_GRE3) and the guide RNA (gRNA) helper vector (pCFB3050) were transformed into the