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A virtual Bio refinery evaluation of the value added separation of different components from Residual Biomass for food and Biofuel applications

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production into a conceptual biorefnery process. The conceptual procedure is intended for an industrial-scalQ

potential of valorizing a larger portion of the biomass at the same cost of raw materials.

K : Protein; Ethanol; Biore nery; Techno-economic analysis; Brewers' spent grain; Palm kernel meal

I

Over 90 million tons of waste is produced annually in the EU as a result of worldwide agriculture and uncontrolled food production, which has a signi cant impact on the environment and contributes to global warming. Additionally, as the world's population continues to grow at an exponential rate, so will the demand for biomass—not just for food but also for fuel, bers, and feed [2]. As a result, there will be intense competition for biomass, land, and other natural resources. A sustainable framework that takes into account all of these factors will be absolutely necessary due to their inherent interconnectedness. Because it is a reliable strategy for better valorizing and creating value from resources, the circularity approach has been adopted in the EU and other nations worldwide [3].

ere are a number of components in biomass that can be put to use in a variety of ways. A portion of the biomass that is converted into biofuel is wasted, preventing the valorization of other important components like proteins. Additionally, utilizing a greater proportion of biomass for a variety of products can reduce the costs of raw materials, which typically make up a sizable portion of manufacturing expenses [4]. As a result, using the integrated biore nery method to turn biomass into a high-value product (like food protein) and produce biofuel (like ethanol) will increase both the circular use of biomass and the economic potential of the products.

M

e conceptual process design is used to estimate the production process's operational expenditure (OPEX) and capital expenditure (CAPEX or xed capital) in the techno-economic analysis. e quality of the parameters and assumptions determines the techno-economic

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e improved on process stream chart of the virtual biore nery is displayed. e process of producing ethanol is depicted at the bottom, while the process of producing protein is depicted at the top. SuperPro Designer is used to create the ow diagram, which makes it possible to calculate mass balances. For the production of ethanol and protein powder, respectively, assumptions and estimates regarding unit operations are provided. e two cycles are associated by an incorporated succession of unit tasks that reach from biomass pre-treatment the entire way to the recuperation of the nal result [8].

B

In view of the mass o set with the stream measures, the hardware size and the bought gear costs are assessed, utilizing scaling factors. e costs of purchasing the equipment are based on Humbird et al. 2017 for Alcalase hydrolysis fermenters; Maroulis and Saravacos (2007) for the lter press and centrifugation; expert knowledge of WR for reverse osmosis; Towler and Sinnott (2013) for spray drying; and SuperPro Designer for ethanol production [9]. e derived xed capital costs and the estimated costs of purchasing equipment Material-related costs. e prices of raw materials were previously determined to be €125 per

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