Biorefinery development for the production of succinic acid and value-added co-products from sunflower meal

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Sunflower is an oilseed cultivated worldwide for oil or biodiesel production due to its considerable capability of adaptation to different soil and climatic conditions. The estimated global production for 2018-2019 is 19.3 Mt, while the respective EU production corresponds approximately to 19% of the global one (USDA, 2019). Sunflower meal (SFM) is the by-product obtained by the sunflower oil industry and it is mainly used as animal feed. SFM production is estimated at around 20.7 Mt globally and 4.8 Mt in Europe (USDA, 2019). Sunflower meal contains proteins, lignocellulosics and antioxidants. The protein content of SFM depends on dehulling and oil extraction processes and ranges from 29% to 45%. Valorization of low-cost feedstocks through biorefinery development for the production of value-added products and commodities, such as bio-based chemicals, and implementation of bioprocesses into an existing industrial plant could increase process profitability. The circular economy is gaining attention globally and biorefinery development will boost the transition to the new sustainable era. In this study, SFM was utilized for the development of a biorefinery for the production of value-added co-products and succinic acid via fermentation.

Various strategies were evaluated in order to maximize the extraction of antioxidants and proteins. Antioxidant extraction was carried out using various solvents, while a protein concentrate was obtained via SFM treatment at high pH followed by ultrafiltration. The remaining fraction was hydrolyzed using crude enzyme consortia produced via solid state fermentation (SSF) of *Aspergillus awamori*. Initial moisture content was optimized in SSF resulting in maximum enzyme production at 55% of initial moisture content. SFM hydrolysis was optimized at different initial solid concentrations and temperatures. Commercial cellulases were also used to maximize cellulose hydrolysis. Optimization of hemicellulose and cellulose resulted up to 70% hydrolysis yield leading to the generation of a fermentation feedstock, rich in sugars, amino acids, peptides and minerals. The SFM hydrolysate was utilized as the sole substrate for the production of succinic acid via fed-batch fermentation in a bench-top bioreactor using the natural succinic acid producer *Basfia succiniciproducens*. The final succinic acid concentration was 35 g/L with yield of 0.60 g/g and productivity of 0.78 g/L/h.

Keywords: Biorefinery, Fermentation, Succinic acid

References:

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