BIENZYMATIC PRODUCTION AND REACTION-INTEGRATED SEPARATION OF LAMINARIBIOSE BY AD- AND DESORPTION ON ZEOLITE BEA

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Carbohydrates are fundamental constituents in nutrition, feed and numerous technical applications. Especially for the “rare sugars”, a growing number of applications in chemical and pharmaceutical industry have been developed recently. Laminaribiose has been identified as possible building block in new cancer medication This contribution introduces a bienzymatic production strategy for laminaribiose with a reaction-integrated adsorption to overcome the disadvantage of consecutive reactions and to improve the purity of the product.

Laminaribiose is produced using sucrose and glucose as cheap reactants with sucrose phosphorylase and laminaribiose phosphorylase as enzymatic catalysts. Immobilization strategies were developed to retain the enzymes in the reaction solution enabling a continuous process and improving the operation time of the process. BEA 150 zeolites are used as adsorbent due to their specific adsorption of laminaribiose. The batch process was conducted in vessels between 2 mL and 25 mL and a MATLAB tool was developed to model this processes. Therefore, single enzyme kinetics and single component isotherms were used in the model. Furthermore, the loss of capacity over reaction time for the zeolite was determined using dynamic methods and integrated into the model. Simulations showed a good agreement between the model and the experimental data for all experiments, see figure 1 left. The derived model was then used to optimize the process conditions leading to a final loading of the zeolites of approximately 27 $mg_{laminaribiose}/g_{zeolite}$. Downstream processing of these zeolites included several washing and desorption steps and improved the purity in the final desorbate to approximately 75 % with an overall yield of the downstream process of 25 % although downstream processing is not optimized yet (figure 1 right). In comparison, the purity in the supernatant after the reaction was about 25 %. Moreover, the products of unwanted consecutive reactions could be decreased by 20 % resulting in an increase of laminaribiose formed by about 5 % with 200 $g_{zeolite}$/L by the reaction-integrated separation in comparison to the reaction without zeolites.

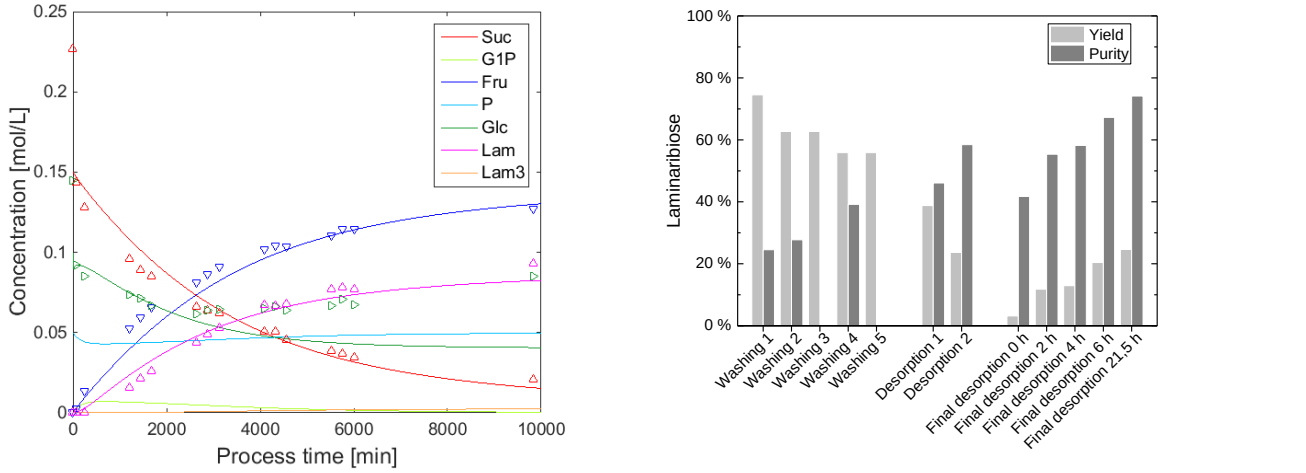

Figure 1: Comparison between experimental data (open symbols) and simulation (lines) for the production of laminaribiose (left) and the resulting yields and purities in different steps of the downstream process (right).