Membrane-based downstream processing of microbial xylitol production

Ria Desiriani, author

Abstrak

Xylitol is a sugar alcohol used as a sweetener in the food industry. Xylitol can be produced from D-xylose using a fermentation process, but it then needs to be separated from the other components of the fermentation broth (e.g., metabolic products, residual substances, biomass cells, and mineral salts), before being purified as xylitol crystals. Therefore, to obtain high purity xylitol, various separation processes are required. One very promising downstream processing method is membrane separation. This study evaluated membrane-based processes for the separation of biomass cells and other impurities, determined the concentration of xylitol produced from Debaryomyces hansenii yeast fermentation broth, and proposed a polysulfone ultrafiltration (UF) membrane for biomass-cell separation followed by polyamide nanofiltration (NF) to remove low-molecular-weight compounds (e.g., acetic acids) from sugars. The effects of operating pressure were examined using a fermentation broth model solution. The results showed that a higher pressure caused a higher permeate flux; however, the permeate flux’s rate flow decreased over time due to concentration polarization, and fouling in the UF and NF membranes. Nevertheless, at all pressures, UF achieved a 99% rejection of biomass cells. In addition, microscope analysis showed that no biomass cells were detected in the permeates of UF. The resulting NF concentrates revealed high xylitol retention and a beneficially lower concentration of acetic acids. The operating pressures of the UF test conditions were 1 barg and 1.5 barg, illustrating that, at a pressure of 5.5 barg, the experiments achieved reasonably high xylitol retention (above 90%) indicating negligible losses of sugar in the permeate port. Moreover, this was proven to be a feasible way to concentrate xylitol up to three times from the initial concentration of the model fermentation broth (MFB). Therefore, the results demonstrated that a two-stage combination of UF and NF is a promising system for the downstream processing of microbial xylitol production.