

Title: Membrane technology to recover xylo-oligosaccharides

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Abstract:

Following global sustainability principles, the forestry, pulp and paper industries have been given more attention to the recovery of underutilised streams to generate valuable products. Among those, xylo-oligosaccharides (XOS) are considerably attractive for their potential applications in the pharmaceutical, phytopharmaceutical, and food industries. The XOS are derived from hemicellulosic biomass, and produced after a two-step process consisting of hemicellulose pre-treatment to extract xylan which is subsequently depolymerised into XOS by chemical or enzymatic hydrolysis. The applications of XOS are determined by their degree of polymerisation (DP), and side groups making crucial their fractionation. However, separation of XOS has been accomplished merely by chromatographic techniques which can be costly, present very low yields, and scaling-up remains the obstacle preventing its wide industrial implementation. Membrane technology presents several advantages for the purification of XOS due to the intrinsic feasibility of scaling up, its potential for integration into already existing industries and processes, present low energy consumption, and high processing capacity.

Herein, the implementation of membrane technology has been explored to fractionate XOS mixtures by their DP. Tubular ceramic membranes with molecular weight cut-off (MWCO) of 3 nm (ultrafiltration), 750, 450 and 200 Da (nanofiltration) were used in cross-flow filtration mode to fractionate hydrolysate liquours containing XOS with a wide DP range. Different pressures and temperatures were evaluated to determine their influence on XOS fractionation, permeate flux and membrane fouling. The ultrafiltration membrane showed its effectiveness on retaining macromolecules and remaining enzyme present in the hydrolysate liquours, as well as XOS with side groups. Fractionation of low, medium and high DP XOS could be accomplished by the nanofiltration membranes. This study showed the potential to integrate membrane technology into the existing pulp and paper industries for large scale production of XOS to fully realise their commercial applications.

Keywords: Hemicellulose; Nanofiltration; Ultrafiltration; Xylo-oligosaccharides

