Directing filtration to narrow molecular weight distribution of oligodextran in an enzymatic membrane reactor - DTU Orbit (27/07/2019)

Directing filtration to narrow molecular weight distribution of oligodextran in an enzymatic membrane reactor

Oligodextrans with molecular weight (Mw) within the range of 5.0–8.0kDa have great commercial potential as precursors of iron-dextran for anemia treatment. Traditional oligodextran production consists of sucrose fermentation, acid hydrolysis and ethanol precipitation, which results in an uneven Mw product, hypersaline wastewater discharge and potential safety hazards. In this work, a novel enzymatic membrane reactor (EMR) system to produce oligodextran is proposed, whereby in-situ product recovery can be manipulated to control the Mw distribution of the resulting products. Results showed that the membrane material played an important role in the permeate flux and transmission of oligodextran. Among the tested membranes, a 20kDa polyethersulfone (PES) membrane was found to be optimal for building up the EMR, as it successfully controlled the oligodextran Mw within the desired range with a relatively narrow distribution and high productivity. Moreover, high transmembrane pressures (3 bars) and low stirring rates (160rpm) promoted yields beyond 50% in 120min. Higher permeate fluxes prevented further product hydrolysis and enhanced the yield. However, the resulting concentration polarization (CP) should be minimized to reduce accumulation of large oligodextran molecules on the membrane surface, which might diffuse through the membrane and thus broaden the Mw distribution of the products in the permeate. Both dextranase and dextran caused membrane irreversible fouling. The fouling caused by the enzymes not only favored the enzyme immobilization itself, but also contributed to narrow the membrane pore size distribution. As a result, a higher uniformity of oligodextran products compared with the pristine EMR was obtained, especially at the beginning of operation with EMR (which was improved by 22%). It was concluded that selecting the suitable membrane type and permeate flux, maximizing the shear rate, and narrowing the membrane pore size distribution were effective strategies to obtain high-quality oligodextran products by EMRs.

General information
Publication status: Published
Organisations: Department of Chemical and Biochemical Engineering, Center for BioProcess Engineering, Chinese Academy of Sciences
Pages: 268-279
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Journal of Membrane Science
Volume: 555
ISSN (Print): 0376-7388
Ratings:
BFI (2018): BFI-level 2
Scopus rating (2018): CiteScore 7.24 SJR 2.119 SNIP 1.761
Web of Science (2018): Impact factor 7.015
Web of Science (2018): Indexed yes
Original language: English
Keywords: Ultrafiltration, Oligosaccharide, Dextranase, Membrane fouling, Product separation
DOIs: 10.1016/j.memsci.2018.03.062
Source: RIS
Source-ID: urn:7920240048985973EBC4D1EF025C583A
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review