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EFFECT OF TEMPERATURE AND CROSS-FLOW VELOCITY ON FLUX DURING THE SYNTHESIS OF GALACTOOLIGOSACCHARIDES IN AN ULTRAFILTRATION MEMBRANE BIOREACTOR

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Galacto-oligosaccharides (GOS) are enzymatically synthesized prebiotics using lactose as substrate and β-galactosidase as catalyst. The reaction is kinetically controlled and inhibited by galactose derived from lactose hydrolysis. Membrane bioreactors (MBR) are a promising alternative to improve this bioprocess enabling the selective removal of the products from the reaction media. The aim of this work was to evaluate the effect of temperature and cross-flow velocity on the flux obtained during GOS synthesis in an ultrafiltration-MBR. To retain the enzyme, a tubular ceramic-membrane (cutoff: 50 kDa) and retentate recirculation mode was used. The reacting mixture was composed of lactose solution (40%w/w) at pH 4.5 containing *Aspergillus oryzae* β-galactosidase dosed at 50 IU/g-lactose. Transmembrane pressure was fixed at 2.5 bar. A 2^k factorial design with two central points was used to evaluate the effect of temperature (40°C, 50°C and 60°C) and cross-flow velocity (3.5 m/s, 4.4 m/s and 5.3 m/s) on the flux reached at 240 minutes of filtration. As expected, temperature had a strong effect on flux; cross-flow velocity had no significant effect ($p < 0.05$) and no interaction between these variables was observed. This could be due to a decrease in the permeate viscosity when the temperature was increased (from 3.2 cp at 40°C to 1.9 cp at 60°C). An optimum stable flux value of 49.5 kg/m2/h was predicted at 60°C and 3.5 m/s. Therefore, best process condition was reached at the lower crossflow velocity, increasing the system productivity with less power requirement.

Keywords: galacto-oligosaccharides, ultrafiltration, membrane-bioreactor, *Aspergillus oryzae*, β-galactosidase

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