Process Design for the Biotechnological Production of Xylitol and Value-Added Coproducts

Vollmer, Nikolaus I.

Publication date:
2021

Document Version
Publisher's PDF, also known as Version of record

Nikolaus I. Vollmer
PhD Student
PROSYS, KT Consortium
nikov@kt.dtu.dk

Supervisors
Gürkan Sin, DTU
Solange I. Mussatto, DTU
Krist V. Gernaey, DTU

Interests & Keywords
- CAPE
- PSE
- Process Design
- Bioprocesses
- Optimization

Process Design for the Biotechnological Production of Xylitol and Value-Added Coproducts

Xylitol is a sugar substitute with manifold beneficial health properties that gained significant attraction in the last decade [1]. There exists a great potential to be produced biotechnologically with engineered cell factories, as opposed to the current chemical production process, which imposes high requirements regarding, e.g., purity and consequently leads to high product prices [2]. Moreover, lignocellulosic biomass as feedstock for the biotechnological process adds further benefits in terms of sustainability. However, the use of lignocellulosic biomass as feedstock introduces several challenges for the conceptual design of the biotechnological processes, as considerations about potential value-added co-products, pretreatment technologies, and possibilities for process integration amongst others, as shown in Figure 1.

In the presented study for a base-case process design, a synergistic optimization-based process design framework (S3O) is used to overcome the named hurdles and to conceptually design this process [3]. In this base case, succinic acid and sustainable aromatic kerosene are chosen as value-added co-products and wheat straw as feedstock. Also, the generation of heat as a product for possibly integrating it with the other products' downstream processes is considered. As the objective function in the framework, key performance indicators (e.g., net present value) are selected. The resulting process itself is evaluated against both criteria of being economically viable compared to the chemical process and being sustainable.

Figure 1. Set of primary and value-added co-products for the biotechnological production of xylitol

Acknowledgments

The project is part of the Fermentation-Based Biomanufacturing Initiative at DTU and is funded by the Novo Nordisk Foundation under the grant NNF17SA0031362.

References

[1] A.F. Hernández-Pérez et al. *Critical Reviews in Biotechnology*, Vol. 39(7), 2019, pp. 924-943.
[2] Y.D. Arcaño et al. *Catalysis Today*, Vol. 344, 2020, pp. 2-14.
[3] N.I. Vollmer et al. *Frontiers in Chemical Science and Engineering*, under review.