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Published in:
Digitally Driven Biotechnology 4th DTU Bioengineering symposium

Publication date:
2023

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

Poster no 9

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Lignin from lignocellulose has remarkable properties to exploit in future applications like batteries, carbon fibers, plastics, and even pharmaceuticals [1]. However, the utilization of lignocellulose is challenging to exploit due to high recalcitrance and current conversion strategies are destructive, which significantly reduces the quality, consistency and therefore potential use of the aromatic polymer. I want to investigate how extraction of lignin can be improved by the use of enzymes and non-catalytic proteins. I hypothesize that microbial expansin-like proteins can disrupt non-covalent interactions within the lignocellulosic matrix and thereby aid the fractionation of high-quality lignin. Expansins are originally found in plant cells where the function is to loosen the compact structure of the wall to make cell elongation possible. Microbial expansins are found in plant associated and plant degrading bacteria and fungi. Since these organisms do not have cellulosic cell walls the expansins are considered related to the plant-microbe interactions. The expansin structure consists of two domains: a double-psi β-barrel (DPBB) and a carbo-hydrate-binding module family 63 (CBM63). The DPBB is structural similar to glycoside hydrolase family 45 (GH45) but without catalytic activity. I will in my project investigate the physical interaction between soluble microbial expansins and insoluble substrates from biomass to achieve milder and more specific processes for high value lignin extraction. I will assess the binding affinity of expansins with pull-down assays and QCM-D and study synergistic effects of microbial expansins and lignocellulose active enzymes.

References

[1] Abu-Omar, M. M., Barta, K., Beckham, Guidelines for performing lignin-first biorefining. Energy & Environmental Science, 14, 262-292 (2021).