Cellulases adsorb reversibly on biomass lignin

Adsorption of cellulases onto lignin is considered a major factor in retarding enzymatic cellulose degradation of lignocellulosic biomass. However, the adsorption mechanisms and kinetics are not well understood for individual types of cellulases. This study examines the binding affinity, kinetics of adsorption, and competition of four monocomponent cellulases of *Trichoderma reesei* during adsorption onto lignin. *TrCel7A*, *TrCel6A*, *TrCel7B* and *TrCel5A* were radiolabeled for adsorption experiments on lignin-rich residues (LRRs) isolated from hydrothermally pretreated spruce (L-HPS) and wheat straw (L-HPWS), respectively. Based on adsorption isotherms fitted to the Langmuir model, the ranking of binding affinities was *TrCel5A* > *TrCel6A* > *TrCel7B* > *TrCel7A* on both types of LRRs. The enzymes had higher affinity to the L-HPS than to the L-HPWS. Adsorption experiments with dilution after 1 h and 24 h and kinetic modelling were performed to quantify any irreversible binding over time. Models with reversible binding parameters fitted well and can explain the results obtained. The adsorption constants obtained from the reversible models agreed with the fitted Langmuir isotherms and suggested that reversible adsorption-desorption existed at equilibrium. Competitive binding experiments showed that individual types of cellulases competed for binding sites on the lignin and the adsorption data fitted the Langmuir adsorption model. Overall, the data strongly indicate that the adsorption of cellulases onto lignin is reversible and the findings have implications for development of more efficient cellulose degrading enzymes.

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