Semi-mechanistic modelling of enzyme secretion and activity, in rate limiting enzymatic hydrolysis processes.

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Background

Anaerobic digestion of recalcitrant substrate for biogas production, is often a limiting factor in terms of the rate of digestion. This is typically caused by the rate limiting step of enzymatic hydrolysis. In spite of the pivotal role of enzymatic hydrolysis, the kinetics of these in associated biotechnological processes, is not well understood. Instead, current models assume a first-order kinetic when describing the rate of hydrolysis. This may suggest that the rate of hydrolysis is directly proportional to the size of the microbial community, which is not necessarily true [1].

Project

This project will:

1) Track kinetics of mass transfer between the cellular domains using isotope labelling, NMR and MS.
2) Perform transient enzyme activity assays to determine enzyme activity in the extracellular domain.
3) Combine intracellular and extracellular kinetics to a semi-mechanistic model for enzymatic hydrolysis.

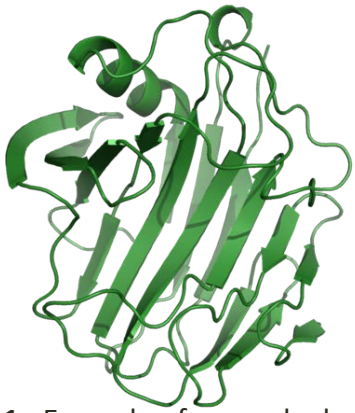

Fig 1. Example of an endoglucanase enzyme (a cellulase). Originates from *Streptomyces lividans* [2].

Motivation

Circumvention of rate limitations of enzymatic hydrolysis could result in biomass being anaerobically treated at higher rates, suggesting more biomass can be treated annually. The increased rates of biomass utilization and efficiency could play a pivotal role in making many biotechnological processes economically viable in the future, and aid the transition to a bio-based economy.

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