Study of enzymatic synergies in lignocullulosic biomass bioconversion

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Abstract

Lignocellulosic biomass can be converted into fermentable sugars by the synergistic action of enzymes including exo- endo-glucanases and β-glucosidases. Commercial cellulolytic cocktails based on T. reesei enzymes, such as Celluclast 1.5 L, are generally deficient in β-glucosidase activity, and are therefore complemented by the latter for lignocellulosic biomass processing. In this context, the β-glucosidase produced by Aspergillus niger strain BG has been tested for its ability to saccharify cellulose from lignocellulosic biomass such as sugarcane bagasse and wheat straw and bran, which are abundant renewable resources in the biosphere and can be hydrolyzed to glucose by the synergistic action of the cellulase complex for conversion to bioethanol.

The ability of β-glucosidase to saccharify lignocellulosic biomase was assessed by measuring the glucose released from pre-treated sugarcane bagasse, straw and wheat bran. Commercial cocktails rich in enzymatic activity were used as catalysts (Novozymes, Copenhagen, Denmark). These were mixtures of Celluclast 1.5 L, rich in cellobiohydrolase and endoglucanase activity, with either purified β-glucosdase enzyme, or NS-50010, which is a cocktail with high β-glucosidase activity. Lignocellulosic biomase (3g) was saccharified in 250 mL Erlens containing 100 mL of enzyme solution (2 U/mL) in sodium formate buffer (50 mM) pH 4.0. Free glucose was measured at different reaction times using the commercial Glucose-TR kit (Spinreact).

Synergistic effects show that supplementation with A.niger β-glucosidase improves biomass saccharification, compared with the use of celluclast alone, achieving yields of 18% with wheat bran, 14% with wheat straw and 29% with bagasse.

These findings suggest that the β-glucosidase from A.niger strain BG could be a suitable protein in the lignocellulosic biomass valorization process, representing an efficient and inexpensive alternative for cellulose saccharification.

Keyword: Lignocellulosic biomass, synergistic effect, Saccharification, B-glucosidase,