


Use of an inexpensive carbon source for the production of a cellulase enzyme complex from *Penicillium ucsense* S1M29 and enzymatic hydrolysis optimization

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Abstract: The high cost of cellulolytic enzyme complexes (CECs) has been a significant impediment to the commercial production of bioproducts from lignocellulose biomass. This study aimed to develop a cost-effective CEC derived from *Penicillium ucsense* (former *Penicillium echinulatum*), utilizing diverse forms of pretreated sugarcane bagasse as the primary carbon/inductor source. Among the different pretreatments used, the hydrothermal pretreatment followed by NaOH delignification (BHD) produced higher FPase and xylanase activities (4.5 FPU mL⁻¹ and 120 IU mL⁻¹) in bioreactor experiments at 20 g BHD L⁻¹ initial concentration. A batch-mode assay conducted across a range of initial carbon source (5 to 60 g L⁻¹) confirmed the highest FPase activity (4.0 to 5.0 FPU mL⁻¹ at 120 h), in the range of 20–40 g BHD L⁻¹. During these assays the agitation rate, controlled by dissolved O₂, tended to stabilize at lower levels, indicating substrate limitation. Conversely, higher initial carbon source concentrations led to an excess of glucose, likely triggering carbon catabolite repression and inhibiting cellulase production. This insight prompted the development of a controlled pulsed fed-batch strategy, resulting in FPase activity of 11 FPU mL⁻¹ at 220 h using 90 g L⁻¹ BHD controlled fed into the bioreactor. An enzymatic hydrolysis procedure using the generated CEC was also optimized using a central composite rotational design (CCRD). The optimized enzyme hydrolysis conditions achieved a reducing sugar concentration of 80.9 g L⁻¹ in 48 h using 170 g L⁻¹ of BHD as the substrate at a ratio of 15 FPU of enzyme substrate per g of BHD.

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