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Chrysoporthe cubensis: A new source of cellulases and hemicellulases to application in biomass saccharification processes

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HIGHLIGHTS

- *Chrysoporthe cubensis* is new fungal source of cellulases and hemicellulases.
- The enzymes showed pH and temperature optimum appropriate to biomass conversion.
- *C. cubensis* extract was more efficient than commercial cellulases for biomass hydrolysis.
- *C. cubensis* extract can be used as β-glucosidase supplement.

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ABSTRACT

The plant pathogenic fungus *Chrysoporthe cubensis* was cultivated under solid state employing different substrates and the highest endoglucanase (33.84 U g^{-1}), FPase (2.52 U g^{-1}), β-glucosidase (21.55 U g^{-1}) and xylanase (362.38 U g^{-1}) activities were obtained using wheat bran as carbon source. Cellulases and xylanase produced by *C. cubensis* showed maximal hydrolysis rate at pH 4.0 and in a temperature range of 50–60 °C. All enzymatic activities were highly stable at 40 and 50 °C through 48 h of pre-incubation. Saccharification of alkaline pretreated sugarcane bagasse by crude enzyme extract from *C. cubensis* resulted in release of 320.8 mg/g and 288.7 mg/g of glucose and xylose, respectively. On another hand, a similar assay employing commercial cellulase preparation resulted in release of 250.6 mg/g and 62.1 mg/g of glucose and xylose, respectively. Cellulolytic extract from *C. cubensis* showed a great potential to be used in biomass saccharification processes.

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1. Introduction

There is currently great interest in the degradation of lignocellulosic materials to monomeric sugars through the concerted action of cellulolytic enzymes, since sugars can serve as raw materials for production of valuable products such as ethanol, acid lactic, methane, hydrogen and others (Juhasz et al., 2005). Growing concerns over the potential consequences of a worldwide shortage of fossil fuels, the emission of greenhouse gases and air pollution by incomplete combustion has resulted in an increased focus on the production of bioethanol from lignocellulosics and especially the possibility of using cellulases and hemicellulases to perform enzymatic hydrolysis of the lignocellulosic materials (Camassola and Dillon, 2007; Kumar et al., 2009)

The biotechnological conversion of cellulose into fermentable sugars requires a cooperative and synergistic action among three main enzyme types. Endoglucanases (E.C. 3.2.1.4) randomly attack cellulose chains generating reducing and non-reducing ends. Cellobiohydrolases (E.C. 3.2.1.91) act over the reducing and non-reducing ends, releasing cellobiose units which are converted to glucose by the action of β-glucosidase enzymes (E.C. 3.2.1.21) (Lynd et al., 2002). Moreover, hemicellulolytic enzymes such as xylanases (E.C. 3.2.1.8), mannanases (E.C. 3.2.1.78), β-xylosidases (E.C. 3.2.1.37), β-mannosidases (E.C. 3.2.1.25), α-Arabinofuranosidase (E.C. 3.2.1.55) and α-galactosidases (E.C. 3.2.1.22), also play an important roles in the cellulose depolymerization process. These enzymes hydrolyze and remove the hemicellulose fragments that coat the cellulose fibers, increasing cellulose accessibility and boosting the action of cellulases (Berlin et al., 2007; Juhasz et al., 2005).

The major bottleneck to lignocellulosic bioethanol production is the high cost of the cellulolytic enzymes. Large-scale application of cellulases for lignocellulosic material degradation processes

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