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Performance of hemicellulolytic enzymes in culture supernatants from a wide range of fungi on insoluble wheat straw and corn fiber fractions

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ABSTRACT

Filamentous fungi are a good source of hemicellulolytic enzymes for biomass degradation. Enzyme preparations were obtained as culture supernatants from 78 fungal isolates grown on wheat straw as carbon source. These enzyme preparations were utilized in the hydrolysis of insoluble wheat straw and corn fiber xylan rich fractions. Up to 14% of the carbohydrates in wheat straw and 34% of those in corn fiber were hydrolyzed. The degree of hydrolysis by the enzymes depended on the origin of the fungal isolate and on the complexity of the substrate to be degraded. *Penicillium*, *Trichoderma* or *Aspergillus* species, and some non-identified fungi proved to be the best producers of hemicellulolytic enzymes for degradation of xylan rich materials. This study proves that the choice for an enzyme preparation to efficiently degrade a natural xylan rich substrate, is dependent on the xylan characteristics and could not be estimated by using model substrates.

1. Introduction

Filamentous fungi are a good source of hemicellulolytic enzymes for biomass degradation. Their levels of enzyme excretion in the fermentation media are high, although strongly dependent on growth conditions (Gírio et al., 2010; Van Gool et al., 2011). By degradation of soluble complex substrates it was found that hemicellulolytic enzymes are produced by soil microbes. Between different types of soil microbes, a huge variation in production of specific hemicellulolytic enzymes exists, next to various levels of expression of those enzymes (Van Gool et al., 2011). For the selection of powerful cellulases it has been stated before that instead of using dyed substrates, the use of real-life insoluble substrates is a better selection tool (Kabel et al., 2006; Zhang et al., 2006). Furthermore, Berrin and Juge (2008) reported that solubility of a substrate is one of the factors affecting xylanase functionality. Therefore, different insoluble substrates, varying from a relatively simple to a complex xylan-cellulose network like wheat straw and corn fiber, may be useful to reveal the potential ability of the xylan degrading enzyme preparations to degrade these substrates.

The composition of wheat straw and corn fibers is described in literature (Appeldoorn et al., 2010; Remond-Zilliox et al., 1997; Van Eylen et al., 2011). Next to cellulases to degrade the cellulose, hydrolysis of xylans requires a variety of enzymes. Hydrolysis of the xylan backbone is done by endoxylanases (EC 3.2.1.8) and β-xylosidases (EC 3.2.1.37). The endoxylanases will cleave the xylan backbone into oligosaccharides, which are degraded to xylose by β-xylosidases. Arabinose residues can be removed by arabinofuranosidases (EC 3.2.1.55). Glucuronic acid residues and their 4-O-methyl ethers can be removed from the xylan backbone by α-glucuronidases (EC 3.2.1.131). Acetyl xylan esterases (EC 3.1.1.72) release acetyl residues from the backbone of cell wall polysaccharides (Van Gool et al., 2011). Finally, feruloyl and *p*-coumaroyl esterases (EC 3.1.1.73) can remove the ferulic- and coumaric acid residues (Appeldoorn et al., 2010).

The current research focused on the screening of 78 fungal culture supernatants for their ability to digest insoluble wheat straw and corn fiber fractions. Results will be discussed and compared with the results of previously tested wheat arabinoxylan (WAX) and eucalyptus xylan hydrolysate (EXH) (Van Gool et al., 2011).

2. Methods

2.1. Fungi

Culture supernatants of 78 mesophilic lignocellulolytic fungi grown on wheat straw as carbon source, were obtained as described previously (Van Gool et al., 2011). The taxonomy the fungi is described in Supplementary Table A1.

2.2. Chemicals and substrates

All chemicals were, if not mentioned otherwise, of analytical grade. Wheat straw water unextractable solids (WS WUS) and corn fiber alcohol insoluble solids (CF AIS) were used as substrates.

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