Paenibacillussp. A59 GH10 and GH11 - Extracellular Endoxylanases: Application in Biomass Bioconversion

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Abstract

The cost-efficient degradation of xylan to fermentable sugars is of particular interest in second generation bioethanol production, feed, food and pulp and paper industries. Multiple potentially secreted enzymes involved in polysaccharides deconstruction are encoded in the genome of Paenibacillus sp. A59, a xylanolytic soil bacterium. Several were recognized as part of the xylanolytic system, such as three endoxylanases, seven GH43 β-xylosidases and two GH30 glucuronoxylanases. In secretome analysis of xylan grown cultures, 23 proteins were identified, including the three predicted endoxylanases, confirming their active role in xylan deconstruction. The two uni-modular xylanases, a 32 KDa-GH10 and a 20 KDa-GH11,were recombinantly expressed and activity on xylan was confirmed, showing differences in activity pattern consistent with their predicted GH family. Both endoxylanases released mainly xylobiose (X2) and xylotriose (X3) from xylan and pre-treated biomasses (extruded wheat straw, barley straw and sweet corn cob). However, in all cases, only rGH10XynA released xylose (X1), while rGH11XynB released soluble XOS of DP≥4. rGH10XynA presented optimal conditions at pH6, with thermal stability at 45°C-50°C, whilerGH11XynBshowed activity in a wider range of pH, from 5 to 9, and was thermostable only at 45°C.This study provides a detailed analysis of the complete set of carbohydrate active enzymes encoded in Paenibacillus sp. A59 genome and those effectively implicated in hemicellulose hydrolysis, contributing to understanding the mechanisms necessary for the bioconversion of this polysaccharide. Moreover, we have fully characterized the activity of recombinant GH10XynA and GH11XynB, the main free secreted endoxylanases, which can be applied in industrial bioprocesses on lignocellulosic biomass.

Keywords

Paenibacillus; endoxylanases; GH10; GH11;wheat straw.

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