Identification and characterization of GH11 xylanase and GH43 xylosidase from the chytridiomycetous fungus, Rhizophlyctis rosea

The early-lineage, aerobic, zoosporic fungi from the Chytridiomycota constitute less than 1% of the described fungi and can use diverse sources of nutrition from plant or animal products. One of the ancestral sources of fungal nutrition could be products following enzymatic degradation of plant material. However, carbohydrate-active enzymes from these ancient fungi have been less studied. A GH11 xylanase (RrXyn11A) (EC 3.2.1.8) and a GH43 xylosidase (RrXyl43A) (EC 3.2.1.37) were identified from an early-lineage aerobic zoosporic fungus, Rhizophlyctis rosea NBRC 105426. Both genes were heterologously expressed in Pichia pastoris and the recombinant enzymes were purified and characterized. The optimal pH for recombinant RrXyn11A and RrXyl43A was pH 7. RrXyn11A had high stability over a wide range of pH (4–8) and temperature (25–70 °C). RrXyn11A also showed high substrate specificity on both azurine-cross-linked (AZCL) arabinoxylan and AZCL xylan. RrXyl43A had β-xylosidase and minor α-L-arabinofuranosidase activity. This enzyme showed low product inhibition and retained 51% activity in the presence of 100 mM xylose. A combination of RrXyn11A and RrXyl43A exhibited significantly higher hydrolytic and polymer degradation capability and xylose release on wheat bran and beechwood xylan compared to treatment with commercial enzymes. This study was the first to heterologously express and characterize the GH11 xylanase (RrXyn11A) and GH43 xylosidase (RrXyl43A) from the ancient fungus, R. rosea. Meanwhile, this study also demonstrated that the enzymes from the ancient fungus R. rosea can be easily handled and heterologously expressed in Pichia, which presents a promising path to a new source of enzymes for biomass degradation.

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