MODIFIED XYLANASES

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of molecular biology. In particular, the present invention relates to the modification of xylanases and the use of the same in detergents.

BACKGROUND

[0002] In commercial detergent products, proteases, lipases and carbohydrate-active enzymes are commonly included to enhance the cleaning effect of the detergents. However, not all enzymes can tolerate exposure to a washing solution containing a detergent.

[0003] Thus, there is an unmet need for enzymes with improved activity when used in solutions containing detergents.

SUMMARY

[0004] In one aspect, the present disclosure refers to a modified enzyme comprising a heterologous non-catalytic carbohydrate-binding domain, wherein the enzyme is a xylanase and wherein the modified enzyme shows increased enzymatic activity in detergent solutions, wherein the non-catalytic carbohydrate-binding domain is selected from the group consisting of a non-catalytic carbohydrate-binding domain from *Cellulomonas fimi* (Cex) and a non-catalytic carbohydrate-binding domain from *Clostridium cellulovorans* (Clos), and wherein the modified enzyme shows increased enzymatic activity in the absence of cellulosic fabric or material.

[0005] In another aspect, the present disclosure refers to a composition comprising a detergent and modified enzyme as disclosed herein.

[0006] In yet another aspect, the present disclosure refers to a method of cleaning.

[0007] In a further aspect, the present disclosure refers to a method of modifying a xylanase enzyme for use in detergent solutions, the method comprising modifying the xylanase by attaching a carbohydrate-binding domain, wherein the carbohydrate-binding domain is selected from the group consisting of a non-catalytic carbohydrate-binding domain from *Cellulomonas fimi* (Cex) and a non-catalytic carbohydrate-binding domain from *Clostridium cellulovorans* (Clos), and wherein the modified xylanase shows increased enzymatic activity in the absence of cellulosic fabric or material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will be better understood with reference to the detailed description when considered in conjunction with the non-limiting examples and the accompanying drawings, in which:

[0009] **Fig. 1** shows column graphs depicting data showing the enzyme activity of rXyl, rXyl-CBDcex and rXyl-CBDclos in 0.2% v/v MES-based detergent solution containing 0.5% w/v xylan. Equal molar recombinant enzyme (25 pmol) was used in the enzyme assay. Hydrolysis was performed at 30°C, 40°C and 60°C, respectively, 1000 rpm, for 20 minutes. All experiments were performed in duplicates. The enzyme activity is expressed as μmol/mL of reducing sugar released in 20 minutes of reaction time. rXyl: control xylanase; rXyl-CBDcex: xylanase fused

CLAIMS

1. A modified enzyme comprising a heterologous non-catalytic carbohydrate-binding domain, wherein the enzyme is a xylanase and wherein the modified enzyme shows increased enzymatic activity in detergent solutions, wherein the non-catalytic carbohydrate-binding domain is selected from the group consisting of a non-catalytic carbohydrate-binding domain from *Cellulomonas fimi* (Cex) and a non-catalytic carbohydrate-binding domain from *Clostridium cellulovorans* (Clos), and wherein the modified enzyme shows increased enzymatic activity in the absence of cellulosic fabric or material.

2. The modified enzyme of claim 1, wherein the modified enzyme comprises an amino acid sequence selected from the group consisting of SEQ ID Nos. 11 and 12, or wherein the modified enzyme is encoded by a nucleic acid sequence selected from the group consisting of SEQ ID Nos: 5, 6, and 17.

3. The modified enzyme of claim 1 or 2, wherein the modified enzyme shows increased enzymatic activity at a temperature of 30°C, 40°C, or 60°C.

4. The modified enzyme of any one of the preceding claims, wherein the increased enzymatic activity is determined in comparison to the enzymatic activity of a wild-type enzyme.

5. A composition comprising a detergent and modified enzyme according to any one of claims 1 to 4.

6. The composition of claim 5, wherein the detergent is a methyl ester sulfonate-based detergent or a linear alkylbenzene sulfonate-based detergent.

7. The composition of claim 5 or 6, wherein the detergent is present at a concentration between 0.1% and 0.5%.

8. The composition of any one of claims 5 to 7, wherein the modified enzyme is present at a concentration of about 10 pmol/mL to about 400 pmol/mL.

9. The composition of any one of claims 5 to 8, wherein the composition shows increased

enzyme activity compared to a composition comprising a wild-type enzyme.

10. The composition of claim 9, wherein the composition shows increased enzyme activity compared to a composition comprising the wild-type enzyme, and in the absence of cellulosic fabric.

11. The composition of claim 10, wherein the composition is a non-cellulosic fabric detergent.

12. A method of cleaning, wherein the method comprises adding the composition according to any one of claims 5 to 11 before or during a wash process.

13. A method of modifying a xylanase for use in detergent solutions, the method comprising modifying the xylanase by attaching a carbohydrate-binding domain, wherein the carbohydrate-binding domain is selected from the group consisting of a non-catalytic carbohydrate-binding domain from *Cellulomonas fimi* (Cex) and a non-catalytic carbohydrate-binding domain from *Clostridium cellulovorans* (Clos), and wherein the modified xylanase shows increased enzymatic activity in the absence of cellulosic fabric or material.