Post-doctoral position on the activity of LPMO enzymes on cellulose

INRAE Biodiversité et Biotechnologie Fongiques (BBF)

INRAE Biopolymères, Interactions et Assemblages (BIA)

Co-directed by: Jean-Guy Berrin, Bernard Cathala and Ana Villares

Starting date: September 2021 (16 months)

Employer: INRAE

This post-doc is a collaboration between two laboratories:

(i) The Fungal Biodiversity and Biotechnology (BBF) laboratory from INRAE located in Marseille (France) under the supervision of Jean-Guy Berrin. BBF works on innovative means for biomass valorization or chemical precursors, high value-added compounds and energy. Research topics aim at enzymatic degradation of lignocellulose.

(ii) The Biopolymers Interactions and Assemblies (BIA) unit from the French National Institute for Food, Agriculture and Environment Research (INRAE) located in Nantes (France), more precisely in the Nanostructured Assemblies (Nano) team under the supervision of Bernard Cathala and Ana Villares. BIA unit focuses on the preparation of materials/arrangements with biopolymers from agricultural sources and the structural characterization of such nanostructures.

Context:
Lytic polysaccharide monooxygenase (LPMO) enzymes are recently discovered fungal enzymes. They are distributed in seven CAZy families (Carbohydrate Active enZymes database; http://www.cazy.org), which are differentiated by their amino acid sequences and substrate specificities (AA9, AA10, AA11, AA13-AA16).[1-3] LPMOs contain a type II copper ion coordinated by the commonly referred to as the histidine brace, which is composed of an *N*-terminal methylated His and an internal His for the equatorial Cu coordination. LPMO from the AA9 family are only found in fungi, are active on cellulose, cello-oligosaccharides and β-(1-4)-linked hemicelluloses and can contain additional module to strengthen their binding to the substrate.[1, 4]

LPMOs breakdown cellulose by activation of oxygen, in a reducing -dependent manner at a copper-containing active site exposed at the surface of the enzyme. Different electron donors can trigger LPMOs action including cellobiose dehydrogenases, glucose-methanol-choline oxidoreductases and plant-derived and fungal phenols. Oxidative cleavage of cellulose leads to the formation of oxidized glucose units at different positions resulting in the formation of aldonic acids at the C1 position and/or 4-ketoaldoses (gemdiols) at the C4 position.[1]

LPMO enzymes have demonstrated to play a key role in the degradation of lignocellulosic biomass in nature, and they have recently been included in industrial saccharification enzymatic cocktails for biofuels and biorefinery applications. Furthermore, in recent studies, we have demonstrated their potential use as a pretreatment to reduce energy required for cellulose fibrillation when preparing cellulose nanofibers.[5-6]

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However, the mechanism of action of LPMOs on the cellulose fiber is still unclear. This is of special importance for defining conditions in applications including biomass deconstruction, such as saccharification or fibrillation, for both pure LPMO and enzymatic cocktails.

Postdoc project:

This postdoctoral position aims at investigating the action of LPMO enzymes on the cellulose fiber. The purpose of the study is to control the enzymatic activity for two main goals: (i) to get more insight into the mechanism of action of LPMO enzymes, and (ii) to use LPMO enzymes as a tool for the functionalization of cellulose fibers. For this purpose, we propose the following objectives:

1. To understand the mechanism of action of LPMO enzymes on cellulose.
2. To quantify the oxidative action of LPMO enzymes.
3. To develop one-pot functionalization of cellulose.

The candidate will prepare and characterize different cellulose substrates, and he/she will study the effect of LPMO enzymes by different approaches (microscopy, chromatography, NMR…).

Candidate profile:

We look for a candidate having a strong team working ability, with education in chemistry, physical chemistry, biochemistry or related. Knowledge of at least one of the following topics is particularly welcome: biopolymers, physical chemistry of biopolymers, nanotechnology, enzymes.

Application procedure: Send a brief CV (maximum 2 pages) and a cover letter to Jean-Guy Berrin (jean-guy.berrin@inrae.fr), Bernard Cathala (bernard.cathala@inrae.fr) and Ana Villares (ana.villares@inrae.fr) and including two references for possible recommendation.

Deadline for applications: June 16th.

References

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