Utilizing an LPMO from *Fusarium oxysporum* for the functionalization of lignocellulose-derived and bacterial nanocellulose

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Keywords: Lytic Polysaccharide Monooxygenases, AA9, *Fusarium oxysporum*, Enzymatic Functionalization, Bacterial Nanocellulose

Lytic polysaccharide monooxygenases (LPMOs) have gained significant attention for their role in oxidative biomass degradation, particularly in breaking down recalcitrant polysaccharides including cellulose[1]. Their unique mechanism of action improves the efficiency of hydrolytic enzymatic processes for biomass conversion, making them valuable in biotechnological applications. In this study, we examine an AA9 LPMO from *Fusarium oxysporum* (*Fo*LPMO9A), the first AA9 LPMO characterized from this species, and its role in producing functionalized nanocellulose, a material with promising potential for sustainable applications[2]. *Fo*LPMO9A was heterologously produced in *Pichia pastoris* and biochemically characterized, followed by functional studies to explore its interactions with glycoside hydrolases on cellulose depolymerization. Additionally, several lignin-derived phenolic compounds were tested for their ability to act as reducing agents for *Fo*LPMO9A, while the addition of other auxiliary activity enzymes was explored. The enzyme demonstrated broad regioselectivity toward cellulose, producing C1, C4, and C1/C4 oxidized cello-oligosaccharides, a property that was further utilized for applications in cellulosic material grafting. Following its biochemical characterization, *Fo*LPMO9A was applied in two distinct nanocellulose production processes. First, *Fo*LPMO9A, combined with cellulases, acted on lignocellulosic biomass from agricultural waste, producing functionalized nanocellulose and fermentable sugars[3]. These sugars were then used at another process to feed different bacterial species that synthesize nanocellulose. To our knowledge, the employment of LPMO for the functionalization of bacterial nanocellulose represents a novel approach. Structural analysis of the nanocellulose produced from both streams confirmed successful modifications, highlighting its potential as a sustainable alternative to plastics in bio-based material applications, with *Fo*LPMO9A playing a key role.

Acknowledgments: The research project NanoHybrid is implemented in the framework of H.F.R.I's call "Basic research Financing (Horizontal support of all Sciences)" under the National Recovery and Resilience Plan "Greece 2.0" funded by the European Union – NextGenerationEU (H.F.R.I. Project Number: 015795).

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