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A BIOTECHNOLOGICAL STRATEGY FOR THE VALORIZATION OF CELLULOSE THROUGH LEVOGLUCOSENONE

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Levoglucosenone (LGO) is a relatively complex chiral chemical platform obtained through the catalytic fast pyrolysis of cellulose (Furacell™ process). The conservation of a natural chiral center procures to this compound a particular interest for the food/feed, cosmetic and pharmaceutical industries. For instance, it can be transferred to synthetize chiral inhibitors of enzymatic reactions occurring in pathogens. Furthermore, the α,β-unsaturated ketone and the protected aldehyde of LGO allow a wide range of chemical reactions.

Previous studies showed that various synthons can be obtained from LGO.[1-4] (S)-γ-hydroxymethyl-α,β-butenolide (HBO), (S)-γ-hydroxymethyl-α,β-butyrolactone (2H-HBO) and Cyrene® are probably the most interesting among them since they have many applications in the food/feed and pharmaceutical industries. HBO and 2H-HBO are respectively precursors of drugs and flavors, while Cyrene® is a good substituent for toxic dipolar aprotic solvents such as NMP, DMF or sulfolane.

Different pathways to access these molecules of interest were described in the literature (Koseki and Paris procedures),[5,6] but recently Allais et al. developed more efficient and greener pathways.[7] Despite being efficient in terms of yields and cost, not only these methods can be dangerous to perform - notably at large scale - (i.e., dihydrogen), but the presence of potential metal residues - even in ppm quantities - may also limit their utilizations in certain applications. It is the case for the electronical industry which tolerate only a minimal presence of metal ions, i.e. a maximum of 100 parts per billion (ppb). These drawbacks could also limit the potential of these molecules in the food/feed, cosmetic and pharmaceutical sectors.

To overcome these issues, the use of enzymatic reactions has been considered to replace these problematic steps. A biocatalytic process involving an alkene reductase has been developed to access Cyrene® which can be further be transformed to 2H-HBO using a monooxygenase. For both steps, quantitative conversion and yields were observed.

Figure 1 – Cellulose's Valorization through Levoglucosenone

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