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TOPIC(s) : Biocatalytic cascade reactions

Biocatalytic route for castor oil and furan derivatives valorisation

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PURPOSE OF THE ABSTRACT
The utilization of vegetable oils and their derivatives as raw materials came in the spotlight of green chemistry in the past decades. Their universal availability, low price, and biodegradability place oil derivatives as important biobased sources for polymer synthesis, as well [1]. Castor oil is one of the most studied natural oils due to its high content of ricinoleic acid, a natural hydroxy acid (> 80%). The presence of the double bond in the ricinoleic acid molecule allows additional functionalization by grafting reactions. Copolymers of hydroxy acids have been already synthesized by biocatalysis and have promising applications in several fields [2].
5-Hydroxymethylfurfural (HMF), a biobased platform chemical obtained during biomass pretreatment allows a wide range of chemical modifications, leading to important value-added products. Recently, it has been quantitatively oxidized to 5-hydroxymethyl-2-furoic acid (5OH2FA) by Gluconobacter oxydans DSM 50049 cells [3]. A combination of vegetable oil and furan derivatives represents a sustainable synthetic way to materials with original properties obtained through simple, green, and efficient processes.
In this study, the polymerization of ricinoleic acid and 5OH2FA was investigated by a green biocatalytic pathway. The reactions were carried out using commercially available native and immobilized lipases as catalysts in organic solvents, ionic liquids, and solvent-free systems, at various molar ratios and temperatures up to 80°C. The lipase from Pseudomonas stutzeri showed the highest catalytic efficiency at 50°C in t-BuOH. The insertion of 5OH2FA units into the ricinoleic acid estolide backbone was demonstrated by MALDI-TOF MS and 2D NMR analysis. The thermal properties of the oligoester products were evaluated by TG and DSC.
The organogelator ability of the resulted oligoesters in the absence or presence of other components was tested by using several organic solvents with different log P values, at different temperatures. The morphological, and rheological properties of the resulted organogels were evaluated.
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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

ricinoleic acid | 5-hydroxymethyl-2-furancarboxylic | enzymatic polymerization | biocatalytic one-pot synthesis

BIBLIOGRAPHY