Enhanced biocatalytic esterification with lipase-immobilized chitosan/graphene oxide beads

ABSTRACT

In this work, lipase from Candida rugosa was immobilized onto chitosan/graphene oxide beads. This was to provide an enzyme-immobilizing carrier with excellent enzyme immobilization activity for an enzyme group requiring hydrophilicity on the immobilizing carrier. In addition, this work involved a process for the preparation of an enzymatically active product insoluble in a reaction medium consisting of lauric acid and oleyl alcohol as reactants and hexane as a solvent. This product enabled the stability of the enzyme under the working conditions and allowed the enzyme to be readily isolated from the support. In particular, this meant that an enzymatic reaction could be stopped by the simple mechanical separation of the "insoluble" enzyme from the reaction medium. Chitosan was incorporated with graphene oxide because the latter was able to enhance the physical strength of the chitosan beads by its superior mechanical integrity and low thermal conductivity. The X-ray diffraction pattern showed that the graphene oxide was successfully embedded within the structure of the chitosan. Further, the lipase incorporation on the beads was confirmed by a thermo-gravimetric analysis. The lipase immobilization on the beads involved the functionalization with coupling agents, N-hydroxysulfosuccinimide sodium (NHS) and 1-ethyl-(3-dimethylaminopropyl) carbodiimide (EDC), and it possessed a high enzyme activity of 64 U. The overall esterification conversion of the prepared product was 78% at 60°C, and it attained conversions of 98% and 88% with commercially available lipozyme and novozyme, respectively, under similar experimental conditions.

Keyword: Candida rugosa; Chitosan; Graphene oxide; Enzyme immobilization; Enzyme