Optimum Synthesis of Lipase-catalyzed Biodiesel Using a Continuous Packed-bed Bioreactor

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ABSTRACT

Biodiesel (fatty acid alkyl esters) is synthesized by transesterification of triglycerol with short-alcohol and have recently attracted attention due to its environmental benefits and renewable resource. Most of them are industrially produced by chemical method but it has many drawbacks such as high temperature, difficultly in revory glycerol, the removal requirement of salt residues, and high energy cost. To overcome these drawbacks, the utilization of biocatalysts (enzymatic) to synthesize biodiesel by transesterification under mild conditions has attracted considerable attention in recent years. A useful method for enzymatic synthesis biodiesel catalyzed by immobilized lipase from Candida antarctica (NovozymR 435) in a continuous process was investigated. NovozymR 435 was packed in a packed-bed reactor to catalyzed transesterification of methanol (or isopropanol) and soybean oil for biodiesel synthesis in tert-butanol (or solvent-free) system will be discussed in this study. Response surface methodology (RSM) and 3-factor-3-level Box-Behnken design were employed to evaluate the effects of synthesis parameters, such as flow rate (0.1 – 0.5 mL/min),temperature (40 – 50 oC), and substrate molar ratio of methanol (or isopropanol) to soybean oil (1:3 – 1:5) on percentage molar conversion of biodiesel by transesterification. The result shows that temperature and flow rate were significant effects on the percent molar conversion in the two systems (methanol and isopropanol). Based on ridge max analysis, (1) in the conversion of methyl esters, the optimum conditions for synthesis were: temperature 52.09 ?C, flow rate 0.10 mL/min, and substrate molar ratio 1:4. The predicted value was 83.31 ± 2.07% and actual experimental value was 82.81 ± 0.98% molar conversion. (2) In the conversion of isopropyl esters, the optimum conditions for synthesis were: temperature 51.5 ?C, flow rate 0.10 mL/min, and substrate molar ratio 1:4.14. The predicted value was 76.62 ± 1.52% and actual experimental value was 75.62 ± 0.81% molar conversion. Moreover, synthesis methyl and isopropyl esters with continuous process did not show any appreciable decrease in the percent molar conversion for over 30 d and 7 d, respectively. It demonstrates that synthesis of lipase-catalyzed biodiesel was produce by effective in scale-up of industrialization.

Keywords : Biodiesel ; Isopropanol ; Lipase ; Transesterification ; Packed-bed reactor ; Response surface methodology

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