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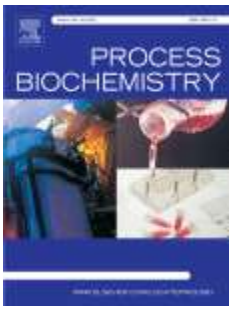

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Kinetic study on the production of biodegradable lubricant by enzymatic transesterification of high oleic palm oil

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Abstract

Kinetic studies are necessary to identify inhibitors of lipase enzyme deactivation in reaction systems because varying substrate concentrations can affect the enzyme's catalytic activity. The present study aimed to analyze the reaction kinetics of palm-based polyol ester production

catalyzed by commercial lipase Novozyme 435 (N435). The enzymatic transesterification reaction was performed in a solvent-free medium. The effect of substrates concentration, specifically high oleic palm methyl ester (HO-PME) and trimethylolpropane (TMP), on the kinetic constant was studied at the initial reaction rate. The study was conducted based on the Ping-pong Bi-bi model, assuming that both substrates could inhibit the reaction. The reaction was carried out at 70 °C and 15.25 mbar with a 3 % (w/w) N435 enzyme load to investigate the effect of various HO-PME and TMP concentrations. The kinetic constants obtained are as follows: ��(HOPME) = 61.112 mol/L, ��(TMP) = 0.336 mol/L, ��(HOPME)= 0.002 mol/L, ��(TMP) = 2.415 mol/L and max = 17.24 mol/L.hr. The results implied that N435 has higher affinity towards TMP than HO-PME. Inhibition constant indicated a lower inhibitory function of the TMP than HO-PME (��(TMP) >��(HOPME)). The reaction kinetics obtained in this study agreed well with the model used with TMP and HO-PME as competitive inhibitor during enzymatic transesterification.

Introduction

Growing environmental concerns and awareness of the detrimental effects caused by petroleum-based lubricants has fuelled research in developing biodegradable lubricants. Biodegradable lubricants, also known as biolubricants, are one of the most promising vegetable oil alternatives. Biolubricants are typically produced by transesterifying fatty acid methyl esters (FAME) and polyhydric alcohols with alkaline, acid or enzymes catalysts [1], [2], [3]. Numerous researches have documented the use of a chemical catalyst to transesterify vegetable oil methyl ester and trimethylolpropane (TMP) [4], [5]. While a chemical catalyst can significantly accelerate the reaction, the downstream purification process and high reaction temperature could raise the overall production costs [6]. These issues can be minimized by using enzyme as catalyst. The absence of product purification step and moderate reaction conditions make immobilized lipases enzyme a more competitive catalyst in biolubricant production [7], [8]. Recent research suggests that the transesterification of FAME with TMP catalysed by *Candida antarctica* immobilized lipase B could result in high biolubricant conversion yield and good characteristics [9], [10], [11], [12].