IMMOBILIZATION OF LIPASE ON SURFACTANT-MODIFIED BENTONITE AND ITS APPLICATION FOR BIODIESEL PRODUCTION FROM SIMULATED WASTE COOKING OIL

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ABSTRACT

The influence of bentonite modification by cationic surfactant hexadecyl-trimethyl-ammonium bromide (HDTMA-Br) and tetramethyl ammonium hydroxide (TMAOH) on its capability to immobilize lipase was studied. Modification of bentonite was conducted by the adding of 4-6% (v/v) HDTMA-Br and TMAOH respectively. The obtained immobilized lipases then were characterized to observe the optimum pH and temperature as well as their stability during reuse application. The observed results show that there is no significant difference between the variations of HDTMA-Br concentrations to the percentage of immobilized enzyme which can immobilize lipase up to 75-78%. However, the best concentration of TMAOH is 4% (v/v) which can immobilize lipase up to 97.95%. The obtained immobilized lipases on HDTMA-Br-modified bentonite show the optimum catalytic activity on reaction temperature of 35-40 ^{o}C and pH of 7.5. In other hand, the optimum catalytic activity of immobilized lipases on TMAOH-modified bentonite is 40^{o}C of incubation temperature and pH of 7. The immobilized lipases on both HDTMA-Br and TMAOH modified bentonite are stable enough so it could be re-used four times before its activity decreased by 48,565% and 46.83 % respectively.
Keywords: Lipase, Cationic Surfactant, Bentonite, HDTMA-Br, TMAOH, Biodiesel, Immobilization.

INTRODUCTION

Lipase (triacylglycerol acylhydrolase, EC.3.1.1.3) is a group of enzymes generally function in the hydrolysis, esterification as well as transesterification reactions of triacylglycerols (triglycerides). (Mingrui *et al*., 2007). This enzyme is also used for the hydrolysis of various forms of fatty acyl esters. Unlike the other esterases, lipase needs an oil–water interface for optimum activity (Yesiloglu, 2005). In this research, we used lipase as biocatalyst for biodiesel production from simulated waste cooking oil. Conventionally biodiesel is produced through transesterification reaction using alkaline catalyst. The disadvantage of using alkaline catalyst is causing saponification reactions. Saponification reaction will reduce the yield of the ester and cause separation of ester and glycerol harder to do (Fukuda et al., 2001). The use of lipase as a biocatalyst can solve this problem. The advantages of using lipase for biodiesel production including operating conditions can be performed in mild conditions, the recovery process of glycerol can be done easily, and free fatty acids can directly converted into biodiesel.

Until recently, enzymes are considered to have little utility for organic synthesis, because in contact with organic solvents, which is usually required for such a process, will inactivate the enzymes (Blanco et al., 2004; Betigeri et al., 2002). The immobilization is an advantageous method that improves the stability of the enzyme, provides for its repeated use and easy separation of the enzyme from the re-action medium. The characteristics of immobilized enzyme are governed by the properties of both the enzyme and the carrier material. The interaction provides an immobilized enzyme with specific chemical, biochemical, mechanical, and kinetic specifications. Numerous supports for the immobilization of lipases have been used. Comparative studies indicated that dramatic differences exist in the activity of lipases supported on different materials (Reslow et al.,