CURRENT RESEARCH AND DEVELOPMENT IN BIOTECHNOLOGY ENGINEERING AT IIUM

VOLUME IV

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IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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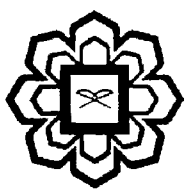

IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Ma'an Alkhatib, Abdullah Al Mamun & Faridah Yusof: Current Reasearch and Development in Biotechnology Engineering at IIUM Volume IV

ISBN: 978-967-418-136-9

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

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CHAPTER 27

IMMOBILIZATION OF LIPASE ON MULTI-WALLED CARBON NANOTUBES

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ABSTRACT

Multi-walled carbon nanotubes (MWNTs) are demonstrated as good support for the immobilization of lipase. In this study, commercially available lipase extracted from *Aspergillus niger* has been immobilized on (MWNTs). The enzyme was bound to carbon nanotubes by covalent bonding, in the presence of N-(3-dimethylaminopropyl)-N'-ethyl)-carbodiimide (EDC) as a coupling reagent. Carbon nanotubes were carboxylated by sonication in 1 M nitric acid prior to treatment with the coupling reagent. Native lipase showed an activity of 2.22 x 10^{-3} U/ml, whereas, immobilized lipase demonstrated an activity of 0.335 x 10^{-3} U/ml, retaining 55 % of the native activity given that only 27.4 % enzyme activity have been achieved. One unit is defined as 1nmol of p-nitrophenol released by the hydrolysis of the substrate 4-nitrophenyl palmitate (pNPP) per 1 ml per minute. The activity of the enzyme was measured spectrophotometrically at a wavelength of 405 nm.

Keywords: *aspergillus niger,* multi-walled carbon nanotubes, immobilized, lipase

INTRODUCTION

Carbon nanotubes are one of the most studied nano materials nowadays. Since their discovery less than 20 years ago, they have attracted researchers' attention due to their unique properties. Both single and multi-walled carbon nanotubes have high chemical stability, mechanical strength, electrical conductivity, and large surface area-to-volume ratio. These exceptional properties gave carbon nanotubes a wide scope of applications. They are used in the fabrication of bioelectronic devices of molecular scale, biosensors to measure the concentration of certain substrates and detect the presence of specific pollutants, transport and storage of hydrogen, and biofuel cells which utilize enzymes to convert chemical energy stored in different organic materials into electrical energy.

In addition, carbon nanotubes are extensively used as solid supports for protein and enzyme immobilization. This enables the unique properties of different enzymes and proteins to be utilized in conditions where the native form of the protein or the enzyme cannot be used such as in biosensors. In this study, lipase (glycerol ester hydrolase EC 3.1.1.3) from *Aspergillus niger* has been immobilized on multi-walled carbon nanotubes (MWNTs) in the presence of the coupling reagent N-(3-dimethylaminopropyl)-N'-ethyl)-carbodiimide (EDC). The activity of the native and immobilized enzyme has been measured for the hydrolysis of