UNIVERSITI TEKNOLOGI MARA

ELECTROCHEMICAL LIPASE BIOSENSOR SYSTEM BASED ON IONIC LIQUID FOR TRIGLYCERIDE DETERMINATION IN OLIVE OIL

NURUL HUWAIDA BINTI ROSLI

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

November 2017

ABSTRACT

Triglyceride (TG) biosensors gives advantages for TGs determination due to relatively low cost, ease of use and good selectivity that suitable for point-of-care applications. In this study, lipase enzyme was used to hydrolyze triglyceride into glycerol and fatty acid. Ionic liquid has a high ionic conductivity and biocompatibility for enhanced electrochemical response. Hence, the mixture of $[C_2OC_2C_1pyrr][NTf_2]$-GA-Lipase has been immobilized on the surface of screen printed carbon electrode (SPCE) using drop casting technique for triglyceride determination in olive oil. The electrochemical performance of SPCE/$[C_2OC_2C_1pyrr][NTf_2]$-GA-Lipase electrode has been investigated by cyclic voltammetry (CV) method. The effect of different electrolyte and surfactants on surface of SPCE was investigated. The parameters optimization of SPCE/$[C_2OC_2C_1pyrr][NTf_2]$-GA-Lipase electrode was studied, and it shows that pH 7, 30°C and 5 % of lipase enzyme gives an optimum performance. The biosensor was applied to detect triglyceride with a linear calibration range from 0.68 - 2.68 mM was obtained. Common interfering compounds in sample has been investigated as well on the sensor. The $[C_2OC_2C_1pyrr][N(Tf)_2]$-GA-Lipase film modified screen printed electrode showed a response to tributyrin when phosphate buffer solution (PBS) was used as an electrolyte medium. The electrochemical response of the SPCE/$[C_2OC_2C_1pyrr][N(Tf)_2]$-GA-Lipase electrode will be investigated as a function with 2.0 mM of tributyrin concentration using cyclic voltammetry (CV) technique at 100 mVs^{-1} scan rate and potential range -1.0 to +1.0 V in PBS (50mM, pH 7). All electrochemical experiments were performed at room temperature with 50 mM phosphate buffer, PBS as a supporting electrolyte. The TG biosensor detection was compared with Gas Chromatography (GC) analysis with 89 % validation value. The novelty of present TG biosensor is using a single enzymatic reaction in lipase hydrolysis, incorporated with ionic liquid. This biosensor is a promising alternative for TG monitoring in olive oil.

ACKNOWLEDGEMENT

Firstly, I wish to thank God for giving me the opportunity to embark on my MSc and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Prof Madya.Dr. Zainiharyati Mohd Zain, and co-supervisor, Mdm. Nor Monica Ahmad. Thank you for the support, patience and ideas in assisting me with this project. I also would like to express my gratitude to the staff of the Faculty Applied Science and, especially Dr. Yusairie Mohd, En. Ahmad Hambali, and En. Khairul for providing the facilities, knowledge and assistance.

My appreciation goes to the assistant laboratory of chemical instruments at Faculty Chemical Engineering, especially, En. Mohd Yazid Yusof who provided the facilities and assistance during instrument analysis. Special thanks to my colleagues and friends Nor Azreen Zakaria, Nurul Afiqah Hashimah, and Siti Izzati Husna, for helping me with this project.

Finally, this thesis is dedicated to my parents and siblings for the determination to educate me and provided me strength when I need the most. This piece of victory is dedicated to all of you. Alhamdulilah.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY

1.1.1 Triglyceride

Edible oils are complex mixtures containing a wide range of compounds. Most of edible oils are composed of triglyceride (TG) and other minor components, such as fatty acid, glycerol, hydrocarbons and phenolic compounds (Ruiz-Samblás et al., 2010). TG can be generated by esterification process of three hydroxyl (-OH) groups of glycerol with three molecules of fatty acids that produce an ester as product (Narang et al., 2013). TGs can be classified according to their chain length, number, and position of double-bonds of fatty acids that attached to the glycerol backbone (Wu et al., 2016). TG acts is important role in metabolisms as energy source and also as a dietary fat transporter. Figure 1.1 shows the molecular structure of TG which consists of glycerol and three fatty acid molecules.

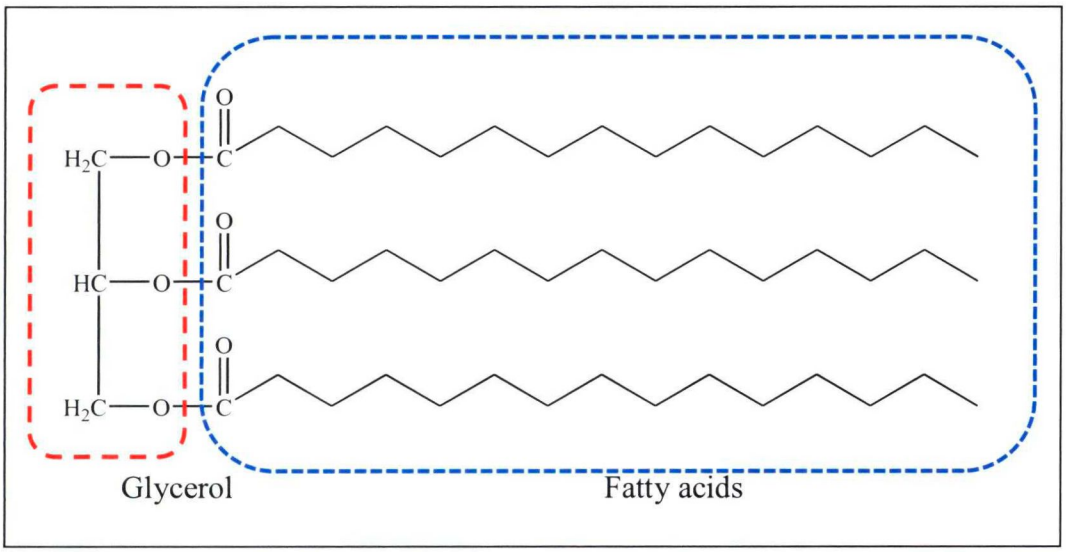

Figure 1.1: Molecular structure of Triglyceride (TG)