UNIVERSITI TEKNOLOGI MARA

LED BASED NIR SPECTROSCOPY FOR DETECTION OF LARD ADULTERATION IN PALM OIL *via* CHEMOMETRICS

KATRUL NADIA BT BASRI

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

Faculty of Electrical Engineering

September 2017

ABSTRACT

Adulteration is a major concern in religion and health. In this study, palm oil was used as it is one of the world most frequent used cooking oil. Near infrared spectroscopy technique is a reliable method to detect adulteration in cooking oil due to less sample preparation, rapid scan and applicable on on-site. Short wave near infrared spectroscopy (NIR) method was implemented in this experiment to detect the presence of lard adulteration in palm oil. MicroNIR was set up in two different scan modes to study the effect of path length to the performance of spectral measurement. Pure and adulterated palm oil sample were classified using soft independent modeling class analogy (SIMCA) algorithm with model accuracy more than 0.95 reported for both transflectance and transmission modes. Additionally, by employing partial least square (PLS) regression, the coefficient of determination (R^2) of transflectance and transmission were 0.9987 and 0.9994 with root mean square error of calibration (RMSEC) of 0.5931 and 0.6703 respectively. In order to remove the uninformative variables, cumulative adaptive reweighted sampling (CARS) has been performed. The result of R^2 and RMSEC after variable selection for transflectance and transmission were improve significantly. Based on the result of classification and quantification analysis, the transmission mode has yield better prediction model compared to the transflectance mode. Based on the critical wavelength obtained in CARS, 1200 nm and 1450 nm LED were chosen to replace the halogen tungsten as a light source for the NIR spectrometer. Using LED, the model accuracy obtained to detect pure palm oil is 0.99 which shows the classification result for LED is better compared using halogen tungsten light source. R^2 acquired of PLS model for LED is 0.9970 for calibration and 0.9962 for prediction. RMSEC and RMSEP value are 0.8886 and 1.0173. For quantification analysis, the results of LED and halogen tungsten light source were on par.

ACKNOWLEDGEMENT

First and foremost, I want to express my gratitude to my supervisor, Dr. Ahmad Sabirin bin Zoolfakar for his guidance and support throughout my master journey. His persistent assistance on my research manuscript was a great help. Besides that, I would like to extend my gratitude to my secondary supervisor, Dr. Zaiton binti Sharif. Her contributions have helped me realizing the goals of this research.

I want to extend my appreciation to my supervisor at MIMOS Bhd, Dr. Mohd Fared bin Abdul Khir who guide me throughout the experiment. Other than that, the equipment and facilities provided by MIMOS Bhd has played a major part in achieving my research goals. As such, I want to thank staff at photonics Research and Development department. On top of it, I want to express my heartfelt appreciation for my research partner, Pn.Mutia Nurulhusna binti Hussain. Without her help, I won't be able to complete my thesis.

My research work would not be possible without financial support by the Ministry of Science, Technology and Innovation of Malaysia (06-03-04-SF0065) and MyBrain for my tuition fees funding. I would like to thank Faculty of Electrical Engineering, UITM and MIMOS Bhd for the conference funding. Finally, my special and greatest appreciation goes to my parent, En. Basri bin Jabar and Pn. Khatijah binti Abdul Rahman for their endless encouragement, prayers and support in the time of need.

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CHAPTER ONE
INTRODUCTION

1.1 MOTIVATION

Halal is derived from Arabic word which can be defined as permitted and lawful whereas the antonym of halal is haram (forbidden or prohibited) [1][2]. Islam follower were obliged to eat halal and toyyib (good) based on the divine commandments in the Holy Quran,

"O mankind! Eat of that which is lawful and wholesome on earth ..." (Quran 2:168)

The purity and cleanliness of the food consume will promote a good health and wholesomeness. Additionally, non-Muslim consumer particularly organic food partisans are concerned on the governance and sustainability of their food [3]. Currently, halal food sector has gained its momentum and predicted to be worth up to US$1.6tn and contribute up to 17.4% of the world food market by 2018 [3].

Most of the food economist believed that the halal food industry will become a major market force in the future and that was proved in Thomson Reuters report, State of the Global Islamic Economy 2014-2015 where the global expenditure on halal food market in 2019 will grow to $2,537 billion [4]. The halal industry emerged as a global economic sector where Malaysia is at the forefront in developing the halal standards [5]. Malaysia has a guidelines for halal food standard and reference documents, MS1500:2009 in halal food-production, preparation handling and storage [6]. Department of Islamic Development Malaysia (JAKIM) has the authority to issue halal certification for national and international markets whereas State Islamic Religious Department or Council (JAIN/MAIN) only responsible for the domestic market [6].

As Malaysia geared towards becoming the global halal hub by 2020, it is critical for the nation to have a strong support of technical competency in terms of halal practicing, skills, research and development of technology [7]. In recent years, the issue of food fraud and adulteration has arisen and consumer are concerned on the