UNIVERSITI TEKNOLOGI MARA

PHYSICALLY UPGRADING CRUDE PALM OIL BY REDUCING FREE FATTY ACID CONTENT THROUGH GLYCEROLYSIS CHEMICAL REACTION IN THE DEACIDIFICATION PROCESS VIA ULTRASONIC PROBE ATOMISATION

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ABSTRACT

CPO is useful for a wide range of applications, from food to cosmetics and industrial products as well as feedstock for biodiesel production, but not without its drawbacks. One of the main concerns with CPO is FFA content, which naturally present in CPO that can cause the oil to become rancid and lead to a decrease in product quality. FFA content in CPO can also corrode machinery and cause safety issues when it is used in the production of biodiesel. There are several technologies that can be used to reduce FFA content in CPO. These include physical refining, chemical refining, and enzymatic refining. One of the alternatives for CPO upgrading to reduce FFA content is UPA. However, there is no research reported on the GCR via UPA. This method allows for more efficient reduction of FFA content in the CPO, resulting in a higher–quality product and fewer safety concerns. GCR via UPA is a novel way that improve understanding in the research area. The first objective of the research is to evaluate the CPO physicochemical and quality characteristics using GC of methyl esters, Wijs-Titrimetry, spectrophotometry, open-ended capillary tube, and Pycnometry prior to GCR via UPA. The modified method of AOCS Official Method Ce 1h-05 was used for the first objective. The second objective of the research is to analyse the CPO reaction using FlatMol 2 Lite software to predict the mechanism and to determine the mass of glycerol for the GCR via UPA. The canvas method was used for the second objective. The third objective of the research is to investigate the GCR via UPA where the independent variables are method (with and without UPA) and solvent (with and without glycerol) while the dependent variables are FFA content and DPO yield. The OFAT method was used for the third objective. The fourth objective of the research is to determine the CPO modeling for the equation model for GCR via UPA using Design-Expert software. The RSM was used for the fourth objective. All findings in the evaluation of the CPO characteristics meet the recommended value, which indicates that the CPO has good characteristics. The outcome of the analysis of the CPO reaction shows that the FFA content in the CPO is increasing when a hydrolysis chemical reaction occurs and decreasing when a GCR occurs. The research also discovered that the suitable mass ratio of glycerol to CPO in the GCR in the DP via UPA is 24:200. The discoveries made during the investigation of the CPO upgrading reveal that the GCR via UPA is a worthwhile process as it may reduce the FFA content in the CPO while minimising the processing time, energy, and operating costs. The results of the determination of the CPO modeling show that both models of FFA content and DPO yield were valid and can be used to re-establish the future results GCR via UPA. Generally, the research shows that the GCR in the DP using UPA is sustainable and should be utilised for CPO upgrading to reduce FFA content in DPO production.

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CHAPTER ONE
INTRODUCTION

1.1 Overview

An introduction to recent research is provided in this chapter. This chapter gives details on the research background, problem statement, objectives, scope, and limitations of the research, as well as the significance of research. The thesis outline is also described in this chapter.

1.2 Research Background

Elaeis guineensis is the scientific name for the oil palm tree, which is normally found in Malaysia. It has been widely planted and has become one of the major economic sources for Malaysia. Malaysia becomes the major exporter of the palm oil industry to export palm oil to other countries that have no oil palm trees since palm oil is used globally. The oil palm tree produces palm fruits, also known as Fresh Fruit Bunches (FFB). FFB is then extracted to produce palm oil. There are two types of palm oil that can be obtained from the FFB, namely Crude Palm Oil (CPO) and Crude Palm Kernel Oil (CPKO). CPO is obtained from the mesocarp of the fruit, while CPKO is obtained from the kernel of the fruit. The CPO and CPKO processes for palm oil production are different because they depend on the type of palm oil itself, as their feedstock is in different conditions (mesocarp and kernel). Most palm oil products are edible and have been widely used in the food industry for food applications such as frying, specialty fats, margarine, and shortening (May & Nesaretnam, 2014). Palm oil contains constituents that are nutritional and favourable to human health. Carotenoids, specifically beta–carotene, are antioxidants found in CPO that can be converted into vitamin A (Fattore & Fanelli, 2013). Tocopherols in CPO are compounds that have vitamin E activity and are also known to have antioxidative properties (Kannan & Gundappa, 2014).