UNIVERSITI TEKNOLOGI MARA

ULTRASONIC-ASSISTED EXTRACTION OF SUNFLOWER SEEDS OIL: KINETIC AND THERMODYNAMICS STUDY

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ABSTRACT

This study has been conducted to evaluate the kinetic and thermodynamics of oil extraction from sunflower seeds using ultrasonic-assisted extraction (UAE). The first scope was one factor at a time (OFAT). The OFAT study involved different type of solvent, extraction time, temperature, and liquid to solid (L/S) ratio. The maximum oil yield (54.4%) was obtained with the used of ethyl acetate as solvent at 20 minutes, 40ºC of temperature, and 100 ml/g of L/S ratio. Second order kinetic model was used in describing the extraction process. The model coefficients were observed with determination coefficient ($R^2 \geq 0.9779$) and MRPD value 2.0692% – 9.5936%. Thermodynamics study showed that the activation energy in this extraction process was 1526.78 J mol^{-1}.

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Nurul Aqilah Alias

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CHAPTER ONE

INTRODUCTION

1.1 Research Background

Sunflower (*Helianthus annuus*) was believed as spiritual and attractive flower until 19th century. After that time, sunflower (*Helianthus annuus L.*) was first cultivated to become an oilseed plant in Russia. [1] Nowadays, sunflower becomes one of the greater oilseed crops throughout the world. According to Sharma et al. (2009), worldwide sunflower crop is ranking third after groundnut and mustard. [2] The major worldwide crop of this beautiful plant is due to the fourth largest vegetable oil sources after soybeans, palm, and rapeseed. In Europe, sunflower oil is the second extensively utilized oil after rapeseed. Sunflower seeds are a nutrient component that contains 20-30% of protein, iron, vitamin A, vitamin B (including B_1, B_3, and B_6), vitamin E, calcium, nitrogen and phosphorus. [3] Based on the research that has been done in Russia, the cultivated oilseed percentage is increased from 25% to 46%. [1] Moreover, sunflower oil which is a non-volatile oil that produced from sunflower seed may contain a low level of saturated fat and elevated level of unsaturated fat. [3] The low percentage level of saturated fat in sunflower seeds oil displayed that it is very good benefits for cardiovascular. [4]

Sunflower seed can produce two types of oil which are linoleic sunflower oil and high oleic sunflower oil. Both of the oil may have some differences, but all are arising with the standard and approved breeding procedures. Linoleic sunflower oil contains a high composition of essential fatty acid. Therefore, it is a good home cooking oil due to clean taste and a minimum level of saturated fat. On the other hand, high oleic sunflower oil consists of 80% or above monounsaturated fat. This type of oil is employed in many industrial applications, and one of them is food applications. Besides, British Pharmacopoeia organization has conducted a research and concluded that sunflower oil contains 4-9% of palmitic acid, 1-7% of stearic acid, 14-40% of oleic acid, 48-74% of linoleic acid, tocopherols, carotenoids, lecithin, and waxes. [4] At room temperature, sunflower oil is in a liquid state with a light appearance, slightly yellowish-orange colour, and slightly fatty odour. [4, 5] Furthermore, sunflower oil also has a higher