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Physicochemical Properties of Crude Rubber Seed Oil for Biogasoline Production

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Abstract

The growing concern on fossil fuel depletion, environmental awareness, increasing energy consumption and food-fuel conflict has initiated the thought of using non-edible oils such as crude rubber seed oil (RSO) to produce renewable fuels. Besides being largely available in Malaysia the rubber seeds is still underutilized. In this study the physicochemical properties of RSO as a potential inedible oil for biogasoline production were analysed using American Oil Chemists Society (AOCS) standard procedures. The RSO was characterised in terms of colour (dark brown), state (liquid), viscosity (40.86 mm^2/s), specific gravity (0.91), peroxide value (3.42 Mg/g), moisture content (0.37wt%), high heating value (39.71 MJ/kg), acid value (83.76 mg KOH/g), free fatty acid contents (41.64 %), iodine value (118.8) and sulphur content (0%). These values obtained were then analysed and compared with the commonly used crude palm oil. The acquired results produced were convincing and matched in agreeable values with other literatures on RSO. The results strongly suggest that RSO is a promising alternative energy source to fuel vehicles in the coming future.

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Keywords: Crude rubber seed oil; Physicochemical properties; Characterization; Biogasoline

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1. Introduction

According to Energy Information Administration (EIA) the world energy consumption is likely to rise by 56% from 2010 to 2040 [1]. The ever increasing pressure in energy supply is driven by several factors such as increasing population, better lifestyle and expanding urbanization. The world population is expected to grow by 25% in the coming 20 years according to Chevron Corporation [2]. However, the petroleum reserve is expected to run out in less than 50 years [3]. Simultaneously, the greenhouse gases emitted by the petroleum based fuels causes detrimental effect on the environment as well as on people's health.Therefore there is a need to shift towards greener alternative fuel thus finding the potential feedstocks.

To date palm oil is the common feedstock used for biogasoline production. Various experiments have been conducted by [4-12] on the catalytic cracking of palm oil to produce biogasoline because it is abundantly available especially in Malaysia. However the food-energy trade off is the main constraint experienced eventhough the supply capacity of palm oil is readily available [13]. Hence to overcome this issue other non edible oil feedstocks should be considered in biogasoline production.

RSO is a promising feedstock for biogasoline production which is extracted from the rubber seed of the rubber tree. In year 2009 Malaysian Rubber Board has reported that Malaysia has an estimated acreage of 1,229,940 hectares of rubber plantation producing an estimated average of more than 1.2 million metric tons of rubber seeds annually [14]. The rubber seed consist of about 40% kernel with 20-25% moisture. Approximately 40-50% of oil is found in the dried kernel which contributes to 20 million litres of oil yearly [15].

Up to now the rubber seed oil has no major application. All this while these rich in oil seeds are disregarded as waste. The common commercial product of the rubber industry is the natural rubber which has contributed greatly to Malaysia's economy after palm oil. In year 2011 about 71% of the natural rubber was used for glove manufacturing [16]. Besides the rubberwood from the industry has also been used to make furnitures. Consequently diversifying the uses of the rubber tree could economically benefit the country and at the same time prevent waste generation.

Despite rubber industry being the second largest plantation in Malaysia after oil palm, until now only dearth of information available on the suitability of the physicochemical chemical properties for biogasoline production. Hence in this paper, the aim is to characterize and analyse the properties of rubber seed oil in terms of appearance, viscosity, specific gravity, moisture content, high heating value, free fatty acid content, iodine value and sulphur content and then compare it with palm oil properties obtained from the literature. The characterization can potentially help in determining the suitability of the oil for biogasoline production.

2. Methodology

Crude rubber seed oil (CRSO) is obtained from Chemical Kinetics, Vietnam. The appearance is observed based on colour and state of the oil through visual observation. The dynamic viscosity is measured using Brookfield's viscometer (CAP2000+, USA). Specific gravity was evaluated using Specific Gravity Hydrometers (Fisher Scientific, Pittsburgh, PA). The peroxide value, acid value and iodine value were calculated following the AOCS standard method (Cd 8b-90), (Cd, 3d-63) and (Cd, 1c-85) respectively. The moisture content test was carried out using Karl Fisher moisture analyser (870 KF Titrino Plus). Bomb calorimeter (C5000, IKA Werke, Germany) was used to measure the high heating value (HHV). Free fatty acid composition was analysed using Gas Chromatograph (QP5050, Shimadzu, Japan) following the AOCS (Ce 2-66) standard. Lastly the sulphur content was determined using CHNS-Analyser (Loco, USA).

3. Results and discussion

Table 1 shows the physicochemical properties of rubber seed oil (CRSO) analysed compared to the properties of crude palm oil (CPO) obtained from the literature. In Malaysia CPO is widely available and has been utilized vastly in the production of biofuel. Numerous literatures are available on catalytic cracking of palm oil to produce gasoline hydrocarbon fractions. Therefore the similarities of the properties of CRSO here is compared to CPO to ensure the reliability and feasility of CRSO to be used as a potential feedstock for biogasoline production. Besides type of