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PERFORMANCE EVALUATION OF MALAYSIA RUBBER SEED OIL (RSO) AS FUTURE COOKING OIL

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ABSTRACT

Rubber plantation is one of the major commodities in Malaysia and the tree produces by product, which is rubber seed. Each rubber seed contain 40-50% oil and it can be extracted via chemical or physical process. In this research, the properties of pure refined rubber seed oil (RSO) was studied and compared with current Malaysia palm cooking oil (PMO). From the nutrient content, it indicates that in 100 g RSO, it contains 855 kcal calories, 0.5 g protein, 94.8 g fat and 0 g carbohydrate. In term of double bond content, the average value of the iodine content for RSO is 90g/100g RSO while PMO depict 55g/100 g PMO. Viscosity of RSO is slightly higher with 51.9 cP and 39 cP for PMO. Density figures same values with 0.92 g/cm^3, whereas saponification value shows 220.88 mg KOH/g for RSO and 240 mg KOH/g for PMO.

Keywords: Rubber Seed Oil (RSO); palm cooking oil (PMO); iodine value; saponification test; viscosity and nutrient fact.

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1. INTRODUCTION

Malaysia's dominant plantation commodities comprise of palm oil, timber, rubber, pepper, tobacco and cocoa. Beside tourism and manufacturing, plantation commodity is also a dominant contributor to the economy. Rubber is a major plantation crop covering 9.76 million hectares worldwide [1]. According to Malaysian Rubber Board digest, in year 2017, Malaysia is one of the well know producers of natural rubber (NR) in the world with almost 1.1 million hectare of area under rubber tree (*Hevea Brasilienses)* plantation [2] and each hectare can produce a rough number of 150 kg of rubber seeds. Rubber plantation is not only produce latex but also rubber seeds, rubber honey and rubber wood. The tree starts to bear rubber seed at four years of age. The resource of rubber seed is abundant and these seeds were not edible causing it becomes one of the unused waste materials [3]. Rubber seed oil (RSO) is obtained from the extraction of rubber seeds from the rubber plant. It has been found that RSO is highly unsaturated oil and contained a significant percentage of long chain polyunsaturated fatty acids such as alpha-linolenic acid (ALA), which play important roles in human metabolism because it is one of the important elements of omega-3 fatty acid [4].

Cooked and boiled rubber seeds are eaten by Indians people in South America [5] without adverse effects. However, according to [6], the presence of a cyanogenetic glucoside, toxic factor, in rubber seed can be a limitation to be used as a food source. Her research based in Malaysia confirmed that there is 18.6 mg of hydrogen cyanide (HCN) per 100 g rubber seed. Due to the toxin contain, rubber seed is categorized as non-edible. Other researcher, in [7] reported that fresh rubber seeds from India consist about 63.8 to 74.9 mg of HCN per 100 g. Appropriate storage at room temperature for a minimal duration of two months exhibit to be efficient in decreasing the number of HCN. [8]. In addition, the HCN content also can be reduced using high temperatures during the oil extraction process [9].

There is wide variety of cooking oil from plant sources such as canola oil, olive oil and corn oil but the most common production of cooking oil in Malaysia is palm oil. Currently, the second world's largest exporter and producer of palm oil after Indonesia is Malaysia. Palm oil was used as the renewable raw material. Unfortunately, its constraint was due to low unsaturation on fatty acid chains [10]. In a study by Nigerian researchers found out that the oil

in an oxidized state can threaten biochemical functions and physiological of the body. They certify that the harmful of oxidized palm oil consist organotoxicity of the kidney, heart, lungs and liver as well as reproductive toxicity. Additionally, they note that oxidized palm oil can cause enlargement in free fatty acids, phospholipids and cerebrosides [11].

The objective of this research paper to is to evaluate the performance of refined cooking oil from RSO compared with palm cooking oil (PMO). This also due to European ban on palm oil can cripple Malaysia's oil palm industry, thus study should carry out to find the alternative. The quality performance of RSO as domestic users was evaluated by nutrition fact such as protein, fat, calories and carbohydrates, density, iodine value, viscosity and saponification value.

2. METHODOLOGY

2.1. The Oil Extraction

The rubber seed was collected from Muar, Johor and was stored for a month. Rubber seed in good condition were dishelled, grinded and transferred into the paper thimble in the soxhlet extractor apparatus. The particles were extracted using solvent which is hexane at 70 Celsius for maximum 6 hours. Lastly the solvent were removed out by using rotavapor and undergo refining process to get the pure RSO.

2.2. Determining Nutrient Fact Value (Protein, Fat, Calories and Carbohydrates)

For nutrients fact, the RSO samples was sent to a private lab which certified by the Ministry of Health Malaysia (KKM). AOAC Official Method 979.09 was used to determine the amount of protein content in the RSO. The method used in the fat determination is called Foss – Let Fat analysis referring to Official Method 960.39, AOAC 2000. Next, the total carbohydrates content was calculated by subtracting the summation of the total fat, crude protein, moisture and dust from the total weight of the food. While calories was calculated by subtracting the insoluble dietary fiber (IDF) using protein x 4, (carbohydrates-IDF) x 4 and fat x 9.

2.3. Iodine Titration Test

The iodine test is carried out using standard testing method ASTM D 1959 in order to study the quantity of double bond presence in oil. The oil is titrated with sodium thiosulphate

($Na_2S_2O_3$) to obtain iodine value. A few drops of the starch indicator are added and the titration of the sodium thiosulphate is continued with vigorous shaking until the blue colour disappears This test is repeated three times to obtain average value of iodine. To calculate the iodine number, the volume of $Na_2S_2O_3$ used in the titration was calculated using following formula:

$$\text{Iodine Number} = \frac{(\text{mL 0.1N } Na_2S_2O_3 \text{ Blank} - \text{mL 0.1N } Na_2S_2O_3 \text{ Test})\ (100)\ (12.7)}{\text{Weight of sample (g)}}$$

where mL 0.1 N $Na_2S_2O_3$ Blank: The volume of $Na_2S_2O_3$ required to titrate the blank solution mL and 0.1 N $Na_2S_2O_3$ Test: The volume of $Na_2S_2O_3$ required to titrate the test solution that contained samples.

2.4. Viscosity Test

The viscosity of the samples were done by using Brookfield digital viscometer (model DV-11+) and referring to ASTM D 1084 as standard method for this test. The dynamic viscosity measurement in unit cP also called centiPoises was used in the viscosity measurement method.

2.5. Density Test

Density test was conducted using density cup stainless steel model Elcometer 1800.The empty cup was weighted and fill up with sample. Next, the lid was placed on the cup and excess oil was removed before final weight. The density was calculated using formula weight divide by its unit volume.

2.6. Saponification Test

Saponification test was done by referring to ASTM D 5558 as standard method. 2 g of the oil was added with 25 mL of potassium hydroxide solution (KOH) in a conical flask. The flask was heated and attached with reflux condenser for 1 hour and the phenolphthalein indicator was added during the solution is still hot. The solution was titrated with 0.5 N hydrochloric acid (HCl) and the volume of titration used was recorded. Saponification number was obtained by using the following law:

$$\text{Saponification value: } \frac{56.1\ (\text{blank} - \text{sample})\ \text{x}\ 0.5}{\text{Weight of sample (g)}}$$

where Blank: Volume in mL of HCL titration required by blank and Sample: Volume in mL of HCL titration required by sample.

3. RESULTS AND DISCUSSION

3.1. Nutrient Fact

To commercialize the RSO to the next level, information on nutrients fact values are compulsory. The results was double confirmed by private lab, which certified by KKM. The result is summarize in Table 1 where the amount of protein contains in RSO per 100 g is 0.5%, while content of protein in PMO per 100 g is 0%. The amount of protein RSO is slightly higher than PMO where protein is beneficial to our body mainly to build and repair tissue. For carbohydrate content, the results were the same where there is no carbohydrate was detected in both cooking oil. Information on calories or energy value is to be expressed as kcal (kilocalories) and value for RSO is 855 kcal, while for PMO is 899 kcal. The result indicates that PMO has more calories compared with RSO and our body need calories as energy and its energy to produce heat. Lastly, the amounts of fat that exist in RSO and PMO are 94.8 g and 99.9 g per 100 ml respectively. This is due to the PMO containing saturated fat which is palmitic acid that will contribute to the increases of the fat value while the RSO contain unsaturated fatty acid which is Oleic 18:1, Linoleic 18:2 and Linolenic 18:3 that contribute a little amount of fats. The increase of the fats value is also contributed by the existence of the triglycerides in the oil because the triglycerides are saturated with the hydrogen atom and the molecules chains are closely packed [12].

Table 1. Nutrient fact result of RSO and PMO for 100g serving

	Calories (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)
RSO	855	0	0.5	94.8
PMO	899	0	0.1	99.9

3.2. Iodine Titration Test

Iodine value is used to determine the quantity of unsaturation in fat where the higher the value of iodine number, the higher the amount of C=C bond present in the fat. The average iodine value for three RSO samples was 90 g/100g whereas for PMO is only 55 g/100g. However,

the RSO value is lesser than European soy bean oil with 130 g/100g, walnut oil with 155 g/100g and sunflower oil with 125g/100g. Other researcher reported an iodine content of 82.5g/100g was found in Indian RSO. Reducing iodine number of the RSO exposed to ambient light in the middle of storage may be due to the oxidation [13].

3.3. Saponification Test

Researcher reported that the smaller the saponification values the longer the average fatty acid chain. If the fatty acids present in the glycerides are low molecular weight (short-chain acids), there will be more glycerides molecules per gram of fat than if the acids are high in molecular weight (long-chain acids) [14]. Saponification value obtained from RSO is 220.88 mg KOH/g and 240 mg KOH/g in PMO. From the result, PMO depict higher saponification value than RSO and high saponification value also indicates high content of lauric acid in that oil. However, saponification value for unrefined vegetable oils may also be affected by the compounds in the nonsaponifiable fraction. Researcher from Nigerian found the saponification value for RSO is 203 mg KOH/g shows that the nature of alkali hydrolysis of RSO is similar to that of common vegetable oils such us as coconut oil [15].

3.4. Viscosity and Density Test

Viscosity is a measurement of fluid friction where the higher the viscosity the thicker the liquid and oil film which is interfacial tension. The value for viscosity of RSO is 51.9 cP and for PMO is 39 cp. The higher the double bond content the lower the viscosity was obtained. This can be support by palm oil which has more palmitic acid content and has higher viscosity than the RSO [16]. Whereas, the density depict the same amount for both RSO and PMO at 0.92 g/cm^3.

4. CONCLUSION

In conclusion, since rubber tree is the second largest Malaysia's plantation-based commodities, the application of this plantation should be widen up. Rubber seed is abundant in Malaysia because people still not discover the potential of this waste. From the result, the test indicate almost same properties for both oil in term of nutrient fact and density except for iodine and viscosity value where RSO is higher while PMO is higher in saponification value. More study

should be done to confirm that RSO can be alternative for PMO cooking oil. Rubber producing countries can use this project not only to solve their ecological problems but also to improve their economy.

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