lines was verified by collecting a background spectrum and comparing it to previous data. These spectra were recorded as absorbance value at each data point in triplicate [10].

3. Results and Discussion

3.1. Proximate Analysis of Picung Seed Kernels

Proximate analysis of picung seed kernels per 100 g (wet basis) is shown in Table 1. Picung seed kernels from Riau Province had water, lipid, and ash contents which were lower; while protein, crude fiber, and carbohydrate contents were higher than that of picung seed kernels from Sarawak, Malaysia [11] Picung seed kernels from Riau Province were collected from fruits which fell from the tree and probably oxidation process already happened before the fruits were collected. However, this study did not investigate the effect of oxidation process on picung seed kernels.

Picung seed kernels were relatively high as a source of oil with lipid content 8.91% (wb) or 20.53% (db). According to Andarwulan *et al*, [3], during seeds germination, the crude fat content of picung seeds decreased from 46.00 to 18.50% (db). In fact, for a plant to be suitable for oil production, it must meet the following two criteria : (i) the oil content must reach minimum for commercially viable exploitation, and (ii) the plant must be suitable for high acreage cultivation. The only exceptions are plant which contains unique lipids in their composition or with properties that can not be found elsewhere [12].

Table 1. Proximate Analysis Fresh Picung Kernel Seeds[a]

Component	Persen (wet basis)
Water	30.26 ± 0.06
Protein	8.37 ± 0.05
Lipid	8.91 ± 0.08
Ash	1.08 ± 0.00
Crude fiber	36.88 + 0.08%
Carbohydrate[b]	14.50 ± 0.10%

[a] Mean ± standard deviation
[b] Carbohydrate obtained by difference

3.2 Chemical Analysis

Chemical analysis data of PKO are presented in Table 2. The peroxides value of a vegetable oil reflects its oxidative level and thus its tendency to become rancid. Peroxide value in PKO was 8.53 meq of O_2/kg of oil. According to Codex Standard [13] , the maximum peroxide value for edible fats and oils is 10 meq of O_2/kg of oil, this means that the PKO still suitable to be used as edible oil. However, when picung kernel oil compared to PO or CO, the peroxide value was higher than PO or CO. The high content of unsaturated fatty acid, especially linoleic acid (C18:2) and oleic acid (C18:1) in PKO was the reason of peroxide value become high. Unsaturated fatty acids easily react with oxygen to form peroxides. Oil with high peroxide value are unstable and easily become rancid.

Iodine value is a measure of the degree of unsaturation of fats and oils. The iodine value of PKO was 111.49, higher than PO or CO which were 51-65 and 7.5–10.5, respectively [14]. The high of iodine value indicated that PKO has high degree of unsaturation. In this research, we found that ratio of unsaturated:saturated fatty acid in PKO was 79.76:20.24, PO and CO was 53.9:46.03 and 9.45:90.55, respectively.

Table 2. Chemical properties of picung kernel, palm, and coconut oil

Chemical properties	Picung kernel oil	Palm oil	Coconut oil
Peroxide value (meq of O_2/kg of oil)	8.53	max 10 [13]	max 10 [13]
Iodine value (g of I_2/100 g of oil)	111.49	51-65 [14]	7.5-10.5 [14]
Saponification value (mg of KOH/g of oil)	126.44	194-202 [13,14]	248-265 [13], 248-264 [14]
Acid value (mg of KOH/g of oil)	16.64	max 0.6 [13]	max 0.6 [13]

Saponification value is a measure of the average molecular weight of all the fatty acids present. The higher saponification value, the shorter the fatty acids on the glycerol backbond. As compared to PO and CO, PKO oil has low saponification value, which indicated that picung kernel oil contains a low amount of short chain fatty acids. According to Codex standard [13], specification for saponification value of edible

CO should be 248-265 mgKOH/g oil, and PO 194-202 mgKOH/g oil. The lower amount of short chain of fatty acid, the better quality of the oil producing soap and detergents. It was also stated that for soap making, the required percentage of free fatty acid values should be between 2-5%.

Free fatty acid are responsible for undesirable flavor and aromas in fats and oil. Free fatty acids are formed by hydrolytic rancidity, due to hydrolysis of an ester by lipase or moisture [15]. According Codex standard [13], the maximum acid value for refined oils was 0.6 mg KOH/g oil, PKO has acid value higher than standard. High presence of unsaturated fatty acid in PKO makes this oil easily oxidize by lipase or moisture. However, acid value analysis were done on crude PKO, which has not been purify. The relatively high acid value for oil makes the oil undesirable for nutritional application.

3.3 Fatty acid composition

Table 3. showed fatty acid compositions of PKO, PO and CO. Generally, PKO is rich in saturated and unsaturated fatty acid, same as PO and CO with difference ratio. Ratio of unsaturated:saturated fatty acid in PKO was 79.76:20.24, PO and CO was 53.97:46.03 and 9.45:90.55, respectively. Same as Andarwulan *et al*, [3] and Puspitasari-Nienaber [4], linoleic (C18:2) and oleic acids (C18:1) were the most dominant unsaturated fatty acids in PKO which was 40.79% and 38.31, respectively. PKO had the highest content of linoleic acid compared to PO and CO. In comparison to another seed oil, linoleic acid in PKO was lower than soybean, sunflower, sesame, safflower, poppy, and walnut seed, but higher than peanut, rapeseed, and linseed oil [16].

The presence of high amount of linoleic acid suggest that PKO could be used as a good source of essential fatty acid. The high percentage of oleic, make it suitable for use as edible cooking oil, similar to PO and desirable in terms of nutrition and high stability cooking and frying oil. The relatively high degree of unsaturated fatty acids allows PKO to be oxidize easily when used to deep-fat frying [17]. Therefore, edible oil industry has focused attention on high oleic vegetable oils.

The major saturated fatty acids in PKO were stearic acid, 12.91% and palmitic acid, 7.04%, relatively resemble PO rather than CO. Thus, the characteristic of saturated fatty acids seems to explained that the fat's suitability for formulation of margarine and cocoa butter substitutes, also in some cosmetic and pharmaceutical preparations. Besides, the higher content of stearic acid maybe an advantage to the paint industry and coating formulation.

Table 3. Fatty acids composition of picung kernel, palm, and coconut oil[a]

Fatty acids	Trivial name	Picung kernel oil	Palm olein	Coconut oil
C12:0	Lauric	0.01 ± 0.01	0.26 ± 0.02	46.22 ± 0.10
C14:0	Myristic	0.06 ± 0.01	1.01 ± 0.01	18.40 ± 0.03
C14:1	Myristoleic	0.01 ± 0.01	0.03 ± 0.00	0.01 ± 0.01
C16:0	Palmitic	7.04 ± 0.39	39.29 ± 0.17	9.56 ± 0.02
C16:1	Palmitoleic	0.06 ± 0.04	0.05 ± 0.04	0.02 ± 0.00
C18:0	Stearic	12.91 ± 2.14	5.23 ± 3.93	3.04 ± 0.02
C18:1	Oleic	38.31 ± 1.28	42.47 ± 3.92	9.26 ± 0.08
C18:2	Linoleic	40.79 ± 0.76	10.85 ± 0.08	0.03 ± 0.07
C18:3	Linolenic	0.31 ± 0.01	0.38 ± 0.00	0.03 ± 0.03
C20:0	Arachidic	0.12 ± 0.07	0.14 ± 0.00	0.06 ± 0.05
C22:1	Erucic	0.03 ± 0.02	0.06 ± 0.00	0.01 ± 0.01
C24:0	Lignoceric	0.05 ± 0.04	0.08 ± 0.00	0.04 ± 0.00

[a]Mean ± standard deviation

3.4 Lipid profilling

Fourier transform infrared (FTIR) spectroscopy is an excellent tool for quantitative analysis, as the intensities of the bands in the spectrum are proportional to the concentration of the corresponding samples according to Beer's Law [18]. The spectra of PKO, PO, and CO are shown in Figure 1. These spectra look very similar and showed a typical characteristic of absorption bands for common triacylglycerol [19]. The assignment of prominent peaks are compiled in Table 4.

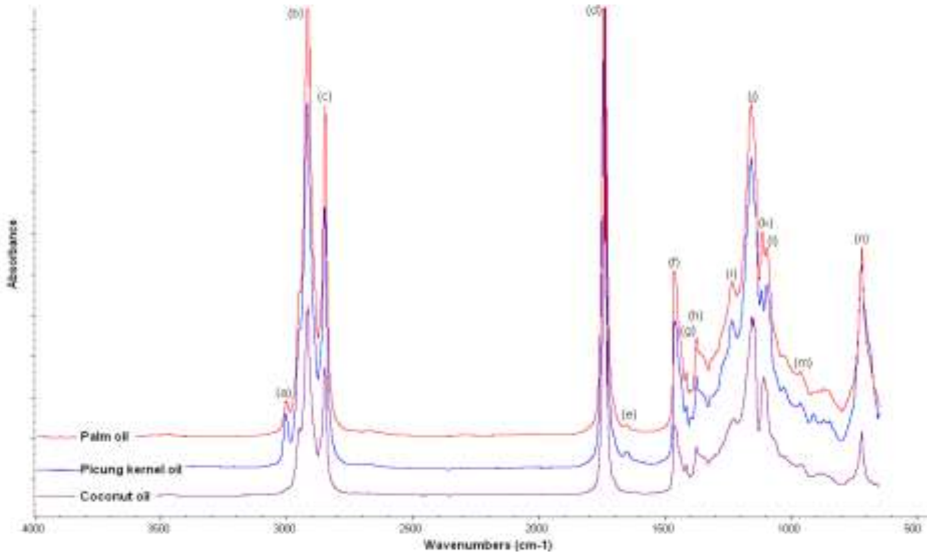

Figure 1. FTIR spectra of picung kernel, palm, and coconut oil

Upon a closer scrutiny, PKO is resemble PO rather than CO. PKO has major unsaturated and saturated fatty acids which are the same with PO, especially oleic (C18:1), linoleic (C18:2), palmitic (C16:0), and stearic acids (C18:0), as determined using gas chromatography (Table 3.). Differences between PKO and PO to CO are observed at several different spectra. CO didn't show spectrals at region at 3005.4/cm (a) which is due to the cis C=CH stretching, at 1655/cm (e) caused by cis C=C, and at 1116 and 1097/cm (k and l) corresponding to CH bending vibration and CH deformation vibration on fatty acids. This result is similar to Rohman and Che Man [10], differences spectra between palm and virgin coconut oil. PKO and PO contain more unsaturated fatty acids than CO, especially linoleic (C18:2) and oleic acid (C18:1). The presence of unsaturated fatty acid was observed in its FTIR spectrum at 3005.4/cm, which is absent in CO spectrum.

Table 4. Functional groups and modes of vibration in picung kernel, palm, and coconut oil spectra

Assigment	Frequency (/cm)	Functional group vibration
(a)	3005	*cis* C=CH stretching
(b)	2952	Asymmetric stretching vibration of methyl ($-CH_3$) group
(c)	2852	Asymmectric or symmetric stretching vibration of methylene ($-CH_2$) band
(d)	1747	Carbonyl (C=O) functional group from the ester linkage of triacylglycerol
(e)	1655	*Cis* C=C
(f)	1465	Bending vibrations of CH_2 group
(g)	1418	Rocking vibrations of CH bond of cis-disubsituted alkenes
(h)	1377	Symmetric bending vibrations of CH_3 groups
(i)	1236	Vibrations of stretching mode from the C-O group in esters
(j)	1160	Vibrations of stretching mode from the C-O group in esters
(k) and (l)	1116 and 1097	-CH bending and –CH deformation vibrations of fatty acids
(m)	962	Bending vibration of CH functional group of isolated trans-olefin
(n)	722	Overlapping of the methylene (-CH2) rocking vibration and to the out of plane vibration of cis-disubstituted olefins

Source : [10,18,20]

4. Conclusion

Crude PKO has chemical properties such as acid value 16.64, saponification value 126.44, iodine value 111.49, and peroxide value 8.539. This study showed that fatty acid composition of PKO is rich in oleic and linoleic acid, and the oil can be classified as unsaturated oil. The presence of high amount of linoleic acid suggest that these oil could be used as a good source of essential fatty acid. The high percentage of oleic, refined PKO might be used as edible cooking oil. Thus, the characteristic of saturated fatty acids seems to explain the fat's suitability to the formulation of margarine and cocoa butter. FTIR spectra also showed that PKO resembled PO rather than CO.

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