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Article

Physicochemical Characterization of Oil and Metallic Soaps from Two Varieties of Palm Kernel Oil (Tenera and Dura)

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Abstract: Palm kernel oil (PKO) was extracted from two varieties of palm kernel seeds using n-hexane as the extracting solvent, the results of the physical characteristics of the oils (dura-PKO and tenera-PKO) were as follows: yield (51.28%, 50.92%), colour (yellow, pale yellow), density (1.1g/cm^3, 0.9g/cm^3), viscosity (723.9kg/m/s, 505.4kg/m/s), moisture content (2.95%, 4.15%), refractive index (0.5676, 0.6885), specific gravity (1.1, 0.9), the odours of both oils were non-offensive and both oils had distinct taste. The chemical characteristics were as follows: acid value (7.29 mgKOH/g, 5.61 mgKOH/g), free fatty acids (12.22%, 21.81%), peroxide value (20 mg/kg, 10 mg/kg), pH value (6.49, 6.72), iodine value (57.78 gI_2/100g, 74.93 gI_2/100g), saponification value (207.57 mgKOH/g, 258.06 mgKOH/g) and ester value (200.28 mgKOH/g, 252.45 mgKOH/g) respectively. Both oils have good yields, their iodine values classified them as non-drying oils which make them suitable for industrial purposes, the peroxide value of dura-PKO was higher than that of tenera-PKO, which makes dura-PKO to be more susceptible to oxidative rancidity, dura-PKO is preferable as lubricant because of high viscosity and low iodine value, while tenera-PKO is more suitable for production of soap because of high saponification value and also suitable for the production of biodiesel because of its high fatty acids content. The result also showed that both oils are soluble in chloroform and ethanol, insoluble in water and partially soluble in petroleum ether. The metallic soap of Mn^{2+}, Zn^{2+} and Cu^{2+} were prepared from the extracted oils. The result revealed that both oil give good yields of metallic soap which ranged as fellows: tenera (51.22 – 53.81%), dura (51.50 – 55.20%). Ash contents of all the metallic soap increase with decrease in metal contents. However tenera soap had greater ash contents and lower metal contents. All metallic soaps were insoluble in water but soluble in acetone, kerosene and partially soluble in ethanol.

Keywords: PKO, Tenera and dura, Palm Kernel Oil, Metallic soaps

1. Introduction

In Nigeria, there are abundant vegetable oils namely; cotton seed oil, groundnut oil, rubber oil, palm kernel seed oil, coconut oil, etc. Vegetable oils are normally extracted from fruits, seeds, kernels and nuts, either by mechanical press or by solvents extraction using normal-hexane, petroleum ether, etc.

Palm kernel is the edible seed of oil palm tree (*Elaeis guineensis*). The fruit yield two distinct oils; palm oil derived from the outer parts of the fruit (mesocarp) and the palm kernel oil (PKO) derived from the kernel seed (endocarp) of the palm tree. Nutritional and industrial processes have increased the demand for oils and this in turn has led to the search for oils from different types of seeds. Oils are used in a variety of ways. They are used for food texturing, baking, frying and industrially; in manufacturing of soap, detergent, cosmetics, biodiesel and paint etc. [1].

The market demand for PKO is huge as it is used in soap, pharmaceutical, paint, food industries, etc. The raw material for the production of PKO is palm kernel nuts from which seeds are gotten. In Nigeria, palm trees are found in the Easten and Western regions of the country; in states such as Akwa Ibom, Imo, Abia, Rivers, Delta, Edo, Anambra, Ebonyi etc. Several varieties and forms of *Elaeis guineensis* (African oil palm) from which palm kernel seeds are obtained are: *E. guineensis* fo. dura, *E. guineensis var. pisifera*, and *E. guineensis* fo. tenera. They have different characteristics. Their physiochemical properties determine their usefulness in various aspects of life.

Soap is generally described as sodium or potassium salts of long chain fatty acids that are soluble in water [2]. However, Metallic soaps have been described as alkaline-earth or heavy metal salt of long-chain carboxylates which are insoluble in water, but soluble in non-aqueous solvents [3].

The soaps of the heavy metals have important applications. Soaps of barium, cadmium, lead, zinc and calcium have found practical application as thermal stabilizers for poly (vinyl chloride) [4, 5]. Calcium and magnesium soaps are used as corrosion inhibitors in non-polar media. Lead, manganese, cobalt and zinc soaps are used in paints to accelerate drying while copper soaps are well known for their fungicidal properties [6].

This research aim at extracting and characterizing the oils from two varieties of palm kernel seeds; namely, dura and tenera seeds, and preparation and characterization of metallic soaps of copper, zinc and manganese from the oils in order to evaluate the physicochemical properties of each oil and relate them to the properties of metallic soaps gotten from them.

2. Materials and Method

2.1. Materials, Chemicals and Equipment

The materials, chemicals and equipment used in carrying out this research include palm kernel oils, from two varieties of palm kernel seeds (dura and tenera varieties), n-hexane, distill water, phenolphthalein indicator, chloroform, ethanol, alcohol KOH, acetone, NaOH, ethanolic potash, HCl, potassium iodide, Hanus solution, metal salts of Mn, Zn, Cu, pestle and mortar, weighing balance, measuring cylinder, graduated beaker, burette, pipette, retort stand, pH meter, stop clock, oven, furnace, water bath, thermometer, conical flash, rubber stopper, Ostwald viscometer, specific gravity bottle, crucible tong, desiccator, concave mirror, search pin, filter funnel and Atomic Absorption Spectrophotometer (AAS).

2.2. Sample Collection and Preparation

Palm fruits were obtained from Ikot Obio Inyang in Etinan Local Government Area, Akwa Ibom State, Nigeria. The mesocarps of the Palm fruits were removed, the kernels were sun-dried and the shells were further broken using palm nut cracker to obtain palm kernel seeds. The palm kernel seeds were screened to remove debris i.e. pieces of shell and defective kernels. Prior to oil extraction, the seeds were ground in domestic grinder (mortar and pestle) and were stored separately in a plastic container.

2.3. Extraction of Oil

Exactly 800 g of each ground sample were used for the extraction of oil using n-hexane as the extracting solvent. Samples were soaked in 250 mL of n-hexane for about 24 hours, and were then filtered. The extracting solvent was separated from the oil using rotary evaporator. The PKO were refrigerated prior to analysis.

2.3. Characterization of Oil

Physico-chemical properties of the oils were determined using Standard methods of AOAC and

British Standard methods for analysis [7- 9].

2.3.1. Determination of odour and colour

The odours and coloursof oils were determined using physical methods

2.3.2. Determination of oil yield

The percentage yield of the oil was determined using the formula below:

$$\text{Yield}(\%) = \frac{Weight\ of\ oil}{Weight\ of\ ground\ sample} \times 100$$

2.3.3. Determination of moisture content

A known weight of the empty beaker and that of the oil samples were measured. The oil in beaker were kept in an oven for 6 hours and maintained at a temperature of 105°C and reweighed after cooling in a desicator to constant weight.

The percentage of moisture content was calculated as:

$$\text{Moisture content}(\%) = \frac{b-c}{b-a} \times 100$$

where a = weight of empty beaker, b = weight of beaker + oil before drying in the oven, c = weight of beaker + oil after drying in the oven

2.3.4. Determination of viscosity (Ostwald viscometer)

The viscosity of the oil was measured using Ostwald viscometer; in which oils were drawn up into the upper bulb of a 2 bulbs separated by capillary tubing. The time required for its meniscus to fall between calibration marks above and below the upper bulb was accurately measured. A similar measurement was made with water of known viscosity which serves as a standard. Both samples and the standard were performed in duplicate to obtain the average.

$$Viscosity = \frac{\mathrm{n}_1}{n_2} = \frac{\rho_1 t_1}{\rho_2 t_2}$$

where n_1 = viscosity of sample, n_2 = viscosity of water, ρ_1= density of sample, ρ_2 = density of water, t_1= flow time of sample, t_2 = flow time of water.

2.3.5. Determination of refractive index (RI)

A concave mirror was placed at the base of the stand with a search pin clamped appropriately to enable the adjustment of its position until coincided with its image at point C. The distance (CA) was measured as its initial measurement. Small quantity of each oil sample was poured into the mirror and the position of the pin adjusted again until a new position C' was found and where it coincided with its image was measured again to be $C'A$. The R.I. is calculated as:

$$\text{Refractive index (RI)} = \frac{CA}{C'A}$$

2.3.6. Determination of density

Density bottle was washed and weighed (M_1). The bottle was filled with water and placed on water bath until the temperature of water reaches 25^{o}C. The weight of the bottle and water was taken (M_2). Water was poured out and the bottle dried after which the bottle was filled with the oil samples at the temperature of 60^{o}C. This was allowed to stand for 30 minutes in water bath and the content weighed after cooling to 25^{o}C (M_3).

Density of oil was calculated using this formula:

$$\text{Density } = \frac{Mass\ of\ sample}{Volume\ of\ sample}$$

2.3.7. Determination of specific gravity (S.G)

The specific gravity of oil samples were calculated using the formula:

$$\text{S.G.} = \frac{Density\ of\ substance\ (g/ml)}{Density\ of\ reference\ substance\ (g/ml)}$$

2.3.8. Determination of pH value

The pH values of the oil samples were determined using a pH meter.

2.3.9. Determination of taste

PKO is edible oil [1]. However, the taste of both oil samples was determined after the result for acid values were obtained. The taste was determined with the use of human tongue.

2.3.10. Determination of free fatty acid value

The percentage of free fatty acid (FFA) was obtained after 25 mL of ethanol was added to 1.5 g of the sample in a conical flask. The mixture was heated to 60^{o}C then cooled. 1 cm^3 of phenolphthalein indicator was added to the solution. Titration was done using 0.1M NaOH solutions while shaking the mixture constantly for proper mixing. This was calculated using this formula:

$$\text{FFA(\%)} = \frac{Titre\ value \times 0.0282\ \times 100}{Weight\ of\ the\ sample}$$

2.3.11. Determination of acid value

Exactly 25 cm^3 of chloroform was measured into 100 mL conical flask, 1 g of each PKO was added, 2 drops of phenolphthalein indicator were also added to the mixtures. Titration was done with 0.1M alcoholic potassium hydroxide until a colour change was obtained. Blank determination was also carried out. Similar method was repeated for both oil samples.

The acid value was calculated using this formula:

$$\text{Acid value} = \frac{Sample\ titre - Blank}{Weight\ of\ the\ sample}\ 0.1 \times 56.1$$

2.3.12. Determination of saponification value

The method above was used and 2 g of the oil samples were weighed into 25 mL, of 0.5 ethanolic potash in a conical flask. To another flask, 25 cm^3 of the 0.5 ethanolic potash was placed without the oil, this was used as blank. Both flasks were boiled in a water bath for 30 minutes with frequent shaking and 2 drops of phenolphthalein indicator were added. Titration was done with 0.5M HCl without delay with vigorous shaking to get the end point.

Saponification value (S.V) was calculated using this formula:

$$\text{S.V.} = \frac{Average\ blank\ titre - Average\ sample\ titre}{Weight\ of\ sample} \times 28.01$$

2.3.13. Determination of ester value

Ester value for oils (dura and tenera-PKO) was obtained as the difference between saponification value (SV) and acid value (AV).

$$Ester\ value = S.V. - A.V.$$

2.3.14. Determination of iodine value

Using the method above, 0.5 g of the sample was dissolved in 10 mL of chloroform in a conical flask, 25 mL of the Hanus solution was added to the chloroform and corked. This was kept in desiccator for 30 minutes in the dark. A blank was also carried out under the same conditions. When reaction was completed, 15 cm^3 of 10% potassium iodide solution and 10 mL of distilled water was added to each flask and mixed by gentle shaking. The content of both flaks were titrated with 0.1N $Na_2S_2O_3$ to pale yellow and 2 mL of starch solution indicator was added. Titration was continued until the blue-black colour was completely discharged. This was calculated using this formula:

$$Iodine\ value = Blank\ titre\ value\ - Titre\ value\ \times 6.35$$

2.3.15. Determination of peroxide value

Using the method above, 5.00 g of dura-PKO was weighed into a 250 mL glass stoppered Erlenmeyer flask. By graduated cylinder, 30 mL of acetic acid-chloroform solution (3:2) was added and the flask was swirled until the sample was completely dissolved (careful warming on a hot plate was necessary). Using 1mL Mohr pipette, 0.5 mL of saturated potassium iodine solution was added and the flask was stoppered and the content swirled for exactly 1 minute. Immediately, 30 mL of distilled water was added using a graduated cylinder, stoppered and shake vigorously to liberate the iodine from the chloroform layer, and 1mL of starch solution indicator was added using a dispensing device. Titration was done with 0.1N sodium thiosulfate until blue-gray colour disappeared in the upper layer. Similar method was repeated for the second sample (tenera-PKO).

A blank solution was prepared with the sample. The peroxide value was calculated using the formula:

$$\text{Peroxide value} = \frac{(Sample\ titre - Blank\ titre) \times N\ thiosulfate \times 1000}{Weight\ of\ sample}$$

2.4. Preparation of metallic soap

Metallic soaps of manganese, zinc and copper were prepared according to the method reported by Ekpa and Ibok [11]. 50 g of each oil was heated to 90-95 ^{o}C in a 500 mL beaker and 125 mL of 10 M NaOH was added with stirring until the whole mixture emulsified into a thick layer, after which the soap was allowed to cool. The soap was filtered and then washed with cold distilled water to neutral pH and oven dried. The dried soap was ground into powdery form.

0.05 M solution of sodium soap was prepared in hot water and added to 0.15M solution of each metal salt ($ZnSO_4.7H_2O$, $CuSO_4$.5H2O and $MnCl_2.H_2O$). The metallic soaps which precipitated were filtered, washed with distilled water and oven dried at 40^{o}C to constant weight. The yield, moisture content, ash content, metal content, melting point and pH were determined using standard methods. Solubility of the metallic soaps in water, kerosene, acetone and ethanol were also determined.

3. Results and Discussions

3.1. Characterization of Oil

3.1.1. Yield

As presented in Table 1, PKO from dura and tenera varieties have the oil yield of 51.28% and 50.92% respectively. The yield for both oil samples were high compared to 47.5% oil content from dura-

PKO obtained by Ibiam *et al*., [12]. This may be due to the method of extracting and the age of the palm tree in which the seeds were obtained.

Table 1: Some physical properties of PKO from Dura and Tenera

Chemical properties of the oil	Dura-PKO	Tenera-PKO
Yield (%)	51.28	50.92
Colour	Yellow	Pale-yellow
Odour	Non-offensive	Non-offensive
Taste	Distinct	Distinct
Moisture content (%)	2.95	4.15
Viscosity (kg/m/s)	723.9	505.4
Density (g/cm3)	1.1	0.9
Specific gravity	1.1	0.9
Refractive index	1.256	1.268

3.1.2. Moisture content

Oil may have different levels of moisture content depending on extraction methods, storage factors, variety, geographical location and season. The moisture content (accurately drying weight loss) for dura PKO and tenera PKO were 2.95% and 4.15% respectively. The values are higher compared to 0.89% for dura- PKO reported elsewhere [12] and 1.2 and 0.1 for avocado pear fruit oil and native pear fruit oil respectively [13].

3.1.3 Odour and taste

The odour of the oil samples (dura and tenera- PKO) was non-offensive. The taste of both oil samples was determined after the result for acid values were obtained. The oil acid values showed that both oils are edible because their acid values were below the toxic level, and the taste were determined to be agreeable or distinctive; they can be distinguished from another oil sample.

3.1.4.pH value

The pH values obtained were 6.49 and 6.72 for Dura and Tenera- PKO respectively. The results obtained showed that Dura- PKO is slightly acidic, while Tenera- PKO (6.72) tends towards neutral at 25^{o}C.

3.1.5. Refractive index

This is the ratio of velocity of light in a medium or angle of refraction. The refractive index obtain were 1.256 for Dura and 1.268 for Tenera oil respectively. These values were lower compared to the refractive index of avocado pear, native pear fruit oil and PKO [12- 14]. Hence, the values obtained for both oil samples were good as they were lower when compared to other oil samples.

3.1.6.Colour

The colour of Dura of the palm fruits obtained by solvent extraction was yellow, while that of Tenera-PKO was pale-yellow (light yellow). Colour is a useful characteristic of oil but is not necessarily the major determination of the potential end-use in industrial applications [15-16]. The colour is the same with the colour of groundnut oil, olive oil and PKO determined by others, except the PKO is produced or extracted by the traditional method before the colour could be dark brown.

3.1.7. Viscosity

The viscosity of oil reduces with increase in temperature. The viscosity of Dura-PKO was 723.9 kg/m/s, while that of Tenera- PKO was 505.4 kg/m/s. The viscosity of Tenera- PKO was in the range of that of avocado pear fruit oil (532.8 kg/m/s) reported by Akpabio *et al*., [13] but that of dura- PKO (723.9 kg/m/s) was higher compared to the values above. Dura- PKO may have an advantage as lubricant than tenera- PKO.

3.1.8. Density and specific gravity

The density of the samples was conducted to determine the compatibility of the samples. The results showed that Dura- PKO and Tenera- PKO have the density of 1.1 g/cm^3 and 0.9 g/cm^3 respectively. The density of Dura- PKO was higher than that of Tenera- PKO. The density of tenera- PKO could be compared to the density of avocado pear and native pear fruit oils [13] and also same with the density of tenera- PKO (0.9 g/cm^3) [12]. Density of Tenera- PKO was found to be the same as the density of cashew nut oil [17].

However, the specific gravity obtained for tenera- PKO (0.9) was the same as the specific gravity of seed oils from rubber (*Hevea brasilliensis*); 0.9 for the seed sourced from Chiang Rai and 0.9 for the rubber seed sourced from Surin Provines of Thiland respectively [18] that of Dura- PKO (1.1) was slightly higher than the values above.

3.1.9. Acid value

The acid values obtained for dura-PKO and tenera-PKO were 7.29 mgKOH/g and 5.61 mgKOH/g respectively (table 2). The values are higher than 3.53 mgKOH/g reported by Ibiam*et al* [12] but lower when compared to the value reported by Atasie and Akinhanmi [14]. Acid value of dura-PKO is higher than tenera-PKO, The values for both oil samples are higher than 3.53 mgKOH/g,hence they are better oils for paint and soap manufacturing. However the oils are edible because the values are below the toxic level. High acid value cause oil to turn sour and discolouration may also occur [1].

Table 2: Chemical Properties of Dura and Tenera oil

Chemical properties of the oil	Dura-PKO	Tenera-PKO
Peroxide value (mg/g)	20.00	10.00
Iodine value (gI_2/100g)	57.78	74.93
Acid value (mgKOH/g)	7.29	5.61
pH value	6.49	6.72
Free fatty acid (%)	12.22	21.81
Saponification value(mgKOH/g)	207.57	258.06
Ester value (mgKOH/g)	200.28	252.45

3.1.10. Free fatty acid (%)

Low free fatty acid is a disadvantage in the paint and soap industries but may be an advantage in terms of human consumption. The %FFA of tenera- PKO (21.81) makes tenera- PKO better oil for paint and soap industries which give its advantage over dura- PKO with %FFA of 12.22. However dura- PKO may be of advantage in terms of human consumption. Therefore, tenera- PKO contain greater percentage of unsaturated fatty acid than dura- PKO.

3.1.11. Iodine value

The iodine value gives an indication of the degree of unsaturation of oils. Triglyceride oils are divided into three groups depending on their values; drying, semi-drying and non-drying oils. The iodine value of a drying oil is higher than 130. This value is between 90 and 130 for semi-drying oils. If the value is lower than 90, then the oil is called non-drying [19]. The iodine values obtained in this research were 57.78 gI_2/100g and 74.93gI_2/100g for dura and tenera- PKO respectively. The values are higher compared to that of PKO reported to be 45.6 g/100g [12] and 41.24 g/100g [14]. These differences may be due to the age of the palm fruit, location, varieties and method of extractions.

However, the iodine values of samples in this study agreed with the standard, hence the oils could be classified as non-drying oils because their iodine values are below 90 [19 - 20].

3.1.12. Peroxide value

The peroxide value obtained for the oil samples were 20 mg/kg and 10 mg/kg for dura and tenera-PKO respectively. Peroxide value is the measure of the degree of oil oxidation. The value helps in determining susceptibility of oil to oxidative rancidity. The rate of non-enzymatic rancidity of oil depends on the extent of its exposure and its susceptibility to oxidation. Hence, the peroxide value of dura-PKO suggests that it would be more susceptible to rancidity than tenera-PKO [21-22]. The peroxide value of tenera-PKO is comparable with dura-PKO (10 meq./kg) but higher than 1.70 meq./kg reported elsewhere [12, 14]. Peroxide value of tenera-PKO is lower than that of palm oil [1] while the peroxide value of dura-PKO is lower than that of native pear fruit oil (126.3 mg/kg) and can be compared with avocado pear fruit oil (28.8 mg/kg) [13].

3.1.13. Saponification value

The saponification values of the oil samples were 207.57 mgKOH/g and 258.06 mgKOH/g for dura and tenera-PKO respectively. The value of tenera-PKO is higher than that of dura-PKO. The values are comparable with the saponification values of PKO reported [14]. The values are higher than those of baobab seed oil 186, peanut oil 165, and palm oil 140 [1]. The values can also be compared with African pear oil 227.205 mgKOH/g [16] but lower than native pear oil 25.9 mgKOH/g [13]. Saponification value of oil is an important parameter in determining the suitability of oil in soap making. Higher saponification values of the oil samples suggest that both oils are good for soap making, however tenera oil is more preferable than dura oil.

Table 3: Solubility of PKO in some solvents

Solvent	Solubility
Chloroform	Soluble
Petroleum ether	Partially soluble
Ethanol	Soluble
Water	Insoluble

3.2. Characterization of the Metallic Soaps

The physico-chemical properties of the metallic soap of Mn, Zn and Cu from tenera and dura seed oils are presented in Table 4. The characteristics of soaps are determined by the amount and composition of the component fatty acids in the oil [23].

Table 4: Some physico-chemical properties of metallic soap of Mn, Zn and Cu from Tenera and dura seed oil

	Tenera seed oil			**Dura seed oil**		
	Mn soap	Zn soap	Cu soap	Mn soap	Zn soap	Cu soap
Yield (%)	51.22	52.90	53.81	52.50	51.5	55.2
Moisture content (%)	0.89	1.25	1.48	1.20	0.96	1.85
Ash content (%)	24.57	22.48	20.50	17.50	14.52	12.70
Melting point (^{o}C)	100.5	86.5	77.5	82	91	76.5
PH	8.30	6.85	7.76	6.91	7.42	5.40
Colour	Cream	White	Blue	cream	White	Blue
Metal content (%)	3.70	9.20	12.0	4.3	9.60	14.00
Texture	Powder	Powder	Powder	Powder	Powder	Powder

The yield of the copper soap was higher for both oils. However the yield of the metallic soap from both oils ranges between 51.2 to 55.20%. These results are comparable to that of copper soap 51% and zinc soap 53% from *Cucumeropsis mannii* seed oil reported [23].

Metal content of metallic soap of tenera seed oil was lower than that of dura seed oil while the ash content of that of tenera seed oil was higher than that of dura seed oil. The metal content of Manganese soap was lower for both oils and metal content of Zn soap was higher for both oils, it was observed that the higher the ash content, the lower the metal content. These results agreed with the previous report elsewhere [23-24]. These may be due to the number of unpaired electrons present in the d-orbital of the metal ions and the properties of the oil in which metallic soap is prepared from.

The melting points of the metallic soaps ranges between 77.5 and 100.5^oC. These results are generally low compared to the melting point of metallic soaps of Ni, Cu and Zn from *Cucumeropsis mannii* seed oil [23] which ranges from 114 to 120^oC and Al, Cu and Zn soaps from commercial palm kernel oil which ranges from 100 to 115^oC [24]. High melting point poses solubility and handling problem [23] hence metallic soaps from tenera and dura seed oils are suitable for applications at these temperatures (77.5 to 100.5^oC).

The ash contents and pH of metallic soaps from tenera seed oil were higher than those of dura seed oil. Ash content indicates the level of non-combustible organic and inorganic matter in the soap while pH indicates the level of acidity or alkalinity of the metallic soap. The high pH of tenera metallic soap may be due to the high pH value of the oil reported in Table 2.

The colour of metallic soap of Mn, Zn, and Cu were cream, white and blue respectively. These colours depend on the number of unpaired electrons present in d-orbital of the metal ions.

All the metallic soap obtained were insoluble in water but soluble in acetone, kerosene and partially soluble in methanol

Table 5: Solubility of metallic soaps in some solvents

Solvent	Solubility (dura and tenera soaps)
Kerosene	Soluble
acetone	Soluble
methanol	Partially soluble
Water	Insoluble

4. Conclusion

The results showed that oil with good yield can be obtained from dura and tenera palm kernel seeds, using n-hexane as the extracting solvent. The iodine values of both oils indicate that they are non-drying oils and are suitable for industrial purposes. Palm kernel oil (PKO) from dura variety may be of advantage as lubricant because of its high viscosity. Dura-PKO may be susceptible to oxidative rancidity because of high peroxide value. Though dura-PKO and tenera-PKO are suitable for paint, cosmetics and soap production, tenera-PKO may be more suitable for commercial production of soap because of its high saponification value. Metallic soaps of good yield were obtained from both oils and their properties showed that tenera oil metallic soaps have higher ash content and pH but lower metal content compared to dura oil metallic soaps. However ash contents of all the metallic soap increase with decrease in metal contents.

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