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Physicochemical Characterization of Seed and Seed Oil of certain *Jatropha* L. species

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ABSTRACT

The seed of *Jatropha* was collected from the TNAU, Coimbatore, India and it was utilized for determination of seed and seed oil characterization. The *Jatropha* oil was extracted using light petroleum ether (60-80°C) by soxhlet apparatus. The physicochemical properties of *Jatropha* oil were evaluated. The result showed that the seeds consist of 21.90-40.31% (dry w/w) oil, moisture and volatilities (5.59-5.87% v/w) and protein content (13.40-22.57%). The physicochemical properties shows acid value (6.05-6.83), iodine value (101.54-109.43 mg/g) and saponification value (184.5-193.6 mg/g). The unsaponifiable matter was 0.79-0.85%. Negative Halphen test indicated the absence of cyclopropanoid acids in seed oil. GC analysis of *Jatropha* oil showed presence of palmitic acid (14.63-16.01%), stearic acid (5.7-6.2%), oleic acid (39.32-42.66%) and linoleic acid (34.42-39.32%).

Keywords: *Jatropha* species; seed characterization, seed oil characterization; physiochemical properties.

Introduction

The world's energy demand continues require increasing as we use more machines in our day-to-day lives. As there was rapid decline in fossil fuel due to increased energy consumption, high prices and associated environmental degradation a considerable interest was focused on the development and expansion of alternate source of energy i.e., biofuels. According to the estimate even 5% replacement of fossil fuel by biodiesel will help saving foreign exchange of over Rs. 4000 crores [1]. Though many non edible oil seeds were available, *Jatropha* L. recognized as the most potential genus for biodiesel production, since the seeds contain high oil content of 28 to 38%. The ultimate goal in this programme is to identify seed characters and oil characters to study the interactions in certain Jatropha species.

The genus *Jatropha* L. belongs to the family Euphorbiaceae and it is a native species of Central America and has been spread to other tropical and subtropical countries. It is locally known as Ratanjyot (Hindi) and Physic nut or Purging nut in English. It is a drought tolerant perennial crop, grows quickly and survives in all kinds of soil. It is a morphologically diverse genus which comprises of 176 species of rhizomatous subshrubs and herbs [2]. Plants of this genus are herbs, shrubs or trees, monoecious (rarely dioecious), exudate is watery to white; possess poisonous substance in the sap/seed. Indumentum has simple hairs and sometimes glandular hairs; leaves alternate, often digitately lobed. Flowers are terminal cymes with a single pistillate flower at the end of the primary axis. Sepals are 5 in number, free, imbricate; petals – 5, mainly free; staminate disc annular or 5 free glands, stamens 6–10, in two whorls; pistillate foliaceous annular, 5-lobed; fruits capsular to tardily dehiscent and sub-drupaceous [3]. Even though 12 *Jatropha* species were notified by several Indian floras, research has been confined to eight species only among the *Jatropha* species. *J. curcas* is the most primitive form and has the potential to be cultivated for biodiesel and medicinal properties. The following are the *Jatropha* species available in India and its description for identification.

Each fruit contains 2 to 3 oblong black seeds which can produce oil. The seed kernel oil contained 40-60% (w/w) oil [4]. The seeds of *Jatropha* contain viscous oil, which can be used for manufacture of candles and soap, in cosmetics industry, as a diesel/paraffin substitute or extender [5] and useful in medicinal and veterinary purposes, as insecticide. In view of these, the present research was designed to study the psycho-chemical properties including the fatty acids and TAGs composition of *Jatropha* oil seed [6].

Address for correspondence:

Material and Method

Collection of Seed Materials

Jatropha seeds of 8 different species were collected from Tamil Nadu Agricultural University, Coimbatore, India. The ripe seeds were selected and the damaged seeds were discarded. The seeds were cleaned, de-shelled and air dried in the shade for few days. The seeds were ground to powder using a grinder prior to oil extraction. All chemicals used in the study were analytical grade and used without further purification.

Seed Characterization

(i) Seed Index

Weight and volume occupied by 1000 seeds was determined.

(ii) Moisture and Volatilities

About 5 to 6 g of seeds were accurately weighed in a petridish and kept in hot-air oven maintained at 110°C for 4 hrs. After cooling in a dessicator, the loss in weight was recorded in each case. This procedure was repeated till constant weight was obtained.

(iii) Protein content

Deoiled meal (about 1 g) was weighed accurately by transfer method into a Kjeldhal's digestion flask. Sodium sulphate (10 g), copper sulphate (0.1g), a pinch of selenium metal and 20 mL of concentrated sulphuric acid were added to the flask and the mixture was heated gently in fume chamber for 15 min and then strongly for 2 to 3 until the mixture in the flask became colourless. This point indicates complete conversion of nitrogen into ammonium sulphate. The flask was cooled and the contents dissolved in 200 mL distilled water and made to 250 mL in the measuring flask. From this, 25 mL solution was taken in round bottom flask fitted with cork carrying a dropping funnel and delivery tube. A 25 mL of 50% sodium hydroxide taken in the dropping funnel. The delivery tube was connected via condenser to conical flask. The flask contains 100 mL of 20 % boric acid in which condenser tip just dipped. Round bottom flask was cooled by ice cold water and sodium hydroxide, about 20 mL was added immediately. The flask was heated for 20 min so that contents of Kjeldhal's flask were distilled to expel ammonia in conical flask in the form of bubbles. Top of funnel containing sodium hydroxide was opened. Flask was cooled, assembly dismantled, washed condenser and receiver with little quantity of distilled water. The contents of flask were titrated with 0.1N sodium hydroxide using bromophenol blue indicator. End point is from blue to greenish yellow. A blank experiment was also done side by side [7].

Seed Oil Characterization

Extraction of Oil:

100 gm of the grounded seeds were taken and placed in the Soxhlet apparatus and the oil was extracted using light petroleum ether as solvent (60-80°C) for 24-48 hr. in each case. petroleum ether as solvent. Combined petroleum ether (60-80°C) extract was dried over with Anhydrous Sodium Sulphate was added to remove any trace of moisture from the extracted solution. The oil was separated from the solvent using vacuum at 40°C with rotary evaporator to recover oil [8]. The seed oils were filtered through Whatman filter paper No.1 to remove foreign particles and pure oil. The percentage of oil content can be calculated as below

$$\% \text{ of oil} = \frac{\text{Wt of oil obtained in gm}}{\text{Wt of seed taken in gm}} \times 100$$

After the oil had been obtained and its percentage of oil content is calculated the same is subjected to determination of physicochemical characteristics of seed oil such as acid value, iodine value and saponification value and chemical analysis of seed oil. Official and tentative methods (1993) of AOCS Chicago were followed for the determination of physicochemical characteristics of seed oil [9].

Oil Content:

The weight of oil extracted from 10 g of seeds powders was measured to determine the lipid content. Result was expressed as the percentage of oil in the dry matter of seed powders.

(i) Refractive Index

Refractive index was determined on Abbe's refractometer. The prisms were cleaned with xylene and dried. Place few drops of oil on the prism, close the prisms and allow to stand for 1-2 min, adjusted the instrument and light to obtain the most distinct reading and determine the refractive index. Refractive index of oil increases with the increase in unsaturation and also chain length of fatty acid [10].

(ii) Viscosity

Viscosity of seed oil was carried out using Brookfield RV-I. Spindle of S03 was used at 10 rpm in room temperature.

(iii) Density

The density of the samples was determined at 25°C by using density meter Anton paar DMA 4500.

(iv) Acid Value

Acid value of seed oil was determined according to AOAC Official Method Cd 3a- 63. Two gram of the pure oil was weighed accurately by transfer method into a 250 mL conical flask. Neutral ethanol (20 mL) was added by means of a pipette and the flask heated on a steam bath for 3-min. Then the flask was cooled and the contents titrated with 0.1N alcoholic potassium hydroxide solution using phenolphthalein as an indicator. A blank titration was also conducted side by side. Percentage free fatty acids (FFAs) were calculated using oleic acid as a factor.

(v) Peroxide value

The peroxide value was determined according to AOAC Official Method 965.33.

(vi) Iodine Value

Iodine value of seed oil was determined according to AOAC Official Method 993.20. Oil (0.2 g) was weighed accurately by transfer method into a 250 mL iodine flask and dissolved in chloroform (20 mL). Wij's reagent (20 mL) was added by means of a pipette. The flask was stoppered and kept in darkness for one hr. with intermittent shaking. Then 15% of potassium iodide solution (10 mL) and 50 mL of distilled water were added to the flask and mixture was shaken well. The liberated iodine was titrated with 0.1 N sodium thiosulphate solution using fresh starch solution as indicator. A blank titration was also conducted side by side.

(vii) Saponification value and saponification equivalent

The saponification value was determined according to MPOB Official Test Method 2004. Two gram of oil was weighed accurately by transfer method into a 250 mL round bottom flask. Freshly prepared 0.5 N alcoholic potassium hydroxide solution (25 mL) was added to the sample by means of pipette and the mixture gently refluxed on a water bath using an air-condenser for one hr. Then the flask was cooled, the condenser tip washed with little distilled water and the contents were titrated with 0.5 N hydrochloric acid solution using phenolphthalein as indicator. A blank titration was carried out simultaneously.

(viii) Unsaponifiable matter

After the titration of the sample for saponification value was completed, the contents of the flask were made alkaline and extracted with light petroleum ether (60-80°C) and ether twice. The combined ethereal solution was washed thoroughly with distilled water, dried over sodium sulfate, solvent evaporated and the residue weighed. It was dissolved in neutral alcohol and the free acid titrated with 0.02 N alcoholic potassium hydroxide solution using phenolphthalein as indicator.

(ix) Estimation of cyclopropenoid fattyacids

The Halphen test was originally developed as an empirical method of testing the adulteration of various vegetables oils by cotton seed oil [11]. Though many modifications of the reagent and reaction conditions have been described [12]. The method involves heating the oil with a 1.0% solution of sulphur in carbon disulphide combined with one part of amyl alcohol. If oil contain cotton seed oil a pink colour develops. The reaction is now believed to be specific for the cyclopropane ring [13]. The method is quick and easy for checking cyclopropenoid fatty acids in a mixture of oils. It is possible to use the reagent as TLC sprays [14]. Under controlled conditions the reaction can also be used as a colorimetric method of estimating the total cyclopropane fatty acid content of oil [15].

Fatty Acid Compositions

The GC-FID analysis was performed with Shimadzu, GC-14B series gas chromatograph equipped with FID detector and the capillary column DB-23 (30 m × 0.25 mm; 0.5 μM). About 0.1 ml oil was converted to methyl ester using 1ml NaOMe (1 M) in 1ml hexane before being injected into the GC. The column temperature was initially maintained at 160°C for 2 min, increased to 180°C at 6°C/min., maintained for 2 min at 180°C, then further increased to 230°C at 4°C/min and finally maintained for 10 min at 230°C. The carrier gas was nitrogen at a flow rate of 1.5 mL/min. The injector and detector temperature were maintained at 230 and at 250°C, respectively and split ratio was 50:1. The identification of the peaks was achieved by retention times by means of comparing them with authentic standards analyzed under the same conditions.

TAGs Composition

TAGs profile of jatropha oil was determined by using high-performance liquid chromatography (HPLC) equipped with ELSD 800 detector (altech). The TAGs of the oil was separated using commercially column, inertsil ODS 3 (250mm x 4.6mm) The mobile phase was a mixture of acetonitrile: diclhrohometane (60:40) set at a flow rate of 0.8 ml/min, with pressure 2.3 bar. TAG peaks were identified based on the retention time of available commercial TAGs standard.

Results and Discussion

Physical properties of 1000 seeds are given in Table 1. Chemicals are contained either in pulp or kernel that directly affected by the physical parameters. The average weight and volume of seed directly relate to the hardness of seeds that directly affects process of analysis. Physical properties of one seed to another seed could distinct the product quality of *Jatropha* seed and its chemicals. The Jatropha seed contains 21 - 40% of oil and 13.40 - 22.57 % of protein. It has been reported that the toxicity and the disagreeable odour of seed is due to protein. The 4.1 – 4.8% w/w total ash content of seeds indicates presence of abrasive solids, soluble metallic soaps, and silica residue in the seed.

The property of different fats and oils depends upon characterization of the degree of unsaturation or saturation with respect to hydrogen. Hence different oils are less or more saturated according as they contain greater or lesser proportion of the saturation in fatty acids. The various number of test parameters like: refractive index (RI), Viscosity, Specific Gravity (SG), Density, Acid Value (AV), Peroxide Value (PV), Iodine Value (IV), Free Fatty Acids (FFA), Saponification Value (SV), Unsaponifiable Matter Content (UsMC), Free Fatty Acid Composition (FFAC) and Triacylglycerols Composition (TAGsC) are applied to the sample. Results are presented in Table 2. *Jatropha* oils are showing the iodine value from 109.43 to 101.54 due to its high content of unsaturated fatty acids (Table 3). The IV has found applications to various chemical and physical

Table - 1
Seed Characterization

Characterization of seeds	*J. curcas*	*J. nana*	*J. gossipi-folia*	*J. glandu-lifera*	*J. inter-gerimma*	*J. tanjo-rensis*	*J. multi-fida*	*J. podagrica*
1000 seed weight (g)	610.8 ± 1.7	550.7± 0.4	580.6 ± 1.7	590.2 ± 0.8	570.8 ± 1.2	600.1 ± 1.0	630.8 ± 0.9	630.1 ± 0.5
Oil content (% v/w)	35.16-40.31	22.53-29.16	28.69-30.33	21.9-27.65	28.11-40.14	25.63 - 32.69	32.01-40.03	31.9 8-38.05
Volume of 1000 seeds (mL)	730.0± 0.5	719.6± 0.5	722.3± 0.5	725.2± 0.5	720.5± 0.5	728.9 ± 0.5	736.2 ± 0.5	733.4 ± 0.5
Relative density (g/cm3)	0.71 ±0.01	0.81 ±0.01	0.76 ± 0.01	0.77 ± 0.01	0.75 ± 0.01	0.80 ± 0.01	0.73 ± 0.01	0.74 ± 0.01
Moisture and volatilities (% w/w)	5.80± 0.01	5.59± 0.01	5.61± 0.01	5.63± 0.01	5.60± 0.01	5.73 ± 0.01	5.85 ± 0.01	5.87 ± 0.01
Moisture content (%)	5.12 ± 0.2	5.53 ± 0.2	5.92 ± 0.2	5.38 ± 0.2	5.77 ± 0.2	5.51 ± 0.42	5.79 ± 0.2	5.42 ± 0.2
Ash content (%)	4.3 ± 0.2	4.5 ± 0.2	4.1 ± 0.2	4.8 ± 0.2	4.5 0.2	4.7 ± 0.2	4.4 ± 0.2	4.5 ± 0.2
Protein content (d.b.%) (%w/w)	22.57 ±0.2	19.59 ± 0.02	13.40 ± 0.2	16.59 ± 0.2	20.57 ±0.2	21.86 ± 0.02	22.51 ± 0.2	21.64 ± 0.02
Halphen test	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

Table-2
Seed Oil Characterization

S. No.	Seed Oil Properties	*J. curcas*	*J. nana*	*J. gossipi-folia*	*J. glandu-lifera*	*J. inter-gerimma*	*J. tanjo-rensis*	*J. multifida*	*J. podagrica*
1	Colour	light yellow	lightish yellow	light yellow	brownish yellow	light yellow	lightish yellow	light yellow	light yellow
2	Refractive Index(28^0C)	1.496	1.486	1.489	1.452	1.469	1.476	1.435	1.465
	Viscosity at 20^0C	42.5	39.6	41.5	37.7	39.4	42.1	41.0	40.1
3	Specific gravity(28^0C)	0.913	0.908	0.919	0.899	0.920	0.917	0.926	0.944
	Density at 20°C (g/ml)	0.9031	00.8976	00.9017	00.8907	00.8915	00.8986	00.9033	00.9037
4	Acid Value (mgKOH/g)	6.73	6.05	6.64	6.83	6.38	6.49	6.33	6.51
5	Peroxide Value	1.92	1.84	1.89	1.87	1.91	1.95	1.89	1.76
6	Iodine Value	102.6	101.54	107.25	105.93	108.54	109.43	106.43	103.06
12	Free Fatty Acid (%)	3.37	3.26	3.80	3.75	3.66	3.54	3.28	3.29
13	Saponification Value (mg/g)	193.6	184.5	189.4	191.6	192.7	189.9	193.1	192.2
14	Unsaponifiable matter content (%)	0.83	0.79	0.84	0.85	0.83	0.82	0.85	0.83
15	**Fatty Acid Composition (%)**								
	Palmitic (C 16:0)	15.86	16.01	14.84	15.83	15.60	15.01	14.80	14.63
	Palmitoliec (C 16:1)	0.11	0.9	0.8	0.10	0.8	0.10	0.13	0.12
	Stearic (C 18:0)	5.8	6.2	5.7	5.9	5.7	5.8	6.0	6.1
	Oleic (C 18:1)	39.95	40.12	40.40	39.32	42.66	42.10	40.95	41.04
	Linoleic (C 18:2)	38.73	35.70	38.64	34.42	38.02	39.32	36.75	37.53
	Sat. FA	22.10	21.43	20.74	21.64	20.96	22.63	24.23	22.33
	MUFA	37.53	34.64	38.53	35.64	38.53	33.57	38.64	38.44

	PUFA	49.45	50.12	47.90	53.4	49.16	52.56	47.64	51.34
	TAGs Composition (%)								
a.	OOL	20.43	16.57	21.76	22.52	18.98	19.76	20.87	21.98
b.	OLL	18.98	17.96	15.98	17.95	17.87	19.86	17.87	18.86
c.	POL	15.01	14.86	14.79	14.38	13.90	14.74	15.38	14.96
d.	PLL+MOL	7.10	6.96	7.77	7.58	7.35	7.39	7.95	7.35
e.	MPP+OOO	14.78	16.86	15.87	17.01	16.84	15.86	15.96	16.53
f.	POO	10.67	10.01	10.27	9.85	9.49	10.17	10.94	10.78
g.	Nd	3.69	3.69	3.91	3.30	3.26	3.74	3.51	3.77

properties of fats and oils, having physiological applications, and serving as a quality control method for hydrogenation, these applications include use in standards for biodiesel and in assessing oxidative stability.

The saponification value (SV) is expressed as the number of milligrams of potassium hydroxide (KOH) required to saponify 1 g of sample. The saponification value of *Jatropha multifida* seed oil (193.6 mg/g) was higher compared to the *J.nana* seed oil (184.5). Negative Halphen test indicated the absence of cyclopropanoid acids in the seed oil. The fatty acid composition of *J. curcas* oil was analysed by gas chromatography (Table-2). Table 2 shows major long chain fatty acids present in the *Jatropha seed* oil which are palmitic acid (14.63-16.01%), palmitoliec acid (0.8-0.13%), stearic acid (5.7-6.2%), oleic acid (39.32-42.66%), linoleic acid (34.42-39.32%) and. *J. multifida* oil contains high percentage of saturated fatty acid which is about 24.23%.

Chemical and Physical Properties

The data collected from the study of the physical and chemical properties of the test samples (Table 1) shown oil content of *jatropha* kernel was determined from 21.90-40.31%. Oil content of *jatropha* kernel was found higher than linseed, soybean, and palm kernel which is 33.33%, 18.35% and 44.6%, respectively (Gunstone, 1994). High oil content of *Jatropha* indicated that *Jatropha* are suitable as non-edible vegetable oil feedstock in oleochemical industries (biodiesel, fatty acids, soap, fatty nitrogenous derivatives, surfactants and detergents, etc).

The iodine value is a measured of the unsaturation of fats and oils. Higher iodine value indicated that higher unsturation of fats and oils (Knothe, 2002; Kyriakidis and Katsiloulis, 2000). The iodine value of jatropha oil was determined at 101.54-109.43 gm. $I_{2/100g}$ standard iodine value for biodiesel was 120 for Europe's EN 14214 specification. The limitation of unsaturated fatty acids is necessary due to the fact that heating higher unsaturated fatty acids results in polymerization of glycerides. This can lead to the formation of deposits or to deterioration of the lubricating (Mittelbach, 1996). Fuels with this characteristic (e.g Sunflower oil, soyabean oil and safflower oil) also likely to produce thick sludges in the sump of the engine, when fuel seeps down the sides of the cylinder into crankcase (Gunstone, 2004). The iodine values of *Jatropha* place them in the semi-drying oil group. High iodine values of *Jatropha* are caused by high content of unsaturation fatty acid such as oleic acid and linoleic acid. The iodine values of *Jatropha* seed oil of suggest their use in production of alkyd resin, shoe polish, varnishes etc. (Akintayo, 2004). The usual method of assessment hydroperoxides (primary oxidation products) is by determination of peroxide value (Gunstone, 2004). Peroxide value of *Jatopha* oil seed showed a low value (as crude seed oil) of 1.76-1.95 meq/kg, proving the oxidative stabilities of the seed oil relatively. The high iodine value and oxidative stability shows that the seed oil upholds the good qualities of semidrying oil purposes (Eromosele et al., 1997). Saponification values of the studied oil were 184.5-193.6. High saponification value indicated that oils are normal triglycerides and very useful in production of liquid soap and shampoo industries. Experimental result showed that Jatropha oil seeds have FFA content 3.26-3.80%. The FFA and moisture contents have significant effects on the transesterification of glycerides with alcohol using catalyst (Goodrum, 2002). The high FFA content (>1% w/w) will happen soap formation and the separation of products will be exceedingly difficult, and as a result, it has low yield of biodiesel product. The acid-catalyzed esterification of the oil is an alternative (Crabbe *et al*., 2001), but it is much slower than the base-catalyzed transesterification reaction. Therefore, an alternative process such as a two-step process was investigated for feedstock having the high FFA content (Veljkovic´ *et al*., 2006). Viscosity defined as resistance liquid to flow. Viscosity increased with molecular weight but decreased with increasing unsaturated level and temperature (Nouredini et al 1992). At 200C viscosity of the sample were detected at 37.7-42.5 cp. The viscosities of *Jatropha* oil seeds must be reduced for biodiesel application since the viscosity of biodiesel were very low compared to vegetable oils. High viscosity of the *Jatropha* oil seed are not suitable if its use directly as engine fuel, often results in operational problems such as carbon deposits, oil ring sticking, and thickening and gelling of lubricating oil as a result of contamination by the vegetable oils. Different methods such as preheating,

blending, ultrasonically assisted methanol transesterification and supercritical methanol transesterification are being used to reduce the viscosity and make them suitable for engine applications (Pramanik, 2003; Banapurmath, 2008). The density of a material is a defined as the measured of its mass per unit volume (e.g. in g/ml). The density vegetable oil lower than of water and the differences between vegetables oil are quite small, particularly amongst the common vegetable oils. Generally, the density of oil decreases with molecular weight, yet increase with unsaturation level (Gunstone, 2004). From the experiment was conducted, the density of *Jatropha* seed oil were 0.8907-0.9037 g/ml.

Fatty Acid Composition

Fatty acid composition determination was another important characteristic carried out on this study (Table 2). The properties of the triglyceride and the biodiesel fuel are determined by the amounts of each fatty acid that are present in the molecules. Chain length and number of double bonds determine the physical characteristics of both fatty acids and triglycerides (Mittelbach and Remschmidt, 2004). Transesterification does not alter the fatty acid composition of the feedstocks and this composition plays an important role in some critical parameters of the biodiesel, as cetane number and cold flow properties (Ramos et al., 2008). Fatty acid omposition of studied oil shown in table 2 compared with other vegetable oils such as palm oil, sunflower oil, palm oil and soyabean oil. There are three main types of fatty acids that can be present in a triglyceride which is saturated (Cn:0), monounsaturated (Cn:1) and polyunsaturated with two or three double bonds (Cn:2,3). Various vegetable oil is a potential feedstock for the production of a fatty acid methyl ester or biodiesel but the quality of the fuel will be effected by the oil composition. Ideally the vegetable oil should have low saturation and low polyunsaturation i.e be high in monounsaturated fatty acid (Gunstone, 2004). Vegetable oils that rich in polyunsaturated such as linoleic and linolenic acids, such as soybean, sunflower (table 2), tend to give methyl ester fuels with poor oxidation stability. Vegetable with high degree unsaturation tend to have high freezing point. This oil have poor flow characteristic and may become solid (e.g palm oil) at low temperatures though they may perform satisfactorily in hot climates. (Gunstone, 2004). The predominant fatty acid in studied oil consists of monounsaturated (33.57-38.64%), followed by polyunsaturated fatty acid (47.64-53.40%) and saturated fatty acid (20.74-24.23%). Monounsaturation of *Jatropha* seed oil higher than other vegetable oil as palm kernel, sunflower and palm oil (table 2). The major fatty acids in *Jatropha* seed oil were the oleic, linoleic, palmitic and the stearic fattyacid. Oleic acid showed the highest percentage of composition of 42.66% J. intergerimma followed by linoleic acid with 39.32% of J. tanjorensis. Thus, *Jatropha* seed oil can be classified as oleic–linoleic oil. Compared to others vegetable oil (table 2), *Jatropha* oil seed has highest oleic contain than palm oil, palm kernel, sunflower, coconut and soybean oil. According to the European standard the concentration of linolenic acid and acid containing four double bonds in FAMEs should not exceed the limit of 12% and 1%, respectively. *Jatropha* oil seed only consist of 0.2% linolenic acid, which is lower compared to the sunflower oil and palm oil (table 2).

TAGs Composition

The TAGs profile of *Jatropha* seed oil, was characterized by reversed phase HPLC where the mechanism in separating the TAGs involves the chain length and degree of unsaturation of the fatty acids (Gutierrez and Barron, 1995). The identified TAGs of Jatropha seed oil were concluded by comparing the retention time of standard TAGs peak chromatographs obtained under same analytical condition. Triacyglycerol content of Jatropha oil seed is showed at table 2. From the chromatograph obtained, showed that the most prominent polyunsaturated TAG was OOL (16.57-22.52%), and followed by OLL (15.98-19.86%), POL (13.90-15.38%) and PLL + MOL (6.96-7.95%). Monounsaturated that has been detected were MPP+OOO (14.78-17.01%) POO (9.49-10.94%) and Nd (3.26-3.91%).

Conclusion

The major fatty acids in *Jatropha seed* oil were the oleic acid, linoleic acid, palmitic acid and the stearic acid. The most prominent TAGs of Jatropha seed oil were OLL and OOL. The oil extracts exhibited good physicochemical properties and could be useful as biodiesel feedstock and industrial application. Feedstock costs account for a large percent of the direct biodiesel production costs, including capital cost and return. The way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids such as inedible oils, animal fats, waste food oil and by products of the refining vegetables oils. With no competing food uses, this characteristic turns attention to *Jatropha*, which grows in tropical and subtropical climates across the developing world. *J. glandulifera* oil contains high percentage of unsaturated fatty acid which is about 53.4%. The study shows that fatty acids composition of the *J. integerimma and J. tanjorensis* oil is rich in oleic and linoleic acids and the oil can be classified as unsaturated oil. Hence the *J. integerimma and J. tanjorensis* oil has a great potential for oleochemical application such as surface coating and low pour point biodiesel. Therefore, it is amiable to have more research on *Jatropha* seed oil in the future to explore its potentials for future industrial oilseeds crop.

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