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NON-WOOD FORESTRY PRODUCTS: SEED COMPOSITION OF *Koelreuteria paniculata* LAXM. AND *Pongamia pinnata* L.

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ABSTRACT

The present study was conducted during 2010 and 2011 in the Forestry and Timber Trees Dept., Hort. Res. Inst., A R C, Giza, Egypt to evaluate the composition of *Koelreuteria paniculata* Laxm. and *Pongamia pinnata* L. seeds, which were: ash (3.53 and 2.52%), moisture (6.52 and 5.20%) and the highest yield of oil (35.66 and 35.42 %), respectively. Physicochemical properties of *Koelreuteria paniculata* Laxm. and *Pongamia pinnata* L. oil were peroxide value meq O_2/kg of oil (2.80 to 5.06) and (5.10 to 6.40), p-anisidine value (4.0 to 4.23) and (4.19 to 4.36), free fatty acids mg/g (1.04 to 1.05) and (2.10 to 2.81), acid value mg/g (1.88 to 1.89) and (4.18 to 5.58), iodine value g/100 g (81.77 to 82.13) and (90.10 to 92.0), saponification number mg KOH/g of oil (184.58 to 188.84) and (193.08 to 195.23), cetane number (56.81 to 57.39) and (53.68 to 53.98), and ester value mg KOH/g of oil (182.69 to 186.96) and (189.23 to 191.05), respectively. The major fatty acid in *K. poniculata* was Gadoleic acid (47.05 to 48.47 %) while in *P. pinnata* was Oleic acid (53.33 to 54.89 %), according to methods of extract. Nitrogen, phosphorus and potassium percentages of *K. poniculata* and *P. pinnata* defatted cake were (3.81, 0.34 and 4.04 %) and (4.05, 0.31 and 3.94 %), respectively.

Key word: *fatty acid, Koelreuteria paniculata, Pongamia pinnata, seed oil.*

1. INTRODUCTION

Egypt suffers from shortage of oil resources either edible or non-edible. Imported quantity from fats and oil (tons) was 57249 and its values (1000 $) 69,774,000 according to FAO (2009). This research is directed to some uses of non-forestry products such as seeds of woody trees grown in Egypt and produce well harvest of seeds. The first one, *Koelreuteria paniculata* Laxm, is deciduous species which belongs to the family Sapindaceae, grown for their large panicles of yellow flowers and the handsome compound foliage. Fruit is bladder triangular, three-celled capsules about 1.5 to 2 inches long. When they ripen in winter the color changes from a reddish to brown. Within the papery walls of the ripe fruit, there are three roundish, black seeds. A single arborescent or shrubby species of tropical Asia and Australia. The second is *Pongamia pinnata* L., a tall erect tree or climber, with glabrous branches and leaves. The ash of the wood is used for dyeing. The seed yields red-brown oil used for illuminating and medicinal purposes. The foliage is bright and very handsome. The tree sometimes reaches a height of 40 ft. (Bailey, 1969). *P. pinnata* is a semi-deciduous or evergreen tree according to the environmental conditions. *P. pinnata* grows in tropical and subtropical climates across the world. Also, it is drought resistant and nitrogen fixing leguminous tree, (Bobade and Khyade 2012). It can grow on waste land or unproductive land and adaptable to wide agro-climatic conditions. The plant commonly occurs along river banks near the sea coast with roots either in fresh or salt water. Its coastal habitat indicates that *Pongamia* could cope with water logging and salt concentration of sea water, (Rangan 2013). Pongamia (karanja) tree takes 4-7 years to mature. In a hectare, 1111 karanja trees can be planted with a spacing of 3 × 3 m. The yield of kernels per tree is reported between 8 and 24 kg. Thirty-three percent of oil can be extracted from the seeds of karanja, so the amount of oil that can be harvested from a hectare of land will range between

2933 and 8799 kg (Yogesh *et al.*, 2010). The seed oil is extracted and sold for non-edible commercial purposes. Currently, it is used in soap making and in the leather industry (Vivek and Gupta, 2004).The oil has been applied in scabies, herpes, leucoderma and other cutaneous diseases. Internally, it has sometimes been used as a stomachic and cholagogue in case of dyspcpsia with sluggish liver (Tanaka *et al.*, 1992). Different parts of this plant are traditionally claimed to be used for the treatment of broad spectrum of ailments including bronchitis, whooping cough, rheumatism, diarrhea, dyspepsia, flatulence, gonorrhea and leprosy to list a few. There has been a tremendous interest in this plant as evidenced by the voluminous work in the last few decades. Its oil is a source of biodiesel. It can also be an alternative source of energy, which is renewable, safe and non-pollutant (Arote and Yeole, 2010).

In fact, biodiesel contains no petroleum, even though it can be used in pure form in the compression ignition engine with little or no engine modification, or it can be used in blend with petroleum diesel at any level (Pugazhvadivu and Rajagopan, 2009). Increasing the percentage of biodiesel in the blend, decreases the emission of CO_2. This may be because of the fact that biodiesel is a low carbon fuel and also biodiesel has low elemental ratio of carbon to hydrogen as compared to diesel (Sureshkumar *et al.*, 2008). Diesel blends of Pongamia, Jatropha, and Neem methyl ester showed reasonable efficiencies, lower smoke, CO and HC. Pongamia methyl ester gives better performance compared to Jatropha and Neem methyl ester (Venkateswara *et al.*, 2008). Biodiesel molecule contains carbon of biological nature. Thus, all CO_2 released by the burning of biodiesel has no adverse effect on greenhouse gas formation. However, in the case of diesel, all CO_2 releases are contributing to the formation of greenhouse effect. The advantage of biodiesel lies in the fact that CO_2 level is kept in the balance as the crops of biodiesel are readily absorbing the CO_2, thus biodiesel is CO_2 neutral (Makareviciene and Janulis, 2003; Maunder *et al*.,1995; Ramadhas *et al*., 2005). The methane content of biogas derived from non-edible oil seed cakes of *P. pinnata* has been found to be 70 % against 55 % from cattle dung (Ram *et al*., 2006).

The two tree species can be planted and grown well in Egypt in marginal land and using waste water, either from field drainage or sewage water.

The main objective of the present work was to conduct a detailed analysis and to investigate the composition of *Koelreuteria paniculata* Laxm and *Pongamia pinnata* Linn seed oil grown in Egypt.

2. MATERIALS AND METHODS

The present study was conducted in the Forestry and Timber Trees Department, Horticulture Research Institute, Agriculture Research Center during 2010 and 2011. *Pongamia pinnata* L. mature seeds were collected from trees growing along the roadside in Ismailia city during June. *Koelreuteria paniculata* Laxm mature seeds were collected from trees growing in the Agricultural Museum garden, Giza during January. The seeds were air dried (25 ± 4 ℃).

Determination of moisture: The moisture content was determined according to the method of the AOAC (2006) by drying the seed samples of both species in an oven at 95 - 100 °C ± 5 to a constant weight.

Determination of ash: The sample seeds were heated in a muffle furnace for two hours at 600℃, according to AOAC (2006).

Extraction of oil and Determination of total lipids:

1- The air-dried *P. pinnata* and *K. paniculata* seeds were extracted with hexane or petroleum ether (250 ml) in Soxhlet apparatus for 8 h, and total lipids were calculated, according to AOAC (2006).
2- The air-dried seeds of both species were pressed with laboratory type of Carver hydraulic press under 10.000 Ib/in^2 (psi) pressure for 1H at room temperature then the percentage of total lipids was calculated according to the method of Üstun *et al*. (1990).

Determination of nitrogen, phosphorous and potassium: Nitrogen (N) of defatted samples was determined using the microkjeldahl method. The phosphorus content (P) was determined by the spectrophotometric method. Potassium content (K) was determined using Flame Photometer, according to the method of the AOAC (2006).

Physical and chemical properties of oil:

Acid value (AV): The acid value was determined according to the method of the AOAC (2006). The acid value was calculated according to the following equation:

$$\text{Acid value} = (V \times N \times 56.1)/W$$

where: V = Volume of KOH (ml), N = Normality (potassium hydroxide), W = Weight of sample (g),

56.1 = Equivalent weight of the KOH.

Peroxide value: The peroxide value was calculated as (meq. peroxides kg^{-1}oil), according to the method described by the AOAC (2006). The peroxide value was calculated according to the following equation:

Peroxide value = $(S \times N \times 1000)/W$ where:

S = ml of $Na_2S_2O_3$ (blank corrected), N = Normality (sodium thiosulfate), W = Weight of sample (g).

Free fatty acid value (FFA): FFA determine by using of ethanol and NaOH, according to the method described by the AOAC (2006). FFA value was calculated according to the following equation:

$$FFA\% = V \times 0.0282 / W \times 100$$

Where: V = titer value (0.1 N NaOH), also 1 cm^3 of 0.1 N NaOH contains 0.0282 of oleic acid, W = weight of the sample,

Iodine value (IV): The iodine value was determined by using the method of the AOAC (2006). The iodine value was calculated according to following equation:

$$\text{Iodine value} = [(B - S) \times N \times 12.69]/W$$

Where: B = Volume of sodium thiosulfate solution 0.1 N required by blank.

S = Volume of sodium thiosulfate 0.1 N required by oil.

N = Normality (sodium thiosulfate). W= Weight of sample (g).

Saponification value (SV): Saponification value was determined by using the method of AOAC (2006). The calculation was made according to the following equation:

$$\text{Saponification value} = [(V - V`) \times N \times 56.1]/W,$$

where:

V = Volume of hydrochloric acid solution 0.5 N required by blank.

V` = Volume of hydrochloric acid solution 0.5 N required by oil

N = Normality of hydrochloric acid solution.

Cetane Number (CN): Cetane number was calculated by use of the equation given by Krisnangkura (1986).

$$CN = 46.3 + 5458/SN - 0.225 \times IV$$

Where: SN is the saponification value, IV is the iodine value.

Ester Value (EV): The ester value of the oil was calculated from the equation:

$$EV = SV - AV$$

Where: SV is the saponification value and AV is the acid value.

Fatty acids percentage: was determined according to AOAC methods (2006), by the areas under the chromatographic peak were measured with electronic integrator.

Statistical analysis: Data were analyzed statistically by applying one-way ANOVA, followed by Least Significant Difference test using SAS program. Analysis was carried out in triplicate; the values of different parameters were expressed as the mean ± Standard Deviation (x ± S.D).

3. RESULTS AND DISCUSSION

3.1. Seed oil percentage of *Koelreuteria paniculata* and *Pongamia pinnata*

Oil content is shown in Table (1), there were significant differences in the extracted oil percentage according to solvent type, petroleum ether had a higher dissolving power than hexane. Oil percentage of *K. paniculata* (35.660 and 32.336 %), while *P. pinnata* (35.420 and 31.727 %) by using petroleum ether and hexane, respectively. These results are close to the findings of Manju *et al.* (2010) who found that, seed oil yield of *P. pinnata* was 29% when using hexane. However, oil percentages as used mechanical press were significantly decreased (25.506 and 23.683%) for *K. paniculata* and *P. pinnata*, respectively compared with both solvents used. These results are in the same trend with the finding of Bobade and Khyade (2012).

Table (1): Effect of extraction methods on seed oil percentage of *Koelreuteria paniculata* and *Pongamia pinnata.*

Tree species / Extraction methods	*K. paniculata* (Oil %)	*P. pinnata* (Oil %)
Mechanical press	**25.506**	**23.683**
Petroleum ether	**35.660**	**35.420**
Hexane	**32.336**	**31.727**
LSD at 0.05	**1.357**	**3.380**

3. 2. Fatty acid composition of *Koelreuteria paniculata* seed oil

The fatty acid profile of the total lipid extracts was further analyzed by GLC (Figs. 1, 2 and 3).

These data (Table 2) revealed that there was a

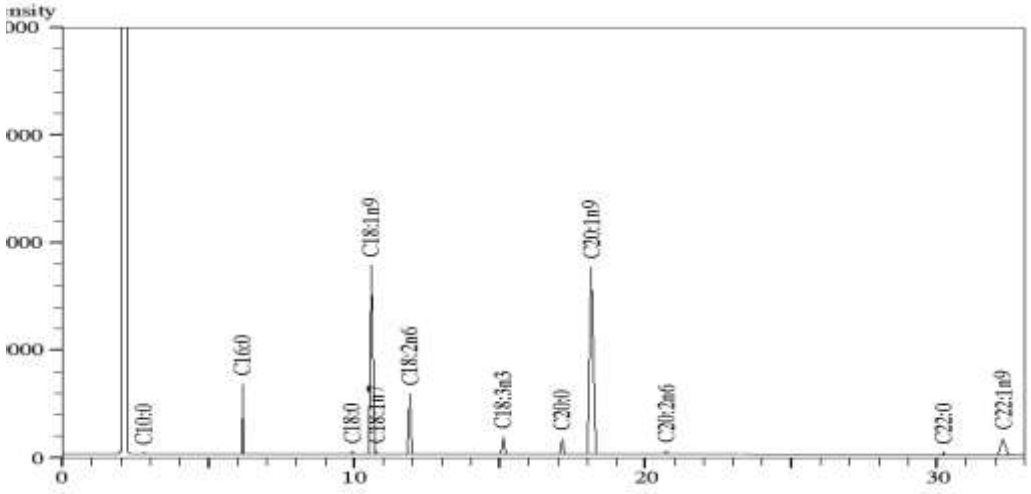

Fig. (1): GLC of *Koelreuteria paniculata* **seed oil using mechanical press.**

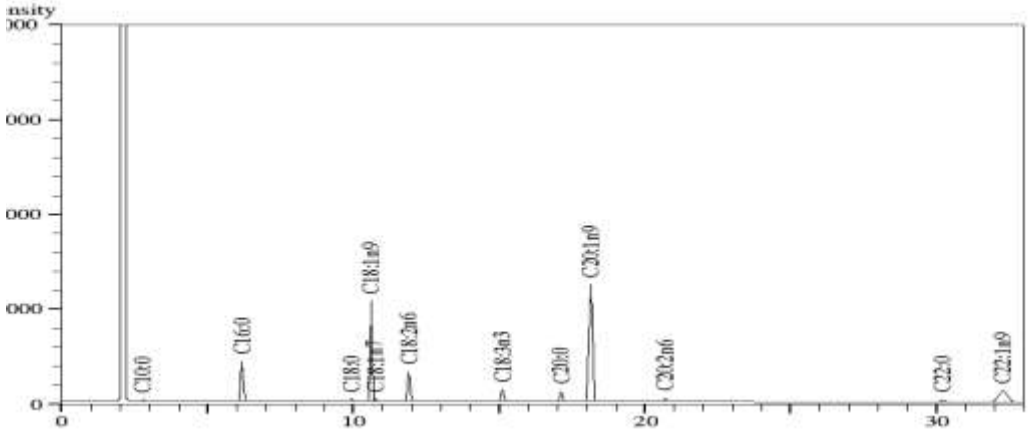

Fig. (2): GLC of *Koelreuteria paniculat***a seed oil using petroleum ether solvent.**

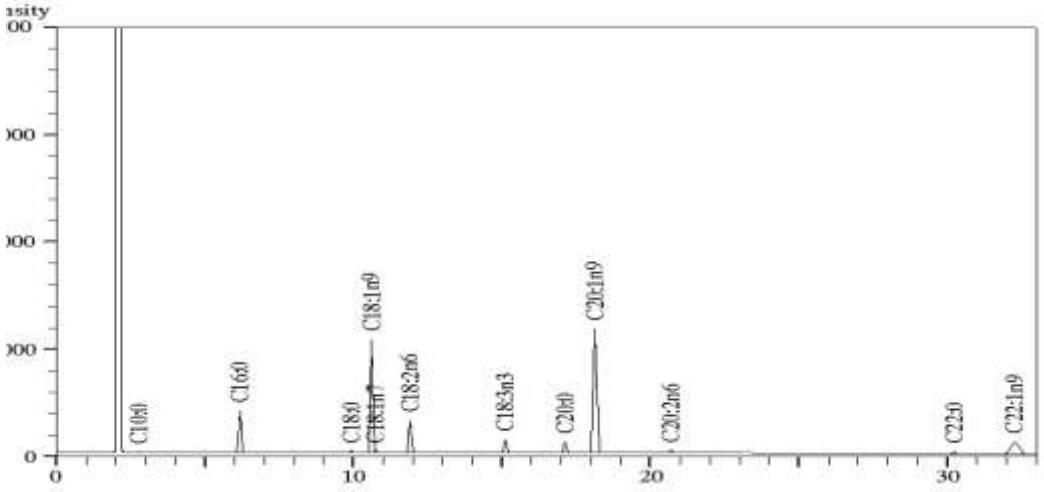

Fig. (3): GLC of *Koelreuteria paniculata* **seed oil using hexane solvent.**

Table (2): Fatty acids composition of *Koelreuteria paniculata* **seeds oil (%).**

No.	Fatty acids	Relative distribution		
		Mechanical press	Petroleum ether	Hexane
Saturated fatty acids (SAFA)				
1	Decanoic (10:0)	0.22±0.010	0.25±0.015	0.20±0.018
2	Palmitic (16:0)	5.35 ±0.108	5.48±0.264	5.27±0.037
3	Stearic (18:0)	0.87±0.002	0.82±0.086	0.73±0.016
4	Arachidic (20:0)	3.18±0.000	3.25±0.202	3.46±0.018
5	Behenic (22:0)	1.83±0.011	1.91±0.001	1.96±0.030
Total of SAFA		11.45	11.71	11.62
Monounsaturated fatty acids (MUFA)				
6	Oleic (18:1n9)	22.59±0.142	21.91±0.051	21.77±0.006
7	Vaccinic (18:1n7)	0.92±0.092	0.57±0.005	0.54±0.005
8	Gadoleic (20:1n9)	47.05±0.227	47.89±0.573	48.47±0.013
9	Erucic (22:1n9)	6.00±0.127	6.19±0.089	6.28±0.014
Total of MUFA		76. 56	76.56	77.06
Polyunsaturated fatty acids (PUFA)				
10	Linoleic (18:2n6)	8.12±0.007	7.13±0.093	7.01±0.011
11	Linolenic (18:3n3)	2.82±0.222	3.08±0.032	3.03±0.008
12	Eicosadienoic (20:2n6)	1.00±0.006	1.14±0.036	1.12±0.006
Total of PUFA		11.94	11.35	11.16
-	Non-identified	0.80	0.50	1.10

Each value is the mean ± SD from three replicates.

little difference among fatty acids content and properties of seed oil according to the extraction method used. *K. paniculata* seed oil consists of a larger amount of monounsaturated fatty acids (76.56, 76.56 and 77.06 %) than polyunsaturated fatty acids (11.94, 11.35 and 11.16 %) as used to mechanical press, petroleum ether and hexane, respectively. Gadoleic acid 20:1 was the major fatty acid in *K. paniculata* seed oil (47.05, 47.89 and 48.47%), followed by oleic acid (22.59, 21.91 and 21.77%), linoleic (8.12, 7.13 and 7.01%), erucic acid (6.00, 6.19 and 6.28%), palmitic (5.35, 5.48 and 5.27%), arachidic (3.18, 3.25 and 3.46%), linolenic (2.82, 3.08 and 3.03%), behenic (1.83, 1.91 and 1.96%), and finally eicosadienoic (1.00, 1.14 and 1.12%), as used to mechanical press, petroleum ether and hexane, respectively. In addition, there were traces from decanoic, vaccinic, stearic and non-identified fatty acids.

3. 3. Fatty acids composition of *Pongamia pinnata* seed oil

The fatty acid profile of the total lipid extracts was further analyzed by GLC (Figs. 4, 5 and 6). These data (Table 3) revealed that, *P. pinnata* seed oil consists of a larger amount of monounsaturated fatty acids (56.84, 55.99 and 55.15) than polyunsaturated fatty acids (24.74, 24.23 and 23. 64 %) as used to mechanical press, petroleum ether and hexane, respectively. This trend of results was reported by Punsuvon *et al.* (2011) who reported that, *Pongamia pinnata* oil consists of a larger amount of monounsaturated fatty acids (47.68%) than polyunsaturated fatty acids (20.59%), so this oil is suitable for biodiesel feedstock.

Oleic acid (18:1) was the major fatty acid in *P. pinnata* seed oil (54.89, 54.25 and 53.33 %), followed by linoleic (20.24, 19.53 and 18.90 %), palmitic (9.66, 10.21 and 10.62 %), linolenic and stearic which were close, linolenic (4.50, 4.70 and 4.74 %) and stearic (4.39, 4.63 and 4.74 %), behenic (3.19, 3.46 and 3.33%), a little percent from arachidic (1.00, 1.08 and 1.47 %) and gadoleic (1.12, 1.13 and 1.15 %), as used mechanical press, petroleum ether and hexane, respectively. In addition there were traces from vaccinic and non-identified fatty acids. The results of fatty acid

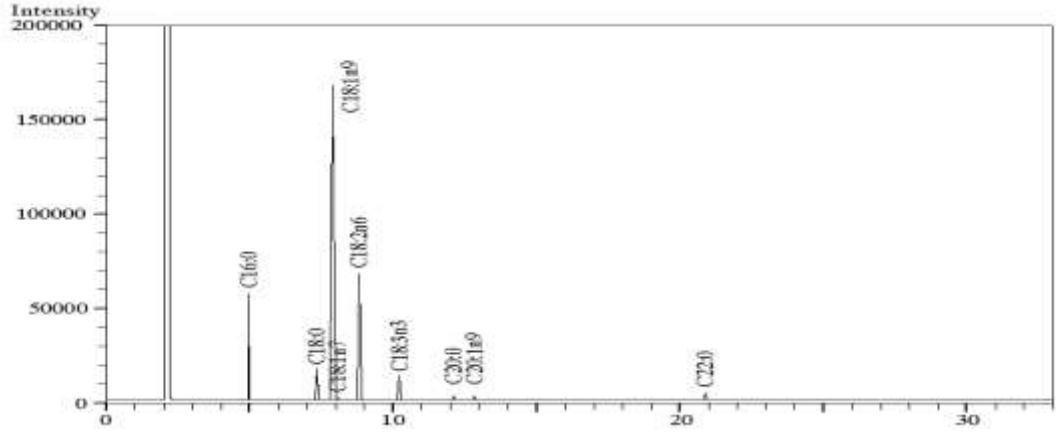

Fig. (4): GLC of *Pongamia pinnata* **seed oil using mechanical press.**

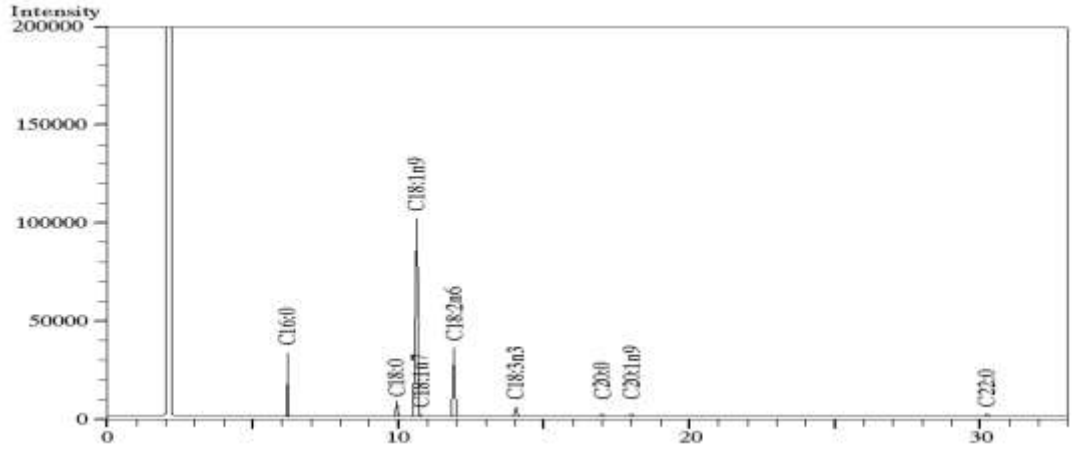

Fig. (5): GLC of *Pongamia pinnata* **seed oil using petroleum ether solvent.**

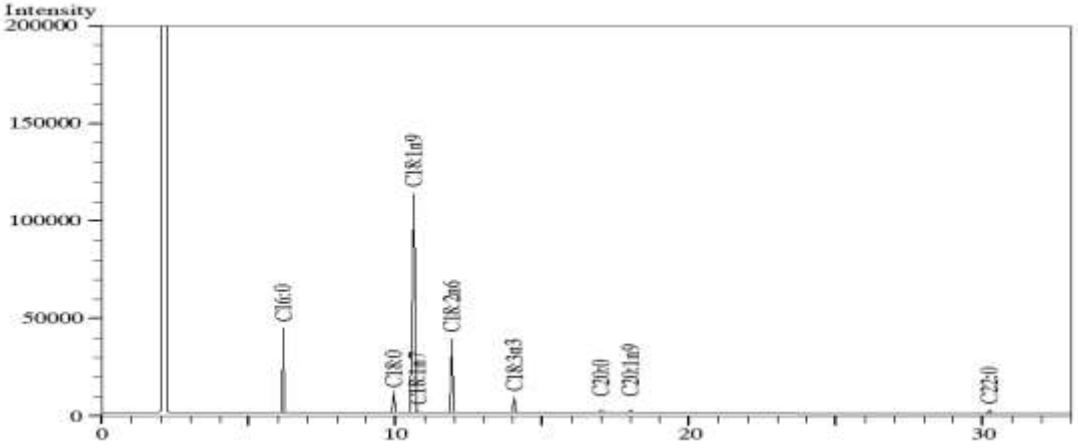

Fig. (6): GLC of *Pongamia pinnata* **seed oil using hexane solvent.**

composition of *P. pinnata* oil was the same trend with Manjau *et al. (*2010). Oleic acid has an important role in nervous cell construction. It can be changed by the organism into a set of compounds close to prostaglandins which have an important role at the vessel level and for blood coagulation. Moreover, it can prevent cardiovascular diseases. On the other hand, linoleic fatty acid is indispensable for the healthy growth of human skin (Bruckert, 2001).

Free fatty acid (FFA) mg/g and acid value(AV) mg/g of *K. paniculata* were non-significantly different when used to mechanical press, petroleum ether and hexane that were (1.05, 1.04 and 1.05) and (1.89, 1.88 and 1.89), respectively. However, there was a significant decrease in free fatty acid and acid value of *P. pinnata* (2.10 and 4.18) by using hexane compared with petroleum ether (2.80 and 5.57) and mechanical press (2.81 and 5.58), respectively, and there were non-significant differences between

Table (3): Fatty acids composition of *Pongamia pinnata* **seeds oil (%).**

No.	Fatty acids	Relative distribution		
		Mechanical press	Petroleum ether	Hexane
Saturated fatty acids (SAFA)				
1	Palmitic (16:0)	9.66±0.059	10.21±0.026	10.62±0.313
2	Stearic (18:0)	4.39±0.032	4.63±0.023	4.74±0.197
3	Arachidic (20:0)	1.00±0.010	1.08±0.015	1.47±0.433
4	Behenic (22:0)	3.19±0.013	3.46±0.034	3.33±0.031
Total of SAFA		18.24	19.38	20.16
Monounsaturated fatty acids (MUFA)				
5	Oleic (18:1n9)	54.89±0.132	54.25±0.202	53.33±0.237
6	Vaccinic (18:1n7)	0.83±0.031	0.61±0.014	0.67±0.028
7	Gadoleic (20:1n9)	1.12±0.069	1.13±0.023	1.15±0.065
Total of MUFA		56.84	55.99	55.15
Polyunsaturated fatty acids (PUFA)				
8	Linoleic (18:2n6)	20.24±0.004	19.53±0.057	18.90±0.094
9	Linolenic (18:3n3)	4.50±0.028	4.70±0.010	4.74±0.323
Total of PUFA		24.74	24.23	23.64
-	Non-identified	0.80	0.50	1.10

Each value is the mean ± SD from three replicates.

3.4. Physicochemical *Koelreuteria paniculata* and *Pongamia pinnata* seed oil

Data in Tables (4) and (5) show that, there was a significant decrease in peroxide value (meq O_2 / kg) of *K. paniculata* (2.80) and *P. pinnata* (5.10) seed oil by using hexane compared with petroleum ether (4.60 and 6.40) and mechanical press (5.06 and 6.40), respectively. At the same time, there was a significant decrease in peroxide value by using petroleum ether compared with the mechanical press in *K. paniculata*. However, there was a non-significant difference in peroxide value of *P. pinnata* when using petroleum ether or mechanical press.

There was a significant decrease in p- anisidine value of *K. paniculata* (4.01 and 4.00) and *P. pinnata* (4.29 and 4.19) seed oil when was used hexane and petroleum ether compared with the mechanical press (4.23) and (4.36), respectively. them. The lower values of acidity peroxide and p-anisidine found in seed oil of both species suggest that the oil can be stored for a long period without deterioration (Ojeh, 1981).

The iodine value (IV) g/100g of *K. paniculata* and *P. pinnata* was not significantly different as used to mechanical press, petroleum ether and hexane that was (82.13, 81.77 and 82.13) and (92.00, 91.46 and 90.10), respectively. That means dominated by monounsaturated fatty acids in the oil of both species, this also supported by the results of GLC analysis (Tables 2 and 3). These results agree with Nag and Haldar (2006) who reported that IV of *P. pinnata* oil is (91.4), FFA (1.93) and dominated by fatty acid C18:1 (52%). This showed that, the decomposition of the oil either naturally or during the extraction process have not taken place to a great extent.

Saponification number (SN) and ester value (EV)

of *K. paniculata* significantly decreased in seed oil by using the mechanical press (184.58 and 182.69) as compared to petroleum ether (188.84 and 186.96), respectively. However, there were non-significant decreases in SN and EV when using hexane. It was (186.25 and 184.36), respectively as compared to petroleum ether. There was non-significant difference in cetane number (CN) of *K. paniculata* (57.39, 56.81 and 57.13) as used mechanical press, petroleum ether and hexane, respectively.

Saponification number (SN), cetane number (CN) and ester value (EV) of *P. pinnata* were non-significantly different (193.08, 195.23 and 195.23), (53.87, 53.68 and 53.98) and (189.23, 189.66 and 191.05) as used mechanical press, petroleum ether and hexane, respectively. The high saponification value of both species indicates a very high content of low molecular weight triacylglycerols.

Cetane number is the ability of fuel to ignite after being injected. These high values are the better ignition quality of fuel. This one of the important parameters, which is considered during the selection of FAMEs for use as biodiesel. For this, different countries organization has specified different minimum values. Biodiesel standards of Germany (DIN 51606), USA (ASTM. D 6751), and European Organization (EN 14214) have set this value as 47, 49 and 51, respectively (Biodiesel Standard, 1994, 2002 and 2003). Both species under this study have CN value higher than 51, the highest minimum value among the three biodiesel standards.

The previous results showed that, some values of

Table (4): Physicochemical analysis of *Koelreuteria paniculata* **seed oil as used mechanical prees, petroleum ether and hexane.**

Extraction methods / Oil characteristic	Mechanical press	Petroleum ether	Hexane	LSD at 0.05
Peroxide value (meq/kg of oil)	5.06	4.60	2.80	0.065
P-anisidine value	4.23	4.00	4.01	0.037
Free fatty acids (mg/g)	1.05	1.04	1.05	0.012
Acid value (mg/g)	1.89	1.88	1.89	0.020
Iodine value (g I_2/100g of oil)	82.13	81.77	82.13	2.636
Saponification number (mg KOH/g of oil)	184.58	188.84	186.25	3.562
Cetane number	57.39	56.81	57.13	0.969
Ester value (mg/g)	182.69	186.96	184.36	3.565

Table (5): Physicochemical analysis of *Pongamia pinnata* **seed oil as used mechanical press, petroleum ether and hexane.**

Extraction methods / Oil characteristic	Mechanical press	Petroleum ether	Hexane	LSD at 0.05
Peroxide value (meq/kg of oil)	6.40	6.40	5.10	0.103
P-anisidine value	4.36	4.19	4.29	0.057
Free fatty acids (mg/g)	2.81	2.80	2.10	0.046
Acid value (mg/g)	5.58	5.57	4.18	0.091
Iodine value (g I_2/100g of oil)	92.00	91.46	90.10	1.927
Saponification number (mg KOH/g of oil)	193.08	195.23	195.23	2.206
Cetane number	53.87	53.68	53.98	0.574
Ester value mg/g	189.23	189.66	191.05	1.533

physicochemical seed oil of *K. paniculata* and *P. pinnata* were different according to the type of extract, these results are in agreement with Bera *et al.* (2006) who reported that, the properties such as refractive index, density, saponification and free fatty acid values were also affected by type of solvent used in the extraction process.

3. 5. Some contents of seeds and defatted cake of both species

Data presented in Table (6) showed that, ash and moisture content of *K. paniculata* seeds were 3.53 and 6.90 % while in *P. pinnata* were 2.52 and 5.20 %, respectively. These results are in trend with Bringi and Mukerjee (1987) who reported that ash content of *P. pinnata* was 2.4 %.

Nitrogen, phosphorus and potassium (NPK) content (Table, 6) of *K. paniculata* defatted cake was 3.81, 0.34 and 4.04 %, while *P. pinnata* was 4.05, 0.31 and 3.94 %, respectively. That probably, the defatted cake may be used for feed purposes or fertilizers after detoxification.

The pongamia and Koelreuteria cake is rich in nitrogen and potassium as compared with farm yard or chicken manure. Pongamia cake increases yields by at least 25 % as compared with farmer's practices. However, the optimum solution is a 50:50 mix of pongamia cake and inorganic fertilizer, (D'Silva, 2005).

Table (6): Ash and moisture % in seeds and NPK % in defatted cake of *Koelreuteria paniculata* **and** *Pongamia pinnata* **seeds.**

Tree species / **Parameters**	*K. paniculata*	*P. pinnata*
Ash %	**3.53±0.12**	**2.52±0.03**
Moisture%	**6.90±0.66**	**5.20±0.17**
Nitrogen %	**3.81±0.10**	**4.05±0.07**
Phosphorus %	**0.34±0.06**	**0.31±0.00**
Potassium %	**4.04±0.06**	**3.94±0.03**

Each value is the mean ± SD from three replicates.

Conclusion

- This study revealed that, *Koelreuteria paniculata* and *Pongamia pinnata* are the most important biofuel crop, because they contain small amounts of saturated and polyunsaturated fatty acids and have desirable IV and CN values.
- After detoxification the leftover defatted cake can be used for feed purposes or biofertilizer with environmental friendly.
-Determinations of oxidation parameters like peroxide and *p*-anisidine values demonstrated a good oxidative stability of the investigated both seed oil.
-Some values of physicochemical seed oil of *K. paniculata* and *P. pinnata* were different according to type of extract, such as peroxide value and p- anisidine value. Also, free fatty acid (FFA) and acid value (AV) in *P. pinnata*, and saponification number (SN) and ester value (EV) in *K. paniculata* seed oil.
-The extensive literature survey revealed that, *K. paniculata* and *P. pinnata* are multipurpose trees with immense medicinal and economic value so evaluation needs to extensive knowledge of the genetics, physiology and pharmacology on both species. In particular, research should be targeted to maximize the plant growth, seed product and oil yield.

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المنتجات غير الخشبية للغابات: محتوى مكونــات بذور أشجار
Koelreuteria paniculata LAXM. و *Pongamia pinnata* **L.**

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قسم بحوث الأشجار الخشبية والغابات - معهد بحوث البساتين – مركز البحوث الزراعية

ملخص

أجريت هذه الدراسة خلال عامي ٢٠١٠ – ٢٠١١ بقسم بحوث الأشجار الخشبية و الغابات ، معهد بحوث البساتين ، مركز البحوث الزراعية ، الجيزة، مصر. قيمت النسبة المئوية لمكونات البذور لنوعين من الأشجار الخشبية هما الكلريوتيريا (*Koelreuteria paniculata*) و البونجاميا (*Pongamia pinnata*) وكانت النتائج كما يلي: الرماد (٣,٥٣ - ٢,٥٢٪)، الرطوبة (٦,٥٢- ٥,٢٠٪)،أعلى محصول للزيت (٣٥,٦٦-٣٥,٤٢٪) على التوالي. كانت الخصائص الفيزيائية و الكيميائية للزيت المستخلص من بذور الكلريوتيريا و البونجاميا كما يلي: رقم البيروكسيد ملليمكفيء أكسجين/كجم زيت (من ٢,٨٠ حتى ٥,٠٦) و (من ٥,١٠ حتى ٦,٤٠)، رقم الانسيدين (من ٤,٠ حتى ٤,٢٣) و (من ٤,١٩ حتى ٤,٣٦)، الأحماض الدهنية الحرة ملجم/جم (من ١,٠٤ حتى ١,٠٥) و (من ٢,١٠ حتى ٢,٨١)، رقم الحمض ملجم/جم (من ١,٨٨حتى ١,٨٩) و (من ٤,١٨ حتى ٥,٥٨) رقم اليود جم/ ١٠٠جم (من ٨١,٧٧ حتى ٨٢,١٣) و (من ٩٠,١٠ حتى ٩٢,٠)، رقم التصبن ملجم ايدروكسيد البوتاسيوم/جم (من ١٨٤,٥٨ حتى ١٨٨,٨٤) و (من ١٩٣,٠٨حتى ١٩٥,٢٣)، رقم السيتان (من ٥٦,٨١ حتى ٥٧,٣٩) و (من ٥٣,٦٨ حتى ٥٣,٩٨)، رقم الاستر ملجم ايدروكسيد البوتاسيوم/جم (من ١٨٢,٦٩ حتى ١٨٦,٩٦) و (من ١٨٩,٢٣حتى ١٩١,٠٥)، على التوالي. وكان الحمض الدهني الرئيسي في الكلريوتيريا حمض الجادوليك (من ٤٧,٠٥ حتى ٤٨,٤٧٪)،في حين كان في البونجاميا حمض الأوليك (من ٥٣,٣٣ حتي٥٤,٨٩٪)، وفقا لطريقة الاستخلاص . كانت النسبة المئوية للنيتروجين والفوسفور والبوتاسيوم في المتبقي من البذور بعد استخلاص الزيت في الكلريوتيريا والبونجاميا هى (٣,٨١، ٠,٣٤، ٤,٠٤٪) و (٤,٠٥، ٠,٣١، ٣,٩٤٪) على التوالي.

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