



Variability Assessment of *Pongamia Pinnata* Oil from Various Sources in Southern Region of Thailand for Biodiesel Quality



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Abstract :

The present study was undertaken to assess the existence of variability for some of the important biodiesel quality as a prelude in selection of more efficient biodiesel yield. With this objective the survey, collection and characterization of *Pongamia pinnata* which was the native plant grown in the Southern part of Thailand had been undertaken to assess the variability existing for various economically important parameters for development as a profitable crop for biodiesel production in the future of Thailand. The oil content was observed in 45 tree accessions of *P. pinnata* collected from three provinces in the Southern region of Thailand. Out of these, fatty acid profiles of 20 accessions with varying seed oil content were examined. Large variation in fatty acid content (%wt) were observed in stearic (C₁₈), oleic (C_{18:1}) and linoleic (C_{18:2}) acid with the value 3.88-13.84% (wt), 37.15-47.42% (wt) and 16.61-22.23% (wt), respectively. While less variation in fatty acid content (%wt) with the value 12.82-17.63% (wt), 0.00-5.88% (wt) and 6.30-12.87% (wt) were found with palmitic (C₁₆), linolenic (C_{18:3}) and behenic (C₂₀) acid. Saponification number (SN), Iodine value (IV) and Cetane number (CN) of fatty acid methyl esters or biodiesel of oils varied from 196.81-207.69, 61.66-90.07 and 52.72-59.41, respectively. Fatty acid composition, IV and CN were used to predict the quality of fatty acid methyl esters of oil for using as biodiesel fuel. Fatty acid methyl esters of oil of *P. pinnata* accessions RB3, RS11, RS15 (from Rayong), PK2 (from Phungnga) and KB1 (from Krabi) were found most suitable (CN more than 52.72) oil for using as biodiesel and they met the major specification of commercial biodiesel standard.

Introduction:

Biodiesel is renewable, non-toxic, environmental friendly and biological origin alternative fuel for diesel engines. Many studies have shown that the fuel properties of biodiesel are very close to diesel fuel. It has higher cetane number than diesel fuel, and contains no aromatics, almost no sulfur, and 10-12% oxygen. Biodiesel fuelled engines produces less CO, HC, and particulate emissions than petroleum diesel fuelled engines

Pongamia pinnata belongs to the family Leguminaceae. It can grow under a wide range of agroclimatic condition and it is a common sight around coastal areas, riverbanks, tidal forests and roadsides. The seeds kernel of *P. pinnata* contains 27-40% oil, contains mainly oleic acid (C_{18:1}; 44.5-71.3%) and linoleic acid (C_{18:2}; 10.8-18.3%) along with minor quantity of palmitic acid (C_{16:0}; 3.7-7.8%), stearic acid (C_{18:0}; 5.5-6.0%). *P. pinnata* oil consists of karanjin, Karanjone, diketone pongamol that is a four angular furanoflavone present in the seeds which is used in several industries including medicine. Freshly extracted oil is yellowish orange to brown in color having a disagreeable odor and a bitter taste. The presence of toxic karanjone make *P. pinnata* oil as inedible oil.

P. pinnata oil is regarded as a potential fuel substitute that it contains 16-22 carbon atoms per molecule. Attempts have been made for the conversion of *P. pinnata* oil to methyl esters. With the growing interest in the seed oil of *P. pinnata*, the need for raising of plantation has been realized. In this context, the present study was undertaken to assess the existence of variability for some of the important biodiesel quality as a prelude in selection of more efficient biodiesel yield. With this objective the survey, collection and characterization of *P. pinnata* that is the native plant in the Southern part of Thailand has been undertaken to assess the variability existing for various economically important parameters for development as a profitable crop for biodiesel production in the near future of Thailand.

Materials and Methods



SN and IV Determination

CN Determination

$$CN = 46.3 + \frac{5458}{SN} - 0.225 \times IV$$

Characterized *P. pinnata* oil analysis from equation

Results and Discussion :

Table 1: Frequency distribution of 45 tree accessions of *P. pinnata* for seed oil content

Characteristic	Range (%wt)	Number of accessions
Seed oil	25.0-30.0	33
	30.1-35.0	12

Table 2: Variability for oil content, fatty acid composition and biodiesel quality in 20 accessions on *P. pinnata* oil

Code No.	Seed oil content (%)	Fatty acid composition ^a						SN	IV	CN	O/L _b
		Palmitic	Stearic	Oleic	Linoleic	Linolenic	Behenic				
RB1	26.65	13.01	5.32	47.42	14.99	4.49	9.12	207.65	83.75	53.74	3.16
RB2	26.83	13.31	13.28	37.15	18.14	4.23	6.30	205.99	83.45	54.02	2.05
RB3	30.48	14.09	8.71	44.36	16.27	3.36	7.25	198.56	71.95	57.60	2.73
RB4	27.97	15.39	13.84	40.86	12.21	1.91	7.42	202.27	61.66	59.41	3.35
RB5	26.89	16.67	51.16	48.15	12.47	2.17	8.27	213.69	71.89	55.67	3.86
RS11	30.51	12.95	5.61	42.04	20.98	3.69	8.65	206.85	88.41	52.79	2.00
RS12	27.35	13.34	5.06	42.97	20.43	4.07	8.48	203.35	87.72	53.40	2.10
RS13	27.81	15.35	4.89	43.64	16.43	2.29	10.24	198.95	81.02	55.50	2.66
RS14	30.09	13.45	5.87	47.34	18.18	2.50	7.64	207.69	78.41	54.94	2.60
RS15	31.31	12.82	6.32	46.22	18.89	2.83	8.55	199.29	83.40	54.92	2.45
PK1	30.07	13.59	4.67	40.84	21.52	3.26	9.89	195.40	83.62	55.42	1.89
PK2	33.12	12.59	4.71	40.19	19.84	3.90	11.56	204.69	85.71	53.68	2.03
PK3	28.75	14.06	6.34	41.41	19.67	2.42	9.98	201.82	81.96	54.90	2.11
PK4	32.53	13.70	3.88	38.33	22.23	3.66	11.32	195.04	84.77	55.21	1.72
PK5	29.19	17.63	6.18	44.20	10.61	-	12.87	202.04	67.73	58.08	4.17
KB1	30.70	13.75	5.28	43.39	18.56	4.71	10.70	204.52	90.07	52.72	2.34
KB2	29.28	13.37	5.03	45.40	17.54	4.24	10.80	206.23	79.96	54.77	2.59
KB3	30.29	13.93	4.88	44.53	21.24	4.27	7.92	196.81	85.12	54.88	2.09
KB4	26.67	15.69	4.99	45.26	15.56	2.82	11.58	203.58	80.24	55.06	2.91
KB5	28.40	15.62	4.49	42.24	16.19	5.88	11.03	201.15	76.52	56.22	2.61
Mean	29.24	14.22	8.53	43.30	17.60	3.69	9.48	202.78	80.37	55.15	2.57
SD	1.93	1.38	10.39	2.97	3.26	1.03	1.77	4.66	7.25	1.70	0.64
Range	26.65-33.12	12.82-17.63	3.88-13.84	37.15-47.42	10.61-22.23	0-5.88	6.30-12.87	196.81-207.69	61.66-90.07	52.72-59.41	1.72-4.17

^a percentage may not add to 100% due to the noninclusion of other constituents. ^b Oleic/linoleic acid SN=Saponification number, CN = Cetane number, IV = Iodine value

Biodiesel quality

P. pinnata oil could produced fatty acid methyl esters with most suitable for using as biodiesel since it met the major specification of biodiesel standards of USA and European organization.

Conclusions :

The present study documents the variation in oil content, fatty acid composition, saponification number, iodine value and cetane number of Thai *P. pinnata* oil from Southern region of Thailand. The present investigation, code number RB3, RS11, RS15 from Rayong, PK2 from Phungnga and KB1 from Krabi province were selected with oil content > 30% (wt), CN>51 and IV<120 that meet the specific requirement of biodiesel standard.

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