TARC Note

Chemical Composition of Some Oil Seeds in Thailand

Although many kinds of oil crops are produced in the tropics, it is very important to exploit and utilize new oil resources. Especially, after the oil crisis, a keen attention has been paid to biomass which can serve as new energy sources or foodstuff. Therefore, authors initiated a study aiming at the exploitation and utilization of fat and oil resources in Thailand. Several crop seeds were taken up for chemical analysis, and the results are shown in Tables 1, 2 and 3. A study along this line was so far made by Kato et al.[7] on ruber seeds, rambutan seeds, longan seeds etc. in Thailand.

1) Sea almond seeds

The Sea almond (*Terminaria catappa* L.) is a popular tree in the Southeast Asian countries. It belongs to Combretaceae family. The fruit are greenish yellow in color, consisting of fibrous and porous pericarp and endocarp. Caryopsis contains a slender, white and soft kernel covered with brownish skin.

Kafuku et al.[6] studied chemical and physico-chemical characteristics of the kernel oil of Sea almond collected in Okinawa, Taiwan and Hainan. Beri et al.[2] investigated the shell, kernel, kernel oil and its defatted cake of Sea almond in India. Though Sea almond tree is common in Thailand, no investigation has been done so far. Accordingly, it was chosen as an unexploited oil crop in Thailand.

The kernel of the seeds contains about 59.2% of oil and 26.6% of protein (on dry matter basis). The oil consisted of 39% of saturated fatty acids and 61% of unsaturated fatty acids. The former included 34.3% of palmitic and 4.7% of stearic acid, while the latter 28.4% of linoleic and 32.8% of linolenic acid. The refined oil showed 0.86 of Acid Value and 79.07 of Iodine Value. The I.V. indicates that the oil belongs to the non-drying oil category.

The kernel resembles to groundnut and may be used for culinary purpose or confectionary raw materials. Yield of kernel, however, is low, nearly 5.5% of the whole seed, and shell of the seed has fibrous hard texture so that it needs to develop a new seed cutter.

2) Alexandrian laurel seeds

Alexandrian laurel (*Calophyllum inophyllum* L.) can be found in Southeast Asian countries as an ornamental tree. It belongs to Guttiferae. Fresh fruit are spherical and green in color with one seed. Kafuku et al.[6] and Hata[4] reported chemical and physico-chemical characteristics of kernel and kernel oil of the seeds collected in Okinawa, Taiwan and Hainan. Dhingra[3] also studied chemical characteristics of kernel oil of the seeds collected in India.

The seeds have so far not been utilized satisfactorily in Thailand, except using the oil as a folk medicinal or lightening oil in rural areas.

The seeds collected in Phuket, south Thailand, were used for the present study.

The kernel contained about 83% of oil and 6% of protein (on dry matter basis). This oil content applies to that of high-oil crops. The oil consisted of 29.7% of saturated fatty acid, 66.6% of unsaturated fatty acid and some low-molecular fatty acids, below C_{10}. Main components of saturated fatty acids are 1.1% of myristic, 15.9% of palmitic and 12.6% of stearic acid. The unsaturated fatty acids are 33.8% of linoleic and 32.5% of linolenic acid. Special feature of the oil is its high Acid Value. Hata[6] recognized the same feature and suggested that the presence of hydrolytic enzymes in the kernels. The oil is not utilized satisfactorilly, probably due to high A.V., some toxic substances and odd smell[6]. However, it may be able to be used as a raw material of soap manufacturing or other industrial purpose such as lubricant or engine oil.

3) Winged beans

This plant (*Psophoculpus tetragonolobus* L.

Table 1. Chemical composition of some oil seeds in Thailand

	Sea almond (whole kernel)	Alexandrian laurel (whole kernel)	Winged beans L.* (whole seed)	Winged beans I.** (whole seed)	Okra seeds (whole seed)	Cassava seeds*** (whole seed)
Moisture	5.53%	5.90%	11.83%	9.60%	10.70%	7.12%
Fat	55.96	78.25	16.64	15.42	15.80	25.28
Protein	25.11	5.58	31.71	36.03	22.70	18.33
N.F.E.****	6.72	6.06	25.87	25.76	20.60	—
Fiber	2.26	2.63	9.62	9.15	26.20	—
Ash	4.62	1.57	4.33	3.95	4.00	—

*: Local variety
**: Average of 3 samples, introduced varieties
***: Average of 6 samples
****: Nitrogen free extract

Table 2. Fatty acid composition of some oil seeds in Thailand

	Sea almond (whole kernel)	Alexandrian laurel (whole kernel)	Winged beans L.* (whole seed)	Winged beans I.** (whole seed)	Okra seeds (whole seed)	Cassava seeds*** (whole seed)
	%	%	%	%	%	%
F.A. $< C_{10}$****	—	3.76	—	—	—	—
Myristic acid	—	1.12	—	—	0.30	—
Palmitic acid	34.25	15.99	19.14	10.48	35.00	13.62
Palmitoleic acid	—	0.35	—	—	—	—
Stearic acid	4.65	12.55	6.38	5.09	3.70	5.11
Oleic acid	28.35	33.75	18.19	37.53	20.40	22.46
Linoleic acid	32.75	32.48	54.22	26.59	40.60	58.90
Linolenic acid	—	—	1.00	2.66	—	—
Arachidic acid	—	—	1.07	2.47	—	—
Behenic acid	—	—	—	15.17	—	—

*, **, ***: See Table 1
**** : Fatty acids with molecular weight less than lauric acid

Table 3. Chemical and physical characteristics of some oil seeds in Thailand

	Sea almond (whole kernel)	Alexandrian laurel (whole kernel)	Winged beans I.* (whole seed)	Okra seeds (whole seed)
Acid Value	0.86	24.01	0.50	0.05
Iodine Value	79.07	87.74	87.67	124
Saponification Value	186.85	192.39	187.9	193
Unsaponifiable matter	0.20	0.29	—	—
Refractive index	1.4661	1.4773	—	—

* mixed oil, introduced varieties

(DC)) belonging to Leguminosae is also widely distributed in Southeast Asian countries. In Thailand, the green pods of this plant are eaten as a kind of vegetable.

In recent 10 years, an increasing attention has been paid to the importance of winged beans as a promising high protein and nutritious crop in the tropics[12].

Three introduced and one local varieties were used for the study. Little differences

were found between local and introduced varieties in chemical composition of beans. The protein content was nearly 40% in an average of 3 introduced varieties (on dry matter basis) and 36% in the local variety. The fat content was 17% in the introduced varieties and 19% in the local variety.

The fatty acid composition of the introduced varieties was 33.2% of saturated fatty acids and 66.8% of unsaturated fatty acids while that of the local variety was 26.6% and 73.4% respectively. Slight differences were also found between the introduced and local varieties on some fatty acid contents. Oleic acid in the former ranged from 33.6% to 40.8%, while the latter contained only 18.2% which is nearly the same as Japanese soybean oil[11]. Linoleic acid in the former ranged from 22.4% to 29.5%, but the latter contained 54.2% which is also similar to that of Japanese soybean oil. Special differences are found in arachidic acid and behenic acid between the introduced and local varieties, especially the former contained 12.9–17.9% of behenic acid, but only trace in the latter.

Some chemical characteristics of the mixed oil of introduced varieties are as follows; Iodine Value: 87.67, Saponification Value: 187.9. The I.V. shows that the winged bean oil belongs to the non-drying oil category.

The winged bean is sometimes called "Tropical soybean". The chemical constituents are some what similar to that of the soybeans. They may be able to be used as a new raw material for edible oil manufacturing. If the defatted material is used as a substitute for high-protein foods, it must contribute to relieve the protein deficiency of people.

4) Okra seeds

Okra (*Hibiscus esculenta* L.) belonging to Malvaceae is a popular plant in Thailand. The immature green pods are commonly used as a vegetable for culinary purpose. However, it is not well known that okra seeds have high protein and oil. It was pointed out that some varieties of okra in South America can compete with soybeans, sunflower, sesame, groundnuts, castor beans, wheat, corn and potatoes in terms of oil and protein production/ha[1]. As there are not many cultivars of okra in Thailand, seeds of one local variety were used for the study.

Okra seeds contain about 18% of oil and 25.4% of protein (on dry matter basis). Fiber content, however, is about 29%, considerably higher than those of other oil crops, such as soybeans, sesame, cotton seed etc.

The oil consisted of 39% of saturated fatty acids and 61% unsaturated fatty acids. Major components of the former are 35% of palmitic and 3.7% of stearic acid. The latter consisted of 20% of oleic and 40% of linoleic acid. Iodine Value of refined oil is 124, indicating that the okra seed oil belongs to the drying oil category. According to Markley[8], seeds of Malvaceae plants sometimes contain cycropropenoid fatty acids, such as malvalic or sterucuric acid. As okra belongs to Malvaceae, the presence of those fatty acids was examined by Halphen reaction[5]. Positive reactions in both crude and refined oils were found, especially crude oil showed strong red color. However, refined oil gave only pale pinkish color. Iodine Value of the oil was 121, which is close to soybean oil, but slightly higher than those of cotton seed or sesame oil, showing that okra seed oil belongs to the semi-drying oil category.

The okra seed oil can be used for food oil and raw material of margarine.

5) Cassava seeds

Cassava (*Manihot esculenta* Grantz) is known as a root crop cultivated from subtropics to tropics in the world except deserts. It belongs to Euphorbiaceae.

Cassava is widely grown in Thailand on nearly six million rais (one million ha), and the potential tuber production is estimated at about 12.4 million tons in 1977/78[9].

It is, however, not well known that cassava seeds contain high oil and protein. Cassava is classified into three types, viz. easy, rare and non fructification. It was presumed that the varieties cultivated in Thailand usually belonged to the non fructification type.

However, the joint research team between

Field Crop Division, Department of Agriculture, Thailand and Tropical Agriculture Research Center, Japan, found out that some varieties of the Thai cassava can produce about 100 grams of seed per one plant, approximating to 1.0 to 1.5 ton/ha of seed production potential.

Therefore, 6 samples of cassava seeds were collected for the study, and it was found that the seeds contain 27.2% of oil and 19.7% protein (average of 6 samples, on dry matter basis). The oil consisted of 18.7% saturated fatty acids and 81.4% unsaturated fatty acids.

The saturated fatty acids are 13.6% of palmitic and 5.1% of stearic acid, while, unsaturated fatty acids are 22.5% of oleic and 58.9% of linoleic acid. Prasada Rao et al.[10] reported that oil and protein contents of cassava seeds produced in India are 27.4% and 19.4% respectively (on dry matter basis). Also they found 10 fatty acids in Indian cassava seed oil, and the majority were 11.4% of palmitic, 25.1% oleic and 51.4% of linoleic acid. These values are almost similar to that found in our work. According to them[10] the cassava seed oil can be used for culinary purpose.

Chemical and physical characteristics are now still under study.

Oil seeds usually contain high protein together with high oil content. Recently, vegetable oil industries have remarkably developed in Thailand. Accordingly, it is necessary to study effective utilization of by-products of the industry, such as cakes or defatted meals commonly used as raw materials of food processing or cattle feed because of rich protein. However, in the use for food or feed, quality of protein and quantity of amino acids are important nutritive factors. Experiments on this problem are also in progress.

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