



Fig.97 Morphology of the leaves of Thian-tung-khao

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|----------------------|-----------------------|----------------------|
| 1 = Thian Dam | 2 = Thian Dang | 3 = Thian Khaao |
| 4 = Thian Khaoplueak | 5 = Thian Taatakataen | 6 = Thian Yaowapanee |
| 7 = Thian Sattabut | 8 = Thian Taakob | 9 = Thian Klethoi |

Table 28 Comparison of the leaves and flowers of Thian-tung-khao

Thian	Leaf		inflo- rescence	petal
	shape	margin		
Dam	deltoid	1-3 pinnately dissected	simple	white
Dang	ovate	1-2 pinnately dissected	raceme	white to lt.purple
Khaao	ovate	ternately dissected	umbel	rose
Khaoplueak	deltoid	3-4 pinnately dissected	umbel	yellow
Taatakkataen	deltoid	3-4 pinnately dissected	umbel	yellow
Yaowapanee	deltoid	2-3 pinnately dissected	umbel	gr.white
Sattabut	reniform	serrate or pinnately dissected	-	-
Taakob	oblong	2-3 pinnately dissected	-	-
Klethoi	linear	entire	spike	scarious

lt.purple = light purple; gr.white = greenish white

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Thian Khaoplueak and Thian Taatakataen both have the same characters of the leaves and yellow flowers. However, the green color of the leaves of Thian Taatakataen is more intense. More obvious distinguishable characters of these two Thian are in fruits and seeds which will be mentioned in the following chapters.

4. The crude drugs of most Thian are different from others in morphology, colors and sizes (Fig.98 and Table 29) except for Thian khaao and Thian Taakob which are similar except for slight differences in the outer surface, color and size. The outer surface which is bristled for Thian Khaao, is glabrous for Thian Taakob which is also darker in color and smaller in size.

Among the Thian in the Family Umbelliferae, the largest is Thian Khaoplueak and the smallest is Thian Yaowapanee. When compared to other Thian, Thian Yaowapanee has nearly the same size as Thian Dam, Thian Dang and Thian Klethoi.

Fig.99 showed the differences of Thian-tung-khao in dorsal and sectional views.

5. Histology of Thian in the family Umbelliferae possessed similar cell structures and sizes for endocarp, spermoderm, endosperm and embryo. The latter two are also similar in cell contents, which are oil globules, aleurone grains and microcrystals. The differences of the umbelliferous Thian are, therefore, at the epicarp and mesocarp layers.

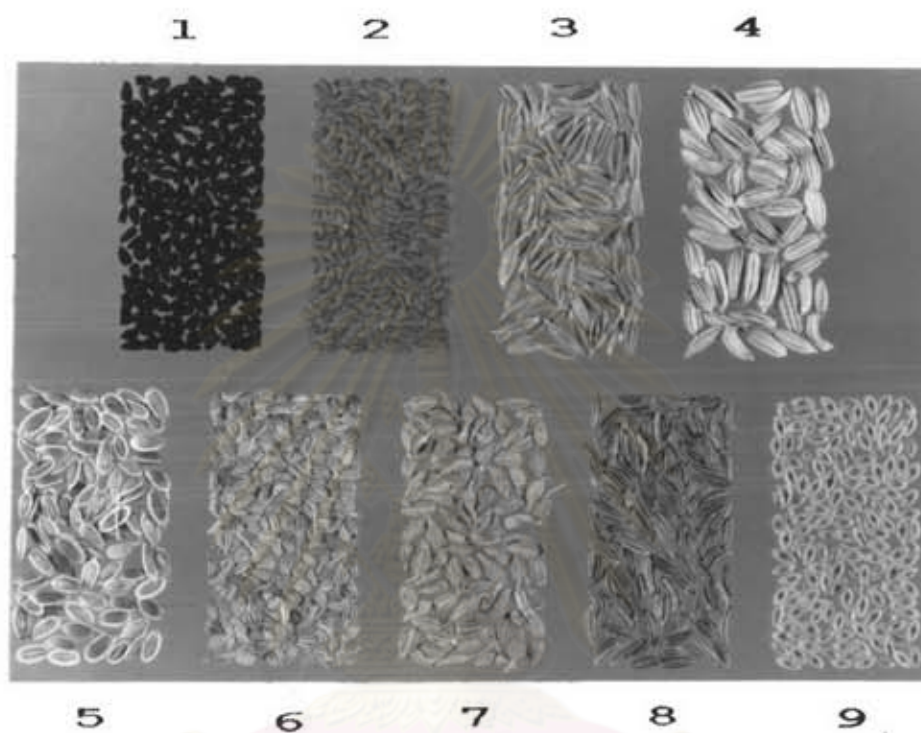


Fig.98 Morphology of the crude drugs of Thian-tung-khao

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Table 29 Comparison of the morphological characters of the crude drugs
of Thian-tung-khao

Thian	occurrence	shape	colour	size	
				length (mm)	width (mm)
Dam	seed	ovoid to lanceolate, 3 or nearly 5 angled	black	2.5-3.0	1.4-1.8
Dang	seed	ovoid	red	2.5-2.8	1.0-1.4
Khaao	mericarp	narrowly elliptical with bristles	brown	4.5-6.2	1.3-2.0
Khaoplueak	cremocarp	oblong	brown	-	-
	mericarp	elliptical	brown	5.0-8.0	2.0-2.5
Taatakkataen	cremocarp	broadly ovoid	dk.brown	-	-
	mericarp	broadly compressed ovoid	dk.brown	4.0-6.2	1.8-2.8
Yaowapanee	cremocarp	broadly ovoid	brown	-	-
	mericarp	crescent shaped	brown	2.0-3.1	1.0-1.4
Sattabut	cremocarp	ovoid	brown	-	-
	mericarp	crescent shaped	brown	3.0-4.8	1.4-2.0
Taakob	mericarp	narrowly elliptical without bristle	dk.brown	4.8-5.9	1.0-1.4
Klethoi	seed	ovoid to elliptic	brown	2.2-3.1	1.1-1.7

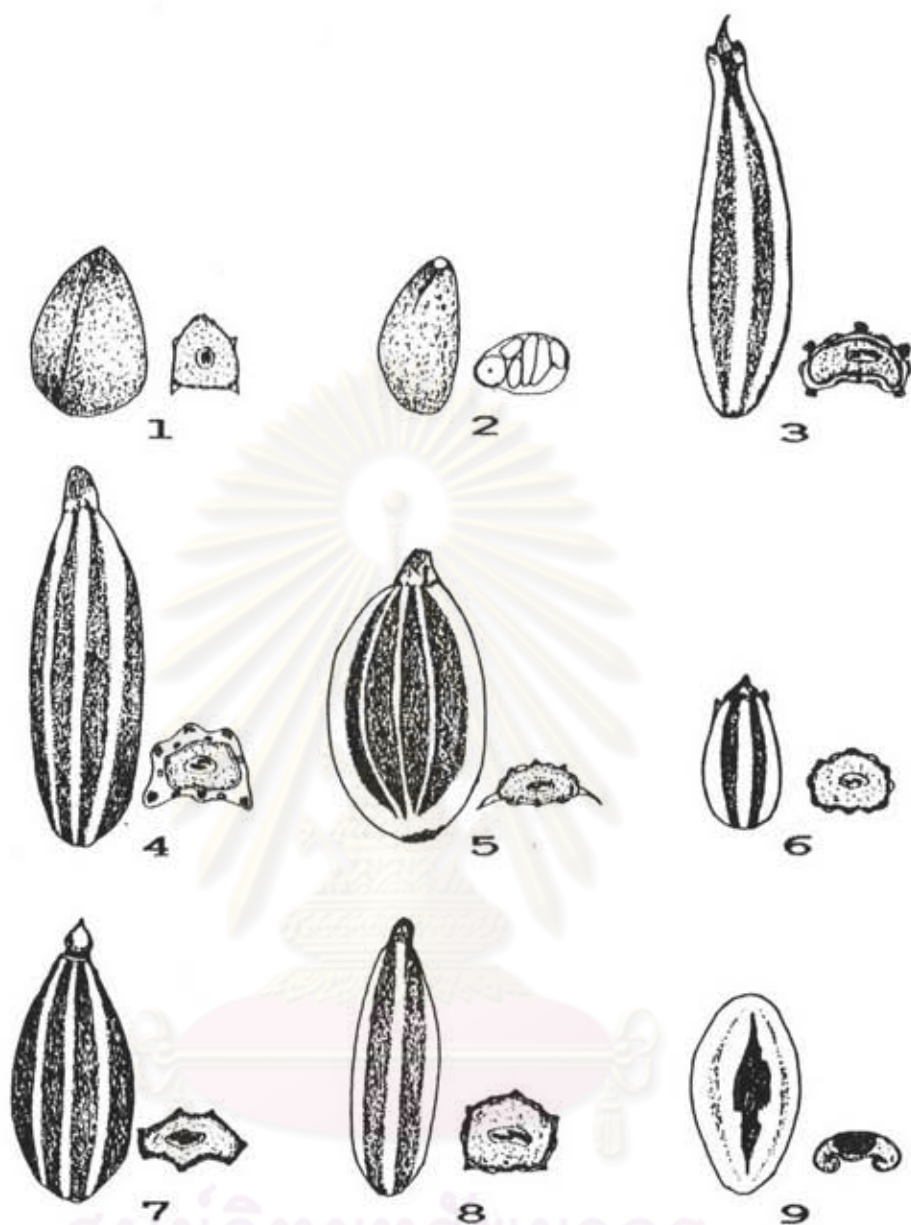


Fig.99 Morphology of the crude drugs in dorsal and sectional views of Thian-tung-khao

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Table 30 and Fig.100 showed differences in outline cross sections for each Thian. In addition, Thian Khaoplueak possessed a smooth cuticle while the other umbelliferous Thian are striated.

As previously mentioned, Thian Khaoplueak and Thian Taatakkataen are very much alike in the morphology of the leaves and flowers. The differences between the two are clearly shown in Fig. 98,99 and 100.

Covering trichomes, which were found in Thian Khaao, Thian Yaowapanee and Thian Sattabut, were absent in Thian Khaoplueak, Thian Taatakkataen and Thian Taakob.

The mesocarp of Thian Sattabut occurred as a large number of small vitta distributed along the dorsal side while other umbelliferous seeds were found four large vittae at the same position.

Thian Dam, Thian Dang and Thian Klethoi are derived from seeds, therefore, epicarp, mesocarp and endocarp were absent.

Mucilage was found in the outer epidermis of Thian Dang and Thian Klethoi and was absent in the outer epidermis of Thian Dam.

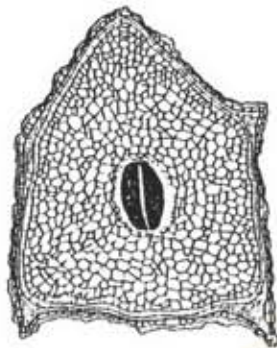
The pigment layer was found at the outer and inner epidermis of Thian Dam while Thian Dang found at the outer epidermis and Thian Klethoi found at the inner epidermis.

Table 30 Comparison of the histological characters of Thian-tung-khao

Thian	outline of cross section	epicarp		mesocarp	spermoderm	endosperm
		cuticle	trichome	vittae (number)	mucilage	micro crystal
Dam	nearly pentagonal	-	-	-	a	a
Dang	ovate	-	-	-	p	a
Khaao	pentagonal	striated	p	p(6)	a	p
Khaoplueak	pentagonal	smooth	a	p(6)	a	p
Taatakataen	wing-liked compressed orbicular	striated	a	p(6)	a	p
Yaowapanee	pentagonal	striated	p	p(6)	a	p
Sattabut	reniform	striated	p	p(32-43)	a	p
Taakob	nearly equilaterally pentagonal	striated	a	p(6)	a	p
Klethoi	reniform	-	-	-	p	a

p = present

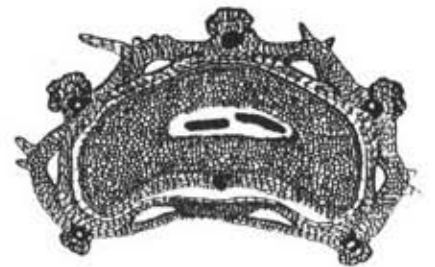
a = absent



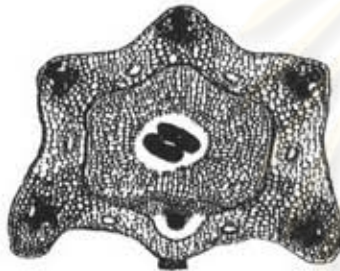
Thian Dam



Thian Dang



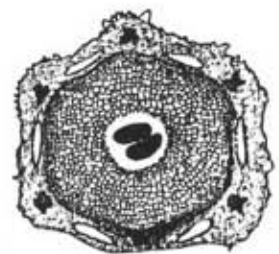
Thian Khaao



Thian Khaoplueak



Thian Taatakataen



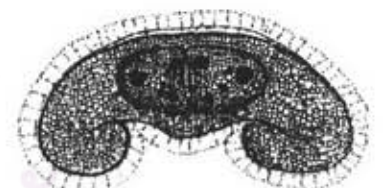
Thian Yaowapanee



Thian Sattabut



Thian Taakob



Thian Klethoi

┆ 0.1 mm

Fig.100 Histology of Thian-tung-khao

Endosperm of Thian Dang fully filled with cotyledons while Thian Dam and Thian Klethoi lied with cotyledons in the center. The three Thian are similar in cell contents which are the present of oil globules and aleurone grains and the absent of microcrystals.

6. Microscopical characters of the powdered drugs of Thian Khaao, Thian Khaoplueak, Thian Taatakkataen, Thian Yaowapanee, Thian Sattabut, and Thian Taakob are nearly similar since they are parts of cremocarp and mericarp which possessed similar cell structures. In case of Thian Dam, Thian Dang and Thian Klethoi, they are very much alike due to the powder are parts of the seed with similar cell structure.

Table 31 showed the differences in the powdered drug of Thian-tung-khao which were divided into two groups according to part used. A more obvious differences among each kind of Thian in Thian-tung-khao are illustrated in Fig.101.

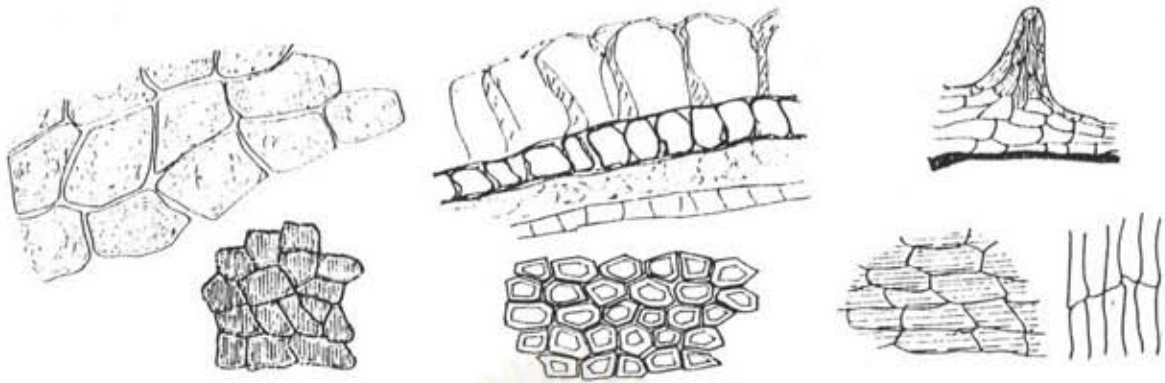
7. One-dimensional TLC indicated that the alcoholic extracts of Thian gave negative results to Leibermann-Burchard, Kedde's and Dragendorff's reagents. Positive results were obtained with vanillin-sulphuric acid reagent and under UV light. However, specific one-dimensional TLC pattern was successively obtained for each particular Thians. (Fig.102)

Table 32 showed the characteristic spot of the extract of each Thian.

Table 31 Comparison of the microscopical characters of the powdered drugs of Thian-tung-khao

Thian	outer epidermis	inner epidermis
Dam	dark brown, thicken walls	brown, stripped thicken double walls
Dang	brown, thicken double walls	colourless, thin walls
Klethoi	colourless, thicken walls	brown, thicken walls

Thian	trichome	epicarp, cuticle	endocarp, surface
Khaao	multicellular	striated	smooth
Khaoplueak	absent	smooth	sinuous striped marked
Taatakataen	absent	faintly striated	sinuous striped marked
Yaowapanee	unicellular	striated	smooth
Sattabut	unicellular	faintly striated	smooth
Taakob	absent	faintly striated	smooth



Thian Dam

Thian Dang

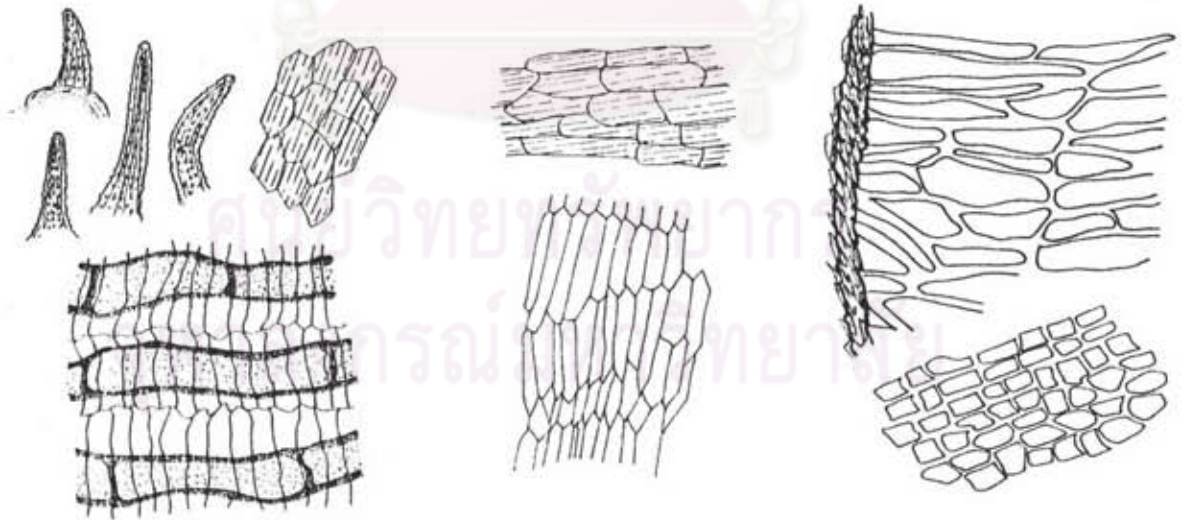
Thian Khaao



Thian Khaoplueak

Thian Taatakataen

Thian Yaowapanee

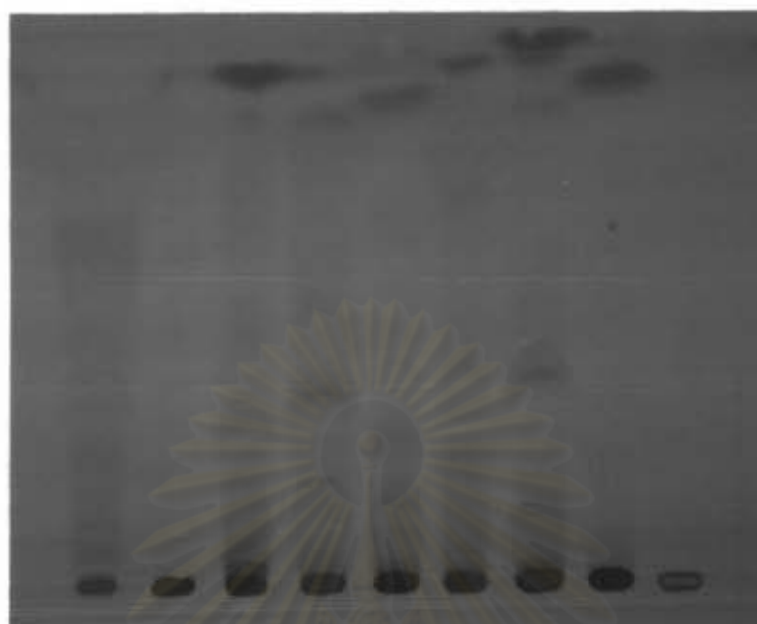


Thian Sattabut

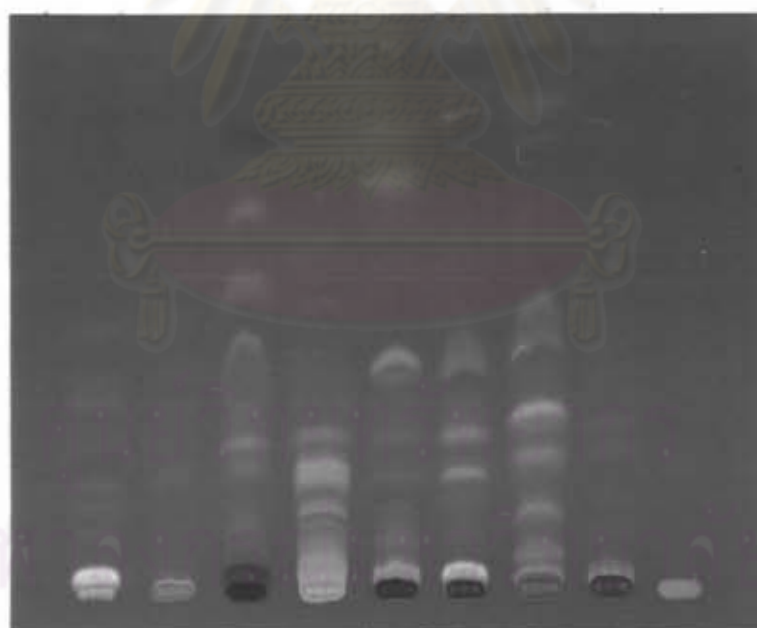
Thian Taakob

Thian Klethoi

Fig.101 Microscopical characteristics of the powdered drugs of Thian-tung-khao

UV₂₅₄

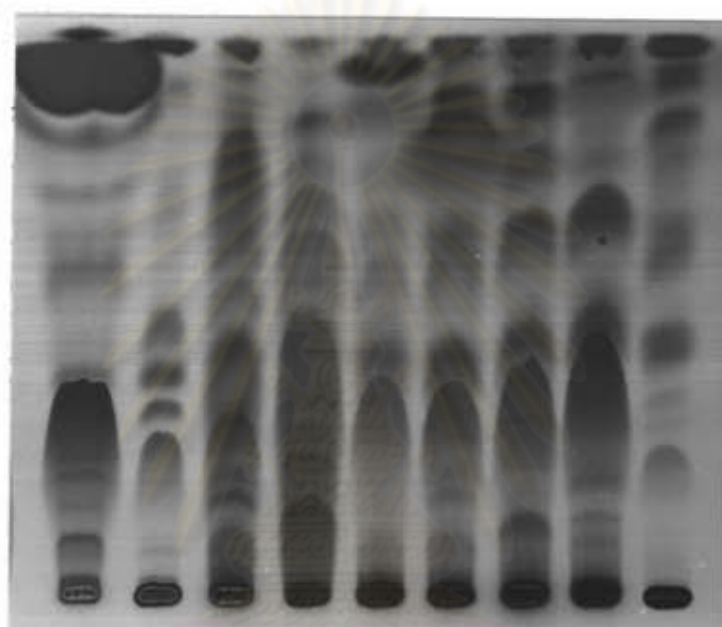
1 2 3 4 5 6 7 8 9

UV₃₆₅

1 2 3 4 5 6 7 8 9

Fig.102 One-dimensional TLC characteristics of the extracts of
Thian-tung-khao

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|----------------------|------------------------|----------------------|
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Vanillin-H₂SO₄

1 2 3 4 5 6 7 8 9

Fig.102 One-dimensional TLC characteristics of the extracts of

Thian-tung-khao (continued)

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|----------------------|-----------------------|----------------------|
| 1 = Thian Dam | 2 = Thian Dang | 3 = Thian Khaao |
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Table 32 Characteristic spots of the extracts of Thian-tung-khao in one-dimensional TLC

Thian	Rf value	UV ₂₅₄	UV ₃₆₅	vanillin-H ₂ SO ₄
Dam	0.95	-	-	reddish brown
Dang	0.54	-	-	purple
Khaao	0.76	-	blue	green
Khaoplueak	0.20	-	pink F	blue
Taatakataen	0.88	dark	-	pink
Yaowapanee	0.84	-	-	pink
Sattabut	0.16	-	light blue	bluish purple
Taakob	0.93	dark	-	pink
Klethoi	0.48	-	-	yellow

F = fluorescent

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8. Chromatographic study of the extracts of Thian showed that the patterns of the alignment of spots and their colors with spraying reagent on two-dimensional TLC chromatograms are characteristics for each kind of Thian (Fig. 103), which were called TLC fingerprint by some authors.

9. Ultraviolet spectra of the extracts of Thian-tung-khao are characteristics for each Thian. (Fig.104)

Table 33 showed the chemical constituents and their UV absorptions⁽²¹⁰⁾ of Thian-tung-khao which are in good agreement with the UV spectrum of each Thian.



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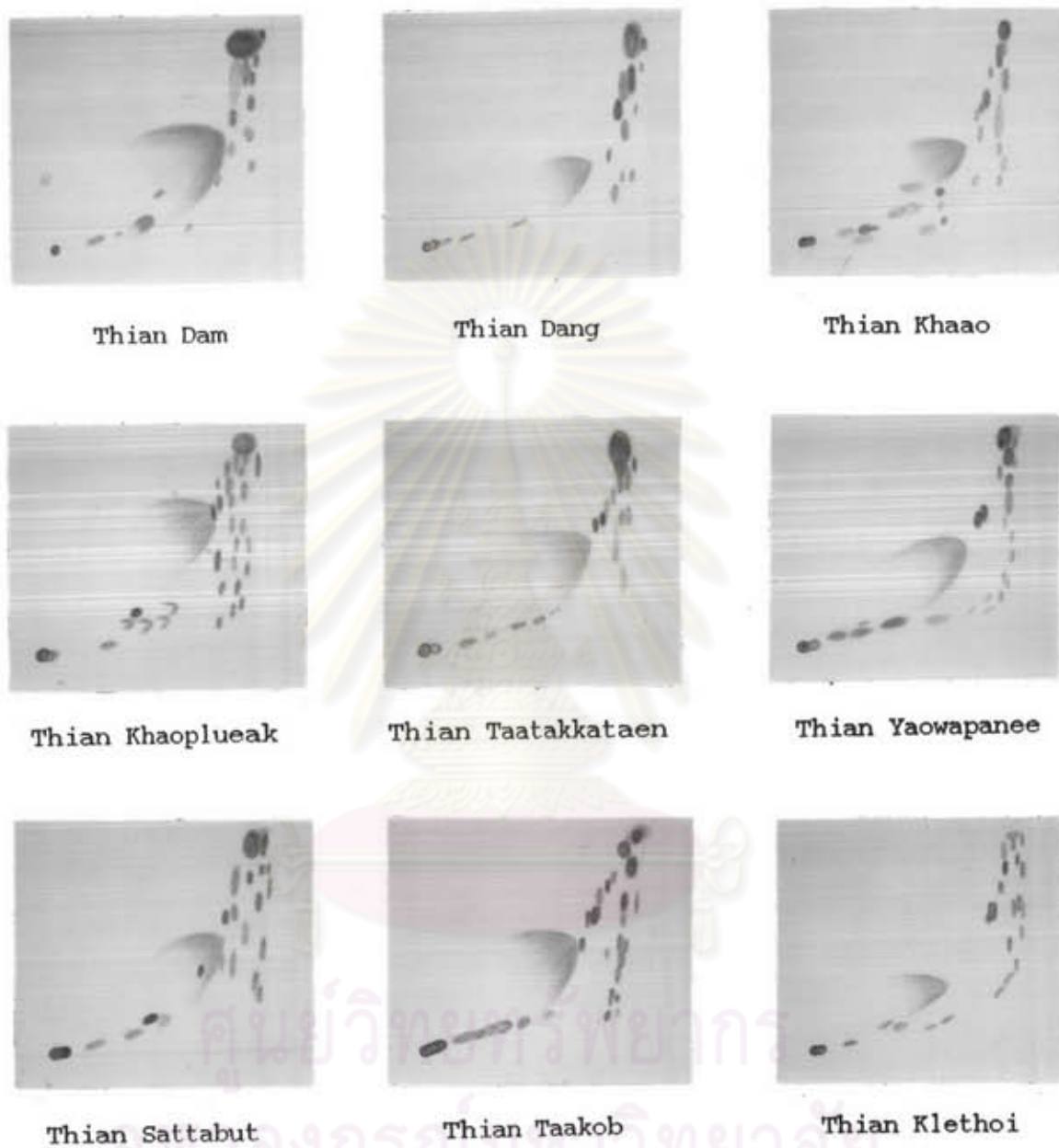


Fig.103 two-dimensional TLC characteristics of the extracts of Thian-tung-khao

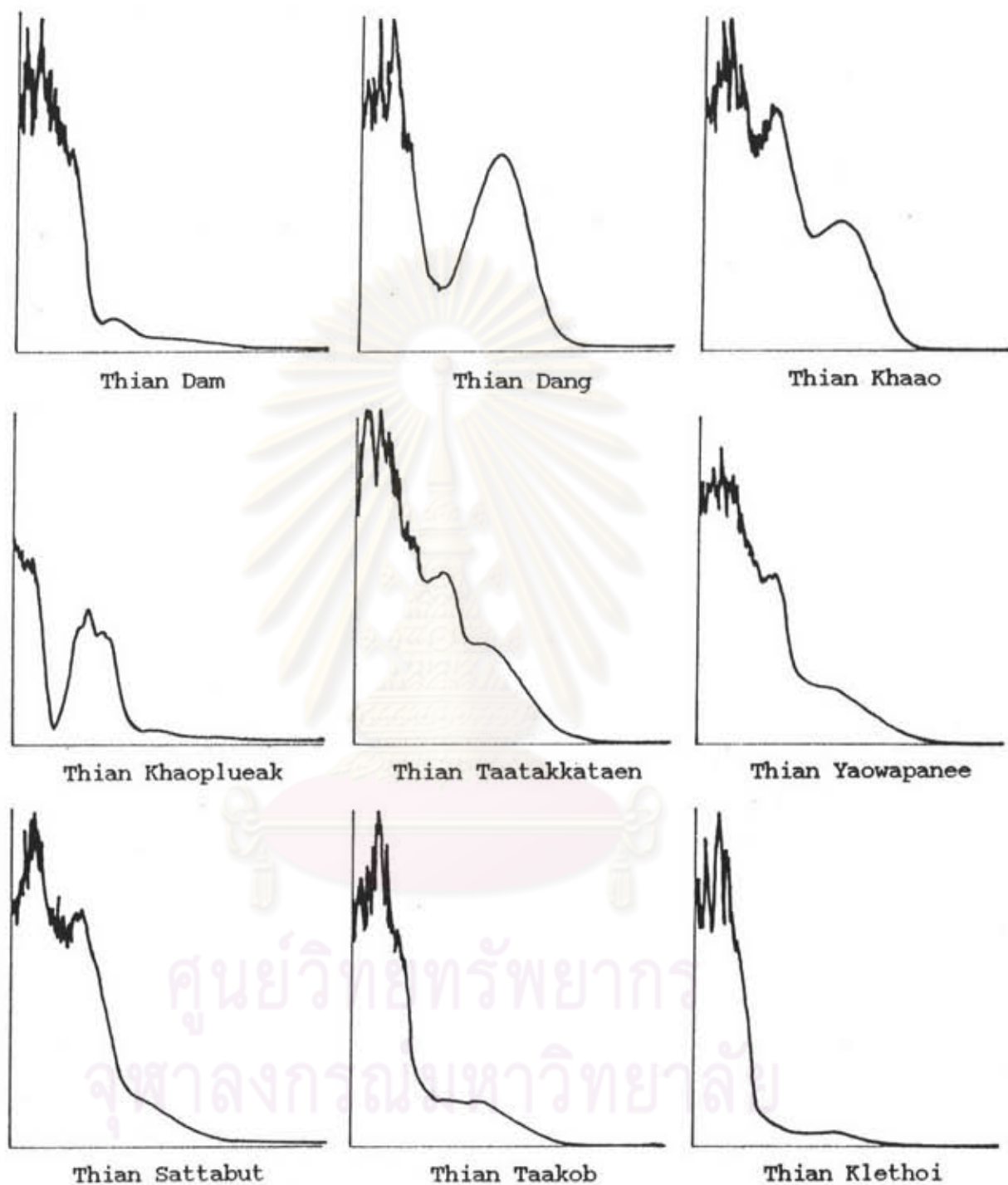


Fig.104 Ultraviolet spectra of the extracts of Thian-tung-khao

Table 33 UV absorptions of the chemical constituents of
Thian-tung-khao

Thian	λ_{\max}	chemical compound
Dan	294	thymohydroquinone
	241, 206	nigellone
Dang	333, 240, 225	sinapic acid ethyl ester
	280	lepidine
	247	benzylisothiocyanate
	223	benzylthiocyanate
Khaao	256	luteolin
	251	cuminaldehyde
Khaoplueak	288	fenchone
	258	anethole
Taatakataen	320, 235	carvone
	254	quercetin, scopoletin
	240, 216	umbelliferone

Table 33 UV absorptions of the chemical constituents of
Thian-tung-khao (continued)

Thian	λ_{\max}	chemical compound
Yaowapanee	274	coumarin
	245	isopimpinellin
	205	stigmasterol
Sattabut	274	coumarin
	268, 246	isopimpinellin
	258	anethole
	244	caffeic acid
	206	stigmasterol
Taakob	318, 236	carvone
	251, 220	limonene
	238	citral
	226	myrcene
	210	α -pinene
	208	β -pinene
	205	camphene
Klethoi	232	linoleic acid
	210	palmitic acid, stearic acid