CHAPTER I

INTRODUCTION

Typha elephantina Roxb.

Typha Linn., the only genus in the family Typhaceae, commonly known as CAT-TAILS, is a genus of hardy perennial herb, often growing gregariously in fresh water and marshy places with creeping rhizomes, the occurence of which is world wide except for the cold regions (1-4). Twelve species of *Typha* are found widely in tropical and temperate regions (3,4). Four species occur in North America (2). There are two species in Britain, the larger, *T. latifolia* Linn. (Reed Mace) and the smaller, *T. angustifolia* Linn. They occur in ditches, ponds, lakes, on river-banks and are widely spread in both hemispheres, but more especially in the north (4).

Utilization of this genus has been reported in many countries. The rhizomes which are rich in starch are eaten in many regions where food is scarce or in periods of famine. The leaves are used for thatching huts, for matting and for coarse basket work. The spikes are often used for decoration, the plush of the ripe female spadices is formerly used for stuffing pillows (5). The fibres obtained from some species can be substituted for cotton wool and jute, and are also suitable for paper making (1). The rootstock is astringent and diuretic (6).

The following species are used medicinally (6);

in Europe :- *T. elephantina* Roxb., *T. latifolia* Linn.

in Japan and China :- *T. elephantina* Roxb.,
T. japonica Miq., *T. laxamani* Lepech.

in Malaya :- *T. shuttleworthii* Koch. and Sond.

in Madagascar :- *T. javanica* Schnitzl.

in South Africa :- *T. capensis* Rohrb.,
T. latifolia Krauss.

According to Smitinand (7), there is only one species in Thailand which has been reported that *T. elephantina* Roxb. is synonymous with *T. angustifolia* Linn. so that the author would like to report a species of *T. elephantina* Roxb. as an accepted name (Figure. 1 p. 5).

This plant is known in various local names such as Kok-chaang กกช้าง (Central); Feua เฟื้อ (Nakhonchaisri); Thunp ruesee ธูปฤาษี (Bangkok); Yaa salaap luang หญ้าสลาบหลวง (Northern) and in English name as Lesser Reedmace and Narrowleaf Cat-Tail (7).

Typha elephantina Roxb. is a gigantic gregarious marsh plant, 1.8-3.6 m high with erect grass-like. Leaves are 1.2-1.8 m long, 1.8-3.8 cm broad, somewhat convex dorsally and concave ventrally, becoming narrower keeled and trigonous towards the sheath. Flowering stem embraced at the base by the leaf sheaths, straight, glossy, spongy within the top forming the rachis of the female and male spikes. Lower female spike is 15-25 cm long by 7.5-25 mm diameter, finally brown, a deciduous foliaceous spathe embraces the whole inflorescence when is young. Male spike is 15-30 cm long, longer

than female one, seperated from it by an interval of $\frac{1}{2}$ - 1.2 cm, pale coloured with a basal spathe and 2-3 smaller upper ones, all deciduous. Stamens 2-3 are on a minute common stalk, intermixed with narrowly linear or narrowly spatulate hairs; the apex of these often broadened, entire or shortly toothed; anther is 1.5-2.5 mm. long with 4-globate pollen. Bracts are between the flowers very numerous filiform 2-3 cleft. Female flower with flattened lanceolate stigma, mixed with clavate pistillodes and bracteoles with fasciated obtuse or subtruncate apex; seeds oblong (1,5,6).

Typha elephantina Roxb. has been used in traditional Indian medicine as cooling agent, aphrodisiac and for treatment of leprosy. The rootstock is somewhat astringent and diuretic, and is employed in Eastern Asia in dysentery, gonorrhea and measles. The pollen is substituted for the spores of *Lycopodium* spp. The soft and wooly floss of male spikes and the down of the ripe fruits are used in emergency as medicated absorbent to wounds and ulcers (1,6).

In Thailand, there is no report about the medicinal uses of this plant. In the central part of Thailand, leaves are used for making mats and baskets. Formerly, plushy florets were used for stuffing pillows.

Typha elephantina Roxb. is only one species which is found in fresh water and marshy places in Thailand. Previously, there have been no reports on phytochemical studies of this plant. On phytochemical screening, it was found that all parts of this plant exhibit positive result with Liebermann-Burchard Test. Hence it is indicated the presence of steroidal compounds and the most concentration part

is in the fruits.

Accordingly, this present investigation deals with extraction, isolation and identification of steroid(s) occurring in the fruit, in order to contribute our knowledge of the constituents containing in this species and to search for compound(s) which might exert physiological activities.

Figure 1 *Typha elephantina* Roxb. fruits.

(photographed by Professor Vichiara A. Jirawongse Ph.D.)

Chemical Constituents of *Typha* spp.

Members of the genus *Typha* are found to contain a wide range of chemical constituents. Flavonoid, steroid, sugar, alkaloid and long chain hydrocarbon are among the various compounds isolated from *Typha* species.

Lists of compounds found in various plants of *Typha* genus are shown in table 1. (page 7)

Table 1 Chemical constituents found in *Typha* spp.

Botanical Origin	Plant Part	Compound	Reference
Typha angustata Bory & Chaub.	pollen	Pentacosan, Sitosterol	8
T. angustifolia Linn.	all parts	1H-Indole-3-butyric acid	9
		1H-Indole-3-propionic acid	9
		1H-Indole-3-acetic acid	9
T. australis Schum.	flower	Flavonol glucoside (quercetin)	1
	leaf and flower	Alkaloid	1
T. latifolia Linn.	leaf	Quercetin-3-glucoside	10
		Quercetin-3-galactoside	10
		Quercetin-3-neohesperidoside	10
		Kaempferol-3-glucoside	10
		Kaempferol-3-galactoside	10
		3,3'-Di-O-Methylquercetin 4'-O-glucoside	11
		Isorhamnetin 3-O-glucoside and 3-O-neohesperidoside	11
	pollen	Glucose, Fructose	12
		Rhamnose, Arabinose	12
		Nigerose, Maltose	12
		Isomaltose, Sucrose	12
		Turanose, Leucrose	12
		Maltotriose, Raffinose	12
		Sitosterol	8

From table 1, steroids have been reported in at least 2 species, namely *T. angustata* Bory & Chaub. and *T. latifolia* Linn. Sitosterol 1(Figure 2) is only steroid, found in *Typha* spp. but there is no report on isolation of steroids from *T. angustifolia* Linn. or *T. elephantina* Roxb.

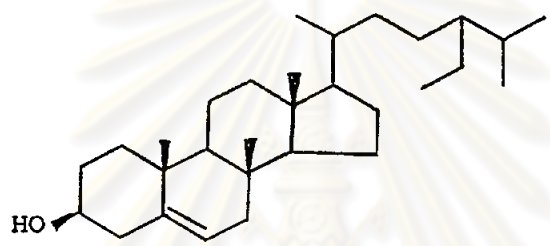

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Figure 2 Steroid found in *Typha* spp.

Randia siamensis Craib

Randia Linn., is a large genus of erect or climbing shrubs and trees of subfamily Gardenieae, family Rubiaceae. One hundred and fifty species of *Randia* are distributed widely in the tropical and sub-tropical regions especially in Asia and Africa (4,13,14). About 14 species occur in India (13).

In Thailand, there are at least 37 valid species of *Randia* which are commonly found in evergreen forest (15,16). *Randia* species in Thailand are listed below :-

(15,16)	*Randia armigera* K. Schum.	
(15)	*R. auriculata* Steud.	
(7,15,16)	*R. bispinosa* Craib	Salak khieo สลักเขี้ยว Khopkhieo ขบเขี้ยว
(15)	*R. celastroidea* Ramuti	
(15)	*R. crassispina* Geddes	
(17)	*R. dasycarpa* Bakh.f.	Khet เคด
(7,15,16)	*R. elliptica* Geddes	Khad khaonam คัดเค้าน้ำ
(7,15,16)	*R. eucodon* K. Schum.	Mak maw หมักม่อ (Chonburi) Farang paa ฝรั่งป่า (Rayong)
(7,15,16)	*R. exaltata* Griff.	Kraduuk kop กระดูกกบ
(15)	*R. fusca* Arbor.	
(15,16)	*R. griffithii* Hook.f.	
(7,15)	*R. klossii* Ridl.	Khao wua เขาวัว
(16)	*R. ligustrifolia* Geddes	
(7,15,16)	*R. longiflora* Lamk.	Khet khao เคดเค้า

(7,15,16)*Randia longispina* DC. Khlet nam เคล็ดน้ำ

Ked kao เค็ดขาว

(15)*R. murina* Arbor

(15)*R. mussaendoides* Arbor

(7,15)*R. nutans* DC. Ra wiang so ระเวียงสอ

(7,15,16)*R. oocarpa* Ridl. Khlet nuu เคล็ดหนู

(7,15,16)*R. oppositifolia* Koord. Khat khao thong คัดเค้าทอง

(15,16)*R. oppositifolia* Koord. var. *parvifolia* Craib

Kem chaeng เข็มช้าง

(15)*R. ovoidea* Pierre ex Pitard, var. *parvifolia* Pitard

(7,15)*R. parvula* Ridl. Khat khao lek คัดเค้าเล็ก

Khat khao mu คัดเค้าหมู

(7,15)
R. parvula Ridl. var *mollis* Craib

Khieo nguu เขี้ยวงู

(7,15,16)*R. pauciflora* Ridl. Yo tha kaa โยทะกา

(15)*R. pauciflora* Ridl. var. *minor* Craib

(7,15,16)*R. pilosa* Craib Khat khao nuu คัดเค้าหนู

(15)*R. plumbea* Craib

(7,15,16)*R. siamensis* Craib Khat khao คัดเค้า

(16)*R. similis* Craib

(7,15,16)*R. sootepensis* Craib Salang homkai สะแล่งหอมไก่

(15)*R. stenantha* Drake var. *tomentosa* Pitard

(15,16)*R. tomentosa* Hook.f. Klet เคล็ด, Ta klet ตะเคล็ด

(7,15,16)*R. uliginosa* Poir. Talumphuk ตะลุมพุก

(7,15,16)*R. wallichii* Hook.f. Lek kee เหล็กกี

(15)*R. wallichii* Hook.f. var. *subtruncata* Craib

(7,15,16)*R. wittii* Craib Mak maw หมักม่อ

Craib (15) reported that *Randia siamensis* Craib is synonymous with *R. longiflora* Hook.f., *R. uncata* Ridl., *Griffithia siamensis* Miq., *Webera siamensis* Kurz. (Figure 3-4, p. 14). It can be found in all parts of Thailand and Burma especially in the humid regions.

This plant is known in various local names in Thailand as Khat khao คัดเค้า (Central); Khat khao khruea คัดเค้าเครือ (Nakhon Ratchasima); Khat khao naam คัดเค้าหนาม (Chaiyaphume); Khet khao เค็ดเค้า (Northern); Chee khao จี๋เค้า; Naam lit khao หนามลิดเค้า (Chiang mai) and Phayaa thao eo พญาเท้าเอว (Kanchanaburi)(7,15,16).

Randia siamensis Craib is an evergreen large scandent shrub, armed with opposite, recurved, sharp spines. All parts are glabrous, stipules are deciduous. Leaves are oblong to oblong-lanceolate, obliquely acute at the base, 3-5 in. long, entire and thin-coriaceous (glabrous). Flowers are rather small, white, almost sessile, or the median one of the 3 flowers in the cymbiform-connate bractlets pedicelled, forming a quite glabrous short cyme on the reduced branchlets opposite to the alternately solitary leaves or arising from the fork of the branchings. Calyx is long, quite glabrous, tapering at the base, the tube as bell-shaped and rather ample, the teeth are very short, 3-angular, acute. Corolla is glabrous, somewhat dilated at the slightly exserted upper end, the lobes oblong, somewhat longer than the tube and stigmatic lobes are elongate. Fruits are berry (17).

In Thailand, all parts of *R. siamensis* Craib have been used in folk-loric medicine, such as its fruits have been used for inducing abortion, emmenagogue and hematinic, the leaves are claimed for controlling blood pressure, the root is used as anti-pyretic and antiscurvy, the flowers have been used for stopping nosebleed and its stems have been used as hematinic (18).. But there is no report in any literature on pharmacological investigation of this plant. The young leaves are used as vegetable in Singhburi.

Chemical studies of many other species of *Randia* have been reported the presence of triterpenoid acid, for example oleanolic acid or randialic acid. Subsequently, there were reports of triter-penoids present in the root of *R. siamensis* Craib collected in Thailand (19,20). Previous work on the root of this plant has yielded triterpenoid acid such as mesembryanthemoidigenic acid, 3β-acetyl oleanolic acid (19) and 3-O-hydroxy ursolic acid (20); triterpenoid saponin such as 3-O-[α-L-arabinosyl] oleanolic acid (19). However, there have been no previous reports of any triterpenoid isolated from the fruits of this plant.

Accordingly, the uses of *Randia siamensis* Craib in folk medicine and the interest in the indigenous plants of Thailand stimulated a re-appraisal of constituents present in various parts of this species. This present investigation deals with the extraction, isolation and identification of triterpenoid(s) occurring in the fruits in order to expand our knowledge of the constituents containing

in this species and to search for compound(s) which might exert physiological effects.

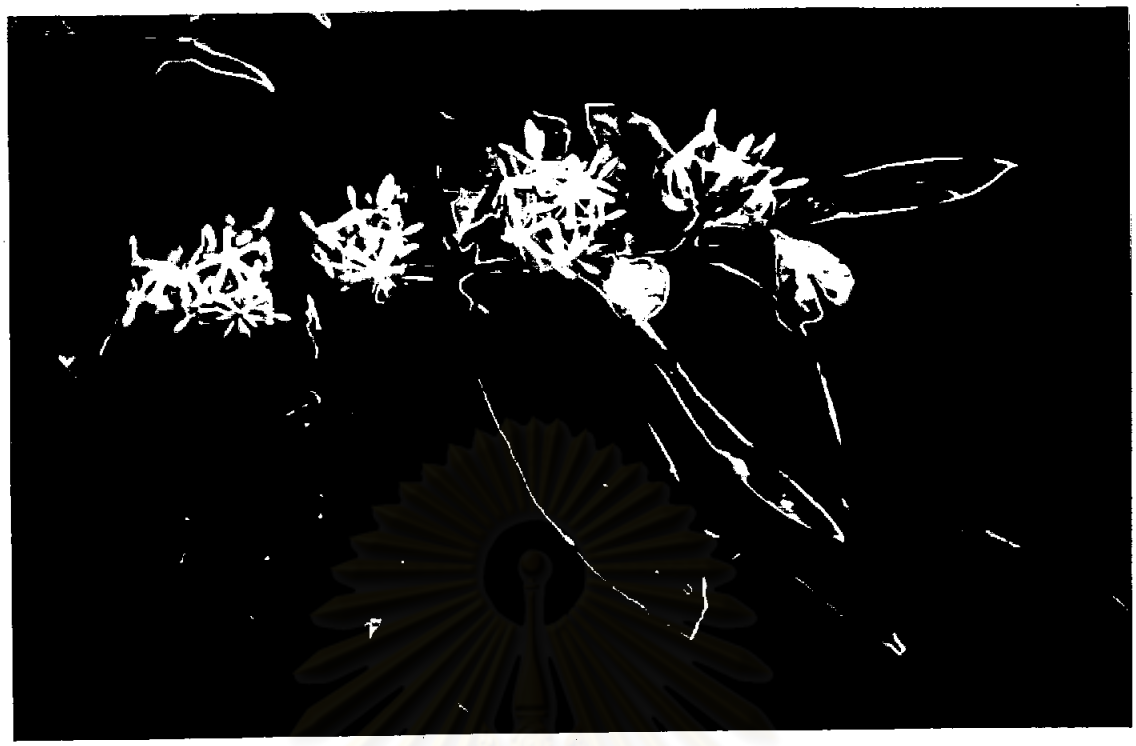

Figure 3 *Randia siamensis* Craib flowering Twig.

(photographed by Professor Vichiara A. Jirawongse Ph.D.)

Figure 4 *Randia siamensis* Craib fruiting Twig.

(photographed by Professor Vichiara A. Jirawongse Ph.D.)

Chemical Constituents of *Randia* spp.

Members of the genus *Randia* are found to contain a wide range of chemical constitutents such as coumarin,carbohydrate, flavonoid, iridoid, steroid and triterpenoid compounds. Interestingly, triterpenoid saponin and sapogenin occur frequently in *Randia* spp.

Lists of compounds found in various plants of *Randia* spp. are shown in table 2 (pp. 16-22).

Table 2 Chemical investigations of *Randia* spp.

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia brandisii Gamble	fruit	Oleanolic acid	Triterpenoid	21
R. canthioides Champ. ex. Benth.	leafy twigs	10-Dehydrogardenoside	Iridoid	22
		Dimeric 10-Dehydrogardenoside	Iridoid	22
		Randioside	Iridoid	22
		Deacetylasperulosidic acid methyl ester aglycone	Iridoid	22
		Gardenoside	Iridoid	22
		Scandoside methyl ester	Iridoid	22
	leaf	β-Sitosterol	Steroid	23
		Cincholic acid	Triterpenoid	23
		6-Deoxy-D-glucose	Carbohydrate	23
	stem	β-Sitosterol	Steroid	23
R. dumentorum Lamk.	bark	Randialic acid A (19-α-Hydroxyursolic acid)	Triterpenoid	24

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia dumentorum Lamk.	bark	Randialic acid B (19-Dehydro ursolic acid)	Triterpenoid	24
	stem-	α-Amyrin	Triterpenoid	25
	-heartwood	β-Sitosterol	Steroid	25
		Oleanolic acid	Triterpenoid	25
		Ursolic acid	Triterpenoid	25
		D-Mannitol	Carbohydrate	25
	ripe fruit	Randioside A (β-D-Galacto-pyranosyl(1-3)-oleanolic acid)	Triterpenoid saponin	26
	fruit	Randianin	Triterpenoid saponin	27
		-	Fatty acid	27
		-	Essential oil	27
		-	Neutral saponin	27
		-	Acid saponin	27

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia dumentorum Lamk.	fruit	-	Acid resin	27
			Green coloring matter	27
	fruit pulp	Dumentoronin A	Triterpenoid saponin	28
		Dumentoronin B	Triterpenoid saponin	28
		Dumentoronin C	Triterpenoid saponin	28
		Dumentoronin D	Triterpenoid saponin	28
		Dumentoronin E	Triterpenoid saponin	28
		Dumentoronin F	Triterpenoid saponin	28
		Oleanolic acid + 1 mol of glucose + 1 mol of fructose + 1 mol of xylose + 2 mol of glucuronic acid	Triterpenoid saponin	29
	pericarp	Glucose, Fructose	Carbohydrate	29
	seed	Sucrose	Carbohydrate	29

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia dumentorum Lamk.	seed	-	Saponin	30
	seed oil	Palmitic acid	Free fatty acid	31
		Stearic acid	Free fatty acid	31
		Oleic acid	Free fatty acid	31
		Linolenic acid	Free fatty acid	31
		Arachidic acid	Free fatty acid	31
		Lignoceric acid	Free fatty acid	31
R. formosa K. Schum.	stem bark	10-Caffeoyldeacetyldaphylloside	Iridoid glycoside	32
		Feretoside	Iridoid glycoside	32
		Gardenoside	Iridoid glycoside	32
		Deacetylasperulosidic acid	Iridoid	32
R. nilotica Stapf.		Isoscopoletin	Coumarin	33
		Umbelliferone	Coumarin	33
		Syringic acid	Coumarin	33

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia nilotica Stapf.		Scopoletin	Coumarin	33
		Scopotin	Coumarin	33
R. siamensis Craib	root	D-Mannitol	Carbohydrate	34
		β-Sitosterol	Steroid	34
		Campesterol	Steroid	34
		Oleanolic acid 3-acetate	Triterpenoid	19
		Oleanolic acid 3-α-L arabinoside	Triterpenoid saponin	19
		Mesembryanthemoidigenic acid	Triterpenoid	19
		30-Hydroxyursolic acid	Triterpenoid	20
R. sinensis (Lour.) Schult.	stem	Stigmasterol	Steroid	23
		β-Sitosterol	Steroid	23
		Mesembryanthemoidigenic acid and glucose	Triterpenoid saponin	23
	leaf	β-Sitosterol	Steroid	23

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia spinosa (Thunb.) Poir.	all parts	Spinosic acid A	Triterpenoid	35
		Oleanolic acid	Triterpenoid	35
		Siaresinolic acid	Triterpenoid	35
		Spinosic acid B	Triterpenoid	35
		β-Sitosterol	Steroid	35
		Stigmasterol	Steroid	35
R. tetrasperma Benth. & Hook.	stem and leaf	β-Sitosterol	Steroid	36
		Scopoletin	Coumarin	36
		Randialic acid A	Triterpenoid	36
		Randialic acid B	Triterpenoid	36
	root	D-Mannitol	Carbohydrate	36
		Scopoletin	Coumarin	36

Table 2 (Continued)

Botanical Origin	Plant Part	Chemical Substance	Category	Reference
Randia uliginosa Poir.	fruit	Leucoanthocyanidin	Flavonoid	37
		Mannitol	Carbohydrate	37
		Oleanolic acid	Triterpenoid	37
	seed oil	Stearic acid	Free fatty acid	38