



## CHAPTER 1

### INTRODUCTION

Rutaceae is a family in the order Rutales, other families of which includes Simaroubaceae, Cneoraceae, Burseraceae and Meliaceae (Benson, 1888).

The family Rutaceae consists of 83 genera and 650 species distributed in the tropics and extratropical regions, many are found in S. Africa and Australia ( Hooker, 1890)

Rutaceae is a large family chiefly of the old world and the south hemisphere.

Description of the plants in the Rutaceae is as follows ( Benson, 1888; Fernald,1950).

Plants with simple or compound leaves dotted with pellucid glands and abounding in a pungent or bitter-aromatic acid volatile oil, producing hypogynous mostly regular 3-5 merous flowers, the stamens as many or twice as many as the sepals (rarely more numerous); the 2-5 pistils separate or combined into a compound ovary of as many locules, raised on a prolongation of the receptacle (gynophore) or glandular disk. Embryo large, usually in fleshy albumen. Styles commonly united or cohering. Fruit usually a capsule, berry or samara. Stipule none.

#### **Rutaceae plants in Thailand**

The occurrence of Rutaceous plants in Thailand has been reported by Tem Smitinand in the Thai Plants Names (1980). This family consists of various plant species as shown below:-

*Aegle**A. marmelos* Corr.**Local names:** มะตูม Matuum (Central, Peninsular)*Atalantia**A. floribunda* Wight = *A. monophylla* Correa.*A. griffithii* Craib = *Paramignya scandens* Craib.*A. monophylla* Correa.**Local name:** มะนาวผี Manaao phae (Chiang Mai, Ratchaburi)*A. spinosa* Koord = *A. monophylla* Correa.*Citrus**C. aurantifolia* Swing.**Local name:** มะนาว Manaao (General)*C. aurantium* Linn.**Local name:** ส้ม (Central)*C. maxima* var. *sinensis* Linn. = *C. sinensis* Osb.*C. decumanus* Linn. = *C. maxima* Merr.*C. grandis* Osb = *C. maxima* Merr.*C. halmii* B.c. Stone**Local name:** ส้มจืดใต้ Som cheettai (Nakhon si Thammarat).*C. hystrix* DC.**Local name:** มะกรูด Ma Kruut (General)*C. ichangensis* Swing.**Local name:** มะसान Ma-Saan (Chiang Mai).

*C. japonica* Thunb.

**Local name:** ส้มจี๊ด Som cheet (Bangkok); Kumquat.

*C. latipes* Swing.

**Local name:** ส้มละโว้ Som lawo (Central).

*C. limon* Burm.f.

**Local name:** มะนาวเทศ Manaao thet

*C. macroptera* Mont.

**Local name:** ส้มโอผี Som o phee (Yala)

*C. maxima* Merr.

**Local name:** ส้มโอ Som O (General)

*C. medica* Linn.

**Local name:** มะนาวควาย Manaao Khwaai (Yala-Pattani)

*C. medica* Linn. var. *limon* Linn.

*C. medica* Linn. var. *sarcodactylis* Swing.

**Local name:** ส้มมือ Som mue (Central)

*C. microcarpa* Bunge=*C. mitis* Blanco

*C. mitis* Blanco.

**Local name:** ส้มมะปืด Som mapit (Trat)

*C. papeda* Miq. = *C. hystrix* DC.

*C. reticulata* Blanco

**Local name:** ส้มเขี้ยวหวาน Som khieo waan (General)

*C. semperflorens* Lush.

**Local name:** มะนาวเมรี Manaao meree (Bangkok)

*C. sinensis* Osb.

**Local name:** มะเกลือยง Ma Kliang

### *Clausena*

*C. cambodiana* Guill.

**Local name:** สมุยหอม Samui hom (Nakhon Si Thammarat).

*C. excavata* Burm.

**Local name:** หวดหม่อน Huat mon (Central, Northern)

*C. guillauminii* Tanaka.

**Local name:** ส่องฟ้า Song faa (Loei, Si sa ket).

*C. harmandiana* Pierre.

**Local name:** ส่องฟ้าดง Song faa dong (Loei).

*C. lamsium* Skeels.

**Local name:** มะไฟจีน Mafai cheen (Nan)

*C. wallichii* Olive.

**Local name:** Phia faan (Lampang).

*C. wampi* Olive = *C. lamsium* Skeels.

### *Evodia*

*E. glomerata* Craib.

**Local name:** มะม่วงน้อย Ma muang noi (Chiang Mai).

*E. gracilis* Kurz. = *E. leptota* Merr.

*E. leptota* Merr.

**Local name:** เพี้ยกระตึง Phia kra thing (Northern).

*E. meliifolia* Benth.

**Local name:** มักแกก Mak kaek

*E. roxburghiana* Benth.

**Localname:** สามง่าม Saam ngaam (Central, Southeastern)

*F. vitina* Wall.

**Local name:** มะปิ่นดำ Ma peen dam (Lampang)

***Feronia***

*F. elephantum* Corr = *F. limonia* Swing.

*F. limonia* Swing.

**Local name:** มะขวิด Ma khwit (Central)

*F. lucida* Scheff. = *Feroniella lucida* Swing.

***Feroniella***

*F. lucida* Swing.

**Local name:** มะสัง Ma sang (Central, Northeastern)

***Glycosmis***

*G. chlorosperma* Tan.

**Local name:** น้ำข้าวเข่า Nam khaao khao (Nakhon Si Thammarat)

*G. cochinchinensis* Pierre = *G. pentaphylla* Corr.

*G. pentaphylla* Corr.

**Local name:** เขยต่าย Khoel taai

*G. subsessilis* Craib.

**Local name:** คางคาวหนู Khaang khaao nuu (Nakhon Ratchasima).

*G. tomentella* Ridl. = *G. chlorosperma* Tan.

*G. trifolia* Spreng.

**Local name:** ประยงค์ป่า Prayong paa

***Hesperethusa***

*H. cremulata* Roem.

**Local name:** กระเจาะ Kra chae

***Luvunga***

*L. scandens* Ham.

**Local name:** ช้างงาเดียว Chaang ngaa dieo (Chanthaburi)

***Micromelum***

*M. glanduliferum* B. Hansen.

**Local name:** สมัดน้อย Samat noi (Loei).

*M. hirsutum* Olive. = *M. minutum* Wight & Arn.

*M. integerrimum* Roxb.

**Local name:** นมวัว Nom wua (Chiang Mai).

*M. minutum* Wight & Arn.

**Local name:** หัสคุณ Hatsakhun (Saraburi).

*M. pubescens* Bl. = *M. minutum* Wight & Arn.

***Murraya***

*M. koenigii* Spreng.

**Local name:** หอมแขก Hom khack (Bangkok)

*M. paniculata* Jack.

**Local name:** แก้ว Kaeo

*M. siamensis* Craib.

**Local name:** โปรงฟ้า Prong faa (Prachin Buri)

***Paramignya***

*P. rectispinosa* Craib.

**Local name:** นามควาก Naam khwaak (Chiang Mai).

*P. scandens* Craib.

**Local name:** ช้างงาเดียว Chaang ngaa dieo (Chanthaburi)

***Toddalia***

*T. aculeata* Pers.= *T. asiatica* lamk.

*T. asiatica* lamk.

**Local name:** เครื่องงูเห่า Khruua nguu hao (Northeastern)

***Triphasia***

*T. trifolia* P. Wils.

**Local name:** มะนาวเทศ Ma naao thet (Bangkok)

***Zanthoxylum***

*Z. alatum* Roxb.=*Z. armatum* DC.

*Z. armatum* DC.

**Local name:** หมักกาก Mak kaak (Northern).

*Z. budrunga* Wall. ex Hook.f.=*Z. limonella* Alston.

*Z. collinsae* Craib.= *Z. nitidum* DC.

*Z. miltonianum* Engler= *Z. nitidum* DC.

*Z. limonella* Alston.

**Local name:** กำจัดต้น Kamchatton

*Z. nitidum* DC.

**Local name:** กำจัดหน่วย Kamchat nuai (Peninsular)

*Z. rhetsa* DC.=*Z. limonella* Alston.

***Aegle marmelos* Correa.**

A deciduous tree, 20-25” in height and 3-4’ in girth, with straight sharp axillary thorns and trifoliate aromatic leaves. The cultivated tree is less spiny. The bark is shallowly furrowed and corky. The greenish-white fragrant flowers appear from May to July and the fruits ripen by December. The fruit is globose (2-4” in diameter), grey

or yellowish, and with a smooth hard aromatic rind. The fruits of cultivated tree are much larger in size. Seeds are numerous, oblong, compressed and with a mucous testa found embedded in sweet, orange-coloured, thick, mucilagenous pulp.

The unripe or half-ripe fruit is regarded as astringent, digestive and stomachic. It is beneficial in cases of diarrhoea and dysentery. The ripe fruit is sweet, aromatic and cooling. It is generally used in the form of a sherbet or marmalade.

The root bark, and sometimes the stem bark also is administered in intermittent fevers. In Celebes, the bark is used as a fish poison (Burkill, 1935). According to Duxit and Dutt the bark contains umbelliferone and other coumarins, different from marmalasin obtained from the fruits. Their proportion however, varies with the age of the bark and also the locality from which it is obtained. The bark contains also 0.5% of an alkaloid,  $C_{10}H_{11}O_3N$ , m.p.  $142^\circ C$  which was shown by Chakravarty to be identical with fagarine from the leaves of *Zanthoxylum coco* Gill. ex Hook. and Arn.

#### ***Atalantia monophylla* Correa.**

A small tree with smooth brown bark and thorny branches, distributed throughout the mountainous regions of South India, Assam and Ceylon, extending to the Andamans and Burmer.

Anatomically, the wood is characterised by very small vessels, encircled by parenchyma and extensive tracts of short, fine, libriform fibers, containing yellow gummy deposits and starch grains.

The berries yield an oil which is used externally in rheumatism (Council of Scientific and Industrial Research, 1948).



***Citrus aurantifolia* Swingle.**

A much branched thorny shrub or small bushy tree, leaves small with narrowly winged petioles; fruit more or less round, smooth; rind thin, tightly attached, green or tinged with yellow when ripe; pulp yellow-green, acid, aromatic; cells fine and shiny.

Lime is extensively used for culinary purpose. It is used for flavoring jams, jellies, marmalades and alcoholic drinks, as a garnish for fish and meat, and for preparing beverages such as limeade and lime rickey. It is good source of vitamin C. The important commercial products of lime are lime juice, lime oil and calcium citrate. Lime cordial, dried or dehydrated lime peel, lime powder and pickle are other well known products made from lime. Dried lime peel powder and lime sediment obtained when lime juice is clarified are utilized for cleaning metalware. Lime peel is also used as cattle feed (Burkill, 1935).

Lime is an appetizer, stomachic and anthelmintic (Kirt & Basu, 1935). It checks biliousness. Salted lime peel is recommended for indigestion

***Citrus hystrix* DC.**

The chief use of the fruit, among the Malays, is for washing the fruit for washing hair and other parts of the body a proceeding which lead to the use of the word 'pelimau' for a washing-place. The custom of using it extends northwards to the Burmese. There is a variety of the species in the Philippine Islands, var. *microcarpa*, with a small fruit, which is there used in particular for washing the hair (Council of Scientific and Industrial Research, 1950).

In washing the hair, the halved fruit, or the grated rind, is rubbed on the head, or the whole fruit is boiled, for the purpose, with one of the barks which serve as a substitute for soap.

From the use of the juice in washing, it is but a step to its use in ointments.

Among the Malays the peel enters into their universal tonic medicines, apparently its function is the driving away of evil spirits.

The juice is very acid; but is sometimes used as a flavouring in sauces, but only in small quantities, as much of it upsets the digestion. Before the fruit is ripe the juice is gummy, but with ripeness becomes thin and watery, though never abundant.

The peel is sometimes used as a flavouring. It has a characteristic sweet and somewhat biting bitter taste.

The peel, distilled in Java, gave 4 per cent. of oil, containing 40 per cent. of citral; but in a short space of time the distillate became highly resinnified (Gildemeister, 1990).

### ***Citrus maxima* Burm.**

A bushy tree about 15 ft. high; leaves dark green, large with broadly winged petioles; fruits globose, oval or broadly pyriform, 6-8 in. diam., yellow, sometimes crimson, when ripe; rind thick; pulp white or red; cells large and separate from each other.

Pummeloos are distinguished from grapefruits mainly by their larger size, thicker rind, tough and solid pulp; they bear fruits singly. Variety yielding oblate, elongated or round fruits with white or pink flesh, have been propagated vegetatively. Seedless or nearly seedless varieties are also known. Pummeloos grow well both under irrigated and rain-fed conditions in the higher elevations of South India and amidst coffee and tea plantations. The fruits are esteemed for dessert; they are also made into jams and marmalades (Macmillan, 1946).

The fruit is considered to be nutritive and refrigerant. The leaves are useful in epilepsy, chorea and convulsive cough (Kirt. & Basu, 1935).

***Citrus medica* Linn.**

A shrub or small tree about 10 ft. high, with short, thick, straggling, thorny branches; leaves large; petiole short, wingless or narrowly margined; fruit large or obovoid, usually mamillate; rind thick, rough or irregular or warted, yellow when ripe; pulp pale yellow, scanty, mildly acid or sweetish and insipid.

The fruits are used mainly for pickling. The juice is refrigerant and astringent. Preserved rind is used as a remedy for dysentery. Candied peel of citron is a commercial product. The peel and pulp are made into marmalades and other preserves.

***Citrus reticulata* Blanco.**

A bushy, evergreen, glabrous, moderate-sized tree with rather small and slender leaves; petiole short, almost wingless; fruit globose or sub-globose, flattened on the top, with thin, loose rind easily separating from the segments, bright orange or scarlet orange when fully ripe; pulp juicy, sweet to sub-acid.

The pulp is sweet when ripe. It is, however, included under sour orange (*C. aurantium*) which, it resembles in foliage. It is classified by Tanaka as a separate species, *C. maderaspatana*.

Mandarin orange is the most valued commercial orange of India. The fruit is used mainly as dessert and in the production of orange juice. The rind of the fruit yields an oil on expression which is rich in limonene (Council of Scientific and Industrial Research, 1950).

***Clausena anisata* Hook.**

A shrub or small tree, growing from 3 to 6 meters in height. The leaves are 20 to 30 centimeters long, 7 to 11 leaflets which are ovate-lanceolate to lanceolate, and 5 to 11 centimeters long. The panicles are 15 to 20 centimeters long, are terminal, and in the upper axils. The flowers are greenish white, fragrant, 5-parted, and about 8 millimeters in diameter. The fruit is nearly spherical or ovoid, almost 1 centimeter in diameter, and whitish when mature.

The leaves when crushed are aromatic. According to Bacon, the alcoholic extracts have a very strong aniselike odour.

In the Philippines, a decoction of the roots and fruit is prescribed for coughs with fever, and, of the leaves, for nausea during conception. Guerrero states that the leaves, stuffed into pillows and placed under the head, have a soporific effect, and that they are also used in baths for rheumatism (Council of Scientific and Industrial Research, 1950).

***Clausena excavata* Burm. f.**

A shrub with an unpleasant odour occurring in the eastern sub-Himalayan tract, East Bengal and Burma. The plant is diuretic, and is useful in the treatment of digestive troubles (Kirt. & Basu, 1935). An infusion of the root, flowers or leaves, is given in colic. Pounded roots are applied as poultice for sores. The timber, which is white, is suitable for making handles of axes (Burkill, 1909).

***Feronia limonia* Linn.**

A small deciduous tree with short, erect, cylindrical stem, 30-40 ft. high and 2-4 ft. in girth, bearing thorny branches; leaves pinnate, 3-4 in. long, with small ovate or obovate leaflets; flowers polygamous in lax panicles; fruit large, globose or oblate, 1.0-

2.5 inches in diam. with hard, rough, woody pericarp; seeds numerous, small, compressed, embedded in a sweetish aromatic edible pulp.

Two types are recognised, one with small acidic fruits and the other with large sweet ones. The fruits ripen generally from November to March. The pulp of the ripe fruit is eaten as such or with sugar. It can be used for making sherbat in the same way as bael (*Aegle marmelos* Correa). The pulp is used in making chutney (Bhat, 1943).

The fruit is considered tonic, refreshing, cardiacal, astringent (when unripe), antiscorbutic and alexiformic. It is used as a substitute for bael in the treatment of diarrhoea and dysentery. The pulp is used for affections of the gum and throat (Kirt. & Basu, 1935; B.P.C., 1949).

***Glycosmis pentaphylla* Correa.**

An odorous shrub or a small tree found all over India and sometimes grown in gardens for its dark green glossy leaves and white or pinkish berries. Leaves alternate, imparipinnate, usually pentafoliate, sometimes 4-1 foliolate; flowers in axillary panicles, white, small; berries pulpy, glandular, edible.

The plant is used in indigenous medicine for cough, rheumatism, anaemia and jaundice. The juice of the leaves, which is bitter, is used in fever, liver complaints and as vermifuge. A paste of the leaves with ginger is applied in eczema and skin affections. A decoction of the root is given for facial inflammations. The twigs are fibrous and astringent; they are used as tooth brush in parts of Bengal (Council of Scientific and Industrial Research, 1956).

***Hesperethusa crenulata* Roem.**

A small straight-stemmed tree, with pale corky bark and thorny branches, reaching a height of 25-30 ft. and a stem diameter of 6-12 in. The tree is handsome with light green foliage. Leaves imparipinnate: leaflets 2-9, sessile, ovate, crenulate ; flowers small, white, fragrant, borne in axillary racemes; fruit a small globose berry, black when ripe.

The fruit is bitter and occasionally used as a condiment with fish, meat, etc. in India and Arabia. It is used in Java as a substitute for soap. Leaves, fruits and roots are medicinal. The root is yellow, bitter and aromatic and is reported to possess purgative and sudorific properties ; dried is tonic and stomachic, and useful in malignant and pestilent fevers, and as an antidote for poisons ( Haines, 1916; Kirt. & Basu, 1935 ; Dymock, Warden & Hopper, 1890).

***Micromelum minutum* Wight & Arn.**

A shrub or small tree found in Andaman Islands. Leaves imparipinnate, large: leaflets ovate to broad lanceolate : flowers greenish-white, in many-flowered cymes ; fruit a small, ovoid or oblong, yellow berry.

The plants is used medicinally in Malaya and Indonesia, It is recommended for phthisis and chest troubles. The root is chewed with betel for coughs. The boiled roots are applied as a poultice for ague. Leaves give positive tests with alkaloidal reagents.

The wood is light and durable and is used for making house.

***Murraya paniculata* Linn.**

A handsome evergreen shrub or a small tree with spreading crown and short, often crooked. Bark pale yellowish brown, rather corky, fragrant ; leaves imparipinnate : leaflets 3-9, ovate or elliptic-lanceolate or rhomboid, gland-dotted ; flowers in corymbose cymes, white, fragrant; berries oblong or ovoid, red or deep orange when ripe, 1-2 seeded.

The leaves are stimulant and astringent ; they are reported to be used for diarrhoea and dysentery in the Philippines. Powdered leaves are applied to cuts. Leaves and root bark are sometime used against rheumatism, coughs and hysteria. Twigs are used for cleansing teeth. The leaves possess antibiotic activity against *Micrococcus pyogenes* var. *aureus* and *Escherichia coli* (Kirt. & Basu. 1935; Burkill, 1935).

***Paramignya scandens* Craib.**

*P. scandens* Craib. in part, found in Assam and Orissa bears very acid fruits.

Burkill and Haniff recorded that a decoction of the roots of a *Paramignya*, which appears to be *P. scandens*, Craib, is drunk in Perak and Pahang for abdominal complaints, and after childbirth, and that, for syphilis, it is used as a lotion (Council of Scientific and Industrial Research, 1962).

***Toddalia asiatica* Linn.**

A very variable rambling, prickly, sarmentose shrub, In the plains, particularly in dry situations, the plant assumes the form of a low shrub with smaller and narrower leaflets. Roots woody with 2 mm. thick bark, consisting of a soft, yellow, corky external layer, longitudinally wrinkled; leaves digitately trifoliolate; leaflets oblong, elliptic or obovate, glandular; flowers white or greenish yellow, in axillary cymes, polygamous; fruits fleshy, globose, orange-coloured, 7-12 mm. in diam. ; seeds reniform.

The root bark is aromatic and pungent, and is credited with diaphoretic, stomachic and antipyretic properties. It was used medicinally in the past in Europe under the name Lopez Root or Cortex Radicis. It is considered to be a potent antimalarial drug and is said to have shown both antipyretic and antiperiodic effect similar to that of the alkaloids of cinchona. An infusion of the root bark administered in mild cases of malaria was found beneficial, but experiments carried out with the tincture of the root bark did not give any encouraging results. An infusion of the fresh root bark is a stimulating tonic and carminative. The root bark is also used in cases of diarrhoea and constitutional debility during convalescence. In Gabon (Africa), the macerated root bark is used as a remedy against gonorrhoea. The root is also used for the treatment of cough and influenza. It is reported to contain a poisonous resin which produces in guinea pigs abortion in small doses, and paralysis and death in large doses. It indicated the possibility of its usefulness in amenorrhoea. The alcoholic extracts of leaves and roots have been found to possess antibacterial properties. The root bark yields a yellow dye (Council of Scientific and Industrial Research, 1962).

***Triphasia trifolia* (Burm. f.)P. Wils.**

A thorny shrub or small tree, sometimes up to 7 m. high, commonly planted in the gardens for the ornamental fruits. It has run wild in some parts of the peninsular India and has also been recorded from Car Nicobar islands. Leaves trifoliolate; leaflets ovate or elliptic, coriaceous, dark green, thorns straight, very sharp, in pairs; flowers white, fragrant, solitary, axillary; fruits small, ovate, dull red, gland-dotted, 12 mm. in diam., fleshy; seeds 1-3, green.

The ripe fruits are sweetly aromatic and fleshy; they contain spicy, mucilaginous and juicy pulp, possessing agreeable taste and aniseed-like flavour. The green fruits possess a strong flavour of turpentine and the pulp is very sticky. The fruits are eaten, either raw or pickled and are also employed in jellies, marmalades, etc. The ripe fruits are preserved in syrup and are said to be useful against cough. A cordial is made by soaking the ripe fruits in brandy. The rind contains an essential.



fruits are eaten, either raw or pickled and are also employed in jellies, marmalades, etc. The ripe fruits are preserved in syrup and are said to be useful against cough. A cordial is made by soaking the ripe fruits in brandy. The rind contains an essential. The fruits contain semi- $\beta$ -carotenone and  $\beta$ -carotenone, which appear to be responsible for their red colour. The leaves are reported to be employed in diseases of skin and in the preparation of bath salts (Bailey, 1947; Burkill, 1935). The wood is useful for small articles, such as toolhandles. It makes satisfactory charcoal. (Burkill, 1935).

***Zanthoxylum limonella* (Dennst.) Alston.**

A lofty, deciduous tree, up to 35 m. tall, with a spreading crown and a bole of 4-6 m., commonly found in the evergreen monsoon forests of the foothills of Assam and Meghalaya and in the eastern and western ghats in peninsular India. Main stem generally armed with broad conical spines, 2-3 cm. long; branchlets usually sparsely armed with straight or ascending prickles, often swollen and hollow, apparently housing ants; bark cream-coloured or yellowish grey, studded with conical spines, thick, deeply and finely reticulatefissured; leaves paripinnate or imparipinnate, 30-40 cm. long, glabrous, clustered at the ends of branches; leaflets 5-8 pairs, opposite or subopposite, ovate to elliptic, chartaceous, occasionally with scattered pellucid dots, oblique, entire to glandular-crenate; flowers white to yellowish white, in terminal paniculate cymes which may sometimes be located in the upper leaf-axils; follicles globose, aromatic, red, rugose, 6-7 mm. in diam.; seeds blue-black, subglobose, shining

The oil is used as an antiseptic and disinfectant. It showed anti-inflammatory activity against the exudative phase of inflammation in formalin and carragenin induced rats hind-paw oedema. This property has been proved clinically by topical application of the drug in cases of inflammatory dermatosis. The oil also showed local anaesthetic activity by infutration and corneal application in guinea-pigs, its maximum potency being in a concentration of 0.2 percent; it lacked surface anaesthetic activity. The oil

the effect was transient. The drug possesses a wide margin of safety (Council of Scientific and Industrial Research, 1976).

There are still some essential oil containing plants of Rutaceae in Thailand's rain forest which have not been investigated. These include the plant species of *Aegle*, *Clausena*, *Glycosmis*, *Murraya*, *Micromelum*, *Atalantia*, *Toddalia*, *Triphasia*, *Paramignya* and *Zanthoxylum*.

The objective of this study is to screen for new essential oils from rarely studied Thai medicinal plants in the family of Rutaceae which occur in Thai forests and to evaluate the potential of the isolated essential oils for commercial use.