Triphasia trifolia

Scientific Name

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

Synonyms

Limonia diacantha DC., *Limonia trifolia* Burm.f., (basionym), *Limonia trifoliata* L., *Triphasia aurantiola* Lour., *Triphasia trifoliata* DC.

Family

Rutaceae

Common/English Names

Lemon China, Limeberry, Lime Chinese, Lime Orange Berry, Trifoliate Limeberry, Trifoliate Limeberry, Triphasia, Triphasia Limeberry.

Vernacular Names

Chamorro: Lemon China, Lemon De China, Lemoncito, Lemondichina, Limon-China, Limoncito;
French: Orangine;
India: Chini Naranghi (Hindu);
Indonesia: Jeruk Kingkip, Jeruk Kingkit (Java), Kingkip, Kaliyage (Sundanese);
Malaysia: Limau Kiah, Limau kaya, Limau Kikir, Limau Kingkip, Limau Kingkit, Limau Kelinket, Limau Kerinket, Limau Kerisek (Peninsular);
Philippines: Sua-Sua, Limonsitong-Kastila, Suaang-Kastila (Bikol), Kalamansito (Ibanag), Kalamansito (Iloko), Tagimunau (Negrito), Limonsito (Spanish), Limonsito, Kamalitos (Tagalog);
Spanish: Lemon De China, Lemoncito, Lemondichina, Limon-China, Limoncito;
Thailand: Manao Tet.

Origin/Distribution

Its origin is uncertain, it is believed to have come from China or elsewhere in southeast Asia. It is an ancient introduction to Peninsular Malaysia, now naturalised. It was also introduced and naturalised in Thailand and the Philippines and elsewhere in tropical Asia. Now it has been widely introduced and cultivated in other subtropical to tropical countries and has also naturalized on a number of islands in the Pacific.

Agroecology

A tropical species but will grow well also in the subtropics. Commonly found in the lowlands from near sea level to 300 m altitude. A common naturalized shrub of limestone, in the undergrowth,

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sometimes forming dense, spiny thickets or in dry waste places. It is also cultivated as ornamental hedge plants.

Edible Plant Parts and Uses

The ripe, red fruits (Plates 1 and 2) are eaten raw, candied or are made into preserves, jams, marmalade, beverages and pickles.

Botany

An evergreen, erect, glabrous, perennial shrub or small tree, 1–3 (–7) m high with terete twigs bearing paired spines in the axils of the leaves. Leaves are trifoliate, glossy dark green, at the base of each leaf there are two, slender, sharp, and straight spines (Plate 3). Leaflets are ovate to oblong-ovate, the terminal one being 2–4 cm long by 1.2-cm wide, and the lateral ones smaller, margin crenate; petiolules and petioles short (5 mm or less) and wingless. Flowers are axillary, 1–3 in axils on peduncles 3–4 mm long, fragrant, bisexual, trimerous, calyx cupular with 3 ovate triangular small, green, persistent lobes, petals rounded and pellicid near apex, white; stamens 6 with slender filaments and oblong anthers; ovary ovoid or fusiform, 3-locular; locules 1-seeded, style filiform-clavate, with a capitate 3-lobed stigma. The fruit is ovoid or subglobose berry, fleshy, dull reddish-orange or crimson when ripe (Plates 1, 2 and 3), somewhat resinous,1.2–1.5 cm across, flesh mucilaginous, pulpy acid-sweet. Seeds 1–3, flattened, 1–3 mm long embedded in mucilaginous pulpy flesh.

Plate 1 Ripe and unripe fruit

Plate 2 Ripe crimson subglobose fruit

Plate 3 Ovoid fruit, trifoliate leaves with sharp axillary spines

Nutritive/Medicinal Properties

Phytochemicals

Two naturally occurring carotenoid ketones semi-β-carotenone and β-carotenone were isolated from *T. trifolia* (Yokoyama and White 1968); α- and β-carotene, and cryptoxanthin were found in immature fruit of *Triphasia trifolia*, but not in fully ripe fruits being pigmented by semi-α-carotene and semi-β-carotenone, triphasiaxanthin (I)

and β-carotenone (Yokoyama and White 1970). The essential oils obtained from leaves, stems and fruits of *Triphasia trifolia* were characterized by a high amount of sabinene (leaf: 31.1%, stem: 21.1%, fruit: 23.9%) and β-pinene (leaf: 40.8%, stem: 36.2%, fruit: 32.4%) (Zoghbi and Andrade 2009). Sabinene, β-pinene and γ-terpinene also were the major compounds identified in the pentane extract.

The main components of the leaf oil of *T. trifolia* of Mauritius were the monoterpenes terpinen-4-ol (29.0%) and carvacrol (14.2%) (Gurib-Fakin et al. 1995). The major constituents of oil obtained from *Triphasia trifolia* leaves from Cuba were sabinene (35.4%) and myrcene (34.1%) while the prevalent compounds in oil from fruits were sabinene (37.2%), β-pinene (23.95) and γ-terpinene (16.3%) Another study reported the 81 compounds were identified in the oil of *T. trifolia* leaves and the major constituent was germacrene B (16.3%) (Pino et al. 2006). *Triphasia trifolia* also had two other coumarins, heraclenol and isomeranzin (Rastogi et al. 1998), and a bicoumarin derivative from mexoticin and meranzin hydrate which were known constituents of the plant (Dondon et al. 2006).

A high percentage of the chemical composition of the oils was determined (99.9% for leaves and 98.4% for fruit) (Santos et al. 2008). The essential oil of the leaves turned out to be composed mainly of monoterpenes (90.0%), of which sabinene (35.4%) and myrcene (34.1%) were the main components. Other components were identified in significant levels in the leaves include sesquisabine hydrate (6.3%), γ-terpinene (5.7%), limonene (4.5%), terpinen-4-ol (4.1%) and α-pinene (2.5%). Similarly, in the essential oil of fruits monoterpenes dominated, accounting for 92.0% of the oil. The major constituents were sabinene (37.2%), β-pinene (23.9%) and γ-terpinene (16.3%), followed by limonene (5.3%), α-pinene (3%), terpinen-4-ol (3.3%). In both oils, a small fraction of sesquiterpenes, representing 6.0–8.2% was identified. Except for the presence of sesquisabine hydrate, which contributed 6.3% of the oil from the leaves and 2.8% of the oil of the fruit, no other sesquiterpene was identified in high amount. The presence of low levels of aliphatic aldehydes n-dodecanal (1.7%) and n-decanal (1.6%) were detected in the leaf oil but not in the fruit oil.

The fruit decoction also yielded the coumarins isopimpinelin, (R)-byakangelicin and (S)-mexoticin. From leaves were isolated the coumarins (R)-byakangelicin, aurapten, (S)-mexoticin, isosibiricin, isomerazin and coumurrayin and the flavonoid vitexin (Santos et al. 2008).

Antimicrobial Activity

Both *Triphasia trifolia* fruit and leaf oils showed moderate antimicrobial activity (Santos et al. 2008). The fruit oil was active against only two types of bacteria, *Bacillus subtilis* and *Chromobacterium violaceum.* In contrast, the leaf oil was moderately effective against all strains tested (*Bacillus subtilis* and *Chromobacterium violaceum, Enterobacter aerogenesis, Klebsiiella pneumoniae, Pseudomonas aeruginosa, Salmonella choleraeasuis, Staphylococcus aureus).*

Cholinesterase Inhibitory Activity

The fruit decoction yielded the coumarins isopimpinelin, (R)-byakangelicin and (S)-mexoticin. From leaves were isolated the coumarins (R)-byakangelicin, aurapten, (S)-mexoticin, isosibiricin, isomerazin and coumurrayin and the flavonoid vitexin (Santos et al. 2008). All coumarins showed cholinesterase inhibition on TLC tests of the courmarins, Aurapten was the most active followed by isopimpinelin, (R)-byakangelicin, isomerazin, mexoticin and isosibiricin while coumurrayin was less active. The data suggested the plant and it coumarins to be promising anticholinesterase candidates for the development of natural drugs with potential to treat Alzheimer's disease.

Antiviral Activity

A total of 25 phenolic compounds were studied for their inhibitory effects against herpes

simplex virus (HSV)-1, HSV-2, and human immunodeficiency virus (HIV)-1 (Likhitwitayawuid et al. 2005). These include five flavonoids (1–5) and two dimeric stilbenes (6,7) from *Artocarpus gomezianus*, five phloroglucinol derivatives (8–12) from *Mallotus pallidus* and 13 courmarins (13–25) from *Triphasia trifolia*. The results suggested the bis-hydroxyphenyl structure as a potential target for anti-HSV and HIV drugs development.

Traditional Medicinal Uses

The plant has been used in local traditional medicine. In the Philippines, aromatic bath salts are made from the leaves of this plant. A medicine for diseases of the chest is made from the sweetened fruit. In Indonesia, the leaves are utilised for various complaints, such as diarrhoea, colic, and skin diseases. They also use them in cosmetics.

Other Uses

It makes a good bonsai and good hedge plant and is cultivated for its ornamental features – small, red fruit, deep glossy green leaves and fragrant white flowers. The plant is used as rootstock for *Citrus* species. Wood is useful for small objects such as tool-handles; also provides satisfactory charcoal. Young fruits produce a good glue.

Comments

The species is deemed a weed in other introduced locations.

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