Chaenomeles speciosa

Scientific Name

***Chaenomeles speciosa* (Sweet) Nakai**

Synonyms

Chaenomeles lagenaria (Loiseleur-Deslongchamps) Koidzumi, *Cydonia japonica* (Thunberg) Persoon var. *lagenaria* (Loiseleur-Deslongchamps) Makino, *Cydonia lagenaria* Loiseleur-Deslongchamps ex Duhamel, *Cydonia speciosa* Sweet (basionym).

Family

Rosaceaae

Common/English Names

Chinese Flowering Quince, Chinese-Quince, Flowering-Quince, Ornamental Quince Japanese Quince.

Vernacular Names

Chinese: Zhou Pi Mu Gua, Tie Geng Hai Tang;
Czech: Kdoulovec Japonský, Kdoulovec Lahvicovitý, Kdoulovec Žlutoplodý;
Danish: Stor Japankvæde;
Eastonian: Sile Ebaküdoonia;
French: Cognassier Ornemental De Chine;
German: Chinesische Zierquitte;
Hungarian: Japánbirs;
Iceland: Stóri Eldrunni;
Japanese: Boke;
Korean: San-Dang-Hwa;
Polish: Pigwowiec Chinski;
Slovencina: Dulovec Nádherný;
Spanish: Membrillero Del Japón;
Swedish: Storrosenkvitten;
Tibetan: Bse-Yab.

Origin/Distribution

The species is native to Eastern Asia – China and Korea.

Agroecology

A cool temperate species. It thrives in full sun or partial sun on fertile, well-drained soil with a broad pH range of 5.6–7.8.

Edible Plant Parts and Uses

The fruit is very hard and astringent and very unpleasant to eat raw, and are eaten cooked. They are suitable for making liqueurs, jams, jellies, marmalade and preserves, as they contain abundant pectin.

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Botany

Deciduous shrubs, to 2–3 m tall, with Light brown, smooth bark and thorns and arching, dense, tangled crown. Branchlets slender purplish brown or blackish brown, terete, glabrous, Stipules reniform or suborbicular, rarely ovate, large, 5–10 mm, herbaceous, dark green, glabrous, sharply doubly serrate at margin, apex acute; petiole ca. 1 cm, initially sparsely pubescent, glabrescent; Leaves alternate, ovate to elliptic, rarely narrowly elliptic, 3–9 × 1.5–5 cm, glabrous or pubescent abaxially along veins on leaves of shoots, base cuneate to broadly cuneate, margin shortly serrate, apex acute or obtuse (Plate 1). Pedicel absent or short, ca. 3 mm, subglabrous. Flowers precocious, 3–5-fascicled on second year branchlets, 3–5 cm in diameter. Hypanthium campanulate, glabrous. Sepals erect, suborbicular, rarely ovate, 3–4 mm, abaxially glabrous, adaxially pubescent and caducous. Petals scarlet, rarely pinkish or white, ovate or suborbicular, base shortly clawed, apex rounded. Stamens 40–50. Styles 5, as long as stamens, connate at base, glabrous or slightly pubescent. Pome fragrant, green with purplish blush (Plate 1) turning to yellow when ripe, globose or ovoid, 4–6 cm in diameter.

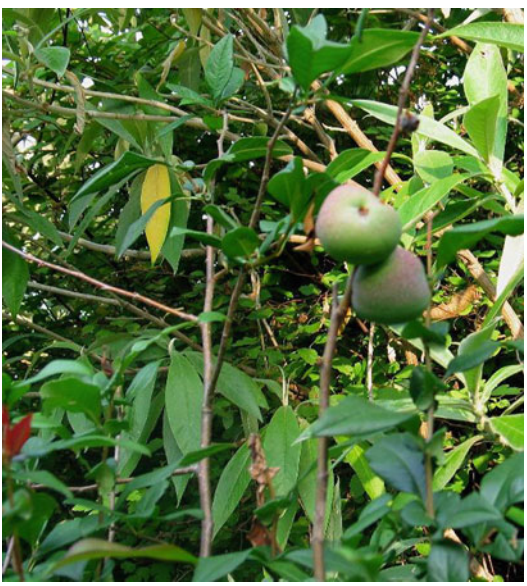

Plate 1 Leaves and fruit

Nutritive/Medicinal Properties

Average fruit weight of *Chaenomeles* fruit was 27–211 g and the juice yield was 42–50% based on fresh weight of fruits (Hellin et al. 2003). The juice was very acidic, with a pH of 2.5–2.8, and the titratable acidity was at most 4.2% calculated as anhydrous citric acid. The following nutrient composition was reported on *Chaenomeles* fruit juice per 100 ml: vitamin C 45–109 mg, phenols 210–592 mg, malic acid 5.1 g and also quinic acid and succinic acid; ten amino acids were detected – phosphoserine, aspartic acid, threonine, serine, asparagine, glutamic acid, alanine, phenyalanine, γ- aminobutyric acid and lysine. The most abundant amino acid was glutamic acid (up to 14 mg/100 ml), followed by phosphoserine and aspartic acid (6 mg/100 ml). Sodium, ammonium, potassium, magnesium and calcium were detected, with potassium present in the highest amount (up to 241 mg/100 ml), fluoride (up to 139 mg/100 ml) and chloride (9 mg/100 ml) were also found. Nine carbohydrates were detected: stachyose, raffinose, sucrose, glucose, xylose, rhamnose, fructose, inositol and sorbitol. Of the carbohydrates, fructose (up to 2.3 g/100 ml), glucose (up to 1.1 g/100 ml) and sorbitol (up to 0.5 g/100 ml) were present in the highest amounts.

The fruit was found to contain more vitamin C than lemons (up to 150 mg/100 g) and to be rich in pectin. Fragrances and associated volatile levels from peel and flesh of *Chaenomeles speciosa* fruit in green ripened stage and full ripen stage were quite different (Zheng et al. 2010). The content of ethyl butyrate (12–15%) was highest in the peel of green or ripe fruit. Butyric acid, 2-methyl-, ethyl ester and ethyl caproate were also high. Linalool was detected in the peel and flesh. Terpenes were low in all samples but edulans especially edulan 1 was high.

Seven compounds were isolated from the fruit and identified as oleanolic acid, betulinic acid, 3-O-acetyl pomolic acid, ethyl chlorogenate, protocatechuic acid, gallic acid, and kojic acid (Yin et al. 2006). Thirteen compounds identified as 3,4-dihydroxybenzoic acid, quercetin, methyl 3-hydroxybutanedioic ester, oleanolic acid, masilinic acid, 3-O-acetyl ursolic acid, speciosaperoxide, ursolic acid, tormentic acid, 3β-acetoxyurs-11-en-13β, 28-olide, roseoside, vomifoliol and (6S,7E,9R)-6,9-dihydroxy-4,7-megastigmadien-3-one 9-O-[β-D-xylopyranosyl (1→6)-glucopyranoside] were isolated from *C. speciosa* fruit (Zhang et al. 2010). Protocatechuic acid (Li et al. 2010), olenolic acid and urolic acid (Li and He 2005) were isolated from the fruits.

Forty compounds, constituting about 85.13% of the total oil, were identified from essential oil of *C. speciosa* fruit (Xie et al. 2007). The main constituents were β-caryophyllene (12.52%), α-terpineol (5.41%), terpinen-4-ol (4.56%) and 1,8-cineole (4.31%). The fruit also contained terpenoid compounds such as speciosaperoxide; 3β-acetoxyurs-11-en-13β,28-olide; 3-O-acetyl ursolic acid; oleanolic acid; ursolic acid; masilinic acid and tormentic acid, and three known norsesquiterpenoids, roseoside, vomifoliol and (6S, 7E,9R)-6,9-dihydroxy-4,7-megastigmadien-3-one 9-O-[β-d-xylopyranosyl (1→6)-glucopyranoside] (Song et al. 2008). None of these compounds exhibited inhibitory activity against T-and B-lymphocyte proliferation.

Seven compounds obtained from the ethyl acetate fraction of *C. speciosa* were identified as cinnamic acid, 2′-methoxyaucuparin, 2-hydroxylbutanedioic acid-4-methylester, esculetin, p-hydroxybenzoic acid, chlorogenic acid, caffeic acid (Yang et al. 2009). Three triterpenoid compounds were separated from *C. lagenaria* fruit and identified as 3-O-acetyl ursolic acid, 3-O-acetyl pomolic acid and betulinic acid (Guo et al. 1998).

Some of the reported pharmacological properties of the plant are:

Antioxidant Activity

Four compounds were isolated from ethyl acetate extract of the dried fruits of *Chaenomeles speciosa* and identified as hydroquinone (1), 3,4-dihydroxybenzoic acid (2), quercetin (3), and methyl 3-hydroxylbutanedioic ester (4) (Song et al. 2007). Compounds(1–3) exhibited antioxidant effects in 2,2′-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay.

Chaenomeles speciosa powder (CSP) was found to be rich in rich in vitamin C and polyphenols (Tang et al. 2010). The ferric reducing antioxidant power of CSP was 173 μmol Fe^{2+}/g and the scavenging activity on 1,1-diphenyl-2-picrylhydrazyl free radical (DPPH•) and O^{2-} were 945 μg DPPH•/g and 700 U/ml, respectively. Both 5 and 10% CSP dietary supplement significantly reduced serum low-density lipoprotein cholesterol and total cholesterol levels in ApoE−/− mice which was fed a high-fat diet for 16 weeks. Comparing with normal group, there was a significant increase of glutathione peroxidase activity and total antioxidative capacity, and a reduction of relative atherosclerotic plaque area of aortic sinus and aortic arch in ApoE−/− mice supplemented with 5% and 10% CSP. The results suggested that CSP had potent antioxidative ability and potential antiatherosclerotic effects.

Antidiarrheal Activity

Chaenomeles speciosa fruit extract was found to inhibit the heat labile enterotoxin (LT)-induced diarrhea in mice by blocking the binding of the B subunit of LT (LTB) to ganglioside GM1 (Chen et al. 2007a). The ethyl acetate (EA) soluble fraction was the most active fraction that significantly abolished the LTB and GM1 interaction. Further, the oleanolic acid, ursolic acid, and betulinic acid from the EA fraction, blocked the toxin binding effects, resulting in the suppression of LT-induced diarrhoea. The findings suggested that oleanolic acid, ursolic acid, and betulinic acid were the active constituents from the fruit and might be considered as lead therapeutic agents in the treatment of enterotoxin-induced diarrhea.

Antiinflammatory/Antiarthritic Activity

Glucosides of *Chaenomeles speciosa* (GCS) was found to exhibit antiinflammatory and immune responses in collagen-induced arthritis (CIA) rats

(Chen and Wei 2003). The administration of GCS inhibited the inflammatory response and restored body weight and the weight of immune organs of CIA rats. The antiinflammatory and immunoregulatory actions and therapeutic effect on CIA rats were found to be due to G protein-AC-cAMP transmembrane signal transduction of synoviocytes, which played a crucial role in pathogenesis of arthritis. GCS was found to have therapeutic effect on adjuvant arthritis in rats, which may be related to modulation function of thymocyte T cells and inhibiting the productions of proinflammatory cytokines secreted by peritoneal macrophages (Dai et al. 2003a, b). Treatment with GCS (60, 120 mg/kg) and Actarit (60 mg/kg) for 5 days significantly diminished the secondary hind paw swelling, as well as relieved the pain response and the polyarthritic symptoms of the whole body as compared with untreated adjuvant arthritis group. Both treatments restored the diminished thymocytes proliferation ConA induced in adjuvant arthritis rats. GCS reduced the enhanced productions of interleukin1, TNF α and PGE 2 from peritoneal macrophages in adjuvant arthritis rats. Glucosides of *Chaenomeles speciosa* were found to have antinociceptive effects, which related to its inhibitory effects on peripheral inflammatory mediators (Wang et al. 2005). The glucosides at different doses inhibited mice's writhing response and second phase of formalin response. They also suppressed the increased arthritic flexion scores in adjuvant arthritis rats. On 28 days after inflammation induction, the glucosides (60, 120 mg/kg) decreased the concentration of prostaglandin E and tumour necrosis factor-α of synovial cells in the adjuvant arthritis rats. Further studies found that GCS down-regulated the levels of serum antibodies in rats with adjuvant arthritis, which may be related to its efficacy in the treatment of rats with adjuvant arthritis (Chen et al. 2007b).

The 10% ethanol fraction (C3) of *C. speciosa* was found to have stronger antiinflammatory effects compared with other fractions at the same dose using carrageenan-induced paw edema in rats (Li et al. 2009). Chlorogenic acid was found to be one of the active constituents responsible for the antiinflammatory effect. Compared with controls, fraction C3 demonstrated significant antiinflammatory activity in the xylene-induced ear edema test, acetic acid-induced peritoneal capillary permeability test, and the cotton pellet granuloma test in mice or rats; it also showed marked analgesic activity in the acetic acid-induced abdominal contraction test and formalin-induced paw licking test in mice and rats. However, fraction C3 showed no significant effect in the hot plate test in mice. The findings supported the use of the *C. speciosa* for treating pain and inflammation.

Three compounds from *C. speciosa* fruit exhibited antioxidant, antiinflammatory and antiviral activities (Zhang et al. 2010). 3,4-dihydroxybenzoic acid (1) displayed high inhibitory activities on DPPH and neuramindase with IC_{50} values of 1.02 μg/ml and 1.27 μg/ml respectively, and quercetin (2) also showed significant inhibitory action on DPPH and NA with IC_{50} values of 3.82 μg/mlL and 1.90 μg/ml. Compounds 1, 2 and methyl 3-hydroxybutanedioic ester inhibited the production of TNF-α by 22.73%, 33.14% and 37.19% at 5 μg/ml compared with the control. Quercetin was found to be active on the release of IL-6 in RAW264.7 macrophage cells, with an inhibitory rate of 39.79%. The compounds may have a cocktail-like role in the treatment of avian influenza, and *C. speciosa* components, especially quercetin, might be a potent source for antiviral and antiinflammatory agents.

Human β2-Adrenoceptor Activity

Chaenomeles speciosa was one of six herbal extracts studied that were suggested to be potential agonists of human β2-adrenoceptor (Wang et al. 2009). The active fraction from the ethanol extract showed significant effects on active reporter gene expression with an EC_{50} of 4.8 μg/ml. Human β2-adrenoceptors are involved in many physiological activities in the human body such as smooth muscle relaxation, lipolysis in adipose tissue, histamine-release inhibition from mast cells, increase renin secretion from kidney, insulin release from pancreatic β cells, etc.

Immunomodulatory Activity

Chaenomeles speciosa glycosides (GCS) (240 mg/kg) decreased the thymus index and spleen index in contact hypersensitive (CHS) mice (Zheng et al. 2004). GCS (60,120,240 mg/kg) and also inhibited the ear swelling of CHS mice and splenocyte proliferation induced by Concanavalin A. GCS (240 mg/kg) decreased CD4+ CD8+ T lymphocytes subsets ratio and restored the CD4+CD8 -subsets ratio in CHS mice. GCS also decreased the TGF-β 1 and IL-2 levels but increased the IL-4 levels in mice thymus with CHS. The findings showed that GCS could suppress mice contact hypersensitive reaction and restore the balance of T lymphocytes subsets in mice thymus with CHS, and also could modulate the cytokines production by CD4+T lymphocytes of CHS mice. *Chaenomeles speciosa* broth exhibited protective effects on the immunosuppressive mouse model induced by cyclophosphamide (Shi et al. 2009). Administration of the broth increased serum hemolysin and lymphocyte transformation rate and downregulated mRNA expression of foxp3, TGF-β, PD1, Fas, Bax compared with the cyclophosphamide mice.

Antiparkinsonian Activity

Chaenomeles fruit (FQ) was found to be a selective, potent dopamine transporter (DAT) inhibitor and had antiparkinsonian-like effects that were mediated possibly by DAT suppression (Zhao et al. 2008). FQ at concentrations of 1–1,000 μg/ml concentration-dependently inhibited dopamine uptake by Chinese hamster ovary (CHO) cells and by synaptosomes. FQ had a slight inhibitory action on norepinephrine uptake by CHO cells and no inhibitory effect on γ-aminobutyric acid (GABA) uptake by CHO cells or serotonin uptake. FQ mitigated 1-methyl-4-phenylpyridinium-induced toxicity in D8 cells. In behavioral studies, FQ alleviated rotational behavior in 6-hydroxydopamine-treated rats and improved deficits in endurance performance in 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-treated mice. Immunohistochemistry revealed that FQ markedly reduced the loss of tyrosine hydroxylase-positive neurons in the substantia nigra in MPTP-treated mice.

Antimicrobial Activity

The essential oil *C. speciosa* fruit was reported to show a broad spectrum of antimicrobial activity against all the tested bacterial strains (Xie et al. 2007). The essential oil had higher sensitivity to Gram-positive than Gram-negative bacteria.

Teratogenic Study

Studies showed that glycosides of *Chaenomeles speciosa* (GCS) exerted no teratogenic effect on pregnant mice embryos (Lu et al. 2008).

Traditional Medicinal Uses

Chaenomeles speciosa has been cultivated widely in Chongqing for hundreds of years and is also a traditional herb for the Chinese because of its many health preventive potentials (Tang et al. 2010). The fruit is reported to be analgesic, antiinflammatory, antispasmodic, astringent and digestive in traditional medicine. A decoction is used internally in the treatment of nausea, arthritis, leg oedema, cholera and associated cramps. Fruit-containing cocktails have been applied to the treatment of neuralgia, migraine, and depression in traditional Chinese medicine (Zhao et al. 2008). The fruit is a traditional Chinese medicine used for the treatment of dyspepsia rheumatoid arthritis, prosopalgia, and hepatitis and various inflammatory diseases (Zhang et al. 2010).

Other Uses

The species is a popular ornamental hedge and a ground cover plant.

Comments

The plant is readily propagated from cuttings.

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