

---

## *Pelargonium crispum*

---

### Scientific Name

*Pelargonium crispum* (L.) L'Hér.

**German:** Orangenpelargonie, Zitronengeranie, Zitronenpelargonie

**Italian:** Geranio Crispum

---

### Synonyms

*Anisopetala crisa* (P.J. Bergius) Walp.,  
*Geranospermum crispum* (P.J. Bergius),  
*Geranium crispum* P.J. Bergius

---

### Origin/Distribution

Lemon Geranium is a native of South Africa. It occurs from Worcester to Bredasdorp in south Western Cape.

---

### Family

Geraniaceae

---

### Agroecology

In its native habitat, it occurs on rocky lower mountain or hill slopes, growing in the shelter of boulders in fairly dry sandy soils. Lemon Geranium prefers well-drained, light-textured neutral to alkaline soil in a sunny position, although it is tolerant of partial shade. It tolerates low temperatures down to about  $-3^{\circ}\text{C}$ .

---

### Common/English Names

Crisped Leaf Pelargonium, Curled Leaved Cranesbill, Finger Bowl Geranium, Lemon Geranium, Lemon-Scented Geranium, Lemon-Scented Leaved Geranium, Variegated Lemon-Scented Pelargonium

---

### Edible Plant Parts and Uses

The leaves have a pleasant lemon aroma and are used to flavour soups, fruit dishes, jellies, sorbets, ice cream, cakes, etc. (Facciola 1990; Bown 1995). Cake pans can be lined with the leaves and the pastry will be infused with their essence. An infusion of the leaves is used as a tea (Bown 1995). The scented geranium flowers

---

### Vernacular Names

**Afrikaans:** Dassiepoeier

**Czech:** Muskát Stojaty

**Danish:** Citrongeranie, Geranie

**Estonian:** Kähär Pelagoon

are also edible. They are used in salads, desserts, drinks and jellies (Barash 1997; Roberts 2000; Deane 2007–2012).

## Botany

An erect, small, much-branched shrub growing 100 cm high with an extensive spreading superficial root system. Stems soft, green, pubescent becoming darker and woody with age. Leaves opposite, lemon scented, fan shaped in outline with palmatifid lamina, hirsute with glandular and non-glandular hairs, soft, green with cordate base, lobes obtuse to acute apexes with crisped, serrated to irregularly dentate margins (Plates 1 and 2). Flowers borne in terminal, 2–4 flowered pseudo-umbel inflorescences. Flowers are zygomorphic, pentamerous and rose-violet; receptacle forming a hypanthium which houses a nectariferous gland in a nectariferous spur opening at base of the posterior sepal; sepals lanceolate, imbricate, unequal, connate at base, green-brown; petals free, spatulate, 2 posterior larger than the 3 anterior ones; stamens 10, connate at base, staminodial; ovary superior, 5-lobed, style filiform, stigma with 5 recurved, red or pink thin branches (Plates 1 and 2).

## Nutritive/Medicinal Properties

*Pelargonium* species including *P. crispum* had been reported to accumulate tartaric acid (Stafford 1961). Studies by Wagner and Loewus (1973) found that in *P. crispum* cv. Prince Albert (Lemon Geranium), L-galactono-1,4-lactone was readily converted to L-ascorbic acid which was found to be a precursor of tartaric acid and oxalic acid. D-glucose-6-<sup>14</sup>C was found to be a better source of label to tartaric acid than D-glucose-1-<sup>16</sup>C in *Pelargonium crispum*. In Lemon Geranium apices, L-[4-(14)C]ascorbic acid yielded internal labelled (+)-tartaric acid, while L-[6-(14)C]ascorbic acid gave an equivalent conversion to carboxyl labelled (+)-tartaric acid (Williams and Loewus 1978). Conversion of d-[5-(3)H,6-(14)C]glucose to



**Plate 1** Pink flowers and palmatifid leaves of red-styled cultivar



**Plate 2** Pink flowers and palmatifid leaves of pink-style cultivar

L-ascorbic acid in detached apices of *Pelargonium crispum* (L.) L'Hér cv. Prince Rupert (Lemon Geranium) was accompanied by complete loss of tritium in the product (Grün et al. 1982). Chemical degradation of D-glucose which was recovered from the labelled apices yielded D-glyceric acid. Sucrose and fructose were also identified in the apices. Metabolic product derived from cleavage

of ascorbic acid from carbons 2 and 3 yielded the 2-carbon compound, oxalic acid. L-threonic acid and L-tartaric acid were the C<sub>4</sub> products of ascorbic acid cleavage at the carbon 2/carbon 3 bond. L-threonic acid is a natural constituent in the leaves of *Pelargonium crispum* (Helsper and Loewus 1982). They demonstrated that detached leaves of *P. crispum* oxidized l-[U-(14)C]threonate to l-[(14)C]tartrate. A small quantity of [(14)C]glycerate was also produced which suggested a process involving decarboxylation of l-[U-(14)C]threonate. Tannins, namely, proanthocyanidins and ellagitannins (in 53 % of taxa) and free ellagic acid (in 50 %), were major components of the leaves of *Pelargonium* species including *P. crispum*. Myricetin (in 38 %), flavone C-glycosides (in 36 %) and luteolin (in 49 % of taxa) were other regular constituents. Myricetin was also found in *P. crispum*.

Chrysin (5,7-dihydroxyflavone) and a related C-methylflavanone were identified as major leaf surface constituents of *P. crispum* (Williams et al. 1997). Many in vitro studies reported that chrysin possessed potent anti-inflammatory, anticancer and antioxidative properties (Woo et al. 2005).

### Antioxidant Activity

In-vitro studies showed that significant cell protection was observed upon preincubation of pancreatic beta cells with chrysin, quercetin, catechin or caffeic acid (50 µM, each) prior to application of oxidative stress (Lapidot et al. 2002).

### Anticancer Activity

Of the flavones tested, chrysin and apigenin markedly augmented the cytotoxicity of tumour necrosis factor-α (TNF) in L-929 tumour cells, while luteolin showed a weak protective effect (Habtemariam 1997). Studies showed that chrysin induced apoptosis U937 human leukemic promonocytic cells in association with the activation of caspase-3 and Akt signal pathway (Woo et al. 2004). The results suggested that Akt pathway played a major role in regulating the apoptotic

response of human leukaemia cells to chrysin and raise the possibility that combined interruption of chrysin and PI3K/Akt-related pathways may represent a novel therapeutic strategy in haematological malignancies. Pretreatment with chrysin greatly sensitized various human cancer cells to tumour necrosis factor-α (TNF-α)-induced apoptosis (Li et al. 2010). Pretreatment with chrysin inhibited TNF-α-induced degradation of inhibitor of kappaB (IκB) protein and subsequent nuclear translocation of p65. As a result, chrysin suppressed the expression of NF-κB-targeted anti-apoptotic gene; c-FLIP-L pretreatment with chrysin greatly sensitized various human cancer cells to tumour necrosis factor-α (TNF-α)-induced apoptosis (Li et al. 2010).

### Antiviral Activity

Chrysin inhibited HIV expression in TNF-α-treated OM-10.1 cultures (Critchfield et al. 1996). Chrysin also inhibited HIV expression in response to PMA in OM-10.1 cells, in ACH-2 cells stimulated with either TNF-α or PMA and in 8E5 cultures.

### Anti-inflammatory Activity

Chrysin demonstrated concentration-dependent inhibitory or modulatory effects in a fibroblast cell culture model but was less potent than apigenin (Koganov et al. 1999). Of the compounds tested, apigenin, chrysin and kaempferol significantly stimulated peroxisome proliferator-activated receptor (PPAR)γ transcriptional activity in a transient reporter assay (Liang et al. 2001). PPARγ transcription factor had been implicated in anti-inflammatory response. Moreover, these three flavonoids strongly enhanced the inhibition of inducible cyclooxygenase and inducible nitric oxide synthase promoter activities in lipopolysaccharide-activated macrophages which contain the PPAR-γ expression plasmids. Studies by Cho et al. (2004) found that nitrate production triggered by lipopolysaccharide (LPS) was suppressed by treatment of cultured Raw264.7

cells (mice macrophage/monocyte) with chrysin and its derivatives, 5-hydroxy-7-methoxyflavone (Ch-2) and 5,7-diacetylflavone (Ch-4). Further, COX-2 enzyme was strongly inhibited by Ch-4 ( $IC_{50}=2.7 \mu M$ ) but not by other derivatives. Woo et al. (2005) found that chrysin significantly suppressed the LPS-induced COX-2 protein and mRNA expression in a dose-dependent manner in Raw 264.7. These effects were mediated, at least in part, by inhibition of NF-IL6 activation.

## Antimicrobial Activity

Steam-distilled essential oil and petroleum spirit and methanol extracts of scented *Pelargonium* leaves including *P. crispum* (cvs. Crispum variegatum and Lemon fancy) exhibited antibacterial activity in vitro against *Staphylococcus aureus*, *Proteus vulgaris*, *Bacillus cereus* and *Staphylococcus epidermidis* (Lis-Balchin et al. 1998). The most potent antibacterial activity for all components was shown by citral, citronellal, citronellic acid, geraniol, linalool and  $\alpha$ -pinene. Major components for the two *P. crispum* cultivars were neral, geranial and sesquiterpenes.

## Traditional Medicinal Uses

All parts of the plant are astringent (Grieve 1971).

## Other Uses

An essential oil is obtained from the leaves and young shoots are used in perfumery and soap making (Usher 1974). The leaves are dried for potpourri and for making herb pillows (Bown 1995).

## Comments

*Pelargonium crispum* can be readily grown from cuttings.

## Selected References

- Barash CW (1997) Edible flowers from garden to palate. Fulcrum Publishing, Golden
- Bown D (1995) Encyclopaedia of herbs and their uses. Dorling Kindersley, London, 424 pp
- Cho H, Yun CW, Park WK, Kong JY, Kim KS, Park Y, Lee S, Kim BK (2004) Modulation of the activity of pro-inflammatory enzymes, COX-2 and iNOS, by chrysin derivatives. *Pharmacol Res* 49:37–43
- Critchfield JW, Butera ST, Folks TM (1996) Inhibition of HIV activation in latently infected cells by flavonoid compounds. *AIDS Res Hum Retrovir* 12:39–46
- Dasuki UA (2002) *Pelargonium* Rosat Group. Record from Protabase. In: Oyen LPA, Lemmens RHMJ (eds) PROTA (Plant Resources of Tropical Africa/Ressources végétales de l'Afrique tropicale), Wageningen
- Deane G (2007–2012) Edible flowers: Part Ten. <http://www.eattheweeds.com/edible-flowers-part-ten/>
- Facciola S (1990) Cornucopia. A source book of edible plants. Kampong Publications, Vista, 677 pp
- Grieve M (1971) A modern herbal. Penguin. 2 vols. Dover Publications, New York, 919 pp
- Grün M, Renstrøm B, Loewus FA (1982) Loss of hydrogen from carbon 5 of d-glucose during conversion of d-[5-h,6-c]glucose to l-ascorbic acid in *Pelargonium crispum* (L.) L'Hér. *Plant Physiol* 70(5):1233–1235
- Habtemariam S (1997) Flavonoids as inhibitors or enhancers of the cytotoxicity of tumor necrosis factor-alpha in L-929 tumor cells. *J Nat Prod* 60:775–778
- Helsper JP, Loewus FA (1982) Metabolism of L-threonic acid in *Rumex x acutus* L. and *Pelargonium crispum* (L.) L'Hér. *Plant Physiol* 69(6):1365–1368
- Koganov MM, Dueva OV, Tsorin BL (1999) Activities of plant-derived phenols in a fibroblast cell culture model. *J Nat Prod* 62:481–483
- Lapidot T, Walker MD, Kanner J (2002) Antioxidant and prooxidant effects of phenolics on pancreatic beta-cells in vitro. *J Agric Food Chem* 50:7220–7225
- Li X, Huang Q, Ong CN, Yang XF, Shen HM (2010) Chrysin sensitizes tumor necrosis factor- $\alpha$ -induced apoptosis in human tumor cells via suppression of nuclear factor-kappaB. *Cancer Lett* 293(1):109–116
- Liang YC, Tsai SH, Tsai DC, Lin-Shiau SY, Lin JK (2001) Suppression of inducible cyclooxygenase and nitric oxide synthase through activation of peroxisome proliferator-activated receptor-gamma by flavonoids in mouse macrophages. *FEBS Lett* 496(1):12–18
- Lis-Balchin M, Buchbauer G, Ribisch K, Wenger MT (1998) Comparative antibacterial effects of novel *Pelargonium* essential oils and solvent extracts. *Lett Appl Microbiol* 27(3):135–141

- Roberts MJ (2000) Edible & medicinal flowers. New Africa Publishers, Claremont, 160 pp
- Stafford HA (1961) Distribution of tartaric acid in the Geraniaceae. *Am J Bot* 48:699–701
- Usher G (1974) A dictionary of plants used by man. Constable, London, 619 pp
- Van der Walt JAA (1985) A taxonomic revision of the type section of *Pelargonium* L'Hérit. (Geraniaceae). *Bothalia* 15:345–385
- Van der Walt JJA, Vorster PJ (1988) *Pelargoniums* of southern Africa, vol 3. Kirstenbosch National Botanical Gardens, Cape Town
- Wagner G, Loewus F (1973) The biosynthesis of (+)-tartaric acid in *Pelargonium crispum*. *Plant Physiol* 52(6):651–654
- Williams M, Loewus FA (1978) Biosynthesis of (+)-tartaric acid from l-[4-C]ascorbic acid in grape and geranium. *Plant Physiol* 61(4):672–674
- Williams CA, Harborne JB, Newman M, Greenham J, Eagles J (1997) Chrysin and other leaf exudate flavonoids in the genus *Pelargonium*. *Phytochemistry* 46(8):1349–1353
- Williams CA, Newman M, Gibby M (2000) The application of leaf phenolic evidence for systematic studies within the genus *Pelargonium* (Geraniaceae). *Biochem Syst Ecol* 28(2):119–132
- Woo KJ, Jeong YJ, Park JW, Kwon TK (2004) Chrysin-induced apoptosis is mediated through caspase activation and Akt inactivation in U937 leukemia cells. *Biochem Biophys Res Commun* 325(4):1215–1222
- Woo KJ, Jeong YJ, Inoue H, Park JW, Kwon TK (2005) Chrysin suppresses lipopolysaccharide-induced cyclooxygenase-2 expression through the inhibition of nuclear factor for IL-6 (NF-IL6) DNA-binding activity. *FEBS Lett* 579(3):705–711

Edible Medicinal and Non Medicinal Plants

Volume 8, Flowers

Lim, T.K.

2014, XIII, 1024 p. 283 illus. in color., Hardcover

ISBN: 978-94-017-8747-5