

Bergenia Genus

Subjects: **Plant Sciences**

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Bergenia(s) are evergreen, perennial, drought-resistant, herbaceous plants that bear pink flowers produced in a cyme. Due to the leaf shape and leathery texture, *Bergenia*(s) have earned some interesting nicknames such as "pigsqueak", "elephant-ear", "heartleaf", "leather cabbage", or "picnic plates". The plants should be planted about two feet apart as they spread horizontally up to 45–60 cm. *Bergenia* species possess several other biological activities like diuretic, antidiabetic, antitussive, insecticidal, anti-inflammatory, antipyretic, anti-bradykinin, antiviral, antibacterial, antimalarial, hepatoprotective, antiulcer, anticancer, antioxidant, antiobesity, and adaptogenic.

Bergenia species,botanical description,traditional uses,phytochemistry

1. Introduction

The use of herbs for healing diseases and disorders can be dated back to at least 1500 BC ^[1]. The traditional system of medicine (TCM) is a source of >60% of the commercialized drugs and is still used by the population in lower-income countries for the cure of chronic diseases ^[2]. As far as primary healthcare is concerned, approximately 75% of Indians rely on Ayurvedic formulations ^{[3][4]}. Many medicinal plants containing various phytochemicals have been successfully used to cure diabetes, cancers, gastrointestinal disorders, cardiovascular, and urological disorders ^[1].

Among the urological disorders, "urolithiasis" is the third most common disorder with a high relapse rate ^{[5][6][7][8]}. The invasive treatments of urolithiasis are costly and precarious, so the search for natural anti-urolithiatic drugs is of immense importance ^{[9][10]}.

The Ayurvedic preparations have used *Bergenia* species down the centuries to dissolve bladder and kidney stones and to treat piles, abnormal leucorrhea, and pulmonary infections ^{[11][12][13]}. These pharmacological properties can be attributed to wide-range polyphenols, flavonoids, and quinones present in *Bergenia* species. The polyphenols constitute a major share of the active ingredients, and the elite among them are "arbutin" and "bergenin" ^{[14][15][16][17][18][19]}. Bergenin alone possesses burn-wound healing, antiulcer, anti-arrhythmic, antihepatotoxic, neuroprotective, antifungal, antidiabetic, antilithiatic, anti-inflammatory, anti-nociceptive, anti-HIV, and immunomodulatory properties ^{[20][21][22]}. *Bergenia ligulata* Wall. Engl. [synonym of *B. pacumbis*] is an essential ingredient of an Ayurvedic formulation, "Pashanbhedha" (Paashan = rockstone, bheda = piercing), which is used as a kidney stone dissolver in the indigenous system of medicine ^{[23][24]}. This drug has been listed in ancient Indian chronicles of medicine including "*Charak Samhita*", "*Sushruta Samhita*" and "*Ashtang-Hridaya*". *B. ligulata* is

reputedly known by other names such as "Pashana", "Ashmabhid", "Ashmabhed", "Asmaribheda", "Nagabhid", "Parwatbheda", "Upalbheda", and "Shilabhed" [25].

2. Distribution

The plant family Saxifragaceae encompasses 48 genera and 775 species, which are mostly distributed in South East Asia. The name "Bergenia" was coined by Conrad Moench in 1794, in the memory of Karl August von Bergen (German botanist and physician). Genus *Bergenia* harbors 32 species of flowering plants, including highly valued ornamental, rhizomatous, and temperate medicinal herbs [16]. Central Asia is the native place for genus *Bergenia* [26][27]. Among the seven species, four (*B. yunnanensis*, *B. scopulosa*, *B. emeiensis*, and *B. tianquanensis*) are endemic to China [28][29][30]. The botanical description of *Bergenia* species [31][32][33][34] is described in Table 1.

Table 1. Botanical description of *Bergenia* species.

S.No.	Bergenia species	Botanical description	References
1	<i>Bergenia ciliata</i> (Haw.) Sternb.	It is commonly called as 'fringed bergenia', 'hairy-leaf bergenia' or 'winter begonia', is a large-leaved, slow-growing, clump-forming, perennial plant that normally grows to 12 inches tall and spreads to 24 inches wide. The plant grows as open rosettes with thick, leathery, finely-toothed, wavy-edged, broad, obovate to round 12-14 inches long green leaves. Leaves are pubescent (ciliate) on both the surfaces (hence the common name 'hairy-leaf bergenia'), with toothed and fringed- margins (hence the common name 'fringed bergenia'). Flowers are pale pink with rose-pink calyces and bloom in early to mid-spring in clusters on 10 inches tall stout-stalks, above the foliage. In some climates, flowers appear before the emergence of new leaves.	[33]

2	<i>Bergenia crassifolia</i> (L.) Fritsch	commonly called 'leather bergenia', 'Siberian tea', 'Mongolian tea', 'winter glut', 'winter glow', 'winter blooming bergenia', 'heartleaf bergenia', 'elephant-ears' is a large-leaved evergreen perennial plant. Rosettes of leathery, fine-toothed, obovate-rounded green leaves (8 inches long and 7 inches wide) form dense, slowly-spreading clumps of 12 inches tall foliage. Lavender pink flowers bloom in panicles from March to early May atop rigid leafless stalks, rising to 18 inches tall. Flowers bloom in winter, hence the additional common name of 'winter blooming Bergenia'. Although evergreen, the leaves of this plant often turn bronze and battered in cold winter temperatures.	[33]
3	<i>Bergenia emeiensis</i> (C.Y. Wu ex J.T. Pan)	It is commonly known as 'snow chimes'. It is a polycarpic plant that grows to a height of 35 cm and bears thick and scaly rhizomes. The leaves are petiolate, leathery and glabrous; cuneate at the base and obtuse at the apex. The inflorescence is cymose with sub-sessile, white or reddish flowers. The petals are narrowly obovate with claw-shaped base.	[31][33]
4	<i>Bergenia ligulata</i> (Wall.) Engl.	It is commonly known as 'Pashenbeda' or 'rockfoil'. It is a perennial herb that grows to a height of 35 cm. The root-stock of this plant is very stout and the stem is procumbent, thick and short. Rhizome is cylindrical, solid and barrel-shaped, 1-3 cm long and 1-2 cm in diameter with small roots. The stem bears few leaves that are glabrous or hirsute. The lamina is sub-orbicular to orbicular, with a cordate base and rounded apex while the margin is entire or denticulate. The petiole is glabrous or hirsute with sheathing towards the base. Flowers are pink	[33]

		to purple in colour contributing to one-sided raceme or corymbose inflorescence	
5	<i>Bergenia purpurascens</i> (Hook. f. & Thomson) Engl.	It is commonly known as 'purple bergenia'. It is a perennial herb that grows up to a height of 13-50 cm and bears thick-scaly rhizomes. The plant exhibits basal phyllotaxy with 2-7 cm long petiole, obovate leathery-leaf blade (glabrous and glandular pitted on both-surfaces) with cuneate base and obtuse apex. Inflorescence is cymose, 3-23 cm long; branches and pedicels densely long glandular and hairy. Petals are purple and ovate with claw-shaped narrow-base.	[33][34]
6	<i>Bergenia scopulosa</i> (T.P. Wang)	It is commonly known as 'elephant ear', 'Vuorenkilvet', 'Bergenie' and is a perennial herb that grows to a height of 10-50 cm and bears thick-scaly rhizomes. The plant exhibits basal phyllotaxy with 1.5-13 cm long petiole and leathery, glabrous, leaf blade having rounded base and obtuse apex and sinuate margin. The inflorescence is cymose and the petals are elliptic or broadly ovate with claw-shaped narrow base.	[33]
7	<i>Bergenia stracheyi</i> (Hook. f. & Thomson) Engl.	It is commonly known as 'Himalayan bergenia' and is a perennial herb that grows up to a height of 20 cm and bears thick rhizomes. The plant exhibits basal phyllotaxy with 1-1.8 cm long petiole and glabrous leaf blade that is obovate (base is cuneate and apex is obtuse). The flowers bear red petals with subspatulate base and obtuse apex, and contribute to cymose inflorescence.	[33]
8	<i>Bergenia hissarica</i> (A. Boriss)	<i>Bergenia hissarica</i> (A. Boriss) is an extremely rare, perennial, herbaceous, rhizomatous plant,	[32]

endemic to Hissar Mountains. Leaves are basal, large, form rosette, oblong-obovate in shape. Leaf apex is obtuse and leaf-margins are densely covered with hairs. The flowers are bell-shaped; 6-8 flowers grow on each pedicel (devoid of glandular hairs) and blossom in May-June. Corolla consists of 5 whitish-pink or white petals. Rhizomes are strong, 1.0-2.5 cm thick, horizontal, covered with remnants of petioles of dead leaves. Fruit is a capsule that harbours elongated seeds. No records are available on the cultivation of *B. hissarica*.

9	<i>Bergenia tianquanensis</i> (J.T. Pan)	<p>It is a perennial herb that grows up to a height of 25 cm and bears dark brown, thick and scaly rhizomes. The plant exhibits basal phyllotaxy with 1.5 cm long petiole and the leathery- glandular leaf blade is obovate (cuneate base and obtuse apex). Inflorescence is cymose type, The plant bears reddish flowers with petals that have claw-shaped narrow base.</p>	[32][33]
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3. Traditional Medicinal Uses

Bergenia species have been used in traditional medicines for a long time. In Unani and Ayurvedic systems of medicine, *Bergenia* spp. rhizomes and roots have been used for curing kidney and, bladder diseases, dysuria, heart diseases, lung and liver diseases, spleen enlargement, tumors, ulcers, piles, dysentery, menorrhagia, hydrophobia, biliousness, eyesores, cough, and fever [35][36][37]. The burns or wounds may be treated with rhizome paste for three to four days [38][39][40]. The paste can be applied on dislocated bones after setting, or consumed to treat diarrhea or along with honey in fevers [41][42].

The leaf extract of *B. ciliata* possesses antimalarial property [43]. Its leaves are revered to as "Pashanabheda", which designates the litholytic property [44]. In Nepal, 1:1 mixture (one teaspoon) of the dried *B. ciliata* rhizome-juice and honey is administered to post-partum women 2–3 times a day as a tonic and remedy for digestive disorders (carminative) [38]. The rhizome-decoction may also be consumed orally as antipyretic and antihelmintic [45].

Since ancient times, consumption of water-extract of *B. ligulata* has cured urogenital and kidney-stone complaints [23][35][46][47]. In Nepal, the rhizome paste of *B. ligulata* is consumed for treating many diseases including diarrhea, ulcer, dysuria, spleen enlargement, pulmonary infusion, cold, cough, and fever [45]. The intestinal worms can also be removed by consuming rhizomes along with molasses (two times/day, 3–4 days) [38]. The Indians use the dried roots of *B. ligulata* for treating burns, boils, wounds, and ophthalmia [46][48]. The dried leaf powder of *B. pacumbis* may be inhaled to bring relief from heavy sneezing [49]. In Lahul (Punjab), the locals use *B. stratecheyi* plants to prepare a poultice, which is applied to heal the joint-stiffness [50]. *Bergenia* species are also used for the treatment of boils and even blisters [19].

In Russian tradition, *B. crassifolia* leaves are commonly used to prepare a health drink. Buryats and Mongols used *B. crassifolia*-young leaves of to prepare tea. Interestingly, in Altai, tea is prepared from old blackened leaves (chagirsky tea having lesser amounts of tannins) [51]. The rhizome infusions can treat fevers, cold, headache, gastritis, dysentery, and enterocolitis [52]. They are also used to treat oral diseases (bleeding gums, periodontitis, gingivitis, and stomatitis) and also possess adaptogenic properties [51][53][54][55]. Mongols used the extracts for treating typhoid, gastro-intestinal ailments, diarrhoea, and lung inflammation. The rhizome extract is also used to strengthen capillary walls to stop bleeding after abortions, alleviate excessive menstruation, and cervical erosion. Therefore, the roots and rhizomes of *B. crassifolia* are claimed as antimicrobial, anti-inflammatory, haemostatic, and as astringent in the official medicine of Mongolia [54].

Tibetans apply fresh leaf-paste on their skin to protect them from harmful ultraviolet radiations [56]. The chewing of leaf helps in relieving constipation and the leaf-juice can treat earaches [11][38][42]. The bullocks and cows are fed on a mixture of *Bergenia* inflorescence and barley-flour to treat hematuria [38]. *Bergenia* roots are also effective in preventing venereal diseases [57]. Thick leaves of *Bergenias* are used in Chinese Medicine to stop bleeding, treat cough, dizziness, hemoptysis, and asthma, and to strengthen immunity [27][58].

4. Phytochemistry

Nowadays, HPLC and HPTLC have become routine analytical techniques due to their reliability in quantitation of analytes at the micro or even nanogram levels plus the cost effectiveness. Phytochemical investigation of nine *Bergenia* species (*B. ciliata*, *B. crassifolia*, *B. emeiensis*, *B. ligulata*, *B. scopulosa*, *B. stratecheyi*, *B. hissarica*, *B. purpurascens*, and *B. tianquanesis*) led to the characterization of several chemical constituents [16][59][60][61][62][63]. The constituents have been categorized into polyphenols, flavonoids, quinones, sterols, terpenes, tannins, lactones, and others [16][26][64][65][66][67]. The major bioactive compounds are bergenin (1), (+)-catechin (2), gallic acid (3), -sitosterol (4), catechin-7-O- -d-glucoside (5), (+)-afzelechin (6), arbutin (10), 4-O-galloylbergenin (12), 11-O-galloylbergenin (13), caffeoylquinic acid (21), pashaanolactone (26), 3,11-di-O-galloylbergenin (64), bergapten (66), kaempferol-3-O-rutinoside (70), quercetin-3-O-rutinoside (79), (+)-catechin-3-O-gallate (83), 2-O-caffeoylarbutin (86), leucocyanidin (124), methyl gallate (gallicin) (125), sitoinoside I (126), -sitosterol-d-glucoside (127), avicularin (128), reynoutrin (129), procyanidin B1 (135), afzelin (140), and aloe-emodin (146).

Arbutin (10) inhibits tyrosinase, prevents the formation of melanin and thus prevents skin darkening [68]. Bergenin (1) is a pharmaceutically important molecule that has hepatoprotective and immunomodulatory potential [69]. It is used clinically for eliminating phlegm, relieving cough, inflammation, etc. [20][70][71]. (+)-catechin (2) possesses antioxidant, glucosidase, renoprotective, matrix-metalloproteinase inhibitory, and cancer preventive activity. Gallicin (125) exhibits antioxidant, anti-tumor, antimicrobial, anti-inflammatory, and cyclooxygenase-2/5-lipoxygenase inhibitory activity [72]. Gallic acid (3) possesses anti-inflammatory, antioxidant, cytotoxic, bactericidal, gastroprotective, and antiangiogenic activity. -sitosterol (4) is well-known for its antioxidant, anti-inflammatory, analgesic, and anti-helminthic effects. It is also efficient in the curing prostate enlargement [73].

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