A review on resource status, bioactive ingredients, clinical applications and biological progress in *Bergenia*

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Accepted 11 August, 2011

*Bergenia* is a very important medicinal plant, widely applied in many fields. To develop effectively the elite germplasm, this paper introduced its resource status, enumerated its bioactive ingredients and clinical applications, and summarized its research progress in biochemistry, cytology and molecular biology. This review is beneficial for further research on *Bergenia*.

**Key words:** *Bergenia*, resource status, clinical application, research progress.

**INTRODUCTION**

*Bergenia*, a genus belonging to the family *Saxifragaceae* (Zhou et al., 2007; Dhalwal et al., 2008), is a kind of perennial herb, containing rich medicinal ingredients and having high application values. To develop and utilize effectively this kind of elite germplasm resource, the following contents reviewed its resource status, bioactive ingredients, clinical applications and research progress in biochemistry, cytology and molecular biology.

**RESOURCE STATUS**

**Phenotypic characteristics**

*Bergenia* is belonging to herbaceous plant. According to the report by Zhou et al. (2007) on *Bergenia purpurascens* and our outdoor survey on the two species *Bergenia tianquanensis* and *Bergenia emeiensis*, plant height of *Bergenia* has a range from 10 to 80 cm, with short internodes. Its underground rhizomes grow creepingly, with radial branches. The alternate-growing leaves of *Bergenia* exhibit dense clusters, thick and soft, with 5 to 25 cm of leaf length and 3 to 17 cm of leaf width. Usually, the leaves displays dark green, but winter comes, they will become red, and spring comes, partial leaves will gradually turn green and send forth new leaves. In addition, *Bergenia* has 3 to 6 inch clusters of delicate flowers, which appear in spring. Flower colors range from deep purplish pink to pale pink and occasionally white.

**Species and distribution**

According to The International Plant Names Index (www.ipni.org), there are 32 species included for *Bergenia* genus throughout the world (Table 1). In China, there are total seven species, growing in the three provinces Sichuan, Sanxi and Shanxi and two Autonomous Region Tibet and Xinjiang. To be mentioned, the four species, including *Bergenia emeiensis*, *Bergenia scopulosa*, *Bergenia tianquanensis* and *Bergenia yunnanensis* are unique, only growing in China.

*Bergenia* is mainly distributed in Asia, involved in East Asia, the southeastern regions of Central Asia and northern regions of South Asia (Chandrareddy et al., 1998; Zhou et al., 2007). Wild *Bergenia* grows generally in high-altitude cold location, on the earth surface covered by forest and shrub, alpine meadow or the crevice of stone (Lu and Wang, 2003a).

To be mentioned, wild *Bergenia* is mainly distributed in high-altitude cold area, and is becoming less and less, because of destruction of ecological environment and excessive excavation.
Table 1. The 32 species included in Bergenia genus searched from The International Plant Names Index (www.ipni.org).

| Bergenia, Bergenia beeisiana, Bergenia bilflora, Bergenia ciliate, Bergenia cordifolia, Bergenia coreana, Bergenia crassifolia, Bergenia delavayi, Bergenia emeleensis, Bergenia fortunei, Bergenia gorbounovii, Bergenia himalaica, Bergenia hissarica, Bergenia ligulata, Bergenia media, Bergenia milesii, Bergenia × newryensis, Bergenia orbicularis, Bergenia ornata, Bergenia pacifica, Bergenia pacumbis, Bergenia purpurascens, Bergenia schmidtii, Bergenia × schmidtii, Bergenia scopulosa, Bergenia smithii, Bergenia spathulata, Bergenia stracheyi, Bergenia thysanodes, Bergenia tianquanensis, Bergenia ugamica, Bergenia yunnanensis. |

Table 2. The main bioactive ingredients in Bergenia.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Main ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphenols</td>
<td>Bergenin, arbutin, catechin, β-sitosterol, gallic acid, β-sitosterol-D-glucoside, tannins, (+)-afzelechin, leucoeyanidin, methylgallate, paashaanolactone, gallic acylated compounds, etc.</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>Kaempferol, Quercetin, diglucoside, mologlucoside, etc.</td>
</tr>
<tr>
<td>Quinones</td>
<td>Aloe emodin, physcion, aloe emodin 8-O-glucoside, chrysophanein, emodin 1-O-β-D-glucopyranoside, Hydroquinone, hydroquinone monomethyl ether, etc.</td>
</tr>
<tr>
<td>Others</td>
<td>Volatile oil, polysaccharide, amino acid, sterols, organic acid, carotenoids, daucosterol, etc.</td>
</tr>
</tbody>
</table>

BIOACTIVE INGREDIENTS

Bergenia has rich chemical components in its roots, stems and leaves, and the bioactive ingredients can mainly be classified into three categories, including polyphenols, flavonoid and quinones (Table 2). (Chandra Reddy et al., 1998; Chandra Reddy and Chawla, 1999; Lu and Wang, 2003a; Wang and Lu, 2005; Pop et al., 2009; Dhalwal et al., 2008; Chen et al., 2008a; Yuan, 2011). To be mentioned, bergenin is the most important pharmaceutical component, can be used to treat many diseases. Currently, it is already in clinical use, such as relieving a cough, eliminating phlegm, diminish inflammation, etc. (Jiang et al., 2010; Nazir et al., 2011; Yuan and Suo, 2011).

CLINICAL APPLICATIONS

Treatment of diseases

Bergenia is one of the most important folk medicinal herbs, in India, the rhizomes of Bergenia have been used for centuries in the Ayurvedic formulations to dissolve kidney and bladder stones, abnormal leucorrhea, piles, and pulmonary affections (Gehlot et al., 1976; Asokar et al., 1992; Srivastava and Rawat, 2008); in China, dry powder of Bergenia is often used for treating cough, stop bleeding, increasing immunity and so on (Lu and Wang, 2003a). From literature, some extracts from Bergenia have high clinical values, take methanol extract as an example, the experimental results obtained by Sinha et al. (2001a) showed that it had a wide spectrum of concentration-dependent antibacterial activity, moreover in the experiments results obtained by Sinha et al. (2001b), this kind of extracts was demonstrated anti-inflammatory potentiality.

Actually, the whole grass of Bergenia can be used in medicine, but its active ingredients were mainly focused on polyphenols, among which bergenin is studied and applied most frequently (Reddy et al., 1999; Chauhan et al., 2000; Ji, 2005; Singh et al., 2007; Dhalwal et al., 2008). Bergenin exhibits various biological activities such as antiulcer, antihepatotoxic, anti-HIV, antiarrhythmic, neuroprotective, antifungal, anti-inflammatory, immunomodulatory and burn wound healing effects (Nazir et al., 2011). Owing to such a broad spectrum of biological activities associated with Bergenin, a number of studies have been devoted to either derivatizes the molecule or synthesize its related compounds to optimize it as a lead molecule (Rousseau and Martin, 2000; Takahashi et al., 2003).

Health food

Bergenia has many kinds of amino acids and mineral elements which are helpful (Yang et al., 2009), so it may be considered in cuisine. Additionally, arbutin contained in Bergenia are beneficial for diuresis and antibiosis, and thus, it can be used as the disinfectant of urine. At same time, it can inhibit degradation of Insulin (Li et al., 2006).

Cosmetics

Bergenia can be applied in cosmetic field, owing to its functional ingredient arbutin, arbutin can make skin...
relationships to arbutin as early as 50 years ago. To this investigations on the tannin in CYTOLOGICAL AND MOLECULAR LEVELS agent.

Dhalwal, because it can prevent tyrosinase within skin from taking effect (Guo et al., 2004). Currently, Bergenia has already been manufactured into cosmetic brightening agent.

BILOGICAL PROGRESS IN BIOCHEMICAL, CYTOLOGICAL AND MOLECULAR LEVELS

For biochemical progress, Friedrich (1954) carried out the investigations on the tannin in Bergenia and its relationships to arbutin as early as 50 years ago. To this day, there are many reports on extraction and analysis of bioactive ingredients in Bergenia (Thieme et al., 1969; Chen et al., 1987; Hasan et al., 2005; Saijyo et al., 2008; Chen et al., 2008b; Dhalwal et al., 2008; Yang et al., 2009). In Chandra, Reddy et al. (1998) isolated four compounds from Bergen and ligulata, subsequently, Lu and Wang (2003b), Wang and Lu (2005) and Chen et al. (2008a) extracted 5, 4 and 40 compounds from B. scopulosa, respectively. Recently, Rajkumar et al. (2010) extracted and analyze the antioxidant activities from Bergenia ciliata. To be noticed, bergenin is the most researched among many bioactive ingredients (Reddy et al., 1999; Ji, 2005; Singh et al., 2007; Chauhan et al., 2000; Dhalwal et al., 2008), owing to various functions in medicinal field.

For the studies at cytological and molecular levels for Bergenia, there are hardly any research reports from literature, except for that Liu et al. (2009) established a regeneration system of Bergenia crassifolia using its leaves as explants.

ACKNOWLEDGEMENTS

This work was financially supported by Scientific Research Foundation of China West Normal University (07B031), P. R. China.

REFERENCES


