**REVIEW ON COMPILATION OF ETHNOPHARMACOLOGICAL PROPERTIES OF BERGENIA CILIATA: THE MEDICINAL HERB OF HIMALAYAS**

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**ABSTRACT**

As mentioned in the texts such as Vedas, Charaka Samhita and Sushruta Samhita, *Bergenia ciliata* is known to be the ancient and medicinal plant belonging to the family Saxifragaceae. It can be found as a shrub or an herb, while some are trees or vines. The family includes about 80 genera, 1250 species and has biological properties that are possessed by the different plant parts including antibacterial, antiviral, antioxidant, anti-ulcer, anti-diabetic, analgesic, anti-plasmodial, antitumor, antitussive activity, antineoplastic, diuretic and anti-inflammatory properties. Many of its members grow in rocky places. *Bergenia ciliata* itself shows that the plant originate between rocks and appears to break them or that it possesses lithotrophic property. It’s different plant parts are reported to have different medicinal properties. There are three species of Bergenia found in India *Bergenia ligulata*, *Bergenia ciliata*, *Bergenia stracheyi*. The rhizomes of these plants are used in the indigenous system of medicines.  

**Keywords**: *Bergenia ciliata*, phytochemicals, rhizome, extract, herb.

**INTRODUCTION**

A medicine or a pill that was being taken for every infectious disease has now been replaced by the increasing occurrence of antimicrobial resistance representing a worldwide major concern for both human and veterinary medicine (Lorian, 1996). Since then, there has been a growing interest in the antimicrobial screening of extract from plants as roots, bark, seeds, leaves, and flowers contain a variety of naturally occurring biochemicals, which contribute to the plant’s medicinal benefits mostly against microorganisms (Folashade *et al*., 2014). The decoction, tincture, infusion, or herbal extract of many herbal plants are traditionally used for the treatment of many diseases (Wendakoon *et al*., 2012). According to data *Bergenia ciliata* is known to have major therapeutic potential to cure gastrointestinal problems, malaria, and kidney stone, etc (Hussain *et al*., 2019). The localities of Himalayan region use dried rhizomes of *B. Ciliata* for tea and tonic helpful in, and muscular pain (Khan *et al*., 2012). The medicinal activity of plant is due to the presence of secondary metabolites like glycosides, alkaloids, terpenoids, steroids, flavonoids, reducing sugars, tannins, fatty acids, and saponins (Khan *et al*., 2016). The species biological and pharmaceutical investigation exhibited its possible antifungal, antiviral, antibacterial, antioxidant, antitussive, anti-inflammatory, anti-neoplastic and anti-ulcer activities in many cases.

Botanical description

Winter begonia and hairy bergenia is another name of this perennial herb *Bergenia ciliata* that belongs to the family Saxifragaceae. It consists of about 30 genera and 580 species worldwide. It mainly has herbs in its family which usually have a flower cluster held well above the basal whorl of leaves. *Bergenia ciliata* height is estimated to be 30-60 cm in height and are evergreen, leathery, with pink to purple flowers (Zbikowska et al., 2017).

Geographical distribution

This plant is found in Northern areas between altitudes of 800–3000 m in Pakistan, Afghanistan, South Tibet, India, Bhutan, Meghalaya, Bhutan, and Nepal (Phull A-R et al., 2016). This plant is generally found in the cold and temperate regions of Himalayas from Kashmir to Bhutan at an altitude of 900-3000m (Handa SS., 1997). In India it is found in the Himalayas (Kumaon), Meghalaya, Lushai hills West Bengal (Darjeeling, Labha, Takdah, Rimbick (Kalimpong), Arunachal Pradesh (Nyang Jang Chu), Kyongnosla, Changu, Karponanag, Lachen to Thong, Nathang, Prekchu-Tsokha, Pangolakha-Subaney Dara, Gangtok (domesticated) in Sikkim (Hafidh et al. 2009).

![A world map showing the geographical distribution of Bergenia species](image)

**Vernacular Names**

<table>
<thead>
<tr>
<th>English</th>
<th>Malayalam</th>
<th>Kullurvanchi</th>
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<tbody>
<tr>
<td>Rock-foil</td>
<td>Oriya</td>
<td>Pasanbhedi</td>
</tr>
<tr>
<td>Paashaanabheda</td>
<td>Tamil</td>
<td>Sirupilai</td>
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<tr>
<td>Pashanbhed, Dakachru</td>
<td>Telugu</td>
<td>Kondapindi</td>
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<tr>
<td>Pashanbheda, Pakhanbheda</td>
<td>Urdu</td>
<td>Pakhanabeda, Zakham-e-hayat</td>
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<tr>
<td>Patarchuri Marathi Pasanbheda</td>
<td>Arabic</td>
<td>Barghienia-mehdiyata</td>
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</table>

**Fig. 2**: A world map showing the geographical distribution of *Bergenia* species (in shaded) (Blupendra Koul et al., 2020)

**Fig. 3**: *Bergenia ciliata* A. Floral branch with flowers & B. Roots. (Ahmad et al., 2018)

**Taxonomic hierarchy** (Kritikar et al., 1935)

- **Classification**: Bergenia Moench.
- **Kingdom**: Plantae-plants
- **Subkingdom**: Tracheobionta-vascular plants
- **Super division**: Spermatophyta-seed plants
- **Division**: Magnoliophyta
- **Class**: Manoliopsida-dicotyledons
- **Subclass**: Rosidae
- **Order**: Saxifragales
- **Family**: Saxifragaceae
- **Genera**: *Bergenia*
- **Species**: *ciliata f. ciliata*.
PHARMACOLOGICAL PROFILE OF BERGENIA CILIATA RHIZOME

Researchers have been always attracted to *Bergenia ciliate* due to its traditional medicinal values for the treatment of many diseases i.e., skin diseases, muscular/skeletal disorders, pulmonary infections, gastrointestinal infections, fever, eye diseases, worm infection, diarrhoea, respiratory diseases, renal disorders, fever, oral infections, cancer, and gynaecological disorders (Ahmad *et al*., 2018).

Toxicology

*Bergenia ciliata* has an acute, systematic and intracutaneous toxic behaviour towards animals when applied. It showed symptoms of various diseases such as erythema, oedema, breathing problem, starting of bloody diarrhoea, blood in stool and gastro intestinal problems in acute systematic case. In case of higher dose, it exhibited cardio-toxic, anti-diuretic and depressant action on the Central Nervous System (Islam *et al*., 2002).

Anti-inflammatory activity

According to Kumar *et al*., 2002 aqueous extract of rhizome of *Bergenia ciliata* showed a potent and dose dependent anti-inflammatory effect comparable to Diclofenac sodium on induce paw edema in rats. For that he screened *Bergenia ciliata* rhizome and found that the methanolic extracts of rhizome were found to be highly active against antiviral activity against HSV-1 (IC$_{50}$ value 6.25µg ml$^{-1}$) and influenza virus A (IC$_{50}$ values from 8to 10µg ml$^{-1}$) (Ruby *et al*.2012).
**Anti-cancer activity**

Methanolic and aqueous extract of *Bergenia ciliata* rhizome showed concentration-dependent cytotoxicity in each of the three cell lines. According to Islam *et al.*, 2002, the IC\textsubscript{50} value to consider a crude extract promising for the development of anticancer drugs is lower than a limit threshold (30µg/ml). *Bergenia ciliata* bear potent anti-neoplastic activities that may have prospective clinical use as precursor for preventive medicine (Bhandari *et al.*, 2008). For chemoprevention/chemotherapy both methanolic and aqueous extract of *Bergenia ciliata* rhizome showed potential therapeutic activity towards neoplastic growth and malignancy target tumours (Venkatadri *et al.*, 2011). *Bergenia ciliata* bear potent anti-neoplastic activities that may have prospective clinical use as precursor for preventive medicine (Islam *et al.*, 2002).

**Antibacterial activity**

Globally the prevalence of bacterial infectious diseases become the major health problem. Lately to fight this some medicinally important plants extracts have been developed which are used as antimicrobials (Shan *et al.*, 2007). The roots and leaves extract viz ethanol, hexane, ethyl acetate, chloroform, butanol, and aqueous (5mg/ml) aliquots of *Bergenia ciliata* were screened and used to test antibacterial activity. *Bergenia ciliata* root extract was found to inhibit the growth of gram-positive bacteria as compared to the gram-negative strain (Rajbhandari *et al.*, 2009).

<table>
<thead>
<tr>
<th>Extract</th>
<th>Susceptible bacteria</th>
</tr>
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<tbody>
<tr>
<td>Acetone extract</td>
<td>Escherichia coli, Bacillus subtilis and Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>Methanol, ethanol, water and n-hexane extracts</td>
<td>Klebsiella pneumonia, Staphylococcus aureus, Bacillus subtilis and Escherichia coli</td>
</tr>
<tr>
<td>Ethanol extract</td>
<td>Salmonella typhimurium and Escherichia coli</td>
</tr>
<tr>
<td>Ethanol, chloroform, butanol, hexane, ethyl acetate and aqueous extracts</td>
<td>Staphylococcus aureus, Bacillus subtilis, micrococcus and Bacillus megaterium</td>
</tr>
<tr>
<td>Callus extract</td>
<td>Pseudomonas aeruginosa, Staphylococcus aureus, Pseudomonas aeruginosa, Staphylococcus aureus and Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>Methanol, ethyl acetate and hexane extracts</td>
<td>Nocardia tenerifensis, Bacillus megaterium and Bacillus subtilis</td>
</tr>
<tr>
<td>Crude extract</td>
<td>Bordetella bronchiseptica, Salmonella Setubal, Escherichia coli, Micrococcus luteus, Staphylococcus aureus and Salmonella typhimurium</td>
</tr>
<tr>
<td>Ethanol, hexane, distilled water and butane extracts</td>
<td>Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Streptococcus faecalis</td>
</tr>
<tr>
<td>Leaves extracts</td>
<td>Staphylococcus aureus and Bacillus megaterium</td>
</tr>
<tr>
<td>Ethanol extract</td>
<td>Bacillus subtilis, Klebsiella pneumonia, Staphylococcus aureus, Escherichia coli, Salmonella typhi, Shigella dysenteriae and Saccharomyces cerevisiae</td>
</tr>
</tbody>
</table>

Fig. 8 : Antibacterial activities of *Bergenia ciliata*. (Shah *et al.*, 2020)

**Antidiabetic activity**

During working on some selected medicinal plant some researchers observed anti diabetic mode of action of *Bergenia ciliata*. The study suggested that due to the inhibition of digestive enzymes, α-glucosidase and α-mylase there is an effective fall in glucose level. Active compounds ([10]-3-O-galloylepicatechin and [10]-3-O-galloylca-techin) isolated from 50% aqueous-methanol extract of *Bergenia ciliata* rhizome showed strong dose dependent enzyme inhibitory activity against rat intestinal α-glucosidase and porcine pancreatic α-amylase. Their results supported the use of *Bergenia ciliata* in traditional medicines for treating diabetes (Chauhan *et al.*, 2012). According to Yadav *et al.* (2011) *Bergenia ciliata* can be classified as hypoglycaemic activity in experimental diabetes ranging from 40-70% of its onset to reduce blood glucose level except chloroform extract of root and leaves out of ethanol, hexane, ethyl acetate, chloroform, butanol and aqueous of *Bergenia ciliata*.

**Antifungal activity**

Kumar and Tyagi (2013) suggested that different extracts of (*Bergenia stracheyi*) exhibit different extent of antifungal activity against all test fungi viz. Alternaria alternate, Aspergillus niger, Colletotrichum gloeosporioides, Fusarium oxysporium, Ganoderma lucidum and Rhizoctonia solani.

**Antimalarial activity**

Due to the growing resistance towards the drugs which has been used to treat malaria that drug had triggered the disease load in endemic regions. Many plant species were being used for the cure of malaria in traditional health systems. For the treatment of fever, local communities of Himalayan Region conventionally use *Bergenia ciliata* which was evaluated for its possible role as antimalarial drug (Rajput and Mandal, 2012). The leaf extract of the plant showed good in vitro ant plasmodial activity with mean survival time of 8.6 ± 1.5 days (Walter *et al.*, 2013).
 Anti- urolithic activity

Administering dose of hydro-alcoholic extract of *Bergenia ciliata*/standard drug cystone along with ethylene glycol showed significant changes in body weight and organ weight of ethylene glycol treated animals. Furthermore, *Bergenia ciliata* extract expressed higher renoprotective index than cystone at the same dose level (Saha et al., 2011). Crude extract of *Bergenia ligulata* rhizome also showed antiurolithic activity (Bashir et al., 2009).

Antioxidant activity

According to Rajkumar et al. 2010 the antioxidant activity of methanolic and aqueous extracts of *Bergenia ciliata* were observed and both extracts were found to have free radical scavenging effect that might prevent oxidative damages to biomolecules. The rhizome extracts also possess lipid peroxidation inhibition potential (Islam et al., 2002). Ruby et al. (2015) reported that the hydroethanolic leaf extracts of *B. ciliata*, *B. ligulata*, and *B. Strachey* have antioxidant and hemorrhoidal potential in vitro using 10 antioxidant assays.

**PHYTOCHEMISTRY OF BERGENIA CILIATA**

Many observants have noticed that the pharmacological effects of plants are due to the presence of metabolites. These are organic compounds and classified into primary metabolites and secondary metabolites. Primary metabolite is common in human body which is essential for growth and development of the body (includes glucose, starch, polysaccharide, protein, lipids and nucleic acid). Plants usually produce secondary metabolites which include alkaloids, flavonoids, saponins, terpenoids, steroids, glycosides, tannins, volatile oils etc (Maurya et al., 2008). These secondary metabolites of plants are responsible for its therapeutic efficacy for curing many diseases and in plants these metabolites are termed as phytochemicals which are pharmacologically active compounds. Some of the pharmacological activities include alkaloids have an antispasmodic, antimalarial, analgesic, diuretic activities; Terpenoids are known for their antiviral, anthelmintic, antibacterial, anticancer, antimalarial, anti-inflammatory properties; Glycosides are reported for antifungal and antibacterial properties; Phenols and flavonoids have an antioxidant, anti-allergic, antibacterial properties etc. and Saponins are reported to have anti-inflammatory, antiviral, plant defence activities (Chopra et al., 2002). The literature search on *Bergenia ciliata* has revealed that very little chemical work has been carried out on this plant (Sticher et al., 1979). Some of the important classes of compounds along with their IUPAC names and general formula isolated from *Bergenia ciliata* are given:
**Bergenia ciliata** is a magical herb that has many therapeutic activities present in it which is because of the occurrence of many bioactive compounds. Many researchers have evaluated various phytochemicals from *Bergenia ciliata*. Approximate 58 phytochemicals are there in the plant out of which 48 volatile compounds are categorized into 11 classes; flavonoids, glycosides, nitro compounds, alcohols, fatty acids, phenols, carboxylic acids, terpenoids, cinnamic acid, sterol and volatile organic compounds (Hussain et al., 2009). The preliminary phytochemical investigation of rhizome of *Bergenia ciliata* showed presence of flavonoids, glycosides, sterols, terpenoids, saponins while alkaloids were found to be absent (Khan and Kumar, 2016). There is also the presence of few other compounds like bergenin, leucocyanidin, gallic acid, methyl gallate, catechin and polymeric tannin (Dixit and Srivastava, 1989). In some studies, the rhizomes also yielded a new lactone compound Paashanolactone (Chandrareddy et al., 1998). Bergenin is major compound in the rhizome (0.6%). It is 4-methoxy-2-[(1S,2R,3S,4S,5R)-3,4,5,6-tetrahydro-3,4,5,6-tetrahydroxy-2H-pyran-2-yl]-α-resorcylic acid δ-lactone monohydrate.

Bhandari et al. (2008) reported the isolation of many biochemical compounds by phytochemical analysis of aerial parts and of leaves of the plant and these are hydroquinone (benzenoids), (+) afzelechin, (+) catechin, quercetin-3-O-β-D-glucuronoside, quercetin-3-O-α-L-arabinofuranoside, eriodictiol-7-O-β-D-glucopyranoside, arbutin, 62-O-p-hydroxybenzoylargin, bergenin, 4-O-gallloylbergenin, 11-O-galloylbergenin, p-hydroxybenzoic acid and protocatechuic acid. 62-O-protocatechuoylargin, 11-O-p-hydroxybenzoylbergenin, 11-O-protocatechuoylbergenin and 62-O-phenoxybenzoylparsoroside (-)-3-O-galloylpectechin and (-)-3-O-galloylcatechin (Sticher et al., 1979). Some phytochemicals are mentioned below:

### Phenols

The most important constituents of *Bergenia ciliata* are Phenols. Bergenin, tannic acid, gallic acid, catechin, [10]-3-O-galloylcatechin and [10]-3-O-galloylpectechin are few of them (Chauhan et al., 2012). Isolation of Bergenin, catechin, (−)-3-O-galloylcatechin and [10]-3-O-galloylpectechin has been observed from rhizome of the plant (Keri and Patil, 2014).

### Bergenin

Bergenin is the most abundant and important component which is found in Saxifragaceae family. It is also known as cuscutin (Chauhan et al., 2012). According to S. Gurav, N. Gurav., 2014. 0.75% bergenin is present in the rhizome of *Bergenia ciliata*, also has antioxidant property and activity against ascorbic acid. It has germicidal effect against many bacteria and can act on fungus too (Han, et al., 1998). It shows activity against Hepatitis C virus, mild activity against HIV, protects liver, blocks the secretion of inflammatory cytokines, stimulate anti-inflammatory messengers, break down fat, increase the activity of norepinephrine (Zuo et al., 2005). No adverse effects of bergenin have been reported even with very large dosages (Chauhan et al., 2012).

### Gallic acid

Gallic acid is present in seed of *Bergenia ciliata*. It has antioxidant, antiviral and antifungal activities, used to treat psoriasis in ointments and is inhibitor of weak carbonic anhydrase (Chauhan et al., 2000).
Tannic acid

It is a polyphenol present in *Bergenia ciliata* in tannin form. It is also known as tannimum, gallotannin, quercotannic acid, acidum, tannicum, digallic acid, oak bark tannin and quercitannic acid. It is used in food and beverage industries as an aromatic compound, taste enhancer, color stabilizer and also as clarifying agent. It can be used in the treatment of burns and injuries (Rajbhandari et al., 2003).

Catechin

It is present in rhizome of *Bergenia ciliata* (Pokhrel et al., 2014). Catechin is also known as Cyanidanol, Cianidol, Catechuc acid, Catechinic acid and D-Catechin. Catechin compounds are strong therapeutic candidates and can also be used to treat Alzheimer’s and Parkinson’s diseases (Kielhorn, Thorngate III., 1999).

Sterol

In *Bergenia ciliata* roots and leaves, phytosterol β-sitosterol is present. It is used in the treatment of hypercholesterolemia as it reduces blood cholesterol level. It hinders cholesterol absorption in intestine and also used to treat benign prostatic hyperplasia (Kauffman, Kirk-Othmer, 2002).

Glycoside

Glycoside, Arbutin also called as Arbutoside hydroquinone β-D-glucopyranoside present in rhizome of *Bergenia ciliata*. It reduces the formation of melanin hence it is used as a skin lightening agent (Yuldashev et al., 1993).

Flavonoid

(+) Afzelechin is a flavonoid present in rhizome of *Bergenia ciliata*. It is also found in B. ligulata rhizome. Afzelechin show α-glucosidase inhibitory activity (Roselli et al., 2012). Other flavonoids present in *B. ciliata* rhizome are quercetin 3- o-β-D xylopyranoside and quercetin 3-o-α-L-arabinofuranoside. According to Rauf et al., 2014 quercetin show anti-oxidant, antiradical property and iron chelating effectiveness.

Terpene

Terpene present in *B. ciliata* rhizome is limonene (Gyawali, 2011).

Other phytochemicals

2-Pentanone, 2,4-Dimethyl-3-pentanone, Hexanal, 2-Methyl-1-propanol, Acetic acid, Heptanal, 2-Ethyl hexanol, 3-Pentanol, 2-Pentanol, Octanal, Heptanal, 3-Methyl-4-hexen-2-one, 2-Nitropropane, Hexanol, 2,4-Hexadienal, 2,4-nonadienal, Pentanoic acid, Hexanoic acid, Hexalactone, Isobutyropheneone, 5,6-Dihydro-2-pyranone, Methyl nonanoate, Methyl cinnamate, β-phellandrene, [E]-4-Hepten-2-one are present in the oil extracted from *B. ciliata* plant (Gyawali, 2011).

Fig. 12: Some important chemical constituents of *Bergenia ciliata*. (www.google.com.)
CONCLUSION

The present study explores that *Bergenia* species is a very effective herb which has been used for medicinal purposes. It contains a wide range of bioactive compounds of therapeutic value. The versatility of *Bergenia ciliata* can be explained by its phytochemical, pharmaceutical and biological investigation. The raising concern of antimicrobial resistance towards allopathic medicine can also be solved to some extent by using the pharmacological properties of whole plant of *Bergenia ciliata*. During the long-period of traditional use it has been noticed the plant can be used to treat many ailments without causing any side effects that leads to its great safety and efficiency that also has been tested and documented every time. It is easily available and cost effective so everyone can use it for the treatment. It has been observed that only 9 species out of 32 possess the pharmacological properties, hence there is a scope for phytochemical analysis and clinical efficacy trials with the rest of the 23 species.

The conservation of the *Bergenia* species is of immense concern from a biodiversity, ethnomedical, and pharmacological perspective. In present situation where old traditional practices are declining and at risk due to rapid modernization there is an urgent need to take actions towards saving these tribal species and help to find ground-breaking ways to untap its efficiency so that it can be used for human welfare in future. It also has been observed that there is deficiency in clinical trials therefore additional clinical attempts on this plant should be conducted so that discovery of new drugs can be made possible, detailed toxicological research work should be carried out. These studies will provide valuable knowledge to the researchers about different disorders which can be treated by the prepared new drugs. However, there is still a scope of research on several other aforementioned therapeutic activities.

REFERENCE


