

VAJRADANTI- A REVIEW OF TRADITIONAL USES, PHARMACOLOGICAL PROPERTIES AND ITS IN VITRO CONSERVATION

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ABSTRACT

This article represents traditional uses of medicinal plant *Barleria* commonly called Vajradanti which is widely distributed throughout the hotter part of India. Different plant parts of Vajradanti used in various diseases. Laboratory studies have demonstrated that all the plant parts or extract used in the treatment of gastrointestinal disorders, curing digestive troubles, hepato-protective, anti tress, and immune-restorative properties, treating fever etc. In present investigation we have observed that extract of leaf and whole plant is used to cure nervine disorders, liver disorders.

Keywords: *Barleria*, *Gastrointestinal Disorders*, *Hepatoprotective*, *Immunorestorative*, *Nervine Disorders*

INTRODUCTION

Barleria prionitis (L.) or Porcupine flower or Vajradanti widely distributed throughout the hotter part of India. The plant is especially well known for treating bleeding gums and toothache because of its antidontalgic property known as ‘Vajradanti’. *Barleria* is an erect, prickly shrub, usually single-stemmed. It belongs to family Acanthaceae.

Barleria is the third largest genus of Acanthaceae with 300 species (Balkwill & Balkwill, 1997; Mabberley, 2008) distributed chiefly in the tropical and subtropical parts of the world. Karthikeyan *et al.*, (2009) enumerated 29 species whereas Balkwill & Balkwill (1997) reported 32 species from India. *Barleria* can be easily distinguished from other genera of Acanthaceae. *Barleria* has combination of three characters: Calyx 4- with 2 large outer segments and 2 smaller inner ones, spheroid, honey-combed pollen grains and the predominance of double cystoliths (calcium oxalate crystals) in the epidermal cells. The whole plant, leaves, bark, stem, flower and roots are used for a variety of purposes in traditional Indian medicine. It is widely planted as an ornamental and cultivated in Asia as a hedge plant (Burkill 1985).

Whole-plant extract of *Barleria* contains a number of active compound classes like alkaloids, terpens, flavonoids, glycosides, lignins, phenolics etc., which have shown potent therapeutic activities against several diseases (Saadabi *et al.*, 2006; Mukherjee *et al.*, 2009; Agrawal *et al.*, 2011; Gantait *et al.*, 2011). *Barleria* also shows various pharmacological effects such as antimicrobial, anthelmintic, anti-fertility, antioxidant, anti-diabetic, anti-arthritis, hepato-protective, diuretic, cytoprotective, antidiarrhoeal, analgesic, antileukemic, anti-inflammatory and hypoglycemic properties without any toxic effects. Extracts of the plant have also been shown to effectively suppress the fungus *Trichophyton mentagrophytes* under *in vitro* studies (Panwar *et al.*, 1979).

Methanolic extract of plant shows anti-inflammatory (Singh *et al.*, 2005; Amoo *et al.*, 2009) and antispematogenic effect without affecting the general metabolism of body (Verma *et al.*, 2005). Extracts of the plant are incorporated into herbal cosmetics and hair products to promote skin and scalp health (Prakruti, 2002, Vaipani, 2002).

Bark powder given in cough and bark juice in ‘anasarka’ root paste applied on boils and glandular swellings (Chopra *et al.*, 1996, Khare, 2007). Bark extract is effective in controlling candidiasis and other oral fungal infections (Aneja *et al.*, 2010). The extract of *Barleria* plant has been found to possess a wide range of pharmacological properties. Extracts of the plant have also been shown to effectively suppress the fungi *Trichophyton mentagrophytes in vitro* (Panwar *et al.*, 1979).

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Classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Scrophulariales

Family: Acanthaceae

Genus & Species: *Barleria prionitis*

English Name: Porcupine flower

Vernacular Names: (Sanskrit)Vajradanti,; (Hindi) Kala Bans, Piabansa, (Urdu) Pila Bansa, Piya Bansa; (Bengali) Peetjhanti; (Gujarati) Kantashila (Kannada) Mullugorante; (Malayalam) Chemmulli, Varelmutti; (Marathi) Kalsunda, Kholeta, Koranta, Pivala-Koranta; (Odia) Daskeranta; (Tamil) Semmulli; (Telugu) Mullugorinta Chettu.

Distribution / Range: *Barleria* is genus of 300 species (Mabberley, 2008). It is a native of Tropical East Africa and Asia including India, Indonesia, Malaysia and the Philippines. It is widely cultivated in many tropical countries including Hawaii and Puerto Rico (Liogier, 1997). It has been cultivated throughout the world as an ornamental plant, and has escaped from gardens in many regions including Mauritius, Hawaii, Puerto Rico and Papua New Guinea. *Barleria* has some beneficial properties that undoubtedly have helped increase its distribution:

Morphology: Vajradanti is a member of Acanthaceae family and exists as both herbs and shrubs (Balkwill & Balkwill, 1997). Vajradanti is an erect, spiny shrub, usually single-stemmed, growing to about 0.6 - 1.8 m tall. The older stems and branches are stiff and smooth and light brown to light grey in colour. Younger stems are somewhat quadrangular in cross-section and greenish in colour. The oppositely arranged leaves are up to 3-10 cm long and 1.5 - 4 cm wide and oval-shaped though narrow at both ends and hairless or slightly hairy. The base of the leaves is protected by three to five sharp, pale coloured spines, 10–20 mm long. The yellow–orange tubular flowers are found bunched tightly together at the top of the plant, but they also occur singly at the base of leaves. Flowers sessile, often solitary in lower axils, becoming spicate above, 3 – 4.5 cm long and corolla are orange-yellow, tubular. Stamens, exerted, filaments 2 – 2.5 cm long; Ovary ovoid, 3 - 2 mm; Capsules ovoid, 1.5 – 2X0.6 – 0.8 cm, compressed, 2-seeded. Seeds ovoid, 7.4 – 8.5 6 – 6.8 mm. (Shetty and Singh, 1991)

It contains two fairly large, flat seeds, typically 8 mm long by 5 mm wide, covered with matted hair. *Barleria* has a central tap root, with lateral roots branching off in all directions. these shrubs flower from September to December and fruit from January to April (Parrotta, 2001). The flowers are sessile, yellow or pale orange in colour, tubular in shape (3-4 cm long) with protruding stamens. Each flower has five corolla lobes and four spine-tipped sepals (about 15 mm long). Flowering occurs mainly during autumn (April and May). The fruit are normally present during winter. The fruit is a capsule (13-20 mm long) with a sharply-pointed 'beak' (about 6 mm long) and contains two seeds. Seeds are reasonably large (about 8 mm long and 5 mm wide), flattened, and densely covered with matted hair (Howard 1989, Liogier 1997).

Chemical Constituents: Whole plant extract of Vajradanti contain iridoid glycosides, barlerin and varbascoside. Two iridoid glycosides, barlerin and acetyl barlerin are reported in Vajradanti which are classified barlerinoside, shanzhiside methyl ester, 6-*O-trans-p*-coumaroyl-8- *O*-acetylshanzhiside methyl ester, barlerin, acetylbarlerin, 7 methoxydiderroside and lupulinoside (Ata *et al.*, 2009). Barlerinoside has shown antioxidant activity. Flavonoids extracted from callus showed maximum antibacterial activity against *S. aureus*. (Chetan *et al.*, 2010). Phytochemical analysis of leaves yielded alkaloids, flavonoids, steroids, saponins, tannin, and phenolic compounds (Aneja *et al.*, 2010).

Cultivation:

Vajradanti is a popular garden ornamental and reproduces by seed; one plant producing hundreds of seeds in a season. Seeds require moist conditions to germinate. Although most seeds germinate within a few meters of the parent plant, infestations can move relatively quickly downhill, where seed transport may be aided by water. Vajradanti can also reproduce vegetatively. *Barleria* grows on a wide variety of soil types

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and seems to prefer well-drained soils. On the Australian mainland it grows well in tropical savanna country and along riverbanks.

Usage: Vajradanti possesses undoubtedly numerous medicinal properties and widely used in treatment of gastro-intestinal disorders, digestive troubles, constipation, intestinal worms, liver disorders, whooping cough, fever, toothache (Burkill, 1985), respiratory syncytial, joint pain (Parrotta, 2001). It shows hepatoprotective, anti-stress, immuno-restorative, diuretic, anti inflammatory, antioxidant properties. It is a good nervine tonic and used in nervine disorders. Crude extract of Vajradanti is also beneficial in graying of hair arthritis and goiter curing (Khare, 2004). Vajradanti reportedly has antimicrobial activity against a wide range of micro-organisms that cause infectious disease (Aneja *et al.*, 2010). It has antiseptic properties, extracts of the plant are incorporated into herbal cosmetics and hair products to promote skin and scalp health (Prakruti, 2002).

As medicine in the Ayurvedic System:

In ancient Indian systems of medicine (Ayurvedic, Siddha) stem, leaves and flowers of *Barleria* are used for toothaches, inflammation, gastrointestinal disorders, whooping cough (Chopra, 1996). Whole plant is used for urinary and paralytic affections, rheumatism, jaundice, hepatic obstruction and dropsy. Paste of roots is applied to boils and glandular swelling, dried bark is given in whooping cough. Juice of the leaves is used in ulcer and fever (Ambasta, 1986)

Leaf juice is given in stomach disorders, urinary affections; mixed with honey and given to children with fever and catarrh. Leaf juice is also applied to lacerated soles of feet in the rainy season and after mixing with coconut oil, it is applied for pimples. Roots paste is applied over boils and glandular swellings. Ash, obtained from the whole plant, mixed with honey, is given in bronchial asthma.

Vajradanti contains a variety of active compound classes like alkaloids, flavonoids, glycosides, phenolics, saponins etc. It has been used in the medicines for their wide therapeutic activities (Saadabi *et al.*, 2006). In modern era of medicine the demand of herbal medicines is increasing rapidly because of their higher safety margin and low cost. Scientific researchers have shown it to be beneficial in different disease.

Antibacterial Activity:

Several reports demonstrated that the extract of *B. prionitis* leaves and callus possesses antibacterial activity against a number of Gram positive bacteria. Ethanolic extract of *B. prionitis* showed antibacterial activity against *Bacillus cereus* and *Pseudomonas aeruginosa* (Kosmulalage *et al.*, 2007). The extracts of barks, leaves and stems showed potent antibacterial activity against oral pathogens *Streptococcus mutans*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Bacillus cereus* causing dental caries (Aneja *et al.*, 2010). The antimicrobial activity of *B. prionitis* may be due to the presence of acetylbarlerin, barlerin, shanzhiside methyl ester, verbascoside, balarenone, pipataline, 13, 14-seco-stigmasta-5, 14-diene-3- α -ol and 6-O-acetyl shanzhiside methyl ester (Kosmulalage *et al.*, 2007; Aneja *et al.*, 2010).

Antifungal Activity:

Methanol, ethanol and acetone extract of Vajradanti bark showed more potent antifungal activity against *Saccharomyces cerevisiae* and two strains of *Candida albicans*. (Aneja *et al.*, 2010). It is investigated that ethanol extracts of stem and root showed fungistatic and fungicidal activities against *Candida albicans* (Amoo *et al.*, 2011).

Antioxidant Activity:

It is found that the whole plant extract of vajradanti possesses potent antioxidant activity. Study evaluated that the ethanolic extract possess more potent antioxidant activity then aqueous (Chetan *et al.*, 2011). Another study revealed that the methanolic extract of roots, leaves and stem possesses significant antioxidant activity (Amoo *et al.*, 2011). It was observed that the leaves showed higher degree of antioxidant potential and high phenolic content in comparison to flower and stem (Jaiswal *et al.*, 2010).

Anti-Inflammatory Activity:

Several studies evaluate the use of Vajradanti in the treatment of inflammations. Anti-inflammatory activity of ethanolic extracts of leaves, stems and roots was documented through *in-vitro* inhibition of enzyme dichloromethane (COX-1 and COX-2) with subsequent inhibition of prostaglandin synthesis (Amoo *et al.*, 2009). Another study revealed that the whole plant extract is very effective against

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carrageenin- induced paw edema in rats (singh, *et al.*, 2003). Moreover, the ethanolic extract of flowers was investigated for significant anti-inflammatory activity in rats (Jaiswal *et al.*, 2010)

Antifertility Activity:

The antifertility activity of *B. prionitis* roots was observed (Gupta *et al.*, 2000). Oral administration of methanolic root extract reduced the spermatogenesis in male albino rats (Gupta *et al.*, 2000; Verma *et al.*, 2005). Decreased number of production of round spermatids, sperm motility, spermatogonia, preleptotene spermatocytes population and mature leydig cells was revealed by Gupta *et al.*(2000). Biochemical investigation reported that the root extract was also reduced the total protein, glycogen, sialic acid contents of the testes, testicular glycogen contents, epididymides, ventral prostate and seminal vesicle (Gupta *et al.*, 2000; Verma *et al.*, 2005). The antifertility effect of root extract may be due to the presence of barlerin and acetyl barlerin via affecting the functions of testicular somatic cells (Gupta *et al.*, 2000).

In Vitro Conservation Studies in Barleria:

Medicinal plants are very useful but due to over-utilization and continuous depletion have affected their supply and loss of genetic. The immediate rising demand of plant-based drugs is unfortunately creating heavy pressure on some important medicinal plant populations in the wild due to their over-harvesting. Most of the study is based on conservation strategies for threatened medicinal plants with special reference to *Barleria prionitis* using *in vitro* and *ex vitro* propagation techniques. Due to over-exploitation of this species, there is a danger of becoming extinct because medicinal plant species are mostly threatened by over-exploitation, land conversion and habitat destruction. More than 95% of almost 400 plant species used in preparing medicine by various industries are harvested from wild populations in India. We have developed here a protocol for plant regeneration of *Barleria prionitis*. The International Union for Conservation of Nature (IUCN) Species survival commission report “Extinction crisis continues apace” for the year 2009 revealed that 70% of plants are under threat. The continuous exploitation of several medicinal plant species from the wild (Kala, 2003 Planning Commission Report 2000) and substantial loss of their habitats during past 15 years have resulted in population decline of many high value medicinal plant species over the years. The primary threats to medicinal plants are those that affect any kind of biodiversity used by humans (Sundriyal and Sharma, 1995; Rao *et al.*, 2004). Use of Plant growth regulators in *in vitro* techniques have found increasing use in the conservation of threatened plants in recent years. Some researchers develop a protocol for callus induction in *Barleria prionitis* (Premjet *et al.*, 2010; Shukla *et al.*, 2011).

Shoot regeneration and multiplication of *Barleria* could be traced in the literature search. There are many reports showing that the application of thidiazuron (TDZ) results in a better shoot regeneration capacity in comparison with other cytokinins (Babaoglu, 2000; Zhang *et al.*, 2001). Much work has been done for conservation of medicinal plants, but only a few studies are reported for *B. prionitis* in the field of conservation management, and there is no report of systematic cultivation of this important plant. However, no successful protocol has been developed yet for plant regeneration of this important medicinal plant (Shukla *et al.*, 2011). Therefore, attention has been focused on develop a best protocol for *in vitro* regeneration of *Barleria* species using different explants and different hormones combinations. Future conservation biotechnology research and its applications must be aimed at conserving threatened, mainly endemic plants from conservation hotspots.

CONCLUSION

From the ancient time Vajradanti occupy a significant place in the Ayurvedic medicine in India. The detailed information as provided in this review on conservation strategies and traditional uses, phytochemistry and pharmacology of the extracts of different parts might be added value in the scientific evaluation of medicinal use of this plant. Literature survey revealed the promising pharmacological activity includes antimicrobial, anthelmintic, antifertility, antioxidant, antidiabetic, anti-inflammatory, anti-arthritis, cytoprotective, hepatoprotective, anti-diarrhoeal, enzyme inhibitory, diuretic and anti-nociceptive activities of the extract and isolated chemical compounds of this plant without any toxic effects. In future study, the conversion of these pharmacological activities in to the modern drugs, proper

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scientific evaluation includes isolation of responsible phytochemicals, their mechanism of actions, toxicity of these molecules and proper standardization need to be explored.

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