Review Article

A Review: Traditional, Ethnomedicinal Utilization, Pharmacological Properties and Phytochemistry of *Barleria prionitis* Linn.

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ABSTRACT

Barleria prionitis linn.is a widely dispersed indigenous plants throughout the Indian subcontinent. In the Ayurvedic medicine of the India, it has a significant place due to its biological and pharmacological activities. The various parts of *B. prionitis* it is are widely used to cure an array of ailments by different ethnic communities. The whole plant or its parts like leaf, root, stem, bark and flower has been widely utilized for the cure of catarrhal affections, swellings, whooping cough, inflammations, toothache, glandular swellings, urinary infection, fever, gastrointestinal infections, diuretic and also in the treatment of dental infections. A lot of efforts have been made by several researchers to substantiate the effectiveness of plant in the course of precise biological and pharmacological activities to cure of various diseases. The examination of scientific literature revealed the outstanding biological activities of this plant such as antidiabetic, antibacterial, antifungal, analgesic, anti-inflammatory, hepatoprotective, antioxidative property etc. The excellent biological activity of the B. prionitis is due to presence of a wide range of phytochemicals like balarenone, pipataline, prionisides, barlerino side, verbascoside, barlerin, acetyl barlerin, lupulinoside, scutellarin that are responsible for a group of biological and medicinal activities. This review summarizes the current knowledge of the *B. prionitis* with a comprehensive insight, especially focusing on their traditional, ethanobotanical properties, pharmacognostic, phytochemical and pharmacological activity.

Keywords: *Barleria prionitis* Linn, Traditional uses and ethnobatanical aspects, Phytochemistry, Pharmacological properties.

INTRODUCTION

Plants have been used as traditional medicine for several thousands of years. Since the beginning of this century, ethno-botanical and traditional uses of natural compounds, mainly of plant origin established much interest as they are well tested for their efficacy and generally believed to be safe for human use. Plant derived medicine is still a basis of about 70-80% of the world's population as they are effortlessly accessible source for healthcare purposes in rural and tribal areas. India being the largest producer of medicinal plants therefore it is perfectly recognized as botanical garden of the world. Plants are the backbone of all life on the Earth and indispensable resource for human welfare as raw medicine, food and fuel. According to WHO more than 80% of world's population relies on traditional medicine for their health care needs[1-3]. Traditional plant derived medicines have been used in most parts of the world and their use in combating microbial diseases is attractive the focus of a number of studies[4-5,3]. Plant derived substances have recently become of great interest owing to their resourceful applications. It has been estimated that 14-28 % of higher plant species are used in the medicinal purposes and that 74% of pharmacologically active phytochemicals components were revealed after following up on ethno medicinal exploit of the plants[6]. In the last couple of decade, a new progress in the research and promotion of plants based drugs has become increasingly towards the herbal medicines[7-8]. At the present time multiple drug resistance has developed due to indiscriminate exploitation of commercial antimicrobial drugs that frequently used in the treatment of infectious diseases[9].

Distribution

B. prionitis is distributed throughout the hotter parts of India and commonly grown in gardens as a hedge plant[10-11]. In India it is commonly found in Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Diu and Daman, Goa, Gujarat, Jharkhand, Karnataka, Kerala, Laccadive and Maldiv Islands, Madhya Pradesh, Maharashtra, Orissa, Pudhucherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal[5].

Habitat

Barleria prionitis Linn. (Acanthaceae) is well known perennial ayurvedic herb dispersed all over Africa, India, Sri Lanka and tropical Asia. In ayurveda it is known by various names like kuranta, kurantaka, kuranda, kurandaka, sahachara, shairiya. In folk medicine it is popularly known as piyaabasaa, jhinti and ketsariyaa. It is also known as 'vajradanti because of its anti dontalgic property[10,12].

Taxonomy

Kingdom – Plantae
Division – Magnoliophyta
Class – Magnoliopsida
Order – Scrophulariales
Family – Acathaceae

Genus – *Baleria*
Species – *prionitis*

Morphology

B. prionitis Linn.is erect, bushy shrub grows up to 1-2 m in height. They possess 2-4 sharp long axillary spines which about 11 mm long. The stems are erected, glabrous, much branched with cylindrical and tapering branchlet[13-14]. *B. prionitis* is a shrub and flowers are yellow in colour. Flowering occurs during August – October [15-16].

The flowers are sessile, and often solitary in lower axils and spictate in the upper axils. Flowers are equally broad as well as tubular and about 3-4 cm in length. The fruits are ovoid and capsular. The leaf are elliptic containing 5-20 mm long spines is about 3-10 cm long and 1.5-4 cm broad. The stems are light tan or gray coloured stiff, round, cylindrical and glabrous[17-18]. Leaves are smooth, opposite, ovate-elliptic to obovate, acuminate, tapering to base, bristle-tipped and about 6-15 cm long and 4-6 cm wide. The petioles are about 0.5-3 cm long [11]. The fruit capsule is ovoid, 2 seeded and about 1.5-2 cm long and 0.6-0.8 cm wide. The seeds are oval-oblong, covered with silky copper-brown apprised hairs and measuring about 7.4-8.5x6-6.8 mm. The seeds of *B. prionitis* are flattened, covered with tangled hairs, about 8 mm long and 5 mm wide. Bracts are acute, linear-lanceolate, foliaceous, about 1-1.5 cm long and 0.2-0.8 cm wide with bristle tipped. The corolla is bright, golden yellow in colour with pubescent outside and glabrous inside and measuring 1.5 cm long. The stamens include 2 fertile stamens and 2 staminoid stamens. The fertile stamens are exerted away from the corolla tube while the staminod stamens are very short. The filaments are hairy and about 2-2.5 cm long, glandular-pubescent and yellowish in colour. The anthers are yellow in colour with 3 mm long [13-14, 11].

Traditional and Ethno botanical uses

The whole plant, root, leaves and bark of the *B. prionitis* Linn. be present in a crucial place in the indigenous system of medicine (Ayurveda) in India for controlling the different types of ailments such as inflammations, swellings, boils, glandular etc[19-21]. The juice of *B. prionitis* has been reported to use for cure of whooping cough in Uttar Pradesh and Madhya Pradesh states of India, and leaves are use for the treatment of toothache, rheumatism, and root powder to cure fever[22-24]. The juice of leaves of *B. prionitis* is useful in fungal infections, ulcer and fever [25-27]. The decoction of aerial parts of *B. prionitis* is used in whooping cough, anti-respiratory synctyial virus, antiarthritic, anti-inflammatory and antifertility activities. It was also reported that 4 g of plant powder mixed with Nimbuka Swarasa and given twice in a day for 10 days to cure tonsillitis[28]. Root extract is uses locally on skin to expel out spine from the skin and decoction is taken orally for the cure of snakebite[29-30]. *B. prionitis* is used in urinary infection, jaundice, hepatic obstruction and dropsy. Ash of the whole plant with honey is uses in bronchial asthma [31-32, 19].

In India, the aerial parts like leaves, stem, and flowers are used in catarrhal affections of children, glandular swellings, boils, fever, toothache, inflammation and gastrointestinal disorders. Bark is uses in whopping cough as an expectorant; the whole plant particularly the roots are used as tonic and diuretic[34-34,15, 35-37]. In medico-botanical survey of villages of Bulandshar district of Uttar Pradesh, (India), rural residents use *B. prionitis* in cases of asthma and whooping cough. Local peoples called it Kala Bansa or Piya-Bansa[38]. *B. prionitis* is used in stiffness of limbs, enlargement of scrotum and sciatica[26-27].

In Maharashtra (India), crushed leaves of *B.prionitis* are applied on the wound[39]. It was revealed in an ethno-medicinal survey that pills prepared from *B. prionitis* are used for massage in combination with coconut oil and these pills give purity, rubefacient and blotchto body[40]. The folk medicinal healers of Bangladesh use the *B. prionitis* for anti-inflammatory activity, and also for the treatment of cancer and tumour[41]. In a study it was reported that *B.prionitis* root with goat milk is given to treat rheumatic fever. Root, stem or leaves powder with cow milk is taken as remedy for dropsy and liver congestion[42]. In a ethanomedicinal survey conducted in Andhra Pradesh, India, revealed that local residents use *B. prionitis* to increase vitality by using seed extract daily once for fortnight. *B. prionitis* also being used in gout, ulcer of mouth and oedema[43]. In Orissa (India) the *B. prionitis* have been used in cuts, wounds and malaria[44], and In Gujarat (India), leaf ash is being used for the management of leucoderma by applying with butter[45]. The use of *B.prionitis* fresh leaf paste has also been reported against Scabies in Karnataka (India)[46].

Antimicrobial properties

Antibacterial activities

The antibacterial activity of different parts of *B. prionitis* has been reported. It was also reported that among the extracts, MeOH bark extract showed potential antibacterial activity against all the pathogens. Crude MeOH extract revealed good antibacterial activity against MDR (multidrug resistance) *E. coli* with 12 mm of inhibition zone[21,47]. Chetan et al., 2010 were reported the antibacterial activity of EtOH (ethanolic) leaf extract of *B. prionitis* against *S. aureus, B. subtilis, P. vulgaris, K. pneumoniae, E. coli* and *P. aeruginosa.* Antibacterial activity of H_2O, PET, $CHCl_3$ and ACE extracts *B. prionitis* were reported against *L.rhamnosus* (MTCC1408), *S.mutans* (MTCC 890), *S.aureus* MTCC 3408), *A. viscoscus* (MTCC 7345), *S. epidermidis* (MTCC 3639), *E.coli* (MTCC 732) and *B. subtilis* (MTCC 3160)[48]. Prominent inhibition of the four extracts was observed for bacterial species, *L. rhamnosus* and $CHCl_3$ extract was found to be more effective against the entire test microorganism[48]. *In vitro* propagated shoot tips and leaves of *B. prionitis* with EtOH, ether and $CHCl_3$ extracts showed the antibacterial activity[31]. Antibacterial activities of *B. prionitis* bark and leaf MeOH extracts against *B.cereus* (22.66 mm) followed by PET leaf extract against *E. coli* (21.66 mm). Minimum

inhibition was showed by PET leaf extract against *A. faecalis* (4.66 mm) followed by MeOH bark extract against *A. faecalis* (5.33 mm)[49]. Patel et al., 2015 reported the ethyl acetate of *B. prionitis* leaves extract showed inhibition zone on Gram positive *B. pumilus* (9.83 mm) and MeOH extract of *B. prionitis* stem showed inhibition zone on Gram negative *E. coli* (0.16 mm). PET extract did not show inhibition except, PET extract of *B. prionitis* stem on Gram positive *B. pumilus* (0.46 mm). MIC was showed by PET extract of *B. prionitis* leaves on Gram positive *B. pumilus* and Gram negative *P. aeruginosa* (1.0 mg/mL). Leaves and stem extract of *B. prionitis* showed difference in antibacterial activity. Aiswarya and Ravikumar, (2014)[50]reported the PET and EtOH extract of *B. prionitis* showed good antibacterial activity. The PET extract of *B. prionitis* was most effective against *P. putida* and *B. subtilus* with a zone of inhibition of 28 mm. Zone of inhibition for PET extracts of *B. prionitis* was compared with standard antibiotics. The EtOH extract of *B. prionitis* was most effective against *P. putida* with a zone of inhibition of 25 mm. Bacterial strains of *E. coli, P. beteli, P. fluouscense, S. paratyphi, S. aureus, B. subitilus, P. putida* were selected. The PET extract of *B. prionitis* was most effective against *P. putida* and *B. subitilus* while the EtOH extract of *B. prionitis* was most effective against *P. putida*[50]. The antibacterial activity of rhizome of *B. prionitis* MeOH extract reported maximum inhibition zone (16.2 mm) against *E. coli* and minimum against *S. typhi*[51]. ACE, EtOH, MeOH extract of bark and ciprofloxacin showed significant activity against *S. mutans* (14.95±1, 11.94±1, 15.65±0.57 and 27.32±0.57 mm), *S. aureus* (14.31±0.57, 14.0±0, 16.32±0.57 and 34.66±0.57 mm), *Pseudomonas* sp. (18.32±0.57, 17.65±0.57, 19.32±0.57 and 33.66±0.57 mm) and *Bacillus* sp.(27.32±0.57, 23.97±1, 28.65±0.57 and 29.65±0.57 mm). The antibacterial activity of *B. prionitis* leaf extracts were reported against *S. typhi, V. cholerae, M. luteus, L. sporogens, Citrobacter, B. subtilus, B. cereus,* and *Providencia*[52].

Antifungal activities

The antifungal activity of ACE, EtOH and MeOH bark extracts of *B. prionitis* against *S. cerevisiae*, *C. albicans* and MeOH extract was found more active against all the fugal strains [31,21]. Antifungal activity of *B. prionitis* were reported against *C. neoformans, C. albicans, C. vaginitis, B. dermatidis* using $CHCl_3$, acetonitrate and EtOH extract of stem, leaves and roots[53].

It was also revealed that PET, dichloromethane and EtOH stem and root extracts of *B. prionitis* showed fungistatic and fungicidal properties against *C. albicans*[12, 54].

Anti-dental decay activity

Crude extract of *B. prionitis* Linn. reported good antimicrobial activity against dental decay pathogens. It was reported that MeOH extract of bark showed much more potent activity against oral pathogens like *S. mutans, S. aureus, Pseudomonas* sp., *Bacillus* sp. and *C. albicans, S. cerevisiae*[21].

Antiviral activities

Two iridoid glycosides (i.e., 6-O-trans-p-coumaroyl-8-O-acetlshanzhiside methyl ester and its cis isomer from *B. prionitis* were reported by Chen et al. (1998)[55]. These bioactive phytochemicals revealed the potent antiviral activity against respiratory Syncytial virus (RSV) with EC_{50} and IC_{50} values of 2.46 and 42.2 µg mL^{-1}, respectively[12,55].

Pharmacological properties

Antioxidant activities

The MeOH extract of root leaves and stems showed potent antioxidant activity. EtOH extract of whole plant of *B. prionitis* showed significant antioxidant activities. It was reported that the antioxidant activity of MeOH extract of leaf and stem were showed IC_{50} values 63.41±0.32, 81.69±0.40, respectively. Reducing power of the MeOH extract of *B. prionitis* was observed maximum[56, 57, 58]. *In vitro* investigation showed that the EtOH and H2O extract of whole plant possess considerable antioxidant activity[58]. MeOH leaf extract showed significant high antioxidant activity (61.73) in 6000 ppm concentration followed by PET bark extract (59.11)[49]. *In vitro* antioxidant activity of crude MeOH extract of *B. prionitis* was reported by Khobragade et al., (2012)[59].

MeOH extracts of roots, leaves and stems showed significant antioxidant potential[54]. The leaves of *B. prionitis* showed high level of antioxidant activities as well as high amount of phenolic content as compared with flower and stem[60]. Thabrew et al., (2001)[61] was reported that effect of marketed preparation containing *B. prionitis* for antioxidant potential on rheumatoid arthritis patients. This investigation showed that three months treatment of preparation has high antioxidant potential.

Anti-diabetic activities

The alcoholic leaves extract of *B. prionitis* revealed antidiabetic potential. In a study it was reported that oral administration of alcoholic extract at dose concentration 200 mg kg^{-1} body weight considerably decreased the blood sugar, glycosylated haemoglobin level and increased serum insulin and liver glycogen level in diabetic test organism (rats). The alcoholic extract of root of *B. prionitis* showed a moderate but insignificant antidabetic activity in investigational animals[62].

Anti-arthritic activities

The TAF fraction was showed antiarthritic activity in *M. tuberculosis* induced adjuvant arthritis rats model[63]. It was observed that *B. prionitis* and isolated shanzhiside esters from the same plant can be strongly categorized under potential antiarthritic drugs since both were active in adjuvant induced arthritic model[64]. From the bibliography search it was revealed that three reports have been known where *B. prionitis* showed anti-arthritic potential[12, 63, 65,66].

Anti-fertility activities

The roots extract of *B. prionitis* showed the antifertility potential[67]. Oral administration of MeOH root extract reduced the sperm formation in male albino rats[67,68]. Root extract decreased the formation of round spermatids, sperm motility, spermatogonia, preleptotene spermatocytes population and mature leyding cells[67].

Anti-helminthic activity

Anti-helminthic activity of *B. prionitis* whole plant extract was reported in dose dependent manner. It was showed that *in vitro* EtOH and H_2O extracts were significantly paralyzed the *P.posthuma*, a worm at 50, 75 and 100mg/mL^{-1} and also comprised with a standard drug albendazole. The extracts of *B. prionitis* caused death above 100 mg mL^{-}[169].

Anti-diarrheal activity

Butanol fraction of *B. prionitis* leaves showed the anti-diarrheal activity. Iridoid rich fraction of butanol (BuOH or n(BuOH)) of leaf extract possess dose dependent anti-diarrhoeal activity at the concentration of 25-100 mg/kg in rats against castor oil induced diarrhoea[70-71].

Anti-inflammatory activities

Several reports demonstrated the usage of *B. prionitis* in the treatment of inflammations. The anti-inflammatory activity of *B. prionitis* was evaluated through *in vitro* enzyme based cyclooxygenase (COX-1 and COX-2) assays. It was found that the dichloromethane (DCM), PET and EtOH extracts of leaves, stems and roots exhibited significant inhibition of COX-1 and COX-2 with subsequent inhibition of prostaglandin synthesis that are involved in pain sensation[54]. The H2O fraction (TAF) of hydro-ethanolic extract of *B. prionitis* whole plant reported to have significant anti-inflammatory activity against the acute inflammation induced by carrageenan, histamine and dextran in rats. The anti-inflammatory activity of the 'TAF' may be due to the presence of iridoid glucosides, shanzhiside methyl ester, acetyl barlerin and barlein[72]. Another study revealed that the H2O extract fractions (FR-III and FR-IV) of root significantly inhibited the caragennan induced rat paw edema[32]. The FR-III and FR-IV at oral dose concentration of 400 mg kg^{-1} body weight inhibited the paw edema by 50.64 and 55.76%, respectively and the results were comprised with the reference standard drug (indomethacin) with a 60.25% of inhibition[32]. The EtOH extract of flowers also exhibited anti-inflammatory activity in rats[73]. Oral administration of flower extract (200 mg kg^{-1} body weight) showed significant dose-dependent reduction in carrageenin induced swelling and cotton pellet granuloma weight that were equivalent to 48.6 and 36.4% protection[73].

Cytoprotective activities/ mast cell migration activity

Mast cells play an important role in inflammatory responses and release histamine upon their degranulation to produce various allergic reactions[74]. Maji *et al*. (2011)[75] reported that the hydro-methanolic extract of *B. prionitis* (whole plant) showed dose-dependent mast cells and erythrocyte membrane protection activity in response to the toxic chemicals. The extract inhibited the compound 48/80 induced mast cells degranulation up to 64.91% at dose concentration 10 µg mL^{-1} and the result was comprised with the reference standard (disodium cromoglycate) (10 µg mL^{-1}) with 19.32% protection[75]. The extract (10 µg mL^{-1}) provided significant erythrocyte membrane protection (27.10%) against hypotonicity haemolysis and the result was comprised with reference standard (indomethacin) (10 µg mL^{-1}) with 61.29% protection[75].

Enzyme inhibitory effects

The extracts from different parts and isolated phytochemicals of *B. prionitis* reported to inhibit the clinically significant enzymes, Acetylcholinesterase (AChE) and glutathione S-transferase (GST). Kosmulalage *et al*. (2007)[76], Ata *et al*. (2007,2009)[77], Amoo *et al*. (2009)[54], reported that the MeOH extracts of leaf, stem and root of *B. prionitis* exhibited AChE inhibitory performance and the leaf and stem extracts exhibited higher potency of inhibition in compare the root extract. Several glycosides compounds showed different levels of AChE inhibitory activity. Prioniside B and prioniside C also showed GST inhibitory activity of which prioniside B and prioniside C were more potential GST inhibitors[76-77].

Hepatoprotective activity

The iridoid glycosides enriched fraction from hydro-ethanolic extract of leaves and stems of *B. prionitis* was reported to show significant hepatoprotection against carbon tetrachloride, galactosamine and paracetamol induced hepatotoxicity in mice and rats[78]. The oral administration of iridoid fraction significantly reduced the hepatotoxin induced elevated levels of serum alanine aminotransferase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP), bilirubin and triglycerides in a dose dependent manner. The fraction was also increased the hepatic glutathione content and reduced the hepatic lipid peroxidation in response to the hepatotoxicity in mice and rats[78].

Diuretic property

B. prionitis showed diuretic activity was reported by the extract of leaves and young inflorescence. Juice of leaves is used in urinary afflictions. The diuretic property may due to the presence of high concentration of potassium[79-80]. The diuretic property of *B. prionitis* flower extract was performed by Musale *et al*. (2011)[81]. The oral administration of flower H_2O extract (200 mg kg^{-1}) was significantly increased the urination (dieresis) and sodium removal but not potassium in rats. The diuretic effect of flower extract (200 mg kg^{-1}) was comprised and statistically significant with drug furosemide (20 mg kg^{-1})[81].

Central nervous system depressant activity

Ethyl acetate portion (at dose concentration of 125 and 250 mg/kg) and diclofenac (4 mg/kg) treatment significantly increased fall off time of motor co-ordination in rota rod test[65]. EtOH extract of *B. prionitis* leafs by using acto-photometer reported fluoxetine stimulant activity in mice as 91.93% while the test drug stimulated the animal only by 49.72%[82].

Toxic effects

In a study it was reported that the alcoholic extract of roots and leaves of *B. prionitis* did not reported any toxic effects in adult albino rats[62]. In a study Dheer and Bhatnagar (2010) observed that the oral administration of alcoholic extract at the dose concentration up to 2.5 g kg^{-1} body weight throughout the 14 days of study period without any mortality. Singh *et al*. (2005)[78] reported that the iridoidglucosides rich aqueous portion *B. prionitis* did not produced any signs of abnormalities or any mortality up to the single oral administration of 3000 mg kg^{-1} dose in mice during the 15 days of study period. Nevertheless, the intra-peritoneal LD_{50} was determined as 2530 mg kg^{-1} for the aqueous portion in mice[78].In another study the acute oral toxicity of MeOH extract of *B. prionitis* was reported using Spargue – Dawley rats (n=5). The LD_{50} was found to be more than 200 mg/kg, with no sign of abnormality or any mortality observed for 14 days after single dose administration[65].

Antinociceptive activity/analgesic activity

The analgesic activity of *B. prionitis* flowers extract was reported using an UgoBasile Analgesy meter induced artificial pain and acetic acid induced writhing models[73]. *In vivo* study showed that the flower extract dose dependently provided a significant increase in the analgesio-meter-induced force and exhibited significant resistance against pain in mice[73]. At a dose concentration of 50 mg kg^{-1} body weight, the flower extract provided statistically significant reduction of writhing by 5.24%[73].

Anti-hypertensive property

The antihypertensive activity of MeOH extracts of leaves of *B. prionitis* using DOCA salt. *B. prionitis* showed significant anti-hypertensive effect in DOCA salt induced hypertensive rats in dose of 200 mg/b.w. and 400 mg/b.w.[83]. DOCA salt induces reabsorbtion of salt and water leading to induced blood volume and hence increased blood pressure. SBP and DBP were increased persistently in DOCA salt treated nephrectomised rats as compared to normal Rat's *B. prionitis* extracts[83].

Anti-cataract activity

Atif et al., (2015)[84] reported that the administration EtOH leaves extract of *B.prionitis* significantly restored the glutathione and malondialdehyde levels. SOD, catalase and glutathione S transferase levels were significantly restored to normal levels ($p<0.05$ and $p<0.01$ respectively). Oral administration of *B.prionitis* significantly late the onset and progression of cataract in selenite as well as galactose induced cataract. It can be said that *B.prionitis* significantly reversed the cataract parameters by virtue of its antioxidant property[84].

Gastro-protective activity

Maximum protections were found to be 66.26% and 59.42% by iridoid fraction (200 mg/kg) in PL induced ulcer and CRS-induced ulcer rat model. Iridoid fraction from leaves reduced ulcer index. In EtOH induced gastric ulcer rat model, MeOH extract of leaf (500 mg/kg bw) and ranitidine provided 67.7 and 75.5% inhibition of ulcer. Same dose of extract and drug displayed 70.3 and 62.2% inhibition in indomethacin induced gastric ulcers model. Extract also showed efficacy against indomethacin induced gastric mucosal damage and increased liver enzymes in EtOH induced ulcer rat model [85].

Anti-arthritic activity

Chaudhary et al., (2014)[65]reported that the ethyl acetate fraction of *B. prionitis* leaves extract possesses antiarthritic activity in Sprague Dawlys rats following OECD 420 guidelines. Dose dependent and significant inhibition of oedema was observed in both acute as well as chronic models. The leaves extract of *B. prionitis* at dose 250 mg/kg showed most potent and significant (P 6 0.05–0.01) paw oedema inhibition which is supported by the results of body weight, biochemical parameters, and motor in coordination and nociceptive threshold in Freund's Complete Adjuvant-induced arthritis model[65]. The effect of two different extracts namely MeOH (ME, prepared by maceration) and butanolic (BE, obtained after partitioning of ME) of *B. prionitis* and the isolated three major iridoids viz., acetylbarlerin (AB), barlerin (B) and shanzhiside methyl ester (SME) from the plant using chromatographic techniques were evaluated in a rat model of Complete Freund's Adjuvant (CFA) induced-arthritis at a single dose of 200 mg/kg for extracts and 1 mg/kg for pure compounds. The results were compared to untreated control and standard (indomethacin, INDO) treated groups. It was observed that on 21st day of experiment, the histopathological, and radiological and biochemical explanations were carried out along with rheumatoid factor. The serum level of cytokines (TNF-α and IL-1β) were also determined using ELISA kits. The results indicate that *B. prionitis* protects rats against the bone loss, body weight changes and haematological perturbations induced by CFA. Further the histopathological and radiological studies also support the generated observations. Thus, the positive effect of the test samples in controlling the various parameters associated with the progression of arthritis demonstrated their pronounced antiarthritic effects, indicating that *B. prionitis* would be a potent candidate for treating arthritis[64].

Larvicidal activity

LC_{50} values were found to be 34.756, 31.351 and 28.577 µg/mL in ACE, CHCl3 and MeOH extract of leaf against *Culextrita eniorhynchus*, respectively[86].

Phytochemical constituents

Preliminary phytochemical screening of *B. prionitis* hydro-methanol extract of whole plant revealed the occurrence of saponins, glycosides, tannins and flavonoids [75].Leaves and stem of *B. prionitis* showed the presence of alkaloids but absence of tannins and saponins were collected from Gujarat (India)[88]. *B. prionitis* reported several phytochemicals such as balarenone, lupeol, prioniside A, prioniside B, prioniside C, pipataline were reported in EtOH extract[77]. Bharat et al., (2006) isolated and identified few phytochemicals from *B. prionitis* like acbarlerin, barlerin, β-sitosterol, flavanol glycoside, iridoids and scutellarein-7-neohesperidoside and showed their anti-inflammatory activities[88]. Some other bioactive phytochemicals like luteolin-7-O-β-D-glucoside, β-sitosterol, scutellarein 7-neohesridoside, apigenin 7-O-glucoside, 13,14-seco-stigmasta-5,14-diene-3-a-ol are found in *B. prionitis*[67,10,76,89,90]. Barlerinoside, 6-O-trans-p-coumaroyl-8-O-acetylshanzhiside methyl ester, 7-methoxydiderroside, 13, and lupulinoside have been isolated from the aerial parts of *B. prionitis*[76-77]. *Barleria* genus is reported to have iridoids, anthraquinones, sterols, fatty acids and flavonoids. Iridoids comprise the major class of compounds isolated from *Barleria* and important bioactive iridoids are acetylbarlerin, barlerin and shanzside methyl ester [91]. For the first time 6-hydroxyflavones have been reported in the family Acanthecae in the genus *Barleria*[90]. The MeOH extract of *B. prionitis* showed the presence of phenols, flavonoids, glycosides, proanthocyanidins, alkaloids and tannins. Phenol and phenolic compounds like flavonoids have been shown to possess significant antioxidant properties [92]. The leaves and flowering tops of *B. prionitis* showed high amount of potassium salts[10]. *B. prionitis* extracts revealed the presence of alkaloids, flavonoids, steroids, saponins, tannins and phenolic compounds, because of these compounds the plants shows significant antihypertensive activity[83]. Total phenolic and flavonoid content of the *B. prionitis* was 0.33±0.1 mgGAE/g and 0.9±0.5 mg of Quercetin equivalent per gram of dry extract respectively[59]. The total polyphenols content in the EtOH and H_2O extract of *B. prionitis* Linn. was showed 43.71 and 35.58 GAE/mg, respectively [58]. The total phenolic content of *B.prionitis* MeOH extract of leaf was found maximum (103.51±0.38mg/g) followed by ethyl acetate (44.31±0.45 mg/g), H_2O (32.82±0.31 mg/g) and n-Haxane (8.33±0.21 mg/g). Stem extract showed maximum with MeOH (94.37±0.18 mg/g) followed by ethyl acetate (44.31±0.45 mg/g), H_2O (32.82±0.31 mg/g) and n-Hexane (8.33±0.21 mg/g), respectively[57]. It was reported that *B. prionitis* showed some antibacterial bioactive compound that include with balarenone, pipataline and 13, 14-seco-stigmasta-5, 14-diene-3-a-ol have been isolated from the ethanolic extract. These phytochemicals showed potent antibacterial activity against *P. aeruginosa* and *B. cereus*[76].

CONCLUSION

B. prionitis Linn. occupy a significant place in the Ayurvedic medicine in all over, India, Sri Lanka including tropical Asia and Africa. *B. prionitis* Linn. depicted the piece of evidence that it is used as a cure for variety of ailments. It is fascinating to message that pure phytochemicals and crude extracts of leaves of *B. prionitis* Linn. have been screened for some pharmacological activities and found to have analgesic, anti-inflammatory, hepatoprotective activity and stem bark of the plant have antidiabetic activity, and juices are screened for hypocholesterolemic and antioxidant activity. The comprehensive survey information as provided in this review on *B. prionitis* traditional uses, ethanobotanical aspects, phytochemistry, pharmacology and toxicity of the extracts of different parts. All-embracing literature survey given away the promising pharmacological includes antimicrobial, anthelmintic, antifertility, antioxidant, antidiabetic, anti-inflammatory, anti-arthritic, cytoprotective, hepatoprotective, anti-diarrhoeal, enzyme inhibitory, diuretic and anti-nociceptive or analgesic activities of the extract and isolated bioactive compounds from *B. Prionitis* devoid of toxicity.

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