ABSTRACT

Barleria prionitis is a famous perennial plant commonly known as porcupine flower or Vajradanti. It is a shrub with yellow flowers and two flat seeds shielded with matted hairs, inhabiting most parts of India. Various parts of the plant such as leaves, roots, aerial parts, flowers, and stems are used in the traditional system of medicine. Conventionally, various infusions are prepared using the plant parts and utilized for the treatment of different kinds of diseases. Owing to its incredible odontalgic property, it is extensively used in treating bleeding gums and toothache. From the pharmacological point, the plant has been effectively screened for antibacterial, antifungal, antiviral, anti-inflammatory, antifertility, antioxidant, enzyme inhibitory, hepatoprotective, antihypertensive, anticancer, and antica racter activities. Compounds such as tannins, saponins, glycosides, phenolic acids, phytosterols, and terpenes have been identified in the plant. The plant contains some specific compounds such as barleroside, barlerine, acetylbarlerine, and balarenone and some common secondary metabolites such as lupeol, β-sitosterol, vanillic acid, and syringic acid. This review provides morphological, ethnomedical, pharmacological, and phytochemical data of the plant B. prionitis.

Keywords: Barleria prionitis, Odontalgic, Tannins, Saponins, Phytosterols, Ethnomedical, Pharmacological.

INTRODUCTION

Barleria prionitis also known as the porcupine flower, which belongs to the family Acanthaceae and genus Barleria. It is native to India, also distributed widely throughout Asia including Malaysia, Pakistan, Philippines, Sri Lanka, Bangladesh, Yemen and tropical Africa [1,2]. Sri Lanka and Eastern Southern and Central Africa. It is an erect, perennial, prickly, and evergreen shrub, usually single-stemmed, growing to about 1.5 m in height from a single taproot. Lateral roots branching in all directions. The leaves are up to 100 mm long and 40 mm wide, oval-shaped though narrow at both ends (ellipsoid). The base of the leaves is protected by three to five sharp, 10-20 mm long, pale-colored spines. The yellow-orange tubular flowers with several long protruding five sharp, 10-20 mm long, pale-colored spines. The yellow-orange tubular flowers with several long protruding stamens. Flowers are packed in bunches tightly together at the top of the plant, but they also occur singly at the base of leaves. Seed capsule which is oval-shaped has two fairly large, flat seeds, shielded with matted hairs with a sharp pointed beak. Stems and branches are stiff and smooth and light brown to light gray in color [3,4]. The taxonomical classification of B. prionitis is given in Tables 1 and 2.

Scientific name - Barleria prionitis
Common name - Porcupine flower
HABITAT

B. prionitis is commonly found in shrub jungles and wayside thickets from plains to 500 m. Common. Tropical Africa, Tropical Asia, Sri Lanka, Pakistan, India, Malaysia. It is commonly found in the following states of India-Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chattisgarh, Delhi, Goa, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, and West Bengal [5].

RATIONALE AND NOVELTY OF THE STUDY

Ethnomedical information about B. prionitis

Family Acanthaceae consists of a large number of medicinal plants and is well known for its use in ethnomedicine. The prionitis species of the genus Barleria provides a variety of traditions properties. The whole plant or its specific parts (leaf, stem, root, bark, and flower) have been utilized for the treatment of catarrhal affections [6], ulcer, whooping cough, inflammations, glandular swellings, urinary infection, jaundice, fever, stomach disorders, and as diuretic and tonic. It is likewise used in urinary infection, jaundice, hepatic obstruction, and dropsy, and the paste of the roots is applied to benefit to boils and glandular swellings. It is also utilized for the treatment of anemia, toothache, and bacterial disorders. The flora is, especially, well recognized for caring for bleeding gums and toothache. Due to its antiodontalgic property, it is as well-known as “Vajradanti” [7]. Some tribal communities utilize the leaves for the treatment of piles and to control irritation. The plant is also utilized for the stiffness of limbs, enlargement of the scrotum, and sciatica [8-11].

Pharmacological activities of B. prionitis

Owing to its traditional use, B. prionitis has been studied for different types of pharmacological activities. Numerous in vitro and in vivo studies on different cell lines and animals have been reported. The present review is focused on giving an overview of the pharmacological activities that have been reported on B. prionitis in the past and present.

Antibacterial activity

Different solvent extracts from leaves and stem parts of B. prionitis L. exhibited antibacterial activity against all Gram-positive bacteria studied (Bacillus pumilus, Bacillus subtilis, Strep tococcus pyogenes, and Bacillus cereus) and Gram-negative bacteria (Escherichia coli, Serratia marcescens, Comamonas acidovorans, and Pseudomonas aeruginosa) [12]. Maximum inhibition was delivered by methanol leaf extract against B. cereus which was followed by pet ether leaf extract against E. coli. Minimum inhibition was shown by pet ether leaf extract against Alcaligenes faecalis, followed by methanol bark extract against A. faecalis. Antibacterial activity of the various extracts of B. prionitis was compared to the standard antibacterial agent ampicillin, tetracycline, and streptomycin, and it appeared to be almost the same [13]. In another study, the petroleum ether extract of B. prionitis was most dynamic against Pseudomonas putida and B. subtilis. While the ethanol extract of B. Prionitis was against P. putida [14]. Some antibacterial phytochemicals include baralene, pipataline, and...
Table 1: Taxonomical classification of *B. prionitis*

| Kingdom       | Plantae |
|---------------|---------|
| Sub Kingdom   | Tracheobionta |
| Division      | Magnoliophyta |
| Class         | Magnolopsida |
| Subclass      | Asterida |
| Order         | Scrophulariales |
| Family        | Acanthaceae |
| Genus         | Barleria |
| Species       | Prionitis |

*B. prionitis: Barleria prionitis*

Table 2: Vernacular names

| Sanskrit        | Vajradanti, Kurantaka, Koranta |
|-----------------|-------------------------------|
| Marathi         | Kalsunda, kholeta, pivalakoranta |
| Tamil           | Aryanycokicci, manjachemulli, mituram, mituri, muli, muli, muliver, pitakantakacci |
| Kannada         | Gorante, gorantedai, muli jaali, muli madarangi, muliugoranta |
| Malayalam       | Manjakkanakambaram, Kanakambaram |
| Hindi           | Kanakambar, Vajradanti, kat-sareya, katsareya, peela bansa |
| English         | Porcupine flower, Crossandra, Barleria |

13,14-seco-stigma-5, 14-diene-3-a-ol have been isolated from the ethanolic extract of *B. prionitis*, and these compounds showed a strong antibacterial activity against *B. cereus* and *P. aeruginosa* [15].

Antifungal activity

The methanolic extract of *B. prionitis* was considered to have a check on Candidiasis and other oral infections, as its bark showed potent activity against the oral fungi such as *Sabcharamyces cerevisiae, Candida albicans* strain 1, and *C. albicans* strain 2, when compared to the standard drug amphotericin-B [16]. In another investigation, the leaf exudates and leaf tissue sap of *B. prionitis* L. have been assessed for antifungal activities against some fungi such as *Curvularia lunata, Curvularia clavata, Alternaria alternata, Nigrospora oryzae*, and *Cladosporium oxysporum*. The percentage inhibition of spore germination was calculated, and the result revealed 40-85% inhibition of all of the species [17].

Antiviral activity

Iridoid glycosides and three phenylpropanoid glycosides, namely, luteoside A, luteoside B, and luteoside C were isolated from *B. prionitis* and shown to have potent in vitro activity against respiratory syncytial virus [18].

Anthelminthic activity

Aqueous and ethanolic extract of the whole plant of *B. prionitis* exhibited anthelminthic activity using *Perethesia posthuma* worms in a dose-dependent manner giving the shortest time of paralysis (P) at 50, 75 mg/ml and death (D) with 100 mg/ml concentration when compared to standard anthelminthic drug albendazole [19,20].

Antifertility activity

The methanolic root extract of *B. prionitis* L. was given orally to male rats (100 mg/d). The duration of the study was 60 days, and the extract reduced the fertility of male rats by 100%. Antifertility effects of Barleria appeared to be arbitrated by conflicts in Leydig and Sertoli cells functions, resulting in the physiomorphological events of spermatogenesis. [21] Antispermatogenic activity is also shown by this [22-24]. In another study done by us, an active component β-sitosterol (BS) was isolated from the methanolic root extract of *B. prionitis*, and its antifertility potential was evaluated in the male albino rats. The rats were orally administered olive oil (Group-L, control), BS at the dose level of 5 (Group-H), 15 (Group III), and 25 mg/kg body weight (BW) (Group IV) for 60 days. BW was measured weekly. The results exhibited that BS from the roots of *B. prionitis* impairs spermatogenesis and fertility that recommends that BS from *B. prionitis* can be used for the development of the male contraceptive drug, which has very limited available options [25].

Antioxidant activity

The antioxidant capacity and the reducing power were found highest in the methanolic leaf and stem extract as inhibitory concentration (*IC₅₀*) values were 63.41±0.32 and 81.69±0.40, respectively. These results may be due to the presence of phenolic contents such as barlerioside, shanzhiside methyl ester, barlerin, acetylbarlerin, 7-methoxydiereroside, and lupulinoside [26]. In another study, antioxidant activity of various fractions of 90% methanolic extract was determined using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. The *IC₅₀* value of hexane, chloroform, ethyl acetate, and butanol soluble fractions of methanolic extract was calculated to determine the DPPH radical scavenging property of these fractions, and ascorbic acid was taken as standard. The maximum effect was demonstrated by the ethyl acetate soluble fractions among all. These methanolic extract fractions follow following order - ethyl acetate > butanol > chloroform > methanolic > hexane for their antioxidant activity [27]. Antioxidant activity of the ethanol extract and aqueous extract of the whole plant of *B. prionitis* was investigated in another study, and in this DPPH radical, 2,2’-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) scavenging activity, hydroxyl radical scavenging activity, reducing power assay, and nitrous oxide scavenging activity of various extracts of *B. prionitis* were calculated to evaluate the radical scavenging potential. Ethanol extract was the more effective antioxidant as compared to the aqueous extract. A direct relationship can be concluded between the antioxidant activity and the phenolic content of *B. prionitis* [28], which was determined using Folin–Gocaltieu reagent. Antioxidant activity was observed in some glycosides which have been isolated from the aerial parts of *B. prionitis*, namely, barlerioside, shanzhiside methyl ester, 6-O-trans-p-coumararoyl-8-O-acetylshanzhiside methyl ester, barlerin, acetylbarlerin, 7-methoxydiereroside, and lupulinoside [29].

Antidiabetic activity

Alcoholic extract of leaf and root of *B. prionitis* was tested for their antidiabetic activity in normal and alloxan-induced diabetic rats, before and 2 weeks after administration of drugs. Effects demonstrated a significant reduction in blood glucose level and glycosylated hemoglobin. A significant increase was observed in serum insulin level and liver glycogen level, whereas the decrease in the BW was arrested by administration of a leaf extract to the animals. This work suggested that alcoholic leaf extract of *B. prionitis* could be considered as one of the comparatively harmless and with fewer side effects herbal drug for the treatment of diabetes mellitus [30]. In another study, the potency of alcoholic and aqueous extracts of leaf, stem, and root was compared with that of chlorpropamide at a dose of 200 and 100 mg/kg, respectively. The blood glucose level was measured calorimetrically. Alcoholic and aqueous extracts of leaf and root caused a significant fall in blood glucose level in diabetic rats. From this study, it was concluded that *B. prionitis* is almost as effective as chlorpropamide in reducing the sugar levels [31].

Glutathione S-transferase, acetylicholindeesterase inhibitory activity

A new compound, balarenone, along with three known compounds, pipatuline, lupeol, and 13,14-seco-stigma-5,14-diene-3-a-ol was isolated from the ethanolic extract of *B. prionitis* of Sri Lankan origin. All four of these expressed moderate inhibitory activity against the enzymes glutathione S-transferase and acetylicholindeesterase [15].

Anticataract activity

Anticataract activity of *B. prionitis* was estimated using selenite- and galactose-induced cataract models in a study. The rats in the test gathering were infused with *B. prionitis* 4 hrs before the selenite administration. *B. prionitis* was administered to the test rats at the dose levels of 200 and 400 mg/kg orally, and control rats received only vehicle every day. Cataract stages were assessed at normal intervals. Morphological valiation verified that selenite-treated rats exhibits
increased opacities as compared with normal. A full in the glutathione level and an increase in the malondialdehyde levels were seen in control rather than normal lenses. These results revealed that the onset and progression of cataract were hindered in selenite and so as in galactose-induced cataract. Slit-lamp microscopic images proved its antcatract activity, which can be due to its antioxidant potential [32].

Anticancer activity
The oil prepared with the whole plant was applied externally during the acute stage of cysts in the blood vessels [33]. It shows its effective anticancer properties.

Anti-inflammatory activity
In a study, various extracts from the B. prionitis roots were extracted. These extracts were evaluated for their anti-inflammatory activity using carrageenan-induced rat paw edema at the dose levels of 200 and 400 mg/kg orally. The aqueous extract was found most active, it was then fractionated into four major fractions, and these fractions were also screened by the same tests. AQSE fractions (FR-IV) of B. prionitis showed maximum percentage inhibition of mt paw edema (52.56% and 55.76%) at a dose of 200 and 400 mg/kg, respectively. Anti-inflammatory activity was found to be dose dependent for all four fractions. These results provide a scenario for the use of this plant as an anti-inflammatory agent [34]. In another study, TAF fraction from the methanol-water extract of B. prionitis Linn. was evaluated for anti-inflammatory activity against different acute and chronic animal test models. Carrageenan, histamine, and dextran which are known inflammagens had anti-inflammatory effect produced by it. Adrenalectomized rats show normal anti-inflammatory activity that expresses that the effect of fraction “TAF” is not controlled by the pituitary-adrenal axis. “TAF” also showed inhibition of vascular permeability and leukocytes migration in vivo into the site of inflammatory insult. Ibuprofen was used as a standard reference drug [35]. In one study, methanolic extract of B. prionitis Linn. at the dose of 500 mg/kg showed anti-inflammatory activity in the early stage as well as in the late stage (up to 180 minutes) comparable to control and standard indomethacin [36].

Antinoceptive activity
One study was undertaken to evaluate the antinoceptive activity of 50% ethanolic extract of the flower of B. prionitis in experimental animals. The analgesic effect of the extract tested in mice of either sex, using an Ugo Basile Analgesy meter. A significant increase was measured in the analgesio-meter-induced force (p<0.01-<0.001) at the dose level of 50, 100, and 200 mg/kg, B. prionitis extract and exhibited resistance again pain after 30 minutes equivalent to 26.3-48.23% protection [37].

Antihypertensive activity
In a study, antihypertensive activity was evaluated in male albino Wistar rats, which were unrestrained. Hypertension was induced by injecting deoxycorticosterone acetate salt, rats were divided into five groups, different dose levels were administered twice a week for the duration of 6 weeks, and instead of water, 1% NaCl was provided for drinking to the rats. Dose levels of 200 mg/BW and 400 mg/BW showed the maximum antihypertensive effect among all. Significant antihypertensive activity is developed by the alkaloids, flavonoids, steroids, saponins, tannins, and phenolic compounds, whose presence in B. prionitis was confirmed through phytochemical screenings [38].

Cytotoxic activity
3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay on human gingival fibroblast and human dermal fibroblast cell lines for ethanolic extract of B. prionitis gave cytotoxicity effects data. The concentration of test needed to inhibit cell growth by 50% (CTC50) value was found to be more than 1,000 µg/ml. Chlorhexidine was found to be more cytoxic with the CTC50 value of 1.25-25 µg/ml. Ethanolic extract of B. prionitis was found significantly cytotoxic (p<0.05) in comparison with control [39]. In another study, the methanolic extract of the whole plant of B. prionitis was studied for the anticancer activity of the Human Ovarian Cancer Cell Line Ovarc-3 and human renal cancer cell line 786-0 in different concentrations (10, 20, 40, and 80 µg/ml) along with standard drug adriamycin (doxorubicin) (positive control compound). On the basis of the results, we can conclude that these extracts were non-cytotoxic [40].

Hepatoprotective activity
Iridoid-enriched fraction (IF) from the ethanol-water extract of the aerial parts (leaves and stems) of B. prionitis Linn. was evaluated for hepatoprotective activity in various acute and chronic animal test models of hepatotoxicity. It afforded significant hepatoprotection against carbon tetrachloride, galactosamine, and paracetamol-induced hepatotoxicity. Silymarin was used as reference hepatoprotective drug. In the safety evaluation study, the oral lethal dose (LD50) was found to be more than 3000 mg/kg, with no signs of abnormalities or any mortality observed for a 15-day period under observation after a single dose of drug administered, whereas intraperitoneal LD50 was found to be 253±578 mg/kg, SE (n=10) in mice. The studies discovered noteworthy and concentration-dependent hepatoprotective potential of “IF” because the maximum altered hepatic parameters which resulted in liver damage of the experimental rodents was reversed by it [41].

Central nervous system (CNS) activity
CNS activity of the 70% ethanol extract of leaves of B. prionitis Linn. (Acanthaceae) in Swiss albino mice was evaluated. General behavior was studied using actophotometer. According to the study, it was observed that the test drug has the stimulant activity. However, in comparison with the standard drug, namely, fluoxetine hydrochloride available in the market, the stimulant activity seemed to be less. Fluoxetine stimulates activity in the animals was found to be 9.193%, whereas the test drug from B. prionitis stimulated the animal only by 49.72%. The results suggested that ethanol extract of B. prionitis exhibits antidepressant activity in testing animal models [42].

Anti-arthritic activity
The anti-arthritis potential of ethyl acetate fractions of chloroform extract from leaves of B. prionitis was evaluated by successive extraction with chloroform and methanol by the hot Soxhlet extraction method. The chloroform extract was further fractionated with solvent ethyl acetate to obtain EABP. Acute non-immunological and chronic immunological arthritis were induced in rats through formaldehyde and Freund’s complete adjuvant, respectively. Then, this fraction was evaluated at two doses 125 and 250 mg/kg, fed to the abovementioned group of rats. Significant inhibition of edema was observed in both acute as well as chronic models in dose-dependent manner. Dose level of 250 mg/kg showed most potent and significant paw edema inhibition. This finding thus supports the traditional use of B. prionitis for rheumatoid arthritis [43].

Larvicidal activity
Larvicidal activity of various extracts of B. prionitis was estimated against the Japanese Encephalitis vector, Culex tritaeniorynchus in Tamil Nadu, India. To identify the active principle present in the promising fraction obtained in Chloroform: Methanol extract. The B. prionitis leaf extracts were tested, employing the World Health Organization procedure against fourth instar larvae of C. tritaeniorynchus, and the larval mortalities were recorded at various concentrations (0.25 - 8.75 µg/ml) the 24 hours lethal concentration values of the B. prionitis leaf extracts were determined following Probit analysis. This investigation proved that B. prionitis could be possibly utilized as an important component in the Vector control program for the eradication of different harmful diseases [44].

Mast cell stabilization and membrane protection activity
Hydroalcoholic whole-plant extract of B. prionitis was tested for the membrane stabilization and mast cell protection activity, the results revealed significant inhibition of the hyposaline-induced erythrocyte membrane hemolysis. Mesenteric mast cells degranulation and
hemolysis of the erythrocytes was significantly reduced in the extract-treated rats [45].

The data on the pharmacological action of B. prionitis are listed in Table 3.

Table 3: Pharmacological action of Barleria prionitis

| Parts of plant | Type of extract/active principle | Animal model/microorganism/cell lines/tissues/assay | Uses | References |
|----------------|---------------------------------|---------------------------------------------------|------|------------|
| Leaf           | Different solvent extract       | Gram-positive bacteria (Bacillus pumilus, B. subtilis, Streptococcus pyogenes, and Bacillus cereus) and Gram-negative bacteria (Escherichia coli, Serratia marcescens, Comamonas acidovorans, and Pseudomonas aeruginosa) | Antibacterial activity | [13] [14] [15] |
|                | Petroleum ether extract, ethanol extract | Pseudomonas putida and Bacillus subtilis Bacillus cereus and Pseudomonas aeruginosa | | |
|                | Balarenone, pipataline, and 13,14-seco-stigmasta-5,14-diene-3-a-ol isolated from ethanol extract | | | |
| Bark           | Methanolic extract              | Saccharomyces cerevisiae, Candida albicans strain 1, and Candida albicans strain 2 Curvularia lunata, Curvularia clavata, Alternaria alternata, Nigrospora oryzae, and Cladosporium oosporum | Antifungal activity | [16] [17] |
| Leaf exudates | Methanolic extract              | | | |
| leaf tissue sap | Methanolic extract              | | | |
|                | Flavonol glycoside - the iridoid glycosides and three phenylpropanoid glycosides, named luteoside A, luteoside B and luteoside C | Respiratory syncytial virus | Antiviral activity | [18] |
| Whole plant   | Ethanolic extract               | Pheretima posthuma | Anthelmintic activity | [19,20] |
| Roots         | Methanolic extract              | Rats | Antifertility activity | [21] |
| Roots         | BS isolated from methanolic extract | Rats | | |
| Leaf, stem    | Methanolic extract              | Reducing power assay | Antioxidant activity | [25] [26] [27] [28] [29] |
| Whole plant   | Various fractions of 90% methanolic extract | DPPH assay | | |
| Aerial parts  | Methanolic extract              | DPPH free radical scavenging assay | | |
| Glycosides    | Ethanol extract and aqueous extract | | | |
| Leaf, root    | Alcoholic extract               | Rats | Antidiabetic activity | [30] [31] [32] |
| Leaf, stem, roots | Alcoholic and aqueous extracts | Rats | | |
| Aerial part   | Ethanolic extract               | | | |
| Whole plant   | Ethanolic extract               | | | |
| Roots         | Methanolic extract              | | | |
| Roots         | Oil                              | Cysts in acute stages of blood vessels | Anticancer activity | [33] [34] |
| Leaf, stem    | TAF fraction from the methanol-water extract | Rats | Anti-inflammatory activity | [35] [36] |
| Whole plant   | Various fractions of 90% methanolic extract | Rats | | |
| Aerial parts  | Methanolic extract              | | | |
| Flower        | 50% ethanolic extract           | Mice | Antinociceptive activity | [37] |
| Leaves        | Methanolic extract              | Male albino Wistar rats | Antihypertensive activity | [38] |
| Leaves        | Ethanolic extract               | | | |
| Whole plant   | Methanolic extract              | Human gingival fibroblast and human dermal fibroblast cell lines Human ovarian cancer cell line Ovar-3 and human renal cancer cell line 786-O | Cytotoxic activity | [39] [40] |
| Aerial parts  | Ethanolic extract               | | | |
| (leaves and stems) | Iridoid-enriched fraction IF from the ethanol-water extract | Mice | Hepatic protective activity | [41] |
| Leaves        | 70% ethanol extract             | Swiss albino mice | | |
| Leaves        | ethyl acetate fractions of chloroform extract | Rats | | |
| Leaves        | Chloroform: Methanol, Acetone: Chloroform fractions of methanol extract | Culex tritaeniorynchus | Larvicidal activity | [44] |
| Whole plant   | Hydroalcoholic extract          | Rat | Mast cell stabilization and membrane protection activity | [45] |

Secondary metabolites play an essential role for the economic importance of medicinal plants, although it’s not only economical also a core prospective for the betterment of our health. Preliminary
phytochemical screening showed presence of phytochemicals such as alkaloid (by Mayer's reagent test, Hager's reagent test, Wagner's reagent test, and Dragendorff's reagent test), flavonoids (by alkaline reagent test and Shinoda's test), saponins (Frothing test), terpenoids (dinitrophenylhydrazine test), phytosterol (Liebermann's test and Liebermann-Burchard test), phenolic compound and tannin (FeCl₃, lead acetate test, and bromine water test), essential oil, proteins, and amino acids (Millon's test, Biuret test, and ninhydrin test), carbohydrates (Molisch test, Fehling's solution A, Fehling's solution B, and Benedict's test), glycosides (Borntrager's test and legal's test) [15,28]. Its aerial parts contain glycosides such as barlerinoside, shanzhiside methyl ester, lupulinoside, 7-methoxydiderroside [45] barlerin, acetylbarlerin, and verbascoside [18]; terpenoid such as lupeol, pipataline, and balarenone; and flavones such as apigenin 7-O-β-D-glucoside [16] and luteolin-7-α-glucoside [45]. Leaves were reported to contain phenolic acids such as Melilotic acid [46], syringic acid, vanillic acid, and p-hydroxybenzoic acid and flavones such as 6-hydroxyflavone and scutellarin [47]. Roots contain phytosterol BS [25]. A brief summary of phytochemical constituents isolated from \textit{B. prionitis} is given Table 4.

**CONCLUSION**

According to ethnomedical study, \textit{B. prionitis} is very effective and safe for medicinal uses. The qualitative and quantitative analysis reported the presence of many bioactive constituents. Currently, some of the phytoconstituents have been isolated and identified from \textit{B. prionitis}. These compounds and crude extracts have been screened for pharmacological activities by \textit{in vivo} and \textit{in vitro} models. The structural activity relation between isolated compounds and their target sites in the human body should be meticulously studied further. Analytical characterization of active principle, developing new strategies in clinical trials, and product development will facilitate \textit{B. prionitis} to be considered as a potent herbal drug for the treatment of various chronic diseases in the near future.

**Table 4: Phytochemical constituents identified, isolated from \textit{Barleria prionitis}**

| Phytoconstituents | Isolated from | Structure | Molecular formula | Class | Possible activity | Reference |
|-------------------|---------------|-----------|------------------|-------|------------------|-----------|
| Barlerinoside     | Aerial parts  | ![Structure](image1) | C₄₂H₅₈O₂₃ | Phenylethanoid glycoside | Glutathione S-transferase (GST) inhibitory activity | [45] |
| Lupulinoside      | Aerial parts  | ![Structure](image2) | C₂₅H₃₈O₁₆ | Iridoid diglucoside | Antioxidant activity | [45] |
| 7-methoxydiderroside | Aerial parts | ![Structure](image3) | C₂₀H₃₀O₁₃ | Secoiridoids | Antioxidant activity, antiviral activity | [45] |
| Balarenone        | Aerial part   | ![Structure](image4) | - | Terpenoid | Glutathione S-transferase and acetylcholinesterase inhibitory activity, antibacterial activity | [15] |
| Lupeol            | Aerial part   | ![Structure](image5) | C₃₀H₅₀O | Triterpene | Anti-inflammatory and anti-cancer, glutathione s-transferase and acetylcholinesterase inhibitory activity, antibacterial activity | [15] |
| Melilotic acid    | Leaves        | ![Structure](image6) | C₉H₁₀O₃ | Phenolic acid | Antioxidant activity, antiulcer activity | [46] |
| Vanillic acid     | Leaves        | ![Structure](image7) | C₈H₈O₄ | Dihydroxybenzoic acid derivative | Anticancer activity, anti-inflammatory activity, antioxidant activity, antinociceptive activity | [47] |

(Contd...)
| Phytoconstituents       | Isolated from | Structure | Molecular formula | Class             | Possible activity                                                                                     | Reference |
|------------------------|---------------|-----------|-------------------|-------------------|-------------------------------------------------------------------------------------------------------|-----------|
| Syringic acid          | Leaves        | ![Structure](image1.png) | C₂₉H₅₀O₆         | Phenolic acid     | Antioxidant activity, anticancer activity, antimicrobial activity, antifungal activity, antidiabetic activity, hepatoprotective activity | [47]      |
| 6-hydroxyflavone       | Leaves        | ![Structure](image2.png) | C₂₀H₁₄O₇         | Flavone           | Anti-inflammatory activity, antioxidant activity, anticancer activity                                | [47]      |
| β-sitosterol           | Roots         | ![Structure](image3.png) | C₃₉H₇₀O         | Phytosterols      | Anti-inflammatory activity, anticancer activity, antihelminthic activity, cytotoxic activity, antisteroidogenic activity, antifertility activity, antioxidant activity, antidiabetic activity | [25]      |
| Scutellarin            | Leaves        | ![Structure](image4.png) | C₂₀H₂₀O₂         | Flavone           | Antioxidant activity, anti-inflammatory activity, cardio protective activity, hepatoprotective activity, antimicrobial activity, anti-inflammatory activity, antihelminthic activity, antihelminthic activity, anti-inflammatory activity, antioxidant activity, antithrombotic activity | [47]      |
| p-hydroxybenzoic acid  | Leaves        | ![Structure](image5.png) | C₁₇H₆O₃          | Phenolic derivative of benzoic acid | Antimicrobial activity, antihelminthic activity, anticancer activity, anti-atherosclerotic activity, antifertility activity, antihelminthic activity, antioxidant activity, antithrombotic activity | [47]      |
| Apigenin 7-O-β-D-glucoside | Aerial parts | ![Structure](image6.png) | C₂₁H₂₀O₁₀        | Glycosyloxyflavone | Antibacterial activity, anti-inflammatory activity, antioxidant activity                           | [15]      |
| Luteolin-7-o-glucoside | Aerial parts  | ![Structure](image7.png) | C₂₁H₂₁O₁₁        | Flavone           | Antibacterial activity, antioxidative activity, antimicrobial activity, hepatoprotective activity, antifertility activity, antioxidant activity, antifertility activity, antihelminthic activity, antihelminthic activity | [45]      |
| Verbascoside           | Aerial parts  | ![Structure](image8.png) | C₂₉H₅₆O₁₅        | Caffeoyl phenylethanoid glycoside | Antimicrobial activity, cytotoxicity activity, anti-inflammatory activity, antioxidant activity, antiviral activity | [18]      |
| Pipataline             | Aerial parts  | ![Structure](image9.png) | C₁₉H₂₈O₂         | Terpenoid         | Enzyme inhibitory activity, antioxidant activity                                               | [15]      |

(Contd..)
Table 4: (Continued)

| Phytoconstituents | Isolated from | Structure | Molecular formula | Class                                  | Possible activity                                                                 | Reference |
|-------------------|---------------|-----------|------------------|---------------------------------------|----------------------------------------------------------------------------------|-----------|
| Barlerin          | Aerial parts  | ![Structure](image1) | C₆H₁₃O₁₂ | Iridoid glycosides                  | Antioxidant activity, antiviral activity, anticancer activity, enzyme inhibitory activity, anti-inflammatory activity | [18]      |
| Acetylbarlerin    | Aerial parts  | ![Structure](image2) | C₆H₃O₁₃ | Iridoid glycosides                  | Antioxidant activity, antiviral activity, anticancer activity, enzyme inhibitory activity, anti-inflammatory activity | [18]      |
| Shanzhisdide methyl ester | Aerial parts | ![Structure](image3) | C₁₇H₂₁O₁₁ | Iridoid glycosides                  | GST, AChE inhibitory activity, antioxidant activity | [45]      |

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