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Review Article

A COMPREHENSIVE REVIEW ON *BARLERIA PRIONITIS* (L.)

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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, inhabit 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 anticataract 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 barlenoside, 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.

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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 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, Chhattisgarh, 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, Streptococcus 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 balarenone, pipataline, and

Table 1: Taxonomical classification of *B. prionitis*

Kingdom	Plantae
Sub Kingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
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	Araniyaccokicceti, manjachemulli, mirutam, mituri, muli, mulli, mulliver, pitakantakacceti
Kannada	Gorante, gorantedai, mullu jaali, mullu madarangi, mullugoranta
Malayalam	Manjakkanakambaram, Kanakambaram
Hindi	Kanakambar, Vajradanti, kat-sareya, katsareya, peela bansa
English	Porcupine flower, *Crossandra*, Barleria

13,14-secco-stigmasta-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 Saccharomyces *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 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].

Anthelmintic activity

Aqueous and ethanolic extract of the whole plant of *B. prionitis* exhibited anthelmintic activity using *Pheretima 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 anthelmintic 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-I, control), BS at the dose level of 5 (Group II), 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 (IC_{50}) 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 barlerinoside, shanzhiside methyl ester, barlerin, acetylbarlerin, 7-methoxydiderroside, 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 IC_{50} 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-ethylbenzothiazoline-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–Ciocalteu reagent. Antioxidant activity was observed in some glycosides which have been isolated from the aerial parts of *B. prionitis,* namely, barlerinoside, shanzhiside methyl ester, 6-O-trans-p-coumararoyl-8-O-acetylshanzhiside methyl ester, barlerin, acetylbarlerin, 7-methoxydiderroside, and lupinoside [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, acetylcholinesterase inhibitory activity

A new compound, balarenone, along with three known compounds, pipataline, lupeol, and 13,14-seco-stigmasta-5,14-diene-3-α-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 acetylcholinesterase [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 valuation verified that selenite-treated rats exhibits

increased opacities as compared with normal. A fall 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 anticatract activity, which can be due to its antioxidant potential [32].

Anticancer activity

The oil prepared with the whole plant is 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 rat 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].

Antinociceptive activity

One study was undertaken to evaluate the antinociceptive 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 against 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 uninephrectomized. 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, tannin, 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% (CTC_{50}) value was found to be more than 1,000 µg/ml. Chlorhexidine was found to be more cytotoxic with the CTC_{50} value of 12.5-25 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 Ovcar-3 and human renal cancer cell line 786-O 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 (LD_{50}) 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 LD_{50} was found to be 2530±87 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 estimated. 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 91.93%, 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-arthritic 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. tritaeniorhynchus,* and the larval mortalities were recorded at various concentrations (6.25 µg/ml); the 24 hrs 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

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]
	Petroleum ether extract, ethanol extract			[14]
	Balarenone, pipataline, and 13,14-secco-stigmasta-5, 14-diene-3-a-ol isolated from ethanol extract			[15]
		Pseudomonas putida and *Bacillus subtilis* *Bacillus cereus* and *Pseudomonas aeruginosa*		
Bark	Methanolic extract	*Saccharomyces cerevisiae*, *Candida albicans* strain 1, and *Candida albicans* strain 2	Antifungal activity	[16]
Leaf exudates and leaf tissue sap		*Curvularia lunata, Curvularia clavata, Alternaria alternata, Nigrospora oryzae*, and *Cladosporium oxysporum*		[17]
	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		[25]
Leaf, stem	Methanolic extract	Reducing power assay	Antioxidant activity	[26]
Whole plant	Various fractions of 90%	DPPH assay		[27]
Aerial parts	Methanolic extract	DPPH free radical scavenging assay		[28]
	ethanol extract and aqueous extract			[29]
	Glycosides			
Leaf, root	Alcoholic extract	Rats	Antidiabetic activity	[30]
Leaf, stem, roots	Alcoholic and aqueous extracts	Rats		[31]
Aerial part	Ethanolic extract		Glutathione S-transferase, acetylcholinesterase inhibitory activity	[15]
		Rats	Anticataract activity	[32]
Whole plant	Oil	Cysts in acute stages of blood vessels	Anticancer activity	[33]
Roots	Various extracts	Rats	Anti-inflammatory	[34]
	TAF fraction from the	Rats	activity	[35]
	methanol-water extract	Rats		[36]
	Methanolic extract			
Flower	50% ethanolic extract	Mice	Antinociceptive activity	[37]
Leaves	Methanolic extract	Male albino Wistar rats	Antihypertensive activity	[38]
Leaves	Ethanolic extract	Human gingival fibroblast and human	Cytotoxic activity	[39]
Whole plant	Methanolic extract	dermal fibroblast cell lines		[40]
		Human ovarian cancer cell line Ovcar-3 and human renal cancer cell line 786-O		
Aerial parts (leaves and stems)	Iridoid-enriched fraction IF from the ethanol-water extract	Mice	Hepatoprotective activity	[41]
Leaves	70% ethanol extract	Swiss albino mice	Central nervous system activity	[42]
Leaves	ethyl acetate fractions of chloroform extract	Rats	Antiarthritic activity	[43]
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]

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.

PHYTOCONSTITUENTS IN *B. PRIONITIS*

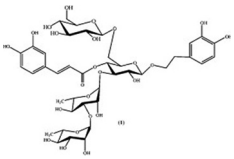
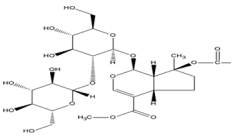
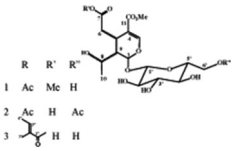
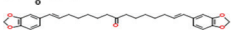
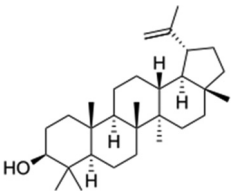
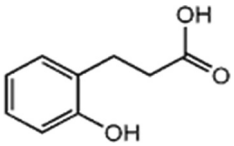
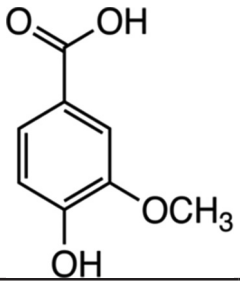
Secondary metabolites play an essential role for the economic importance of medicinal plants, although it's not only economical also a core prospective for the betterment of our health. Preliminary

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 test), saponins (Frothing test), terpenoids (dinitrophenylhydrazine test), phytosterol (Liebermann's test and Liebermann–Burchard test), phenolic compound and tannin ($FeCl_3$, 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-o-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 *B. prionitis* is given Table 4.

CONCLUSION

According to ethnomedical study, *B. prionits* 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 *B. prionits.* These compounds and crude extracts have been screened for pharmacological activities by *in vivo* and *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 *B. prionits* 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 *Barleria prionitis*

Phytoconstituents	Isolated from	Structure	Molecular formula	Class	Possible activity	Reference
Barlerinoside	Aerial parts		$C_{42}H_{58}O_{23}$	Phenylethanoid glycoside	Glutathione S-transferase (GST) inhibitory activity	[45]
Lupulinoside	Aerial parts		$C_{25}H_{38}O_{16}$	Iridoid diglucoside	Antioxidant activity	[45]
7-methoxydiderroside	Aerial parts		$C_{20}H_{30}O_{13}$	Secoiridoids	Antioxidant activity, antiviral activity	[45]
Balarenone	Aerial part		-	Terpenoid	Glutathione S-transferase and acetylcholinesterase inhibitory activity, antibacterial activity	[15]
Lupeol	Aerial part		$C_{30}H_{50}O$	Triterpene	Anti-inflammatory and anti-cancer, glutathione s-transferase and acetylcholinesterase inhibitory activity, antibacterial activity	[15]
Melilotic acid	Leaves		$C_9H_{10}O_3$	Phenolic acid	Antioxidant activity, antiulcer activity	[46]
Vanillic acid	Leaves		$C_8H_8O_4$	Dihydroxybenzoic acid derivative	Anticancer activity, anti-inflammatory activity, antioxidant activity, antinociceptive activity	[47]

(*Contd...*)

Table 4: (*Continued*)

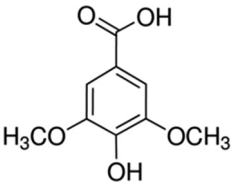
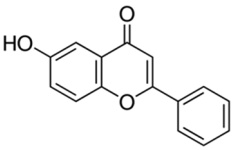
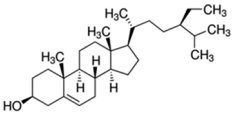
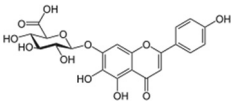
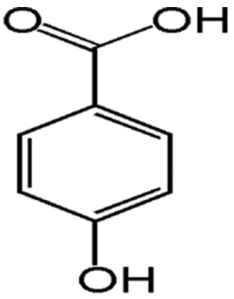
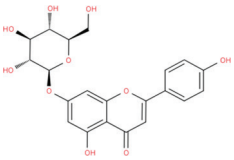
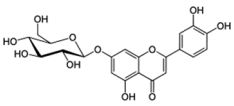
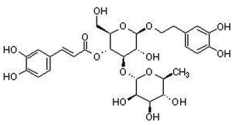
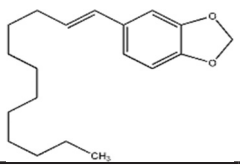
Phytoconstituents	Isolated from	Structure	Molecular formula	Class	Possible activity	Reference
Syringic acid	Leaves		$C_9H_{10}O_5$	Phenolic acid	Antioxidant activity, anticancer activity, antimicrobial activity, antifungal activity, antidiabetic activity, hepatoprotective activity	[47]
6-hydroxyflavone	Leaves		$C_{15}H_{10}O_3$	Flavone	Anti-inflammatory activity, antioxidant activity, anticancer activity	[47]
β-sitosterol	Roots		$C_{29}H_{50}O$	Phytosterols	Anti-inflammatory activity, anticancer activity, anthelminthic activity, cytotoxic activity, antisteroidogenic activity, antifertility activity, antioxidant activity, antidiabetic activity	[25]
Scutellarin	Leaves		$C_{21}H_{18}O_{12}$	Flavone	Antioxidant activity, anti-inflammatory activity, cardioprotective activity, hepatoprotective activity, enzyme inhibitory activity	[47]
p-hydroxybenzoic acid	Leaves		$C_7H_6O_3$	Phenolic derivative of benzoic acid	Antimicrobial activity, anthelmintic activity, anticancer activity, antiartherogenic activity, anti-inflammatory activity, antiallergenic activity, antioxidant activity, antithrombotic activity, cardioprotective activity	[47]
Apigenin 7-O-β-D-glucoside	Aerial parts		$C_{21}H_{20}O_{10}$	Glycosyloxyflavone	Antibacterial activity, anti-inflammatory activity, antioxidant activity	[15]
Luteolin-7-o-glucoside	Aerial parts		$C_{21}H_{20}O_{11}$	Flavone	Antibacterial activity, antioxidative activity, antimicrobial activity, hepatoprotective activity, anti-inflammatory activity	[45]
Verbascoside	Aerial parts		$C_{29}H_{36}O_{15}$	Caffeoyl phenylethanoid glycoside	Antimicrobial activity, cytotoxicity activity, anti-inflammatory activity, antioxidant activity, antiviral activity	[18]
Pipataline	Aerial parts		$C_{19}H_{28}O_2$	Terpenoid	Enzyme inhibitory activity, antioxidant activity	[15]

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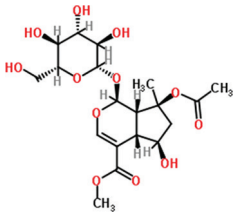
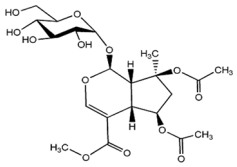
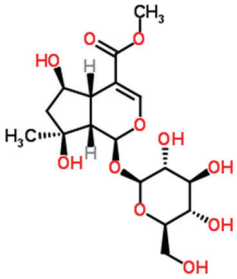
Table 4: (*Continued*)

Phytoconstituents	Isolated from	Structure	Molecular formula	Class	Possible activity	Reference
Barlerin	Aerial parts		$C_{19}H_{28}O_{12}$	Iridoid glycosides	Antioxidant activity, antiviral activity, anticancer activity, enzyme inhibitory activity, antiinflammatory activity	[18]
Acetylbarlerin	Aerial parts		$C_{21}H_{30}O_{13}$	Iridoid glycosides	Antioxidant activity, antiviral activity, anticancer activity, enzyme inhibitory activity, anti-inflammatory activity	[18]
Shanzhiside methyl ester	Aerial parts		$C_{17}H_{26}O_{11}$	Iridoid glycosides	GST, AChE inhibitory activity, antioxidant activity	[45]

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