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Brahmi (*Bacopa monnieri*) : a mental illness drug

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ABSTRACT

Ayurveda is the life science and practice that involve the care of the human being's physical, mental, and spiritual health. The term "*Ayu" is* defined as- "*Sharir Indriya Satva Atma Sanyogo Dhari Jeevtam (Charak)*. According to *Acharaya Charaka* the individuality of *Manas* and *Sarira* is inseparable and interdependent. The paragon of the beauty of Ayurveda is that it always emphasizes prevention over cure. *Yendri (Bacopa monnieri* Linn). Mentioned as *Medhya* by Priyavrat Sharma in his book *Dravyagun Vigyana*. Nowadays, the use of herbal drugs for the treatment of various diseases is developing worldwide. Psychiatric and neurological disorders are generally associated with memory loss, cognitive deficits, impaired mental function, etc. Due to the multi-factorial nature of these diseases, psychoactive drugs of modern medicine have achieved restricted success. Therefore, there is an extended stipulation for novel products that could target multiple pathways and improve mental capabilities. According to "Ayurveda," the Indian traditional medicine system, "*Medhya Rasayana*" presents herbal therapeutics that restores cognitive deficits, boost memory, and improve mental functions. The current review emphasizes the components and application of such type of herbal medication.

Key words: *Ayurveda, Yendri, Medhya Rasayana, Dravyaguna Vigyana, Manas, Sarir.*

INTRODUCTION

Mental health is a state of psychological and emotional well being of an individual. Mental health refers to an individual's feeling, thought, and action, specifically when a person faces stress and challenges in his life. In the present life style, every individual is confronted with mental illness. Neurological and psychiatric disorders are generally associated with memory loss, cognitive deficits, impaired mental function, etc. Due to the multi-factorial nature of these disease, modern medicine based psychoactive drugs have met with limited success. Therefore, there is a growing demand for novel products that could target multiple pathways and improve mental capabilities. According to "Ayurveda," the Indian traditional medicine system, "*Medhya Rasayana*" presents herbal therapeutics that boosts memory, restore cognitive deficits, and improve mental function. *Yendri* (*Bacopa monnieri* Family - Nyctaginaceae) was used as *Ekala Dravya* to treat mental disorders, particularly those involving anxiety, intellect, and poor memory (Singh and Dhawan 1997). This review has shown that herbs contain many active constituents, including several alkaloids and saponins. However, the major components are the steroidal saponins, Bacosides A and B, and suggest that they influence the cholinergic system. However, recently, it

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has been reported that Bacopa has an anti-oxidant effect in rat frontal cortex, striatum, and hippocampus (Bhattacharya *et al.* 2000).

The drug profile of *Yendri* (*Bacopa monnieri*) is given below;

Table 1: *Bacopa monnieri* drug profile.

Ayurvedic Properties	Activity	Ayurvedic Pharmacological activity
Dosha	*Kapha-Vata Shamaka*	*Satva Guna Bahulya*
Guna	*Laghu*	*Prakashak*
Rasa	*Tikta*	*Medya*
Vipaka	*Katu*	*Kaph* and *Tama Nashak*
Virya	*Ushna*	*Dhee, Dhruti, Smriti*
Prabhava	*Medya*	*Medhavi*
Gana	*Balya, Prajasthapana*	Rejuvenator tonic, Proceants

General Information

Habit and Habitat

A small erect herb, commonly growing in marshy places throughout India, ascends up to 1500 m.

Taxonomic classification

- Kingdom - Plantae
- Division - Magnoliophyta
- Class - Magnoliopsida
- Sub class - Asteridae
- Order - Scrophulriales
- Family - Scrophulariaceae
- Genus - Bacopa
- Species - *Bacopa monnieri* (herb of grace)

Regional and other Names

Beng - Udhabini, Brahmi-sak, Dhop-chamni, Jalnimba; **Eng** - Thyme Leaved Gratiola; **Guj** - Neerbrahmi, Bamanevari; **Hindi** - Brahmi, Jalnim, Safed chamni**;** **Kan** - Valabrahmi, Oldelaga, Nirubrahmi, Mandukaparni**;** **Mal** - Brahmi, Nirbrahmi; **Mar** - Jalnam, Bama, Neerbrahmi; **Ori** - Brahmi; **Punj** - Brahmibuti; **Tam** - Brahmi, vazhukkai, Piramiyapundu; **Tel** - Sambarani chettu.

Ayurvedic Description

Sanskrit name - *Brahmi*

Synonyms - *Aindri, Jalnimba, Vangiya-Brahmi, Lavanika*

Properties

Rasa - *Tikta*;

Guna - *Laghu*, *Sara*;

Virya - *Ushna*;

Vipaka - *Katu*

Actions - *Medhya, Prajasthapna, Rasayna, Swarya, Balya.*

Therapeutic uses - *Apasmara, Unmada, Kustha, Sotha, Mutrakracchra, Masurika.*

Therapeutic uses mentioned in Ayurvedic Pharmacopoeia

The plant is used in *Kustha* (skin diseases), *Jwara* (fever), *Sopha* (swelling), *Pandu* (anemia), *Prameha* (urinary disorders) and *Manasa Vikara* (psychiatric disease).

Properties and uses ascribed

The plant is astringent, bitter, cooling, and reported to improve intellect. It is used in the asthma treatment, hoarseness, insanity, epilepsy, and used as a potent

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nervine tonic, cardiotonic, diuretic, and skin disease. The leaves are useful as diuretic and aperients. The leaves juice is given to children in bronchitis and diarrhea. The paste of the leaves is used as a remedy for rheumatism. Stem and leaves are used in snake bites (Nadkarni. 1945; Chopra *et al.,* 1956; the wealth of India, 1988).

Ethnobotanical studies

The plant is used as an antiepileptic, anti-asthamatic, nervine tonic, nootropic, cardiotonic, diuretic and aperients, in skin disease, insanity, nervous disorders, mental disease and hoarseness. The leaves are used in speech disorder, premature ejaculation, in rheumatism. The leaves and stem are used as an antidote to snake bite.

Description of the herb

Bacopa monnieri (BM) is a small, creeping, somewhat succulent herb. The leaf and flower-bearing stems are 10-30 cm long and arise from creeping stems that form roots at the nodes. The growth habit of *Bacopa*, therefore, resembles that of peppermint. The leaves are simple, obovate-oblong, opposite, approximately 2 cm × 1 cm, with entire margins, flowers are blue or white with purple veins, solitarily on long pedicels in the leaf axils. The corollais five-lobed, white or pinkish with purple blotches. The fruit is an up to 5 mm capsule, which develops in the persistent calyx (Fig. 1). *Bacopa* is a member of the family *Scrophulariaceae.*[1,2]

Macroscopic

The plant is succulent when fresh but becomes shriveled on drying; slightly bitter, without any characteristic odor, and composed of crumpled, matted broken pieces of roots, branching stems, leaves, flowers, and few tender fruits.[3,4]

Root

Fragments of dried main roots are cylindrical, about 5 mm in diameter, longitudinally wrinkled, and off-white.

Stem

Pieces of the stem are cylindrical, glabrous, nodes prominent, at places attached with vertically growing branches and ventrally to the cluster of tortuous, brittle roots, internodes about 1-1.5cm in length and 3-4mm in diameter, pale yellowish-green and with a purplish tinge.

Leaf

Simple, opposite and decussate, somewhat sessile, glabrous, obovate- oblong to spatulate in shape, 0.6-2.5cm in length and 3-8mm in width, entire, lower surface dotted with minute specks, obscurely 1-3 nerved, color faint green.[5]

Flower

Pale blue or pinkish-white, nearly regular, solitary, axillary. 0.6-3 cm in length, usually longer than the leaves with two linear bracteoles, pedicel slender, calyx glabrous, deeply 5 partite Corolla gamopetalous, stamens 4, didynamous, anthers 2 celled, pistil carpel, syncarpous ovary two chambered with many ovules, style dilated toward the top, stigma-bilobed.[6,7]

Fruit

Globose to ovoid, glabrous capsule, 5 mm in length, enclosed within persistent calyx, ped 1-3 cm long purplish when fresh.

Seed

Numerous, very minute, <1 cm wide, oblong or irregular.

Microscopic

Root

The root is irregularly circular to angular in shape and shows an outer most piliferous layer, parenchymatous cortex with intervening air spaces and a centrally located solid core of xylem encircled by narrow phloem. The formation of cork cells replaces the piliferous layer, cortex is wide, parenchymatous, traversed with simple and compound starch grain intervened with air spaces, endodermis is distinct, a narrow band of phloem surrounding the located solid core of xylem composed of radially arranged isolated vessels, fibers, and medullary rays (Fig. 2).[8,9]

Stem

The stem is almost circular in outline, shows outer epidermis, broad aerenchymatous cortex occupying

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the major area of the section, a distinct endodermis encircling the ring of stellar tissue and central parenchymatous pith with a layer of thick-walled celled epidermis covered with a thin cuticle, the cortex is very wide, consisting of chlorenchymatous aerenchyma embedded with starch grains, endodermis is distinct, encircling the narrow band of parenchymatous phloem and xylem, the central region being occupied by narrow parenchymatous pith embedded with simple and compound starch grains.

Leaf

The leaf passing through the midrib is almost cylindrical in outline, with a very narrow elevation on the midrib's upper side. In the epidermis, the cells of the upper being bigger in size and at places show striated cuticle, both the epidermis is embedded with stomata and bear sessile- glandular trichomes with multi cellular head. An arrow collenchymatous band is located underneath both the epidermis of the midrib and shows a centrally located conjoint collateral meristele encircled by a parenchymatous sheath. The mesophyll tissue of the lamina is composed of spongy parenchyma, traversed with vascular strands; prismatic and few cluster crystals of calcium oxalate are embedded throughout the parenchymatous cells of the leaf.[7,8]

Powder

Shows fragments of the upper and lower epidermis of leaf in surface view embedded with sessile-glandular trichomes with 4-8 celled head and diacytic to anomocytic stomata, they being more on the lower side, with sinuousanti clinical walls and at places shows striated cuticle; prismatic, cluster crystals of calcium oxalate, starch grains and oil globules scattered as such throughout or embedded in the parenchymatous cells, fragments of longitudinally cut annular and spiral vessels, transversely cut fragments of stem showing aerenchyma to us cortical cells, papillose marginal cells of the petal, testa of the seed in surface view and transversely cut fragments of cotyledon.[11]

Chemical constituents

Major

Bacoside A: The chief constituents are brahmine, herpestine, alkaloids, and saponins. The saponins designated as bacoside A, bacoside B, and betulic acid (Figs. 3 and 4). D-mannitol, stigmastanol, β-sitosterol, and stigma sterol have been isolated, bacoside A, on acid hydrolysis gave three sugars, two of which have been identified as glucose and arabinose bacoside B also gave on hydrolysis glucose and arabinose.[12]

Others

Bacoside B, bacoside A1, bacoside A3, bacogenin A1, bacogenin A2, bacogenin A3, bacogenin A4, bacopa saponin-C, bacopasidesIandII, bacopasidesIII-V, bacopasidesVI-VIII, bacobitacins A-D, monnieraside I, monnieraside III, monnieri, plantioside B; jujubogenin, pseudojujubogenin,3-O-β-D-glucopyranosyl-(l—»3)-[β-D- glucopyranosyl] jujubogenin, 3-O-[β-D--glucopyranosyl-(l—»3)-[β-D-glucopyranosyl] pseudojujubogenin, betulinic acid, wogonin, oroxidin, luteolin, luteolin-7-glucoside, luteolin-7-glucuronide, apigenin- 7-glucuronide; nicotine, 3-formyl-4-hydroxy-2H-pyran, bacosine, bacostcrol, bacosterol-3-O-β-D-glucopyranoside, stigmasterol, stigmastanol, β-sitosterol, D-mannitol, and an uncharacterized glycoside.[11]

Quantitative standards[13]

- Foreign matter : Not more than 2.0%.
- Total ash : Not more than 7.0%.
- Acid-insoluble ash : Not more than 2.0%.
- Ethanol soluble extractive : Not <80.0%.

Preliminary Phytochemical Screening

The aqueous and ethanolic extract of BM (BME) was used for preliminary phytochemical investigation, and for the detection of the following metabolites (Table 2): • Alkaloids • Carbohydrates • Glycosides

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Table 2: Phytoconstituents present in aqueous extract of BM[11,14]

SN	Phytoconstituent	Presence/Absence
1.	Tannins	-ve
2.	Saponins	+ve
3.	Alkaloids	-ve
4.	Carbohydrates	+ve
5.	Protein	+ve
6.	Sterols	-ve
7.	Volatile oil	-ve
8.	Flavonoids	+ve
9.	Triterpenoids	+ve
10.	Glycosides	+ve
11.	Fixed oil	-ve

+ve : Presence, –ve : Absence, BM : Bacopa monnieri

- Phenolic compounds
- Flavonoids
- Protein and free amino acids
- Saponins
- Sterols.

Pharmacology

Ethanol extract (10 mg/kg) brahmi improved motor learning in rats. Both ethanol extract as well as the active principle hersaponin exhibited tranquilizing activity. The active principle also reduced the concentration of noradrenaline and 5-hydroxytryptamine in the brain. Antianxiety effect was reported in ethanol extract and saponin in rat. Antidepressant activity has also been reported. Ethanol extract (50 mg/kg) was found to have antigastric ulcer activity in normal and diabetic rats and also had anti-Helicobacter pylori activity in vitro. Other pharmacological activities reported were anti-oxidant, anticonvulsant, analgesic, antiallergic, antifungal, cardiac depressant, and cardio-tonic either by crude extract or pure principle. Major therapeutic claims Antileprotic, antiepileptic, antipyretic, antidiabetic, anti-inflammatory, and anxiolytic.[15]

Antiepileptic A clinical study was undertaken with the crude aqueous and defatted alcoholic extracts of the plant in 24 patients with varied mental disorders. The study revealed improvement in learning process and correction in the abnormal behavior of epileptic patients treated with defatted-alcoholic extract (2-4 mg/kg b.w.) and crude aqueous extract of "brahmi" two dose daily for 5 months. Defatted alcoholic extract of "brahmi" was found to be more potent than the aqueous form in alleviating the epileptic fits.[16] A controlled clinical trial was carried out with crude BMEs (4 patients), Marsilea minuta (2 patients), and Acorus calamus (6 patients) in epileptic patients with special reference to electroencephalography (EEG) changes to substantiate their sedative and tranquilizing properties. The defatted alcoholic extract of "brahmi" showed improvement in one case each of temporal lobe epilepsy and petit mal epilepsy. There was a close parallelism between the clinical improvement and EEG changes in these two cases.[17]

Antianxiety and **antidepressant** activity Research using a rat model of clinical anxiety demonstrated that a BME containing 25% bacoside A showed anxiolytic activity comparable to lorazepam (a common benzodiazepine anxiolytic drug), and it was attentively noted that the BME did not induce amnesia, side effects associated with lorazepam, but instead had a memory-enhancing effect.[18] The antidepressant potential study of BM showed significant antidepressant effect in the most commonly used behavior paradigms in animal models of depression, such as forced swim test and learned helplessness tests. In the study, of 20-40 mg/kg dose of BME was given for 5 days once in a day, and it was found comparable to standard antidepressant drug imipramine. The same study has showed the role of serotonin and gamma amino butyric acid (GABA) in the mechanism of action accredited for its antidepressant effect with its anxiolytic potential,

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based on the captivating evidence that the symptoms of anxiety and depression overlap each other.[19]

Memory enhancer Efficacy of plant was studied in revitalizing intellectual functions in 40 school going children from rural area in Varanasi. One group was given "brahmi" syrup one teaspoon full (350 mg), thrice daily for 3 months, and the other group was given syrup "simplex" used as placebo in the same dose. There were renovation and improvement of the perceptual-motor functions during the development phase in the group receiving "brahmi." A double-blind controlled study was carried out to evaluate the effect of a micro ("suksma") medicine derived from the plant by 1 month treatment on 110 boy students in the age of 10- 13 years and having average IQ 100. The study showed encouraging results in enhancing some factors of intelligence, viz., memory (direct), arithmetic skill, and some verbal factors. Need for long-term study was felt.[20]

Sedative and tranquilizing properties earlier studies reported a sedative effect of glycosides named hersaponins. A subsequent study on albino rats and dogs showed that the alcoholic and aqueous extract of plants exhibited tranquilizing effects. On the other hand, study showed that the alcoholic extract of the plant and chlorpromazine improved the performance of rats in motor learning. An earlier research showed that a single dose of the glycoside, hersaponin, is better than the drug pentobarbitone in facilitating acquisition and retention of brightness discrimination reaction.[21]

The effect of Brahmi Rasayan, an ayurvedic preparation, was studied in mice and rats for its effects on the central nervous system at 1 and 30 g/kg oral dose. Observational screening in mice was taken following the multiparametric check list. It was studied for its effect on pentobarbitone hypnosis, motor coordination, reaction time, tail withdraws haloperidol-induced catalepsy, electroshock, chemoconvulsions, and conditioned avoidance response. It exhibited a sedative effect and remarkably extended the hypnotic action. It also produced a variable blockade of conditioned avoidance response. The chemoconvulsions, ability to antagonize the haloperidol-induced catalepsy, presence of a significant antinoclceptive effect, along with the ability to offer protection against electroshock seizures, suggests an involvement of the GABAergic system in the Brahmi Rasayan's effect on CNS.[22]

Anti-oxidant and adaptogenic properties BME or bacosides have shown an anti-oxidant activity and antistress.[21] An earlier study suggests an involvement of the GABAergic system in the mediation of these central nervous system effects of BM.[22] Based on animal study, bacosides were shown to have anti-oxidant activity in the hippocampus, frontal cortex, and striatum.[23] Animal studies shown that the BMEs change the expression of certain enzymes that are involved in generating and scavenging of reactive oxygen species (ROS) in the brain.[24] In another study, BME was found not only to induce the constitute expression of heat-shock protein 70 (Hsp70) but also induce the cytochrome P450 (CYP 450) enzymes in all regions of the brain. The level of heat shock protein Hsp70 was found to be increased in the brain as a response of stress condition. On the other hand, the group that was pre-treated for 1 week with 20-40 mg/kg/daily dose of BM, before giving stress, the protein Hsp70 was in lower concentration. An increase in CYP 450-dependent enzymes 7-pentoxyresorufin-odealkkylase and 7-ethoxyresorufin-o-deethylase activity was observed in all the brain regions after exposure to stress alone and with both doses of BME although the magnitude of induction observed was less with a higher dose of the same. Thus, it was suggested that the BM primed the brain for stress by stockpiling these useful enzymes even before stressful conditions and that our susceptibility to stress could be lowered by using this medicinal herb. It was speculated that this induction may be an adaptive response to the stress which needs further investigation. The level of superoxide dismutase (SOD) was also increased in the brain in the groups pre-treated with BME. The data indicated that BME has a potential to modulate the activities of Hsp70, CYP 450, and SOD and thereby possibly allowing the brain

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to be prepared to act under adverse condition-like stress.[25]

Endocrine effects BME (200 mg/kg orally) increased the thyroid hormone, T4, by 41% in mice. T3 was not stimulated, suggesting that the extract may directly stimulate synthesis and/or release of T4 at the glandular level while not affecting conversion of T4 to T3 [26]. BMEs caused reversible suppression of spermatogenesis and fertility. The treatment caused reduction in motility and viability of the sperms and reduced the number of spermatozoa in cauda epididymis and testis, and caused alterations in the somniferous tubules in mice.[26]

The alcoholic extract of the BM whole plant on morphine withdrawal was evaluated in vitro in guinea-pig ileum. After 4 minutes, in vitro exposure to morphine, addition of naloxone-induced a strong contraction condition. Addition of different alcoholic BM concentrations, (100-1000 µg/ml), 15 minutes before exposure to morphine, has reduced the naloxone-induced contraction in a dose-dependent manner. The results suggest that BM extract may be useful in reducing the withdrawal symptoms induced by morphine.[27]

Free radical scavenging effects. The free radical scavenging capacity of a methanolic BM extract, and the effect on DNA cleavage induced by H202 ultraviolet-photolysis was investigated. In addition, it is examined whether this plant extract is capable of reducing the hydrogen peroxide-induced cytotoxicity and DNA damage in human non-immobilized fibroblasts. It showed a dose-dependent effect on free radical scavenging, and a protective effect on DNA cleavage. The results were confirmed by a significant protective effect on H_2O_2 - induced cytotoxicity and DNA damage in human non-immortalized fibroblasts.

Cigarette smoking is considered as a major factor in the development of cardiovascular and cerebrovascular diseases. Creatine kinase (CK), and its isoforms have beer advocated as sensitive markers in the assessment of cardiac and cerebral damage. Therefore, in the present study, it reports the isoenzyme patterns of CK in rats on exposure to smoke and the protective effect of bacoside against chronic smoking-induced toxicity. Adult male albino rats were exposed to cigarette smoke and simultaneously administered with bacoside A, the active constituent from the plant BM, for a period of 12-week the activity of CK was assayed in serum, heart, and brain, and its isoenzymes in serum were separated electrophoretically. Rats exposed to cigarette smoke showed a significant increase in serum CK activity with concomitant decrease in heart and brain also cigarette smoke exposure resulted in a marked increase in all the three isoforms in serum. Administration of bacoside a prevented these alterations induced by cigarette smoking, cigarette smoking is known to cause free radical mediated lipid peroxidation (LPO) leading to increased membrane permeability and cellular damage in the heart and brain resulting in the release of CK into the circulation the protective effect of bacoside on the structural and functional integrity of the membrane prevented the leakage of CK from the respective tissues, which could he attributed to its free radical scavenging and antilipid peroxidative effect.[29]

Hair growth promoting activity Herbal hair oil formulated from Emblica officinalis, BM, and Cyperus rotundus alcoholic extract or as a whole drug. The hair oil was prepared individually, and a mixture of fixed proportion of all the three herbs using coconut oil as a base. The formulated oil was evaluated physical, chemical, and hair growth properties of formulated oil by applying it topically on shaved skin of albino rats. Primary skin irritation test and hair length test were performed, and the hair growth was compared with standard minoxidil 2% ethanolic solution using healthy albino rats. It was observed that hair oil formulation showed the best result among the other formulation evaluated by showing an enlargement of follicular size and prolongation of the anagen phase.[30,32]

Antimicrobial effect the antibacterial activity of BM was screened for different bacterial strains using methanol, ethanol, chloroform, and petroleum ether. The phytochemical screening was carried out to know the compounds responsible for these activities.

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Methanol, ethanol, and chloroform extracts were tested against Bacillus amyloliquefaciens (MTCC 1270), Streptococcus pyogens (MTCC 1923), Vulgarica, Bacillus megaterium (MTCC 3353), Aspergillus niger (MTCC 281), Bacillus pumilus, Salmonella typhi, Bacillus subtilis, and Micrococcus luteus. The susceptibility of the bacteria to the crude extracts on the basis of zones of growth inhibition varied according to microorganism and extracting solvent. In most of the above-mentioned plants, the methanol extract produced the highest activity. On the basis of the results obtained, it could be concluded that methanol could be used for extracting antimicrobial compounds from leaves.[33]

Gastrointestinal affects some in vitro, animal and human studies have investigated the effects of BME on the gastrointestinal tract. In vitro studies have demonstrated direct spasmolytic activity on intestinal smooth muscle, via inhibition of calcium influx across cell membrane channels. This property suggests that BME may be of benefit in conditions characterized by intestinal spasm such as irritable bowel syndrome.[34,35] The results indicated the direct action of the extract on smooth muscles. Furthermore, calcium chloride-induced responses observed in the rabbits' blood vessels and jejunum were reduced in the presence of the BME (10- 700 mcg/mL), suggesting direct interference with the influx of calcium ions. However, since the extract did not affect contractions induced by noradrenalin or caffeine, the authors concluded that the extract had no appreciable effect on the mobilization of intracellular calcium. Based on the results of the experiment, it is postulated that the spasmolytic effect of BME on smooth muscles is predominantly due to the inhibition of calcium influx, applicable to both electrical impulse-mediated and receptor-mediated calcium channels in the cell membrane. Animal and in vitro studies suggested that BM may have a protective and curative effect on gastric ulcers, and studies were reported for its antiulcerogenic activity.[35,36] In rats, a BME standardized for bacoside A was evaluated for its prophylactic and healing effects in five models of gastric ulcers .[37] At a dose of 20 mg/kg for 10 days, BME significantly healed penetrating ulcers induced by acetic acid, significantly strengthened the mucosal barrier and decreased mucosal exfoliation. The extract also alleviated stress-induced ulcers as observed by a significant reduction in LPO in rat gastric mucosa. BM's anti-oxidant properties and its ability to balance SOD and catalase levels were postulated to account for this effect. A recent in vitro study also incubated with human colonic mucosal cells and H. pylori, it resulted in the accumulation of prostaglandin E and prostacyclin, prostaglandins known to be protective for gastric mucosa. Anticonvulsant Crude plant extract of BM or bacosides has also shown anticonvulsive action. It possessed neuroprotective effects in glutamate-mediated excitotoxicity during seizures and cognitive damage occurring in association with pilocarpine-induced epilepsy. The ethanolic extract of BM was tested for anticonvulsant activity using different convulsive models (pentylenetetrazol, maximal electroshock, and strychnine-induced convulsion in rats, as well as hypoxic stress induced convulsions in mice and lithium-pilocarpine-induced status epilepticus). The ethanolic extract of BM was administered as 50-55 mg/kg orally for rats and mice, respectively, 2 and 4 hrs before the respective convulsive stimuli. The ethanolic extract of leaves produced significant anticonvulsant activity for all the different models studied with a mechanism of action similar to that of benzodiazepines (GABA agonist).[16,18]

Safety aspects: The drug used in traditionally prescribed doses may be considered safe.

Dose Powder: 1-3 g.

CONCLUSION

This present review article contains spectrum of information about *Bacopa monnieri* under major heads general information, pharmacognostic, chemical, pharmacological, clinical studies with references.

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