

Pharmacological Activity of Brahmi - A Review

Ashwin Kaarthik R, Jeganath S*, Padhma Priya E, Ilakkiya Azhagi R and Suchithra AB

*Department of Pharmaceutics, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-60011, Tamil Nadu, India.

Received April 09, 2019; Accepted April 16, 2019; Published June 26, 2020

ABSTRACT

Plants have been utilized as medicines for a huge number of years, in light of involvement and society cures and keep on illustration wide consideration for their job in the treatment of gentle and endless ailments. In these periods, concentration on plant inquire has expanded throughout the world also, a vast assemblage of proof has been collected to feature the monstrous capability of medicinal plants utilized in diverse system of medicine. In diverse of medicinal plants *Bacopa monnieri* is one of the most useful plants seen in Ayurveda medicines. *Bacopa monnieri* is a perennial, creeping herb origin to wetlands of southern and eastern India, Australia, Europe, Asia and north and South America. Brahmi has its own individual distinctive strong herbal taste and a bitter aftertaste. Due to alteration in lives and growing awareness for health there is a countless demand of food products that are healthy as well as provide some useful welfare. Its phytochemical substances are alkaloids, flavonoids, glycosides, saponins and the significant constituents such as bacosides, bacopasides and bacopasaponins, which all of these contribute to its helpful properties. It is now being widely promoted to enhance memory, learning and concentration and also to treat anxiety, depression and systemic disorders like cardiovascular, gastrointestinal, hepatic, neurological and also respiratory problems. This article mainly incorporates on the overview of *Bacopa monnieri* collection, cultivation, Ayurveda benefits.

Keywords: *Bacopa monnieri*, Bacoside, Brahmi, Bacopasaponin C, Anti-Parkinson

INTRODUCTION

Brahmi is a typical herb originated all over India. It is a plant which lives more than two years (perennial) of 10 cm high. Brahmi leaves are sessile arranged in opposite direction, which is small and fleshy. The flowers are of 1-2 cm and white in color. It even grows in hot and moisture place. It is one of the medicinal plants in India [1]. The word Brahmi comes from the word 'Brahman' which means Consciousness of God. Brahmi gives a state of calmness to the body, soul and spirit. It is mainly originate from Karnataka, Kerala, Odisha, Bihar, Punjab, Haryana, Bengal, Tamil Nadu, Himachal Pradesh and Uttrakhand. In subtropical and poorly water drained areas it grows well. It grows faster at 30-40°C. Created on their role in treatment of slight and enduring health problems, plants have been used for a thousand years now. As of late, herbal plants are in attention due to their ability to show hopefully outcomes in numerous health difficulties. It even grows in swamp and marshy places of Nepal, Sri Lanka, China, Bangladesh and USA. *Bacopa monnieri* Linn. (Herpestismoniera) synonym. Bacopa popularly known as brahmi, Jalnim in Hindi and Nirpirami, Piramiyapundu in Tamil which belongs to the family Scrophulariaceae [2].

Taxonomical classification

Kingdom: Plantae

Division: Angiosperms

Class: Eudicots

Order: Lamiales

Family: Scrophulariaceae

Genus: *Bacopa*

Species: *monnieri*

Corresponding author: Dr. S Jeganath, Department of Pharmaceutics, School of Pharmaceutical Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Pallavaram, Chennai-600117, Tamil Nadu, India, Tel: 91 9442302356; E-mail: jeganaths@gmail.com

Citation: Ashwin Kaarthik R, Jeganath S, Padhma Priya E, Ilakkiya Azhagi R & Suchithra AB. (2020) Pharmacological Activity of Brahmi - A Review. J Drug Design Discov Res, 1(1): 4-11.

Copyright: ©2020 Ashwin Kaarthik R, Jeganath S, Padhma Priya E, Ilakkiya Azhagi R & Suchithra AB. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Plants parts used

Whole herb is used- Seeds, roots, leaves, rhizomes

Cultivation

Temperature: 33-40°C

Rainfall: 50-100 cm

Altitude: 1300-1400 m

Harvesting temperature: 20-25°C

Sowing temperature: 25-30°C [3]

Soil condition

It can be grown under varying soil conditions, but wet soil with poor water drainage, is found to be suitable for its growth. It can be grown in marshy areas, canals and several water bodies. It requires acidic soil for its good growth [4].

Cultivation details

Seeds can be used, but due to excessive loss of seeds, vegetative propagation (plant cutting) is widely practiced. Transplanted during summer March-May or June-July [5].

Land preparation

Land is ploughed twice or thrice thoroughly and made weed free. Well decomposed manures/hectare is added, again ploughed, leveled and irrigated a day before planting. Nursery bed is raised by using mixture of soil, manure and sand. It is irrigated well to keep the soil moist. Within, few months the seedling is ready for transplanting [6].

Time of sowing

The planting should be done in the month of mid-June or early July.

Spacing

Seedlings are transplanted at the distance of 20 × 20 cm the mother plants are cut into small pieces along with roots,

which are ideal transplanting material. It is moist loving, marshy plant, hence requires adequate irrigation. First irrigation after transplanting is essential for establishment of plants, followed by flood irrigation and no additional irrigation is required during monsoon, 7-8 irrigation is sufficient [7].

Fertilizer

At the time of land preparation, apply organic manure such as FYM and mix well in soil. Apply inorganic fertilizer dose of Nitrogen: Phosphorus: potassium in the form of Urea. Phosphorus and potash are applied as a basal dose and Nitrogen is applied in 3 split doses. First application is done 30 days after planting then second application is done at 60-70 days and third application is applied at 90 days after planting [8].

Weeding

During initial stages of plant growth, hand weeding is preferred at an interval of 10-15 days and proliferates with dense mass, weeding is carried out as and when required [2].

Harvesting

Plant starts yielding by 5-6 months after transplantation. Harvesting is done in the month of October-November [9], 2008 the upper portion from the base, i.e., 4-5 cm from the base is cut for harvesting. 2-3 harvestings are done in one year. Harvested material is washed and cleaned of the external matter [10]. It is then spread in thin layer on ground under shade at room temperature. The product is tossed twice a day for uniform drying. The drying process takes about 8 to 10 days [11] then packing is done in airtight bags for long distance transportation. The total dry herb yield of plant in two harvesting seasons is approximately 100 quintal per hectare [11].

Microscopical feature

The microscopical features are mentioned in **Table 1**.

Table 1. Microscopical features of *Bacopa monnieri*.

Characters	<i>Bacopa monnieri</i>
Stem	Herbaceous, branched, solid with prominent nodes and internodes, cylindrical, green in color
Root	Tap and adventitious root
Leaf	Opposite decussate, sessile, estipulate simple
Flower	Solitary, stalked, ebracteate, zygomorphic, bisexual, hypogynous
Calyx	Gamosepalous, inferior, persistent, irregular
Corolla	Gamopetalous, deciduous, inferior, irregular, color-white with tinge purple
Androecium	Stamen-4, epipetalous, antisepalous, antherbilocular, black dorsifixed
Gynoecium	Syncarpous, carpels, ovoid in shape, style-1, stigma-2
Fruit	Capsule

MICROSCOPICAL STUDY

Transverse section (T.S.) of root (Table 2)

Table 2. Microscopical study of Bacopa roots.

Epidermis	Single layered with wide cortical parenchymatous region
Endodermis	Distinct and single layered and pericycle was not differential
Central region	Stele consisted of 1-5 layers of peripheral phloem and centrally located xylem vessels

Transverse section (T.S.) of stem (Table 3)

Table 3. Microscopical study of Bacopa stems.

Epidermis	Single layer
Cortex	Chlorenchymatous paerenchyma or air spaces, cortical cells with starch grains
Endodermis	Single layered
Pericycle	1-2 layered
Phloem	Narrow zone composed of continuous vascular ring
Xylem	Located towards centre
Parenchymatous	Centrally located, pith with simple, round to oval starch grains
Stomata	Anomocytic and diacytic
Trichomes	8 celled sessile glandular trichomes

Transverse section (T.S.) of leaf (Table 4)

Table 4. Microscopical study of Bacopa leaves.

Epidermal	Distinct upper and lower, presence of sub epidermal foliar idioblasts
Vascular bundles	Collateral encircled by a parenchymatous sheath
Mesophyll	Few crystals of calcium oxalate were seen embedded

POWDER CHARACTERISTICS

Whole plant powder (Table 5)

Table 5. Powder characteristics of whole Bacopa plant.

Starch grain	Simple, round to oval shaped
Stomata	Anomocytic and diacytic
Calcium oxalate crystal	Prismatic
Xylem vessel	Spiral thickenings
Trachids	Pitted

Root powder (Table 6)**Table 6.** Powder characteristics of Bacopa root.

Color	Brown
Starch grain	Simple
Xylem vessel	Spiral thickening
Trachids	Pitted xylem

Stem powder (Table 7)**Table 7.** Powder characteristics of Bacopa stem.

Color	Light color
Taste	Bitter
Xylem vessels	Spiral thickening
Trachids	Pitted xylem
Starch grain	Simple, oval, round

Leaf powder (Table 8)**Table 8.** Powder characteristics of Bacopa leaves.

Color	Green
Taste	Bitter
Stomata	Anomocytic and diacytic
Mesophyll tissue	Prismatic calcium oxalate crystal
Starch grain	Simple

ORGANOLEPTIC CHARACTER

Colour: Green

Taste: Bitter [12]

Size (leaves): About 2 cm [13]

CHEMICAL CONSTITUENT

This plant in the indigenous system of medicine, orderly chemical inspections of the plant have been carried out by numerous groups of scientists. Some of the chemical constituent that are present are alkaloids, flavonoids, glycosides, saponins and the significant constituents such as bacosides, bacopasides and bacopasaponins, which all of these contribute to its helpful properties. It also contains bacopaside X, bacopaside II, bacoside A3 and bacopasaponin C [14] (**Figure 1**).

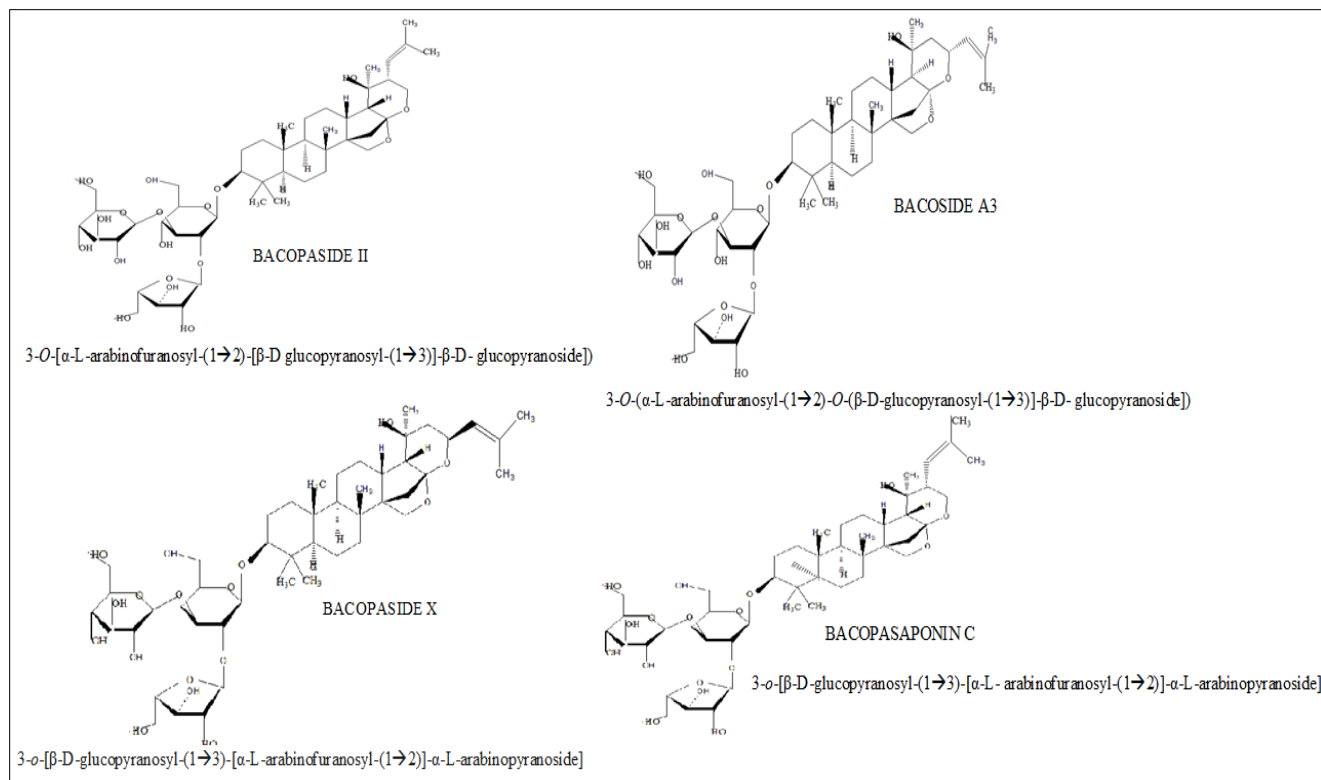


Figure 1. Significant constituents of Bacopa.

ETHNOMEDICAL USES

- Brahmi is utilized for oxidative damage and also act as a powerful antioxidant agent.
- It relieves backache, mental illness, epilepsy, irritation in the bowel and joint pain [15].
- Elephantiasis is treated by brahmi root ointment [16].
- Gonorrhoea, the sexually transmitted diseases is treated by using powder leaf of brahmi which is mixed with milk [17].
- The leaf extract of brahmi is used to cure jaundice and fever and its other applications is neurological tonic which also acts as neuroprotective properties; even it cures asthma and bronchitis [18].
- It is also treated for dysentery in children [18].
- To increase the blood and for enhancing the nervous system, brahmi leaf juice is administered [19].
- The leaves purify the blood and used to cure mental illness, cholera, home medication for piles and amenorrhoea are also treated by using brahmi [20].
- When brahmi is mixed as a composition with tulsi, neem, amla it promotes the growth of nails, hair and skin [21].

- It provides nutrition supplement for the hair, and make it longer and thicker [22].
- It is also used as a medicament to cures ulcer, Alzheimer's disease and tumor [23].
- It is used against indigestion, leprosy and anemia and even treats spleen disorder and skin diseases [24].

PHARMACOLOGICAL USES

Central nervous effects

Memory enhancement: The Ayurvedic herb brahmi also called Bacopa. It helps in increasing the memory and learning skill of human and it also sharpen the brain [25,26]. It's used to treat Alzheimer's disease, anxiety, along with fighting stress and improving memory [27].

Antioxidant

The antioxidant potential is good in brahmi which protects from oxidative destructions [28]. The cellular destruction is due to free radical and which also enhance antioxidant activity in other organs that mainly acts on brain related to the cognitive functions [29].

Anti-depressant

The active ingredients affect the hormonal balance in the body and affect the stress hormone in our body [30]. It increases the serotonin levels in the brain, which relieves

from anxiety, nervousness and allows relaxing the mind, when brahmi leaf is administered [30].

Anti-Parkinson

The cluster of alpha-synuclein protein in the substantia nigra, the dopamine producing cell of the brain is reduced by brahmi [31]. It kills dopamine producing cells. Brahmi prevents the death of dopamine cells and symptoms of Parkinson's [24].

Anti-convulsant

It has a neural pathway and prevents the epileptic fits. Bacoside promote acetylcholine which activates GABA, it balance the chemicals within the brain that controls the

seizure activity [32]. It also enhances GABA activity and reduces the cognitive problems [33].

Anti-inflammatory

It is used for systemic redness in the brain and swelling in the body [36]. When brahmi leaf is applied in the affected part, it reduces swelling and decreases the irritation level inside the body. This also has important anti-inflammatory action that may well be applicable to its efficiency in the curative of numerous inflammatory situations in traditional medicine. It also knowingly inhibited 5-lipoxygenase (5-LOX), 15-LOX and cyclooxygenase-2 (COX-2) activities. This activity may be due to occurrence of the triterpenoids and bacosides in it. It can be used for people suffering from arthritis, gout and other swelling situations [33].

VERNACULAR NAMES (TABLE 9)

Table 9. Names of Bacopa in different languages.

Arabic	Zarazab
Bengali	Brahmisak, Jalanimba
Bombay	Bama
Chinese	Pa-Chi-Tlien
English	Water Hyssop, Thyme leaved gratiola
Hindi	Brahmi, Jalnim, Barambhi
Kannada	Nirubrahmi, Kirubrahmi, Neeruppigida
Konkan	Brahmi
Malay	Bremi
Malayalam	Brami, Nirbrahmi
Marathi	Nirbrahmi
Persian	Jaranab
Sanskrit	Aindri, Brahmi, Gundala, Indravalli, Jalasaya
Tamil	Nirpirami, Piramiyepundu, Vivitamcampirani
Urdu	Jalanim, nirbrahmi
Telugu	Sambrani Chettu, Neeri Sambrani mokka, sambraani aaku

REFERENCES

- Gk S, MS Bharath M (2011) Exploring the role of "Brahmi" (*Bacopa monnieri* and *Centella asiatica*) in brain function and therapy. Recent Patents on Endocrine, Metabolic and Immune Drug Discovery 5: 33-49.
- Ramawat KG (2004) Biotechnology of medicinal plants: Vitalizer and therapeutic. Science Publishers, Inc.
- Neetu, Singhal HK, Kataria A (2016) A critical review on brahmi (*Bacopa monnieri* (L.) Pennell). Eur J Pharm Med Res 3: 270-276.
- Ariffin F, Heong Chew S, Bhupinder K, Karim AA, Huda N (2011) Antioxidant capacity and phenolic composition of fermented *Centella asiatica* herbal teas. J Sci Food Agric 9: 2731-2739.
- Soumyanath A, Zhong YP, Yu X, Bourdette D, Koop DR, et al. (2005) *Centella asiatica* accelerates nerve

- regeneration upon oral administration and contains multiple active fractions increasing neurite elongation *in vitro*. J Pharm Pharmacol 57: 1221-1229.
6. Kumar MV, Gupta YK (2002) Effect of different extracts of *Centella asiatica* on cognition and markers of oxidative stress in rats. J Ethnopharmacol 79: 253-260.
 7. Nandagaon VS, Kulkarni AR (2013) In vitro antioxidant and cytotoxicity activity of *Bacopa monnieri* and *Baliospermum montanum* Muell arg. Int J Pharm 4: 63-67.
 8. Mahesh B, Satish S (2008) Antimicrobial activity of some important medicinal plant against plant and human pathogens. World J Agric Sci 4: 839-843.
 9. Tothiam C, Phrompittayarat W, Putalun W, Tanaka H, Sakamoto S, et al. (2011) An enzyme-linked immunosorbant assay using monoclonal antibody against bacoside A3 for determination of jujubogenin glycosides in *Bacopa monnieri* (L.) Wettst. Phytochem Anal 22: 385-391.
 10. Debjit B, Pankaj T, Tripathi KK, Kumar KS (2010) Traditional Indian memory enhancer herbs and their medicinal importance. Ann Biol Res 1: 41-46.
 11. Pritee S, Gondkar S, Saudagar R, Mahajan K (2016) Formulation and evaluation of jelly using herbal extract. Int J Univ Pharm Biosci 5: 2319-8141.
 12. Warriar PK, Nambiar VP (1993) Indian medicinal plants: A compendium of 500 species. Orient Blackswan.
 13. Chaudhari KS, Tiwari NR, Tiwari RR, Sharma RS (2017) Neurocognitive effect of nootropic drug brahmi (*Bacopa monnieri*) in Alzheimer's disease. Ann Neurosci 24: 111-122.
 14. Bhattacharya SK, Kumar A, Ghosal S (1999) Effect of *Bacopa monnieri* on animal models of Alzheimer's disease and perturbed central cholinergic markers of cognition in rats. Research Communications in Pharmacology and Toxicology 4: II-1.
 15. Onsa-ard A, Scholfield CN, Ingkaninan K, Srimachai S, Kamkaew N, et al. (2012) Oral *Bacopa monnieri* is antihypertensive in rats chronically treated with L-NAME. J Physiol 25: 23-26.
 16. Mukherjee A, Gombar V, Shamsi Y, Gupta M, Sinha S (2017) Effectiveness of brahmi in various illnesses: Review paper. Herb Med 3: 10.
 17. Caroline R, Richard B, Scoot (2003) Brain bioenergetics and cognitive ability. Dev Neurosci 25: 324-331.
 18. Elangovan V, Govindasamy S, Ramamoorthy N, Balasubramanian K (1995) *In vitro* studies on the anticancer activity of *Bacopa monnieri*. Fitoterapia 66: 211.
 19. Tripathi YB, Chaurasia S, Tripathi E, Upadhyay A, Dubey GP (1996) *Bacopa monniera* Linn. as an antioxidant: Mechanism of action. Indian J Exp Biol 34: 523-526.
 20. Phrompittayarat W, Wittaya-Areekul S, Jetiyanon K, Putalun W, Tanaka H, et al. (2008) Stability studies of saponins in *Bacopa monnieri* dried ethanolic extracts. Planta Medica 74: 1756-1763.
 21. Jain P, Khanna NK, Trehan N, Pendse VK, Godhwani JL (1994) Anti-inflammatory effects of an ayurvedic preparation, brahmi rasayan, in rodents. Indian J Exp Biol 32: 633-636.
 22. Cheng CL, Koo MW (2000) Effects of *Centella asiatica* on ethanol induced gastric mucosal lesions in rats. Life Sci 67: 2647-2653.
 23. Chatterjee TK, Chakraborty A, Pathak M, Sengupta GC (1992) Effects of plant extract *Centella asiatica* (Linn.) on cold restraint stress ulcer in rats. Indian J Exp Biol 30: 889-891.
 24. Khare CP, Chopra RN (2000) Indian herbal therapies. Vishv Books.
 25. Chowdhuri DK, Parmar D, Kakkar P, Shukla R, Seth PK, et al. (2002) Anti-stress effects of bacosides of *Bacopa monnieri*: Modulation of Hsp70 expression, superoxide dismutase and cytochrome P450 activity in rat brain. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives 16: 639-645.
 26. Rao SB, Chetana M, Devi PU (2005) *Centella asiatica* treatment during postnatal period enhances learning and memory in mice. Physiol Behav 86: 449-457.
 27. Kumar A, Dogra S, Prakash A (2009) Neuroprotective effects of *Centella asiatica* against intracerebroventricular colchicine-induced cognitive impairment and oxidative stress. Int J Alzheimers Dis.
 28. Yu Z, Cheng G, Hu B (1997) Mechanism of colchicine impairment on learning and memory and protective effect of CGP36742 in mice. Brain Res 750: 53-58.
 29. Chopra RN, Nayar SL (1956) Glossary of Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi.
 30. Nadkarni KM (1996) Indian materiamedica. Dr. KM Nadkarni's Indian materiamedica: with Ayurvedic, Unani-Tibbi, Siddha, allopathic, homeopathic, naturopathic and home remedies, appendices and indexes. 1. Popular Prakashan.

31. Rae C, Scott RB, Lee M, Simpson JM, Hines N, et al. (2003) Brain bioenergetics and cognitive ability. *Dev Neurosci* 25: 324-331.
32. Singh RH, Singh L (1980) Studies on the anti-anxiety effect of the medyharasayana drug Brahmi (*Bacopa monniera* Wettst.). *Res Ayur Siddha* 1: 133-148.
33. Chowdhuri DK, Parmar D, Kakkar P, Shukla R, Seth PK, et al. (2002) Anti-stress effects of bacosides of *Bacopa monnieri*: Modulation of Hsp70 expression, superoxide dismutase and cytochrome P450 activity in rat brain. *Phytother Res* 16: 639-645.
34. Dhanasekaran M, Holcomb LA, Hitt AR, Tharakan B, Porter JW, et al. (2009) *Centella asiatica* extract selectively decreases amyloid β levels in hippocampus of Alzheimer's disease animal model. *Phytother Res* 23: 14-19.
35. Aboitiz F (1992) The origin of the mammalian brain as a case of evolutionary irreversibility. *Medical Hypotheses* 38: 301-304.
36. Ponnusamy K, Mohan M, Nagaraja HS (2008) Protective antioxidant effect of *Centella asiatica* bioflavonoids on lead acetate induced neurotoxicity. *Med J Malay* 63: 102-163.