

# An Overview on Ethano-Medicinal and Pharmacological Effects of Bacopa Monnieri

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## ABSTRACT:-

For millennia, bacopa monnieri has been used as a sedative, anti-epileptic, memory and learning enhancer, and in combination with other herbs in Ayurvedic treatment. The purpose of this review was to emphasize the advantages of B. monnieri extracts (BME) for health, with an emphasis on neurological disorders and anticancer treatments. We looked at the phytochemistry and pharmacological use of BME in clinical research. We also emphasized the potential therapeutic applications of these extracts as well as their mode of action in various cancer types. Furthermore, we looked into the underlying molecular mechanisms of safety issues, toxicities, therapeutic interventions, and synergistic potential in neuroprotection and cognition. In summary, this analysis offers more profound understanding of the potential therapeutic applications of Brahmi as a lead formulation for neurological illnesses and its ability to enhance cognitive function.

**Key Words:-** Baccopa Moonier. Brahmi, Medhaya Rasayana. Alkaloids, Bacoside. Ayurvedic, Athar-Ved Samhita, Phytochemistry, Terpenoid, Flavonoid.

## I. INTRODUCTION:

A well-known ayurvedic medicinal herb, Bacopa monnieri (L.) – (BM) (common names: Brahmi, Bacopa, Waterhyssop), is a nootropic plant that belongs to the family Scrophulariaceae. India is used as a cerebral tonic to lengthen life, enhance brain function, and enhance intelligence and memory.[2] Complementary and alternative medicines (CAM) have been widely used throughout history. One Common CAM treatment from the Ayurveda medicinal system is Bacopa monnieri (L.) Wettst. (B.monnieri), Or “Brahmi”, from the family Scrophulariaceae. B.monnieri, is a perennial creeping herb that thrives in damp soils and marshes throughout the subcontinent and is classified as a nootropic (i.e., a cognitive enhancer).[2] The herb Bacopa monnieri, which is a member of the Scrophulariaceae family and is also referred to as Brahmi, grows natively throughout South and Southeast Asia. It has a

lengthy history in conventional medicine and is well-known for improving memory and lowering anxiety.[3] It is utilized as a brain tonic, memory booster, intellectual booster, and sensory organ revitalizer in the Ayurvedic medical system. The benefits of bacopa for memory, learning, and concentration have been the main focus of recent research, and the findings corroborate the ancient ayurvedic claims. It is also asserted that the activity improves memory. To be beneficial in the management of respiratory and cardiac.[4] Brahmi, also called Bacopa monnieri Pennel (Scrophulariaceae), is a key Ayurvedic medication for enhancing cognition and memory. And improving sensory organ vitality. Numerous researchers have thoroughly examined the plant's nootropic potential, and alcoholic/hydroalcoholic preparations of the entire plant have demonstrated this ability. The main chemical components of the alcoholic extract that were separated and identified (using spectrum techniques) are triterpenoid saponins of the dammarane type, with the 1. aglycones jujubogenin and 2. pseudojujubogenin.[5] B. monnieri is a weak, creeping, slightly succulent herb that grows in wet, marshy places all over India). The active principle A couple of saponins that have been documented include includee bacoside A and bacoside B. [6] BM is widely used in India as a rejuvenating herb that improves memory and nervous system performance. BM is a white, creeping herb with tiny leaves that is branching. Light purple flowers from the Schrophulariaceae family. It can be found in moist, marshy, sandy places next to streams in tropical sections of the Indian subcontinent's wetlands. There are about 100 species of aquatic herbs in the genus Bacopa, which are found outside of India in Nepal, Sri Lanka, Taiwan, China, and some areas of the United States.[7]

## Taxonomic Classification:-

Kingdom: Plantae  
Division: Tracheophyta  
Class: Magnoliopsida  
Order: Lamiales  
Family: Schrophulariaceae

Genus: Bacopa  
Species: monnieri (L.) [8]

### Plant Description And Morphology:-

Bacopa monnieri is a tiny, creeping herb with many branches, short oblong leaves, and light purple flowers. It belongs to the Scrophulariaceae family. It grows natively in marshes, shallow water, and moist soil in India and the tropics. The herb grows at higher altitudes. It may be easily grown anywhere from sea level to 4,400 feet in elevation, provided there is enough water available. In the summer, the plant has flowers and fruit, and its whole is utilized medicinally. [9] This herb grows up to 1500 meters in altitude in the moist regions of adjacent tropical countries and India. It is glabrous, creeper-like, and somewhat succulent. Bacopa's reputation as medhya rasayana stems from its capacity to enhance cognitive qualities of the brain and is a highly popular herb used by all Ayurvedic practitioners to treat memory loss, fever, inflammation, pain, asthma, epilepsy, and insanity. The primary molecule responsible for these neuropharmacological effects is bacoside A, a triterpenoid saponin of the dammarane class. [10]

### Leave:-

Turns over. On new leaves, observations were made. Mature leaves at the fourth node from the tip of the stem apex were the leaves that were chosen. Bacopa leaf morphology was defined using a number of quantitative and qualitative characteristics. The numerical, The width and length of the leaves were noted characteristics. A ruler was used to measure the length and width of the leaf (accuracy 0.1 cm). The width of the leaf was measured at its broadest point, and the length

was measured from the apex to the base of the leaf. By comparing the length and width of the leaf, measurements of its length and width can be used as a guide to ascertain the form of the leaf. There were qualitative character observations made. [11]

### Root :-

The shape of the root ranges from unevenly round to angular, with an outermost piliferous layer, parenchymatous cortex, and air between. Gaps and a strong core of xylem surrounded by narrow phloem in the center. The piliferous layer is replaced by the formation of cork cells; the endodermis is a distinct band of phloem that surrounds the solid core of xylem, which is made up of radially arranged isolated vessels, fibers, and medullary rays; the cortex is wide and parenchymatous, traversed by simple and compound starch grain interspersed with air spaces. [12]

### Stem:

prostrate, green or purplish-green in color, thick and fleshy, herbaceous, soft, and featuring prominent internodes and nodes. [13] The transverse section of the stem exhibits discrete cells that are composed of many layers. The epidermis, which is the topmost layer, has barrel-shaped cells that are grouped together in a single row, sort of like a chain. Underneath this are two or three layers of hypodermis made up of parenchymatous cells containing chlorophyll and a cortical area made up of parenchyma cells with lots of air gaps. Certain cells in this area contain grains of starch and prismatic calcium oxalate crystals. Endodermis comes next, the. [14] shown (Fig.No.1)

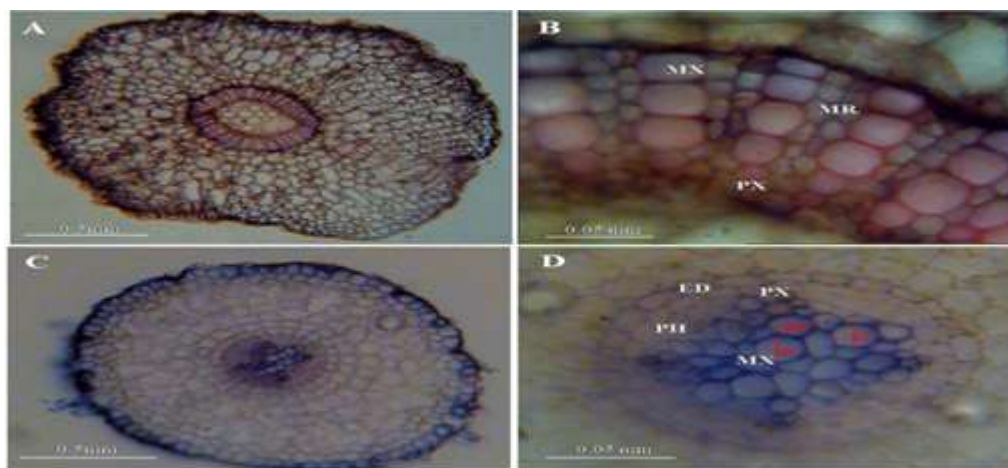


fig.No.1.Stem Cells Of Baccopa Monnieer

**Flowers:**

Actinomorphic, solitary, white with bands of violet and green and dotted with glittering dots while they are fresh. Flowers have a limited

lifespan and their color gradually lightens. Pedicel is slender in form, and axillary, bracteate, and bracteoles are shorter than pedicel.[13A] Shown In Fig.No.2

**(Fig.No.2.Flower Of Bacopa Monnier**



**Biological Activity Of Bacopa Monnier:-**

Utilized for at least three millennia, *B. monnieri* is mentioned for its ability to improve memory in the Vedic writings “Athar-Ved Samhita” (3:1) from 800 BCE, as well as in Ayurveda. Dedicated phytochemical researchers were drawn to this herb because of its outstanding pharmacological effects, including those related to cognition, memory improvement, anxiety reduction, antidepressant, anticonvulsant, and antioxidant properties, among others. In animal models, the herb exhibited cognition-promoting, antidementic, and acetylcholinesterase-inhibiting actions, suggesting that it contains phytochemicals with potential for treating debilitating conditions like Alzheimer’s disease. [15].

**Neuropharmacological Activity:-**

BM has been thoroughly investigated both in vitro and in animal models. Despite the fact that BM is used to treat epilepsy, anxiety, and other neurological diseases, this review will focus on memory, learning, and cognition. The above clinical trials only address memory; they leave out aspects of cognition such as creativity or fluid intelligence. Previous clinical trials were usually only 12 weeks long and were not longitudinal.

Animal trials indicate significant protection against age-related neurodegeneration rather than gradual toxicity or tolerance building, yet the long-term effects of BM on humans are unknown.[16] The main ingredients are bacosides, which are dammarane-type triterpene saponins. They are in charge of cognitive processes. Jujubogenin and pseudojujubogenin are two forms of saponins that differ solely in the type of sugar units present in the glycosidic chain. Bacoside A is the primary molecule responsible for the neuropharmacological actions of BM. It is a mixture of bacoside A3, bacoside II, bacosaponin C, and an isomer of bacosaponin C called jujubogenin. According to a study, the system’s oral treatment of BM extract results in behavioral benefits.[8]

**Antioxidant Activity:-**

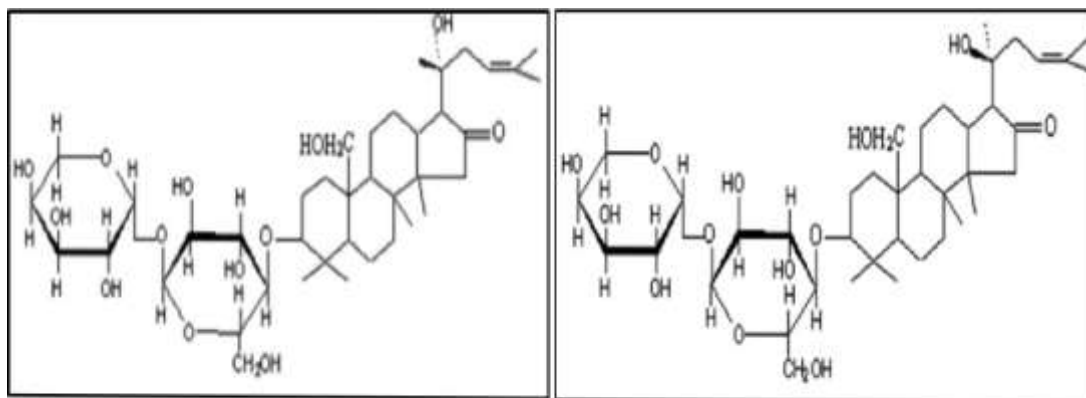
Data from many labs indicate that the BM’s capacity to promote cognition may be partially ascribed to the bacosides’ antioxidant properties. In one investigation, ferrous sulphate and cumene hydroperoxide were used to measure the effects of alcohol and the hexane extract of BM on lipid peroxidation in rat liver homogenate (Tripathi et al., 1996). The alcohol fraction showed stronger defenses against the two inducers. Additionally, the

outcomes were contrasted with those of established antioxidants, such as tris (2-amino-2-hydroxymethyl-1,3-propanediol), a hydroxyl trapper, EDTA, a metal chelator, and vitamin E (100 mg of the BM alcoholic extract was equal to 247 mg of EDTA and 58 mg of vitamin E). BM was only marginally protected against the ferrous sulphate-induced peroxidation, while EDTA and vitamin E provided dose-dependent protection. Oxidation of reduced glutathione, indicating that metal chelation at the start of the chain reaction triggered by free radicals or the quenching of free radicals at the propagation stage may be the mechanisms by which BM exerts its antioxidant function.[17]

**Phytochemistry:-**

The aqueous extract of powdered specimens underwent phytochemical screening

utilizing industry standard protocols (Harborne technique). Tannin the following substances were screened: phenol, cardiac glycoside, terpenoid, saponin, flavonoid, steroid, alkaloid, anthraquinone, and carbohydrate.[18]Bacosides and bacopasaponins, two types of tritetrapenoid saponins, were identified as the main constituents. Additionally, two saponins known as pseudojujubogenin and jujubogenin were discovered as aglycones. Primarily differ from one another in terms of the makeup of sugar units due to variations in the locations of the olefinic side chain and glycosidic chain inside the aglycone. Bacopaside I, Bacopaside II, Bacopaside X, Bacopaside A3, Bacopaside N2, and Bacopasaponin C were a few more significant active ingredients identified. Bacopaside III, IV, V, E, and F were a few of the small active ingredients.



Bacoside A (levorotatory);

(b) Bacoside B (dextrorotatory)

Fig.No.3 Structure of drug preant B.M

**Effect Of Bacopa Monnieri:-**

It has been documented that using Bacopa monnieri improves the behavior of numerous laboratory animal models in a variety of experimental settings, such as mice. According to reports, bacopa monnieri has therapeutic potential for treating neurological conditions and enhancing memory. The main ingredients are bacosides, which are dammarane-type triterpene saponins. They are in charge of cognitive function. There are two varieties of saponins: pseudojujubogenin and jujubogenin, which differ solely in the type of sugar units in the glycosidic chain. Bacoside A is the primary molecule responsible for the neuropharmacological actions of BM. It contains a milieu of jujubogenin, bacopaside A3, bacopaside II, and bacopasaponin C.[8B]

**Bacopa Monnieri in Depression:-**

One of the hallmarks of major depression, a neurological disorder, is a minimum of two weeks of sadness. Anhedonia, or the loss of interest in enjoyable activities, is frequently a sign of significant depression, along with energy loss, low self-esteem, and pain that has no apparent reason. The primary theory about the etiology of depression is that monoamine deficiency at the brain's synaptic cleft exists. This is Backed by the observation that almost all antidepressants impede the absorption of monoamines or stop their breakdown, hence increasing the amount of monoamines available at the synapses. Currently, only 50% of patients find the regularly given antidepressant medications to be effective, with 80% of patients only seeing partial effects. But



there's a requirement for fresh and enhanced antidepressant medications.[3]

#### **Bacopa Monnieri In Alzheimer's Disease:-**

A number of genes are crucial to the pathophysiology of AD. The most significant and researched ones include apolipoprotein E (APOE), presenilin-1 (PSEN-1), presenilin-2 (PSEN-2), and amyloid precursor protein (APP). Early onset AD is caused by mutations in the APP and PSEN-1 genes; PSEN-2 has a more varied onset, however the APOE mutation is used in late-onset AD.[20] It has been demonstrated that bacopa lowers betaamyloid deposits in the brains of animals used as Alzheimer's disease models. It has a major memory-enhancing impact. It Enhances learning tasks' acquisition, retention, and retrieval.[21] The application of different compounds with both synthetic and natural origins is one of the therapeutic options for AD. The varied chemical composition of ayurvedic herbs allows for the testing of many combinations against different aspects of AD. Indian ginseng, ashwagandha, has a reputation for being beneficial against. Since AD, ashwagandha's alkaloids are known to improve cognitive function by regulating acetylcholine levels and reducing amyloid- $\beta$  aggregation.[22]

#### **Bacopa Monnieri In Diabetes :-**

In diabetic individuals, oxidative stress has been linked to problems such neuropathy, nephropathy, and cardiomyopathy. The preventive function of *B. monnieri* in streptozotocin-induced tissue antioxidant defense system and lipid peroxidative status. The effects of *B. monnieri* extracts administered orally on lipid peroxidation and enzymatic and non-enzymatic antioxidant levels were measured in the kidney, cerebellum, cerebrum, and midbrain of diabetic rats. The outcomes were compared to those of glibenclamide, a reference medication. [10A]

#### **Bacopa Monnieri In Cancer:-**

*B. monnieri* exhibits anti-tumor efficaciousness against several forms of cancer. Revealed that the terpenoid bacopaside I and II from *B. monnieri* can work in concert. Impede the membrane transport system aquaporin's functional activity; AQP1 has also been linked to the advancement of tumors. In breast cancer cell lines, the decreased transcriptional expression of AQP1 suppresses proliferation, migration, and invasion.[23] the ability of strangelmasterol, which is extracted from *Bacopa monnieri*'s aerial portions,

to inhibit Ehrlich ascites cancer in Swiss albinos. Mice. It is believed that protein phosphatase activation mediates the anti-tumor effect of strangelmasterol.[8C]

#### **Bacopa Monnieri In Parkinson's Disease:-**

Although movement disorders are the main symptom of Parkinson's disease (PD), non-motor symptoms are also present. It has an impact on the dopaminergic neurons in the brain, and PD symptoms are brought on by the death of these neurons. Because dopamine is linked to motor activity, a progressive loss of dopaminergic neurons causes bradykinesia, tremors, and stiffness in the muscles in addition to mental, cognitive, sleep, personality, and behavioral disorders like anxiety and depression.[24]

#### **Traditional Uses Of Bacopa Monnieri:-**

"The sum total of knowledge, skills and practices based on the theories, beliefs and experiences of different cultures that are used to maintain health, as well as to prevent, diagnose, improve or treat physical and mental illnesses" is how the World Health Organization defines traditional medicine. Many people in developing nations have gone back to using traditional botanicals to keep themselves healthy and happy. Nowadays, with migration surging, newcomers frequently bring traditional plants from their home countries to utilize as dietary supplements. This has led to the marketing of certain exotic plants abroad, especially those utilized in Chinese and Ayurvedic traditional medicine.[25] The herb has a long history of use, and its proven ability to improve memory is particularly relevant to modern medicine. Functioning and offering individuals suffering from anxiety neurosis comfort. Brahmi is classified as a "medhya rasayana" in Ayurveda, meaning brain tonic, having the capacity to enhance cerebral activity and offer overall rejuvenating effects. [26]

## **II. CONCLUSION:-**

One of the traditional plants used in Ayurvedic and herbal treatment is bacopa. BM exhibits enormous potential for improving several neuropharmacological, inflammatory, depressive, and other conditions. At different doses, the methanolic and ethanolic extract of BM is essential for treating human illnesses. Bacoside A is the main molecule responsible for the therapeutic effect found using several study models. Nonetheless, additional research is necessary to ascertain the

intended function of the bioactive substances found in the bacoside fraction separated from BM.

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