

removal

by Bacopa Plag

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Abstract

Herbal medicines are gaining importance these days over the contemporary medicines owing to their minimal side effects. Bacopa monnieri has been considered as an efficient traditional medicine since vedic times and has considerable reputation in Ayurveda as a memory and intellect enhancer. It has also been used as a cure for various other ailments and nervous disorders. The natural products has gained much preference, hence Bacopa and its neuropsychotropic actions need to be studied in much detail, to know about the pathways it affects, its molecular basis of action. However, it is also imperative to look into the adverse effects caused by Bacopa. Several studies (both in-vitro and in-vivo model) have been done in this light to establish its neuroprotective effects. This review is the compilation of the medicinal effects of Bacopa, also the molecular basis of action in neuroprotection and memory enhancement. A brief mention of the toxicity and adverse effects has also been done. With the increase in pollution, radiation and free radical damages the incidences of neurodegenerative diseases like alzheimers is rising. It is now imperative that we look for promising neuroprotective and memory enhancing drug that help to cope with the harmful effects of pollution and free radical. To establish Bacopa as a herbal medicine it still needs to be weighed for its promised benefits and the unwanted harmful effects and we need to take caution while advising supplementation in different age groups. The present review summarizes our current knowledge of pharmacological activities-clinical and non clinical, major bioactive compounds in Bacopa, mechanism of action of Bacopa and possibility of interaction of herb with conventional drugs.

This review reiterates the medicinal and neuroprotective benefits of Bacopa monnieri. It is essentially a valuable medicinal herb with cognition enhancing properties mediated via several mechanisms and is fairly non toxic. BM is a highly prominent herb used in ayurveda since ancient times. it has been traditionally used for increasing memory, concentration, cognition and in reducing stress-induced anxiety. Since ancient times it is best known as a neural tonic and memory enhancer [1,2]. It is considered to be a "medhya rasayana", an herb that sharpens the mind and the intellect. It is also used for its antioxidant properties [3] and as a cure for various ailments like epilepsy, cardiovascular diseases, ulcers, ascites, enlargement of spleen, indigestion, inflammations, leprosy, anaemia. [4,5]

Bacopa monnieri (Family: *Scrophulariaceae*; Genus: *Bacopa*; Species: *B. Monnieri*) also known as brahmi, is one of the ancient medicinal plants traditionally used in various systems of medicine [10]. It is popular for aquarium use as it grows in wet, tropical environments and thrive underwater.

Brahmi is a perennial, creeping herb, succulent, juicy, glabrous with rooting at nodes that grow in prostrate way on wetland, marshy areas and muddy shores, in semi-shaded conditions. Bacopa monnieri generally grow in tropical Asia like in India, Africa, North and South America, Europe, Australia, China, Sri Lanka, Taiwan and other places [11,12,13].

Leaves are simple, ovate, opposite with punctate patterns. These are oblanceolate, fleshy, decussate, sessile, grow in cluster of 2 or alternately. Flower are solitary, axillary, white or purple tinged with long slender pedicels that flowers mainly in September –October. It bears yellow brown coloured ellipsoid seed [14].

Bacopa has been used traditionally as a neurological tonic in general, for allaying anxiety, as a cognition enhancer, memory and intellect booster for centuries in Ayurveda-The traditional Indian System of Medicine. It is named "Brahmi," after the name of Lord Brahmā, The creator (in Hindu mythology).

Medicinal properties of Bacopa

Several studies have been performed to study the neuroprotective roles of Brahmi, apart from the other medicinal properties that it possesses. It is reported to have antioxidant [15,16], anti-inflammatory [17], analgesic [18], tranquilising [19,20], antipyretic action [21]. It is a potent free radical scavenger. It is studied to have broncho-vasodilator and smooth muscle relaxant and mast cell stabilizing properties [22]. It is also known to have antiulcer[23], anticancer[24], hepatoprotective action[25].

Bacosides, the active ingredients of Bacopa monnieri are believed to be responsible for these benefits. These Bacosides show powerful anti-oxidant properties, reduce inflammation and blood pressure, boost brain function, help to reduce ADHD symptoms, prevent anxiety and stress and possess anti-cancer properties as well.

18 1. Sedative properties

Studies have also shown that Brahmi Rasayana possesses sedative effect, prolonged the hypnotic action of pentobarbitone, and caused a variable blockade of conditioned avoidance response. It also offered protection against electroshock seizures and chemoconvulsions.

2 2. Cognition

Some research shows that taking specific Bacopa extracts improves some measure of memory in otherwise healthy older adults. Also, taking Bacopa extract seems to improve some measures of memory and hand-eye coordination in children aged 6-8 years.

2 3. Antidepressant and anti-anxiety effects

Early research suggests that taking 30 mL of Bacopa syrup daily for 4 weeks reduces symptoms of anxiety, including nervousness, racing heart, trouble sleeping, headaches, tiredness, difficulty concentrating, and stomach discomfort.

2 4. Anti-epileptic effects

Early research suggests that taking Bacopa extract for 5 months prevents seizures in some people with epilepsy.

5. Anti-arthritic

Bacopa Monnieri contains many antioxidant, antibacterial, and anti-inflammatory properties. These properties reduce redness and irritation associated with eczema and psoriasis, and increase the ease and comfortability of joint movement that may be affected by arthritis and previous injuries. Brahmi also contains naturally occurring Nitric Oxide, which plays a role in inflammation and pain perception. This also improves joint pain associated with arthritis, as well as muscle soreness. Aside from skin and joint health, Brahmi oils and powders have been used to strengthen hair and promote healthier, longer, fuller hair with less split ends. It has also been known to reduce dandruff.

6. Anti-cancer

Test-tube and animal studies have found that Bacopa monnieri may have anticancer properties. Bacosides, the active class of compounds in Bacopa monnieri, have been shown to kill aggressive brain tumor cells and inhibit the growth of breast and colon cancer cells in test-tube studies. Additionally, Bacopa monnieri induced skin and breast cancer cell death in animal and test-tube studies. Research suggests that the high levels of antioxidants and compounds like bacosides in Bacopa monnieri may be responsible for its cancer-fighting properties.

7. 17 Anti-diabetic

Brahmi has been historically used in the treatment of various conditions that present with oxidative stress-induced damage. This makes it a candidate in the management of hyperglycaemia-induced oxidative stress that underlies diabetic complications.

10 8. Anti-microbial

Among the various extracts, diethyl ether extracts of B. monnieri has an antibacterial potency against Staphylococcus aureus (gram positive), and ethyl acetate extract showed effects on E. coli (gram negative) at higher concentrations of 300 microgram mL⁻¹. The ethanolic extract has potent

antifungal activity against the fungus (*Aspergillus flavus*, and *Candida albicans*) compared to diethyl ether and ethyl acetate-ether. Both extracts (diethyl ether and ethyl acetate) has a minimum antifungal effect while these extracts showed more inhibitory effects on tested bacteria.

9. Anti-oxidant

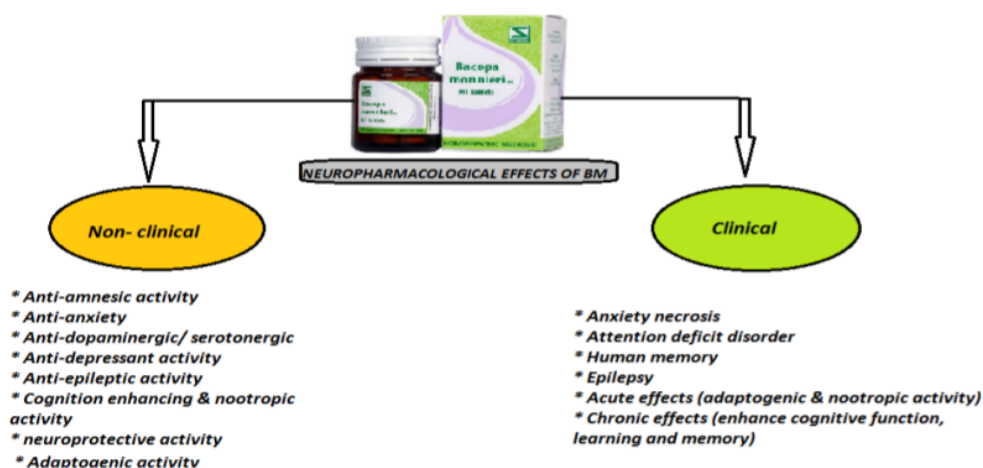
Bacopa monnieri extract exhibits interesting antioxidant properties, expressed by its capacity to scavenge superoxide anion and hydroxyl radical, and to reduce H₂O₂ induced cytotoxicity and DNA damage in human fibroblast cells. Results showed promise in conquering the disease and protecting the brain from damage by the antioxidant activity of the extract in the hippocampus, frontal cortex and striatum.

10. Anti-parkinsonism

Bacopa monnieri helps in coping with combined hypoxic, hypothermic and immobilization stress that could lead to the onslaught of 'free radicals' during the progress of PD.

11. Alzheimer's disease

Bacosides, particularly bacosides a and b, are found in high concentrations in *Bacopa Monnieri*. Bacosides affect the neurotransmitters of the brain, and improve cognitive function, and the function of the Central Nervous System. Studies show that patients between 50-65 years of age who had Alzheimer's and were given brahmi supplements showed improved short term memory, as well as decreased instances of anxiety and agitation.



Bioactive molecules

In this delicate herb, numerous neuroboosting compounds are found, the most active among them are bacoside A and bacoside B.

Saponins (specifically Bacosides A and B) are the active ingredients that are responsible for the memory enhancing effects of *Bacopa*. They are believed to have procholinergic effects.

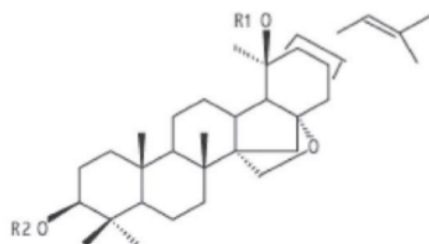
Bacosides are triterpenoid saponins, comprise a family of 12 called *bacopasides* I–XII.

The constituent most studied has been *bacoside A*, which was found to be a blend of bacoside A3, bacoside II, bacosaponin C, and a jujubogenin isomer of bacosaponin C. Saponins are glycosides, a sugar unit attached to an aglycone portion (the sapogenin). Chemical structure of Bacoside-A, B and C are represented as 3-O- α -L-arabinopyranosyl- 20-O- α -L-arabinopyranosyl-jujubogenin, 3-O-[α -L-arabinopyranosyl (1-2) α -L-arabinopyranosyl] pseudojujubogenin and 3-O-[β -D-

glucopyranosyl (1-3){ α -L-arabinofuranosyl (1-2)} α -L-arabinopyranosyl pseudojubenin respectively [13].

The chemical constitution of *Bacopa monnieri* was found as:

Alkaloids such as Hydrocotyline, Brahmine and Herpestine. [3] Glycoside such as Asiaticoside and Thanakunide.

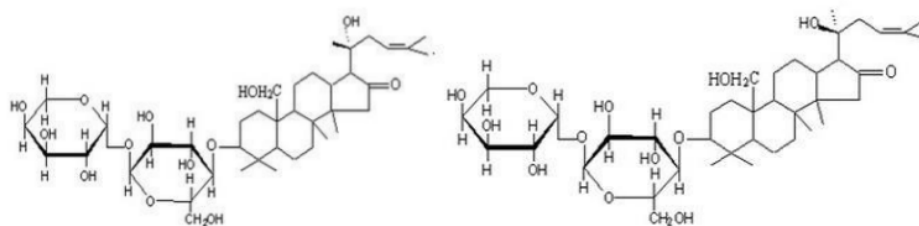


	R ₁	R ₂
Bacoside A	H	α -L-arabinofuranosyl (1-3) α -L-arabinopyranosyl
Bacoside B	H	β -D-glucopyranosyl (1-3)-O- α -L-arabinofuranosyl 1-2
Bacosaponin B	H	α -L-arabinofuranosyl (1-2) α -L-arabinopyranosyl

Flavonoids such as Apigenin and Luteonin. Saponins such as D-mannitol, Acid A, Monnierin [C₅₁H₈₂O₂₁3H₂O] Bacoside A [C₄₁H₆₈O₁₃4H₂O] and Bacoside B [C₄₁H₆₈O₁₃5H₂O].

Additional **Phytochemicals** such as Betulinic acid, Wogonin, Oroxindin, Betulic acid, Stigmasterol, beta-sitosterol, numerous **Bacosides** and **Bacopasaponins**, amino acids like alpha alanine, Aspartic acid, Glutamic acid, and Serine, and its esters, Heptacosane, Octacosane, Nonacosane, Triacotane, Hentriacontane, Dotriacontane, Nicotine, [4] 3-formyl-4-hydroxy-2H-pyran (C₆H₆O₃), and its 7-glucoside.

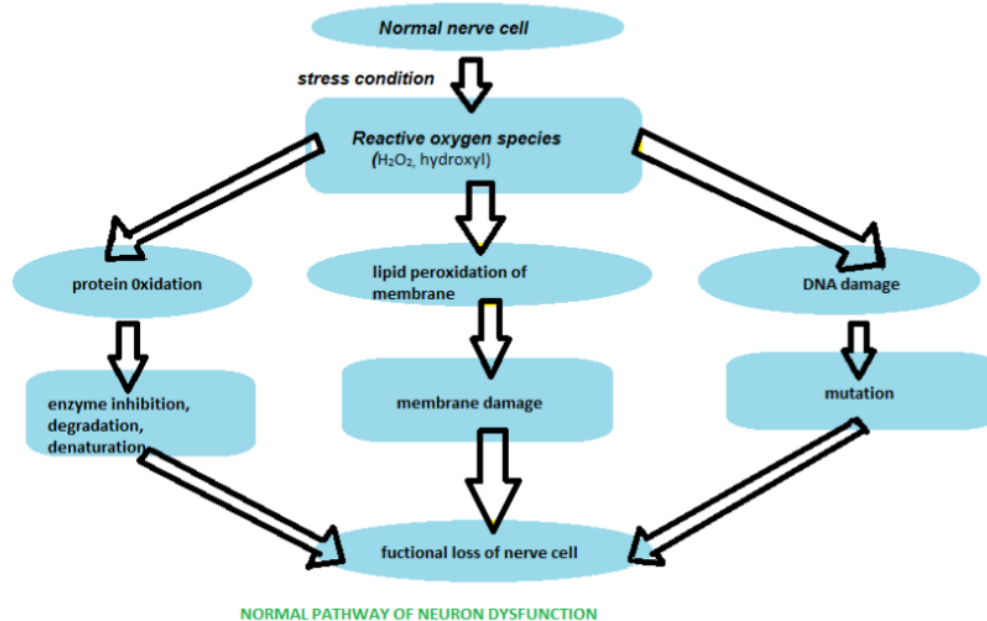
Brahmoside, Brahminoside, Brahmic acid, Isobrahmic acid, Vallerine, pectic acid, fatty acids, tannin, volatile oil, ascorbic acid, thanakunide acid and asiatic acid [5–10]. Jujubacogenin and pseudojujubacogenin [11].

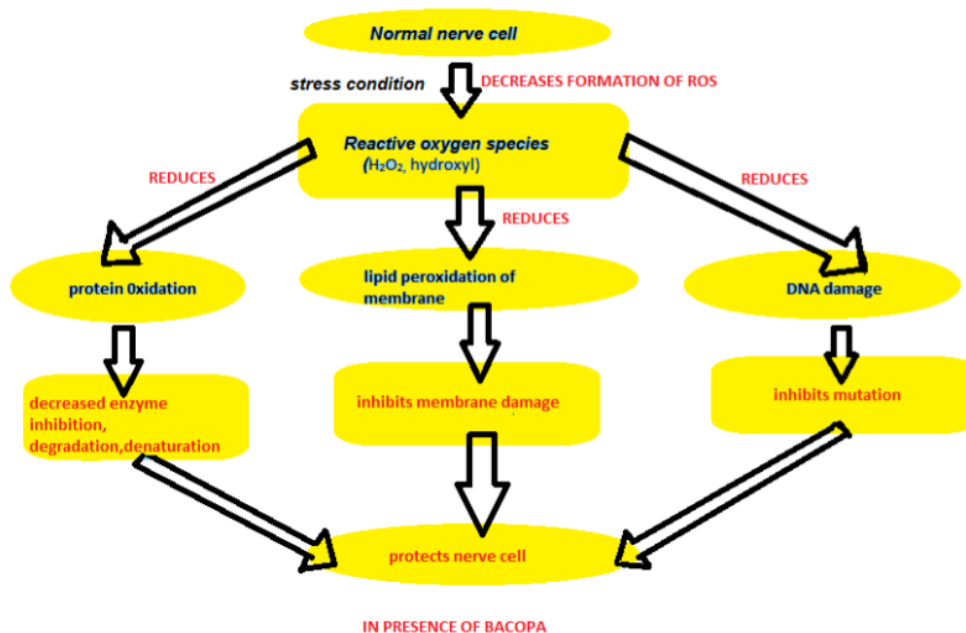


Bacoside- A

Bacoside-B

Nevertheless, Several *in-vivo* and *in vitro* studies have revealed its potential medicinal properties, including its nootropic utility in humans. Studies also suggest potential improvement in dementia, Parkinson's disease, and epilepsy.[2,5] Current understanding suggests that BM acts via the following mechanisms—anti-oxidant neuroprotection (via redox and enzyme induction), acetylcholinesterase inhibition and/or choline acetyltransferase activation, β -amyloid reduction, increased cerebral blood flow [6], and neurotransmitter modulation (acetylcholine [ACh], 5-hydroxytryptamine [5-HT], dopamine [DA]) [7,8,]. BM appears to exhibit low toxicity in model organisms and humans; however, long-term studies of toxicity in humans are yet to be conducted [2]. In modern biomedical studies, bacopa has been shown in animal models to inhibit the release of the pro-inflammatory cytokines TNF- α and IL-6. However, less is known regarding the anti-inflammatory activity of Bacopa in the brain [9]. This review will integrate molecular neuroscientific mechanisms involved and their impact in behavioral research. In 2019 US Food and Drug administration warned manufacturers of dietary supplement product containing Bacopa against illegal and unproven claims that the herb can treat various diseases like Epilepsy, Alzheimers and other neurodegenerative diseases





Molecular Mechanism underlying effects of *Bacopa monnieri*

Bacopa contains alkaloids (nicotine, herpestine), flavinoids (luteolin, apigenin) and saponins (bacoside A3, bacopaside-1, bacopaside-2, bacopa saponin-C). various studies showed that Bacopa has cognition and memory enhancing properties.

It was found that Bacopa primarily inhibits ³⁷ nzymes- COMT, PEP, PARP. It also has an antagonistic effect on 5HT₆, 5HT_{2A} receptors, which are associated with memory, learning disorders and age related memory impairment.

COMT controls dopamine metabolism and modulates memory function. Entacapone (COMT inhibitor) is used as adjuncts to levadopa and parkinson's disease. It forms an important component of prefrontal dopaminergic signaling pathway.

Bacopa monnieri increases concentration of dopamine and serotonin in aged rat brain. Hence, inhibition of COMT enhances memory and cognition.

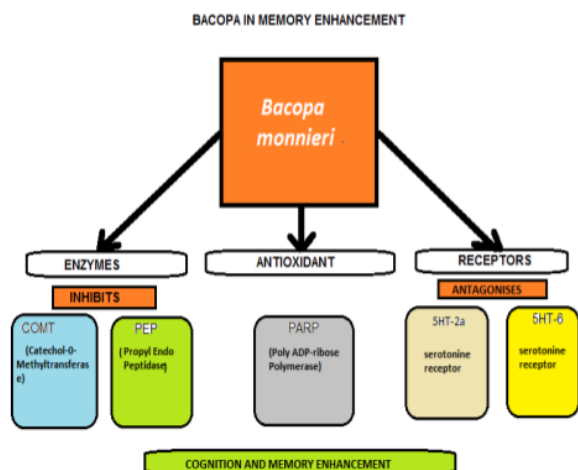
Neuropeptidases (PEP, insulin regulated amino peptidases) cleaves short peptides, which is involved in positive reinforcement, social interactions, emotions, stress responsivity. Inhibition of PEP increases Ca⁺² concentration. Calcium is involved in neurotransmitter release which in turn is responsible for cognition enhancement.

Bacopa monnieri decreases whole brain AChE activity. Dysfunction of cholinergic neuron activity in hippocampus is seen in neurodegenerative diseases.

Bacopa also antagonizes 5HT₆ receptors which can be used for cognition dysfunction and sleep promotion. 5HT₆ receptor blockade enhances cholinergic and glutaminergic neurotransmission which increases dopamine.

Oxidative stress is important for age related memory disorder. Stress leads to secondary injuries which produces DNA strand breaks, which leads to neuronal death.

Bacopa also inhibits activity of PARP enzyme & generation of free radical. So, involved in neuroprotection.



FORMS AND DOSAGE OF BACOPA

3 Forms and Dosing of Bacopa

Forms	Dosage
Daily doses in traditional practice	3 5–10 g of nonstandardized, powdered herb, 30 mL of syrup, or 8–16 mL of infusion
40 Capsules, often standardized to 20%–50% bacosides	3 200–400 mg/day in divided doses for adults; 100–200 mg/day in divided doses for children
3 Tinctures 1:2 fresh plant or 1:4 recently dried herb, 3	2–30 mL/day in divided doses

(extracted from Kathy Abascal, BS, JD, RH (AHG) and Eric Yarnell, ND, 2011)

SIDE EFFECTS OF CONSUMPTION OF BACOPA

20 It is safe for adults if consumed orally for a period of 12 weeks. The most commonly reported adverse side effects of *B. monnieri* in humans are nausea, increased intestinal motility, and gastrointestinal upset (Singh and Dhawan, 1997; Pravina et al., 2007). Apart from these xerostomia, fatigue, GI and urinary tract congestion, ulcers, bradycardia, lung conditions like asthma, emphysema and increase in thyroid hormone levels have been reported.

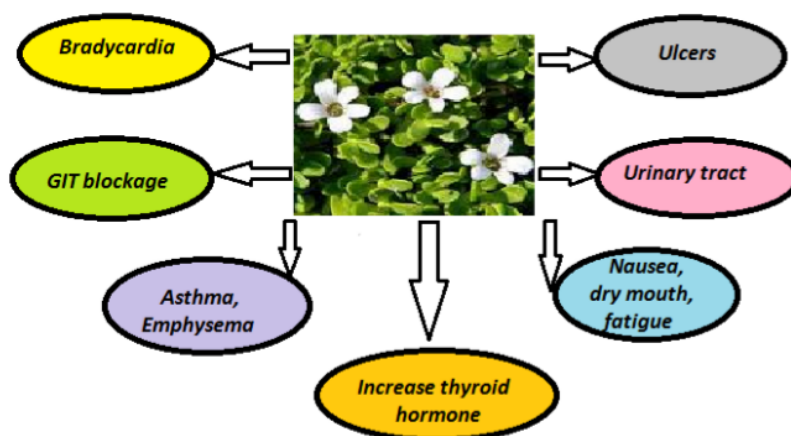
28 Toxicology analysis

Aqueous extracts of *Bacopa monnieri* may elevate serum thyroxine 20 and decrease spermatogenesis, sperm count, and fertility in male mice (Singh and Singh, 2009). The rat LD50 was found to be 2400 mg/kg following a single oral administration (Allan et al., 2007).

Toxic elements such as Cd, Cr, Hg, As, Rb, and Pb are present in the *B. monnieri* herb (Kumar et al., 2005; Narg et al., 2007; Singh and Garg, 1997; Behera et al., 2014a; Behera et al., 2014b; Shukla et al., 2007; Treleaven et al., 1993; Ernst, 2002).

These environmental toxicants cause poisonous effects on both plants and animals. The toxic and heavy metals such as Pb, Hg, etc., have been a regular constituent in the Indian traditional Ayurvedic medicines. The efficacy and side effects of these elements are evaluated by various authors. It has been expected that these may cause serious harm to patients taking such remedies.

SIDE EFFECTS OF BACOPA MONNEIRI



Model used/study design	dosage	Protective effect seen	references
		¹ Bacopa strengthens memory and intellect	Medhya; Kumar, 2006; Singh, 2013; Singh et al., 2008
To investigate the effect of ¹³ osides on induced experimental amnesia in mice, using Morris water maze test, all the agents were administered 30 min before the acquisition trials on each day and repeated for 4 consecutive days,	¹³ Scopolamine(3 mg/kg, ip), sodium nitrite (75 mg kg ⁻¹), ip) and BN52021 (15 mg kg ⁻¹), ip)	¹ The alcoholic extract of Bacopa monnieri improved acquisition, consolidation, and retention of memory in a foot shock-motivated brightness-discrimination test and a conditioned-avoidance test in rats	Kishore and Singh, 2005

13 and on 5th day during the retrieval trials.			
Administration of Bacosides in aged wistar rats to study age related changes in neurotransmission action, behavioural paradigms, hippocampal neuronal loss and oxidation status	200mg/kg for three months	1 Protective effect against age-associated alterations in the neurotransmission system, behavioral paradigms, hippocampal neuronal loss, and oxidative stress markers	Rastogi et al., 2012a, 2012b
Meta analysis 7 To investigate the effect of standardized extract of Bacopa monnieri and 7 Melatonin on Nrf2 pathway in Okadaic acid induced memory impaired rats	OKA (200 ng) was administered intracerebroventricularly (ICV) to induce memory impairment in rats. Bacopa monnieri (BM-40 and 80 mg/kg) and Melatonin (20 mg/kg) were administered 1 hr before OKA injection and continued daily up to day 13.	1 Standardized extract of Bacopa prevented okadaic acid-induced cognitive dysfunction in rats by decreasing oxidative stress and neuroinflammation and downregulating the expression of nuclear factor erythroid 2 related factor 2	Dwivedi et al., 2013
1 Administration of standardized extract of Bacopa	300 and 600 mg treatment for 12 weeks 15	Improvement in attention, cognitive processing, and working memory in healthy elderly volunteers partly via the suppression of AchE activity 1	Peth-Nui et al., 2012
In-vivo double blind placebo controlled cross over study in humans	Each capsule contained 160 mg Bm extract 15	Improvement in cognitive performance of normal healthy volunteers 1	Downey et al., 2013
In-vivo oral administration of Bm to male wistar rats and were tested for spatial memory and density of cholinergic neurons	Alcoholic extract of 16 Bm at 20/40/80mg/kg for a period of 2 weeks before and 1 week after induction of AD in rats	Improvement in cognitive function and prevented neurodegeneration in the animal model of AD 1	Uabundit et al., 2010

1 Administration of ethanolic extract of Bacopa leaves	40/160mg/kg for two and eight months	Reduces $A\beta_{1-40}$ and $A\beta_{1-42}$ levels in the cortex of PSAPP mice	Holcomb et al., 2006
4 PSAPP mice To evaluate the neuroprotective potential of BM against cognitive impairment, in colchicine-induced	Bacopa at the dose of 50mg/kg	1 Neuroprotective effect in the colchicines model of dementia through its antioxidant effects and restoration of Na^+K^+ ATPase and AChE activities	Saini et al., 2012a, 2012b
22 dementia To examine the effects of standardized extract of BM on behavioral changes of Wistar rats when administered the extract for various durations and in varying dose	39 Bacopa at the dose of 20mg/kg, 40mg/kg, and 80mg/kg	Memory enhancing effect due to neuronal dendritic growth-stimulating property	Vollala et al., 2011
11 To examine the acute effects of an extract of Bacopa monnieri on cognitive function in normal healthy human subjects. The study was a double-blind, placebo-controlled independent group design in which subjects were randomly allocated to one of two treatment	1 Single dose of 300mg Bacopa monnieri extract (containing 55% combined bacosides A and B)	1 No significant change in cognitive function at two hours	Nethan et al., 2001
16 additions Seventy-six adults aged between 40 and 65 years took part in a double-blind randomized, placebo control study in which various memory functions were tested and levels	Bacopa 1 administration (300mg for subjects under 90 kg and 450mg for subjects over 90kg, equivalent to 6g and 9g dried rhizome, respectively for six weeks)	1 Significant improvement in retention of new information in 40 to 65 years old healthy adults	Roodenrys et al., 2002

of anxiety measured			
25 To examine the chronic effects of an extract of B. monniera on cognitive function in healthy human subjects.	Bacopa administration 300mg/day (containing 55% combined bacosides) for 12 weeks	Significant improvement in verbal learning, memory consolidation, and faster information processing	Stough et al., 2001
21 To calculate the effect sizes of positive cognitive effect of the pharmaceutical modafinil in order to benchmark the effect of two widely used nutraceuticals Ginseng and Bacopa		42 Neurocognitive enhancement in healthy human subjects	Neale et al., 2013
34 To evaluate effects of Bacopa monnieri whole plant standardized dry extract on cognitive function and affect and its safety and tolerability in healthy elderly study participants	Standardized B. monnieri extract 300 mg/day or a similar placebo tablet orally for 12 weeks.	1 Enhancement in auditory verbal learning tests results and delayed word-recall memory scores	Calabrese et al., 2008
15 To study the efficacy of standardized Bacopa monniera extract (SBME) in subjects with age-associated memory impairment (AAMI) without any evidence of dementia or psychiatric disorder.	Standardized 125mg Bacopa extract twice a day for 12 weeks to over 55years of subjects with memory impairment	1 Significant progressive improvement in mental ability, memory, and associated learning	1 Raghav et al., 2006

<p>Meta analysis</p> <p>11 Randomized, placebo controlled human intervention trials on chronic ≥ 12 weeks dosing of standardized extracts of <i>Bacopa monnieri</i> without any co-medication were included in the study</p>		Improves cognition	Kongkeaw et al., 2013
<p>4 To evaluate the neuroprotective potential of BM against cognitive deficits in colchicine-induced model of AD with an aim to understand if its beneficial action is mediated through attenuation of oxidative stress.</p>	<p>Standardized extract of <i>Bacopa</i> 50 mg/kg body weight/day for a period of 15 days.</p>	<p>1 Scavenge free radicals, preserve mitochondrial activity and restore tyrosine hydroxylase levels</p> <p>4 BM administration attenuated oxidative damage, as evident by decreased LPO and protein carbonyl levels and restoration in activities of the antioxidant enzymes. The activity of membrane bound enzymes (Na⁺)K⁺ ATPase and AChE) was altered in colchicine treated brain regions and BM supplementation was able to restore the activity of enzymes to comparable values observed in controls.</p>	Saini et al., 2012
<p>To examine the effect of the botanical, on aggregation of alpha synuclein, degeneration of dopaminergic neurons, content of lipids and longevity of the nematodes.</p>		Anti-parkinsonism effect	Jadiya et al., 2011
<p>23 evaluate whether alcoholic extract of <i>Bacopa monnieri</i> (AEBM), an antioxidant and memory enhancer can slow the neuronal injury in a 6-OHDA-rat model of Parkinson's</p>	<p>14 20 and 40 mg/kg bodyweight of AEBM for 3 weeks</p>	<p>1 Neuroprotective effect in the 6-OHDA rat model of Parkinsonism</p>	Shobana et al., 2012

<p>30</p> <p>To examine the neuroprotective properties of BM against rotenone induced oxidative damage and neurotoxicity in adult male flies</p>	<p>7</p> <p>BM powder for 7 days in the diet exhibited significant diminution in the levels of endogenous oxidative markers</p>	<p>1</p> <p>Neuroprotective effect against paraquat- and rotenone-induced oxidative stress, neurotoxicity and lethality in <i>Drosophila melanogaster</i></p>	<p>Hosamani & Muralidhara, 2009, 2010</p>
<p>Effect of 32 orophyll o BM <i>Valeriana wallichii</i> on ischemia and reperfusion induced cerebral injury in mice</p>	<p>Aqueous extract of Bacopa (2g BM and V. wallichii in the form of powder and was stirred vigorously in a 30ml warm distilled water for 24 min)</p>	<p>1</p> <p>Attenuate the ischemia-reperfusion-induced brain injury</p>	<p>Rehni et al., 2007</p>
<p>To test whether B. monniera could alleviate the ischemia induced brain injury and cognitive dysfunction in Wistar rats. The effect of B. monniera on transient intracarotid artery (ICA) occlusion induced ischemia by testing the neurobehavioral and biochemical parameters on treated and control rats</p>	<p>120mg kg(-1), 160mg kg(-1) and 240mg kg(-1) P.O.</p>	<p>1</p> <p>Improvement in cognitive function and ameliorated cerebral injury in the transient intracarotid artery occlusion rat model of stroke through its anti-oxidant action</p>	<p>Saraf et al., 2010b</p>
	<p>Administration of Bacopaside 1 for 6 days at 3/10/30mg</p>	<p>1</p> <p>Amelioration in neurological deficit, cerebral infarct volume, and edema in a rat model of transient focal ischemia by improving cerebral energy metabolism and by anti-oxidant actions</p>	<p>Liu et al., 2013a</p>
		<p>Bacoside A ameliorated the epileptic-like seizures in <i>Caenorhabditis elegans</i></p>	<p>Pandey et al., 2010</p>

		prevent behavioural impairment and GABA receptor dysfunction in epileptic rats	Mathew et al., 2010a, 2010b, 2010c, 2011, 2012
Administration of Bacosides to investigate the neuroprotective effect against age related chronic neuro-inflammation in wistar rat brain on 3 months treatment	29 Orally once with bacosides at the dose of 200 mg/kg for 3 months	Amelioration of age associated neuroinflammation signified by decrease in pro-inflammatory cytokines, iNOS protein expression, total nitrite and lipofuscin content in middle aged and aged brain cortex on long term Bacoside treatment.	Rastogi M et al., 2012

DISCUSSION:

3
It is unrealistic to expect this herb to be curative for a disease such as Alzheimer's. However, bacopa has a real role to play as part of any treatment for patients in which anxiety, depression, or mental function are issues. Ayurvedic colleagues typically use bacopa as a mental/nervous restorative to calm and balance the mind. Ayurvedic clinical applications range from treating insomnia and attention-deficit hyperactivity disorder to depression and dementia. Bacopa is also used to ameliorate the mental/emotional aspects of hypothyroidism.‡

We should use it similarly in our practices. In summary, bacopa combines attributes of an adaptogen, a multifaceted nervine, and a cognitive enhancer that is greatly needed in our botanical apothecary.

Herb drug Interaction

2 Drying medications (Anticholinergic drugs) Interaction

Bacopa might increase levels of certain chemicals in the body that work in the brain, heart, and elsewhere. Some drying medications called "anticholinergic drugs" can also increase these same chemicals, but in a different way. These drying medications might decrease the effects of Bacopa, and Bacopa might decrease the effects of drying medications.

Some of these drying medications include atropine, scopolamine, some medications used for allergies (antihistamines), and some medications used for depression (antidepressants).

2 Medications for Alzheimer's disease (Acetylcholinesterase (AChE) inhibitors) Interaction

Bacopa might increase certain chemicals in the brain, heart, and elsewhere in the body. Some medications used for Alzheimer's disease also affect these chemicals. Taking Bacopa along with medications for Alzheimer's disease might increase effects and side effects of medications used for Alzheimer's disease.

Various medications used for glaucoma, Alzheimer's disease, and other conditions (Cholinergic

2 Drugs)Interaction

Bacopa might increase certain chemicals in the brain, heart, and elsewhere in the body. Some medications used for glaucoma, Alzheimer's disease, and other conditions also affect these chemicals. Taking Bacopa with these medications might increase the chance of side effects.

Some of these medications used for glaucoma, Alzheimer's disease, and other conditions include pilocarpine (Pilocar and others), donepezil (Aricept), tacrine (Cognex), and others.

2 Thyroid hormoneInteraction

The body naturally produces thyroid hormones. Bacopa might increase how much thyroid hormone the body produces. Taking Bacopa with thyroid hormone pills might cause too much thyroid hormone in the body, and increase the effects and side effects of thyroid hormone.

removal

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