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Review Paper

PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITY OF BACOPA MONNIERA AS A POTENTIAL MEDICINAL PLANT: A REVIEW

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ABSTRACT

In this current persual, we all know that the Bacopa monniera (L.) a widely growing plant has been reported to posses' number of medicinal properties and other purposes. In this present review, an effort to give a detailed description on the literature on the Pharamacognosy, Phyto-chemistry, traditional uses and pharmacological studies of the plant Bacopa monniera (L.). This is a very important leaf species which is present in the world. Besides this, it has been utilized as an important medicines for the thousands of years and now there is a growing demand for plant based medicinal products, health products, pharmaceuticals and cosmetics products. Bacopa monniera (L.) is widely growing plant which is mostly used traditionally as astringent, tranquilizer, antioxidant, smooth muscle relaxant, laxative, carminative, digestive, anti-inflammatory, anticonvulsant, depurative, and tonic actions, anti-anxiety, adaptogenic, brain tonic, sedative and antidepressant activity. Various plant chemical constituents have been isolated and identified from different parts of the plant belonging to the chemical constituent'scategory of alkaloids, saponins, and sterols. Many alkaloids like Brahmine and herpestine, saponins d-mannitol and hersaponin, acid A, and monnierin--were isolated in India over 40 years ago. Other active chemical constituents identified include betulic acid, stigmastarol, beta-sitosterol, as well as numerous bacosides and bacopasaponins. The chemical constituents are responsible for Bacopa's cognitive effects are bacosides A and B. A review of plant description, phytochemical constituents present and their pharmacological activities are given in the present article.

Keywords: - Bacopamonniera (L.), Phytochemical Constituents, Pharmacological Activities.

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INTRODUCTION:

The Brahmi has been used in traditional Indian medicine system for over 3000 years. Bacopa is a most common plant which is basically used for the treatment for a wide variety of illnesses, including brain, nervous, respiratory, digestive and circulatory issues. According to Indian system of medicine the Brahmi increase mental abilities and this is widely used in the treatment of Alzheimer's disease, Parkinson's disease, Attention Deficit Disorder and memory loss. In the folklore of Ayurvedic system of medicine, various herbs have been used traditionally as brain tonic or nerve tonics. One of the most important of these herbs is Bacopa monniera (BM), a well-known as memory booster. One of the currently popular central nervous system (CNS)-activating herbal plants."Sparreboom et al, 2004" The Brahmi is also the name given to Centella asiatica, which is particularly in north India, "Warrier et al, 1996" The Brahmi was widely used as a brain tonic to the improvement of memory development, learning skill, and concentration. "Agrawal, et al, 1993" The preclinical studies supported the two open clinical studies reporting improved memory development and effects of learning with B. monniera in children& young generation"Sharmaet al, 1987" and patients with state of anxiety. "Singh et al, 1980" Bacopa is also known as Brahmi, this name was derived from Brahma, the creator god of the Hindu pantheon of deities. In the Ayurveda the Materia Medica, bacopa has been recognized for its quality of brain improvement. So we can say that the main important use of Bacopa for memory improvement goes back 3000 years or more in our country, when it was cited for its medicinal characteristics, especially the memory improving capacity, in the Vedic texts Athar-Ved Samhita(3:1) of 800 B.C. and in Ayurveda. Bacopa is reputed to have played a very important role in improving the ability to memorize the great epic poems, possibly helping new generations to learn more & more

from the past and not make the same mistakes - a value spoken of by philosopher George Santayana when he wrote, "Those who cannot remember the past are condemned to repeat it."

Taxonomical Classification: "Chowdhuri et al, 2002"

Kingdom: Plantae.
Division: Angiospermae.
Class: Dicotyledonae.
Order: Tubiflorae.
Family: Scrophulariaceae.
Genus: Bacopa.
Species: monnieri Linn.

GEOGRAPHICAL TREND AND DISTRIBUTION:

Brahmi is widely spread all over the India, Nepal, Sri Lanka, China, Taiwan, Vietnam, and this is also found in Florida and other southern states of the USA. In India the Brahmi is originate in several states of India like-Uttar Pradesh, Punjab, Haryana, Bihar, Bengal, Tamil Nadu, Kerala, Karnataka, Foot hills of Himachal Pradesh and Uttaranchal.

Chemical Constituents:

Brahmi herb contains various chemical constituents like-alkaloids brahmine, herpestatine and a three basesmixture. Brahmine is highly toxic also Brahmi herb also contains saponins, monnierin, hersaponin, bacoside-A and sbacoside–B. Monnierin, on hydrolysis, gave glucose, arabinose and aglycone whereas, bacosides A and B gave glucose, arabinose and bacogenines A, A2, A3 and A4; bacogenines A1and A 2. are epimers, and A4 is an ebelin lactone. The main chemical constituents of Brahmiare saponins, bacosides, bacopasides, monnierin, brahmine, nicotine, herpestine and hersaponin. "Samiulla et al, 2001"

Some Other Chemical Constituents:

Saponins, tetracyclic triterpenoids and bacosides A & B are the main active chemical constituents of the plant. Of all of them, bacosides A are the most predominant. Other saponins include: Bacosides A1, bacosides A3, bacosaponins A, B, C, D, and E& F. Other less predominant compounds are: Alkaloids, herpestinae and bramine; flavonoids, luteolin-7-glucoside, glucoronil-7-apigenin and glucoronil-7-luteolin, these are common phytosterols. "Chowdhuri et al, 2002" The isolation of D-mannitol and a saponin, hersaponin and potassium salts by "Chakravarty, 2003"Three new saponin have been isolated from the Bacopamonniera designated as bacopasides III, IV, V with structures 3-O-α-L-arabinofuranosyl-(1→2)-β-D-glucopyranosyljujubogenin,3-O-β-D-glucopyranosyl-(1→3)-α-Larabinopyranosyl jujubogenin, 3-O- β-D-glucopyranosyl-(1→3)-α-L-arabinofuranosyl pseudojujubogenin. "Chatterji, 1965"

Active Chemical Constituents:"Kulshreshtha and Sastri, 1973, 1959"

The major active chemical constituents are responsible for neuro-pharmacological effects and the nootropic action or anti-amnesic effect of BM is bacoside A, assigned as 3-(a-L-arabinopyranosyl)-O-b-D-glucopyranoside-10, 20-dihydroxy-16-keto-dammar-24-ene.

On acid hydrolysis, bacosides yield a mixture of aglycones, bacogenin A1, A2, A3,"Kulshreshtha, Chandel and Chakravarty, 1973, 1977, 2003"

- The three new saponins from BM, was designated as bacopasides III, IV and V were isolated. "Rastogi, 1990"
- Bacoside A is also present with bacoside B; the latter differing only occur in optical rotation and most probably an artefact which is produced during the process of isolation of bacoside A. "Kulshreshtha, 1973"
- On the process of acid hydrolysis, bacosidesgives a mixture of aglycones, bacogenin A1, A2, A3,"Kulshreshtha, Chandel and Deepak, 1973,1977,2003"
- The various chemical structures of saponins was isolated from BM, like-bacoside A levorotatory, bacoside B dextrorotatory.

Various Pharmacological Activities:

Anti-Depressant Activity

The antidepressant activity B. monniera were evaluated by forced swimming test (FST) and tail suspension test (TST) with methanol extract and various different fractions of B. monniera in mice. The results exert that the methanol extract, EtOAc fraction, and n-BuOH fraction significantly reduced the immobility times both in FST and TST in mice after being administrated orally for 5 consecutive days. "Zhou et al, 2009"

Brain tonic Activity

Bacopa monnieri is also known Ayurvedic Indian medicinal plant which is traditionally used as a memory enhancer. In this present study, two new dammarane-type triterpenoid saponins, bacopaside-XI (1) and bacopaside-XII (2), together with known compounds, bacopaside IV, bacopaside V, and apigenin, were isolated from the aerial parts of the B. monnieri. "Pawar et al, 2001"

Anti-Inflammatory Activity

Bacopa monniera (L.) is a very important plant in the Ayurveda. In this present study is to identify that the anti-inflammatory activity of two fractions from the methanolic extract of Bacopa, viz. the triterpenoid and bacoside-enriched fractions. The quality of these two fractions to inhibition of the production of pro-inflammatory cytokines like tumor necrosis factor-α (TNF-α) and interleukin-6 was tested using lipopolysaccharide (LPS)-activated peripheral blood mononuclear cells and peritoneal exudate cells in vitro.

We also found that triterpenoid and bacoside-enriched fractions significantly inhibited LPS-activated TNF-α, IL-6 and nitrite production in mononuclear cells. Significant antioxidant activity was showing by the bacoside enriched fraction which is compared to the triterpenoid fraction. Carrageenan-induced hind paw oedema assay revealed that triterpenoid and bacoside-enriched fractions showing anti-oedematogenic effect, while in the arthritis model only the triterpenoid fraction showing an anti-arthritic potential. "Viji et al, 2010"

Anti- Alzheimer Activity

Bacopa monniera Linn (Syn. Brahmi) is one of the good anti-amnesic drug agent which is widely used in the Ayurvedic system of medicine in the treatment of various disease. We have earlier reported the reversal of diazepam-induced amnesia with B. monniera. In this study we wanted to test if scopolamine-induced impairment of spatial memory can also be alleviated by B. monniera by using water maze mouse model. The main objective of this study was to study the effect of B. monniera on scopolamine-induced amnesia. We employed Morris water maze scale to test the amnesic effect of scopolamine and its reversal by B. monniera. The Rota-rod test was conducted to screening the activity of muscle coordination in mice. Bacopa monniera extract was able to reverse both anterograde and retrograde amnesia. We propose that B. monniera effects on cholinergic system may be helpful for developing alternative therapeutic approaches for the treatment of Alzheimer's disease. "Saraf and Prabhakar et al, 2010"

Anti-Epileptic Activity

Bacopa monnieri is a very important nerve tonic which is widely used for enhancing the mental performance. It also used in concentration, comprehension, recall and alertness, Brahmi is more health beneficial as it aids in categorizing information in brain and its subsequent expression. Bacopa is also known as a natural antioxidant which may give details its neuro-protective role seen in the memory centers of the brain. Epilepsy is neuronal disorder which is characterized by learning skill, cognitive and memory impairments. The present review summarizes information concerning botany, chemistry and beneficial effect of Bacopamonnieri on epilepsy associated behavioral deficits. "Mathew and Paul et al, 2010"

Anti-Rheumatic Activity

We all know that the Bacopamonnieri (L.) is very important herb with anti-rheumatic activity. The current study is investigated that the therapeutic potential of Bacopamonnieri in the treatment of rheumatoid arthritis by using a type II collagen-induced arthritis rat model. Paw swelling, arthritic index, inflammatory mediators like- cyclooxygenase, lipoxygenase, myeloperoxidase and significantly increased paw edema and other specific signs of arthritis coupled to up regulation of inflammatory mediators like cyclooxygenase, lipoxygenase, neutrophil infiltration and increased anti-collagen IgM and IgG levels in serum. Basically BME inhibiting the footpad swelling and arthritic symptoms. BME was effective in inhibiting the cyclooxygenase and lipoxygenase activities in arthritic rats. Serum anti-collagen IgM and IgG levels were consistently decreased. The anti-arthritic effect of Bacopamonnieri for the treatment of arthritis which might confer its anti-rheumatic activity. " Viji and Kavitha et al, 2010"

Neuro - Protective Activity

B. monniera is an Indian herbal medicine, exerting antioxidant activity and anti-stress activity by modulation of the anti-oxidative defense system. In studied we found that the effect of B. monniera (120 mg kg^{-1}, 160 mg kg^{-1} and 240 mg kg^{-1} P.O.) on transient intra-carotid artery (ICA) occlusion induced ischemia by testing the neurobehavioral and biochemical parameters on treated and control rats. Findings B. monniera attenuated the decreased transfer latency in ischemic rats in a step through test and showed a protective effect on ischemia induced memory impairment in the plus maze task. It also decreased nitrite, nitrate and lipid peroxidation and significantly improved catalase activity. So that's why we can say, this study was very important for the neuro-protective and antioxidant activity of B. monniera on ischemia induced brain injury and pave the way for future investigations. "Saraf and Sudesh et al, 2010"

Anti-Ischemic Activity

In this present study, Rat's heart isolated were per fused in a Langendorff model to study for the cardio-protective action of Bacopa monniera, a very important medicinal herb which is widely used in the Ayurvedic system of medicine on cardiomyocyte apoptosis and antioxidant status following ischemia–reperfusion (I-R) injury. The Forty-eight rats were randomly divided into four groups: sham group, B. monniera control group; ischemia–reperfusion control group and B. monniera-treated group. Post-ischemic reperfusion injury resulted in significant cardiac necrosis, apoptosis, depression of heart rate, decline in antioxidant status and elevation in lipid peroxidation. So that's why we can say, the cardio protective effects of B. monniera (75 mg/kg) in the experimental model of ischemia–reperfusion injury. "Mohanty and Maheshwari et al, 2010"

Anti-Bacterial Activity

The Bacopa monniera is widely used in the treatment of cough or we can also say this herb is also used as an antiseptic. The traditional applications of this plant suggest its possible antibacterial activity. The evaluation of antibacterial activity of Bacopa monniera against the

pathogenic bacteria by using the disk diffusion method. Various five different kind of concentrations of crude leaf extracts of Bacopa monniera were used and tested for the antibacterial activity against the seven Gram-positive and 11 Gram negative bacteria. The maximum activity was found by ethyl acetate extracts and methanol extracts, which is followed by aqueous extracts, benzene extracts, and petrol extracts. The Phyto-chemical analysis of the Bacopa monniera leaf showing the presence of alkaloids, flavonoids, and saponins. So that's why we can say this plant may be highly effective in treatment of different kind of pathogenic diseases. "Khana and Ahmedb et al, 2010"

Hepato-protective Activity

The main purpose of this study was that Bacoside A, the main active chemical constituent of Bacopa monniera Linn., which is anticipated to play an important role in chemo-prevention of liver cancer. By the methods of chemo-preventive action of bacoside A against N-nitrosodiethylamine-which was induced Hepato-carcinogenesis in an animal model. So the results is this the Bacoside A co-treatment maintained the N-nitrosodiethylamine-induced alterations at near normal level. Histo-pathological and electron microscopic study of the liver tissue also supports the above biochemical observations. "Janani and Sivakumariet al, 2010"

Anti-Oxidant Activity

In this present study the evaluation of the protective action of Bacopa monniera, this is a very important medicinal plant, on tissue antioxidant defense system and lipid peroxidative status in streptozotocin-induced diabetic rats. The activity of antioxidant enzymes (SOD, Catalase), levels of GSH and lipid per-oxidation was predicted in kidney, cerebrum, cerebellum and midbrain of diabetic rats and analyzed with the reference drug like-Glibenclamide. The administration of plant extract to the diabetic rats exerts important reversal of disturbed antioxidant status and per-oxidative damage. So undoubtedly improved in SOD, CAT, activity and levels of GSH were observed in extract of Bacopa monniera which is used in the treatment of diabetic rats. "Kapoor and Srivastava et al, 2009"

Immuno-stimulant Activity

The great and crucial saponins portion of Bacopa monniera were processed and estimated for in vitro immune response by using immune cells. Thioglycollate medium obtained peritoneal exudates cells (PEC) were generally used to study about the in-vitro action of the essential saponins fragments of Bacopa monniera on releasing of immune mediators. The crucial saponins portion of Bacopa monniera was estimated at numerous different concentrations (832 – 6.5µg/ml) for releasing of nitric oxide (NO), superoxide (NBT reduction), lysosomal and myeloperoxidase assessment on PEC. "Hule and Juvekar, 2009"

Anxiolytic Activity

The main purpose of this present research work is to study about the anti-depressant and anxiolytic action of Brahmi, which are included Brahmi, Vacha, Shankhapushpi and Kushtha processed in cow's ghee. Brahmi is generally is the main active component of this preparation, which is manifested for its Tranquilizing, Smooth muscle relaxant, Nootropic, Nerve tonic, Adaptogenic, Anti stress, Anxiolytic, Anti-depressant, Memory booster, learning facilitator effects. The Vacha has sedative, analgesic and tranquilizing actions. Kushtha exert anti-cytotoxic effects, diuretic, hypo-lipidemic effects, hypotensive, spasmolytic, Immuno-stimulant effect. The Shankhapushpi has spasmolytic, hypotensive, and sedation, anti-inflammatory, and anti-stress, anti-anxiety effcets. This present research work exert important raise of L-DOPA action in comparison to water control, but the activity was inconsequential in comparison to ghrita control."Deole and Ashok et al, 2008"

Anti-clastogenic Effect

The main purpose of this current research work is to positively identify and quantified the main active chemical constituent which is present in BM by HPLC and HPTLC. Antioxidant and anti-clastogenic action of BM were designed in vitro with & without metabolic activation. The different types of doses of BM were selected on the basis of mitotic index (MI) and cytokinesis-block proliferation index (CBPI). The results of this current research work is HPLC and HPTLC sttudy of BM published the appearance of bacoside A_3,bacopaside I, bacoside II, jujubogenin isomer of bacopasaponin C, bacoside, luteolin, apigenin, bacosine, and β-sitosterol D glucoside. BM exhibit momentous antioxidant activity. So undoubtedly we can say, BM secured human lymphocytes beside the several clastogens. "DEB and Kapoor et al, 2008"

Anti-Amnesic Effect

Principally as Benzodiazepines are called to produce amnesia by collaboration of the GABAergic system. The main purpose of this study is the action of standardized extract of B. monniera on diazepam- influenced amnesia in mice by using Morris water maze. The rota rod test as a shielding calculate for muscle ignporance conformed by the Morris water maze extent to estimate the action of B. monniera on amnesia. And the outcomes disclosed antiamnesic actions of B. monniera on diazepam influenced amnesia. And the inferences of this study is The antiamnesic actions of Bacopa indicate is to be expected a gamma-aminobutyric acid–benzodiazepine pathway possibly impressive long-term heightened. "Prabhakarand Saraf et al, 2007"

Anti-Stress Activity

Bacopa monniera (BM) is also called for its neuro-pharmacological actions. The action of BM was estimated on acute stress (AS) and chronic unpredictable stress (CUS) influenced exchanges in plasma corticosterone and monoamines-noradrenaline (NA), dopamine (DA) and serotonin (5-HT) in cortex and hippocampus regions of brain in rats. In CUS regimen, levels of NA, DA and 5-HT were remarkably exhausted in cortex and hippocampus area of brain. "Sheikh and Ahmad et al, 2007"

Anti-Ulcer Activity

The rise in the degree of superoxide dismutase (SOD), catalase (CAT), depleted glutathione (GSH) and membrane bound enzymes such as Ca^{2+}ATPase, Mg^{2+}ATPase, and $Na^{+}K^{+}$ATPase and diminish in lipid per-oxidation (MDA) in both the template exert the antioxidant action of the conformation. Therefore, it can be come to an end that DHC-1 aquires anti-ulcer action, which can be assigned to its antioxidant mode of effect. "Bafna and Balaraman, 2003"

Adaptogenic Activity

We all know that stress is associated with various types of diseases; investigation on a powerful anti-stress agent (adaptogen) from plants has acquired significance. Pre-treatment with B. monniera at 40 mg/kg po remarkably decreased the AS-influenced rise in the ulcer index, mass of adrenal gland, plasma glucose, AST, and CK. A dose of 80 mg/kg po remarkably altered the AS-influenced modification in mass of adrenal gland, mass of spleen, plasma glucose, ALT, and AST. According to investigation, it is come to an end that the systematized extract of B. monniera controls dynamic effects of adaptogen. "Rai and Bhatia et al, 2003"

Broncho-Vasodilatory Activity

The bioassay-directed partition of B. monniera ameliorated the broncho-dilatory effect in several parts and admixture **1**(2–219×) in anaesthetized rats. In vitro, the KCl- influenced contraction was uniformly prohibited by raw extract materials, petroleum ether and methanol portions on trachea suggesting bronchodilatory effects continued the same portions. On pulmonary artery petroleum ether, dichloromethane and methanol portions formed 2–2.6 times more vasodilatation as compared to raw extract materials of B. monniera. Subsequent sub-fractions failed to show the existence of Broncho-Vasodilatory activity; however, the $CHCl_3$/MeOH sub-fraction significantly reduced the acetylcholine-induced contraction on ileum. Both the methanol fraction and $CHCl_3$/MeOH sub-fraction caused marked reduction of barium chloride-, potassium chloride- and calcium chloride-induced contraction on guinea-pig ileum, indicating their interference with Ca^{2+} ion movement. Thus, it may be concluded that various fractions derived from B. monniera possess Broncho-Vasodilatory activity, which is attributed mainly to inhibition of calcium ions. "Channa and Dar et al, 2003"

Mast-Cell Stabilizing Activity

Successive petroleum ether, chloroform, methanol and water extracts of Bacopamonnieri were tested (in vitro) for mast cell stabilising effect. The methanolic fraction exhibited potent activity comparable to disodium cromoglycate, a known mast cell stabiliser. "Samiulla and Prashanth et al, 2001"

Ca^{++} Antagonistic Activity

The ethanol extract of plant inhibited the spontaneous movements of both guinea-pig ileum and rabbit jejunum.A marked reduction in acetylcholine- and histamine-induced a direct action of the extract on smooth muscles. Calcium chloride-induced responses in the rabbit blood vessels and jejunum. Spasmolytic effect of the B. monniera extract in smooth muscles is predominantly due to inhibition of calcium influx via both voltage and receptor operated calcium channels of the cell membrane."Dar and Channa, 1999"

Anticancer Activity

On Bacopamonnieri (Linn.) Pennell; different concentrations of the ethanolic extract were tested with a sarcoma-180 cell culture; cell growth was significantly inhibited with increasing concentrations; a H-thymidine uptake study suggested that the site of action may be at the DNA replication stage."Elangovan and Govindasamy et al, 1995"

Cardiovascular Activity

The effects of the crude ethanolic extract of whole plant of Bacopamonnieri have been evaluated on left ventricular contractility, heap me and coronary flow in isolated rabbit hearth showed cardiac depressive activity in all parameters, like quinidine."Rashid and Lodhi et al, 1990"

Cerebral Activator

The effects of Bacopamonnieri and its active component, bacoside A, on motor deficit and alterations of GABA receptor functional regulation in the cerebellum of epileptic rats were investigated. Scatchard analysis of [^{3}H] GABA and [^{3}H] bicuculline in the cerebellum of epileptic rats revealed a significant decrease in B_{max} compared with control. Real-time polymerase chain reaction amplification of $GABA_A$ receptor subunits—$GABA_{A\acute{a}1}$, $GABA_{A\acute{a}5,}$ and $GABA_{A\delta}$— was down regulated ($P < 0.001$) in the cerebellum of epileptic rats compared with control rats. Treatment with B. monnieri and bacoside A prevents the occurrence of seizures thereby reducing the impairment of GABAergic activity, motor learning, and memory deficit."Mathew and Kumar et al, 2010"

Antiparkinson

Bacopa monnieri, on pharmacological Caenorhabditiselegans models of Parkinson's, reduced alpha synuclein aggregation, prevents dopaminergic neuro degeneration and restores the lipid content in nematodes, thereby proving its potential as a possible anti-Parkinsonian agent. "Jadiya and Khan et al, 2012"

Anti-inflammatory and analgesic effects:

Bacopsamonniera effectively suppressed experimentally induced inflammatory reaction effect by inhibiting the prostaglandins synthesis and partly by stabilizing lyosomal membrane sand didn't cause gastric irritation at anti-inflammatory doses. "Jain and Khanna, et al, 1994"The ethanol extract of the whole plant of Bacopamonnieri produced significant writhing inhibition in acetic acid induced writhing in mice at the oral dose of 250 and 500 mg/kg ($P<0.001$)comparable to diclofenac sodium 25mg/kg. "Ajalusand Chakmaet al, 2013" The anti-inflammatory effects of them any extracts of Bacopamonnieri were investigated on carrageenan induced edema in rat' shind paws**.** The methanol extract and aqueous fractions (100mg/kg) showed a significant reduction in theedema paw volume, while, petroleumether and hexane extracts didn't reduced inflammation. "Mathur and Verma et al, 2010"

Human red blood cell (HRBC) membrane stabilization method was used to assay the in vitro anti-inflammatory activity of Bacopamonnieri. Methanolic extract and the callus (100, 200, 300µg) produced membrane estabilization better than diclofenac sodium. "Sundriyal and Rawat et al, 2013"The anti-inflammatory activity of Bacopamonnieri is due to the triterpenoid and bacoside presentin the plant. Bacopamonniera has the ability to inhibit inflammation through modulation of pro-inflammatory mediator release. The fractionscontaining triterpenoids and bacosides inhibited the production of pro-inflammatory cytokines such as tumor necrosis factor-alpha and interleukin-6. "Viji and Helen, 2010"

Gastrointestinal effects

The ethanol extract of the whole plant of Bacopamonnieri was showed anti diarrhoeal effect on castor oil induced diarrheainmice. It increased mean latent period and decreased frequency of defecation significantly at the oral dose of 500 mg/kg comparable to loperamide50mg/kg. "Ajalus and Chakma et al, 2013" Fresh Bacopamonniera juice exerted significant anti ulcerogenic activity. "Rao and Sairam et al, 2000"Bacopa have a protective and curative effect for gastric ulcers. Inrats, the Bacopa extract standardized for bacoside-A was evaluated for its prophylactic and healing effects in five modelsof gastric ulcers. At a dose of 20 mg/kg for10 days, Bacopa extract 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 significant reduction in lipid peroxidation in rat gastric mucosa. It was also exerted anti H.pylori effect. "Sairam and Rao et al, 2001", "Goel and Sairam et al, 2003"A double-blind, randomized, placebo controlled trial of 169 patients with irritable bowel syndrome, effects of an Ayurvedic preparation containing Bacopamonniera and Aeglemarmelos was compared with standard therapy (clidinium bromide, chlordiazepoxide, and psyllium). Subjects were randomly assigned to standard drug treatment, botanical treatment, orplacebo for sixweeks. Treatment was administered orally as drug, botanical, or placebo three times daily. Ayurvedic therapy was superior to placebo, however, the two botanicals were not given separately, and the benefit could not link specifically to the Bacopa portion of the Ayurvedic preparation."Yadav and Jain et al, 1989"

Endocrine effects:

Bacopa extract (200 mg/kg orally) increased the thyroid hormone, T4, by41%inmice.T3 was not stimulated, suggesting that the extract may directly stimulate synthesis and/or release of T4 at the glandular level, while not affecting conversionofT4 to T3. "Kar and Panda et al, 2002" Bacopamonniera extracts 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 caudaepididymidis "Akanksha and Singh, 2009" And testis, and cause alterations in the somniferous tubulesinmice.

Other effects

Ethanolic extract of whole plant of Bacopamonnieri has shown cardiac depressive activity on left ventricular contractility, heart rate and coronary flow in isolated rabbit heart and it appeared that, the activity of ethanolic Bacopamonnieri extract was similar to that of quinidineon heart. "Rashid and Lodhi et al, 1990" Bacopahas relaxant effects on pulmonary arteries, aorta, trachea, ileal, and bronchial smooth muscles in experimental animals. The methanol extract of Bacopa possessed potent mast cell stabilizing activity comparable to disodium cromoglycate. "Samiulla and Prashanth et al, 2001"

Contraindications and adverse effects

Therapeutic doses of Bacopa are not associated with any known side effects and Bacopa has been used safely in Ayurvedic medicine for several hundred years. The clinical studies have confirmed the safety of the bacosides in healthy male volunteers at both single and multiple doses administered over a period of 4 weeks. Concentrated bacosides given in single(20-30 mg) and multiple (100-200 mg) daily doses were well tolerated and without adverse effects. "Singh and Dharwan, 1997" The LD50 of Bacopa extracts administered orally to

ratswas5 g/kg for aqueous extracts and 17 g/kg of the alcohol extract. Neither alcoholic noraqueous extract resulted in gross behavioral changes at these concentrations. “Martis and Rao, 1992”

Dosage

Daily doses of Bacopa are 5-10g of non-standardized powder, 8-16 ml of infusion, and 30 ml daily of syrup. Dosages of a1:2 fluid extract are 5-12 ml per day for adults and 2.5-6 ml per day for children ages6-12. For Bacopa extracts standardized to20-percent bacosides A and B, the dosage is 200-400 mg daily in divided dosesforadults,and100-200 mg dailyin divided doses for children. “Monograph, 2004”

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