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A CRITICAL REVIEW ON BRAHMI [BACOPA MONNIERA(L.) PENNELL]

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ABSTRACT

Traditionally Brahmi is described in various ancient authentic textbooks like Charaka Samhita, Atharva-Veda and Sushruta Samhita as a medhya rasayana that taken to sharpen intellect and attenuate mental deficits. Latin name of this medicinal herb is Bacopa Monniera (L.) Pennell. Due to its varied therapeutic potential, it has now become a subject of interest for modern scientific attention. To explore this drug and its properties we made an effort to collect literature mentioned in ancient textbook backed with recent research evidences. To achieve this, known database like pubmed, medline were selected for studies from 1980 to till today. Data obtained in english language from clinical and experimental studies on Bacopa Monniera (L.) Pennell were considered. This is concluded from study that Brahmi (Bacopa Monniera (L.) Pennell) shows effects on cognition, learning disorders, ADHD, epileptic seizures, memory, free radical scavenger activity, anxiety, depression, thyroid gland and carcinogenic activity.

KEYWORDS: Bacopa Monniera (L.) Pennell, Brahmi, Charaka Samhita, Sushruta Samhita, Atharava veda.

INTRODUCTION

Bacopa Monniera (L.) Pennell is a plant of scrofulariaceae family that is commonly known as Brahmi, thyme-leafed gratiola, water hyssop, herb of grace, Indian pennywort. Bacopa has been used in traditional Ayurvedic treatment for epilepsy and asthma.[1] It is one of the ingredients of many Ayurvedic formulations used for ulcers, tumors, ascitis, spleenomegaly, inflammatory disorders, leprosy, anemia and gastroenteritis. Brahmi is also the name given to Centella asiatica, particularly in North India and Kerala where it is also identified in Malayalam as muttil or kodakan. This identification of brahmi as Centella asiatica has been in use for long in northern India, as Hemadri's Commentary on Astanghridya treats mandukparni (Centella asiatica) as a synonym of brahmi,[2,3,4] although that may be a case of mistaken identification that was introduced during the 16th century.[5] Bacopa monnieri was initially described around the 6th century A.D. in texts such as the Charaka Samhita, Atharva-Veda, and Sushruta Samhita as a medhya rasayana–class herb taken to sharpen intellect and attenuate mental deficits. Ancient Vedic scholars to memorize lengthy sacred hymns and scriptures allegedly used the herb. Traditionally it is known as Soumya, Divyateja, Mahousadhi, Kapotavega, Brahmasuvarcala, Sarasvati, Soma, Satyahva, Divya, Kapotavitaka, Munika, Lavanya, Somavallari, Kapotavanka, Somavalli, Surasrestha, Suvarcala, Vaidhatri, Svayambhuvi, Somalata, Surejya, Matsyaksi, Surasa, Medhya, Vira, Bharati, Vera, Parameshini, Saradi, Brahmacharini, Chaidhatri,vallari. Acharya Charaka described this plant under Balya, Prajasthapana mahakashya[6] while Bavprakasha mentioned it in Guduchiadi gana.[7]

It is a scattering, evergreen, fleshy herb. Its branches multiply on moist ground and forms dense pad. Roots are found growing at nodes. The leaves are small, club shaped, stalk less, and fleshy which is bitter in taste. The long stalk flowers are found single at the axis of the leaves. Flowers are pale blue or whitish, axillary, solitary, arranged on long slender pedicels. Fruits are ovoid, acute, 2-celled, 2-valved capsules and tipped with style base. Seeds are minute and numerous.[8]

Bacopa monnieri contains compounds as dammarane-type triterpenoid saponins that known as bacosides, with jujubogenin or pseudo-jujubogenin moieties as aglycone units.[9] Bacosides comprise a family of 12 known analogs.[10] Other saponins called bacopasides I–XII have been identified more recently.[11] The alkaloids brahmine, nicotine, and herpestine have been catalogued, along with D-mannitol, apigenin, hersaponin, monnierasides I–III, cucurbitacin and plantainoside B.[12,13,14] The constituent most studied has been bacoside A that was found to be a blend of bacoside A3, bacopacide II,

bacopasaponin C, and a jujubogenin isomer of bacosaponin C.[15] These assays have conducted using whole plant extract and bacoside concentrations may vary depending upon the extracted part. In one Bacopa monnieri sample, Rastogi et al. found this bacoside profile—bacopaside I (5.37%), bacoside A3 (5.59%), bacopaside II (6.9%), bacopasaponin C isomer (7.08%), and bacopasaponin C (4.18%).[16]

MATERIAL AND METHODS

The present study was aimed to collect literature mentioned in ancient textbook backed with recent research evidences. This was achieved by referring known database like pubmed, medline from 1980 to till today.

Pharmacodyanamic Properties

Table no-1 shows pharmacodynamic properties of Bacopa Monieeri according to various Ayurvedic scientist.

S.No	Nighantu (Ay.Text)	Rasa	Virya	Vipaka	Guna	Doshaghnata	Others Properties
1	P.N[17]	Tikta	Sheeta	-	Sara,Laghu		Rasayana, Medhya
2	R.N[18]	Tikta,Kasaya	Hima	-	-	Vata, Rakta, Pitta	-
3	S.N[19]	Tikta	--	Katu	Sara	Kapha	-
4	D.N[20]	Tikta	Sheeta	-	Sara	Vata, Kapha	-
5	B.P.N[7]	Tikta, Kasaya, Madhur	Hima	Swadu	Hima,Sara, Laghu	-	Rasayana
6	K.N[21]	Tikta, Kasaya, Madhur	Sheeta	Swadu	Sara,Laghu	-	Hridaya, Rasayana
7	M.P.N[22]	Swadu	Sheeta	-	Laghu,Sara	-	Rasayana
8	M.V.N[23]	Swadu	Hima	-	Sara, Laghu	Pitta,Kapha	Rasayana
9	G.R.N	Tikta, Kasaya Madhur	Hima	Swadu	Sara ,Laghu, Seetala	-	Rasayan
10	N.R	Kasaya, Tikta	Sheeta	Madhur	Sara, Laghu	Sarvadosha	-

(P.N.-Priya Nighuntu, R.N.- Raj Nighuntu, S.N.- Sodhala Nighuntu, D.N.-Dhanwantri Nighuntu, B.P.N.- Bhav prakash Nighuntu, K.N.- Kaiydeva Nighuntu, M.P.N.- Madanpal Nighuntu, M.V.N.-Madan Vinod Nighuntu, N.R- Nighantu Ratanakar)

Therapeutic properties

Dipani (appetizers),[20] Medhya(brain tonic),[24] Ayusya (longevity), Rasayani (rejuvinators),Svarya(speech improver), Smriti Prada (memory enhancers)[7] Buddhi (intellect) Prajasakti (aphoristic), Unmada vinashini (depressant).[25]

Roga-Haratwa (Indications)

Kustha(antileprotic), Pandu (anemia), Jwara(fever), Kasa (cough), Visha (poision), Sopha (oedema)[7,22] Kandu (pruritic), Vatabalasa,[20] Asrapitta (hemorrhagic disorders).[18]

Effect on Cognitive Function

1) In a double-blind study placebo-controlled independent-group design in which subjects were randomly allocated to one of two treatment conditions, bacopa (300 mg) or placebo. Neuropsychological testing was conducted pre-(baseline) and at 5 and 12 weeks post drug administration. Bacopa significantly improved speed of visual information processing measured by the IT task, learning rate and memory consolidation measured by the AVLT and state anxiety compared to placebo, with maximal effects evident after 12 weeks. This suggest that Bacopa Monniera (L.) Pennell may improve higher order cognitive processes that are critically dependent on the input of information from our environment such as learning and memory in healthy human subjects.[26]
2) Significant improvements in forty children from rural India (ages 6-8) were noted in strengthened exploratory drive (as measured by maze learning), improved perceptual images of patterns, and increased perceptual organization and reasoning ability (as measured by reaction time).[27]
3) In adults, it appears only chronic administration is associated with cognitive-enhancing effects. In a double-blind, placebo-controlled trial of 38 healthy volunteers (ages 18-60), subjects were given a single dose of 300 mg Bacopa Monniera (L.) Pennell extract (standardized to 55-percent combined bacosides A and B) or placebo. Subjects were tested two hours after drug administration, coinciding with maximum pharmacodyanamic effect. Acute administration of this dose of Bacopa extract resulted in no significant changes in cognitive function when compared to baseline values. Parameters assessed included attention, working and short-term memory, verbal learning, decision making, memory consolidation, executive processes, planning and problem solving, speed of information processing, and motor responsiveness.[28]

Learning Aid

1) Oral treatment of rats with the extract of B. monnieri for 24 days facilitated their ability to learn mazes.[29]

In another study shows that The extract of Bacopa was found to improve the performance of rats in various behavioral models of learning.[30]

2) A study conducted on rats in different conditioning schedules by administering an aqueous suspension of an alcoholic extract (40 mg/kg, p.o.) for three or more days. The first schedule induced a labile behaviour using a shock-motivated brightness-discrimination reaction. The brahmi-treated group showed better acquisition, improved retention and delayed extinction (p is less than 0.01-0.05). Similarly, in an active conditioned flight reaction, the drug-treated animals showed a shorter reaction time than the controls (p less than 0.01). Also in the continuous avoidance response the drug-treated group performed better than the controls (p less than 0.01-0.05). Finding point out that Bacopa Monniera (L.) Pennell can improve the performance of rats in various learning situations.[31]
3) Treatment with plant extract (alcoholic extract) improved maze learning (learning performance) in rats and the activity is due to saponins bacosides A&B and other saponins.[32]

Effect on Neurotoxicity

1) Aluminium -induced neurotoxicity is well known and different salts of aluminium have been reported to accelerate oxidative damage to biomolecules like lipids, proteins and nucleic acids. The objective of the present study was to investigate whether Bacopa Monniera (L.) Pennell could potentially inhibit aluminium toxicity in the cerebral cortex. Male Wister rats (8 months old) were administered with AlCl (3) orally at a dose of 50mg/kg/day in drinking water for 1 month. Experimental rats were given AlCl (3) along with Bacopa Monniera (L.) Pennell extract at a dose of 40mg/kg/day. One group of rats was treated with l-deprenyl at a dose of 1mg/kg/day along with AlCl(3) treatment. We have observed that Bacopa Monniera (L.) Pennell prevented accumulation of lipid and protein damage significantly which resulted from aluminium intake. Decline in the activity of endogenous antioxidant enzymes associated with aluminium administration was also inhibited by Bacopa Monniera (L.) Pennell extract. The potential of Bacopa Monniera (L.) Pennell to inhibit Al-induced oxidative stress was observed to be similar to that of l-deprenyl, which was taken as standard. The potential of Bacopa Monniera (L.) Pennell extract to prevent aluminium neurotoxicity was reflected at the microscopic level as well, indicative of its neuroprotective effects. These findings strongly implicate that Bacopa Monniera (L.) Pennell has potential to protect brain from oxidative damage resulting from aluminium toxicity.[33]

Effect on ADHD

1. A double blind randomized placebo controlled trial of 36 children with diagnosed attention deficit/hyperactivity disorder was conducted over a 16-week period. Nineteen children received an extract of Bacopa (standardized to contain 20-percent bacosides) at a dosage of 50 mg twice daily for 12 weeks and 17 subjects were given a placebo. The mean age of the children in the two groups was 8.3 years and 9.3 years, respectively. Active drug treatment was followed by four weeks of placebo and the children were evaluated on numerous cognitive function tests at baseline, four, eight, 12, and 16 weeks. A significant benefit was observed in Bacopa-treated subjects at 12 weeks as evidenced by improvement on sentence repetition, logical memory and paired associate learning tasks.[34]
2. Another double blind study at BRD Medical College, at Gorakhpur, India, on children with ADHD (Attention Deficit Disorder) showed benefit after 12 weeks of B. monnieri use in sentence repetition, logical memory and paired associated learning tasks. The children were given the test four weeks after the B. monnieri had been withdrawn and it affirms its lasting effect.[35]

Free radical scavenger activity and protective effect of Bacopa Monniera (L.) Pennell on DNA damage

1) In a study, this was established by a significant protective effect on H_2O_2 induced cytoxicity and DNA damage in human non-immortalized fibroblasts.[36]
2) Bacopa may function as an antioxidant in the body. More specifically, it may reduce oxidation of fats in the blood stream which is a common risk factor for the development cardiovascular diseases.[37]

Effect of bacopa on epileptic seizures

1) A study conducted in the 1960s suggested that bacopa may be useful in improving the symptoms and occurrence of epileptic seizures.[38,39]
2) A more recent Indian study also examined the anticonvulsant properties of Bacopa extracts in mice and rats. Researchers determined that intraperitoneal injections of high doses of Bacopa extract (close to 50 percent of LD50) given for 15 days demonstrated anticonvulsant activity. When lower doses (approaching 25 percent of LD50) was worthless.[40]
3) A active constituents of bacopa, Hersaponin exhibited protection against seizures in mice[41] but it did not protect rats against electro shock.

Anxiety and Depression

1) Research using a rat model of clinical anxiety demonstrated a Bacopa extract of 25-percent bacoside A exerted anxiolytic activity comparable to Lorazepam, a common benzodiazapene anxiolytic drug. Importantly the Bacopa extract did not induce amnesia; side effects associated with Lorazepam, but instead had a memory-enhancing effect.[42]
2) A one-month, limited clinical trial of 35 patients with diagnosed anxiety neurosis demonstrated that administration of Brahmi syrup (30 mL daily in two

divided doses, equivalent to 12 g dry crude extract of Bacopa) resulted in a significant decrease in anxiety symptoms, level of anxiety, level of disability, mental fatigue and an increase in immediate memory span. Other changes noted were increased body weight, decreased respiration rate and decreased systolic blood pressure.[43]

3) A study on plant extract for one month reduced the level of anxiety, adjustment disability leading to improved mental function. Levels of urinary V.M.A .and corticoids were also reduced and thus seem to have anti - anxiety activity.[44] Bacopa was found to be very effective in anxiety -neurosis cases and in revitalising intellectual faculty.[45]
4) Singh and Singh (1980) reported that for four weeks, 35 patients were treated for anxiety neurosis. After treatment, they were assessed for clinical anxiety levels, maladjustment level, mental fatigue rate and immediate memory span. In those patients receiving Bacopa anxiety levels were lowered by about 20%. Maladjustment was significantly lower than its corresponding pre-treatment value. Mental fatigue, as determined in total daily work output, was lower. Immediate memory-span scores were significantly increased.[46]

Effect on Memory

1. The effects of Brahmi (Bacopa monniera) on human memory have been seen in seventy-six adults aged between 40 and 65 years, who took part in a double-blind randomized, placebo control study in which various memory functions were tested and levels of anxiety measured. There were three testing sessions: one prior to the trial, one after three months on the trial and one six weeks after the completion of the trial. The results show a significant effect of the Bacopa Monniera (L.) Pennell on a test for the retention of new information. Follow-up tests showed that the rate of learning was unaffected, suggesting that Bacopa Monniera (L.) Pennell decreases the rate of forgetting of newly acquired information. Tasks assessing attention, verbal and visual short-term memory and the retrieval of pre-experimental knowledge were unaffected. Questionnaire measures of everyday memory function and anxiety levels were also unchanged.[47]
2. In a study the memory enhancer effect of Brahmi rasayana (BR) was recognized. BR (100 and 200 mg kg^{-1} p.o.) was administered for eight successive days to both young and aged mice. Elevated plus maze and passive-avoidance paradigm were employed to evaluate learning and memory parameters. Scopolamine (0.4 mg / kg i.p.) was used to induce amnesia in mice. The effect of BR on whole brain AChE activity was also assessed. Piracetam (200 mg kg^{-1} i.p.) was used as a standard nootropic agent. BR significantly improved learning and memory in young mice and reversed the amnesia induced by both scopolamine (0.4 mg kg^{-1} i.p.) and natural aging. BR significantly decreased whole brain acetyl cholinesterase activity. BR might prove to be a useful memory restorative agent in the treatment of dementia seen in elderly.[48]

Antistress effect (Adaptogenic effect)

1. In a study, the adaptogenic property of a standardized extract of Bacopa Monniera (L.) Pennell against acute (AS) and chronic stress (CS) models in rats had been seen.[49]
2. The antistress effect of bacosides of Brahmi (Bacopa monnieri, BBM) dissolved in distilled water was - studied in adult male Sprague Dawley rats by administering oral doses of 20 and 40 mg/kg for 7 consecutive days. The data indicate that BBM has potential to modulate the activities of Hsp70, P450 and SOD thereby possibly allowing the brain to be prepared to act under adverse conditions such as stress.[50]

Toxicity

1. Therapeutic doses of Bacopa are not associated with any known side effects.A double blind placebo controlled clinical trial of healthy male volunteers investigated the safety of pharmacological doses of isolated bacosides over a four-week period. Concentrated bacosides given in single (20-30 mg) and multiple (100-200 mg) daily doses were well tolerated and without adverse effects.[51]
2. The LD50 of Bacopa extracts administered orally to rats was 5 g/kg for aqueous extracts and 17 g/kg of the alcohol extract. Neither extract resulted in grossb ehavioral changes at these concentrations.[52]

Protection from Drug Toxicity

1. In vitro and animal studies have demonstrated Bacopa extracts may have a protective effect against certain drugs and their negative side effects. An in vitro study using guinea pig ileum isolates examined the effect of Bacopa extract on drug-induced morphine withdrawal. Addition of 1,000 g/mL Bacopa extract to the tissue isolates prior to injection of morphine significantly reduced the naloxone-induced withdrawal effects.[53] Some researcher reported anticholinergic and calcium antagonistic activity.[54]
2. A second study examined the effects of an alcohol extract of Bacopa on morphine-induced hepatotoxicity in rats as measured by lipid peroxide accumulation and antioxidant enzyme levels. Administration of Bacopa extract with morphine significantly decreased lipid peroxidation and increased levels of antioxidant enzymes and glutathione in rat hepatic tissue when compared to morphine alone. These results suggest a protective effect for Bacopa on the hepatic antioxidant status in morphine-treated rats. Some of the same researchers reported a similar effect for brain mitochondrial enzyme activity of morphine treated rats.[55]
3. In mice, Bacopa administration with phenytoin significantly reversed phenytoin-induced cognitive

impairment as noted by improved acquisition and retention of memory. These results suggest a potential corrective effect of Bacopa extracts in phenytoin-induced cognitive deficit.[56]

Hypothyroidism

A study in mice demonstrated high doses (200 mg/kg) of Bacopa extract increased the thyroid hormone, T4, by 41 percent when given orally.T3 was not stimulated, suggesting the extract may directly stimulate synthesis and/or release of T4 at the glandular level while not affecting conversion of T4 to T3. Therefore, this study indicates Bacopa extract does have a stimulatory effect on thyroid function, the doses were very high and the typical 200-400 mg daily dose in humans may not have the same effect.[57]

Anti cancerous Activity

In vitro research demonstrated Bacopa saponin fractions have cytotoxic activity for sarcoma-180 cells. It is thought this might be due to Bacopa's inhibition of DNA replication in the cancerous cell line.19 Research in humans may be indicated.[58] In a study its saponins were found to have antihemolytic[59] and anthelmintic activity using C. elegans as a test organism.[60]

CONCLUSION

It is concluded by above literature that Bacopa Monniera (L.) Pennell (Brahmi) is highly potential medicinal plant that is using in Ayurveda since a long time. Lots of experimental & clinical trial certifies its ancient claims of its therapeutic values on cognition, learning disorders, ADHD, epileptic seizures, memory, free radical scavenger activity, anxiety, depression, thyroid gland and carcinogenic activity. However, numbers of research are required in future to validate its effectiveness in various disorders.

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