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Bacopa monniera -a Future Perspective

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ABSTRACT
Bacopa moniera, a traditional Ayurvedic plant, used for centuries as a memory enhancing, anti-inflammatory, analgesic, antipyretic, sedative and antiepileptic agent. The plant, extract and isolated bacosides (the major active principles) have been extensively investigated in several laboratories for their different biological activities. In addition researchers have evaluated the anti-inflammatory, cardio tonic and other pharmacological effects of *Bacopa monniera* preparations/exracts. Therefore, in view of the important activities performed by this plant, research is an on going process over *Bacopa monniera.*

Keywords: *Bacopa monniera*, Brahmi, Scrophulariaceae, Brama.

INTRODUCTION

While pharmaceutical companies continue to invest enormous resources in identifying agents that could be used to alleviate debilitating disorders and retard mental deterioration afflicting numerous people around the world, a source of potentially beneficial agents, namely phytochemicals, would appear to have significant benefits that have yet to be fully exploited. Therefore, several plants have been selected based on their use in traditional systems of medicine. One plant that has been used as brain tonic and restorative in debilitated condition is *Bacopa monniera*, family Scrophulariaceae the Indian subcontinent in wet, damp marshy areas and used by Ayurvedic medicinal practitioners in India for almost 3000 years and is classified as a medhyarasayana, a drug used to improve memory and intellect (medhya). [1]

***Bacopa monniera*- the plant**

This plant belong to family Scrophulariaceae, Genus Bacopa include over 100 species of aquatic herbs distributed throughout the warmer regions of the world [3] This medicinal plant is locally known as brahmi. The name Brahmi is derived from the word 'Brama' the mythical "creator" in the hindu pantheon.

Bacopa monniera is small herb with purple flowers. It grows in wet and sandy areas and near the streams in tropical regions. It is a creeping herb with numerous branches and small fleshy, oblong leaves. Flowers and fruits appear in summer. The stem and leaves of the plants are used. [4]

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In view of the importance of this plant in the indigenous system of medicine, systematic chemical examinations of the plant have been carried out by several groups of researchers. In 1931 Bose and Bose reported the isolation of the alkaloid "brahmine" from *Bacopa monneria*. Later,other alkaloids like nicotinine, and herpestine have also been reported. [5-6] The isolation of D-mannitol and a saponin, hersaponin and potassium salts by. [6] The major chemical entity shown to be responsible for the memory-facilitataing action of *Bacopa monniera*, Bacosides A, was assigned as 3-(α-L-arabinopyranosyl)-*O*-β-D-glucopyranoside-10, 20-dihydroxy-16-keto-dammar-24-ene. [7]

Three new dammarane-type triterpenoid saponins of biological interest,bacopa saponinsA, B and C isolated and identified as 3-*O*-α-L-arabinopyranosyl-20-*O*-α-L-arabinopyrasonyl-jujubogenin,3-*O*-[α-L-arabinofuranosyl-(1→2)-α-L-arabinopyranosyl] pseudojujubogenin and 3-*O*-β-D-glucopyranosyl(1→3)-{α-L-arabinofuranosyl-(1→2)}-α-L arabinopyrasonyl] pseudojujubogenin by spectroscopic and chemical transformation methods. [8] They also reported the new dammarane-type pseudojujubogenin glycoside, bacopasaponin D, defined as 3-*O*-[α-L-arabinofuranosyl-(1→2)-β-D-glucopiranosyl]pseudojujubogenin by spectroscopic and chemical transformation methods. Two new pseudojujubogenin glycosides reported [9] designated as bacopasides I and bacopasides II from the methanol extracts. Moreover, three new phenylethnoid glycosidews,viz monnierasides B have been isolated from the glycosidic fraction of *Bacopa monniera.* [10]. Three new saponin have been isolated from the Bacopa monniera designated as bacopasides III, IV, V with structures 3-*O*-α-L-

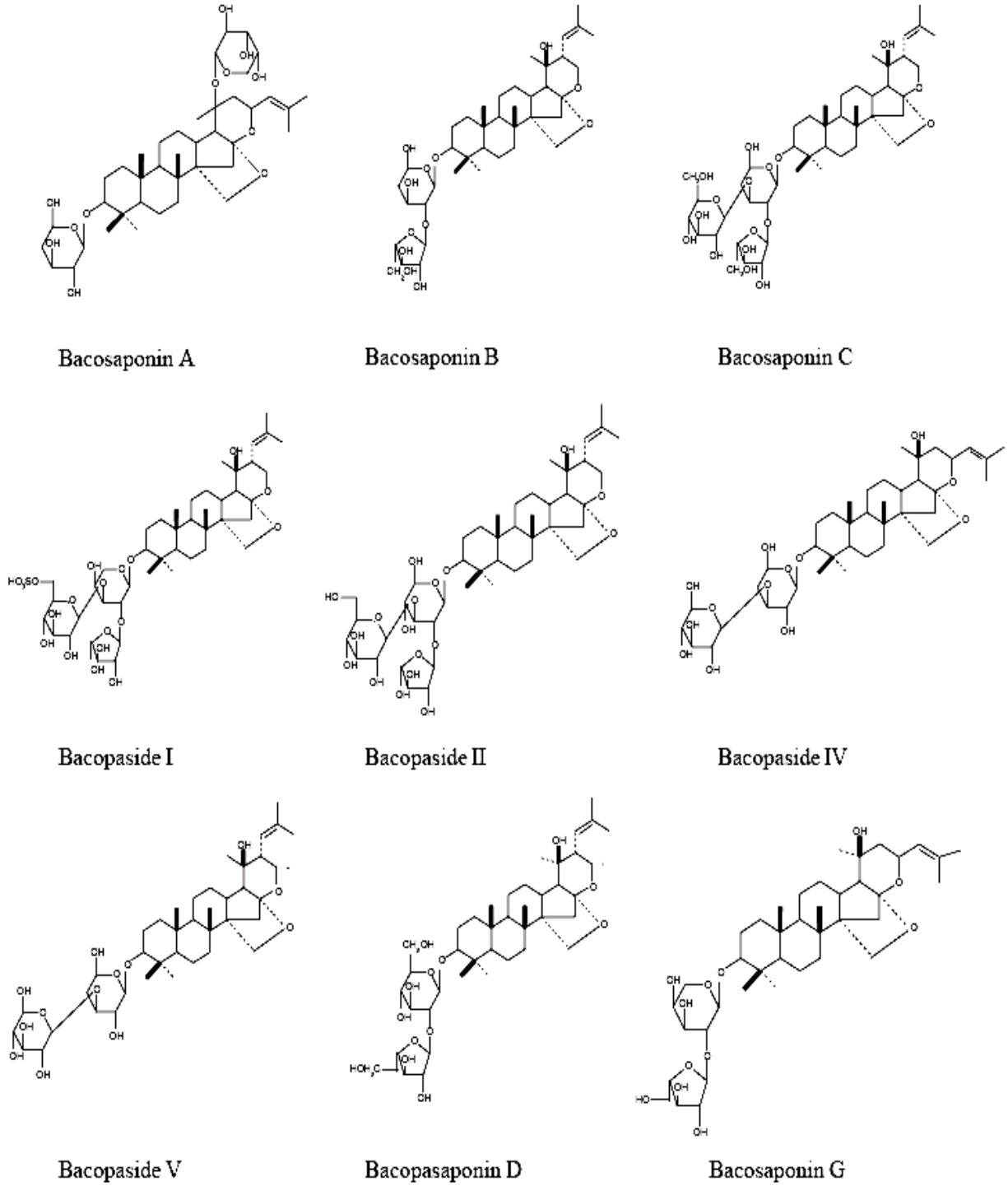

Fig. 1. Chemical structure of some saponins isolated from BM.

arabinofuranosyl-(1→2)-β-D-glucopyranosyljujubogenin, 3-*O*-β-D-glucopyranosyl-(1→3)-α-L-arabinopyranosyl jujubogenin, 3-*O*- β-D-glucopyranosyl-(1→3)-α-L-arabinofuranosyl pseudojujubogenin. [11] Chemical structure of some saponin isolated from *Bacopa monneria* are shown in Fig. 1.

Medicinal Uses of *Bacopa monniera*

Bacopa monniera rich in pharmacological activities. The plant, plant extracts and isolated bacosides have been extensively investigated in several laboratories for their neuropharmacological effects, the active principles apart from the facilitating learning and memory in normal fats, inhibited the amnesic effects of scopolamine, electroshock and immobilization stress. Plant also shown to enhance protein kinase activity in the hippocampus which could also contribute to its nootropic action. [12] *Bacopa monniera* is known to neither lower nor epinephrine and increases the 5-hydroxytryptamine levels in hippocampus, hypothalamus and cerebral cortex. The higher doses of *Bacopa monniera* extracts produced significantly greater anxiolytic effects compared to Lorazepam, a stanadard benzodiazepine. [13] Another important use of *Bacopa monniera* in traditional medicine is anticonvulsive action, as reported in different

experimental studies. Data from different laboratories suggest that the cognition-promiting functions of *Bacopa monniera* may be partially attributed to the antioxidant effects of the bacosides.

In 2001 the hepatoprotective activity of *Bacopa monniera* in alcohol extracts have been investigated by administrated orally, on the liver antioxidant status of morphine treated rats. [14] The result obtained demonstrates that co-administration of *Bacopa monniera* exerted a protective influence against the inhibition of antioxidant enzymes and reduction in GSH level in rats.. Study also showed that *Bacopa monniera* effectively suppressed experimently induced inflammatory reactions, by inhibiting the prostaglandins synthesis and partly by stablizing lyosomal membranes and did not cause gastric irritation at inti-inflammatory doses. [15] Fresh *Bacopa monniera* juice has been reported to have significant antiulcerogenic activity. [16] Extracts of the plant also shown to possess anti-cancer activity as it inhibited sarcoma-180 cell growth *in vitro.* [17]

Recent Research on the medicinal uses of *Bacopa monniera*

Recent studies on Bacopa monniera suggest that its treatment causes reversible suppression of spermatogenis and fertility. The treatment caused reduction in motility, vialiblity morphology and number of spermatozoa in caudaepididymidis, testis in mice treated with plant extract showed alterations in the somniferous tubules. [18]

Current study demonstrated that Brahmi extracts protected neurons from the beta-amyloid induced cell death, but not glutamate induced exitoxicity. This neuro protection was possibly, due to its ability to suppress cellular acetyl-cholinestrase activity but not the inhibition of glutamate-mediated toxicity. [19] In addition, culture medium containing Brahmi extract appeared to promote cell survival compared to neuronal cells growing in regular culture medium. Further study showed that Brahmi-treated neurons expressed lower level of reactive oxygen species suggesting that Brahmi restrained intracellular oxidative stress which in turn prolonged the lifespan of the culture neurons. Brahmi extract also exhibited both reducing and lipid per-oxidation inhibitory activities.

More recent research by investigated the anti-inflammatory activity of methanolic extract of *Bacopa monniera*. It brought about 82 % edema inhibitions at a dose of 100 mg/kg i.p when compared to indomethacin (3mg/kg).that showed 70% edema inhibition. *Bacopa monniera* also significantly inhibited 5-Lipoxygenase 15-LOX and cyclooxygenase-2 (COX-2) activities in rat monocytic *in vivo*. [20] Studies also revealed that Brahmi antioxidant propertied including metal ion reduction, free scavenging and lipid per-oxidation inhibitory activities are the sources of treatment of asthama, epilepsy, insanity, inflammation and CVS diseases. It is also demonstrated that various fractions and sub-fractions isolated from *Bacopa monniera* produced significant inhibition of carbachol- induced bronchconstriction, hypotension and bradycardia in anaesthetized rats and that methanol fraction and chloroform /methanol sub-fraction caused marked reduction in calcium chloride- induced contraction on guinea-pig ileum, indicating their interference with calcium ion movement. [21]

It was also reported that standardized *Bacopa monniera* extracts in the dose of 1000 µg/ml showed anti *Helicobacter pylori* activity *in vitro.* [22] Recent research also shown that methanolic extract of *Bacopa monniera* also possesses anti-depressant activity. One of the research indicate that *Bacopa monniera* inhibit the super oxide anion formation in a dose dependent. The free radical scavenging activity of methanolic extract was evaluated through its ability to quench the synthetic radical 1, 1-diphenyl-2-picryl-hydrazyl (DPPH). The free radical scavenging capacity of the plant demonstrated in the Paoletti and in DPPH tests was confirmed by protection against plasmid DNA strand scission, induced by .OH radicals, generated from the UV photolysis of H_2O_2. In fact, extract exhibited a protective effect on H_2O_2-induced cytotoxicity and damage in human non-immortalized fibroblasts. [23]As stress is a factor in many diseases, research on an effective anti-stress agent obtained from plants has gained importance. Researchers have evaluated the effect of a standardized extract of *Bacopa monniera* against acute stress and chronic stress models in rats. [24] Pretreatment with plant at 40 mg/kg per os significantly reduced the acute stress induced changes in adrenal gland weight, spleen weight, plasma glucose, alanine amino-transferase and aspartate amino-tranferase (AST). Chronic stress exposure resulted in a significant increase in the ulcer index, adrenal gland weight, plasma AST and creatinine kinase with a significant decrease in thymus and spleen weight, plasma triglycerides and plasma AST only where as the pretreatment with higher doses significantly reversed chronic stress induced changes in ulcer index, adrenal gland weight, creatinine kinase and AST. On the basis of these results, authors suggested that the standardized extract of *Bacopa monniera* possess an adaptogenic activity.

DISCUSSION

Bacopa monniera, a traditional Ayurvedic medicinal plant used for centuries as a memory enhancing, anti-inflammatory, analgesic antipyretic sedative and antiepileptic agent. From the recent researches, it is concluded that further studies are being conducted to find out the impact of the extracts on other mediators of inflammation and its ultimate effect on gene expression. Recent studies concluded that extract of *Bacopa monniera* may be an alternative direction for ameliorating neurodegenerative disorders like Alzheimer disease.

More recently preclinical studies have reported cognitive enhancing effects with various extracts of *Bacopa monniera* but the exact mechanism of its actions is still uncertain as its multiple active constituents make its pharmacology complex. Brahmi has been used as traditional medicine due to its neurotonic and memory enhancing property. This study demonstrates that Brahmi extract diminishes neuronal death induced by amyloid peptide partly through the suppression of AChE activity .Brahmi extract also exhibited antioxidant properties both *in vitro* and cell-based assays. Over all results from the present study support the potential of Brahmi extract as a remedy to prevent memory loss in natural aging as well as an alternative remedy for neurodegenerative disorders associated with oxidative stress and amyloid-induced memory loss. The dual LOX/COX-2 inhibition by *Bacopa monniera* explains why preparations based on this herb have along history as an effective herbal medicine for the treatment of inflammatory disorders. [25]

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