



MEDICINAL PLANTS WITH NOOTROPIC EFFECT: A REVIEW

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ABSTRACT

Indian system of traditional medicinal knowledge i.e. Ayurveda is well known for its effective herbal treatments. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter. There are approximately 7000 plant species are found in India. Although most of them have a long history in folk - lore medicine, however there is lack of information on their efficacy and safety, especially from human studies. Many of them are used in treatment of various disorders like Alzheimer's disease and Diabetes Mellitus etc. The present review highlights the pharmacological activity of some popular nootropic plants being used in the traditional Ayurvedic medicine.

KEYWORDS: Medicinal plants, Alzheimer's disease, Diabetes Mellitus.

INTRODUCTION

Nootropic drugs used as a memory enhancer can improve memory, and also in treatment of Alzheimer's disease and other diseases that affect the mind. Memory is perhaps the most vital of all aspects that differentiates human beings from other animals. However, there may be fault in memory due to several reasons, and in that case the person is not able to make full use of his or her potentials. Since ages, drugs and natural remedies have been prescribed to enhance memories in people. Approximately four million people are thought to be suffering from age related memory and increased risk of developing Alzheimer's disease.

Alzheimer's disease is one form of dementia that gradually gets worse over time and affects memory, thinking and behavior.^[1] Alzheimer's disease is a specific neurodegenerative disease and is the most common cause of dementia in old people. Clinically, it is characterized by loss of memory, inability to learn new things, loss of language function, a deranged perception of space, inability to do calculations, indifference, depression, delusions and other manifestations. These deficits affect patient's social functioning and make it difficult or impossible for them to carry on with daily living. Alzheimer's disease is inexorably progressive and fatal within 5 to 10 years. Alzheimer's disease patients usually die of complications of chronic illness. Alzheimer's

disease is the fourth to fifth most common cause of death in the United States. Sometimes Alzheimer's disease involves people in their 40 years and 50 years age, but is mainly a disease of old age. Based on clinical evaluations, 13% of persons over 65 years and 45% of those over 85 have Alzheimer's disease.

From the perspective of brain histopathology, Alzheimer's disease has three characteristic features—the appearance of β -amyloid plaques, the presence of neurofibrillary tangles, and the loss of neuronal cells. Although the loss of neurons leads to deficits in neurotransmission, even neurons that are not dead may exhibit impaired neurotransmission in Alzheimer's disease. Thus, malfunctioning of neurons represent an attractive target for the symptomatic treatment of Alzheimer's disease, as correction of their dysfunctional neurotransmission might be expected to yield clinical improvements.

List of few medicinal plants with nootropic activity: (Table-1)

Some of the traditional medicinal plants used in Ayurveda are known to exert nootropic activity. The plants having nootropic activity are categorized in "Medhya- Rasayana". Some of them plants with validated nootropic effect are tabulated below-

Plant name	Common name	Family
<i>Bacopa monnieri</i>	Brahmi	Plantaginaceae
<i>Centella asiatica</i>	Mandookaparni	Apiaceae
<i>Convolvulus pluricaulis</i>	Sankhpushpi	Convolvulaceae
<i>Embllica officinalis</i>	Amla	Phyllanthaceae
<i>Prunus amygdalus</i>	Badam	Rosaceae
<i>Vitis vinifera</i>	Grape seed	Vitaceae
<i>Albizia lebbeck</i>	Indian siris	Leguminosae
<i>Clitoria ternatea</i>	Butterfly pea	Leguminosae
<i>Thespesia populnea</i>	Indian tulip tree	Malvaceae
<i>Rubia cordifolia</i> Linn.	Indian madder	Rubiaceae
<i>Pueraria tuberosa</i>	Indian kudzu	Leguminosae
<i>Eclipta alba</i>	Bhringraj	Asteraceae
<i>Nardostachys jatamansi</i>	Spikenard	Caprifoliaceae
<i>Tabernaemontana divaricata</i>	Crape Jasmine	Apocynaceae
<i>Glycyrrhiza glabra</i>	Mulhathi	Fabaceae

Bacopa monnieri

Bacopa monnieri Linn. (Brahmi) has been used since times immemorial as nerve tonic for Improvement of memory. The chemical constituent responsible for the effect of brahmi on learning schedules was identified as a mixture of two saponins designated as bacosides A and bacosides B. They also enhance protein kinase activity and produce an increase in protein in hippocampus. It was found to be safe in regulatory pharmacological and toxicological studies of bacosides.^[2]

Centella asiatica

Centella asiatica (L.) (Mandookaparni) is a perennial, creeper, faintly aromatic and a valuable medicinal. *Centella asiatica* is one of the chief herbs for treating skin problems, to heal wounds, for revitalizing the nerves and brain cells, hence primarily known as a "Brain food" in India. *Centella asiatica* is one of the important medicinal plants in the International market of medicinal Plant Trade.^[3] Aqueous extract of the herb has significant effect on learning and memory and also significantly decreased the levels of norepinephrine, dopamine and their metabolites in the brain.^[4] The plant accelerates nerve regeneration upon oral administration and contains multiple active fractions increasing neurite elongation *in vitro* suggesting that components of plant may be useful for accelerating repair of damaged neurons.^[5]

Convolvulus pluricaulis

Convolvulus pluricaulis (Shankhpushpi) is a prostrate, spreading perennial wild herb found on sandy or rocky ground under xerophytic conditions in northern India belonging to family *Convolvulaceae*. In Ayurvedic system of ancient Indian medicine, it is mentioned as under Medhya Rasayana means "rejuvenating to intellect". The ethanolic extract of *Convolvulus pluricaulis* and its ethyl acetate and aqueous fractions were evaluated for their memory enhancing properties. Two doses (100 and 200 mg/kg/p.o.) of ethyl acetate and aqueous fractions of the ethanolic extract were administered in separate groups of animals. Both the

doses of all the extracts of *Convolvulus pluricaulis* significantly improved learning and memory in rats.^[6]

Embllica officinalis

Embllica officinalis (Amla), an Ayurvedic plant is one of the richest sources of vitamin-C and low molecular weight hydrolysable tannins which makes Amla a good antioxidant. The tannins of amla like emblicanin-A, emblicanin-B, punigluconin and pedunculagin are reported to provide protection against free oxygen radical included haemolysis of rat peripheral blood erythrocytes. *E. officinalis* on renal dysfunction involved in oxidative stress during the aging process. The raised level of serum creatinine and urea nitrogen in the aged rats was decreased following the administration of *E. officinalis* extract. Furthermore, the tail arterial blood pressure was significantly diminished. The level of thiobarbituric acid in serum, renal homogenate, and mitochondria in aged rats were considerably reduced by the extract, suggesting that *E. officinalis* would ameliorate oxidative stress due to aging. The increases of inducible nitric oxide synthase and cyclooxygenase expressions in the aorta of aging rats were also significantly suppressed.⁷ *E. officinalis* extract for four months reduced the plasma oxidative marker, 8-isoprostaglandin and increased plasma total antioxidant status in uremic patients.^[8]

Prunus amygdalus

Prunus amygdalus (Badam) nuts used as cognitive functions, total cholesterol levels and cholinesterase activity, learning and memory parameters were evaluated using elevated plus maze, passive avoidance and motor activity paradigms. *Prunus amygdalus* reduced the brain cholinesterase activity in rat. *Prunus amygdalus* proves to be a useful memory-restorative agent. It would be worthwhile to explore the potential of this plant in the management of Alzheimer's disease.^[9]

Vitis vinifera

The aerial parts of *Vitis vinifera* (Grape seed or European grape) have been widely used in Ayurveda to treat a variety of common and stress related disorders. The seed

extract of *V. vinifera* was evaluated for antistress activity in normal and stress induced rats. Furthermore, the extract was studied for nootropic activity in rats and *in-vitro* antioxidant potential to correlate its antistress activity. The Nootropic activity of *V. vinifera* was evaluated by using the conditioned avoidance response in rats.^[10]

Albizzia lebbbeck

(Indian siris) The effect of saponin containing *n*-butanolic fraction extracted from dried leaves of *Albizzia lebbbeck* on learning and memory was studied in albino mice using passive shock avoidance paradigm and the elevated plus maze. The seed oil is used for leprosy and the powdered seed in scrofulous swellings. It is also reported to be astringent, pectoral, rejuvenant and tonic. The ethanolic extracts of *A. lebbbeck* leaves exhibited anticonvulsant activity.^[11] Saponins of *A. lebbbeck* leaves reported to be nootropic and anxiolytic activity in albino mice.^[12]

Clitoria ternatea

Clitoria ternatea (Butterfly pea), a traditional Ayurvedic medicine, has been used for centuries as a memory enhancer, nootropic, antistress, anxiolytic, antidepressant, anticonvulsant, tranquilizing and sedative agent. Its extracts possess a wide range of pharmacological activities including antimicrobial, antipyretic, anti-inflammatory, analgesic, diuretic, local anesthetic, antidiabetic, insecticidal, blood platelet aggregation-inhibiting and for use as a vascular smooth muscle relaxing properties.^[13]

Thespesia populnea

Thespesia populnea (Indian tulip tree) is a large tree found in the tropical regions and coastal forests of India. Various parts of *T. populnea* are found to possess useful medicinal properties, such as antifertility, antibacterial, and anti-inflammatory. The learning and memory parameters were assessed using elevated plus maze and passive avoidance apparently. It showed significant improvement in memory of young and aged mice. *T. populnea* bark possessed a powerful memory enhancing activity in mice. Since diminished cholinergic transmission and increased cholesterol levels appear to be responsible for development of amyloid plaques and dementia in Alzheimer patients.^[14]

Rubia cordifolia

Effect of alcoholic extract of roots of *Rubia cordifolia* (Indian madder) Investigated on cold restraint induced stress and on scopolamine-induced memory impairment. Alcoholic extract enhanced brain gamma-amino-n-butyric acid (GABA) levels and decreased brain dopamine and plasma corticosterone levels. Acidity and ulcers caused due to cold restraint stress were inhibited by alcoholic extract. It also antagonized scopolamine induced learning and memory impairment.^[15]

Pueraria tuberosa

Pueraria tuberosa (Indian kudzu) Nootropic effect of alcoholic and aqueous extracts of *P. tuberosa* was evaluated by using Elevated Plus Maze (EPM). A significant reversal effect was observed on rectal temperature in CIH model, reduction of head twitches in LIH models. However no significant reduction in catalepsy scores in HIC models were observed with test extracts and standard piracetam. The results indicate that nootropic activity observed tuber extracts of *P. tuberosa* could be through improved learning and memory either by augmenting the noradrenaline transmission or by interfering with 5-hydroxytryptamine (5-HT) release.^[16]

Eclipta alba

Eclipta alba (Bhringraj) contains wide range of active principles which includes coumestans, alkaloids, flavonoids, glycosides, polyacetylenes and triterpenoids. The leaves contain stigmasterol, β -terthienylmethanol, wedelolactone, demethylwedelolactone and demethylwedelolactone-7-glucoside.^[17] *Eclipta alba* used for sedative, muscle-relaxant, anxiolytic, nootropic and anti-stress activities. The results point towards the potential neuropharmacological activity of the plant *Eclipta alba* as a nootropic and also having the property of attenuating stress induced alterations.^[18]

Nardostachys jatamansi

The ethanol extract of *Nardostachys jatamansi* roots administered intraperitoneally was found to be 569 ± 20.8 mg/kg in rats. However, no mortality was observed with the highest dose (1000 mg/kg) of *Nardostachys jatamansi* following oral administration. The effect of the extract on the central nervous system, autonomic nervous system and behavior during the first 4 h after i.p. and p.o. administrations showed a dose-dependent inhibition of alertness, diminution of spontaneous motor activity and increased sedation. At a dose of 500 mg/kg (i.p.), loss of righting reflex was observed. All the three doses of the extract when administered orally (125, 250 and 500 mg/kg) significantly increased the pentobarbitone induced loss of righting reflex time when compared to the control.^[19]

Tabernaemontana divaricata

The content of acetylcholine esterase inhibitor of *Tabernaemontana divaricata* root and found two bis-indole alkaloids, 19,20-dihydrotabernamine and 19,20-dihydroervahanine A. These compounds showed higher inhibitory activity on acetylcholine esterase in comparison with galantamine.^[20] In vivo study reported that *Tabernaemontana divaricata* extract in various doses could significantly decrease cortical acetylcholine esterase activity resulting in the enhanced neuronal activity in the cerebral cortex.^[21] The sub-chronic oral administration of *T. divaricata* extract remarkably improved cognitive deficits induced by the A β 25–35 peptides which are presumed to be one of the causes of Alzheimer's Disease.^[22]

Glycyrrhiza glabra

The antioxidant activity of the irradiated and non-irradiated control samples of methanolic extracts were determined using 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical.^[23] Chronic administration of aqueous *G. glabra* extract (150 mg/kg, p.o.) to mice for 7 days reversed scopolamine-induced amnesia in passive avoidance paradigm. However, the higher dose of the extract (300 mg/kg, p.o.) did not alter the induced amnesia. One possible interpretation for this paradoxical effect may be the positive allosteric modulation of the GABAA-BDZ receptors by the higher doses of *G. glabra*.^[24] Monoamine oxidase inhibitory effects of *G. glabra* extract which was proven by an in vitro study demonstrating 44–64% inhibition of Monoamine oxidase at the concentration of 30 g/ml.^[25] This is further confirmed by an in vivo study which showed that *G. glabra* ethanol extract (400 mg/kg, p.o.) inhibited rat brain monoamine oxidase activity.^[26]

CONCLUSION

Medicinal plants frequently used as raw materials for extraction of active ingredients and their use in the synthesis of different drugs. Like in case of laxatives, blood thinners, antibiotics and antimalaria medications, contain ingredients from plants. This review is making a focus on the importance of some nootropic plants which have active components useful for cure from neurological disorders.

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