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A Review of Medicinal Plants in Alzheimer's Treatment and Memory Enhancement

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Abstract

Context: The purpose of this study is to review the effectiveness of medicinal plants on memory and learning in both human and animal models.
Material and Methods: Various electronic databases, including PubMed, Embase, Scopus, and Cochrane Library, were searched for randomized controlled trials published between 2010 and 2023.
Results: The studies focused on thirty different herbs, including *Bacopa monnieri*, *Polygonum odoratum*, *Morus alba*, *Ginkgo biloba*, *Salvia officinalis L.*, *Rosmarinus officinalis L.*, *Melissa officinalis*, *Panax ginseng*, *Saraca asoca*, *Polygala tenuifolia*, *Boswellia papyrifera*, *Boswellia serrata*, and *Aegle marmelos*.
Conclusions: The inclusion criteria were adults, participants with cognitive impairment, and healthy participants, without age or gender restrictions. The studies were assessed for risk of bias using the Cochrane tool for randomized trials, and the findings were synthesized narratively.

Keywords: Plant Extracts, Memory, Animal Models

1. Context

Learning and memory are among the most crucial aspects of human cognitive functioning, essential for daily activities, academic success, and overall quality of life. Due to this immense importance, enhancing learning and memory has been the subject of extensive research over the years. Herbal medicines have been touted as powerful enhancers of cognitive functions, including learning and memory (1). However, there is a need for a systematic review to evaluate the scientific evidence for their efficacy and safety in this regard.

Memory is an individual's ability to record, retain, and recall events and information over short or long periods, using this information to match responses to the environment. This ability is essential for preserving and continuing life. Various factors such as age, gender, stress, emotions, environmental factors, and nutrition can lead to forgetfulness, memory loss, and advanced anxiety, including Alzheimer's disease (2).

The use of herbal medicines is widespread globally, with many individuals using them either alone or in conjunction with conventional medicines. The effectiveness of herbal medicines on cognitive enhancement has been supported by preclinical studies and clinical trials (3, 4). However, there is a lack of comprehensive assessment of the effectiveness of herbal medicines on learning and memory in humans and animal models, leading to the need for a systematic review.

A systematic review will provide a rigorous and unbiased synthesis of the available evidence on the impact of herbal medicines on learning and memory. It will help identify the most effective herbal medicines, determine the optimal doses and modes of administration, and highlight any potential safety

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concerns associated with their use (5). This will aid in developing strategies for the safe and efficacious use of herbal medicines to enhance learning and memory in individuals across various age ranges and cognitive abilities.

2. Methods

2.1. Search Strategy

The search strategy included an extensive search of relevant databases such as PubMed, Google Scholar, Medline, ScienceDirect, Scopus, and Web of Science. The keywords used for the search were medicinal plants, memory, learning, cognitive function, and brain function. All articles published up to the date of the search were included.

2.2. Study Selection

The articles were selected based on the following criteria:

- Human and animal studies investigating the effects of medicinal plants on memory and learning.

- Randomized controlled trials.

- Systematic reviews and meta-analyses.

- Articles published in English.

Articles that did not meet these criteria were excluded.

2.3. Data Extraction and Analysis

Data were extracted and analyzed using a qualitative systematic review approach. The extracted data included the name and species of the medicinal plant, the type of study, the dosage of the medicinal plant used, the duration of the study, and the outcome measures used to assess memory and learning.

2.4. Data Synthesis

The data were synthesized using a narrative approach. The effectiveness of the medicinal plants on memory and learning was analyzed based on the outcomes reported in the included studies.

2.5. Subgroup Analysis

Where feasible and appropriate, subgroup analyses were carried out based on the type of medicinal plant, the dosage used, the duration of the study, and the outcome measures assessed.

3. Results

The studies were conducted in different parts of the world, including Asia, Europe, and North America. The herbal medicines evaluated in the studies included *Bacopa monnieri*, *Polygonum odoratum*, *Morus alba*, *Ginkgo biloba*, *Salvia officinalis L.*, *Rosmarinus officinalis L.*, *Melissa officinalis*, *Panax ginseng*, *Saraca asoca*, *Polygala tenuifolia*, *Boswellia papyrifera*, *Boswellia serrata*, and *Aegle marmelos*. The duration of intervention ranged from 4 to 14 weeks. Overall, the results of this systematic review suggest that herbal medicines can improve memory and learning in both younger and older adults. The studies also showed that the effectiveness of herbal medicine varied depending on the duration of the intervention, dosage, and the specific herbal medicine used.

4. Discussion

The present systematic review aimed to investigate the effect of herbal medicine on learning and memory in human and animal models. Several studies were retrieved from various databases, such as PubMed, Embase, and Cochrane Library, published between 2010 and 2023.

Bacopa monnieri is a popular medicinal plant that has been extensively studied for its effects on memory and learning. The active compounds in *Bacopa monnieri*, known as bacosides, have been shown to enhance cognitive function in animal and human studies (6, 7). The mechanism by which *Bacopa monnieri* enhances memory and learning is through the regulation of neurotransmitters, including acetylcholine and serotonin (8).

Ginkgo biloba is another medicinal plant that has been extensively studied for its effects on memory and learning (9). The active compounds in *Ginkgo biloba*, known as flavonoids and terpenoids, have been shown to improve cognitive function in animal and human studies (10). The mechanism by which *Ginkgo biloba* enhances memory and learning is through increased

blood flow to the brain and the inhibition of oxidative stress (10).

Panax ginseng is a popular medicinal plant that has been used for centuries to improve cognitive function (11). The active compounds in *Panax ginseng*, known as ginsenosides, have been shown to enhance memory and learning in animal and human studies. The mechanism by which *Panax ginseng* enhances memory and learning is through the modulation of neurotransmitters, including serotonin and dopamine (12). A number of medicinal plants that are effective in the treatment of Alzheimer's disease are shown in Table 1.

Withania somnifera enhances dendrite and axon regeneration (25-27).

Punica granatum, belonging to the family Punicaceae, has been shown to improve learning and memory performance in mice, with its flower playing a particularly effective role (28).

Crocus sativus, from the family Iridaceae, is used by patients with Alzheimer's disease at a dose of 30 mg per day for up to one year (29).

Melissa officinalis, part of the family Lamiaceae, improves memory and cognitive performance at a concentration of 600 mg (30, 31).

Moringa oleifera, from the family Moringaceae, contains high amounts of vitamin C and E in its leaf extract, which are known antioxidants. This plant also improves memory in Alzheimer's disease. Moringa oleifera contains monoamine compounds involved in memory enhancement (32, 33).

Salvia officinalis, also from the family Lamiaceae, is involved in memory enhancement through interaction with muscarinic and cholinergic pathways (31, 34).

Myristica fragrans, belonging to the family Myristicaceae, is used in the treatment of nervous problems, digestive disorders, leukemia, body pain, vomiting, dizziness, and memory disorders. Perfumes containing this plant are also used in the treatment of Alzheimer's disease and memory enhancement (35, 36).

Bacopa monnieri, from the family Scrophulariaceae, has been reported to relieve anxiety and depression in the elderly and plays a role in increasing memory in the elderly (37, 38).

Evolvulus alsinoides, from the family Convolvulaceae, has been found to play a role in increasing learning and strengthening memory (39). Some other examples of medicinal plants for Alzheimer's treatment are shown in Table 2.

5. Conclusions

In conclusion, the findings of this systematic review suggest that herbal medicine has a positive effect on learning and memory. However, further well-designed, randomized clinical trials with larger sample sizes are needed to establish the efficacy and safety of herbal medicines for improving cognitive function.

Table 1. Medicinal Plants in the Treatment of Alzheimer's

Authors	Medicinal Plants	Traditional Name	Plant Part	Chemical Compounds	Dosage Regimen	Duration Use	Placebo/ Control Group	Ref.
Navneet Kumar	*Bacopa monnieri*	Brahmi	Aerial parts	Bacoside A3, Bacopaside II, Bacopaside X, Bacopasaponin C	150 mg/ day	6 Week	Placebo	(13)
JintanapornWattanathorn	*Polygonum odoratum and Morus alba*	Vietnamese coriander and white mulberry (Respectively	Aerial parts of *P. odoratum* and; leaves of *M. alba*	Polyphenolic compound content, such as quercetin	50 and 1500 mg/ day	8 Weeks	Placebo	(14)
Annette Morgan	*Bacopa monnieri*	Brahmi	Alcoholic extract of the herb	Bacopasaponin C, Bacosine, Luteolin, Apigenin, and β-Sitosterol-d-glucoside	300mg/day	12 Week	Placebo	(15)
Patricia L. Moulton	*Ginkgo biloba*	Ginkgo or Gingko	-	-	120 mg/ day	5 days	Placebo	(16)
NSL Perry	SRM (*Salvia officinalis* L., *Rosmarinus officinalis* L. and *Melissa officinalis* L.)	Sage, Rosemary, Lemon balm, (Respectively	-	Flavones and their glycosides, Diterpenoids and Rosmarinic acid	5ml/ day	2 Week	Placebo (ethanol extract of; *Myrrhis odorata* (L.) Scop.)	(17)
U. Rigney	*Ginkgo biloba*	Ginkgo or Gingko	-	-	120, 150, 240, 300 mg/day	2 days	Placebo	(18)
K.A. Wesnes	*Ginkgo biloba*/*Panax ginseng*	Ginkgo or Gingko/ Asian ginseng	leaves of *G. biloba* and roots of *Panax ginseng*	-	160-mg twice daily and 320 mg once daily	14 week	Placebo	(19)
Mohsen Naseri	*Melissa officinalis* L.	Lemon balm	Aerial; parts	Gallic acid, Catechin	25, 50, or 100 mg/kg	2 Weeks	*M. officinalis*-treated control (50 mg/kg)	(19)
Parameshwari K	*Saraca asoca*	Ashoka Tree	Flower	Tannins, Proteins, Glycosides, Carbohydrates, Saponins, and Flavonoids	50, 100, 250 mg/kg	7 days	Control Group	(20)
Zongyang Li	*Polygala tenuifolia*	Yuan Zhi	Root	-	50, 100, and 200mg/kg	4 weeks	Control Group	(21)
Amir Farshchi	*Boswellia Papyrifera*	Arabian incense	Gum Extract	Alkaloids, Flavonoids and Saponins	50, 100 and 150 mg/kg	-	Positive control group receivedl piracetam (150 mg/kg) orally	(22)
Mohaddese Mahboubi	*Melissa officinalis* and *Boswellia serrata*	Lemon balm and Arabian incense	Flowering aerial parts	Rosmarinic acid, Boswellic acids, 11-keto-β-boswellic acid and acetyl-11-keto–boswellic	200 and 400 mg/Kg orally daily	4 Weeks	Control Group	(23)
Pojala Kumar	*Aegle marmelos*	Bilwa or bael	Leaf and fruit pulp	-	100 and 200 mg/kg	8 days	Control Group	(24)

Table 2. Medicinal Plants Used for the Treatment of AD

Plant	Compound	Family	Growing Area	Reference
Hypericum perforatum	tannins, hayperciyn, hayperpyron, choline and flavonoids (such as quercetin and quercitrin)	Hypericaceae; Juss.	Southeast Asia (Indonesia) and Australia	(40)
Lepidium meyenii	β-sitosterol, campesterol, ergosterol, brasicasterol,	Brassicaceae	Andes of Peru.	(41)
Prunella vulgaris	oleic acid, ursolic acid, butyric acid, flavonoids and rosmarinic acid	Lamiaceae	Korea, Japan, China and Europe	(42)
Cyperus rotundus	pinene, a little cineole, terpenes, and a new alcohol called isociprol	Cyperaceae	Africa, southern and central Europe (north to France and Austria), and southern Asia	(43)
Zizyphus jujube	malic acid, citric acid, sugar, protein, organic minerals and vitamin C	Rhamnaceae	northern China, Central Asia, West Asia and northern Africa	(44)
Melissa officinalis	phenol carboxylic acids- including rosmarinic acid	Lamiacea	*south-central Europe, the Mediterranean Basin, Iran*	(45)
Ginseng	One of the main bioactive components in ginseng is ginsenoside that play an important role in central nervous system	Araliaceae	Northeastern Asia	(46)

Footnotes

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