

Natural Neuroprotectors and their Role in Alzheimer's Disease

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ABSTRACT

Medicinal herbs have garnered significant attention as possible healing go-betweens for Alzheimer's illness due to their diverse bioactive compounds and antioxidant properties. This review explores the efficacy of various medicinal herbs, including *Ginkgo biloba*, Turmeric (*Curcuma longa*), and *Bacopa monnieri*, in managing Alzheimer's virus. These herbs contain compounds such as flavonoids, polyphenols, and curcuminoids, which show antioxidant, anti-inflammatory, and neuroprotective effects. Through mechanisms like free radical scavenging, modulation of neuroinflammatory pathways, and enhancement of synaptic plasticity, these herbs may offer promising adjunctive treatments to conventional therapies. The review highlights current research findings, discusses the mechanisms of action, and identifies future research directions to validate the clinical benefits of these herbal remedies in Alzheimer's virus management.

Keywords: Alzheimer's disease, Medicinal herb, Flavonoids, Polyphenols, Curcuminoids.

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INTRODUCTION

An increasing worldwide health problem is Alzheimer's dementia, a severe neurodegenerative disease characterized by diminished reasoning and nostalgic damage. While there is symptomatic alleviation available with current therapeutic therapies, disease progression is frequently not stopped.¹ Consequently, there is a growing interest in investigating complementary and alternative medicine modalities, including the possible advantages of medicinal herbs. Plants for neurological illnesses and cognitive enhancement have long been used in traditional medical systems, suggesting a wealth of unexplored medicinal compounds.² Even though Alzheimer's disease (AD) has been better understood by contemporary science, the exact cause of the illness is still unknown. Figure 1 shows the illustration of plants and phytochemicals used in Alzheimer's patients.

Although the buildup of neurofibrillary tangles and amyloid-beta plaques in the brain is a well-known pathological characteristic, the exact mechanisms behind neuronal degeneration are intricate and varied.³ This intricacy highlights the necessity of a multifaceted approach to pest organization, which may involve utilizing natural medicines. AD is a complicated and debilitating illness that profoundly affects both the lives of those who have it and those who care for them. The illness usually progresses in phases, with mild memory loss, trouble solving problems, and behavioral or emotional

abnormalities among the initial signs. As the illness progresses, there is a more noticeable reduction in cognitive function, which causes problems with language and spatial orientation and, ultimately, the inability to carry out routine daily tasks.

There is an incalculable emotional and psychological cost associated with AD for both patients and their families, underscoring the critical need for supportive care, treatment, and prevention initiatives that work. Plants have long been known in traditional medicine to help with cognitive decline; more recently, scientific research has provided insight into the mechanisms that underlie these benefits. An increasing amount of research indicates that several therapeutic herbs may have potential effects on AD. Numerous bioactive components found in these plants, including neuroprotective drugs, anti-inflammatory agents, and antioxidants, may slow the disease's course. Although more investigation is required to completely understand their modes of action and therapeutic efficiency, early findings suggest that certain herbs may assist in enhancing cognitive performance, lessen.

AD has roots in the early 20th century, but it is becoming more widely acknowledged as a serious worldwide health concern. Alois Alzheimer, a German psychiatrist, was the first to characterize the illness in 1906. He noticed peculiar alterations in a patient's brain tissue that was experiencing gradual memory loss.⁴ These alterations later recognized as neurofibrillary tangles and amyloid plaques became

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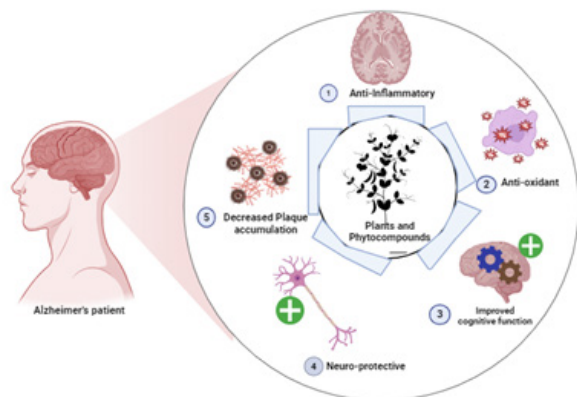


Figure 1: Illustration of plants and phytochemicals used in Alzheimer's patient

the disease's defining pathological characteristics. Before Alzheimer's ground-breaking discoveries, dementia was frequently linked to aging in general or other unclear reasons. His research contributed significantly to our understanding of the illness as a unique neurological ailment. Still, decades would pass before Alzheimer's became a widely recognized illness and research into its causes, prevention, and treatment picked up speed.

Because of *Ginkgo biloba*, which is known to increase blood flow and may improve memory; *Bacopa monnieri*, which has long been used in Ayurvedic medicine to improve cognitive function; and turmeric, which contains curcumin, a substance thought to lessen inflammation and amyloid plaque accumulation in the brain, medicinal herbs have been investigated as possible treatments for AD. The antioxidant qualities and memory-boosting capabilities of sage and rosemary are also emphasized. Even though some herbs seem promising, it is crucial to use caution when using them because further research is required to determine their safety and effectiveness in treating AD. Under the supervision of medical professionals, these herbs should be included in a thorough treatment plan.

Pharmacological Actions of Herb

The hallmark of AD is the gradual deterioration of neurons, which results in memory loss and cognitive impairment. Many therapeutic herbs have been investigated for their ability to reduce AD symptoms or impede the disease's progression via various modes of action. By focusing on important pathological processes associated with AD including as the development of amyloid-beta plaque, tau protein hyperphosphorylation, oxidative stress, and neuroinflammation, these herbs frequently have neuroprotective benefits. *G. biloba*, for instance, has been shown to enhance cerebral blood flow and has antioxidant qualities that lessen oxidative stress in the brain. Turmeric's main ingredient, curcumin, has potent anti-inflammatory properties and prevents amyloid-beta aggregation.⁵

Brahmi, or *B. monnieri*, is a plant that increases synaptic transmission and improves memory by lowering oxidative

damage and regulating neurotransmitter levels. Chinese club moss extract, huperzine A, inhibits acetylcholinesterase, raising brain acetylcholine levels—a critical neurotransmitter for memory and learning. These herbs may also complement traditional therapies in a positive way, providing a multifaceted strategy for the management of AD. Though encouraging, these natural medicines' safety and effectiveness still need to be thoroughly tested in clinical settings.

Antioxidant qualities: The potential therapeutic benefits of medicinal herbs for AD are significantly influenced by antioxidants. These substances function by scavenging free radicals, which are erratic molecules linked to oxidative stress, a state that plays a role in the etiology of AD. The hallmarks of AD, amyloid plaque development and neuronal degeneration, are caused by oxidative stress, which damages lipids, proteins, and DNA within the cell. Antioxidant chemicals, including flavonoids, polyphenols, and curcuminoids, are abundant in medicinal herbs like *G. biloba*, turmeric, and green tea. In addition to scavenging free radicals, these antioxidants also control several signaling pathways, lower inflammation, and prevent neuronal cells from dying. These herbs may help reduce the progression of Alzheimer's disease by reducing oxidative stress.⁶

Anti-inflammatory properties: It is thought that the anti-inflammatory properties of medicinal herbs contribute significantly to their ability to prevent Alzheimer's disease. Alzheimer's disease develops and progresses due in large part to chronic inflammation in the brain, which damages neurons and causes tau tangles and amyloid plaques to accumulate. Curcumin, gingerol, and rosmarinic acid are examples of bioactive chemicals found in medicinal herbs like turmeric, ginger, and rosemary that have been demonstrated to have anti-inflammatory properties. These substances function by preventing the synthesis of pro-inflammatory cytokines and enzymes, which are increased in Alzheimer's disease and include TNF- α , IL-6, and COX-2. Furthermore, these herbs have the ability to modify signaling pathways that are implicated in the inflammatory response, such as the NF- κ B and MAPK pathways. The neuroprotection is the ability of medicinal herbs to obstruct the underlying mechanisms that cause neuronal damage and cognitive decline is thought to be responsible for the neuroprotective benefits of these herbs in Alzheimer's disease. Bioactive substances found in several plants affect important neurodegenerative processes. For instance, substances present in herbs such as ginseng, ashwagandha, and *B. monnieri* help prevent the deadly beta-amyloid plaques from aggregating. These herbs also frequently have anti-inflammatory qualities, which lessen neuroinflammation which worsens neuronal damage.

Additionally, several herbs improve synaptic plasticity and neurogenesis, two processes essential to preserving cognitive function. Additionally, they might increase the expression of proteins called neurotrophic factors, which aid in the development, maintenance, and differentiation of neurons. These therapeutic herbs help to preserve brain function and reduce the

progression of Alzheimer's disease by shielding neurons against oxidative stress, apoptosis, and other types of cellular damage. Cholinesterase inhibition: One important method via which some medicinal herbs may treat Alzheimer's disease is cholinesterase inhibition. Acetylcholine is a neurotransmitter that is essential for memory and cognitive function. Cholinesterase enzymes, mainly acetylcholinesterase (AChE) and butyrylcholinesterase (BChE), are responsible for breaking it down.

In Alzheimer's disease, the levels of acetylcholine are significantly reduced, contributing to cognitive decline. Medicinal herbs such as *Huperzia serrata*, which contains huperzine A, and *Salvia officinalis* (sage) are known for their cholinesterase inhibitory properties. These herbs work by binding to the active sites of AChE and BChE, preventing the breakdown of acetylcholine and thereby increasing its levels in the brain. This enhancement of cholinergic transmission can improve memory and cognitive function, making cholinesterase inhibition an important target in the treatment of Alzheimer's disease. Additionally, these herbs may have neuroprotective effects that further support cognitive health; details are given in Table 1.⁷

Herbs and their Effects

G. biloba

Because of its possible neuroprotective properties, *G. biloba* is one of the therapeutic herbs for Alzheimer's disease that has been examined the most. *G. biloba*'s main active ingredients, flavonoids and terpenoids, are well-known for their antioxidant qualities, which aid in scavenging free radicals and lowering oxidative stress in the brain—a critical element in the onset and advancement of Alzheimer's disease. Furthermore, it's thought that *G. biloba* increases blood flow to the brain, which facilitates the transport of nutrients and oxygen to neuronal cells. This increased blood flow could enhance cognitive performance and guard against neural damage. According to certain research, *G. biloba* may also lessen inflammation and prevent the development of beta-amyloid plaques, which would add to its potential advantages in the treatment of Alzheimer's disease. *G. biloba* shows potential as a supplemental medication to help halt cognitive loss and enhance the quality of life in people with Alzheimer's disease, even if the precise mechanisms underlying the disease are still being investigated.

Curcuma longa

The golden-yellow spice turmeric, which comes from the root of the *C. longa* plant, has attracted a lot of interest due to its possible advantages in the treatment of Alzheimer's disease. Curcumin, its main ingredient, is well known for having strong antioxidant and anti-inflammatory effects. Studies reveal that curcumin is able to penetrate the blood-brain barrier and act directly on the brain. Curcumin aids in the advancement of Alzheimer's disease by lowering oxidative stress and inflammation, two major risk factors. Additionally, it has been demonstrated to prevent the development of tau protein tangles and amyloid-beta plaques, two features common to the pathophysiology of Alzheimer's disease. Furthermore, curcumin may improve synaptic plasticity and neurogenesis to support the health of neurons. Turmeric so presents a viable adjunct to established Alzheimer's therapies, possibly enhancing cognitive performance and slowing disease progression.

B. monnieri

Because of its ability to improve cognitive function, *B. monnieri*, also referred to as Brahmi, is a well-known medicinal herb that is utilized in traditional medicine, especially for treating Alzheimer's disease. Studies have shown that the plant *B. monnieri* contains bioactive substances called bacosides, which have been shown to have strong antioxidant and neuroprotective properties. These substances aid in the fight against inflammation and oxidative stress, two major factors that contribute to Alzheimer's disease neurodegeneration. *B. monnieri* has been demonstrated to increase neurotransmitter levels such as acetylcholine and enhance synaptic plasticity, which in turn improves cognitive function, memory, and learning capacities.

Furthermore, it may help reduce the accumulation of amyloid-beta plaques, which are characteristic of Alzheimer's pathology. Through these mechanisms, *B. monnieri* offers a promising therapeutic approach for managing Alzheimer's disease and supporting cognitive health.

Ginseng

The neuroprotective and cognitive-enhancing qualities of ginseng, especially *Panax ginseng*, have drawn attention to their possible advantages in Alzheimer's disease. Active substances called ginsenosides are found in ginseng and have been demonstrated to have neurogenic, antioxidant,

Table 1: Medicinal herbs with its mechanism of action and potential side effects

Herb	Active compounds	Mechanism of action	Evidence of effectiveness	Potential side effects
<i>Ginkgo biloba</i>	Flavonoids, Terpenoids	Antioxidant, anti-inflammatory, improves blood flow to the brain	Studies suggest cognitive benefits, but results are mixed	Headache, dizziness, gastrointestinal upset
Turmeric	Curumin	Antioxidant, anti-inflammatory, inhibits amyloid plaque formation	Promising preclinical evidence; limited clinical trials	Gastrointestinal issues, allergic reactions
Sage	Rosmarinic acid, thujone	Antioxidant, anti-inflammatory, cognitive enhancement	Some studies show improvements in cognitive function	Nausea, vomiting, allergic reactions

and anti-inflammatory properties. These ginsenosides aid in lowering inflammation and oxidative stress in the brain, two important factors in the development of Alzheimer's disease.⁸ Furthermore, through enhancing synaptic plasticity, boosting neuronal survival, and modifying neurotransmitter systems, ginseng has been shown to improve cognitive abilities. According to preclinical and clinical research, ginseng may enhance memory and cognitive function, which could make it an additional treatment option for Alzheimer's disease in addition to standard medications. However, further research is needed to fully elucidate its mechanisms and establish effective dosages for therapeutic use.

Huperzine A

The Chinese club moss *H. serrata* has a powerful chemical called huperzine A, which has attracted a lot of interest due to its possible benefits in treating Alzheimer's disease. Primarily acting as an acetylcholinesterase inhibitor, huperzine A stops acetylcholine a neurotransmitter essential for mental activities, including memory and learning from being broken down. Acetylcholine levels are frequently reduced in Alzheimer's disease because of the cholinergic neurons' degradation. Huperzine A contributes to the brain's acetylcholine levels by blocking acetylcholinesterase, which may enhance memory and cognitive performance.

Additionally, huperzine A exhibits neuroprotective properties through its antioxidant and anti-inflammatory effects, which may further contribute to its therapeutic potential in slowing the progression of Alzheimer's disease and alleviating symptoms. Research into the efficacy of Huperzine A and its integration into treatment regimens is ongoing, but its role as a promising herbal remedy underscores the broader potential of medicinal herbs in addressing neurodegenerative conditions.⁹

Ashwagandha

Withania somnifera, commonly referred to as ashwagandha, is a well-known plant that has potential uses in the treatment of Alzheimer's disease. One of this adaptogenic herb's active ingredients, withanolides, is believed to be primarily responsible for its neuroprotective effects. These compounds help lower oxidative stress and inflammation, two important aspects of the pathophysiology of Alzheimer's disease. Ashwagandha has been shown to enhance memory and cognitive function by increasing neuronal health and reducing neuroinflammation.¹⁰ It may also help regulate neurotransmitter activity associated with cognitive processes. Because of these pathways, ashwagandha offers a potentially helpful supplementary approach to Alzheimer's disease treatment, as it can slow the disease's progression and improve brain function in general.^{11,12}

Sage

Because sage (*Salvia officinalis*) may have neuroprotective properties, it has attracted a lot of attention when it comes to Alzheimer's disease. Sage has several medicinal uses and is rich in bioactive chemicals such as ursolic acid, rosmarinic

acid, and other essential oils. These substances have potent anti-inflammatory and antioxidant properties, which are vital in preventing the inflammation and oxidative stress linked to Alzheimer's disease. Studies have indicated that sage may improve neurotransmitter activity and shield neural cells from harm in order to improve cognitive performance.¹³ Sage's potential cognitive benefits may also stem from its capacity to decrease acetylcholinesterase activity, an enzyme that hydrolyzes acetylcholine, a neurotransmitter crucial for memory and learning.

Thus, incorporating sage into therapeutic strategies for Alzheimer's disease may offer a promising avenue for managing cognitive decline and improving overall brain health.

Lemon balm

Lemon balm (*Melissa officinalis*) has garnered attention in the study of medicinal herbs for Alzheimer's disease due to its potential cognitive benefits. Lemon balm, which is abundant in rosmarinic acid and other polyphenols, is well-known for its anti-inflammatory and antioxidant qualities.¹⁴ These bioactive substances aid in lowering inflammation and oxidative stress, two major factors that contribute to Alzheimer's disease neurodegeneration. According to research, lemon balm may improve memory and lessen anxiety symptoms, which can be especially helpful for those who are suffering from Alzheimer's disease. Furthermore, it has been demonstrated that lemon balm inhibits the enzyme acetylcholinesterase, which breaks down acetylcholine, a neurotransmitter essential for learning and memory. Lemon balm may help manage Alzheimer's disease and maybe halt its progression by increasing acetylcholine levels and shielding neuronal cells from oxidative damage.

Others

Because they may improve cognitive performance and lessen Alzheimer's disease symptoms in ways more than only antioxidant action, medicinal herbs have attracted attention.¹⁵⁻¹⁷ For example, *G. biloba* is well known for its ability to improve cerebral blood flow, which in turn helps to reduce symptoms of anxiety and depression, which are frequently linked to Alzheimer's disease. This improves cognitive performance and memory. The key ingredient in turmeric, curcumin, has been shown to have anti-inflammatory qualities and the capacity to prevent amyloid-beta peptides from aggregating, which may lessen the risk of brain plaque development. In a similar vein, it has been demonstrated that the polyphenols in green tea, such as epigallocatechin gallate (EGCG), prevent neurodegeneration by improving brain cell survival and regulating neuroinflammatory responses.

Additionally, herbs like *B. monnieri* have been reported to improve memory and cognitive function through mechanisms such as enhancing neurotransmitter levels and reducing oxidative stress. Each of these medicinal herbs offers a multifaceted approach to supporting brain health, making them valuable candidates for further research in the management of Alzheimer's disease.

Clinical studies and evidence

The outcomes of clinical trials on medicinal herbs for Alzheimer's disease are encouraging, if not consistent. Studies on the effects of herbs, including *B. monnieri*, turmeric, and *G. biloba* have suggested that they may boost memory and cognitive performance. Numerous studies have been conducted on *G. biloba*, which is well-known for its anti-inflammatory and antioxidant qualities. Some of these trials have shown minor benefits in daily living activities and cognitive performance. Preclinical research on turmeric, in particular its main ingredient, curcumin, has shown neuroprotective properties. Some clinical trials have also suggested that turmeric may help lower the buildup of amyloid plaque and enhance cognitive function. Numerous studies have indicated that *B. monnieri*, which has been used traditionally in Ayurvedic medicine, may improve memory and cognitive performance.

However, results are not always consistent, and many studies have small sample sizes or methodological limitations. While these herbs offer potential, further large-scale, well-designed clinical trials are necessary to establish their efficacy and safety conclusively for Alzheimer's disease management.

Human clinical trials - Clinical studies investigating the efficacy of medicinal herbs for Alzheimer's disease have yielded mixed results, yet they offer valuable insights into potential therapeutic benefits. *G. biloba*, one of the most studied herbs, has shown some promise in improving cognitive function and slowing cognitive decline in patients with Alzheimer's. Research, including randomized controlled trials, has suggested that *G. biloba* may enhance cerebral blood flow and exert neuroprotective effects. Similarly, turmeric, containing the active compound curcumin, has been investigated for its anti-inflammatory and antioxidant properties. Clinical trials have indicated that curcumin may help reduce amyloid plaque accumulation and improve cognitive performance, although results have been variable. Green tea polyphenols, particularly epigallocatechin gallate (EGCG), have also been studied for their potential neuroprotective effects. Some human trials have reported improvements in cognitive function and reduced oxidative stress with green tea extract. Though the data from this research is encouraging, the body of evidence is still insufficient to provide firm recommendations for treatment. To validate these results and clarify the precise mechanisms by which these medicinal herbs may help people with Alzheimer's disease, further extensive, well-planned clinical trials are required. **Research on animals** Studies on medicinal herbs' effectiveness in treating Alzheimer's disease in humans and animals have produced a mixed bag of preliminary and encouraging results. Clinical investigations on herbs such as *G. biloba* have yielded inconsistent results; some have suggested potential cognitive advantages, while others have found little to no effect. For example, whilst some randomized controlled trials have found little effect, others have reported that *G. biloba* can improve cognitive performance and daily living activities in Alzheimer's patients.

In contrast, animal studies have often demonstrated more consistent positive outcomes. Research involving rodents

has shown that herbs such as turmeric (curcumin) and Panax ginseng can reduce amyloid plaque accumulation and oxidative stress and enhance cognitive performance. These studies typically use various models of Alzheimer's disease to assess the potential neuroprotective effects and mechanisms of action of these herbs. However, while the animal data is encouraging, translating these results to human clinical practice requires further investigation, including larger and more rigorously designed clinical trials to validate the therapeutic potential of these medicinal herbs.

In-vitro studies - Clinical and in vitro studies have provided valuable insights into the efficacy of medicinal herbs in the management of Alzheimer's disease. In clinical trials, herbs like *G. biloba* and Panax ginseng have shown the potential to improve cognitive function and memory in Alzheimer's patients. *G. biloba*, for example, has been reported to enhance cognitive performance and daily living activities, likely due to its ability to improve cerebral blood flow and exert antioxidant effects. Panax ginseng has demonstrated neuroprotective properties and potential benefits in cognitive function through the modulation of neurotransmitter systems. In vitro studies have further supported these findings, showing that herbal extracts can reduce amyloid-beta aggregation, a key pathological feature of Alzheimer's disease. For instance, curcumin from turmeric has been observed to inhibit amyloid-beta plaque formation and exert anti-inflammatory effects in neuronal cell cultures. These studies collectively suggest that medicinal herbs possess promising therapeutic potential for Alzheimer's disease, though more extensive clinical trials are needed to fully establish their efficacy and safety profiles.

Meta-analyses and reviews - Clinical studies and meta-analyses examining the efficacy of medicinal herbs for Alzheimer's disease reveal a promising, though complex, landscape of evidence. Research has demonstrated that several medicinal herbs, including *G. biloba*, *B. monnieri*, and *C. longa* (turmeric), may offer cognitive benefits and symptom relief. Meta-analyses, such as those evaluating *G. biloba*, often indicate modest improvements in cognitive function and overall quality of life in Alzheimer's patients, though results can be variable. Reviews of herbal interventions frequently highlight the potential of these treatments to enhance memory and reduce symptoms of cognitive decline but emphasize the need for more rigorous, large-scale clinical trials to establish definitive efficacy and safety profiles. While the evidence is encouraging, the variability in study design, dosage, and methodology calls for a cautious and well-informed approach to integrating these herbs into Alzheimer's disease management strategies.

Preparation and dosage

The preparation and dosage of medicinal herbs for Alzheimer's disease vary widely depending on the specific herb and its form. Common methods of preparation include infusions, decoctions, tinctures, and standardized extracts. For instance, *G. biloba* is often used in the form of standardized extracts that are typically administered in doses ranging from 120 to

240 mg/day, divided into two or three doses. Turmeric, which contains the active compound curcumin, is often taken as a powder or in capsule form, with dosages ranging from 500 to 2,000 mg per day, depending on the concentration of curcumin. Green tea, rich in polyphenols such as epigallocatechin gallate (EGCG), is generally consumed as a beverage or in supplement form, with recommended doses of 250 to 500 mg of EGCG per day. It is essential to follow dosage guidelines provided by healthcare professionals, as the effectiveness and safety of these herbs can be influenced by factors such as age, overall health, and potential interactions with other medications. Standardization of extracts and adherence to recommended dosages are crucial for maximizing therapeutic benefits while minimizing risks.

Forms of administration -The preparation and dosage of medicinal herbs for Alzheimer's disease vary depending on the form of administration and the specific herb used. Common preparations include tinctures, teas, capsules, and extracts. For instance, *G. biloba*, often used for its cognitive benefits, is commonly administered as a standardized extract in capsule form, with typical dosages ranging from 120 to 240 mg per day. Turmeric, known for its anti-inflammatory and antioxidant properties, is usually consumed as a supplement containing curcumin or as a powder in food, with recommended doses varying from 500 to 2000 mg of curcumin daily. Green tea, another popular herb, is typically consumed as a brewed tea, with the suggested intake being 2 to 3 cups per day or as a concentrated extract in capsules. It is crucial to follow dosage recommendations provided by health professionals, as improper use can lead to side effects or reduced efficacy. Additionally, the quality of herbal preparations can vary, so choosing products from reputable sources is essential for ensuring therapeutic benefit and safety.

CONCLUSION

In conclusion, medicinal herbs offer a promising adjunctive approach to managing Alzheimer's disease, driven primarily by their rich antioxidant properties and ability to modulate neuroinflammatory responses. Herbs such as *G. biloba*, turmeric, and rosemary have demonstrated potential in preclinical and clinical studies, showing benefits in reducing oxidative stress, improving cognitive function, and potentially slowing disease progression. While these herbs exhibit encouraging results, further rigorous research and clinical trials are essential to fully understand their efficacy, optimal dosing, and long-term safety. Integrating these medicinal herbs into therapeutic regimens may complement conventional treatments and contribute to a holistic approach to Alzheimer's disease management, but they should be used under medical supervision to ensure their safe and effective use. Summary of findings: the exploration of medicinal herbs for Alzheimer's disease reveals promising potential in managing and mitigating the effects of this debilitating condition. Herbs such as *G. biloba*, turmeric, and rosemary have demonstrated various beneficial effects through their antioxidant, anti-inflammatory, and neuroprotective properties. These herbs

may help reduce oxidative stress, enhance cognitive function, and potentially slow the progression of Alzheimer's disease. While clinical evidence supports their efficacy to some extent, further research is necessary to fully understand their mechanisms, optimize dosages, and establish standardized treatment protocols. Integrating these medicinal herbs into a comprehensive approach, alongside conventional treatments, may offer a valuable addition to the therapeutic strategies for Alzheimer's disease, potentially improving the quality of life for those affected. Implications for treatment: the exploration of medicinal herbs for the treatment of Alzheimer's disease highlights their promising potential as adjunctive therapies. The antioxidant properties, anti-inflammatory effects, and neuroprotective mechanisms of herbs such as *G. biloba*, turmeric, and rosemary offer valuable avenues for managing cognitive decline associated with Alzheimer's. Additionally, personalized approaches, considering individual health conditions and potential herb-drug interactions, should guide the incorporation of medicinal herbs into therapeutic regimens for Alzheimer's disease.

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