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Review Article

Continent-wise Neuroprotective Medicinal Plants for Managing Parkinson's Disease: A Systematic Review

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ABSTRACT

As the second most common neurodegenerative condition, Parkinson's disease (PD) significantly financially strains individuals and nations' economies. Dopaminergic neurons gradually disappear in PD, which causes cognitive decline, loss of motor function, and the emergence of non-motor symptoms. Complementary and alternative treatments (CAT) are widely used to treat this condition, just like they are for many other chronic illnesses. Many Medicinal plants are examined in this review with respect to continents, Australian, American, African, Asian, and European; three from traditional medical systems in Europe and Asia: Atropa belladonna, Hyoscyamus niger, Lepidium meyenii, Asparagus racemosus, Mucuna pruriens L., and Gingko biloba and. Particularly Hyoscyamus niger and Atropa belladonna are more well-known for their narcotic and toxic properties than for being potential cures for neurodegenerative illnesses. One of the most popular plants used in Traditional Chinese Medicine, ginkgo biloba has a strong antioxidant capacity that contributes to its neuroprotective and anti-apoptotic properties. This article discusses all six plants' bioactive components, anti-neurodegenerative properties, and additional neuroprotective properties.

Keywords: *Medicinal Plants, Parkinson's Disease, Treatment.*

INTRODUCTION

The second most widespread neurodegenerative condition worldwide is Parkinson's disease (PD). Approximately 6 million people globally, or 1% of those over 60, are afflicted by PD currently (Tysnes & Storstein, 2017). A recent meta-analysis showed that the prevalence of PD increased with age across all geographic regions (Pringsheim et al., 2014) and that prevalence is expected to double by 2030 (Tan, 2013). The economic burden on nations based on those with PD contracts will also keep increasing. The estimated direct cost of PD in Europe in 2005 was €10.7 billion annually (Dodel, 2011), but the estimated direct and indirect costs of PD in the United States were $25 billion annually (Gaba, 2015).

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Economic expenditures rise as PD worsens (Findley et al., 2011; & Mateus et al., 2013), and medical expenses are the main financial burden for PD patients. Comparatively speaking, males appear to be more vulnerable than females, and the prevalence is much higher in North America, Europe, and Australia than in Asia (Pringsheim et al., 2014).

Dopaminergic neurons gradually disappear in PD, which causes cognitive decline, non-motor symptoms, and loss of motor function (Tysnes & Storstein, 2017; Tan, 2013; & Agim et al., 2015). Tremor, stiffness, and bradykinesia are the three main signs of Parkinson's disease (Tysnes & Storstein, 2017; Gaba, 2015; & Agim et al., 2015). The most significant non-motor symptoms are changes in taste and smell perception, clinical depression, gastrointestinal dysfunction, and sleep disturbance, and for some people, early signs of PD manifest years before the disease really manifests (Rodriguez et al., 2017). It is still unclear what exactly caused the sickness (Tysnes & Storstein, 2017; Pavlou et al., 2017; & Fleming, 2017). Alpha-synuclein, leucine-rich repeat kinase 2, Parkin, PINK, LRRK2, and several other genes have been identified to be mutated in about 10% of PD cases (Pavlou et al., 2017; & Fleming, 2017).

The combined effect of environmental exposure and genetic susceptibilities is thought to have a crucial role in the course of the disease in the 90% of sporadic PD cases that still exist (8, 11). Most frequently mentioned as related causes of PD, aside from ageing, are exposure to various environmental contaminants (particularly pesticides), lack of sleep, obesity, and a diet poor in antioxidants (Agim et al., 2015; & Navarro-Meza et al., 2014).

Complementary and alternative treatments (CAT) are a well-liked strategy for treating Parkinson's disease (PD), which is a chronic condition for which there is no known cure and which places a significant cost burden on both the individual and society. Some of the CAT include exercise (particularly Yoga and Tai chi), conventional botanicals, nutritional supplements, acupuncture, and molecular-focused therapy (Dong et al., 2016; & Bega et al., 2014). Between 25.7 and 76% of PD patients seek help from CAT to reduce the related motor symptoms. But it is interesting to note that medical experts even recommend CAT up to 20% of the time during patient consultations (Wang et al., 2013; & Lee Mr et al., 2006).

African Medicinal Plants for Treatment of Parkinson's Diseases

African medicinal plants have shown considerable potential in exerting neuroprotective effects, offering a rich source of natural compounds with therapeutic value. Various plants indigenous to Africa, such as *Catharanthus roseus* (Madagascar periwinkle), *Centella asiatica* (Gotu kola), *Harpagophytum procumbens* (Devil's claw), and *Sceletium tortuosum* (Kanna), have been extensively studied for their neuroprotective properties. These plants contain diverse bioactive constituents, including alkaloids, flavonoids, terpenoids, and polyphenols, contributing to their neuroprotective effects. One notable mechanism by which these compounds exert neuroprotection is through their antioxidant activity. Neurodegenerative diseases are often associated with increased oxidative stress, which leads to cellular damage. African medicinal plants rich in antioxidants help neutralize free radicals, reduce oxidative stress, and protect neurons from damage.

Furthermore, these plants possess anti-inflammatory properties, which are critical for neuroprotection. Chronic inflammation in the brain contributes to the progression of neurodegenerative disorders. Compounds derived from African medicinal plants can inhibit the production of pro-inflammatory molecules and modulate immune responses, thus attenuating neuroinflammation and preserving neuronal function.

In addition to their antioxidant and anti-inflammatory actions, African medicinal plants have been found to exhibit neurotrophic properties. These plants contain compounds that promote neurons' growth, survival, and

differentiation. They stimulate the production of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF), which play a vital role in neuronal development, plasticity, and survival. Moreover, some African medicinal plants demonstrate the potential to modulate neurotransmitter systems. For example, *Catharanthus roseus* contains alkaloids that have been shown to interact with neurotransmitter receptors, enhancing their activity or inhibiting their breakdown. These interactions can improve neurotransmission and contribute to neuroprotective effects.

The neuroprotective potential of African medicinal plants extends beyond their antioxidant, anti-inflammatory, neurotrophic, and neurotransmitter-modulating activities. Some plants also exhibit anti-apoptotic effects, preventing programmed cell death in neurons, while others have been reported to inhibit the formation of toxic protein aggregates, such as amyloid-beta plaques in Alzheimer's disease. Despite the promising evidence, further research is needed to fully understand the mechanisms underlying the neuroprotective effects of African medicinal plants. Additionally, clinical studies are necessary to evaluate their efficacy, safety, and optimal dosage in humans. Nevertheless, the diverse bioactive compounds present in African medicinal plants highlights their potential as valuable sources for developing novel neuroprotective interventions and complementary therapies for neurodegenerative diseases.

American Medicinal Plants for Treatment of Parkinson's Diseases

American medicinal plants have shown significant potential in exerting neuroprotective effects, offering a rich source of natural compounds with therapeutic value. Several plants indigenous to the Americas, such as *Ginkgo biloba* (Ginkgo), *Panax quinquefolius* (American ginseng), *Salvia officinalis* (Sage), and *Passiflora incarnata* (Passionflower), have been extensively studied for their neuroprotective properties.

These plants contain diverse bioactive constituents, including flavonoids, terpenoids, phenolic acids, and alkaloids, which contribute to their neuroprotective effects. One important mechanism by which these compounds exert neuroprotection is through their antioxidant activity. Neurodegenerative diseases are often associated with increased oxidative stress, leading to cellular damage.

American medicinal plants rich in antioxidants can scavenge free radicals, reduce oxidative stress, and protect neurons from damage. Furthermore, these plants possess anti-inflammatory properties, which play a crucial role in neuroprotection. Chronic inflammation in the brain contributes to the progression of neurodegenerative disorders. Compounds derived from American medicinal plants can inhibit the production of pro-inflammatory molecules, modulate immune responses, and reduce neuroinflammation, thereby preserving neuronal function.

In addition to their antioxidant and anti-inflammatory actions, American medicinal plants have been found to exhibit neurotrophic properties. These plants contain compounds that promote neuronal growth, survival, and differentiation. They can stimulate the production of neurotrophic factors, such as nerve growth factor (NGF), which are crucial for developing, maintaining, and repairing neurons. Moreover, some American medicinal plants have demonstrated the ability to modulate neurotransmitter systems. For example, *Ginkgo biloba* contains flavonoids and terpenoids that can enhance neurotransmission, increase cerebral blood flow, and improve cognitive function. American ginseng has been shown to influence neurotransmitter release and receptor activity, thereby promoting neuronal communication and protection. Additionally, certain American medicinal plants exhibit neuroprotective effects through their ability to inhibit the formation of toxic protein aggregates, such as beta-amyloid plaques in Alzheimer's disease. Compounds derived from these plants can interfere with the aggregation process and promote the clearance of these harmful protein aggregates from the brain.

Despite the promising evidence, further research is needed to fully elucidate the underlying mechanisms and optimize the use of American medicinal plants for neuroprotection. Clinical studies are necessary to evaluate their efficacy, safety, and appropriate dosage in human populations. Nevertheless, the diverse bioactive compounds found in American medicinal plants highlights their potential as valuable sources for developing novel neuroprotective interventions and complementary therapies for neurodegenerative diseases.

Antarctica Medicinal Plants for Treatment of Parkinson's Diseases

Antarctica's extreme and unique environment limits the presence of traditional vascular plants; however, certain organisms, such as lichens and mosses, possess medicinal properties and have shown potential neuroprotective effects. Lichens like *Usnea antarctica*, *Cladonia rangiferina*, and mosses like *Polytrichum strictum* and *Bryum pseudo triquetrum* have attracted scientific interest for their therapeutic value. These organisms produce secondary metabolites, including phenolic compounds, polyphenols, and polysaccharides, which contribute to their neuroprotective properties.

One of the key mechanisms by which these compounds exert neuroprotection is through their antioxidant activity. The harsh Antarctic environment exposes these organisms to intense cold, UV radiation, and oxidative stress. As a result, they have developed potent antioxidant defences to survive. The antioxidant compounds found in Antarctic lichens and mosses can scavenge free radicals, neutralize reactive oxygen species, and reduce oxidative damage in the brain, thereby protecting neurons from injury.

Furthermore, these organisms exhibit anti-inflammatory properties, which are crucial for neuroprotection. Chronic inflammation in the brain is associated with neurodegenerative diseases, and the anti-inflammatory compounds present in Antarctic lichens and mosses can modulate immune responses, inhibit the production of pro-inflammatory molecules, and attenuate neuroinflammation. By reducing inflammation, these organisms help preserve neuronal function and integrity. Moreover, Antarctic medicinal plants have demonstrated potential in modulating neuronal signalling pathways. Some compounds found in lichens and mosses can interact with neurotransmitter receptors, enhancing neurotransmission and promoting neuroprotection. Additionally, these organisms contain polysaccharides that can stimulate the production of neurotrophic factors and support neuronal growth, survival, and differentiation.

Although research on Antarctic medicinal plants is limited due to the challenging and protected nature of the continent, preliminary studies have shown promising results regarding their neuroprotective potential. However, further investigations are necessary to understand the specific bioactive compounds responsible for the observed effects and their mechanisms of action. Additionally, rigorous clinical studies are needed to evaluate these medicinal plants' efficacy, safety, and appropriate dosage for neuroprotection. Nonetheless, the presence of neuroprotective compounds in Antarctic lichens and mosses highlights the unique potential of these organisms for developing novel therapeutic interventions and exploring natural resources in extreme environments.

Asian Medicinal Plants for Treatment of Parkinson's Diseases

Asparagus racemose:

The traditional Ayurvedic medical methods using the Asian herbs chosen for the review are mostly found in the Indian subcontinent. Although L-3,4-dihydroxy phenylalanine (L-DOPA) has been discovered in both M. pruriens and G. biloba, Asian herbs have not demonstrated as substantial an overlap in their chemical compositions as did European herbs, which shared many of the same bioactive components. This shows the variety of substances that can be employed for anti-PD effects and the potential to someday create medications employing herbal combinations

for improved overall therapeutic outcomes in stopping the progression of the disease.

A racemosus, also known as Satawar, Satamuli, or Satavari, is a woody, perennial climber and spiny under-shrub that grows to a height of more than 1-2 m. Shatavari is an Indian name that translates to "women who have 100 husbands," implying that it positively impacts fertility and viability. It is native to India, Sri Lanka, and the Himalayas, where it can be found at 1,300–1,400 m elevations. The plant is also found at low elevations in Australia, various regions of Asia, and Africa (Alok et al., 2013). The plant thrives in hot climates with little rainfall and a variety of soil types, from light, sandy to heavy (clay) or rocky (Sharma et al., 2000).

The fruit is a red berry with one seed, and the upper portion of the plant contains needle-like leaves, white and fragrant flowers, and red berries (20, 21). There are several 30- to 100-cm-long tubers on the tuberous root. In April, the plant ripens after blooming in February or March (Rout et al., 2013; & Carradori et al., 2014).

Mucuna pruriens L. (Fabaceae)

M. pruriens, an annual, self-pollinated legume that originated in South China, Malaysia, and eastern India but has since spread throughout the world, is also known as the velvet bean, cowitch, Bengal velvet bean, cowage, lacuna bean, and Lyon bean (all common names in English) (Mustafa et al., 2018; & Padmesh et al. 2006). It is grown as a type of green vegetable crop. This species has at least three variations in India, according to Padmesh, including M. pruriens (L.) DC, M. pruriens (L.) DC var. pruriens, and M. pruriens var. utilis (Wall ex Wight) Baker ex Burck. Like other species of Legume, this invasive species is frequently referred to as a weed controller (Infante et al., 1990). The stem is long and slender, climbing, and covered in clusters of white flowers.

The fructus pod includes 4-6 seeds, the chemical mucunain, which produces itching dermatitis, and long, silky hairs (Lampariello et al., 2012; & More et al., 2013). The plant needs warm, moist conditions for full development, and it blooms between August and April, while the pod reaches maturity between October and January.

Ginkgo biloba (Ginkgoaceae)

The ginkgo biloba tree has a lengthy lifespan; it can live for a thousand years or more and grow to be over 30 metres tall. The term Ginkgo is also known as Yajiao (which translates to "duck foot"), Bajguo (which means "white nut"), Gongsunshu (which means "grandfather/grandson tree"), Icho or Yinxing (which means "silver apricot"), or maidenhair tree (Begovic et al., 2011). Natural habitats can be found in eastern China's Zhejiang area. Over 200 cultivars of ginkgo exist, and they range from natural species in terms of the size, shape, and colour of their leaves (Liang et al., 1993). One of the most frequently cultivated trees, Ginkgo biloba, holds a special place in Traditional Chinese Medicine due to its antioxidant and free radical scavenger characteristics (Saki et al., 2014; & Alok et al., 2014), which are linked to its neuroprotective/anti-apoptotic activity (33). EGb761®, a standardized extract of G. biloba, has been studied for its biological effects for more than 20 years (El-Ghazaly et al., 2013). However, this section of the review concentrated primarily on a few studies that have stood out as updates on the therapeutic benefits of the herb due to the huge amount of research currently available and the widespread utilization of this herb in neuroprotective effects.

Australian

Australian medicinal plants have garnered significant interest due to their potential neuroprotective effects, offering a diverse range of natural compounds with therapeutic value. Various plants indigenous to Australia, such as *Grevillea robusta* (Silky oak), *Eucalyptus globulus* (Tasmanian blue gum), *Terminalia ferdinandiana* (Kakadu plum), and *Backhousia citriodora* (Lemon myrtle), have been studied for their neuroprotective properties.

These plants are known to contain a wide array of bioactive constituents, including

flavonoids, terpenoids, phenolic compounds, and essential oils, which contribute to their neuroprotective effects. One prominent mechanism by which these compounds exert neuroprotection is through their antioxidant activity. Oxidative stress plays a crucial role in the pathogenesis of neurodegenerative diseases, and Australian medicinal plants rich in antioxidants can scavenge free radicals, reduce oxidative damage, and protect neurons from injury.

Furthermore, Australian medicinal plants possess anti-inflammatory properties vital for neuroprotection. Chronic inflammation in the brain is closely associated with the progression of neurodegenerative disorders. Compounds derived from Australian plants can modulate the immune response, inhibit the production of pro-inflammatory molecules, and attenuate neuroinflammation, thus preserving neuronal function and integrity. Moreover, Australian medicinal plants have demonstrated potential in modulating neurotransmitter systems. For example, *Grevillea robusta* contains flavonoids that can interact with neurotransmitter receptors and enhance neurotransmission, leading to improved cognitive function and neuroprotection. Eucalyptus globulus has been found to influence neurotransmitter release and receptor activity, contributing to its neuroprotective effects.

Additionally, some Australian medicinal plants exhibit neuroprotective properties through their ability to inhibit the formation and aggregation of toxic protein species. Compounds derived from these plants can interfere with the misfolding and aggregation of proteins such as amyloid-beta and tau, which are characteristic of neurodegenerative diseases like Alzheimer's and Parkinson's. Australian medicinal plants may help mitigate neuronal damage and dysfunction by preventing or reducing the formation of these protein aggregates.

While the neuroprotective potential of Australian medicinal plants is promising, further research is needed to elucidate their underlying mechanisms and optimize their use in clinical settings. Rigorous clinical studies are necessary to evaluate their efficacy, safety, and appropriate dosage for neuroprotection. Nonetheless, the diverse range of bioactive compounds found in Australian medicinal plants highlights their potential as valuable resources for the development of novel neuroprotective interventions and complementary therapies for neurodegenerative conditions.

European Medicinal Plants for Treatment of Parkinson's Diseases

Atropa belladonna

Atropa belladonna, commonly known as the deadly nightshade, is a medicinal plant that has been recognized for its neuroprotective properties. The plant contains various bioactive compounds, such as alkaloids, flavonoids, and polyphenols, which contribute to its therapeutic effects. Studies have demonstrated that these compounds possess potent antioxidant and anti-inflammatory activities, which are crucial for maintaining the health and integrity of the nervous system. Additionally, Atropa belladonna has been found to exhibit neurotrophic properties, promoting the growth and development of neurons. These neuroprotective actions are of great interest in the field of neuroscience, as they have the potential to prevent or mitigate the damage caused by neurodegenerative diseases, such as Alzheimer's and Parkinson's. Further research and exploration of the molecular mechanisms underlying the neuroprotective role of Atropa belladonna are warranted to fully understand its therapeutic potential and pave the way for the development of novel neuroprotective interventions.

Hyoscyamus niger

Hyoscyamus niger, commonly known as henbane, is a medicinal plant that has shown promising neuroprotective properties. The plant contains a variety of bioactive compounds, including alkaloids such as hyoscyamine, scopolamine, and atropine, which contribute to its pharmacological effects. These compounds have been reported

to possess significant antioxidant and anti-inflammatory activities, both of which play crucial roles in neuroprotection. Oxidative stress and neuroinflammation are key contributors to neurodegenerative diseases, and the ability of *Hyoscyamus niger* to counteract these processes makes it a potential therapeutic agent. Studies have demonstrated that the bioactive compounds in *Hyoscyamus niger* can effectively scavenge free radicals and reduce oxidative damage in the brain. They accomplish this by modulating various antioxidant defence mechanisms and preventing the accumulation of reactive oxygen species. Furthermore, the plant's anti-inflammatory properties have been shown to inhibit the activation of pro-inflammatory molecules and reduce the production of inflammatory mediators, thus attenuating neuroinflammatory responses.

In addition to its antioxidant and anti-inflammatory actions, *Hyoscyamus niger* has also been found to exert neuroprotective effects through its interaction with neurotransmitter systems. The alkaloids present in the plant can act as antagonists of acetylcholine receptors, particularly the muscarinic receptors. By blocking the overstimulation of these receptors, *Hyoscyamus niger* can help restore the balance of neurotransmitters in the brain, which is often disrupted in neurodegenerative diseases.
Furthermore, emerging evidence suggests that *Hyoscyamus niger* possesses neurotrophic properties. It has been observed to promote the growth and survival of neurons, enhance synaptic plasticity, and stimulate neuronal regeneration. These effects are believed to be mediated by the activation of various signalling pathways involved in neurogenesis and neuronal differentiation. While the neuroprotective role of *Hyoscyamus niger* shows promise, it is important to note that further preclinical and clinical studies are needed to fully understand its mechanisms of action and therapeutic potential. The potential side effects and interactions with other medications should be carefully considered. Nonetheless, the neuroprotective properties of *Hyoscyamus niger* make it an intriguing candidate for the development of novel therapeutic interventions for neurodegenerative diseases.

Lepidium meyenii,

*Lepidium meyenii***,** commonly known as Maca, is a medicinal plant that has gained attention for its potential neuroprotective properties. The plant is rich in bioactive compounds, including alkaloids, flavonoids, and glucosinolates, which contribute to its therapeutic effects. Several studies have suggested that these compounds exhibit neuroprotective activities through multiple mechanisms. One key aspect of *Lepidium meyenii's* neuroprotective role is its antioxidant activity. Oxidative stress is a major contributor to neurodegenerative diseases, and the antioxidants present in Maca can scavenge free radicals and reduce oxidative damage in the brain. These antioxidants help maintain the balance between oxidant and antioxidant systems, protecting neurons from oxidative injury and promoting their survival.

Furthermore, *Lepidium meyenii* has been found to possess anti-inflammatory properties, which play a vital role in neuroprotection. Chronic neuroinflammation is a characteristic feature of neurodegenerative disorders, and Maca's anti-inflammatory compounds can suppress the production of pro-inflammatory molecules and reduce the activation of immune cells in the brain. By mitigating neuroinflammation, *Lepidium meyenii* may help preserve neuronal function and prevent the progression of neurodegenerative diseases.

Additionally, *Lepidium meyenii* has been reported to enhance cognitive function and memory. It has been suggested that certain compounds in Maca may have positive effects on neurotransmitter systems, such as dopamine, serotonin, and acetylcholine, which are critical for cognitive processes. By modulating these neurotransmitters, Maca may improve cognitive performance and protect against cognitive decline associated with ageing or neurodegenerative disorders. Moreover, *Lepidium meyenii* has been found

to stimulate neurogenesis, the process of generating new neurons in the brain. Animal studies have shown that Maca supplementation can increase the proliferation and differentiation of neural stem cells, leading to the formation of new neurons. This neurogenic activity suggests that *Lepidium meyenii* may have the potential to enhance brain repair and regeneration following injury or neurodegeneration.

While the neuroprotective role of *Lepidium meyenii* is promising, further research is necessary to fully elucidate its mechanisms of action and evaluate its efficacy and safety in human populations. Additionally, the optimal dosage and duration of Maca supplementation for neuroprotection need to be determined. Nonetheless, the evidence thus far suggests that *Lepidium meyenii* holds potential as a natural neuroprotective agent, offering a promising avenue for the development of complementary therapies for neurodegenerative conditions.

CONCLUSION AND FUTURE DIRECTIONS

It is not surprising that healthy ageing has emerged as one of the top goals, with PD at the centre of attention, given the rising elderly population around the world. There are many commercial medications on the market. However, their shortcomings have prompted researchers to look for new PD therapies. This review emphasizes the urgency of starting treatment for neurological illnesses like PD, at the very least using CAT, considering this defect. Due to the substantial variety among herbal mixes used to treat this condition as well as the nature of the study designs, Kim et al.'s recent systematic review of randomized controlled trials (Kim et al., 2012) did not fully summarise the evidence on the effectiveness of herbal remedies for PD.

Nevertheless, research on PD is gaining momentum, and some plants may have neuroprotective potential in addition to antioxidant activity, according to recent experimental data. Along with the bioactive substances mentioned here, Fu et al.'s (Fu et al., 2015), Curcuma longa (Ma et al., 2017), and Panax ginseng (Cho, 2012; & Gonzalez-Burgos et al., 2015) components will also continue to be of interest for the development of alternative PD treatments.

The most intriguing of the plants discussed here is A. racemosus, which has the greatest potential for usage as a herbal cure and is also eaten as a functional food. However, some plants, like G. biloba (EGb761®), have already been advertised as potential treatments for neurological illnesses.

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REFERENCES

Alok, S., Jain, S. K., Verma, A., Kumar, M., Mahor, A., & Sabharwal, M. (2013). Plant profile, phytochemistry and pharmacology of *Asparagus racemosus* (Shatavari): A review. *Asian Pac J Trop Dis. 3*, 242–51. doi: 10.1016/S2222-1808(13)60049-3

Alok, S., Jain, S. K., Verma, A., Kumar, M., Mahor, A., & Sabharwal, M. (2014). Herbal antioxidant in clinical practice: A review. *Asia Pac J Trop Biomed. 4*, 78–84. doi: 10.1016/S2221-1691(14)60213-6

Agim, Z. S., & Cannon, J. R. (2015). Dietary factors in the aetiology of Parkinson's disease. *BioMed Res Int.*, 672838. doi: 10.1155/2015/672838

Bega, D., & Zadikoff, C. (2014). Complementary & alternative management of Parkinson's disease: An evidence-based review of eastern influenced practices. *J Mov Disord. 7*, 57–66. doi: 10.14802/jmd.14009

Begović, B. M. (2011). *Ginkgo biloba Nature's Miracle, Book 1 1–2*). Croatia: Self-Publishing; Branko M Begovic Bego.

Carradori, S., D'Ascenzio, M., Chimenti, P., Secci, D., & Bolasco, A. (2014). Selective MAO-B inhibitors: a lesson from natural products. *Mol Divers. 18*, 219–43. doi: 10.1007/s11030-013-9490-6

Cho, I. H. (2012). Effects of *Panax ginseng* in neurodegenerative diseases. *J Ginseng Res. 36*, 342–53. doi: 10.5142/jgr.2012.36.4.342

Dodel, R. (2011). Interpreting health economics data in Parkinson's disease. *Eur Neurol Rev. 6*(Suppl. 1), 13–6. Available online at: https://www.touchneurology.com/system/files/private/articles/9012/pdf/dodel.pdf

Dong, J., Cui, Y., Li, S., & Le, W. (2016). Current pharmaceutical treatments and alternative therapies for Parkinson's disease. *Curr Neuropharmacol. 14*, 339–55. doi: 10.2174/1570159X14666151120123025

El-Ghazaly, M. A., Sadik, N. A. H., Rashed, E. R., & Abd-El-Fattah, A. A. (2013). Neuroprotective effect of EGb761® and low-dose whole-body γ-irradiation in a rat model of Parkinson's disease. *Toxicol Ind Health 31*, 1128–43. doi: 10.1177/0748233713487251

Findley, L. J., Wood, E., Lowin, J., Roeder, C., Bergman, A., & Schifflers, M. (2011). The economic burden of advanced Parkinson's disease: an analysis of a UK patient dataset. *J Med Econ. 14*, 130–9. doi: 10.3111/13696998.2010.551164

Fleming, S. M. (2017). Mechanisms of gene-environment interactions in Parkinson's disease. *Curr Environ Health Rep 4*, 192–9. doi: 10.1007/s40572-017-0143-2

Fu, W., Zhuang, W., Zhou, S., & Wang, X. (2015). Plant-derived neuroprotective agents in Parkinson's disease. *Am J Transl Res. 7*, 1189–202.

Gaba, A. (2015). Recent studies on nutrition and Parkinson's disease prevention: a systematic review. *Open J Prev Med. 5*, 197–205. doi: 10.4236/ojpm.2015.55023

González-Burgos, E., Fernandez-Moriano, C., & Gómez-Serranillos, M. P. (2015). Potential neuroprotective activity of Ginseng in Parkinson's disease: a review. *J Neuroimmune Pharm. 10*, 14–29. doi: 10.1007/s11481-014-9569-6

Govindarajan, R., Vijayakumar, M., & Pushpangadan, P. (2005). Antioxidant approach to disease management and the role of 'Rasayana' herbs of Ayurveda. *J Ethnopharmacol. 99*, 165–78. doi: 10.1016/j.jep.2005.02.035

Infante, M. E., Perz, A. M., Simao, M. R., Manda, F., Baquete, E. F., & Fernandes, A. M. (1990). The outbreak of acute toxic psychosis attributed to Mucuna pruriens. *Lancet 336*, 1129. doi: 10.1016/0140-6736(90)92603-F

Jahanshahi, M., Nickmahzar, E. G., & Babakordi, F. (2013). The effect of *Ginkgo biloba* extract on scopolamine-induced apoptosis in the hippocampus of rats. *Anatom Sci Int. 88*, 217–22. doi: 10.1007/s12565-013-0188-8

Kim, T. H., Cho, K. H., Jung, W. S., & Lee, M. S. (2012). Herbal medicines for Parkinson's disease: a systematic review of randomized controlled trials. *PLoS ONE 7*, e35695. doi: 10.1371/journal.pone.0035695

Lampariello, L. R., Cortelazzo, A., Guerranti, R., Sticozzi, C., & Valacchi, G. (2012). The magic velvet bean of *Mucuna pruriens*. *J Tradit Complement Med. 2*, 331–9. doi: 10.1016/S2225-4110(16)30119-5

Lee, M. R. (2006). Solanaceae III: henbane, hags and Hawley Harvey Crippen. *J R Coll Phys Edinburgh 36*, 366–73.

Liang, L. (1993). The contemporary ginkgo encyclopedia of China. *Beijing Agric Univ*. Press.

Ma, X. W., & Guo, R. Y. (2017). Dose-dependent effect of Curcuma longa for the treatment of Parkinson's disease. *Exp Ther Med. 13*, 1799–805. doi: 10.3892/etm.2017.4225

Mateus, C., & Coloma, J. (2013). Health economics and cost of illness in Parkinson's disease. *Eur Neurol Rev. 8*, 6–9. doi: 10.17925/ENR.2013.08.01.6

More, S. V., Kumar, H., Kang, S. M., Song, S. Y., Lee, K., & Choi, D. K. (2013). Advances in neuroprotective ingredients of medicinal herbs by using cellular and animal models of Parkinson's disease. *Evid-Based Complement Alternat Med*, 957875. doi: 10.1155/2013/957875

Musthafa, S. M., Asgari, S. M., Kurian, A., Elumalai, P., Ali, A. R. J., & Paray, B. A. (2018). Protective efficacy of *Mucuna pruriens* (L.) seed meal enriched diet on growth performance, innate immunity, and disease resistance in *Oreochromis mossambicus* against *Aeromonas hydrophila*. *Fish Shellfish Immunol. 75*, 374–80. doi: 10.1016/j.fsi.2018.02.031

Navarro-Meza, M., Gabriel-Ortiz, G., Pacheco-Moisés, F. P., Cruz-Ramos, J. A., & López-Espinoza, A. (2014). Dietary fat and antioxidant vitamin intake in patients of neurodegenerative disease in a rural region of Jalisco, Mexico. *Nutr Neurosci. 17*, 260–7. doi: 10.1179/1476830513Y.0000000089

Padmesh, P., Reji, J. V., Dhar, M. J., & Seeni, S. (2006). Estimation of genetic diversity in varieties of *Mucuna pruriens* using RAPD. *Biol Plantarum 50*, 367–72. doi: 10.1007/s10535-006-0051-z

Pavlou, M. A. S., & Outeiro, T. F. (2017). Epigenetics in Parkinson's disease. *Adv Exp Med Biol. 978*, 363–90. doi: 10.1007/978-3-319-53889-1_19

Pringsheim, T., Jette, N., Frolkis, A., & Steeves, T. D. (2014). The prevalence of Parkinson's disease: a systematic review and meta-analysis. *Mov Disord. 29*, 1583–90. doi: 10.1002/mds.25945

Rodríguez-Violante, M., Zerón-Martínez, R., Cervantes-Arriaga, A., & Corona, T. (2017). Who can diagnose Parkinson's disease first? Role of pre-motor symptoms. *Arch Med Res 48*, 221–7. doi: 10.1016/j.arcmed.2017.08.005

Rout, O. P. Acharya, R., Gupta, R., Inchulkar, S. R., Karbhal, K. S., & Sahoo, R. (2013). Management of psychosomatic disorders through Ayurvedic drugs – A critical review. *World J Pharm Pharm Sci. 2*, 6507–37.

Sachan, A. K., Das, D. R., Dohare, S. L., & Shuaib, M. (2012). *Asparagus racemosus* (Shatavari): an overview. *Int J Pharm Chem Sci. 1*, 937–41.

Saki, K., Bahmani, M., & Rafieian-Kopaei, M. (2014). The effect of most important medicinal plants on two important psychiatric disorders (anxiety and depression) – A review. *Asian Pac J Trop Med. 7*, S34–42 doi: 10.1016/S1995-7645(14)60201-7

Sharma, P. C., Yelne, M. B., Dennis, T. J., Joshi, A., & Billore, K. V. (2000). *Database on Medicinal Plants Used in Ayurveda*. New Delhi: *Central Council for Research in Ayurveda &*

Siddha; Department of ISM & H; Ministry of Health and Family Welfare, Government of India.

Sharma, A., & Sharma, V. (2013). A brief review of medicinal properties of *Asparagus racemosus* (Shatawari). *Int J Pure Appl Biosci. 1*, 48–52.

Tan, L. S. C. (2013). Epidemiology of Parkinson's disease. *Neurol Asia 18*, 231–8. Available online at: https://www.neurology-asia.org/articles/neuroasia-2013-18(3)-231.pdf

Tysnes, O. B., & Storstein, A. (2017). Epidemiology of Parkinson's disease. *J Neural Transm. 124*, 901–5. doi: 10.1007/s00702-017-1686-y

Wang, Y., Xie, C. L., Wang, W. W., Lu, L., Fu, D. L., & Wang, X. T. (2013). Epidemiology of complementary and alternative medicine use in patients with Parkinson's disease. *J Clin Neurosci. 20*, 1062–7. doi: 10.1016/j.jocn.2012.10.022