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Review Article

Parkinson's Disease

Assessing the effects of Mucuna Pruriens in the treatment of Parkinson's Disease: A Review

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Mucuna pruriens (Mp) is one of the most widely used medicinal plants in Ayurveda, the traditional Indian system of medicine. Recognized for its high nutritional value, Mp has long been an important food source in Asia, the Americas, and various African countries. Additionally, it serves as a cover crop and animal fodder. Traditionally, Mp has been employed as an antivenom for snake bites. Research suggests that it possesses numerous beneficial properties, including anti-oxidative, anti-inflammatory, anti-epileptic, and anti-microbial activities. It is also commonly used as a potent aphrodisiac.Parkinson's disease (PD) is a complex neurological disorder characterized by the gradual degeneration of dopaminergic neurons, leading to movement impairments such as resting tremors, rigidity, and bradykinesia. The anti-Parkinsonian potential of Mp has been investigated since the 19thcentury, with various studies highlighting its neuroprotective effects. Levodopa (L-DOPA), a key phytoconstituent of Mp, is primarily responsible for its anti-PD properties. Besides L-DOPA, other bioactive compounds present in Mp exhibit antioxidant and neuroprotective effects.This review explores the ethnomedicinal applications, phytochemistry, and anti-PD potential of Mp based on available literature, including preclinical studies and select clinical trials involving PD patients. Furthermore, it underscores the significance of Mp in PD management through a comprehensive analysis of existing research. These insights may contribute to the development of future therapeutic strategies for more effective PD treatment.

Keywords: Mucuna pruriens, Ayurveda, Parkinson’s disease, Neuroprotective

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Introduction

Parkinson's disease (PD) is a degenerative neurological condition that affects movement. PD is the second most common neurodegenerative disorder, second to the Alzheimer's disease (AD). This movement disorder is characterized by the gradual degeneration of dopaminergic neurons in the substantia nigra (SN), leading to dopamine depletion in the striatum (SN). A key pathological feature of PD is the formation of Lewy bodies (LB) due to the accumulation of abnormal α-synuclein protein. The resulting dopamine deficiency in the basal ganglia manifests as motor dysfunction, including bradykinesia, akinesia, gait disturbances, and resting tremors. Non-motor symptoms, such as cognitive decline, typically emerge about a decade after the onset of motor impairments.**[1]**PD is the most rapidly increasing neurological disorder, with its prevalence, disability, and mortality rates rising significantly. The aging population plays a major role in this growth. Current estimates suggest that over 6.2 million people worldwide are affected by PD, and projections indicate this number will surpass 12 million by 2040.**[2]**

The current approach to PD treatment focuses on restoring optimal dopamine (DA) levels and its associated signaling pathways. This is achieved by administering Levodopa (L-DOPA), or L-3,4-dihydroxyphenylalanine, a precursor to DA. While L-DOPA initially helps slow disease progression, its long-term efficacy is limited. To mitigate its side effects, primarily gastrointestinal and cardiovascular issues, it is often prescribed alongside carbidopa, a peripheral decarboxylase inhibitor.**[3]**

Despite advancements in pharmacological treatments, many patients continue to experience worsening disability and a decline in quality of life where healthcare providers face substantial challenges in managing the condition. Given these persistent difficulties, PD management has expanded to include complementary and alternative therapies.

Mp also referred to as "velvet bean" and known as "*Atmagupta*" in India, is a climbing legume widely found in India and various tropical regions, including Central and South America. Its medicinal use dates back to ancient times, with records indicating its application in treating medical conditions as early as 1500 BC.

In Ayurveda there are reference of using *Mucuna* seed in treating a disorder similar to PD.**[3]** It is also a valuable food source due to its high content of crude protein, essential fatty acids, starch, and vital amino acids.

Additionally, it contains various antinutritional factors, including protease inhibitors, total phenolics, oligosaccharides, and certain cyclitols with anti-diabetic properties. Nearly all parts of the plant demonstrate significant medicinal potential, with L-DOPA (5%) being its primary phenolic compound.**[4]**

L-DOPA (5%) is the primary phenolic compound present in Mp, with concentrations ranging from approximately 3.02% to 4.72%, as determined through the HPTLC method.**[5]**

There is growing interest in utilizing nutrition and plant extracts as therapeutic strategies to support individuals with PD. These approaches capitalize on the anti-inflammatory, neuroprotective, and antioxidant properties of certain dietary elements and plant compounds to help mitigate neuronal damage and enhance dopaminergic function beyond conventional treatments.

Numerous studies have provided strong evidence suggesting that specific phytochemicals and nutritional components may play a role in influencing the progression of PD through various mechanisms. Mp has been extensively researched for its neuroprotective effects in various Parkinsonian models. Studies have shown its effectiveness in combating neuroinflammation and oxidative stress, helping to safeguard neurons from degeneration. This review provides an overview of the medicinal properties of Mucuna pruriens, with a focus on studies examining the therapeutic potential against PD& its models.

Materials and Methods

An extensive literature search was carried out manually with online publications from PubMed (NIH)and Google Scholar. Specific terms like "neuroprotective", "*Mucuna pruriens*", "*Kapikachu*", "velvet bean", "Parkinson's disease" using conjugation OR/AND and also search related to geographical distribution, ethnomedicinal uses, phytochemistry, pharmacology of *M. pruriens*. The search was mainly focused on preclinical & clinical use of Mp with respect toPD.

Growth and Geographical Distribution

*Mucuna pruriens (L) Dc. is a fast-growing, annual climbing legume that can reach heights of 3 to 18 meters (*Figure 1*). Native to tropical regions, it is particularly prevalent in Africa, India, and the West Indies. This species is widely distributed across much of the Indian subcontinent, thriving in bushes, hedges, and dry-deciduous lowland forests throughout the plains of India.**[6]***

India is home to 14 species of *Mucuna*, which are distributed across diverse regions, including the foothills of the Himalayas, the plains of West Bengal, Madhya Pradesh, Karnataka, Kerala, Andhra Pradesh, and Uttar Pradesh. These species are also found in the Andaman & Nicobar Islands, as well as in Sri Lanka.**[7]**

A

B

C

Figure 1: M. pruriens A) Natural Habitat B) Dried seeds C) Pods

Traditional Use[8]

The traditional uses of Mp are well documented, anyhow it was used as a green manure crop in tropical regions as it has the ability to fix atmospheric nitrogen, enriching the soil and improving fertility.**[9]** Parts used are seed, leaves & root. For generations, tribal communities have utilized the plant and its extracts as a natural remedy for snakebites. In Asia, America, Africa & Pacific Islands it is a source of food i.e. pods are used as a vegetable and young leaves as animal fodder.**[10]** Mp has a rich history in Indian Ayurvedic medicine, traditionally the seeds are used to treat conditions such as worms, dysentery, diarrhea, snakebite, sexual debility, cough, tuberculosis, impotence, rheumatic disorders, muscular pain, gout, delirium, dysmenorrhea, diabetes, and cancer. In India, it is valued as an aphrodisiac, emmenagogue, uterine stimulant, nerve tonic, diuretic, and blood purifier. In Unani**[86]** and Homeopathic**[87]** system of medicine it is used to manage neurological and reproductive disorders.

In Central America, Mucuna beans have been roasted and ground for decades as a coffee substitute, commonly referred to as "Nescafe." The beans are also cooked and consumed as a vegetable (Table 1). In Brazil, the seeds are used internally for PD, edema, impotence, intestinal gas, and worms, serving as a diuretic, nerve tonic, and aphrodisiac. Externally, they are applied to ulcers. The seeds exhibit astringent, laxative, anthelmintic, aphrodisiac, alexipharmic, and tonic properties,

Making them beneficial in the treatment of gonorrhea, consumption, sterility, vitiated Vata conditions, and general debility. Additionally, the plant's hairs and flowers act as vermifuge agents. In Ayurveda, Mucuna seed powder is specifically utilized to treat PD. The root possesses bitter, thermogenic, emollient, stimulant, purgative, aphrodisiac, diuretic, emmenagogue, anthelmintic, febrifuge, and tonic properties.**[127]**

In Ayurveda, it is valued for addressing imbalances in *Vata*& *Pitta Doshas.* Traditionally, its medicinal applications extend to treating constipation, nephropathy, dysmenorrhoea, amenorrhoea, elephantiasis, dropsy, neuropathy, consumption, ulcers, fever, & delirium. Leaves Possessing (Table 1) aphrodisiac, anthelmintic, & tonic properties, it is beneficial for treating ulcers, inflammation, helminthiasis, cephalalgia, & general debility.

Table 1: Ethnomedicinal uses of M. pruriens in various countries

Country	Part of plant	Use	Reference
India	Pod hairs	Anthelmintic, vermifuge and treated for round worm infections	[11]
	Bark powder	Rheumatic arthritis joint pain	
	roots	bitter, thermogenic, emollient, stimulant, purgative, aphrodisiac, diuretic, emmenagogue, anthelmintic, febrifuge, diuretic and tonic. Also in constipation, nephropathy, strangury, dysmenorrhea, amenorrhea, elephantiasis, dropsy, neuropathy, ulcers, helminthiasis, fever, delirium and for treating Parkinson's disease	
	seeds	astringent, laxative, anthelmintic, aphrodisiac, tonic, also used in treating gonorrhoea, sterility, vitiated conditions ofVata, and general debility, snakebite, Uterine stimulant, Parkinson's Disease, antidepressant, Neurological disorders, Arthritis, scorpion sting. Also consumed as vegetable.	[11] [12] [10][13]
	Leaves	aphrodisiac, anthelmintic and tonic and are useful in ulcers, inflammation, helminthiasis, cephalalgia and general debility. Also used as a fodder crop. Dried leaves are smoked. Bone fractures, cough, dog-bite, madness, pain, pleuritis, ring worm, scorpion sting,snake-bite, sores and syphilis.	[11][13]
	flowers	Snake bite, Uterine stimulant, aphrodisiac	[11]
	Plant	Anthelmintic: intestinal worms, genito-urinary diseases, black tongue, round worm, gonorrhea and stomach disorders. Used in snake bites.	[14] [13]
China	Plant	Vegetable	[15]
Africa		food source i.e. pods used as a vegetable and young leaves as animal fodder	[10]
Central Africa		animal livestock	[16]
Eastern Africa		green manure and as fodder	[9]
Southern Africa			
Indonesia		used as food, animal feed	
Benin (west Africa)	Whole plant	Green manure, fallow and cover crop, Also used as forage, silage, and hay.	
	Seeds	As concentrate feed, roasted beans as coffee substitute, cooked beans as vegetable	
	Young leaves	As vegetable	
Vietnam	Plant	Cover crop & as green manure.	
	seed	Substitute to coffee	
	leaves	As vegetable	
USA	seeds	As ornamental species	[17]
Central America	seeds	Substitute to coffee	[12]
	plant	Fallow rotations	[9]
America	Young leaves	Animal fodder	[10]
	pods	Vegetable	
West Africa	Seed, flower, leaves	Snake bite Uterine stimulant Aphrodisiac	[18] [11]
Brazil	Plant/ seed	Food Parkinson's disease, edema, impotence, intestinal gas and worms. Also used as diuretic, nerve tonic and aphrodisiac.	[18][19]
Nigeria	plant	Food	[18]
		Oral prophylactics for snakebite	[19]
		Elephantiasis	[14]
		Fallow, Minor food crop	[20]

Philippines	Plant	Food	[18]
Ghana	Plant	Food	
	Plant	Minor food crop	[20]
Malawi	Plant	Food	[18]
Asia	Plant	Food source i.e. Pods used as a vegetable and young leaves as animal fodder	[10]
Pacific Islands			
West Indies	Root decoction	Elephantiasis, diuretic	[21]
Guatemala	Seed	Substitute to coffee	[12]
Mauritius	Plant	Vegetable	
		Livestock feed	[22]
Mexico	Seed	Substitute to coffee & known as nescafe	[12]
Guinea	Seed	Used as food i.e. As ragout, tau, porridge and coffee	[23]
	Seed/ Plant	Also used as a cover crop to improve soil fertility	
Persia	Plant	Used to treat infertility	[24]
Malasia	Plant	Green crop	[20]
Java		Green manure crop	
Bali		Green manure crop	
Sumatra		Green manure crop	
Mozambique		Minor food crop	
Srilanka	Seed & leaves	Food	[25]
	Root	Diuretic, paralysis & other neurological disorders	[21]
	seed	Aphrodisiac, scorpion sting	
	Pod hair	Anthelmintic for round worms	
Zambia	Plant	Food	[22]
Malawi		Food	
Thailand	Plant	Depression,dysuria, erectile dysfunction, diuretic, aphrodisiac.	[26]
Combodia	Plant	To promote restful sleep and reduce fatigue, headache, skin problems, fever, respiratory disorders, arthritis, pain relief and even mental health, aphrodisiac & antispasmodic properties.	[27]
Myanmar	leaves	Male disorders, improve lactation, stop bleeding, prevent vomiting	[28]
	fruit	Deworming, urine problems	
	seed	Used as tonic, stimulate lactation, improve circulation, to increase sperm, promote vitality and weight gain, expel intestinal worms, and strengthen the senses. Some neurological problems like numbness, paralysis, stop vomiting & bleeding, scorpion & centipede bite, veneral diseases, wounds, sores	
	Root	Emmenagogue, tonic, aphrodisiac, and purgative, diuretic, cholera, dysentery, edema, paralysis, atropy, elephantiasis	
Nepal	Root	Animal livestock, virility, menstrual problems, aphrodisiac, diuretic, tonic, stimulant, dysentery, fever.	[29]
	Seed	Aphrodisiac, nerve tonic, anthelmintic, blood diseases, antipyretic, and purgative, scorpion sting	
	leaves	Aphrodisiac, anthelmintic, useful in ulcers, inflammation, and general debility, headache	
	Pod hair	Anthelmintic against roundworms	

Phytochemistry*(*Table 3*)*

Overall the ethnobotanical research highlights the diverse range of phytochemicals found in *Mp* (Table 2)(Figure 2). These include alkaloids, amino acids, fatty acids, and other bioactive compounds, such as 1-methyl-3-carboxy-6,7-dihydroxy-1,2,3,4-tetrahydroisoquinolone, 5-hydroxytryptamine, 5-methoxy-N,N-dimethyltryptamine-N-oxide, 5-oxyindole-3-alkylamine, 6-methoxyharman, alanine, arachidic acid, arginine, aspartic acid, behenic acid, β-carboline, β-sitosterol, bufotenine, choline, cystine, leucine, linoleic acid, myristic acid, N,N-dimethyltryptamine, N,N-dimethyltryptamine-N-oxide, nicotine, Oleic acid, palmitic acid, palmitoleic acid, phenylalanine, phosphorus, proline, protein, saponins, serine, stearic acid, threonine, tryptamine, tyrosine, valine, and vernolic acid.**[30]**

The seeds are rich in L-DOPA, a unique non-protein amino acid (3-(3,4-dihydroxyphenyl)-1-alanine) that serves as a direct precursor to the neurotransmitter dopamine.[13] It was first identified L-dopa as a major constituent in 1937. Apart from seeds, the L-DOPA is present in various parts of plant i.e. leaves, stem, root, pod, etc. The content varies across different parts of the plant, with fully matured seeds containing 3.6–4.2%,

Pod-pericarp 0.14–0.22%, leaves 0.17–0.35%, stems 0.19–0.31%, and roots 0.12–0.16%. Interestingly, the highest concentration of L-DOPA is found in seeds.[31]

Beyond L-DOPA, *M. pruriens* contains glutathione, lecithin, gallic acid, and beta-sitosterol, along with additional amino acids. It also contains serotonin (5-hydroxytryptamine), nicotine, dimethyl tryptamine (DMT), bufotenine, 5-MeO-DMT, and beta-carboline.[32]

The seeds contain alkaloids, includingmucunine, mucunadine, mucunadinine, prurienine, prurienidine, and nicotine. In addition, they containbeta-sitosterol, glutathione, lecithin, vernolic acid, and gallic acid. These seeds also harbor variousbioactive compounds, such as tryptamine, alkylamines, steroids, flavonoids, coumarins, and cardenolides.[33] It also contains oils including palmitic, stearic, oleic and linoleic acids.[33] GC-MS analysis showed the presence of phytochemicals like n-hexadecanoic acid (48.21%), squalene (7.87%), Oleic acid (7.62%), ascorbic acid (3.80%) and Octadecanoic acid (6.21%). The two tetrahydroquinoline alkaloids namely: 3-methoxy-1,1-dimethyl-6,7-dihydroxy-1,2,3.4-tetrahydroquinoline and 3-methoxy-1, 1-dimethyl-7,8-dihydroxy-1,2,3.4-tetrahydroquinoline can also be visualized.[34]

There are four alkaloids reported in seeds i.e. L- 3-caboxy- 1,2,3,4-tetrahydroisoquinoline, (-)-1-methyl-3carboxy-6,7-dihydroxy-1,2,3,4 tetrahydroisoquinoline, dimethyl-3carboxy-6, 7-dihydroxy-1,2,3,4- tetrahydroisoquinoline and (-)-1- 3-carboxy- 1, 1- dimethyl- 7, 8- dihydroxy- 1, 2, 3, 4-tetra hydroisoquinolineA.

Three novel lipid derivatives have recently been identified in the n-hexane extract of *Mucuna pruriens* seeds. These compounds include (Z)-Triactont-5,7,9-triene, (Z)-Docos-2,4,6-trien-1,8-diol, and (Z)-Docos-5-en-1-oic acid.[35]

Leaves contain approximately 0.5% L-DOPA, 0.006% DMT, & 0.0025% 5-MeO-DMT. Given its biochemical profile, this plant plays significant role in neurological function, mood regulation, sexuality, & movement.[11][13] It also revealed that presence of L-dopa, 6-methoxyharman, genistein, hydroxygenisteininminimal concentration. Recently three new lipid derivatives were also reported triactont- 5, 7, 9- triene, docos- 2, 4, 6- triene- 1, 8-diol & docos- 5- en- 1- oic acid. 6-methoxyharman also reported to be presentA. Other phytoconstituents include serotonin (5- hydroxy tryptamine, 5-HT), 5-hydroxy tryptophan (5-HTP), nicotine, N, N-dimethyltryptamine (DMT), bufotenine, & 5-imethoxy- N,N-dimethyl tryptamine (5-MeO-DMT) 5- imethoxy-N,N- dimethyl tryptamine-n-oxide (5- MeO-DMT-n-oxide).[31]

Other parts of *Mp* including its roots, stems, & leaves, contain various phytochemicals (Table 2) such as nicotine, physostigmine, serotonin, bufotenine, choline, N-N-dimethyl tryptamine, & several indole compounds. Other compounds like methylated & non-methylated tetra hydroisoquinoline are also present.[31] hairs on pod primarily contain amines, including 5-hydroxy-tryptamine (serotonin) & proteolytic enzyme mucuanain. Notably, serotonin is found exclusively in pods.[33] Most of phytoconstituents exhibit neuroprotective, anti-inflammatory, antioxidant, immunomodulation, etc. activity.

Table 2: Phytoconstituents present in different parts of M. pruriens

Part	Phytoconstituent	Ref
Seed	3-(3,4-dihydroxyphenyl)-1-alanine (L-dopa), glutathione, lecithin, gallic acid, beta-sitosterol, serotonin (5-hydroxytryptamine), nicotine, dimethyl tryptamine (DMT), bufotenine, 5-MeO-DMT, beta-carboline, methoxy-1,1-dimethyl-6,7-dihydroxy-1,2,3.4-tetrahydroquinoline, 3-methoxy-1, 1-dimethyl-7,8-dihydroxy-1,2,3.4-tetrahydroquinoline, palmitic acid, vernolic acid, gallic acid, stearic acid, oleic acid, linoleic acid, mucunine, mucunadine, mucunadinine, prurieninine, pruriendine, ndole-3-alkylamines-N	[31][32][33]
Leaves	3-(3,4-dihydroxyphenyl)-1-alanine (L-dopa), dimethyl tryptamine (DMT), 5-MeO-DMT (5-methoxy-N,N-dimethyltryptamine), nicotine, physostigmine, serotonin (5- hydroxy tryptamine, 5-HT), bufotenine, choline, 5-hydroxy tryptophan (5-HTP), N, N-dimethyltryptamine(N,N-DMT), 5- imethoxy-N,N- dimethyl tryptamine-n-oxide (5- MeO-DMT-n-oxide), 6-methoxyharman, genistein, hydroxygenistein, triactont- 5, 7, 9- triene, docos- 2, 4, 6- triene- 1, 8-diol, docos- 5- en- 1- oic acid, ndole-3-alkylamines-N.	[31]
Stem	3-(3,4-dihydroxyphenyl)-1-alanine (L-dopa), nicotine, physostigmine, serotonin, bufotenine, choline, N-N-dimethyl tryptamine	
root	3-(3,4-dihydroxyphenyl)-1-alanine (L-dopa), nicotine, physostigmine, serotonin, bufotenine, choline, N-N-dimethyl tryptamine, ndole-3-alkylamines-N	
Pod hair	3-(3,4-dihydroxyphenyl)-1-alanine (L-dopa), 5-hydroxy-tryptamine (serotonin), mucuanain	[31][33]
Pod	ndole-3-alkylamines-N	[34]

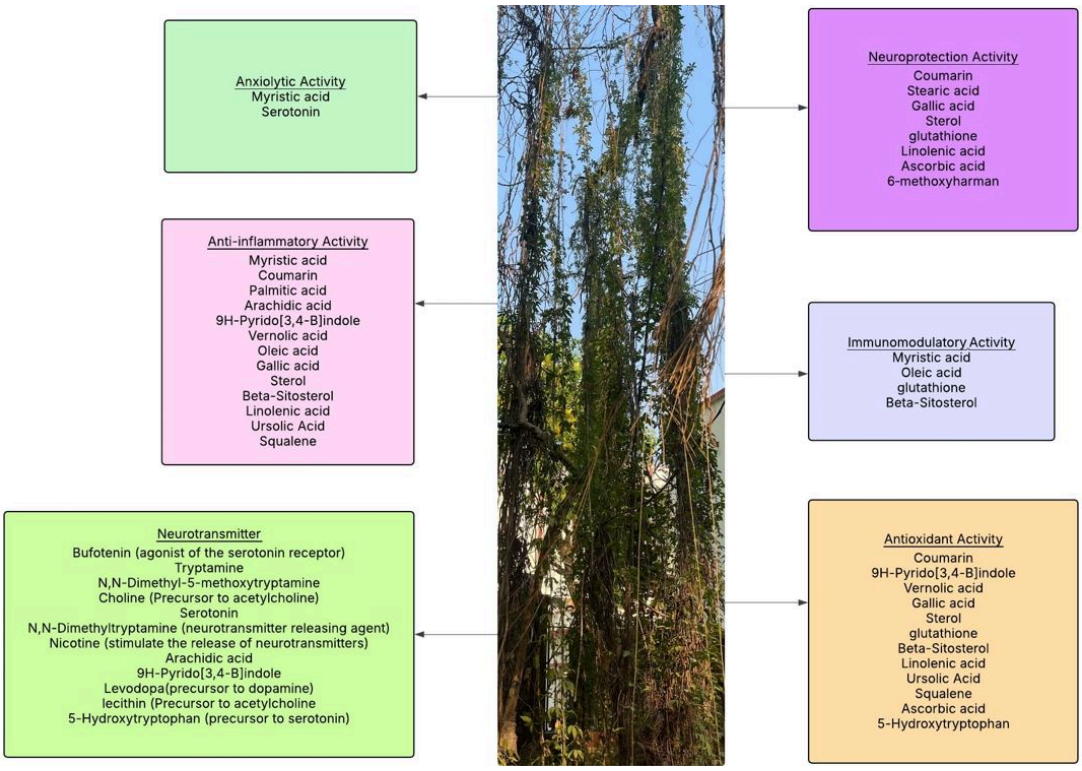

Figure 2: Phytoconstituents of M. pruriens and their neurobiological profile.

Table 3: Phytoconstituents of M. pruriens with their biological activities

Compound	Chemical formula	Biological Activity	Reference
Myristic acid	C14H28O2	Anti-inflammatory effect, antifungal, antiviral, anticancer, antiparacytic, immunomodulatory, Anxiolytic	[36][37][38]
Bufotenin	C12H16N2O	Agonist of the serotonin receptor	[39]
Tryptamine	C10H12N2	Neurotransmitter	[40]
N,N-Dimethyl-5-methoxytryptamine	C13H18N2O	Neurotransmitter [depression, anxiety, stress, PTSD, obsessive-compulsive disorder]	[41]
Coumarin	C9H6O2	Anti-inflammatory, anticoagulant, anti-cancer, antioxidant, anti-microbial, neuroprotective, anti-Alzheimer, analgesic, antioxidant	[42][43][44] [45][46]
Choline	C5H14NO+	Neurotransmitter	[47]
Stearic acid (octadecanoicacid)	C18H36O2	Neuroprotective, antidepressant, antimicrobial	[48][49]
Serotonin	C10H12N2O	Neurotransmitter, Antidepressants; Anxiolytics	[50][51]
N,N-Dimethyltryptamine	C12H16N2	Neurotransmitter releasing agent	[40]
Nicotine	C10H14N2	Neurotransmitter	[52]
Palmitic acid (n-hexanoic acid)	C16H32O2	Anti-inflammatory	[53]
Arachidic acid	C20H40O2	Anti-inflammatory, neurotransmitter	[54][55]
9H-Pyrido[3,4-B]indole	C16H32O2	Anti-inflammation, antioxidant, neurotransmitter	[56][57]
Vernolic acid ((9Z)-(12S,13R)-12,13-Epoxyoctadecenoic acid)	C18H32O3	Neuromodulation, Anti-inflammatory, antioxidant activity	[58][59]
Oleic acid	C18H34O2	Anti-inflammatory, immunomodulation	[60][61]
Gallic acid	C7H6O5	Antioxidant, anti-inflammatory, Neurooprotective (Alzheimer's disease, Parkinson's disease, Anxiety, Depression, Psychosis)	[62][63][73]
Sterol	C17H28O	Anti-inflammatory, antioxidant, neuroprotection	[64][65]
glutathione	C10H17N3O6S	Antioxidant, neuroprotection, immunomodulation, apoptotic and cell protection	[66][67][73]
Levodopa	C9H11NO4	Antiparkinsonism, dopamine precursor	[68][69][73]
Beta-Sitosterol	C29H50O	Anti-inflammatory, immunomodulatory, antioxidant, antinociceptive	[70]
Linolenic acid	C18H30O2	neuroprotective, anti-inflammatory, antidepressant, antioxidant	[71][72]
Ursolic Acid	C30H48O3	antioxidant, anti-inflammatory, antitumor	[74]

lecithin	C42H80NO8P	precursor for choline, synthesis of neurotransmitter acetylcholine,	[75]
Squalene	C30H50	Antioxidant, anti-inflammatory	[76][77]
Ascorbic acid		Neuroprotective, antioxidant	[78][79]
5-Hydroxytryptophan	C11H12N2O3	Antidepressive, precursor to serotonin, antioxidant	[80]
6-methoxyharman	C13H12N2O	Antimicrobial, neuroprotective	[81][82]
Betulinic acid	C30H48O3	Anti-parkinsonism, neuroprotective	[126]

Pharmacological activities[83],[84],[85]

Mp serves as anervine tonic and is widely used in the treating neurological disorders. In reproductive health, it functions as an aphrodisiac, enhancing libido, increasing sperm count and stimulating ovulation. Additionally, it exhibits various pharmacological activities such as anti-inflammatory, antioxidant, antiproliferative, neuroprotective, antifungal, antimicrobial, antivenom, etc. (Figure 3)

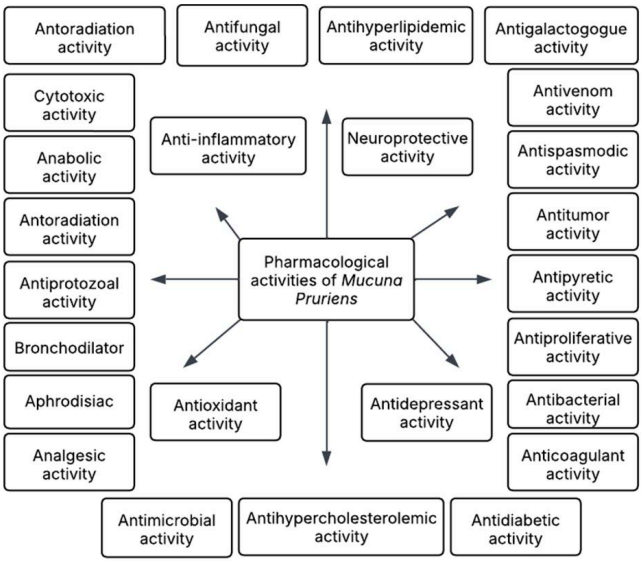

Figure 3: Pharmacological profile of M. pruriens

Study on Parkinson's Disease

In-vitro and In-vivo studies

Various studies show the neurobiological activities in numerous experimental studies. In vitro experiments reveal that Mp cotyledon powder enhances mitochondrial complex-I activity, while monoamine oxidase activity remains unchanged. **[88]** Mp extract with reduced L-DOPA demonstrates significant neuroprotective effects across four different PD models, including Murine Microglia, Human Neuroblastoma Cells, Caenorhabditis elegans and Drosophila melanogaster (Dm). While L-DOPA plays a key role in Mp's neuroprotective activity, other bioactive components may contribute synergistically to its therapeutic potential. This suggests that Mp extract with lower L-DOPA content can still effectively prevent dopaminergic neuron degeneration in various experimental PD models.**[89]** Studies have shown that the n-propanol extract of Mp seeds exhibits substantial neuroprotective effects, promoting the growth and survival of dopaminergic neurons in culture. These findings suggest that a whole seed extract may offer greater therapeutic potential for PD compared to pure L-dopa.**[90]**

In 6-hydroxydopamine (6-OHDA) induced PD model of rats showed the neuroprotective effect stronger than L-dopa. The neurorestorative potential of Mp appears linked to increased complex-I activity, alongside the presence of NADH and coenzyme Q-10 in Parkinsonian rats. Some researchers even describe Mp as a rejuvenator drug with neuroprotective properties.**[88]** Studies also suggest that Mp cotyledon powder (MPCP) plays a role at the genomic level, effectively protecting both plasmid and genomic DNA from L-DOPA and copper-induced damage. This protective mechanism is thought to be linked to MPCP's ability to chelate copper ions, reducing oxidative stress and preventing DNA strand breakage. These findings highlight MPCP's neuroprotective potential, reinforcing its promise as a therapeutic option for PD treatment.**[91]** It demonstrated that Mp exhibits strong antioxidant and metal chelating properties by effectively scavenging DPPH radicals, ABTS radicals, and reactive oxygen species (ROS), helping to reduce oxidative stress. Additionally, Mp has been shown to inhibit lipid and deoxyribose sugar oxidation, further supporting its protective role against cellular damage. Its divalent iron chelating activity contributes to its ability to regulate metal-induced oxidative stress, and importantly, Mp does not exhibit any genotoxic effects on DNA. Notably, its neuroprotective activity is independent of its symptomatic effects, suggesting broader therapeutic potential.**[92]** Following study highlights importance of redox potential & metal homeostasis in PD. Disruptions in metal regulation, particularly in dopaminergic neurons, are crucial factor in neurodegeneration in toxin-induced PD models.

The ability of Mp to help restore metal balance could play a significant neuroprotective role, potentially shielding dopaminergic neurons from progressive damage. This insight strengthens case for exploring herbal medicines that regulate metal homeostasis as promising therapeutic options for PD management.**[93]** The water extract of Mp (MPE) in hemiparkinsonian rat model of PD have compared activity of MPE alone & with an additive like peripheral dopa-decarboxylase inhibitor (DDCI), benserazide (BZ) & L-DOPA alone without BZ in hemiparkinsonian rat model of PD at behavioral level. Mp contains water soluble ingredients that show either intrinsic DDCI-like activity or alleviate requirement of DDCI to improve Parkinsonism.**[94]** In Paraquat (PQ)-induced neurotoxicity of mouse model of PD, it demonstrated strong antioxidant properties, helping to reduce oxidative stress in PD mice. Treatment with Mp seed extract enhanced motor behavior, likely due to its ability to mitigate oxidative damage & increase Tyrosine hydroxylase (TH) expression in substantia nigra (SN) & striatum of brain. PQ enters dopaminergic neurons via neutral amino acid transporter (NAT) & also exhibits affinity for dopamine transporter (DAT). Once inside, PQ disrupts redox potential of nigrostriatal pathways, contributing to neurodegeneration. However, Mp seed extract appears to counteract this impairment, offering potential neuroprotection in PD models (Figure 4).**[95]**

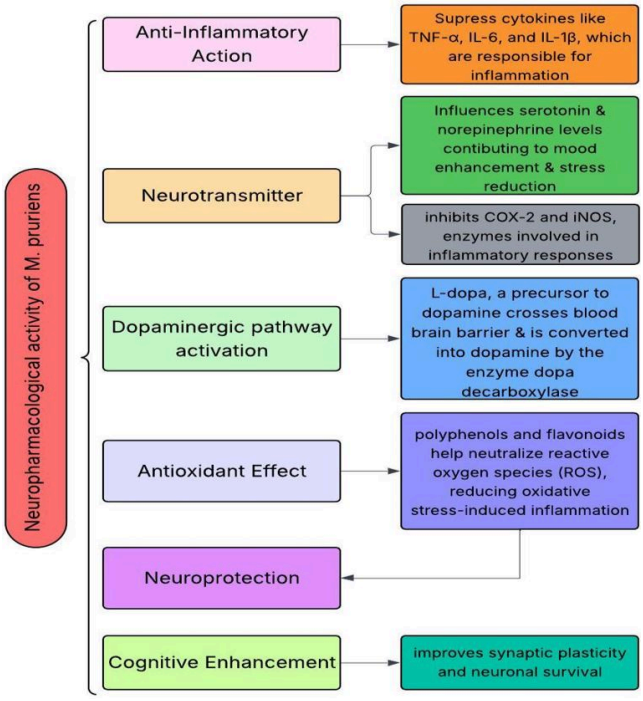

Figure 4: Neuropharmacological profile of M. pruriens

Many studies indicate that Mp has anti-Parkinsonian properties in MPTP-intoxicated nonhuman primates, demonstrating a lower risk of dyskinesia than conventional treatments. Additionally, Mp helps reduce behavioral abnormalities in this primate model. Electrophysiological research suggests that at equivalent doses, Mp provides a more effective response than L-DOPA, likely due to its distinct mechanism of action. This implies that Mp contains neuroprotective components beyond L-DOPA, playing a key role in basal ganglia function. These findings suggest that Mp could be especially beneficial for PD patients experiencing L-DOPA-induced dyskinesia due to long-term use.**[96]** Compared to L-DOPA, estrogen exhibits superior neuroprotective effects in the MPTP-intoxicated mouse model.**[97]** The ethanolic extract of Mp seeds demonstrates strong antioxidant potential in MPTP-induced PD mouse models. The seeds demonstrate strong antioxidant potential, effectively countering reactive oxygen species (ROS) generated in the MPTP model. Additionally, It also enhance motor behavior in Parkinsonian mice by stimulating catecholamine levels and boosting antioxidant activity in the nigrostriatal region. Moreover, Mp treatment improves TH expression in the SN and striatum, while also restoring normal levels of inducible nitric oxide synthase (iNOS) and glial fibrillary acidic protein (GFAP) in MPTP-treated animals. These findings highlight Mp's potential to aid in neuronal recovery and oxidative stress reduction. Interestingly, this study also compared Mp's efficacy to estrogen, revealing that Mp exhibits potent anti-Parkinsonian activity with minimal side effects compared to estrogen. This suggests that Mp could be a promising therapeutic option for PD management.**[98]**

HPTLC analysis of Mp, identifies L-DOPA and Ursolic Acid (UA) showing the neuroprotective property by promoting anti-apoptotic activity as increased expression of Bcl2 and decreased levels of Bax in paraquat mouse model of PD.**[99]** It also exerts anti-inflammatory effects by suppressing inducible nitric oxide synthase (iNOS) expression, thereby safeguarding dopaminergic neurons in substantia nigra (SN).**[100]** Same was seen in MPTP model of PD where MPTP intoxication leads to an increase in iNOS expression in both SN & striatum, contributing to decline in TH expression. Mp counteracts this effect by inhibiting iNOS expression, thereby enhancing TH levels in these regions.

Additionally, MPTP exposure elevates mRNA expression of iNOS, along with biochemical markers such as nitrite and lipid peroxidation. Mp significantly reduces these markers, reinforcing its neuroprotective potential. Hence by reducing the iNOS expression in the Parkinsonian mice model Mp shows immunomodulatory activity in PD.**[100]**

It also mitigates MPTP-induced neuroinflammation by preventing the nuclear translocation of NF-κB, a key regulator of inflammatory responses. Additionally, it suppresses the expression of proinflammatory cytokines, including Tumor Necrosis Factor-alpha (TNF-α), and enzymes such as inducible nitric oxide synthase (iNOS), thereby contributing to its neuroprotective effects.

The Dopamine transporter (DAT) is essential for the uptake of 1-methyl-4-phenylpyridinium (MPP+), but this process leads to DAT damage, which is evidenced by immunofluorescence staining. Once inside dopaminergic neurons, Mp contributes to nigrostriatal neuron degeneration through inflammatory pathways.

MPTP intoxication further reduces the expression of the anti-apoptotic protein pAkt1, exacerbating neuronal damage. However, Mp demonstrates strong anti-inflammatory properties by enhancing DAT and pAkt1 expression while suppressing proinflammatory cytokines, primarily through the inhibition of NF-κB nuclear translocation indicating the anti-inflammatory potential of Mp.**[101],[102]**

Carrageenan-induced rat paw edema model is widely recognized as primary test for evaluating new anti-inflammatory agents. Mp has demonstrated significant inhibition of both carrageenan-induced paw edema & cotton pellet granuloma in rats. Mp extract exhibited dose-dependent suppression of carrageenan edema, with 200 mg/kg & 400 mg/kg doses showing effects comparable to aspirin (150 mg/kg). Similarly, in cotton pellet study, Mp dose-dependently reduced granuloma formation, with 200 mg/kg & 400 mg/kg doses displaying efficacy similar to aspirin.**[103]**

The anti-inflammatory properties of Mp were assessed at doses of 10 and 50 mg/kg against both acute and chronic paw edema induced by carrageenan and formalin. Mp exhibited anti-inflammatory effects, with results compared to diclofenac potassium as the standard anti-inflammatory drug.**[104]**

Administration of Mp at 10 mg/kg and 50 mg/kg led to 9.80% and 47.80% inhibition respectively against acute paw edema caused by carrageenan and 6.60% and 38.80% inhibition respectively against chronic paw edema induced by formalin. The seeds exhibit notable anti-inflammatory activity, which increases with higher doses of seed powder. At doses of 2 g/kg and 3 g/kg, significant effects were observed from the 1st to the 4th hour, with p values < 0.005. In contrast, the 1 g/kg dose demonstrated activity only during the 3rd and 4th hours, with p values < 0.005 and 0.01, respectively in albino mice. No adverse effects, including mutagenicity, were detected.**[105]**

The ursolic acid (UA) of Mp seed extract showed its antioxidative and anti-inflammatory properties in MPTP-induced Parkinsonian mouse models, UA helps reduce oxidative stress in nigrostriatal tissue, leading to improved neurobehavioral function.**[106]** UA also demonstrates potent anti-inflammatory effects, similar to Mp, by inhibiting the nuclear translocation of NF-κB, thereby reducing proinflammatory cytokine expression. This mechanism plays a crucial role in preventing the progression of PD and protecting dopaminergic neurons in the basal ganglia through the NF-κB pathway.**[107]** The UA is proved for its anti-PD activity in rotenone induces PD mouse model.**[108]** UA has demonstrated anti-inflammatory properties in RAW264.7 cells, a mouse monocyte macrophage cell line, by reducing the expression of iNOS and COX-2.**[109]**It also exhibits anti-proliferative, anti-tumor, and antileukemic properties by suppressing NF-kB activation and inhibiting the expression of NF-kB-regulated genes such as lipoxygenase, COX-2, MMP-9, and iNOS.**[110]** The activation of NF-kB, MAPKs, AP-1, and NF-AT, triggered by the interaction between the major histocompatibility complex (MHC) and the T cell receptor (TCR), plays a crucial role in antigen-induced lymphocyte proliferation, cytokine secretion, and cell survival. **[111]**In resting T cells, NF-kB remains in an inactive state, bound by its cytoplasmic inhibitor, IkB-α. Upon T cell activation through the TCR, protein kinase C rapidly activates IkB kinases (IKKs), leading to the phosphorylation and subsequent degradation of IkB proteins. This degradation permits the nuclear translocation of NF-kB.**[112]** It has been reported that UA exerts potent anti-inflammatory effects by suppressing NF-kB, AP-1, and NF-AT.**[113]**

The bioavailability of UA and its dose dependent increase has been well characterized in the brain tissue.**[114]** The methanolic extract of Mp significantly improves motor abnormalities, mitochondrial dysfunction, olfactory impairment, and synaptic deficits in a genetic model of PD. Their study, conducted on Drosophila melanogaster (Dm) which is a mutant for PINK1B9, demonstrated Mp's neuroprotective potential. The study showed a rescue effect on PD progression in this model, highlighting Mp's ability to counteract neurodegeneration.**[115]**

At both larval and adult stages, Mp exhibits strong neuroprotective effects by correcting mitochondrial abnormalities. Additionally, research suggests that Mp extract rescues the serotonergic pathway, further supporting its role in mitochondrial restoration within the PINK1B9 Dm model of PD. **[116]** The combination of Mp seed endocarp (5 g/kg) and carbidopa (50 mg/kg) demonstrated superior effectiveness compared to L-dopa in the free contralateral rotation test induced by 6-hydroxydopamine (6-OHDA) in mice.**[117]**

A comparative study of Mp& WS on the PINK1B9 of Dm model reveal that these flies exhibit reduced glutathione (GSH) and superoxide dismutase (SOD) activity, along with an unexpected elongation of telomerase length compared to wild-type flies. Treatment with Mp has been shown to enhance GSH and SOD activity while reducing telomerase length, indicating superior neuroprotective potential compared to Ws.**[118]**

Clinical Study

A double-blind clinical and pharmacological study investigated the effects of Mp in PD. The findings suggest that Mp may be more effective for long-term PD management compared to conventional L-DOPA treatment, which is known to cause severe L-DOPA-induced dyskinesia with prolonged use.

However, the study had a small sample size (8 PD patients), indicating the need for further research with a larger population to validate these results. **[119]** A study investigating Mp powder from roasted seeds found that a single dose exhibited potent anti-Parkinsonian effects in 18 patients with advanced PD. When compared to dispersible levodopa/benserazide treatment, Mp demonstrated similar motor improvements with fewer dyskinesias and adverse effects.

This suggests that Mp could serve as a potential alternative to conventional levodopa therapy, particularly in regions where access to pharmaceutical levodopa is limited.**[120]** One of the authors was involved in the early levodopa trials conducted with Van Woert at Yale Medical School in the late 1960s. Upon returning to India, he conducted an open clinical trial using Mp seed powder (taxonomically identified with details available in reference) in 23 patients with PD. The study demonstrated both clinical improvement and the safety of levodopa.**[121]** A multi-center, open clinical study on HP-200, a derivative of Mp was conducted in 60 patients with PD over a 12-week period. The results demonstrated significant improvement ($p<0.001$), as assessed using the comprehensive Unified Parkinson's Disease rating scale (UPDRS).**[122]**

The UPDRS showed a significant improvement in the patients who underwent eliminative (panchakarma) with palliative therapy than patients who underwent only palliative therapy. The eliminative therapy includes 28 days followed by 56 days of oral medication (total 84 days of treatment). The palliative treatment involved 84 days of oral administration of dried seeds and roots from four medicinal plants, sourced from the Government Ayurveda College Pharmacy. Specifically, powdered samples of Mp (4.5 g), Hyoscyamus reticulatus (0.75 g), Withania somnifera (14.5 g), and Sida cordifolia (14.5 g) were suspended in 200 ml of lukewarm milk and given twice daily, one hour before meals.**[123]** A 48-year-old woman with PD received MP 800 mg four times daily, providing 160 mg of levodopa per day, along with synthetic carbidopa (25 mg, three times daily) for six weeks. This treatment resulted in a 13-point improvement on the MDS-UPDRS part III motor assessment, as documented through standardized scoring. This case report highlights the potential benefits of combining a dopa-decarboxylase inhibitor (DDCI) with Mp as part of a personalized approach for patients hesitant to initiate levodopa therapy.**[124]** A case report compared the kinetic-dynamic profile of levodopa (LD) in two patients with PD who were chronically using standard LD therapy along with self-prescribed Mp seed extract. Researchers evaluated the effects of a dose containing LD with peripheral aromatic amino acid decarboxylase inhibitors against a nominally equivalent dose from a commercial Mp extract.

The patients received a fasting morning dose of 100 mg LD/25 mg carbidopa (patient 1) or 100 mg LD/25 mg benserazide (patient 2), compared to 100 mg LD from Mp capsules, administered in separate sessions following a 12-hour washout of standard LD formulations. Their kinetic-dynamic LD profile was assessed through continuous plasma drug concentration measurements alongside serial motor performance evaluations. Levodopa bioavailability was significantly lower following Mucuna administration compared to standard LD formulations. In patient 1, peak plasma LD concentration (C_{max}) dropped from 2.0 mg/L to 1.0 mg/L, while the area under the plasma concentration-time curve declined from 137 to 33.6 mg/L per minute.

For patient 2, C_{max} was 0.7 mg/L after receiving LD/benserazide but was almost undetectable after taking Mp. In patient 1, this reduced LD bioavailability led to shorter duration and diminished overall drug response compared to LD/carbidopa. Meanwhile, in patient 2, no significant subacute LD motor response was observed in either condition. Quantitative analysis of the Mp formulation verified that the capsules contained 100 mg LD as labeled. The findings indicate reduced LD bioavailability in the Mp preparation, likely due to the absence of coadministered aromatic amino acid decarboxylase inhibitors. This deficiency may account for Mp's potentially lower dyskinetic effects compared to standard LD formulations.**[125]**

Conclusion

Mucuna pruriens has been utilized worldwide for decades, widely recognized for its aphrodisiac and neuroprotective properties. Scientific evidence strongly indicates that Mp contains a diverse range of bioactive compounds with antioxidant and neuroprotective effects, supporting its antiparkinsonian benefits. Further investigations into these phytoconstituents could provide deeper insights into PD management. Additionally, Mp plays a crucial role in protecting against and slowing the progression of PD. In-vitro and in-vivo studies have demonstrated its ability to promote the growth and survival of dopaminergic neurons. It also offers genomic-level protection by preventing DNA damage. Moreover, Mp enhances tyrosine hydroxylase (TH) expression by mitigating oxidative stress and regulating superoxide dismutase (SOD) and glutathione (GSH) activity.

Clinical studies further indicate that when Mp is administered alongside L-dopa/carbidopa, it improves PD symptoms while minimizing the side effects associated with L-dopa alone.

References

1. Zahra W, Birla H, Singh SS, Rathore AS, Dilnashin H, Singh R, Keshri PK, Gautam P, Singh SP. Neuroprotection by Mucuna pruriens in Neurodegenerative Diseases. Neurochem Res. 2022 Jul;47(7):1816-1829. *doi: 10.1007/s11064-022-03591-3. Epub 2022 Apr 5. PMID: 35380400 [Crossref][PubMed][Google Scholar]*

2. Caronni S, Del Sorbo F, Barichella M, Fothergill-Misbah N, Denne T, Laguna J, Urasa S, Dekker MCJ, Akpalu A, Sarfo FS, Cham M, Pezzoli G, Cilia R. Mucuna pruriens to treat Parkinson's disease in low-income countries: Recommendations and practical guidelines from the farmer to clinical trials. Paving the way for future use in clinical practice. Parkinsonism RelatDisord. *2024 Jul;124:106983. doi: 10.1016/j.parkreldis.2024.106983. Epub 2024 May 8. PMID: 38797572 [Crossref][PubMed][Google Scholar]*

3. Srivastav S, Fatima M, Mondal AC. Important medicinal herbs in Parkinson's disease pharmacotherapy. Biomed Pharmacother. 2017 Aug;92:856-863. *doi: 10.1016/j.biopha.2017.05.137. Epub 2017 Jun 6. PMID: 28599249 [Crossref][PubMed][Google Scholar]*

4. Rai SN, Chaturvedi VK, Singh P, Singh BK, Singh MP. Mucuna pruriens in Parkinson's and in some other diseases: recent advancement and future prospective. 3 Biotech. 2020 Dec;10(12):522. *doi: 10.1007/s13205-020-02532-7. Epub 2020 Nov 10. PMID: 33194526; PMCID: PMC7655893 [Crossref] [PubMed][Google Scholar]*

5. Mohapatra S, Ganguly P, Singh R, Katiyar CK (2019) Estimation of levodopa in the unani drug Mucuna pruriens Bak and its marketed formulation by high-performance thin-layer chromatographic technique. J AOAC Int. https://doi. org/10. *5740/jaoacint.19-0288 [Crossref][PubMed][Google Scholar]*

6. R. P. Rastogi and B. N. *Mehrotra. Compendium of Indian medicinal plants, Vol.5, (CDRI, Lucknow, 1994) pp.554 [Crossref][PubMed][Google Scholar]*

7. A. A. Farooqi, B. S. *Sree Ramu. Cultivation of medicinal and aromatic crops, (Universities Press, New Delhi, 2001) pp.74 [Crossref][PubMed][Google Scholar]*

8. Sathiyanarayanan L, Arulmozhi S. Mucuna pruriens Linn. -A Comprehensive Review. Pharmacognosy Reviews. *2007;1(1) [Crossref] [PubMed][Google Scholar]*

9. Mucuna Pruriens | Factsheet, www. tropicalforages. info, accessed on April 22, 2025. . *[Crossref][PubMed][Google Scholar]*

10. Lampariello LR, Cortelazzo A, Guerranti R, Sticozzi C, Valacchi G. The Magic Velvet Bean of Mucuna pruriens. J Tradit Complement Med. 2012 Oct;2(4):331-9. *doi: 10.1016/s2225-4110(16)30119-5. PMID: 24716148; PMCID: PMC3942911 [Crossref][PubMed][Google Scholar]*

11. Thyaga Raju et al. The Traditional uses and Pharmacological Activities of Mucuna Pruriens(L) Dc: A Comprehensive Review. Indo American Journal of Pharmaceutical Research. 2017:7(01) 9. *[Crossref] [PubMed][Google Scholar]*

12. Lucia Raffaella Lampariello, Alessio Cortelazzo, Roberto Guerranti, Claudia Sticozzi, Giuseppe Valacchi, The Magic Velvet Bean of Mucuna pruriens, Journal of Traditional and Complementary Medicine, Volume 2, Issue 4, 2012, Pages 331-339, ISSN 2225-4110, https://doi. org/10. 1016/S2225-4110(16)30119-5. . *[Crossref][PubMed][Google Scholar]*

13. Kavitha C and Thangamani C. Amazing bean "Mucuna pruriens": A comprehensive review Journal of Medicinal PlantsResearch 2014. 8(2):138-143. . *[Crossref][PubMed][Google Scholar]*

14. Okoli, B. , Ayo, R. , Habila, J. , Japhet, S. *and Ndukwe, G. (2015) In Vitro Anthelmintic Activity of Mucuna pruriens (DC) and Canarium schweinfurthii (Engl) on Ascaris suum. Open Access Library Journal, 2, 1-8. doi: 10.4236/oalib.1101102 [Crossref][PubMed][Google Scholar]*

15. YADAV, MUKESH & Upadhyay, Prabhat & Purohit, Priyanka & Pandey, Bina & Shah, Harish. (2017). Phytochemistry and pharmacological activity of Mucuna pruriens: A review. International Journal of Green Pharmacy. *11. 69-73. 10.22377/ijgp.v11i02.916 [Crossref][PubMed] [Google Scholar]*

16. S. K. Chikagwa-Malunga, A. T. *Adesogan, L.E. Sollenberger, S.C. Phatak, N.J. Szabo, S.C. Kim, C.M. Huisden, R.C. Littell, Nutritional characterization of Mucuna pruriens: 4. Does replacing soybean meal with Mucuna pruriens in lamb diets affect ruminal, blood and tissue l-dopa concentrations?, Animal Feed Science and Technology, Volume 148, Issues 2–4, 2009, Pages 124-137, ISSN 0377-8401, [Article][Crossref] [PubMed][Google Scholar]*

17. Heuzé V. , Tran G. , Hassoun P. , Renaudeau D. , *Bastianelli D., 2015. Velvet bean (Mucuna pruriens). Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. Last updated on October 13, 2015, 13:42 [Article][Crossref][PubMed][Google Scholar]*

18. Pugalenthi, M. , Vadivel, V. &Siddhuraju, P. Alternative Food/Feed Perspectives of an Underutilized Legume Mucuna pruriens var. *Utilis—A Review. Plant Foods Hum Nutr 60, 201–218 (2005). [Article][Crossref][PubMed][Google Scholar]*

19. Nget Hong Tan, Shin Yee Fung, Si Mui Sim, Enrico Marinello, Roberto Guerranti, John C. Aguiyi, The protective effect of Mucuna pruriens seeds against snake venom poisoning, Journal of Ethnopharmacology, Volume 123, Issue 2, 2009, Pages 356-358, ISSN 0378-8741, https://doi. org/10. 1016/j. *jep.2009.03.025 [Crossref] [PubMed][Google Scholar]*

20. Buckles, D. (1995). Velvetbean: A "New" Plant with a History. Economic Botany, 49(1), 13–25. *[Article][Crossref][PubMed][Google Scholar]*

21. Jeyaweera D. M. A. Sri Lanka: National Science Council of Sri Lanka; 1981. *Madicinal plants used in Ceylon Colombo [Crossref][PubMed][Google Scholar]*

22. Jorge MA, Eilitta M, Proud FJ, Barbara Maasdorp V, Beksissa H, Ashok Sarial K, Hanson J. Mucuna species: recent advances in application of biotechnology. Fruit, Vegetable and Cereal Science and Biotechnology, Global Science Books. 2007;1:80-94. *[Crossref][PubMed][Google Scholar]*

23. Diallo OK, Berhe T (2003). Processing the Mucuna for Human Food in the Republic of Guinea. Trop. Subtrop. *Agroecosyst. 1(2/3):193–196 [Crossref][PubMed][Google Scholar]*

24. Tahvilzadeh, M. , Hajimahmoodi, M. , Toliyat, T. , Karimi, M. *and Rahimi, R. (2016), An evidence-based approach to medicinal plants for the treatment of sperm abnormalities in traditional Persian medicine. Andrologia, 48: 860-879. [Article] [Crossref][PubMed][Google Scholar]*

25. Ravindran, Velmurugu& Ravindran, Gane. (1988). Nutritional and anti-nutritional characteristics of mucuna (Mucuna utilis) bean seeds. Journal of the Science of Food and Agriculture. *46. 71 - 79. 10.1002/jsfa.2740460108 [Crossref][PubMed][Google Scholar]*

26. Tangsrisakda N, Kamollerd T, Taoto C, Bunsueb S, Chaimontri C, Choowong-In P, Lapyuneyong N, Wu AT, Thukhammee W, Wattanathorn J, Arun S. Seed extract of Thai Mucuna pruriens (L.) DC. var. *pruriens enhances sexual performance and improves male reproductive damages in ethanol-induced rats. Journal of ethnopharmacology. 2022 Jun 28;292:115219 [Crossref][PubMed][Google Scholar]*

27. Cambodgemag. https://www. cambodgemag. com/en/post/cambodian-mucuna-the-history-and-benefits-of-this-traditional-medicinal-plant. *[Crossref][PubMed][Google Scholar]*

28. DeFilipps RA, Krupnick GA. The medicinal plants of Myanmar. PhytoKeys. 2018 Jun 28;(102):1-341. *doi: 10.3897/phytokeys.102.24380. PMID: 30002597; PMCID: PMC6033956 [Crossref] [PubMed][Google Scholar]*

29. Shrestha, Kumar & Saud, Dammar & Pant, Shankar & Kunwar, Ripu & Jan, Hammand& Bussmann, Rainer & Zambrana, Narel. (2021). Mucuna pruriens (L.) DC. *Fabaceae. 10.1007/978-3-030-45597-2_154-1 [Crossref][PubMed][Google Scholar]*

30. Duke. Phytochemical database, Available at: http://www. raintree. com/db/Mucuna - pruriens - phytochem. *htm. Accessed- January 10, 2007 [Crossref][PubMed][Google Scholar]*

31. K. Thyaga Raju et al. The Traditional uses and Pharmacological Activities of Mucuna Pruriens(L) Dc: A Comprehensive Review. Indo American Journal of Pharmaceutical Research. *2017:7(01) [Crossref] [PubMed][Google Scholar]*

32. Kavitha C and Thangamani C. Amazing bean "Mucuna pruriens". A comprehensive review Journal of Medicinal PlantsResearch 2014. 8(2):138-143. *[Crossref][PubMed][Google Scholar]*

33. Khare CP. Encyclopedia of Indian Medicinal Plants. Berlin, Heidelberg: Springer Verlag; 2004. . *[Crossref][PubMed][Google Scholar]*

34. YADAV, MUKESH & Upadhyay, Prabhat & Purohit, Priyanka & Pandey, Bina & Shah, Harish. (2017). Phytochemistry and pharmacological activity of Mucuna pruriens: A review. International Journal of Green Pharmacy. *11. 69-73. 10.22377/ijgp.v11i02.916 [Crossref][PubMed] [Google Scholar]*

35. L. Misra and H. Wagner. Lipid derivatives from Mucuna pruriens seeds. *Indian Journal of Chemistry Section B 45(3): 801-804 (2006) [Crossref] [PubMed][Google Scholar]*

36. Huang Q, Chen C, Zhang Z, Xue Q. Anti-inflammatory effects of myristic acid mediated by the NF-κB pathway in lipopolysaccharide-induced BV-2 microglial cells. Molecular Omics. 2023;19(9):726-34. *[Crossref][PubMed][Google Scholar]*

37. Javid, S. , Purohit, M. N. , Yogish Kumar, H. , *Ramya, K., Mithuna, N. F. A., Salahuddin, M. D., & Prashantha Kumar, B. R. (2020). Semisynthesis of Myristic Acid Derivatives and their Biological Activities: A Critical Insight. Journal of Biologically Active Products from Nature, 10(6), 455–472. [Article][Crossref][PubMed][Google Scholar]*

38. Contreras CM, Rodríguez-Landa JF, García-Ríos RI, Cueto-Escobedo J, Guillen-Ruiz G, Bernal-Morales B. Myristic acid produces anxiolytic-like effects in Wistar rats in the elevated plus maze. Biomed Res Int. 2014;2014:492141. *doi: 10.1155/2014/492141. Epub 2014 Sep 18. PMID: 25328885; PMCID: PMC4189847 [Crossref] [PubMed][Google Scholar]*

39. McBride, M. C. (2000). Bufotenine: Toward an Understanding of Possible Psychoactive Mechanisms. *Journal of Psychoactive Drugs, 32(3), 321–331. [Article][Crossref][PubMed][Google Scholar]*

40. Jones RS. Tryptamine: a neuromodulator or neurotransmitter in mammalian brain?. Progress in neurobiology. 1982 Jan 1;19(1-2):117-39. *[Crossref][PubMed][Google Scholar]*

41. Reckweg, JTUthaug, MVSzabo, A,Davis, A,Lancelotta, R,Mason, NL et al. (2022). The clinical pharmacology and potential therapeutic applications of 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT). Journal of Neurochemistry, 162, 128–146. *jnc.15587 [Article][Crossref][PubMed][Google Scholar]*

42. Saadati F, ModarresiChahardehi A, Jamshidi N, Jamshidi N, Ghasemi D. Coumarin: A natural solution for alleviating inflammatory disorders. Curr Res Pharmacol Drug Discov. 2024 Sep 25;7:100202. *doi: 10.1016/j.crphar.2024.100202. PMID: 39398983; PMCID: PMC11470182 [Crossref] [PubMed][Google Scholar]*

43. Flores-Morales, V. , Villasana-Ruíz, A. P. , Garza-Veloz, I. *, González-Delgado, S., & Martinez-Fierro, M. L. (2023). Therapeutic Effects of Coumarins with Different Substitution Patterns. Molecules, 28(5), 2413. [Article][Crossref][PubMed][Google Scholar]*

44. Jain PK, Joshi H. Coumarin: chemical and pharmacological profile. Journal of applied pharmaceutical science. 2012 Jun 30(Issue):236-40. *[Crossref][PubMed][Google Scholar]*

45. Kumari S, Sharma A, Yadav S. Pharmacological Potential of Coumarin-Based Derivatives: A Comprehensive Review. Orient J Chem 2023;39(3). . *[Crossref][PubMed][Google Scholar]*

46. Hussain MK, Khatoon S, Khan MF, Akhtar MS, Ahamad S, Saquib M. Coumarins as versatile therapeutic phytomolecules: A systematic review. Phytomedicine. 2024 Nov 1;134:155972. *[Crossref] [PubMed][Google Scholar]*

47. Secades JJ, Frontera G. CDP-choline: pharmacological and clinical review. Methods Find Exp Clin Pharmacol. 1995 Oct;17 Suppl B:1-54. *PMID: 8709678 [Crossref][PubMed][Google Scholar]*

48. Wang ZJ, Li GM, Nie BM, Lu Y, Yin M. Neuroprotective effect of the stearic acid against oxidative stress via phosphatidylinositol 3-kinase pathway. Chem Biol Interact. 2006 Mar 10;160(1):80-7. *doi: 10.1016/j.cbi.2005.12.008. Epub 2006 Jan 31. PMID: 16448636 [Crossref] [PubMed][Google Scholar]*

49. Jubie S, Ramesh PN, Dhanabal P, Kalirajan R, Muruganantham N, Antony AS. Synthesis, antidepressant and antimicrobial activities of some novel stearic acid analogues. Eur J Med Chem. 2012 Aug;54:931-5. *doi: 10.1016/j.ejmech.2012.06.025. Epub 2012 Jun 23. PMID: 22770606 [Crossref] [PubMed][Google Scholar]*

50. Bamalan OA, Moore MJ, Al Khalili Y. Physiology, Serotonin. [Updated 2023 Jul 30]. In: StatPearls [Internet]. *Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: [Article] [Crossref][PubMed][Google Scholar]*

51. "Serotonin | C10H12N2O - PubChem. " https://pubchem. ncbi. nlm. *nih.gov/ compound/Myricetin(accessed April.23,(2025) [Crossref][PubMed][Google Scholar]*

52. Institute of Medicine (US) Committee to Assess the Science Base for Tobacco Harm Reduction; Stratton K, Shetty P, Wallace R, et al. , editors. Clearing the Smoke: Assessing the Science Base for Tobacco Harm Reduction. Washington (DC): National Academies Press (US); 2001. *9, Nicotine Pharmacology. Available from: [Article][Crossref] [PubMed][Google Scholar]*

53. Agostoni C, Moreno L, Shamir R. Palmitic acid and health: Introduction. Critical reviews in food science and nutrition. 2016 Sep 9;56(12):1941-2. *[Crossref][PubMed][Google Scholar]*

54. "Arachidic acid | Metabolon- Metabolon. com" https://www. metabolon. com/metabolites/arachidic-acid/. *[Crossref] [PubMed][Google Scholar]*

55. Jose Sanchez-Prieto, David C. Budd, Inmaculada Herrero, Elena Vázquez, David G. Nicholls, Presynaptic receptors and the control of glutamate exocytosis, Trends in Neurosciences, Volume 19, Issue 6, 1996, Pages 235-239, ISSN 0166-2236, https://doi. org/10. *1016/0166-2236(96)10031-X [Crossref][PubMed][Google Scholar]*

56. Lili Yu, Na Shen, Jiani Ren, Huawei Xin, Yulei Cui, Resource distribution, pharmacological activity, toxicology and clinical drugs of β-Carboline alkaloids: An updated and systematic review, Fitoterapia, Volume 180, 2025, 106326, ISSN 0367-326X, https://doi. org/10. 1016/j. fitote. *2024.106326 [Crossref][PubMed][Google Scholar]*

57. 9H-Pyrido[3,4-B]indole. 1,2,3,4-tetrahydro-6-chloro-3-methyl- | ontosight. ai https://ontosight. ai/glossary/term/9h-pyrido-indole-compound-overview. *--67a26c20c445bf945af08655 [Crossref] [PubMed][Google Scholar]*

58. Arshad, Omji Porwal, Niraj Kumar Jha, M. V. N. L. *Chaitanya, Dinesh Kumar Chellappan, Gaurav Gupta, Piyush Kumar Gupta, Kamal Dua, Rubiya Khursheed, Ankit Awasthi, Leander Corrie, Discovering multifaceted role of vanillic acid beyond flavours: Nutraceutical and therapeutic potential, Trends in Food Science & Technology, Volume 122, 2022, Pages 187-200, ISSN 0924-2244, [Article] [Crossref][PubMed][Google Scholar]*

59. Jaskiran Kaur, Monica Gulati, Sachin Kumar Singh, Gowthamarajan Kuppusamy, Bhupinder Kapoor, Vijay Mishra, Saurabh Gupta, Mohammed F. Arshad, Omji Porwal, Niraj Kumar Jha, M. V. N. *L. Chaitanya, Dinesh Kumar Chellappan, Gaurav Gupta, Piyush Kumar Gupta, Kamal Dua, Rubiya Khursheed, Ankit Awasthi, Leander Corrie, Discovering multifaceted role of vanillic acid beyond flavours: Nutraceutical and therapeutic potential, Trends in Food Science & Technology, Volume 122, 2022, Pages 187-200, ISSN 0924-2244, [Article] [Crossref][PubMed][Google Scholar]*

60. Review on: Role of Oleic Acid in Various Disease. An International Journal of Pharmaceutical Sciences Review and Research article. https://globalresearchonline. net/journalcontents/v67-2/31. *pdf [Crossref] [PubMed][Google Scholar]*

61. Pegoraro NS, Camponogara C, Cruz L, Oliveira SM. Oleic acid exhibits an expressive anti-inflammatory effect in croton oil-induced irritant contact dermatitis without the occurrence of toxicological effects in mice. Journal of Ethnopharmacology. 2021 Mar 1;267:113486. *[Crossref][PubMed][Google Scholar]*

62. Hadidi M, Liñán-Atero R, Tarahi M, Christodoulou MC, Aghababaei F. The Potential Health Benefits of Gallic Acid: Therapeutic and Food Applications. Antioxidants (Basel). 2024 Aug 18;13(8):1001. *doi: 10.3390/antiox13081001. PMID: 39199245; PMCID: PMC11352096 [Crossref][PubMed][Google Scholar]*

63. Bhuia, M. S. , Rahaman, M. M. , *Islam, T. et al. Neurobiological effects of gallic acid: current perspectives. Chin Med 18, 27 (2023). [Article] [Crossref][PubMed][Google Scholar]*

64. Yalcinkaya A, Öztaş YE, Sabuncuoğlu S. Sterols in Inflammatory Diseases: Implications and Clinical Utility. Adv Exp Med Biol. 2024;1440:261-275. *doi: 10.1007/978-3-031-43883-7_13. PMID: 38036884 [Crossref][PubMed][Google Scholar]*

65. Schepers, M. , Martens, N. , Tiane, A. , Vanbrabant, K. *, Liu, H. B., Lütjohann, D., et al. (2020). Edible seaweed-derived constituents: an undisclosed source of neuroprotective compounds. Neural Regen Res 15, 790–795. doi:10.4103/1673-5374.268894 [Crossref][PubMed][Google Scholar]*

66. Guoyao Wu, Joanne R. Lupton, Nancy D. Turner, Yun-Zhong Fang, Sheng Yang, Glutathione Metabolism and Its Implications for Health, The Journal of Nutrition, Volume 134, Issue 3, 2004, Pages 489-492, ISSN 0022-3166, https://doi. org/10. *1093/jn/134.3.489 [Crossref][PubMed] [Google Scholar]*

67. Chava B. Pocernich, D. Allan Butterfield, Elevation of glutathione as a therapeutic strategy in Alzheimer disease, Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease, Volume 1822, Issue 5, 2012, Pages 625-630, ISSN 0925-4439, https://doi. org/10. *1016/j.bbadis.2011.10.003 [Crossref][PubMed][Google Scholar]*

68. Levodopa, https://pubchem. ncbi. nlm. nih. *gov/compound/6047 [Crossref][PubMed][Google Scholar]*

69. Gandhi KR, Saadabadi A. Levodopa (L-Dopa) [Updated 2023 Apr 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. *Available from: [Article][Crossref][PubMed] [Google Scholar]*

70. Ambavade SD, Misar AV, Ambavade PD. Pharmacological, nutritional, and analytical aspects of β-sitosterol: a review. Oriental Pharmacy and Experimental Medicine. 2014 Sep;14:193-211. *[Crossref][PubMed][Google Scholar]*

71. Blondeau N, Lipsky RH, Bourourou M, Duncan MW, Gorelick PB, Marini AM. Alpha-linolenic acid: an omega-3 fatty acid with neuroprotective properties-ready for use in the stroke clinic? Biomed Res Int. 2015;2015:519830. doi: 10. *1155/2015/519830. Epub 2015 Feb 19. PMID: 25789320; PMCID: PMC4350958 [Crossref][PubMed][Google Scholar]*

72. Srivastava D, Singh V, Kumar U, Venkatesh KR. Alpha-linolenic acid. a pharmacologically active ingredient from nature. . *[Crossref][PubMed] [Google Scholar]*

73. Srivastav S, Fatima M, Mondal AC. Important medicinal herbs in Parkinson's disease pharmacotherapy. Biomed Pharmacother. 2017 Aug;92:856-863. *doi: 10.1016/j.biopha.2017.05.137. Epub 2017 Jun 6. PMID: 28599249 [Crossref][PubMed][Google Scholar]*

74. Dong-mei Wu, Jun Lu, Yan-qiu Zhang, Yuan-lin Zheng, Bin Hu, Wei Cheng, Zi-feng Zhang, Meng-qiu Li, Ursolic acid improves domoic acid-induced cognitive deficits in mice, Toxicology and Applied Pharmacology, Volume 271, Issue 2, 2013, Pages 127-136, ISSN 0041-008X, https://doi. org/10. 1016/j. taap. *2013.04.038. ([Article][Crossref] [PubMed][Google Scholar]*

75. George M. Kapalka, Chapter 7 - Mania and Agitation, Editor(s): George M. Kapalka, In Practical Resources for the Mental Health Professional, Nutritional and Herbal Therapies for Children and Adolescents, Academic Press, 2010, Pages 189-218,ISSN 18730450,ISBN 9780123749277, https://doi. org/10. *1016/B978-0-12-374927-7.00007-8 [Crossref][PubMed][Google Scholar]*

76. Cárdeno A, Aparicio-Soto M, Montserrat-de la Paz S, Bermúdez B, Muriana FJ, Alarcón-de-la-Lastra C. Squalene targets pro-and anti-inflammatory mediators and pathways to modulate over-activation of neutrophils, monocytes and macrophages. Journal of Functional Foods. 2015 Apr 1;14:779-90. *[Crossref][PubMed][Google Scholar]*

77. Huang ZR, Lin YK, Fang JY. Biological and pharmacological activities of squalene and related compounds: potential uses in cosmetic dermatology. Molecules. 2009 Jan;14(1):540-54. *[Crossref] [PubMed][Google Scholar]*

78. Moretti M, Rodrigues ALS. Functional role of ascorbic acid in the central nervous system: a focus on neurogenic and synaptogenic processes. Nutr Neurosci. 2022 Nov;25(11):2431-2441. *doi: 10.1080/1028415X.2021.1956848. Epub 2021 Sep 8. PMID: 34493165 [Crossref][PubMed][Google Scholar]*

79. Agnieszka Gęgotek, Elżbieta Skrzydlewska, Chapter Nine - Ascorbic acid as antioxidant, Editor(s): Gerald Litwack, Vitamins and Hormones, Academic Press, Volume 121, 2023, Pages 247-270, ISSN 0083-6729, ISBN 9780443157684, https://doi. org/10. 1016/bs. vh. *2022.10.008 [Crossref][PubMed][Google Scholar]*

80. Michele M Larzelere, Pamela Wiseman, Anxiety, depression, and insomnia, Primary Care: Clinics in Office Practice, Volume 29, Issue 2, 2002, Pages 339-360, ISSN 0095-4543, https://doi. org/10. 1016/S0095-4543(01)00003-3. . *[Crossref] [PubMed][Google Scholar]*

81. Jaspers MW, Bashir AK, Zwaving JH, Malingre TM. Investigation of Grewia bicolor juss. Journal of ethnopharmacology. 1986 Sep 1;17(3):205-11. *[Crossref][PubMed][Google Scholar]*

82. Arif M, Rauf K, Rehman NU, Tokhi A, Ikram M, Sewell RD. 6-Methoxyflavone and Donepezil Behavioral Plus Neurochemical Correlates in Reversing Chronic Ethanol and Withdrawal Induced Cognitive Impairment. Drug Des Devel Ther. 2022 May 28;16:1573-1593. *doi: 10.2147/DDDT.S360677. PMID: 35665194; PMCID: PMC9160976 [Crossref][PubMed][Google Scholar]*

83. Pranali Kurund, Swathi Gandla. Pharmacognostical, Phytochemical and Anti-Parkinson’s profile of Mucuna pruriens. Research Journal of Pharmacology and Pharmacodynamics. 2021;13(4):125-0. *doi: 10.52711/2321-5836.2021.00025 Available on: [Article][Crossref] [PubMed][Google Scholar]*

84. Rai SN, Chaturvedi VK, Singh P, Singh BK, Singh MP. Mucuna pruriens in Parkinson's and in some other diseases: recent advancement and future prospective. 3 Biotech. 2020 Dec;10(12):522. *doi: 10.1007/s13205-020-02532-7. Epub 2020 Nov 10. PMID: 33194526; PMCID: PMC7655893 [Crossref] [PubMed][Google Scholar]*

85. Pathania R, Chawla P, Khan H, Kaushik R, Khan MA. An assessment of potential nutritive and medicinal properties of Mucuna pruriens: a natural food legume. 3 Biotech. 2020 Jun;10(6):261. *doi: 10.1007/s13205-020-02253-x. Epub 2020 May 20. PMID: 32477848; PMCID: PMC7239958 4 [Crossref] [PubMed][Google Scholar]*

86. "A Comprehensive review on TukhmeKonch (Mucuna Pruriens) with Special Reference to Unani System of Medicine. A Review Article", International Journal of Emerging Technologies and Innovative Research (www. jetir. org), ISSN:2349-5162, Vol. *8, Issue 12, page no.c573-c585, December-2021, Available : [Article][Crossref][PubMed][Google Scholar]*

87. Aru Lakshmi, Gawali Sampada, Swapnil Kale, A Detailed Review on- Neuroprotection by Mucuna Pruriens in Neurodegenerative Disease, Int. J. of Pharm. Sci. *, 2024, Vol 2, Issue 12, 1-8. [Article] [Crossref][PubMed][Google Scholar]*

88. Manyam BV, Dhanasekaran M, Hare TA. Neuroprotective effects of the antiparkinson drug Mucuna pruriens. Phytother Res. 2004 Sep;18(9):706-12. *doi: 10.1002/ptr.1514. PMID: 15478206 [Crossref][PubMed][Google Scholar]*

89. Johnson SL, Park HY, DaSilva NA, Vattem DA, Ma H, Seeram NP. Levodopa-Reduced Mucuna pruriens Seed Extract Shows Neuroprotective Effects against Parkinson's Disease in Murine Microglia and Human Neuroblastoma Cells, Caenorhabditis elegans, and Drosophila melanogaster. Nutrients. 2018 Aug 22;10(9):1139. *doi: 10.3390/nu10091139. PMID: 30131460; PMCID: PMC6164394 [Crossref][PubMed][Google Scholar]*

90. Lampariello, L. R. , Cortelazzo, A. , Guerranti, R. *, Sticozzi, C., & Valacchi, G. (2012). The Magic Velvet Bean of Mucuna pruriens. Journal of Traditional Complementary Medicine, 2(4), 331–339. [Article][Crossref][PubMed][Google Scholar]*

91. Tharakan B, Dhanasekaran M, Mize-Berge J, Manyam BV. Anti-Parkinson botanical Mucuna pruriens prevents levodopa induced plasmid and genomic DNA damage. Phytother Res. 2007 Dec;21(12):1124-6. *doi: 10.1002/ptr.2219. PMID: 17622977 [Crossref][PubMed][Google Scholar]*

92. Dhanasekaran M, Tharakan B, Manyam BV. Antiparkinson drug--Mucuna pruriens shows antioxidant and metal chelating activity. Phytother Res. 2008 Jan;22(1):6-11. *doi: 10.1002/ptr.2109. PMID: 18064727 [Crossref][PubMed][Google Scholar]*

93. Chi H, Tang W, Bai Y. Molecular evidence of impaired iron metabolism and its association with Parkinson's disease progression. 3 Biotech. 2020 Apr;10(4):173. *doi: 10.1007/s13205-020-2162-1. Epub 2020 Mar 19. PMID: 32206507; PMCID: PMC7082446 [Crossref][PubMed][Google Scholar]*

94. Lieu CA, Kunselman AR, Manyam BV, Venkiteswaran K, Subramanian T. A water extract of Mucuna pruriens provides long-term amelioration of parkinsonism with reduced risk for dyskinesias. Parkinsonism RelatDisord. 2010 Aug;16(7):458-65. *doi: 10.1016/j.parkreldis.2010.04.015. Epub 2010 May 31. PMID: 20570206; PMCID: PMC2909380 [Crossref][PubMed][Google Scholar]*

95. Yadav SK, Prakash J, Chouhan S, Singh SP. Mucuna pruriens seed extract reduces oxidative stress in nigrostriatal tissue and improves neurobehavioral activity in paraquat-induced Parkinsonian mouse model. Neurochem Int. 2013 Jun;62(8):1039-47. *doi: 10.1016/j.neuint.2013.03.015. Epub 2013 Apr 3. PMID: 23562769 [Crossref][PubMed][Google Scholar]*

96. Lieu CA, Venkiteswaran K, Gilmour TP, Rao AN, Petticoffer AC, Gilbert EV, Deogaonkar M, Manyam BV, Subramanian T. The Antiparkinsonian and Antidyskinetic Mechanisms of Mucuna pruriens in the MPTP-Treated Nonhuman Primate. Evid Based Complement Alternat Med. 2012;2012:840247. *doi: 10.1155/2012/840247. Epub 2012 Sep 10. PMID: 22997535; PMCID: PMC3445014 [Crossref] [PubMed][Google Scholar]*

97. Yadav SK, Pandey S, Singh B. Role of estrogen and levodopa in 1-methyl-4-pheny-l-1, 2, 3, 6-tetrahydropyridine (mptp)-induced cognitive deficit in Parkinsonian ovariectomized mice model: A comparative study. J Chem Neuroanat. 2017 Nov;85:50-59. *doi: 10.1016/j.jchemneu.2017.07.002. Epub 2017 Jul 12. PMID: 28711564 [Crossref][PubMed][Google Scholar]*

98. Yadav SK, Prakash J, Chouhan S, Westfall S, Verma M, Singh TD, Singh SP. Comparison of the neuroprotective potential of Mucuna pruriens seed extract with estrogen in 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced PD mice model. Neurochem Int. 2014 Jan;65:1-13. *doi: 10.1016/j.neuint.2013.12.001. Epub 2013 Dec 11. PMID: 24333323 [Crossref][PubMed][Google Scholar]*

99. Yadav, Satyndra & Rai, Sachchida& Singh, Surya. (2016). MUCUNA PRURIENS SHOWS NEUROPROTECTIVE EFFECT BY INHIBITING APOPTOTIC PATHWAYS OF DOPAMINERGIC NEURONS IN THE PARAQUAT MOUSE MODEL OF PARKINSONISM. EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH. *3 [Crossref][PubMed][Google Scholar]*

100. Yadav SK, Rai SN, Singh SP. Mucuna pruriens reduces inducible nitric oxide synthase expression in Parkinsonian mice model. J Chem Neuroanat. 2017 Mar;80:1-10. *doi: 10.1016/j.jchemneu.2016.11.009. Epub 2016 Dec 2. PMID: 27919828 [Crossref][PubMed][Google Scholar]*

101. Rai SN, Birla H, Zahra W, Singh SS, Singh SP. Immunomodulation of Parkinson's disease using Mucuna pruriens (Mp). J Chem Neuroanat. 2017 Nov;85:27-35. *doi: 10.1016/j.jchemneu.2017.06.005. Epub 2017 Jun 19. PMID: 28642128 [Crossref][PubMed][Google Scholar]*

102. Rai SN, Birla H, Singh SS, Zahra W, Patil RR, Jadhav JP, Gedda MR, Singh SP. Mucuna pruriens Protects against MPTP Intoxicated Neuroinflammation in Parkinson's Disease through NF-κB/pAKT Signaling Pathways. Front Aging Neurosci. 2017 Dec 19;9:421. *doi: 10.3389/fnagi.2017.00421. PMID: 29311905; PMCID: PMC5742110 [Crossref][PubMed][Google Scholar]*

103. V. Bala, A. Debnath, A. K. *Shill and U. Bose, 2011. Anti-Inflammatory, Diuretic and Antibacterial Activities of Aerial Parts of Mucuna pruriens Linn. International Journal of Pharmacology, 7: 498-503 [Crossref][PubMed][Google Scholar]*

104. Uchegbu RI, Ahuchaogu AA, Mbadiugha CN, Amanze KO, Igara CE, Iwu IC, Ikechukwu-Nwankwo PC. Antioxidant, anti-inflammatory and antibacterial activities of the seeds of Mucuna pruriens (UTILIS). Am. Chem. *Sci. J. 2016;13:1-8 [Crossref][PubMed] [Google Scholar]*

105. Javed N, Alam SS, Subhani H, Akhtar MS, Khan AH. Evaluation of anti-inflammatory activity of Mucuna pruriens Linn. seeds. Proc. *SZPGMI. 2010;24:97-102 [Crossref][PubMed][Google Scholar]*

106. Rai SN, Yadav SK, Singh D, Singh SP. Ursolic acid attenuates oxidative stress in nigrostriatal tissue and improves neurobehavioral activity in MPTP-induced Parkinsonian mouse model. J Chem Neuroanat. 2016 Jan;71:41-9. *doi: 10.1016/j.jchemneu.2015.12.002. Epub 2015 Dec 12. PMID: 26686287 [Crossref][PubMed][Google Scholar]*

107. Rai SN, Zahra W, Singh SS, Birla H, Keswani C, Dilnashin H, Rathore AS, Singh R, Singh RK, Singh SP. Anti-inflammatory Activity of Ursolic Acid in MPTP-Induced Parkinsonian Mouse Model. Neurotox Res. 2019 Oct;36(3):452-462. *doi: 10.1007/s12640-019-00038-6. Epub 2019 Apr 23. PMID: 31016688 [Crossref][PubMed][Google Scholar]*

108. Zahra W, Rai SN, Birla H, Singh SS, Rathore AS, Dilnashin H, Singh R, Keswani C, Singh RK, Singh SP. Neuroprotection of Rotenone-Induced Parkinsonism by Ursolic Acid in PD Mouse Model. CNS Neurol Disord Drug Targets. 2020;19(7):527-540. *doi: 10.2174/1871527319666200812224457. PMID: 32787765 [Crossref][PubMed][Google Scholar]*

109. Ryu SY, Oak MH, Yoon SK, Cho DI, Yoo GS, Kim TS, Kim KM. Anti-allergic and anti-inflammatory triterpenes from the herb of Prunella vulgaris. Planta Med. 2000 May;66(4):358-60. *doi: 10.1055/s-2000-8531. PMID: 10865455 [Crossref] [PubMed][Google Scholar]*

110. Ryu SY, Oak MH, Yoon SK, Cho DI, Yoo GS, Kim TS, Kim KM. Anti-allergic and anti-inflammatory triterpenes from the herb of Prunella vulgaris. Planta Med. 2000 May;66(4):358-60. *doi: 10.1055/s-2000-8531. PMID: 10865455 [Crossref] [PubMed][Google Scholar]*

111. Shishodia S, Majumdar S, Banerjee S, Aggarwal BB. Ursolic acid inhibits nuclear factor-kappaB activation induced by carcinogenic agents through suppression of IkappaBalpha kinase and p65 phosphorylation: correlation with down-regulation of cyclooxygenase 2, matrix metalloproteinase 9, and cyclin D1. Cancer Res. 2003 Aug 1;63(15):4375-83. *PMID: 12907607 [Crossref][PubMed][Google Scholar]*

112. Wan, F. , Lenardo, M. The nuclear signaling of NF-κB: current knowledge, new insights, and future perspectives. Cell Res 20, 24–33 (2010). *[Article] [Crossref][PubMed][Google Scholar]*

113. Checker R, Sandur SK, Sharma D, Patwardhan RS, Jayakumar S, Kohli V, et al. (2012) Potent Anti-Inflammatory Activity of Ursolic Acid, a Triterpenoid Antioxidant, Is Mediated through Suppression of NF-κB, AP-1 and NF-AT. PLoS ONE 7(2): e31318. https://doi. *org/10.1371/journal.pone.0031318 [Crossref][PubMed][Google Scholar]*

114. Yin, M. C. , Lin, M. C. *, Mong, M.C., Lin, C.Y., 2012. Bioavailability, distribution, and antioxidative effects of selected triterpenes in mice.J. Agri. Food Chem. 60(31),7697-7701 [Crossref][PubMed] [Google Scholar]*

115. Poddighe S, De Rose F, Marotta R, Ruffilli R, Fanti M, Secci PP, Mostallino MC, Setzu MD, Zuncheddu MA, Collu I, Solla P, Marrosu F, Kasture S, Acquas E, Liscia A. Mucuna pruriens (Velvet bean) rescues motor, olfactory, mitochondrial and synaptic impairment in PINK1B9 Drosophila melanogaster genetic model of Parkinson's disease. PLoS One. 2014 Oct 23;9(10):e110802. *doi: 10.1371/journal.pone.0110802. PMID: 25340511; PMCID: PMC4207759 [Crossref][PubMed][Google Scholar]*

116. Solari P, Maccioni R, Marotta R, Catelani T, Debellis D, Baroli B, Peddio S, Muroni P, Kasture S, Solla P, Stoffolano JG Jr, Liscia A. The imbalance of serotonergic circuitry impairing the crop supercontractile muscle activity and the mitochondrial morphology of PD PINK1B9Drosophila melanogaster are rescued by Mucuna pruriens. J Insect Physiol. 2018 Nov-Dec;111:32-40. *doi: 10.1016/j.jinsphys.2018.10.007. Epub 2018 Oct 26. PMID: 30393142 [Crossref][PubMed][Google Scholar]*

117. Singh SK, Yadav D, Lal RK, Gupta MM, Dhawan SS. Inducing mutations through γ-irradiation in seeds of Mucuna pruriens for developing high L-DOPA-yielding genotypes. Int J Radiat Biol. 2017 Apr;93(4):426-432. *doi: 10.1080/09553002.2016.1254832. Epub 2016 Nov 29. PMID: 27897091 [Crossref][PubMed][Google Scholar]*

118. Baroli, B. , Loi, E. , Solari, P. , Kasture, A. , *Moi, L., Muroni, P., Kasture, S., Setzu, M. D., Liscia, A., Zavattari, P. Evaluation of oxidative stress mechanisms and the effects of phytotherapic extracts on Parkinson's disease Drosophila PINK1B9 model. FASEB J. 33, 11028–11034 (2019). www.fasebj.org [Crossref][PubMed][Google Scholar]*

119. Katzenschlager R, Evans A, Manson A, Patsalos PN, Ratnaraj N, Watt H, Timmermann L, Van der Giessen R, Lees AJ. Mucuna pruriens in Parkinson's disease: a double blind clinical and pharmacological study. J Neurol Neurosurg Psychiatry. 2004 Dec;75(12):1672-7. *doi: 10.1136/jnnp.2003.028761. PMID: 15548480; PMCID: PMC1738871 [Crossref][PubMed][Google Scholar]*

120. Cilia R, Laguna J, Cassani E, Cereda E, Pozzi NG, Isaias IU, Contin M, Barichella M, Pezzoli G. Mucuna pruriens in Parkinson disease: A double-blind, randomized, controlled, crossover study. Neurology. 2017 Aug 1;89(5):432-438. *doi: 10.1212/WNL.0000000000004175. Epub 2017 Jul 5. PMID: 28679598; PMCID: PMC5539737 [Crossref][PubMed][Google Scholar]*

121. Vaidya AB, Rajgopalan TG, Mankodi NA, Antarkar DS, Tathed PS, Purohit AV, Wadia NH. Treatment of Parkinson's disease with the cowhage plant-Mucuna pruriens Bak. Neurology India. 1978;26(4):171-6. *[Crossref][PubMed][Google Scholar]*

122. HP-200 in Parkinson's Disease Study Group. An alternative medicine treatment for Parkinson's disease: results of a multicenter clinical trial. The Journal of Alternative and Complementary Medicine. 1995 Jun 1;1(3):249-55. *[Crossref][PubMed] [Google Scholar]*

123. Nagashayana N, Sankarankutty P, Nampoothiri MR, Mohan PK, Mohanakumar KP (2000) Association of L-DOPA with recovery following Ayurveda medication in Parkinson’s disease. J Neurol Sci 176(2):124–127. https://doi. org/10. *1016/s0022-510x(00) 00329-4 [Crossref][PubMed][Google Scholar]*

124. Radder DLM, Tiel Groenestege AT, Boers I, Muilwijk EW, Bloem BR. Mucuna Pruriens Combined with Carbidopa in Parkinson’s Disease: A Case Report. Journal of Parkinson’s Disease. 2019;9(2):437-439. *doi:10.3233/JPD-181500 [Crossref][PubMed][Google Scholar]*

125. Contin M, Lopane G, Passini A, Poli F, Iannello C, Guarino M. Mucuna pruriens in Parkinson disease: a kinetic-dynamic comparison with levodopa standard formulations. Clinical neuropharmacology. 2015 Sep 1;38(5):201-3. *[Crossref][PubMed][Google Scholar]*

126. Pandey SK, Nanda A, Gautam AS, Singh RK. Betulinic acid protects against lipopolysaccharide and ferrous sulfate-induced oxidative stress, ferroptosis, apoptosis, and neuroinflammation signaling relevant to Parkinson's Disease. Free Radic Biol Med. 2025 Jun;233:340-354. *doi: 10.1016/j.freeradbiomed.2025.04.013. Epub 2025 Apr 7. PMID: 40203997 [Crossref][PubMed][Google Scholar]*

127. Natarajan, K. & Narayanan, N. & Natesan, Ravichandran. (2012). *Review on "Mucuna" - The wonder plant. International Journal of Pharmaceutical Sciences Review and Research. 17. 86-93 [Crossref][PubMed][Google Scholar]*