IJAYUSH
International Journal of AYUSH
AYURVEDA, YOGA, UNANI, SIDDHA AND HOMEOPATHY
http://internationaljournal.org.in/journal/index.php/ijayush/
International Journal Panacea Research library
ISSN: 2349 7025

Review Article | Volume 13 Issue 1 | Jan 2024

ROLE OF *MUCUNA PRURIENS* IN THE MANAGEMENT OF PARKINSON'S DISEASE

***AM.Muthalib[1], MMM.Nifras[2]**

[1]Department of Unani Clinical Medicine, Faculty of Indigenous Medicine, University of Colombo, Sri Lanka

[2]Department of Unani Pharmacology, Faculty of Indigenous Medicine, University of Colombo, Sri Lanka

Corresponding Author's Email ID: mujasha@fim.cmb.ac.lk

ABSTRACT

Parkinson's disease (PD) is the second most common progressive neurodegenerative disease after Alzheimer's disease, affecting about 7 to 10 million patients worldwide. It is caused by degeneration of dopaminergic neurons in substantia nigra. The deficiency of dopamine in the basal ganglia leads to a movement disorder which is characterized by classical Parkinsonian motor symptoms which include bradykinesia, muscular rigidity and resting tremor as well as non-motor symptoms include olfactory dysfunction, cognitive impairment, psychiatric symptoms and autonomic dysfunction. *Mucuna pruriens* is an annual and perennial legume which belongs to the family Fabaceae having different types of therapeutic activity. It is widely utilized as a potent aphrodisiac. For this purpose, Google Scholar and PubMed were explored to obtain studies giving evidence for anti-parkinsonian activity and other pharmacological activities of *Mucuna pruriens*. *Mucuna pruriens* possesses different types of pharmacological activities. The neuroprotective activity and anti-Parkinsonian activity of *Mucuna pruriens* was explored by several researchers. Levodopa is the important constituents responsible for the anti-Parkinsonian activity of *Mucuna pruriens*. Apart from anti-parkinsonian activity, *Mucuna pruriens* possesses some most

common pharmacological activities including Anti-oxidant, anti-inflammatory, aphrodisiac, hepatoprotective and improving semen quality etc. This review emphasizes the anti-parkinsonian role of *Mucuna pruriens* in the management of Parkinson's disease systematically through literature review available to date. Some other activities of *Mucuna pruriens* are also summarized in this review.

Key word: Parkinson's disease, *Mucuna pruriens*, dopamine, levodopa.

INTRODUCTION

Parkinson's disease (PD) is one of the most common progressive neurodegenerative diseases caused by degeneration of dopaminergic neurons in substantia nigra.[1,2] It is the second most common neurodegenerative disease after Alzheimer's disease, affecting about seven to 10 million patients worldwide.[3] The deficiency of dopamine in the basal ganglia leads to a movement disorder which is characterized by classical Parkinsonian motor symptoms which include bradykinesia, muscular rigidity and resting tremor as well as non-motor symptoms include olfactory dysfunction, cognitive impairment, psychiatric symptoms and autonomic dysfunction.[4] The current therapy available for PD primarily relies on Levodopa that offers the potential of slowing down disease progression to some extent but includes lot of side effects. Any potential drug capable of treating or halting the disease still remains to be identified.[5] The progression of Parkinson's disease is characterized by a worsening of motor features; however, as the disease progresses, there is an emergence of complications related to long-term symptomatic treatment. The available therapies for Parkinson's disease only treat the symptoms of the disease.[4]

Mucuna pruriens is an annual and perennial legume which belongs to the family Fabaceae having different types of therapeutic activity.[6] Conventionally, *Mucuna pruriens* seeds are used for maintaining male infertility in traditional medicine and It is widely used as a potent aphrodisiac.[6,7] Reportedly, *Mucuna pruriens* is used as a rejuvenator drug having neuroprotective property.[7] The neuroprotective activity of *Mucuna pruriens* was shown by several researchers. The anti-Parkinsonian activity of *Mucuna pruriens* was explored since

the nineteenth century. Mucuna is a well-known natural source of levodopa (L-dopa).[8] Levodopa is the important constituents responsible for the anti-Parkinsonian activity of *Mucuna pruriens*.[6]

Levodopa is largely unavailable and unaffordable in many low-income countries. Also dopaminergic anti-parkinsonian medications, such as levodopa cause drug-induced dyskinesias in majority of patients with Parkinson's disease.[9] High dose *Mucuna pruriens* induces greater motor improvement than conventional levodopa.[10] *Mucuna pruriens* could be used for symptomatic management of Parkinson's disease.

METHODOLOGY

A systematic literature search was carried out to review articles and to gather the information available in the literature regarding '*Mucuna pruriens*' in the view of description of the plant, chemical constituents, part used, therapeutic action and therapeutic uses, and recent scientific evidence of anti-parkinsonian activity. All the available information on '*Mucuna pruriens*' was compiled from Unani, Ayurveda textbooks and electronic databases such as Google scholar and PubMed.

RESULTS & DISCUSSION

Scientific classification of *Mucuna pruriens*[29]

Kingdom: Plantae

Division: Magnoliophyta

Class Magnoliopsida

Order: Fabales

Family: Fabaceae/ Leguminosae

Genus: Mucuna

Species: pruriens

Fig.1: Leaves, Flowers, Pods and Seeds of *Mucuna pruriens*

Vernacular names

English: Cowhage, Velvet Bean

Tamil: *Poonaikali*

Sinhala: *Wanduru-me*

Unani Tibbi name: *Konch*

Sanskrit name: *Kapikacchu*

Description of the *Mucuna pruriens* plant[30]

A semi-woody twining climber with slender branches clothed with short white deflexed hairs;

Leaves: alternate, stipulate, 3-foliate with stipels, large, rachis 7.5-12.5 cm long, sparingly deflexed hairy, leaflets 7.5-10 cm long, 5-7.5 cm broad, on short, thick, hairy stalks, terminal one smallest and rhomboid-oval, lateral ones very unequal with the lower half greatly dilated, all acute, mucronate, pubescent above, densely covered with shining silvery adpressed hairs beneath, stipules linear, setaceous, hairy.

Flowers: irregular, bisexual, dull dark purple with a yellowish green keel, numerous, 3.7-4.3 cm long, on short pubescent pedicels, usually 2 or 3 together at intervals on a slender, pubescent raceme, 15-30 cm long, bracts 1.2 cm long, lanceolate, hairy, deciduous; sepals 5, fused into a campanulate calyx, densely silky, two upper segments completely connate, lowest much the longest; petals 5, exserted, very unequal, wings twice as long as the standard, keel rather longer than wings, curved into a stiff beak at apex; stamens 10, diadelphous; ovary superior, surrounded at base by a small crenulate disc, unilocular with marginal ovules, style beardless, stigma capitate.

Fruit: legume 6.2-7.5 cm long, 1.2 cm broad, linear, blunt, falcately curved at both ends with a longitudinal rib along the whole length of each valve but without wings, densely covered

with close rather weak orange-brown irritant bristles pointing backwards and readily detached, 4-6 seeded with partitions between them.

Seed: ovoid, 0.6 cm long, compressed, brownish, mottled with black, hilum oblong.

Parts used: Seed, leaf and root.[31]

Chemical Constituents: The plant is reported to have L-3-4 dihydroxy – phenylalanine (L-DOPA) as a major constituent mainly in seeds. Alkaloidal constituents such as Mucunadine, Mucunine, Prurienidine, Prurienine are reported from seeds.[31]

Properties of *Mucuna pruriens* according to the traditional systems of medicine

Table 01 shows the properties of the *Mucuna pruriens* according to Unani and Ayurveda systems of medicine.[32,33]

Table 01: Properties of *Mucuna pruriens* according to Unani and Ayurveda systems of medicine

Unani	Ayurveda
Taste: Sweet ***Mizaj* (Temperament):** Hot 2^0 Dry 1^0 ***Naf 'e Khas* (Actions):** *Qabiz* (Astringent) *Mulayyin* (Laxative) *Muqawwi-e-Bah* (Aphrodisiac) *Muqawwi-e-Asab* (Nervine Tonic) *Mudir-e-Baul* (Diuretic) *Mudir-e-Tams* (Emmenagogue) *Qatil-e-Deedan* (Vermifuge)	***Rasa* (taste):** Sweet and Bitter ***Guna* (attributes):** *Guru* (Heavy) and *Snigdha* (Unctous) ***Virya* (potency):** Usna (Hot) ***Vipaka* (post digestive effect):** Sweet ***Karma*:** It alleviates *Vata*, *Pitta* and *Kapha*, all three dosas. It helps in nourishing all the *Dhatu* (tissue elements) in the body, especially *Sukra* (Semen) in the males.

Therapeutic uses of *Mucuna pruriens* according to the traditional systems of medicine

Table 02 shows the Therapeutic uses of the *Mucuna pruriens* according to Unani and Ayurveda systems.[32,33]

Table 02: Therapeutic uses of *Mucuna pruriens* according to Unani and Ayurveda systems of medicine

Unani	Ayurveda
1. *Jiryan* (Spermatorrhoea) 2. *Sailanur Reham* (Leucorrhoea) 3. *Isterkha* (Paralysis) 4. *Kirm-e-Shikam* (Worm in the abdomen)	1. The seeds are the most commonly used ingredient in many tonics for impotency and for enhancing sexual vitality. It also works well as a restorative for conditions of debility and weakness. 2. The seeds powder of *Kapikacchu* and *Kokilaaksa* impart very potent effect, when taken with sugar and followed by milk. It augments the seminal fluid, vitality and vigour. 3. The hot infusion of the seeds is an excellent panacea for premature ejaculation in men. 4. The seeds are useful galactogouge in lactating mothers. 5. The roots of this plant are diuretic. 6. The decoction of roots is beneficial in renal problems and dysuria. 7. The roots also help regulating the menstrual cycle and enhance sexual vigour in women. 8. In *Vata* diseases like Facial palsy, Cervical spondylosis, Parkinson's disease, Paralysis etc, the decoction of *Kapikacchu* is rewarding.

Compound formulations of *Mucuna pruriens* according to the traditional systems of medicine

Table 03 shows the Compound formulations of the *Mucuna pruriens* according to Unani and Ayurveda systems[32,33]

Table 03: Compound formulations of *Mucuna pruriens* according to Unani and Ayurveda systems of medicine

Unani	Ayurveda
1. *Laboob-e-Kabeer* 2. *Laboob-e-Sagheer* 3. *Majoon-e-Konch* 4. *Safoof-e-Mundi*	1. *Vanari Gutika* 2. *Masabaladi Pacana* 3. *Vajikarana ghrta* 4. *Brmhana Gutika*

Recent Scientific Evidence of Anti-Parkinson Activity of *Mucuna Pruriens*

Cilia R, et al. (2017) carried out a study to investigate whether *Mucuna pruriens* (MP may be used as alternative source of levodopa for indigent individuals with Parkinson disease (PD) who cannot afford long-term therapy with marketed levodopa preparations. They investigated efficacy and safety of single-dose intake of MP powder from roasted seeds obtained without any pharmacologic processing. Single-dose MP intake met all noninferiority efficacy and safety outcome measures in comparison to dispersible levodopa/benserazide. Clinical effects of high-dose MP were similar to levodopa alone at the same dose, with a more favorable tolerability profile.[11]

Adi YK, et al. (2018) evaluated the neuroprotective effect of n-Propanol extracts from fresh, boiled, and fermented seeds of *Mucuna pruriens* in a Parkinson's disease (PD) rat model, based on the total number of dopaminergic (DA) neurons in the substantia nigra pars compacta (SNpc). n-Propanol extract of boiled and fermented seeds could produce a higher neuroprotective effect against DA neuron than fresh seeds in a PD rat model.[12]

Rai SN, et al. (2017) investigated the effects of aqueous extract of Mp (100 mg/kgbwt) on neuroinflammation, orally administered to mice intoxicated with 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) as well as the molecular mechanism involved in the progression of PD. The findings observed thereby indicate that Mp extract have suggestively ameliorated MPTP induced neuroinflammation, restored the biochemical and behavioral abnormalities in PD mouse and thus provided a scientific basis for its traditional claim.[13]

Yadav SK, et al. (2014) carried out a study to evaluate the neuroprotective effect of an ethanolic extract of Mp seed in the 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) model of PD and compared to estrogen, a well reported neuroprotective agent used for treating PD.. Notably, the effect of Mp was greater than that elicited by estrogen. Mp down regulates Nitric Oxide production, neuroinflammation and microglial activation and all of these actions contribute to Mp's neuroprotective activity. These results suggest that Mp can be an effective treatment for neurodegenerative diseases, especially PD by decreasing oxidative stress and possibly by implementing neuronal and glial cell crosstalk.[14]

Lieu CA, et al. (2012) evaluated the effects of *Mucuna pruriens* to determine if its underlying mechanistic actions are exclusively due to LD. We first compared MPEP with and without carbidopa (CD), and LD+CD in hemiparkinsonian (HP) monkeys. Each treatment ameliorated parkinsonism. The distinctive neurophysiological findings in the basal ganglia and the ability to ameliorate parkinsonism without causing dyskinesias strongly suggest that *Mucuna pruriens* acts through a novel mechanism that is different from that of LD.[15]

Lieu CA, et al. (2010) conducted a study to compare the behavioral effects of chronic parenteral administration of a water extract of M. pruriens seed powder (MPE) alone without any additives, MPE combined with the peripheral dopa-decarboxylase inhibitor (DDCI) benserazide (MPE+BZ), LD+BZ and LD alone without BZ in the hemiparkinsonian rat model of PD. This study demonstrates that a simple water extract of *Mucuna pruriens* endocarp powder with no additives has a superior effect to the combination of MPE+BZ on parkinsonism and that MPE alone is superior to LD alone or LD+BZ combinational therapy in terms of efficacy of ameliorating parkinsonism with dramatically reduced risk for DID.[16]

Katzenschlager R, et al. (2004) assessed the clinical effects and levodopa (L-dopa) pharmacokinetics following two different doses of mucuna preparation and compared them with standard L-dopa/carbidopa (LD/CD). The rapid onset of action and longer on time without concomitant increase in dyskinesias on mucuna seed powder formulation suggest that this natural source of L-dopa might possess advantages over conventional L-dopa preparations in the long term management of PD.[17]

Improved L-DOPA concentrations in a soluble phenolic and antioxidant-rich M. pruriens background on day 1 sprouts have potential for Parkinson's disease management.[18]

Manyam BV, et al. (2004) evaluated the neurorestorative effect of *Mucuna pruriens* cotyledon powder on the nigrostriatal tract of 6-OHDA lesioned rats. Unlike synthetic levodopa treatment, *Mucuna pruriens* cotyledon powder treatment significantly restored the endogenous levodopa, dopamine, norepinephrine and serotonin content in the substantia nigra. Nicotine adenine dinucleotide (NADH) and coenzyme Q-10, that are shown to have a therapeutic benefit in Parkinson's disease, were present in the *Mucuna pruriens* cotyledon

powder. This additional finding of a neurorestorative benefit by *Mucuna pruriens* cotyledon powder on the degenerating dopaminergic neurons in the substantia nigra may be due to increased complex-I activity and the presence of NADH and coenzyme Q-10.[19]

Other Pharmacological Activities of *Mucuna pruriens*

Apart from Anti-Parkinson's activity, *Mucuna pruriens* also shows following pharmacological activity as mentioned in Table 4.

Table 4: Other Pharmacological Activities of *Mucuna pruriens*

Pharmacological activities	**References**
Anti-inflammatory[20,21]	Martínez Leo EE, et al. (2018), Rachsee A, et al. (2020)
Anti-oxidant[22,23,24]	Jimoh MA, et al. (2020) Martínez-Leo EE, et al. (2019) Obogwu MB, et al. (2014)
Aphrodisiac[24]	Ahmad MK, et al. (2008)
Hepatoprotective[25]	Obogwu MB, et al. (2014)
Improving semen quality[26,27,28]	Gupta A, et al. (2011), Shukla KK, (2010), Shukla KK, et al. (2009)

CONCLUSION

Parkinson's disease is a progressive, disabling, neurodegenerative disease that requires long pharmaceutical treatment. Levodopa remains the gold standard treatment for Parkinson's disease globally, although it is largely unavailable and unaffordable for the majority of patients in low-income countries. Also dopaminergic anti-parkinsonian medications, such as levodopa cause drug-induced dyskinesias in majority of patients with Parkinson's disease. *Mucuna pruriens* has been shown to induce a great improvement of motor symptoms with

few adverse events in recent studies. We suggest the potential for *Mucuna pruriens* to replace or supplement levodopa-based medicines in countries where levodopa is unaffordable and inaccessible. However, caution is important until data on long-term safety of *Mucuna pruriens* are available. If long-term *Mucuna pruriens* proves to be safe and effective in clinical trials, it may be a sustainable alternative therapy for Parkinson's disease.

REFERENCES

1. 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.
2. Béné R, Antić S, Budisić M, Lisak M, Trkanjec Z, Demarin V, Podobnik-Sarkanji S. Parkinson's disease. Acta Clin Croat. 2009 Sep;48(3):377-80.
3. Abushouk AI, Negida A, Ahmed H, Abdel-Daim MM. Neuroprotective mechanisms of plant extracts against MPTP induced neurotoxicity: Future applications in Parkinson's disease. Biomed Pharmacother. 2017 Jan;85:635-645.
4. De Virgilio A, Greco A, Fabbrini G, Inghilleri M, Rizzo MI, Gallo A, Conte M, Rosato C, Ciniglio Appiani M, de Vincentiis M. Parkinson's disease: Autoimmunity and neuroinflammation. Autoimmun Rev. 2016 Oct;15(10):1005-11.
5. Srivastav S, Fatima M, Mondal AC. Important medicinal herbs in Parkinson's disease pharmacotherapy. Biomed Pharmacother. 2017 Aug;92:856-863.
6. 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.
7. 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.
8. 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.

9. 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 Relat Disord. 2010 Aug;16(7):458-65.
10. Fothergill-Misbah N, Maroo H, Cham M, Pezzoli G, Walker R, Cilia R. Could Mucuna pruriens be the answer to Parkinson's disease management in sub-Saharan Africa and other low-income countries worldwide? Parkinsonism Relat Disord. 2020 Apr;73:3-7.
11. 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.
12. Adi YK, Widayanti R, Pangestiningsih TW. n-Propanol extract of boiled and fermented koro benguk (Mucuna pruriens seed) shows a neuroprotective effect in paraquat dichloride-induced Parkinson's disease rat model. Vet World. 2018 Sep;11(9):1250-1254.
13. 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.
14. 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.
15. 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.
16. 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 Relat Disord. 2010 Aug;16(7):458-65.
17. 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.

18. Randhir R, Kwon YI, Shetty K. Improved health-relevant functionality in dark germinated Mucuna pruriens sprouts by elicitation with peptide and phytochemical elicitors. Bioresour Technol. 2009 Oct;100(19):4507-14.
19. Manyam BV, Dhanasekaran M, Hare TA. Neuroprotective effects of the antiparkinson drug Mucuna pruriens. Phytother Res. 2004 Sep;18(9):706-12.
20. Martínez Leo EE, Arana Argáez VE, Acevedo Fernández JJ, Puc RM, Segura Campos MR. Effect of Enzymatic Digestion of Protein Derivatives Obtained from Mucuna pruriens L. on Production of Proinflammatory Mediators by BALB/c Mouse Macrophages. Appl Biochem Biotechnol. 2018 Nov;186(3):597-612.
21. Rachsee A, Chiranthanut N, Kunnaja P, Sireeratawong S, Khonsung P, Chansakaow S, Panthong A. Mucuna pruriens (L.) DC. seed extract inhibits lipopolysaccharide-induced inflammatory responses in BV2 microglial cells. J Ethnopharmacol. 2021 Mar 1;267:113518.
22. Jimoh MA, Idris OA, Jimoh MO. Cytotoxicity, Phytochemical, Antiparasitic Screening, and Antioxidant Activities of Mucuna pruriens (Fabaceae). Plants (Basel). 2020 Sep 22;9(9):1249.
23. Martínez-Leo EE, Martín-Ortega AM, Acevedo-Fernández JJ, Moo-Puc R, Segura-Campos MR. Peptides from Mucuna pruriens L., with protection and antioxidant in vitro effect on HeLa cell line. J Sci Food Agric. 2019 Jun;99(8):4167-4173.
24. Ahmad MK, Mahdi AA, Shukla KK, Islam N, Jaiswar SP, Ahmad S. Effect of Mucuna pruriens on semen profile and biochemical parameters in seminal plasma of infertile men. Fertil Steril. 2008 Sep;90(3):627-35.
25. Obogwu MB, Akindele AJ, Adeyemi OO. Hepatoprotective and in vivo antioxidant activities of the hydroethanolic leaf extract of Mucuna pruriens (Fabaceae) in antitubercular drugs and alcohol models. Chin J Nat Med. 2014 Apr;12(4):273-83.
26. Gupta A, Mahdi AA, Ahmad MK, Shukla KK, Bansal N, Jaiswer SP, Shankhwar SN. A proton NMR study of the effect of Mucuna pruriens on seminal plasma metabolites of infertile males. J Pharm Biomed Anal. 2011 Jul 15;55(5):1060-6.

27. Shukla KK, Mahdi AA, Ahmad MK, Jaiswar SP, Shankwar SN, Tiwari SC. Mucuna pruriens Reduces Stress and Improves the Quality of Semen in Infertile Men. Evid Based Complement Alternat Med. 2010 Mar;7(1):137-44.
28. Shukla KK, Mahdi AA, Ahmad MK, Shankhwar SN, Rajender S, Jaiswar SP. Mucuna pruriens improves male fertility by its action on the hypothalamus-pituitary-gonadal axis. Fertil Steril. 2009 Dec;92(6):1934-40.
29. Upadhyay P. Phytochemistry and pharmacological activity of Mucuna pruriens: A review. International Journal of Green Pharmacy Apr-Jun 2017, 11 (2) 69-73.
30. Jayaweera DMA, Senaratna LK. Medicinal Plants [Indigenous and Exotic] Used in Ceylon. Part III. The National Science Foundation, Sri Lanka. 2006; p-223.
31. Sathiyanarayanan L, Arulmozhi S. Mucuna pruriens Linn. - A Comprehensive Review. Pharmacognosy Reviews Vol 1, Issue 1, Jan- May, 2007
32. Standardisation of Single Drugs of Unani Medicine. Central Council of Research in Unani Medicine, Department of Ayush, New Delhi. 1987: Part I, p-195-199
33. Paranjpe P. (2001). Indian Medicinal Plants, Forgotten Healers, A Guide to Ayurvedic Herbal Medicine. Chaukhamba Sanskrit Pratishthan, Delhi. Pg.122-123.