Review Article

REVIEW ON "*MUCUNA*" - THE WONDER PLANT

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ABSTRACT

Mucuna is an unconventional plant species having promising nutritional, pharmaceutical and cosmaceutical bioactive constituents. *Mucuna pruriens* is reported to have the highest content of L-dopa. Researchers from various countries have identified *Mucuna* as a good nutritional supplement in livestock feed and as a fodder crop. The demand for *Mucuna* is increasing day by day due to its pharmaceutical potency. Approximately 120 species have been reported from worldwide and 15 species from India. Most of the species had been studied for its nutraceuticals potential and few reported for its pharmaceutical values. *M. pruriens* had been evaluated and concluded as a potential medicinal herb in terms of anti cholestrolemic, antiparkinson, antidiabetic, aphrodisiac and antimicrobial. The present study presents a comprehensive review of *Mucuna* genus and its species, their morphology, phytochemical constituents, traditional uses, medicinal values and some pharmacological activities.

Keywords: *Mucuna*, Nutritional value, Medicinal use.

INTRODUCTION

Herbs are the major source of natural products used as pharmaceuticals, agrochemicals, flavoring agents, fragrants, ingredients in food additives and pesticides[1]. The recent research admits priority in search for new plant derived chemicals towards sustainable conservation and rational utilization of biodiversity. There has been explosion of scientific information concerning plants, crude plant extracts and various substances from plants as medical agents during last few decades. Indian system of medicine has existed since long period; however the mechanism of plants as polyherbal formulations in treating ailments remains largely unexplored. This has prompted researchers to focus their investigations to understand the holistic information specially their functional properties of such plants.

Sustaining the nutritional requirements is one of the important tasks for any developing as well as developed countries. Nevertheless, combating several existing and newly spreading dreadful diseases is a major problem. In resolving these combined factors, potential herbs should be identified and their properties need to be evaluated. Many herbs in current use have any one of the above resolving capacity. But from the traditional and scientific data available, legumes have promising potential source in terms of nutrition, medicine and agricultural development in developing countries. One such known legume is *Mucuna pruriens*. Its L-dopa content is scientifically proved to be a very effective in neurodegenerative disorder. It is also a best nutritional source as it contains rich nutrients especially protein and carbohydrate. *Mucuna* can be processed properly and can be utilized as best nutrient and medicine. L- dopa isolated from *Mucuna* was found to be more effective than the synthetic product[2]. Extracts of *M. pruriens* has been evaluated worldwide and concluded as a potential medicinal herb. Approximately 120 species of *Mucuna* had been reported so far[3] and 130 species according to the Zipcodezoo Data Base (table 2). In India, 15 species (table 3) were identified and reported[4]. Various works in taxonomical and nutritional characters on different geographical accession were reported by more number of scientists[5]. The herb is very much acceptable as livestock feed after removing the anti nutritional constituents. The present review reports a comprehensive information of *Mucuna* genus its different species, traditional uses, nutritional value, medicinal value, phytochemical constituents and pharmacological activities.

TAXONOMY - THE GENUS AND SPECIES

Mucuna genus belongs to the family Fabaceae and its taxonomy is described in table 1. This is the second largest family of flowering plants and contains 600 genera and about 12000 species[3]. The leaves are stipulate nearly always alternate and range from bipinnately or palmately compound to simple. The petiole base is commonly enlarged into a pulvinus that commonly functions in orientation of the leaves. The flowers are usually bisexual actinomorphic to zygomorphic, slightly to strongly perigyrous and commonly in racemes, spikes or heads. The perianth commonly one or many stamens distinct of variously united sometimes. The pistil is simple often stipulate comprising a single style and stigma and a superior ovary with one locule containing two or many marginal ovules. The fruit is usually a legume sometimes a loments, follicle, indehiscent pod, achene, drupe or berry. The seeds often have a hard coat with hour glass shaped cells and sometimes bear a u-shaped line called plaerogram[3].

Most of the *Mucuna* species are herbaceous twining plant. It is indigenous to tropical regions especially Africa,

India and West Indies. They possess trifoliate leaves unequal at base. Flowers are white to dark purple in colour and hang in long clusters. Pods are sigmoid, turgid and longitudinally ribbed. Seeds are ovoid black or white. *Mucuna* pods are covered with reddish orange hairs which are readily dislodged. *Mucuna* seeds collected from different locations show different botanical features, and environment has no interference in genetic diversities of *Mucuna*[5].

Table 1: Taxonomy of *Mucuna*

Domain	*Eukaryota*
Kingdom	*Plantae*
Subkingdom	*Viridaeplantae*
Phylum	*Magnoliophyta*
Subphylum	*Spermatophytina*
Infraphylum	*Angiospermae*
Class	*Magnoliopsida*
Subclass	*Rosidae*
Superorder	*Fabanae*
Order	*Fabales*
Family	*Fabaceae*
Subfamily	*Faboideae*
Tribe	*Phaseoleae*
Genus	*Mucuna*

TRADITIONAL USES

The seeds are traditionally used as nervine tonic, emmenagogue, astringent, aphrodisiac, leucorrhoea and paralysis. The hairs of the pods are vermifuge and treated for round worm infections. *Mucuna monosperma* is used as an expectorant and sedative given in cough and asthma[6]. Bark powder mixed with dry ginger is used for rubbing over painful rheumatic joints[7]. The roots are bitter, thermogenic, emollient, stimulant, purgative, aphrodisiac, diuretic, emmenagogue, anthelmintic, febrifuge, diuretic and tonic. In Ayurveda they are useful in vitiated conditions of *vata* and *pitta*, constipation, nephropathy, strangury, dysmenorrhoea, amenorrhoea, elephantiasis, dropsy, neuropathy, ulcers, helminthiasis, fever, delirium and for treating Parkinson's disease. The leaves are aphrodisiac, anthelmintic and tonic and are useful in ulcers, inflammation, helminthiasis, cephalalgia and general debility. The seeds are astringent, laxative, anthelmintic, aphrodisiac and tonic. They are useful in gonorrhoea, sterility, vitiated conditions of *vata*, and general debility[8]. The seeds are restorative and are sometimes consumed as a vegetable[4]. Seed diet produced hypoglycaemic effect in normal rats[9].

NUTRITIONAL CONSTITUENTS

Mucuna form a rich source of protein, carbohydrate, lipid, fiber, minerals and amino acids. Eight different species of *Mucuna* were studied viz *M.cochinchinensis, M. jaspeada*, *M. veracruz*, *M.gigantean, M.monosperma*, *M. pruriens, M. solanei, M.utilis*[10-15] for its nutritional property. The ranges of the compositions in eight *Mucuna* accessions were as follows, crude protein (24 - 31.44 %), crude carbohydrate (42.79 - 64.88 %), crude lipid (4.1 - 14.39 %), crude fiber (5.3 - 11.5 %), ash (2.9 - 5.5 %).

Table 2: Different *Mucuna* species found world wide

S.No	*MUCUNA* SPECIES
1.	*Mucuna acuminata Baker*
2.	*Mucuna amblyodon Harms*
3.	*Mucuna andreana*
4.	*Mucuna anguinea Sweet*
5.	*Mucuna argyrophylla Standl.*
6.	*Mucuna aterrima*
7.	*Mucuna atropurpurea (Roxb.)Wight & Arn.*
8.	*Mucuna aurea C.B.Rob.*
9.	*Mucuna axillaris*
10.	*Mucuna benettii*
11.	*Mucuna biplicata Kurz*
12.	*Mucuna birdwoodiana Tutcher*
13.	*Mucuna brachycarpa*
14.	*Mucuna bracteata DC.*
15.	*Mucuna calophylla W.W.Sm.*
16.	*Mucuna canaliculata Verdc.*
17.	*Mucuna capitata*
18.	*Mucuna championii Benth.*
19.	*Mucuna cochinchinensis*
20.	*Mucuna collettii Lace*
21.	*Mucuna comorensis*
22.	*Mucuna comosa DC*
23.	*Mucuna coriacea Baker*
24.	*Mucuna cristata Buch.-Ham. ex Wall.*
25.	*Mucuna curranii Elmer*
26.	*Mucuna cyclocarpa F.P.Metcalf*
27.	*Mucuna cylindrosperma Welw. ex Baker*
28.	*Mucuna deeringiana (Bert) Merrill*
29.	*Mucuna deerlingianum (954) Smal*
30.	*Mucuna diabolica Keuchenius.*
31.	*Mucuna diplax Wilmot-Dear*
32.	*Mucuna discolor Merr. & L.M.Perry*
33.	*Mucuna elegans Merr. & L.M.Perry*
34.	*Mucuna elliptica (Ruiz & Pav.)DC.*
35.	*Mucuna elmeri Merr*
36.	*Mucuna erecta*
37.	*Mucuna eriocarpa Barb.Rodr*
38.	*Mucuna fawcettii Urb.*
39.	*Mucuna ferox Verdc.*
40.	*Mucuna ferruginea*
41.	*Mucuna flagellipes Hook.f.*
42.	*Mucuna gigantea (Willd.)DC*
43.	*Mucuna glabra (Reinecke) Wilmot-Dear*
44.	*Mucuna glabrialata (Hauman)Verdc.*
45.	*Mucuna gracilipes Craib*
46.	*Mucuna grevei*
47.	*Mucuna hainanensis Hayata*
48.	*Mucuna hirsuta*
49.	*Mucuna holtonii (Kuntze)Moldenke*
50.	*Mucuna hooglandii Verdc.*
51.	*Mucuna horrida*
52.	*Mucuna huberi Ducke*
53.	*Mucuna humblotii Drake*
54.	*Mucuna imbricata Baker*
55.	*Mucuna inflexa*
56.	*Mucuna interrupta Gagnep.*
57.	*Mucuna iriomotensis Ohwi*
58.	*Mucuna japira A.M.G.Azevedo, K.Agostini & Sazima*
59.	*Mucuna junghuhnianum Backer ex Koord.-Schum.*
60.	*Mucuna keyensis Burck.*
61.	*Mucuna killipiana*

S.No	*MUCUNA* SPECIES
62.	*Mucuna lamellata Wilmot-Dear*
63.	*Mucuna lamii Verdc.*
64.	*Mucuna lane-poolei Summerh*
65.	*Mucuna lignosa Scop.*
66.	*Mucuna lindro Piper*
67.	*Mucuna longipedunculata Merr.*
68.	*Mucuna luzoniensis*
69.	*Mucuna macmillanii Elmer*
70.	*Mucuna macrobotrys Hance*
71.	*Mucuna macrocarpa Wall.*
72.	*Mucuna macroceratides (Raddi)DC.*
73.	*Mucuna macrophylla Miq.*
74.	*Mucuna macropoda Baker.f*
75.	*Mucuna manongarivensis Du Puy & Labat*
76.	*Mucuna mapirensis (Rusby)J.F.Macbr.*
77.	*Mucuna mattogrossensis*
78.	*Mucuna melanocarpa A.Rich.*
79.	*Mucuna membranacea Hayata*
80.	*Mucuna mindorensis Merr.*
81.	*Mucuna warburgii K.Schum. & Lauterb*
82.	*Mucuna mitis (Ruiz & Pav.)DC.*
83.	*Mucuna mollis (Kunth)DC.*
84.	*Mucuna monosperma Wight*
85.	*Mucuna montana*
86.	*Mucuna mutisiana (Kunth)DC.*
87.	*Mucuna manongarivensis Du Puy & Labat*
88.	*Mucuna nigricans (Lour.)Steud.*
89.	*Mucuna nivea*
90.	*Mucuna novo-guineensis Scheff.*
91.	*Mucuna oligiplax Niyomdh. & W.-Dear*
92.	*Mucuna ovalis Baker f.*
93.	*Mucuna pachycarpa Wiriad.*
94.	*Mucuna pachylobia Rock*
95.	*Mucuna pacifica Hosok.*
96.	*Mucuna pallida Cordem.*
97.	*Mucuna paniculata Baker*
98.	*Mucuna platycarpa*
99.	*Mucuna platyphylla A.Gray*
100.	*Mucuna platyplekta Quisumb. & Merr.*
101.	*Mucuna pluricostata Barb.Rodr.*
102.	*Mucuna poggei Taub.*
103.	*Mucuna pruriens (L.)DC.*
104.	*Mucuna psittacina Miers*
105.	*Mucuna quadrialata*
106.	*Mucuna recta*
107.	*Mucuna reptans Verdc.*
108.	*Mucuna reticulata Burck*
109.	*Mucuna revoluta Wilmot-Dear*
110.	*Mucuna rhynchosioides*
111.	*Mucuna rostrata Benth.*
112.	*Mucuna rubro-aurantiaca*
113.	*Mucuna samarensis Merr.*
114.	*Mucuna schlechteri Harms*
115.	*Mucuna sempervirens Hemsl.*
116.	*Mucuna sloanei Fawc. & Rendle*
117.	*Mucuna stanleyi C.T.White*
118.	*Mucuna stans Baker*
119.	*Mucuna stenoplax Wilmot-Dear*
120.	*Mucuna suberosa*
121.	*Mucuna subferruginea Hayata*
122.	*Mucuna subumbellata Wilmot-Dear*
123.	*Mucuna taborensis Schweinf. ex Piper*
124.	*Mucuna terrens H.Lev.*
125.	*Mucuna thailandica Niyomdham & Wilmot-Dear*
126.	*Mucuna tomentosa K.Schum.*
127.	*Mucuna toppingii Merr.*
128.	*Mucuna urens (L.)Medik.*
129.	*Mucuna venenosa A.Murr.*
130.	*Mucuna venulosa*

Table 3: *Mucuna* species reported in India

S.No	Indian *Mucuna* species
1.	*Mucuna atropurpurea,* DC.
2.	*Mucuna bracteata,* DC.
3.	*Mucuna capitata,* Wight & Arn.
4.	*Mucuna cochinchinensis* (Lour.) Cheval
5.	*Mucuna deeringiana*, (Bort) Merrill
6.	*Mucuna gigantea,* DC.
7.	*Mucuna hirusta,* Wight & Arn.
8.	*Mucuna macrocarpa* Wall.
9.	*Mucuna monosperma,* DC.
10.	*Mucuna nigricans*, DC.
11.	*Mucuna pruriens* (Linn.) DC.
12.	*Mucuna prurita,* Hook
13.	*Mucuna urens*
14.	*Mucuna utilis,* Wall

For minerals, 12 different species were studied[10] and their constituents ranged from, 806 - 2790 mg/100g for potassium, 4 - 70 mg/100g for sodium, 104 - 900 mg/100g for calcium , 98 - 498 mg/100g for phosphorus**,** 85 - 477 mg/100g for magnesium**,** 1.3 - 15 mg/100g for iron, 0.33 - 4.34 mg/100g for copper, 1 - 15 mg/100g for zinc and 0.56 - 9.26 mg/100g for manganese. Various amino acids were reported in *M.cochinchinensis, M. pruriens* and *M. solanei* such as glutamic acid, aspartic acid, serine, threonine, proline, alanine, glycine, valine, cystine, methionine, isoleucine, leucine, tyrosine, phenyl alanine, tryptophan, lysine, histidine and arginine supporting the genus for nutritional value[13-17].

PHARMACEUTICAL CONSTITUENTS

Extract of the whole herb is reported to have L-dopa as a major constituent and mainly in seeds[18-19]. Four alkaloids in *Mucuna pruriens* seeds were recently reported. They are 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 hydroisoquinoline[20]. Dr. Dukes Phytochemical and ethno botanical database[21] describes diversified chemical constituents in *Mucuna* seeds like**,** 5- hydroxytryptamine, 5-methoxy- N, N- dimethyltryptamine- N- oxide, 5- oxyindole- 3- alkylamine, 6- methoxyharman, arahidic-acid, arginine, ash, asparticacid, behenicacid, betacarboline, betasitosterol, bufotenine, choline, cis- 12, 13- poxyctadec- trans- 9- cis- acid, cis- 12, 13- epoxyoctadec- trans- 9- enoicacid, gallicacid, glutamicacid, glutathione, indole- 3- alkylamine, linoleicacid, linoleicacid, mucunadine, mucunain, mucynine, myristic-acid, N, N- dimethyltryptamine, N, N-dimethyltryptamine, -N-oxide, niacin, nicotine, oleicacid, palmiticacid, prurienine, riboflavin, saponins, serotonin, stearicacid, thiamine, vernolicacid. In *Mucuna* leaves the data base reveals the presence of L-dopa, 6-methoxyharman, genistein, hydroxygenistein in minimal concentration. Recently three new lipid derivatives were also reported, triactont- 5, 7, 9- triene, docos- 2, 4, 6- triene- 1, 8- diol and docos- 5- en- 1- oic acid[22].

MEDICINAL VALUE

Many *Mucuna* species have been reported processing medicinal value apart from nutritional value and as fodder crop[23]. The main use of this herb is to treat the symptomatic effects in Parkinson's disease. The constituents bufotenine, choline, β-carboline were reported for their antiepileptic and antineoplastic activity[24-25]. *Mucuna birdwoodiana* seeds are also used to treat joint pain and irregular menstruation[26]. *Mucuna* pod hairs blended with honey can be used as vermifuge. *Mucuna* seed powder is used to treat leucorrhoea, spermatorrhoea[7]. Seeds posses anabolic, androgenic, analgesic, anti-inflammatory, antispasmodic, antivenom, aphrodisiac, febrifuge, cholesterol lowering, hypoglycemic, immunomodulator, antilithiatic, antibacterial, antiparasitic, cough suppressant, blood purifier, carminative, hypotensive, and uterine stimulant properties[17].

NUTRITIONAL EVIDENCE

Daidzin and genistein, were the main isoflavones responsible for the antioxidant activity present in soybean and *Mucuna.* The total daidzin and genistein in *Mucuna* was found to be higher than in soybeans, while it is the opposite in Indonesian traditional food (Tempe) formulation. Factor II (6, 7, 4; trihydroxy isoflavone) and genistein in *Mucuna* and its tempe were higher than in soybeans. *Mucuna* and its tempe contain higher Factor II (6, 7, 4; trihydroxy isoflavone) and lower daidzin and glycitein than that of soybeans[27]. Comparative analysis between traditional mucuna seed tempe and soybean tempe revealed the following results; mucuna tempe had a higher dietary fibre level, but lower vitamin E content. The mucuna tempe contains 31.5% protein, 7.3% fat, 3.0% ash, 58.1% carbohydrate and 9.1% fibre. It contains 0.551 mg/L isoflavone aglucone; daidzin is the highest, followed by Factor II (6, 7, 4 trihydroxy isoflavone) that is much higher than that of soybeans tempe. These are much higher isoflavone aglucone contents than found in soybeans tempe[28]. From these studies it is evident that *Mucuna* is a good nutritional supplement well comparable to soybean.

PHARMACOLOGICAL EVIDENCE

Mucuna has been tested for its several pharmacological activities for the past decades. The pharmacological evidence reports that *Mucuna* is one of the major constituents in polyherbal extract formulations for treating different ailments. Few recent evidences are discussed below.

Anti Parkinson's effect

The extract of *Mucuna pruriens* used for antiparkinson's disease (MPE) is known to contain, among other components, 12.5% L-dihydroxyphenylalanine (L-dopa), as compared to the equivalent doses of L-dopa[29]. An acute administration of MPE at a dose of 16 mg/kg (containing 2 mg/kg of L-dopa) consistently antagonized the deficit in latency of step initiation and adjusting step induced by a unilateral 6-hydroxydopamine lesion, whereas L-dopa was equally effective only at the doses of 6 mg/kg. At the same dosage, MPE significantly improved the placement of the forelimb in vibrissae-evoked forelimb placing, suggesting a significant antagonistic activity on both motor and sensory-motor deficits. The effects of MPE were moreover investigated by means of the turning behavior test and in the induction of abnormal involuntary movements (AIMs) after either acute or sub-chronic administration. MPE acutely induced a significantly higher contra lateral turning behavior than L-dopa (6 mg/kg) when administered at a dose of 48 mg/kg contains 6 mg/kg of L-dopa. On sub chronic administration, both MPE (48 mg/kg) and L-dopa (6 mg/kg) induced sensitization of contra lateral turning behavior; however, L-dopa alone induced a concomitant sensitization in AIMs suggesting that the dyskinetic potential of *M. pruriens* is lower than that of L-dopa. *M. pruriens* (48 mg/kg) was also effective in antagonizing tremulous jaw movements induced by tacrine, a validated test reproducing Parkinsonian tremor. Furthermore, *M. pruriens* induced no compartment preference in the place preference test, indicating the lack of components characterized by rewarding effects in the extract. Finally, in a sub-chronic mice model of 1- methyl- 4- phenyl- 1, 2, 3, 6 tetrahydropyridine hydrochloride (MPTP) - induced dopamine neuron degeneration, MPE did not prove, capable of preventing either tyrosine hydroxylase decrease induced by MPTP or astroglial or microglial activation as assessed by means of glial fibrillary acidic protein (GFAP) and CD11b immunohistochemistry, supporting the absence of neuroprotective effects by *Mucuna pruriens*. Characterization of MPE strongly supports its antiparkinson's activity. Also one another study proved the neuroprotective effects of *M. pruriens* in which the neurorestorative effect of *M. pruriens* cotyledon powder on the nigrostriatal tract of 6- hydroxyl dopamine (6-OHDA) lesioned rats was evaluated[30]. The results revealed that *M. pruriens* cotyledon powder significantly increased the brain mitochondrial complex-I activity but did not affect the total monoamine oxidase activity (*in vitro*) and unlike synthetic L-dopa treatment, *M. pruriens* cotyledon powder treatment significantly restored the endogenous L-dopa, 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 *M. pruriens* cotyledon powder. Earlier studies showed that *M. pruriens* treatment controls the symptoms of Parkinson's disease. The additional finding of a neurorestorative benefit by *M. 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.

Aphrodisiac effect

The second most potential effect proved for this *Mucuna* is aphrodisiac. The *Mucuna pruriens*, ethanolic extract

administered in either sex rats significantly increased the mounting frequency, intromission frequency and ejaculation latency, and decreased the mounting latency, intromission latency, post-ejaculatory interval and inter-intromission interval. The potency test significantly increased erections, quick flips, long flips and total reflex. The ethanolic extracts of *M. pruriens* seed produced a significant and sustained increase in the sexual activity of normal male rats at a particular dose (200mg/kg), when compared to the control[31].

Effect on Fertility

Mucuna pruriens improves male fertility by its action on the hypothalamus-pituitary-gonadal axis. A study on treatment with *M. pruriens* significantly improved serum testosterone, luteinizing hormone, dopamine, adrenaline, and noradrenaline levels in infertile men and reduce the levels of follicle stimulating hormone (FSH) and prolactine hormone (PRL). Sperm count and motility were significantly recovered in infertile men[32]. The quality of seminal changes due to psychological stress was assessed after treating the case with *M. pruriens* seed powder @ 5 g/ day orally. For carrying out morphological and biochemical analysis, semen samples were collected twice, first before starting the treatment and second after 3 months of treatment. The results demonstrated the decreased sperm count and motility in subjects who were under psychological stress. Moreover, serum cortisol and seminal plasma lipid peroxide levels were also found elevated along with decreased seminal plasma glutathione (GSH) and ascorbic acid contents, reduced superoxide dismutase (SOD) and catalase activity. Treatment with *M. pruriens* significantly ameliorated psychological stress and seminal plasma lipid peroxide levels along with improved sperm count and motility. Treatment also restored the levels of SOD, catalase, GSH and ascorbic acid in seminal plasma of infertile men. *M. pruriens* not only reactivates the antioxidant defense system of infertile men but also helps in the management of stress and improves semen quality[33]. The effects of *M. urens* on the gonads of male Guinea pigs were investigated and found to be the potential male antifertility agent even at a lower dosage of 70mg/kg[34].

Antioxidant effect

The antioxidant activity on *in vivo* models of lipid peroxidation concluded that the seed ethanolic extract of *Mucuna pruriens* has an antilipid peroxidation property which is mediated through the removal of super oxides and hydroxyl radicals[35]. Experiment on *in vitro* lipid peroxidation of *M. pruriens* seeds revealed the inhibition of ascorbate/$FeSO_4$ induced peroxidation by methanolic extract of *M. pruriens* which was monitored by the changes in optical density of the prepared concentrations (10-320 µg/ml). The inhibition increased with increase in concentration of the extract[36].

Antitumour effect

The antitumour effect and antioxidant role of methanolic extract of *Mucuna pruriens* seed against Erlich Acites Carcinoma (EAC) bearing Swiss albino mice were studied. The effect of methanolic extract of *M. pruriens* on tumor growth and host's survival time was studied by the following parameters; tumor volume, packed cell volume viable and non viable cell count and life span of the host. Extract was administered at 125 and 250 mg/kg body weight once daily for 14 days, starting after 24 h of tumor inoculation. Decrease in tumor volume, packed cell volume and viable cell count were observed in extract treated animals when compared to EAC treated animals. Treatment with extract at a dose of 125 and 250 mg/kg increased the mean survival time to 29.5± 0.55 and 34± 0.2 days respectively. The extract also decreased the body weight of the EAC tumor bearing mice**.** There was a significant decrease in WBC count and increase in RBC counts in extract treated animals when compared to EAC treated animals. The study was also extended to estimate the liver biochemical parameters such as LPO, GSH and antioxidant enzymes like SOD, catalase etc. Treatment with extract decreased the levels of lipid peroxidation and increased the levels of glutathione, superoxide dismutase and catalase. The results suggest that the methanolic extract of *M. pruriens* seeds exhibits significant antitumor and antioxidant effects in EAC bearing mice [37].

Antidiabetic effect

Many reports have been established relating to antidiabetic property of *Mucuna*. The hypoglycemic activity of *M. pruriens* ethanolic extract in alloxan induced rats and streptozotocin induced mice produced the maximum activity at 6th week in 200mg/kg/day dose [38]. A comparative study of the hypoglycemic effect of aqueous extract of the seeds of *M. pruriens* between normal, glucose load conditions and streptozotocin induced diabetic rats were analyzed. The results showed that in normal rats, the aqueous extract of the seeds of *M. pruriens* (100 and 200 mg/kg body weight) significantly ($p<0.001$) reduced the blood glucose levels after an oral glucose load from 127.5 ± 3.2 to 75.6 ± 4.8 mg % 2 h after oral administration of MPE seed extract. It also significantly lowered the blood glucose in streptozotocin induced diabetic rats from 240.5 ± 7.2 to 90.6 ± 5.6 mg % after 21 days of treatment ($p<0.001$). Thus, the study concludes that *M. pruriens* has an antihyperglycemic action and it could be a source of hypoglycemic compounds[39]. Comparative evaluation of hypoglycemic activity of some ethanolic extracts of Indian medicinal plants in alloxan induced diabetes condition was done and the plants are positioned according to the significant blood glucose lowering activities in decreasing order in the following 24 samples: *Coccinia indica, Tragia involucrata, Gymema sylvestre, Pterocarpus marsupium, Trigonella foenum-graecum, Moringa oleifera, Eugenia jambolana, Tinospora cordifolia, Swertia chirayita, Momordica charantia, Ficus glomerata, Ficus*

*benghalensis, Vinca rosea, Premna integrifolia***,** *Mucuna prurita, Terminalia bellirica, Sesbenia aegyptiaca, Azadirachta indica, Dendrocalamus hamiltonii, Zingiber officinale, Aegle marmelos, Cinnamomum tamala, Trichosanthes cucumerina and Ocimum sanctum*[40].

Antibacterial effect

Antibacterial activity of methanolic extract of *Mucuna pruriens* was evaluated and well documented the broad spectrum activity against all strains used[36]. The methanolic extract of *Mucuna monosperma* seeds were evaluated for its antibacterial activity. The result was broad spectrum as it showed activity against Gram positive *Bacillus cereus, Staphylococcus* and Gram negative *Proteus vulgaris*[41].

Antiprotozal effect

Methanolic extract of leaves of *Mucuna pruriens* has the potency to eradicate *Lichthyophtirius multifilis* infection (90%) in gold fish after treatment in baths of plant extracts at 200 mg/ liter and parasite induced fish mortality was reduced significantly. The *in vitro* studies shows 100% mortality of parasite tested in 150 mg/liter of *M. pruriens* extract[42].

Study of analgesic and anti-inflammatory activity

Mucuna pruriens was evaluated for its anti-inflammatory, analgesic and antipyretic activity and found to produce significant effects[43- 44].

Anti Snake venom effect

The protective effects of *Mucuna pruriens* seed extract (MPE) against histopathological changes induced by intravenous injection of *Naja sputatrix* (Malayan cobra) venom in rats pretreated with the MPE seed extract was examined. Examination by light microscope revealed that the venom induced histopathological changes in heart and blood vessels in liver, but no effect on brain, lung, kidney and spleen. The induced changes were prevented by pretreatment of the rats with MPE. Finally it is suggested that MPE pretreatment protects rat heart and liver blood vessels against cobra venom induced damages[45].

MPE pretreatment was given to rats and the animals were challenged with various snake venoms[46]. The effectiveness of MPE to neutralize the lethalities of snake venoms was investigated by *in vitro* neutralization and concluded as MPE effectively protect the animal models against lethality of *Naja sputatrix* venom and moderate protection against *Calloselasma rhodostoma* venom. Indirect ELISA and immunoblotting studies showed that there were extensive cross-reactions between anti-MPE IgG and venoms from many different genera of poisonous snakes, suggesting the involvement of immunological neutralization in the protective effect of MPE pre-treatment against snake venom poisoning. *In vitro* neutralization experiments also showed that the anti-MPE antibodies effectively neutralized the lethalities of *Asiatic cobra* (Naja) venoms, but were not very effective against other venoms tested.

CONCLUSION

Mucuna pruriens is one of the major constituents in more than 200 indigenous herbal preparations available. Nutritional value of *M. pruriens* is as good as soybeans and even better than any other legumes. Its medicinal values in Parkinson's disease, aphrodisiac, fertility, impotency, snake bite and much more pharmacological activities were investigated and proved as the best**.** Few properties and the activities reported for some species of *Mucuna were* found to be one and the same. The phytoconstituents and the morphological differences were also reported. Considering these factors, it can be predicted that the different species of the genus *Mucuna* may contain same or different activity with diversified bioactive constituents. So exploration and exploitation of diversity without affecting the biodiversity and the fragile ecosystem will improve this pharma potential herb to the optimum heights.

The diversities in genus *Mucuna* needs further intensive attention and exploration by the researchers for their potency in pharmaceutical, nutraceutical and cosmaceutical applications. Upon effective processing the herb, it is possible to develop the extracts with acceptable ratio of nutritional and the bioactive constituents for the use in indigenous drug formulations. Many of the bioactive constituents and their pharmacological mechanisms of *M. pruriens* need to be established. It is very well understood that the constituent of this herb differs due to the geographical location, climatic condition, harvest, processing technique and some other factors. So comparative analysis between the species regarding bioactive principles and activities need to be done. Fermentative applications can be developed for this genus, for improving its nutritional and pharmaceutical efficacy.

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