



Review on phytochemistry and pharmacological activity of mucuna pruriens

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Abstract

Mucuna pruriens Linn. is a popular Indian medicinal plant, widely known as “velvet bean,” a vigorous annual climbing legume originally from Southern China and Eastern India, it has been shown that its seeds are potentially of substantial medicinal importance. The ancient Indian medical system, Ayurveda, traditionally used *M. pruriens*. A wide range of phytochemical constituents has been isolated from this plant are Alkaloidal, mucunadine, mucunine, prurienidine, pruriene, Epoxy fatty acids, Lecithin, 1-methyl-3-carboxy-6, 7-dihydroxy-1,2,3,4-tetrahydro isoquinolone, 5-hydroxy tryptamine, 5-methoxy-n, n-dimethyl tryptamine-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 and traditional uses and some activities are present in Antioxidant, Antimicrobial, Aphrodisiac, Anti-Inflammatory, Antivenom, Hypoglycemic, Neuroprotective, Antineoplastic, Anti-protozoal and Learning and Memory Enhancement and also management of male infertility activities have been described.

Keywords: review, mucuna pruriens, phytochemistry, pharmacological properties

Introduction

The genus *Mucuna pruriens* (MP) belonging to the Fabaceae family, subfamily Papilionaceae, commonly called velvet bean is a tropical legume indigenous tree to Africa and tropical Asia and many parts of America [1]. It includes approximately 150 species of annual and perennial legumes. It is considered a viable source of dietary proteins due to its high protein concentration (23-35%) in addition to its digestibility, as compared to other pulses such as soybean, rice bean, and lima bean [2]. The plant is famous for the extreme itchiness it produces on contact, particularly with the young foliage and the seed pods due to the presence of 5-hydroxy tryptamine (5-HT). The plant is an annual, climbing shrub with long vines that can reach over 15 m in length [3-5]. Its seeds contain many micronutrients including amino acids, zinc, selenium, carbohydrates, and the most important of these bioactive compounds of plants are alkaloids, flavonoids, tannins, and phenolic compounds [6-7]. The chemical constituents may be used for the various purposes such as activity against pathogenic bacteria [8].

But the researches discover that all parts of *M. Pruriens* are generally used to treat in many other diseases such as for treating arthritis, anxiety, cancer, cough, diarrhea, dysentery, diabetes, dysmenorrhea, delirium, gonorrhea, gout, impotence, muscular pain, parasitic infections, rheumatic disorders, as analgesic and antipyretic, to induce vomiting, to treat snakebite and scorpion stings, sexual debility, sterility, tuberculosis and its direct application on skin can help to stimulate surface blood flow in conditions that involve paralysis and in the management of Parkinsonism [9-13]. And it is considered an aphrodisiac, diuretic, emmenagogue, nerve tonic and uterine stimulant. [14-15].

Description of Mucuna Pruriens

The Common names of *Mucuna Pruriens* Its known as “Magic bean” in Indian System of Medicine. The other vernacular names of this plant are Cowhage, Kiwanch or Konch (Hindi), Velvet bean or Cowitch (English), Atmagupta or Kapikacchu (Sanskrit), Poonaiikkaali (Tamil), Alkushi (Bengali), Khaajkuri (Marathi), (German) Juckbohne, Itch bean (Portuguese) Mad Bean, (Malayalam) Naykaranam, (Thai language) MahMui and also, Scientific classification of *Mucuna Pruriens* is (Division) Magnoliophyta, (Class) Magnoliopsida, (Order) Fabales, (Family) Fabaceae, (Subfamily) Faboideae, (Tribe) Phaseoleae, (Genus), *Mucuna*, (Species) *M. pruriens* [16].

The plant is an annual, climbing shrub with long vines that can reach over 15 m in length. When the plant is young, it is almost completely covered with fuzzy hairs, but when older, it is almost completely free of hairs. The leaves are tripinnate, ovate, reverse ovate, rhombus-shaped, or widely ovate. The sides of the leaves are often heavily grooved, and the tips are pointy. In the young plant, both sides of the leaves have hairs. The stems of the leaflets are 2-3 mm long, and additional adjacent leaves present are about 5 mm long. The flower heads take the form of axially arrayed panicles. They are 15-32 cm long and have two to three or many flowers. The accompanying leaves are about 12.5 mm long, the flower stand axes are from 2.5 to 5 mm. The bell is 7.5-9 mm long and silky. The sepals are longer or of the same length as the shuttles. The crown is purplish or white. The flag is 1.5 mm long. The wings are 2.5-3.8 cm long. In the fruit ripening stage, a 4-13 cm long, 1-2 cm wide, unwinged, leguminous fruit develops. The husk is very hairy and carries up to seven seeds. The seeds are flattened uniform ellipsoid, 1-1.9 cm long, 0.8-1.3 cm wide, and 4-6.5 cm thick. This plant is widely distributed in South East Asia largely found in Bangladesh, India, Sri Lanka, Malaysia. It

is also found in Asia, America and Africa [17]. It is cultivated any types of soil and environment in rainy seasons. It is successfully grown in acidic soil (pH 4.0 and annual temperature 19-27°C [18].

Phytochemistry

The plant is reported to have L-Dopa as a major constituent mainly in seeds. Alkaloidal constituents (15, 16) viz., mucunadine, mucunine, pruriendine, prurienine (17) are reported from seeds. Numbers of amino acids are reported from this plant [19-26]. Epoxy fatty acids viz., cis-12, 13-epoxyoctadec-trans-9-cis-acid, cis-12, 13-epoxyoctadec-trans-9-enoic acid are reported [27]. Lecithin is reported to be present in seed [28]. According to Dr. Duke's phytochemical and ethnobotanical databases *Mucuna pruriens* contains many diverse phytochemicals like 1-methyl-3-carboxy-6, 7-dihydroxy-1,2,3,4-tetrahydroisoquinoline, 5-hydroxy tryptamine, 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, tyrodine, valine and vernolic acid [29].

Recently three new lipid derivatives were reported from n-hexane extract of seeds of *Mucuna pruriens*, namely (Z)-Triactont-5,7,9-triene; (Z)-Docos-2,4,6-trien-1,8-diol and (Z)-Docos-5-en-1-oic acid [30]. This plant is a source of minerals [31]. Misra and Wagner reported isolation of four 1,2,3,4 tetra hydroisoquinoline alkaloids from the seed this is active constituents' presence of *Mucuna Pruriens* plant [32].

Traditional Uses

Mucuna Pruriens Plant of parts are used- Seed, leaf and root. The *Mucuna pruriens* finds traditional use in number of diseases and its various parts are used for various

purposes. In Root is bitter, thermogenic, emollient, stimulant, purgative, aphrodisiac, diuretic, emmenagogue, anthelmintic, febrifuge and tonic. They are useful in vitiated conditions of vata and pitta in Ayurveda. The Ayurvedic usage of roots still extend for constipation, nephropathy, strangury, dysmenorrhea, amenorrhea, elephantiasis, dropsy, neuropathy, consumption, ulcers, fever and delirium. And Leaves was present in number of phytoconstituents and activity of Aphrodisiac, anthelmintic, tonic, and are useful in ulcers, inflammation, helminthiasis, cephalalgia and general debility. Seeds was present in number of phytoconstituents and activity for worms, dysentery, diarrhea, snakebite, sexual debility, cough, tuberculosis, impotence, rheumatic disorders, muscular pain, gonorrhea, sterility, gout, delirium, dysmenorrhea, diabetes, and cancer. In India, it is considered an aphrodisiac, emmenagogue, uterine stimulant, nerve tonic, diuretic, and blood purifier.

In Central America, *Mucuna* beans have been roasted and ground to make a coffee substitute for decades and is widely known as Nescafé for this reason. The bean is cooked as a vegetable. In Brazil, the seed has been used internally for Parkinson's disease, edema, impotence, intestinal gas, and worms. It is considered a diuretic, nerve tonic, and aphrodisiac. Externally it is applied to ulcers. Seeds are astringent, laxative, anthelmintic, aphrodisiac, alexipharmic and tonic. They are useful in gonorrhea, consumption, sterility, vitiated conditions of vata and general debility. The hairs and flowers are vermifuge. In Ayurvedic system, powder of *Mucuna* seeds is used for treating Parkinson's disease [33, 34].

Pharmacological Activity

All over the world scientific research is getting momentum to evaluate the pharmacological activities, side effects and medicinal uses of *Mucuna Pruriens* belong to Fabaceae family against different diseases. On the basis of various experimental and clinical researches, The Fabaceae family belong to *Mucuna Pruriens* was common following pharmacological activities or medicinal properties have been reported.

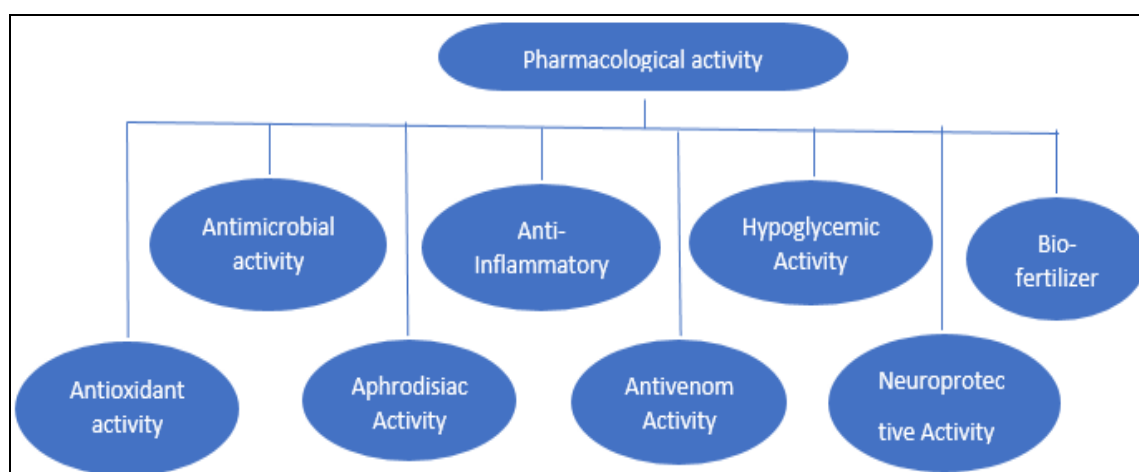


Fig 1: Pharmacological Activity for *Mucuna Pruriens*

Antioxidant Activity

The hydrogen-donating ability of the methanol extract of *M. pruriens* (MEMP) was measured in the presence of 1,1-diphenyl-2-picryl-hydrazyl radical. Ethyl acetate and MEMP plant, which contains large amounts of phenolic

compounds, exhibits high antioxidant and free radical scavenging activities [35]. Reactive oxygen species (ROS) react readily with free radicals to become radicals themselves. Antioxidants provide protection to living organisms from damage caused by uncontrolled production

of ROS and concomitant lipid peroxidation, protein damage and DNA strand breakage. The alcohol extract showed significant antioxidant activity which was comparable with standard ascorbate and total phenol content [36].

Antimicrobial Activity

Antimicrobials of plant origin have enormous therapeutic potential. Phytochemical compounds are reportedly responsible for the antimicrobial properties of certain plants [37]. Crude MEMP leaves have been shown to have mild activity against some bacteria, probably due to the presence of phenols and tannins. This extract is mainly effective against *Escherichia coli*, *Salmonella typhi*, *Bacillus subtilis*, and *Shigella dysenteries*. The antimicrobial potency was evaluated by zone of inhibition (ZI) where *E. coli* showed higher ZI (2.8 cm) than *B. subtilis* ZI (2.1 cm) [38].

Aphrodisiac Activity

A clinical trial was conducted on 60 subjects, related to aphrodisiac activity of *M. Pruriens* where the powder was administered at 5gm/day orally once. It showed significant improvement in sperm count and motility. There was significant increase in SOD, GSH, ascorbic acid and catalase levels in infertile men [39]. All their parameters suggested that *M. Pruriens* has strong aphrodisiac activity.

Anti-Inflammatory Activity

The aerial parts of the plants had significant anti-inflammatory activity in both cotton pellet implantation and carrageenin induced paw edema method in rats. There was reduction in weight of cotton pellet and paw edema volume in test animals than control ($p < 0.001$). It was observed that the extract of *M. Pruriens* were effective at 200 and 400 mg/kg doses in both method [40].

Antivenom Activity

The antivenom activity was investigated Fung *et al* (2010) It contains of seeds where there was reduction in neuromuscular and cardiovascular depressant effects of *Naja Sputatrix* venom in rats which was pretreated with *M. Pruriens* seed [41]. The same group of researchers also described similar effects against *Calloselasma rhodostoma* venom. Where *M. Pruriens* aqueous extract was given intra-peritoneal for 3 weeks. After 3 weeks, *Calloselasma rhodostoma* venom was administered intra-venously and studied various pharmacology parameters like blood pressure, heart rate, respiratory rate and muscle twitch tension in rats. All pharmacological responses were found to be decreased in treated groups with respect to control group [42]. Seed part showed strong antivenom activity which might be due to presence of higher number of phytochemicals.

Hypoglycemic Activity

The hypoglycemic activity of seeds aqueous extract was evaluated using streptozotocin induced diabetic, normal and glucose load condition rat models. The seed extract of *M. Pruriens* at doses of 100 and 200mg/kg body wt. reduced oral glucose load from ~ 127 to 75mg% after 2 h of oral administration. In another experiment there was reduction of blood glucose from ~ 250 to 90mg% in streptozotocin diabetic rats after 21 days. The previous investigation suggested that the antidiabetic activity may be due to its dietary fiber content [43]. It is reported that cholesterol, urea

and creatinine is responsible for increase the blood glucose level. They observed that both cholesterol and creatinine levels were decreased in streptozotocin diabetic rats in similar experiment. They explained that this hypocholestric activity is due to presence of squalene content [44].

Neuroprotective Activity

The seed powders of *Mucuna pruriens* are more beneficial to Parkinson's patients than the synthetic drug, when it is used for long term have been report [45]. An n-propanol extract of *M. pruriens* seeds yields the highest response in neuroprotective testing involving the growth and survival of DA neurons in culture. Interestingly, n-propanol extracts, which contain a negligible amount of L-DOPA, have shown significant neuroprotective activity, suggesting that a whole extract of *M. pruriens* seeds could be superior to pure L-DOPA with regard to the treatment of Parkinsonism. The dopamine content in brain tissue is reduced when the conversion of tyrosine to L-DOPA is blocked. L-DOPA, the precursor of dopamine, can cross the blood-brain barrier and undergo conversion to dopamine, restoring neurotransmission [46].

Learning and Memory Enhancement

In the study by Poorna Chandra *et al*, *Mucuna pruriens* showed significant activity on learning skills and memory enhancement in Wistar male rats. Results on memory retrieval, assessed on 17th day suggested an increase of 15% and 35 % memory retrieval in animals that received extract only in memory retrieval session and animals that received extract during both in training and memory retrieval sessions respectively [47].

Antineoplastic activity

Antineoplastic activity of *M. pruriens* was evaluated by several studies. Gupta *et al* reported the antineoplastic efficacy in their search for anticancer plants. The effect of methanolic extract of *Mucuna pruriens* seeds on tumour growth and host's survival time in Ehrlich ascitic carcinoma bearing Swiss albino mice was reported by Yerra Rajeshwar *et al* [48-49]. *Mucuna pruriens* at a dose of 125 and 250 mg/kg body weight showed decrease in tumour volume, packed cell volume, viable cell count and increase in the mean survival time in treated animals compared to control. Hematological studies resulted in restoration of Hb content to near normal levels, significant decrease in RBC count and increase in WBC counts in extract treated animals when compared to control. *M. pruriens* decreased the levels of lipid peroxidation and increased the levels of glutathione, superoxide dismutase and catalase.

Anti-Protozoal Activity

Ekanem *et al* proved that the crude methanolic extract of leaves of *Mucuna pruriens* has potential for effective control of *I. multifils* infection in Goldfish. There was a 90% reduction in numbers of *I. multifils* on fish after treatment in baths of plant extract at 200 mg/liter and parasite-induced fish mortality was reduced significantly. *In vitro* tests led to a 100 % mortality of *I. multifils* in 150 mg/liter of *M. pruriens* extract [50]

Conclusion

Mucuna pruriens is an exceptional plant. On the one hand it is a good source of food, as it is rich in crude protein,

essential fatty acids, starch content, and certain essential amino acids. On the other hand, it also contains various anti-nutritional factors, such as protease inhibitors, total phenolics, oligosaccharides (raffinose, stachyose, verbascose), and some cyclitols with anti-diabetic effects. In fact, all parts of the *Mucuna* plant possess medicinal properties. The best and quickest way to species selection for and pharmacological phytochemical works is by reviewing the literature. Due to presence of diverse phytoconstituents such as Alkaloidal, mucunadine, mucunine, prurienidine, pruriene, Epoxy fatty acids, Lecithin, 1-methyl-3-carboxy-6, 7-dihydroxy-1,2,3,4-tetrahydro isoquinolone, 5-hydroxy tryptamine, 5-methoxy-n, n-dimethyl tryptamine-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. On the basis of the literature, *Mucuna pruriens* can be used as different medicines by its pharmacological activities such as a Antioxidant, Antimicrobial, Aphrodisiac, Anti-Inflammatory, Antivenom, Hypoglycemic, Neuroprotective, Antineoplastic, Anti-Protozoal and Learning and Memory Enhancement. *Mucuna pruriens* have been proved by various studies of researchers found significant in prevention, control of various diseases or disease conditions.

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