Mucuna pruriens magical velvet bean the wonder plant - A review

Zulfa Nooreen*, Ankita Wal, Anuja Shukla, Anil Yadav

PSIT-Pranveer Singh Institute of Technology (Pharmacy) Bhauti Kanpur Uttar Pradesh,India- 209305

***Corresponding Author: Dr. Zulfa Nooreen**

Abstract

Popular Indian medicinal plant *Mucuna pruriens* Linn.Has been used for many years in traditional ayurvedic Indian medicines to treat illnesses including Parkinson's disease. L-DOPA, an amino acid that acts as a natural precursor of the neurotransmitter dopamine and is found in abundance in *M. pruriens* seed, is used extensively to treat Parkinson's disease. There have been reports of about 130 species from all over the world, including 15 species from India. Most of the species had been investigated for their potential as nutraceuticals, but there were just a few reports of their medicinal benefits. Pharmacological research on this plant has focused on its potential as an anti-diabetic, aphrodisiac, anti-cancer, anti-epileptic, and anti-microbial agent. This plant has produced a wide variety of phytochemical components that have been identified. In light of the numerous recent results on this plant that are significant, a detailed explanation of the morphological, phytochemical components, traditional usage, pharmacological actions, and analytical methodologies presented are given.

Keywords: Mucuna pruriens, Phytochemistry, Pharmacology, L-Dopa, Aphrodisiac, Anti-Parkinsonian

1. Introduction

Mucuna belonging to the family Fabaceae is a well-known herbal remedy used to treat neurological problems, male infertility, and as a libido. It has recently been demonstrated that the seeds of this plant may have significant medical value. Ayurveda, an antiquated Indian medical system (Lampariello LR, 2012) Mucuna is an unusual plant species with intriguing bioactive ingredients for food, medicine, and cosmetics. The plant *Mucuna pruriens* is said to contain the most L-dopa. Scientists from the several nations have determined that Mucuna is an excellent nutritious addition to feeding livestock as well as a fodder crop. Owing of Mucuna's potency as a medicine, demand for it is growing every day(Natarajan K,2012). The genus Mucuna contains over 150 species of annual and perennial legumes and is a member of the Fabaceae family, subfamily Papilionaceae. The velvet bean, *Mucuna pruriens*, is one of the many underutilized wild legumes and is found all over the world in tropical and subtropical climates. It is regarded as a trustworthy source of dietary proteins(Lampariello, 2012). Due to its high protein concentration (23–35%) in addition its digestibility, which is comparable to that of other pulses such as soybean, rice bean, and Lima bean (Gurumoorthi,2003). It is therefore regarded a good source of food. According to recent study, finding novel compounds derived from plants is important for the conservation and wise use of biodiversity. Over the past few decades, scientific knowledge on plants, basic plant extracts, and diverse plant-derived compounds as therapeutic agents has exploded. The Indian system of medicine has been around for a while, but little is known about how plants act

as ingredients in polyherbal remedies to treat illnesses. This has led researchers to concentrate their studies on understanding the holistic information, particularly the functional characteristics of such plants. One of the most significant challenges for both developed and developing nations is maintaining the dietary needs. However, a significant issue is containing a number of terrible diseases that are already there and are currently spreading. Potential herbs should be found and their qualities assessed in order to address these combined factors. Many plants that are now used have one or more of the resolving properties listed above. Legumes have a promising future in terms of nutrition, medicine, and agricultural development in poor nations, according to traditional and scientific research. The well-known legume *Mucuna pruriens* is one of these. Its L-dopa content has been shown through scientific research to be particularly effective in treating neurodegenerative disorders. It is also the best source of nutrition because it is rich in nutrients, particularly protein and carbohydrates. Mucuna can be used as the best vitamin and medicinal when processed properly. It was discovered that L- dopa extracted from Mucuna was more efficient than the conventional substance (Hussian,1997). More than one scientist has reported on various works in taxonomy and nutrition on several geographic locations5. Once the anti-nutritional components have been removed, the herb is perfectly safe for use as cattle feed. The current research provides detailed information on the Mucuna genus, including information on its various species, traditional usage, nutritional and therapeutic benefits, phytochemical components, and pharmacological activity (Gurumoorthi, 2003). Herbs are the primary source of naturally occurring materials used as insecticides, flavoring agents, agricultural chemicals, medicines, and other items (Balandrin MF,1985).

2. The genus and species in taxonomy

The taxonomy of the Mucuna genus, which is a member of the Fabaceae family, is presented in table 1. There are around 12000 species in this second-largest family of flowering plants, which has 600 genera. The leaves, which might be bipinnately or palmately complex or simple, are almost invariably alternating. The petiole base is frequently expanded to form a pulvinus, which frequently aids in leaf orientation. The flowers are frequently in racemes, spikes, or heads and are typically bisexual, actinomorphic to zygomorphic, and mildly to severely perigynous. The perianth typically has one or more stamens that are separate or occasionally irregularly joined. A superior ovary with one locule that contains two or more marginal ovules and a single style and stigma make up the pistil, which is often quite basic. Typically, the fruit is a legume, though it can also be a follicle, an indehiscent pod, an achene, a drupe, or a berry. The seeds occasionally carry a polarograms, a u-shaped line, and frequently have a hard coat with hourglass-shaped cells(Natarajan, 2012). The majority of Mucuna species are twining herbaceous plants. It is native to tropical areas, particularly to Africa, India, and the West Indies. They have trifoliate leaves with bases that are uneven. Long clusters of flowers range in color from white to deep purple. Pods have longitudinal ribs and are sigmoid and turgid. Ovoid, white or black seeds are used. The reddish orange hairs that cover Mucuna pods are easily detached. Distinct locales' Mucuna seed exhibit different biological characteristics and the environment have little impact on the genetic diversity of Mucuna (Gurumoorthi, 2003).

3. Traditional uses of Mucuna the wonder plant

The seeds are commonly used for leucorrhea, paralysis, aphrodisiacs, nervine tonics, and emmenagogues. The pod hairs are vermifuge to treat infections with roundworms. As a cough and asthma expectorant and sedative, *Mucuna monosperma* is utilized (Khory, 1999). Rub a mixture of oak powder and dried ginger across aching rheumatoid joints (Nadkarni,1982). The roots are aphrodisiac, diuretic, emmenagogue, anthelmintic, febrifuge, diuretic, and tonic in addition to being bitter, thermogenic, emollient, stimulant, purgative, and stimulant. According to Ayurveda, they are beneficial for treating Parkinson's disease as well as vitiated vata and pitta disorders, constipation, nephropathy, stranguria, dysmenorrhea, amenorrhea, elephantiasis, dropsy, neuropathy, ulcers, helminthiasis, fever, and delirium. The leaves are beneficial for ulcers, inflammation, helminthiasis, cephalalgia, and general weakness. They are also aphrodisiac, anthelmintic, and tonic. The

seeds have laxative, anthelmintic, aphrodisiac, and tonic properties. They are beneficial for gonorrhea, sterility, vata-vitiated diseases, and general malaise. The seeds are healing and occasionally eaten as a vegetable. Rats on a seed diet had hypoglycemia(Natarajan, 2012).*M. pruriens* is a well-known medicinal herb in India. It has been utilized for a very long time in traditional Ayurvedic Indian medicine is used to treat illnesses like Parkinsonism (Sathiyanarayanan, 2007). This plant is very common. Utilized in the historic, conventional science of Ayurveda Since ancient times, India has utilized medical science. The Vedic period (1500–1000 BC). In the *M. pruriens* L-dopa is reportedly one of its components. Additionally, the beans have been used in Ayurveda as a potent aphrodisiac (Chaudhri, 1996). They are employed to treat nervous system problems, arthritic pain using the bean as an example paste is applied on scorpion stings and is said to absorb the poison(Amin, 1996; Jeyaweera, 1981). L-dopa, an amino acid produced from non-protein this underused legume seed contains the amino acid (3, 4-dihydroxy phenylalanine), which deters insect attack. During storage, biological infestation is under control. According to D'Mello (1995), every antinutritional substance provides plants with pest and disease protection. Further, the seeds' L-dopa has been removed to offer commercial Parkinson's disease medications disease. A powerful precursor of neurotransmitters is L-Dopa. It is thought to be partially to blame for the toxicity. Derived from Mucuna seed (D'mello JP, 1998; Lampariello, 2012). the methanol extract is antiepileptic and anti-neoplastic According to reports of M. pruriens(Gupta, 1997). MP seeds' methanol extract has showed anti-oxidant properties in vitro, and there are additionally signs tha methanol extracts. *M. Pruriens* may serve as a source of organic antioxidants and anti-microbial substances(Rajeshwar Y, 2005).All parts *M. Pruriens* has been studied for its anti-diabetic, aphrodisiac, anti-neoplastic, anti-epileptic, and anti-microbial actions, among other beneficial medical characteristics (Sathiyanarayanan, 2007). Guerranti et al. (2002) explored its anti-venom properties, and Jalalpure (2002) revealed its anti-helminthic action (2007). M. Pruriens has also demonstrated neuroprotective properties(Misra L, 2004). It has shown to have both painkilling and anti-inflammatory effects(Hishika R, 1981).It is used to treat a variety of illnesses, including ulcers, neurological and menstrual diseases, and constipation, edema, fever, TB, and urinary tract disorders(Katzenschlager R, 2004), elephantiasis, and helminthiases(Oudhia P, 2002). Historically, the ground seeds of *M. Pruriens* were discovered to boost rats' overall mating behavior, and consequently their sexual activity (Amin, 1996).

Roots are bitter, thermogenic, anthelmintic, diuretic, emollient, stimulant, aphrodisiac, purgative, febrifuge, and tonic, according to Ayurveda. Constipation, nephropathy, dysmenorrhea, amenorrhea, elephantiasis, dropsy, neuropathy, ulcers, helminthiasis, fever, and delirium are among the conditions (Longman, 2007). Leaves are grown as a feed source and are helpful for cephalalgia, ulcers, inflammation, and general malaise. Dried *M. sacra* leaves Prurients are occasionally smoked. The pods have rough hairs and trichomes that irritate and can lead to eczema, blisters, and dermatitis. Pods can also be eaten as vegetables. Pod hairs are employed as an anti-helminth. As a vermifuge, honey and hairs are combined. An ointment made with hairs works as a mild vesicant and local stimulant (Sastry).

4. Medicinal (therapeutic) value

In addition to its nutritional value and use as a fodder crop, many Mucuna species have been found to have therapeutic uses (Caius, 1989). This herb is mostly used to treat Parkinson's disease's symptomatic symptoms. The components bufotenine, choline, and -carboline have been linked to antiepileptic and anti-cancer action (Gupta,1997; Ghosal, 1971). As a vermifuge, Mucuna pod hairs and honey can be combined. Leucorrhoea and spermatorrhoea are conditions that are treated with Mucuna seed powder ((Nadkarni, 1989). Anabolic, androgenic, analgesic, anti-inflammatory, antispasmodic, antivenom, aphrodisiac, febrifuge, hypoglycemia, immunomodulator, antilithiatic, antibacterial, antiparasitic, cough suppressant, blood purifier, carminative, hypotensive, and uterine stimulant qualities are all present in seeds (Sridhar ,2007).A total of 130 species, including 15 species from India, have been recorded globally. Few species have been documented for their pharmacological benefits, while the majority of species have been investigated for their potential as nutraceuticals. The following are some species names:

Mucuna lamiiver DC., *Mucuna pallid* Cordem, *Mucuna platyplekta*Quisumb&Merr., *Mucuna nivea*, *Mucuna luzoniensis*., *Mucuna Montana*, *Mucuna ovalis* Baker f., *Mucuna nigricans* [LOUR] steud., *Mucuna lane pooleisummerh, Mucuna mutisiana*DC.,*Mucuna mindorensis* MERR., *Mucuna Mapirensis* RUSBY. F. MACBR., *Mucuna stanleyi* C.T. WHITE., *Mucuna cyclocarpa* F.P. Metcalf., *Mucuna calophylla*W.W.Sm.,*Mucuna terrens* H.LEV., *Mucuna platyphylla*A. GRAY.,*Mucuna melanocarpa*A. RICH., *Mucuna eriocrapa* Barb-Rodr., *Mucuna japira* A.M.G. Azevedo, K. AGOSTINI& SAZIMA., *Mucuna manongarivensis*DU. PUY & LABAT., *MucunaKeyensis*-Burck., *Mucuna cyclocarpa* F.P. Metcalf., *Mucuna iriomotensis* OHWI.

*Mucuna pruriens.*is a well-known Indian medicinal plant that has been used for a long time in traditional Ayurvedic Indian medicine to treat illnesses including Parkinsonism This plant is being investigated pharmacologically for a variety of functions, including anti-diabetic, aphrodisiac, anti-cancer, anti-epileptic, and anti-microbial effects. A large number of phytochemical compounds have been identified from this plant. In light of the numerous recent results on this plant that are significant, a detailed explanation of the morphology, phytochemical components, traditional usage, pharmacological actions, and analytical methodologies presented are given (Sathiyanarayanan, 2007) Leguminosae-family member *Mucuna pruriens*, also known as cow-age, cowitch, velvet bean, or Alkushi, is a medicinal plant that has been used for centuries in Indian medicine. M. Pruriens seed is a naturally occurring source of L-DOPA, an amino acid that is a direct precursor to the neurotransmitter dopamine, which is a key component of the treatment for Parkinson's disease (PD). The additional substances present in M are nicotine, ox triptan, serotonin, N, N-DMT, and bufotenine. L-DOPA and pruriens are also used(Kavitha, 2014). The plant also referred to as "velvet bean" is a robust annual climbing legume that was first named eastern India and southern China, where it was formerly frequently grown as either a green vegetable crop. Among the most widely used types of green Vegetables grown in the tropics nowadays include velvet beans are believed to have excellent potential as both food and feed. Based on observations made across the globe certain ethnic groups have historically used the velvet bean as a food source groups in many nations. Asia is where it is grown. Where its pods are found throughout America, Africa, and the Pacific Islands are consumed by humans as a vegetable, and its Animal feed is made from new leaves. The plant has alternating, long, thin branches. White flowers with a bluish-purple, butterfly-shaped corolla; lanceolate leaves; and. the legumes or pods average 4 inches in length, are thick, hairy, and leathery; are designed with four violin-like sound holes. Six seeds total. They are a deep, rich shade of brown. coated in a thick layer of stiff hairs. India's senior citizens Mucuna bean seeds are typically consumed by The Kanikkars, a hill tribe from South India, after to destroy anti-nutritional elements, boil the food. Numerous Mucuna spp. demonstrate adequate resistance to a variety of abiotic despite the fact that they are vulnerable to frost and perform badly in cold, wet soils, they are subject to a number of challenges, such as drought and low soil fertility(Duke JA,1981). The species thrives best in warm, wet environments that are below 1500m above sea level, and in regions with abundant precipitation. The velvet bean, like the majority of legumes, has the capacity to fix atmospheric nitrogen through a mutualistic interactionwith the microbes in the soil. Mucuna species reported to contain the harmful substancestryptamines with psychedelic properties and L-dopa andunfavorable nutrients like phenols and tannins(Awang,1997). Because of the intense concentrations Velvet bean is a commercial source of L-dopa (4-7%). of this medication, used to treat Parkinson’s illness. Unprocessed velvet bean poisoning may what causes the plant's low susceptibility to pest insects (Duke,1981). Being familiar with velvet bean purportedly has nematicide properties, in addition to noteworthy allelopathic activity that may serve to suppressing rival plants. The overview of the plant is discussed in Figure1.and health benefit in Figure 2.

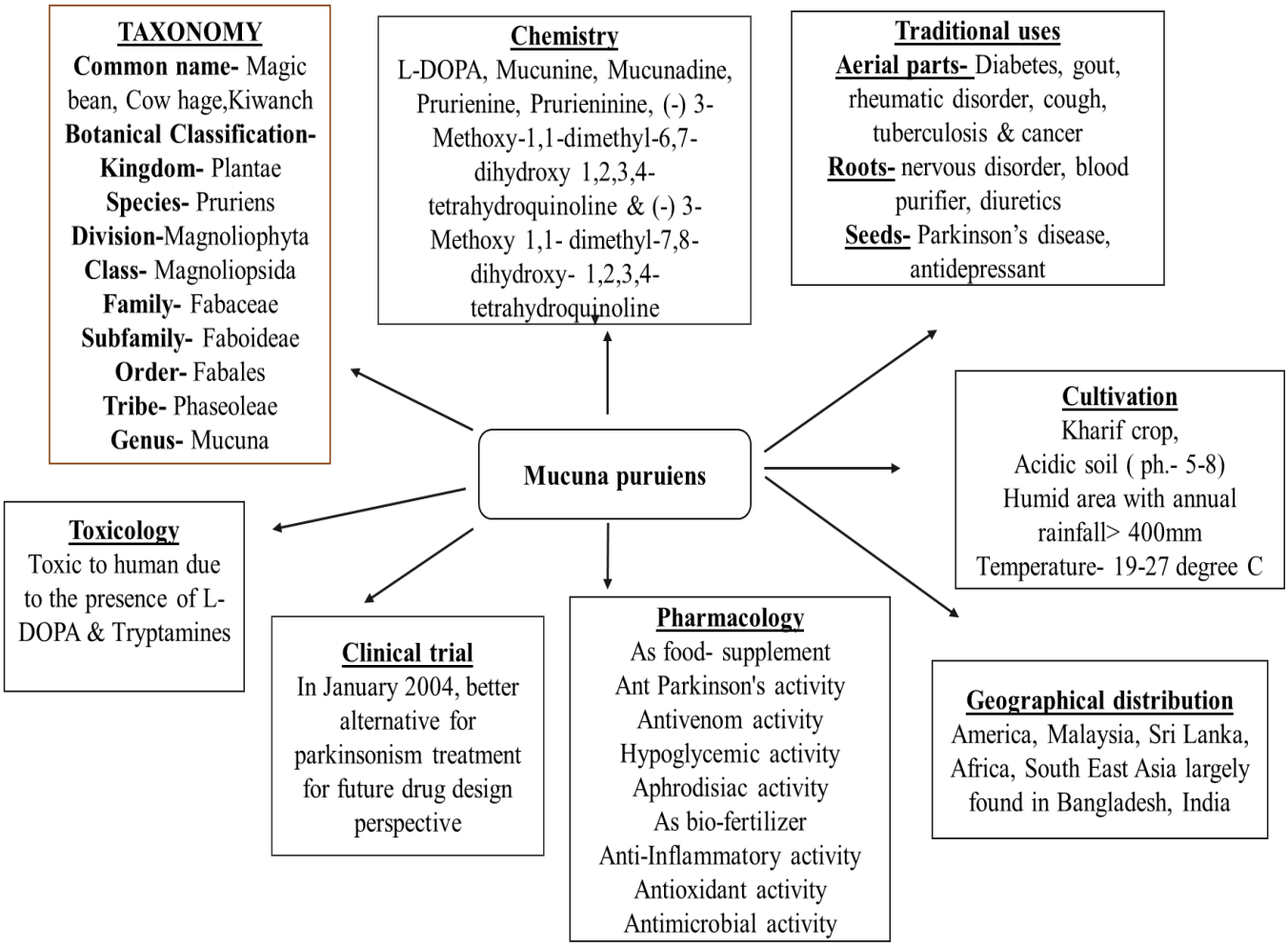


Figure1: Different-Different approaches of Mucuna purueins

5. Botany

This genus is widespread throughout the world, particularly in tropical Africa, India, and the Caribbean forests. *M. Pruriens* is a twining annual with a maximum length of 15 meters. When young, the plant's fuzzy hairs almost entirely cover it, but as it gets older, the hairs almost totally disappear(Sahaji PS,2011). Trifoliate, alternating, or spiraling leaves are gray-silky underside; petioles are lengthy and silky, ranging in length from 6.3 to 11.3 cm. Membranous leaflets with smaller terminal and greatly varying lateral sizes are present. Flowers are in drooping racemes and are dark purple, white, or lavender in color (6 to 30), pea-like but bigger, and have distinctively bent petals. Fruits are curving, longitudinal pods with 4 to 6 seeds that are about 10 cm long. They are heavily covered in trichomes, which are long-lasting, pale-brown or grey and can irritate the skin by forming blisters. Protein, mucunain, and serotonin are the molecular molecules in charge of the itching. 12 mm long, ovoid and lustrous black or brown seeds(Agharkar,1991; Sastry; Verma, 1993).

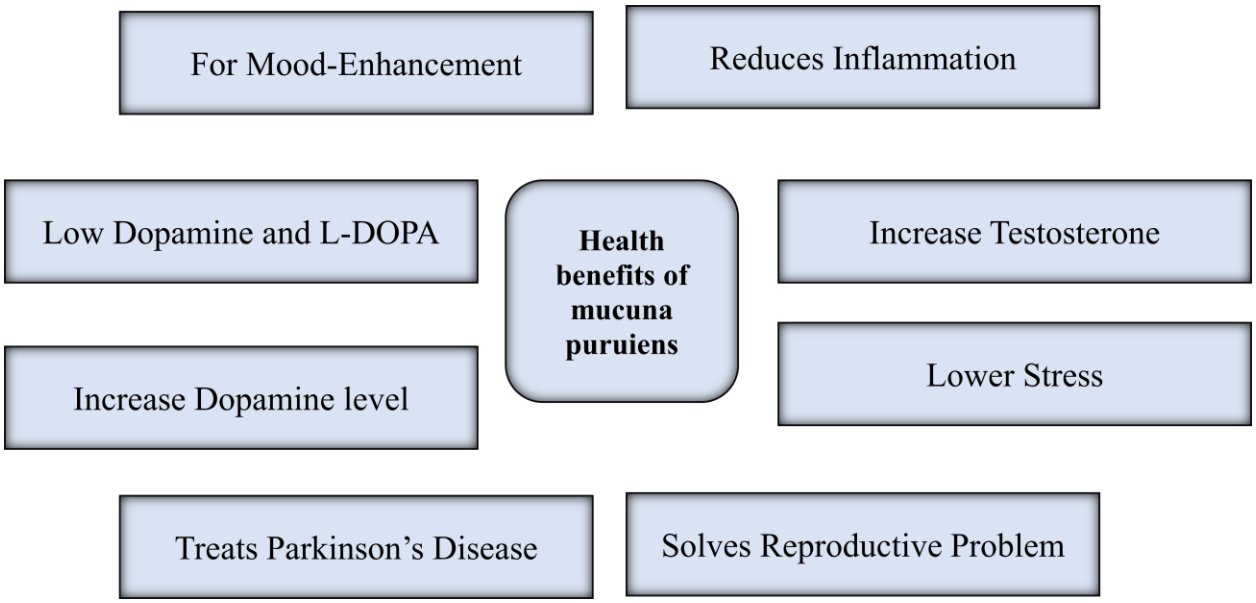


Figure2: Various health benefits of Mucuna puruiens

6. Cultivation

In India, Mucuna is cultivated as a kharif crop. Plants are spaced 60 cm apart, and 50 kg of seeds are seeded per ha. Despite the lack of a recognized Mucuna cultivar, locally accessible seeds have good viability and a greater germination rate (Oudhia, 2001). For a plant to grow, assistance is necessary. By helping one can increase yield by up to 25% and reduce pest infestation. Flowering typically starts 45 to 50 days after sowing (Oudhia ,Tripathi, 2001). According to Thomas and Palaniappan (1998a, b), the treatment of 50 kg P2O5 ha-1 considerably improved velvet bean growth, yield components, and seed yield. According to Kumwenda and Gilbert (1998). *M.Pruriens* produced the most biomass with P2O5 treatment, averaging 7.3 t ha-1. The nutrient omission trial in Mucuna revealed that biomass output was severely reduced on average by 69% (N) and 33% (P) when N and P were not present in the total fertilizer treatment (P) (Houngnandan P, 2001).According to Philip et al. (2001), dry matter production in M was equal for applications of 30 and 45 kg P2O5 ha-1. Bracteate*M. Pruriens* caused the plant's senescence to be postponed, which resulted in better plant growth, more leaves, and leaves that lasted longer. Both organic (cocopeat at 5 t/ha and farm yard manure at 12.5 t/ha) and inorganic (NPK 40:30:30 kg/ha) forms of nourishment were given to pruriens plants(Kavitha, 2006). Mucuna's biomass production is directly correlated with the length of the growing season and the fertility of the soil. Longer growing seasons were associated with higher biomass accumulation (10 t ha-1). Additionally, it was shown that varietal traits had an impact on the rate of dry matter production (IITA, 1997). According to Becker and Johnson (1998), soil phosphorus has a significant role in the buildup of Mucuna biomass because legumes need phosphorus for both growth and nitrogen fixation. Harvesting at the dry pod stage and using an integrated nutrient combination with organic manures (cocopeat at 5 t/ha and farmyard manure at 12.5 t/ha) and inorganic fertilizers (NPK 40:30:30 kg/ha) had a stronger favorable impact on dry matter production(Kavitha C, 2008).The yield of Mucuna seeds, according to Kay (1979), varied from 700 to 1100 kg ha-1 in India, 1700 to 2200 kg ha-1 in the USA, and 600 kg ha-1 in Australia. According to Humphreys and Riveros (1986), staking is typically advised for enhancing the number and quality of Mucuna seed production. There are typically 4 to 8 globular or reniform seeds per pod, and they are typically black, white, creamy yellow, or speckled. The weight of a hundredth seed ranged from 25 to 110 g(Buckles, 1995).

According to Chadha (1995), the seed yield of irrigated and rainfed crops varied. A rainfed crop yielded between 1500 and 1750 kg ha-1 of seed without staking, and between 3000 and 3750 kg ha-1 with staking. 5000 kg/ha of yield have been observed from well-managed, staked irrigated crops(SHIGH B, 1995; Farooqi AA, 1993). According to Kavitha and Vadivel (2006b), the integrated nutrient combination of inorganic fertilizers (NPK 40:30:30 kg/ha) and organic fertilizers (cocopeat at 5 t/ha and farmyard manure at 12.5 t/ha) led to a high seed production.

7. Phytochemistryon the basis of plant part

Leaf: Dopa, L (Proteid), Dopamine, Genistein, Genistein, Hydroxygen, Harman, Bufotenine (Indole Alkaloid), Choline (Alkaloid-misc.), 6-methoxy Tryptamine, 5-hydroxy Tryptamine, n-n-dimethyl and n-n-dimethyl tryptamine: 5-methoxy (Indole Alkaloid)

Pod: Bufotenine, tryptamine, and 5-hydroxytryptamine Tryptamine, n-n-dimethyl: methoxy, and 5-hydroxytryptamine N-n-dimethyl tryptamine: n-oxide (Indole Alkaloid)

Seed: 1-Methyl-3-Carboxy-6,7-Dihydroxy-1,2, 3, -4 Tetrahydroisoquinolone, the amino acid alanine, the alkylamine 5-oxyindole-3-, Indole-3, indole-5-oxyindole-3 Arachidic acid, Arginine, Aspartic, and Behenic acids are all included in the proetid's amino acid analysis. Beta-carotene, calcium, Carbohydrates, Beta carboline, Cis-12,13 epoxyoctadec-trans-9-cis-acid, Cis-12,13 epoxyoctadec-trans-9-enoic acid inhibitor of chymotrypsin the amino acid cysteine, and DOPA-L (Proteid), Unsaturated fat, fatty acids, Flavone, 4'-5-6-trihydroxy-3'-7-8-trimethoxy4'-O-beta-d-xylopyranosyl(1-2) Galactose, D (Carbohydrate), Gallic acid, Glycine, Glutamic acid, Glutathione, Histidine (Amino Acid), Iron (Inorganic), Indole-3-alkylamine, Isoleucine, and Lecithin (Carbohydrate) amino acid leucine, leucine, iso Linoleic acid, linolenic acid (a lipid), methionine (an amino acid), mannose, D (a carbohydrate), mucunadine, mucunain, and Cacao polysaccharide (Carbohydrate), The compound P from *Mucuna pruriens* Q, an alkaloid from *Mucuna pruriens* Alkaloid found in *Mucuna pruriens* Alkaloid S from *Mucuna pruriens* Alkaloid derived from *Mucuna pruriens* (Alkaloid-misc.), the myristic acid N,N-dimethyltryptamine and N,N-dimethyltryptamine-n-oxide are examples of inorganic niacin. Nicotine, Phosphorus, Phenylalanine, Palmitoleic Acid, Oleic Acid, Palmitic Acid, and Palmitoleic Acid (Lipid) (Inorganic), Carbohydrate polysaccharide, amino acid proline, and protein (Protein) Prurienidine, Prurieninine (Miscellaneous Alkaloid), Quinoline, iso: 1-2-3-4-tetrahydro (Isoquinoline Alkaloid), Riboflavin (Inorganic), Saponins (Saponin), Serine (Amino Acid), Serotonin, Sitosterol, Stearic acid, Stizolamine (Alkaloid), Thiamin (Inorganic) (Lipid)(Taylor L, 2005; Muralia S, 2003; Sharma BK, 2012; Verma SC, 2014; Ross IA, 2003).

7.1. Phytochemistry on the basis of class of compound

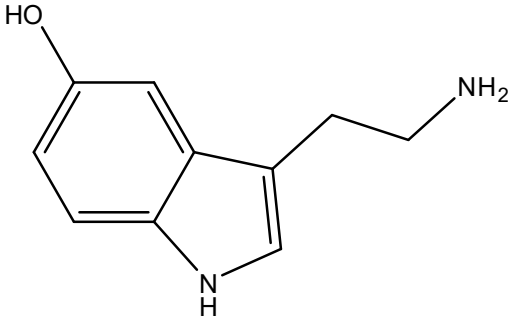
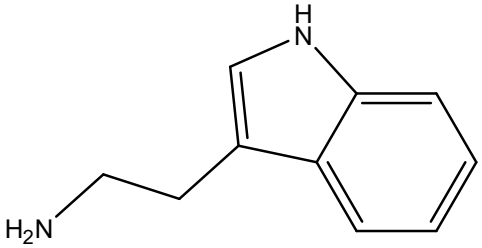
Seed of velvet beans are reported to generate the unordinary nonprotein amino acid 3-(3,4-dihydroxyphenyl)-l-alanine (L-DOPA))(Buckles, 1998). As well includes beta sitosterol, gallic acid, and glutathione. It contains unknown bases like mucunine, prurieninine, prurienine, and mucunadine. Other bases separated from pods, seeds, leaves & N-indole-3-alkylamines and N-dimethyltryptamine are examples of roots. Leafy also provided 6-methoxyharman. Serotonin is present in only pods (Khare CP, 2004). Additionally, the seeds also contain oil with oleic, palmitic, stearic, & linoleic acids(Misra). GC-MS analysis revealed the presence of such as n-hexadecenoic acid (48.21 Oleic acid (7.62%), Squalene (7.87%), Octadecanoic acid (0.8%) with ascorbicacid (3.8%) (6.21%) were detected in the extract (Bhaskar, 2011). Additionally, the seed contains two tetrahydroquinolines. Specifically, alkaloids (-) 3-methoxy-1,1-dimethyl-6,7- Tetrahydro-1,2,3.4-dihydroxyquinoline and (-)-3 methoxy-1,1-dimethyl-7,8-dihydroxy-1,2,3.4- tetrahydroquinoline[60].Additionally, it includes serotonin (5-hydroxytryptamine, Nicotine, 5-HT, 5-hydroxytryptophan (5-HTP), Bufotenine, N, N-dimethyltryptamine (DMT), and 5-MeODMT (5-MeODMT) is also known as 5-imethoxy-N, N-dimethyl tryptamine-oxide (5-MeO-DMT-n-oxide). the finished seeds of the plant contain around 3.1-6.1% L-DOPA, with minute amounts of nicotine,

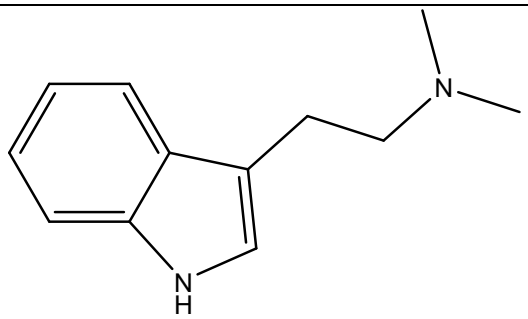
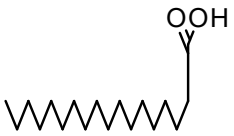
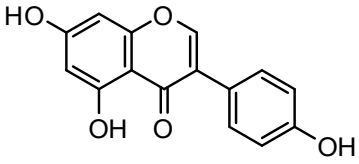
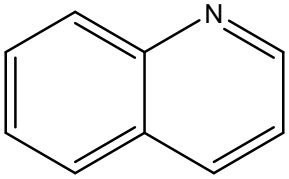
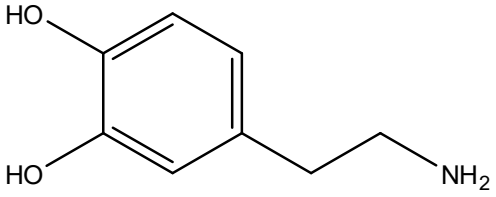
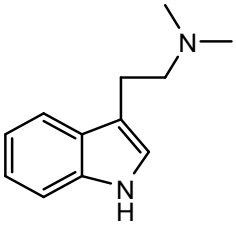
serotonin beta carboline, 5-MeO-DMT-n-oxide, and bufotenine. About 0.5% LDOPA, 0.006% DMT, and 0.0025% 5-MeO-DMT are present in the leaves. And DMT n-oxide at 0.003% (Misra L, 2004; Kumar, 2013)

7.1.1. Alkaloids

These crucial biological processes prompted chemical analyses of *M. pruriens* seeds to separate various fatty acids and amino acids in addition to L-DOPA (Siddhuraju, 1996). A class of naturally occurring chemical compounds known as alkaloids consists primarily of basic nitrogen atoms. Additionally, this group consists of certain linked compounds with neutral or even somewhat acidic characteristics. Alkaloids have also been reported, and their provisional names include prurienine, prurieninine, and prurienidine, as well as bases P, Q, R, S, and X stated in Table 1. (Rakshit, 1956; Ghosal, 1971)

Table 1: Alkaloids compound identified in Mucuna puruiens-

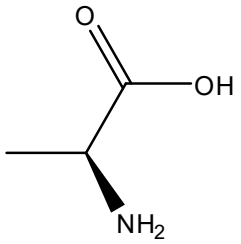
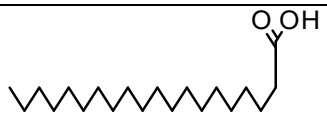
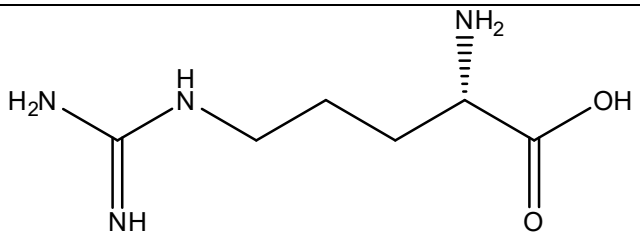
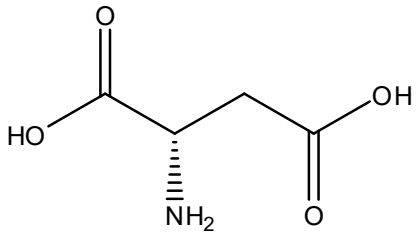
Name	Plant Source	Structure	Reference
5-Hydroxy tryptamine	Pod		[35,52]
Tryptamine	Pod		[35,52]
n-n-DimethylTryptamine	Pod		[35,52]

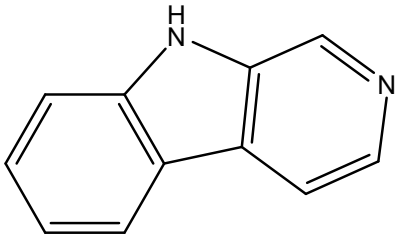
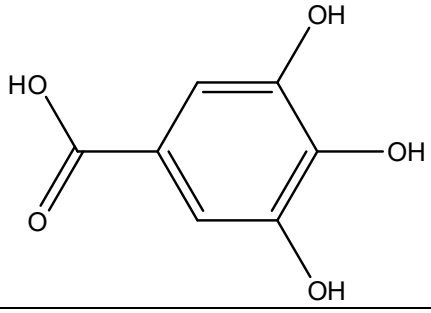
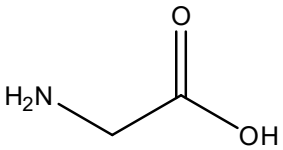
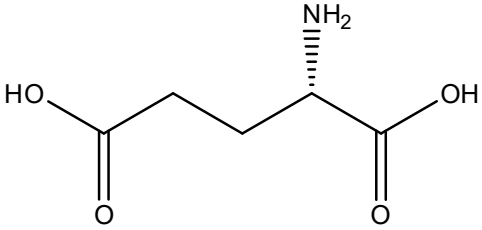
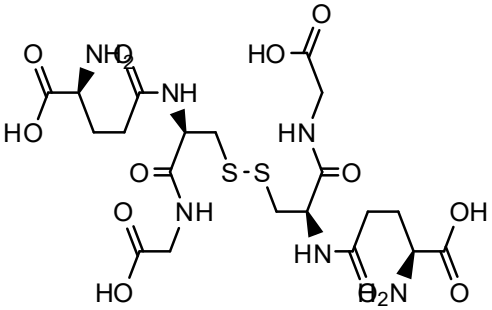
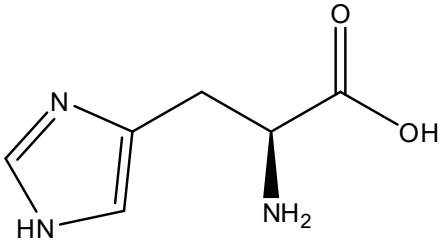
			
Stearic acid	Seed		[35,52]
Genistein	Leaf		[35,52]
Quinoline	Seed		[35,52]
Dopamine	Leaf		[35,52]
Bufotenine	Pod		[35,52]

7.1.2. Amino acids

These beans have a comparable amino acid composition to other legume and vegetable beans, ranging from 18 to 44% dry weight (Kay, 1979). Several studies demonstrate that Mucuna protein, which is composed of albumin and globulins and typically has a positive representation of essential amino acids (Bressani, 2000). Compared to oat grains and root crops, which are poor in protein and lysine, these beans are exceptional examples of additional protein monogastric meal due to their high lysine content and the compound are listed in Table 2.

Table 2: Amino acids compound identified in Mucuna puruiens

Name	Plant Source	Structure	Reference
Alanine	Seed		[35,52]
Arachidic acid	Seed		[35,52]
Arginine	Seed		[35,52]
Aspartic acid	Seed		[35,52]
Behenic acid	Seed		[35,52]
Beta- carboline	Seed		[35,52]

			
Gallic acid	Seed		[35,52]
Glycine	Seed		[35,52]
Glutamic acid	Seed		[35,52]
Glutathione	Seed		[35,52]
Histidine	Seed		[35,52]

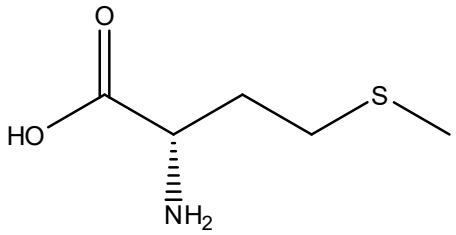
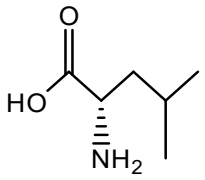
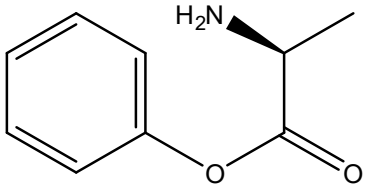
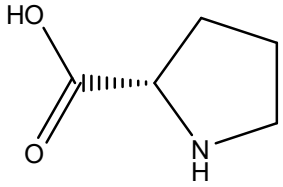
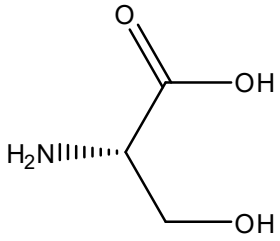
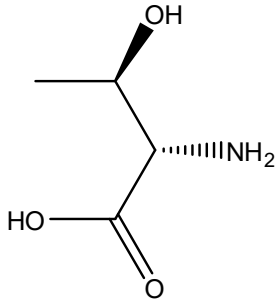
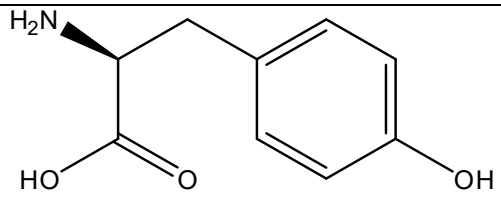
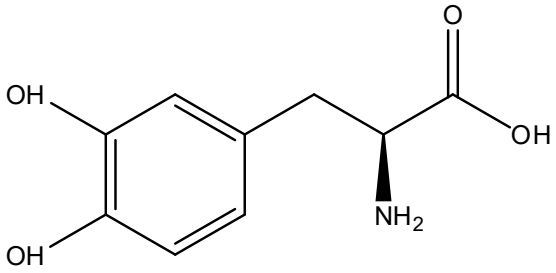
Methionine	Seed		[35,52]
Leucine	Seed		[35,52]
Phenylalanine	Seed		[35,52]
Proline	Seed		[35,52]
Serine	Seed		[35,52]
Threonine	Pod		[35,52]
Tyrosine	Seed		[35,52]

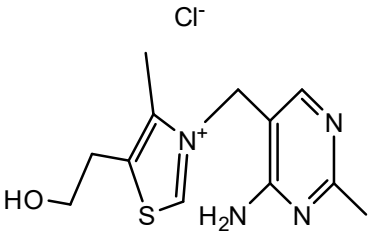
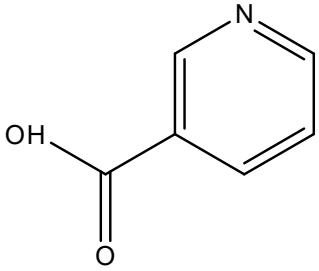
Table 3:Proteidcontent identified in Mucuna puruiens

Name	Plant Source	Structure	Reference
L-DOPA	Leaf		[35,52]

7.1.3. Others

Mucuna pruriens leaves were found to have 18.70, 15.03, and 19.08 mg/g of flavonoids, alkaloids, and saponins, respectively, compared to 8. And 35.5 mg/g of each. The two plants that were studied have the highest concentration of saponins(Ushie).The mature seeds have 525.6 g/kg of carbs, 314.4 g/kg of crude protein, 51.6 g/kg of crude fiber, 67.3 g/kg of crude fat, and 41.1 g/kg of ash(Siddhuraju, 1986). Table 3 and Table 4. possess Proteid and Inorganic content respectively,while in Table 5. Lipid compound was recorded

Table 4: Inorganic content identified in *Mucuna puruiens*

Name	Plant Source	Structure	Reference
Thiamine	Seed		[35,52]
Myristic acid	Seed		[35,52]
Niacin	Seed		[35,52]

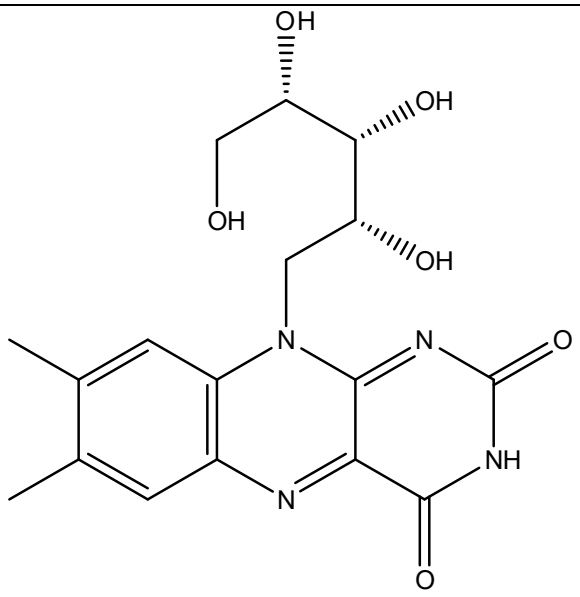
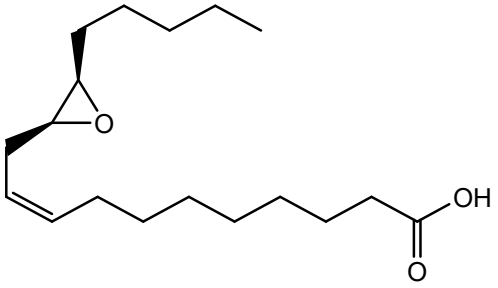
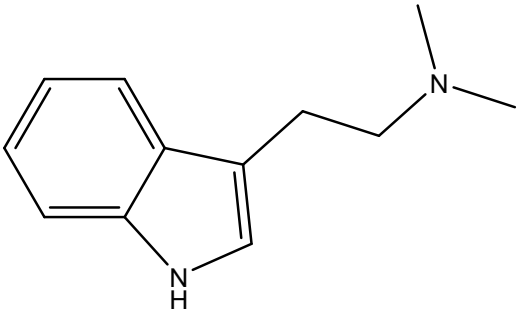
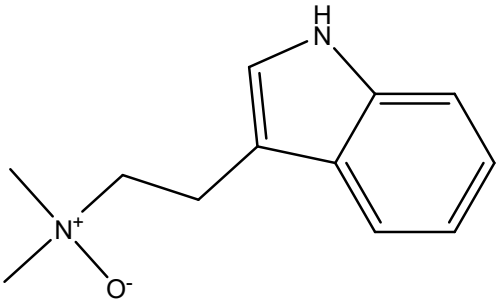
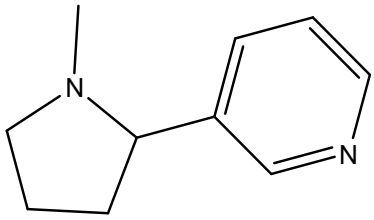
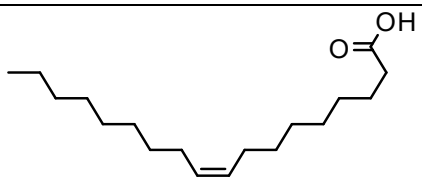
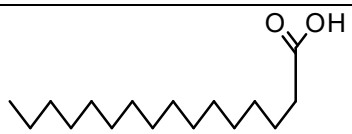
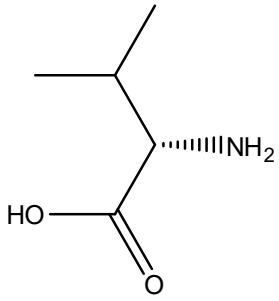
Riboflavin	Seed		[35,52]

Table 5: Lipid compound identified in *Mucuna puruiens*

Name	Plant Source	Structure	Reference
Vernolic acid			[35,52]
n-n Dimethyltryptamine	Seed		[35,52]
n-n-Dimethyltryptamine: n-oxide	Pod		[35,52]

Nicotine	Seed		[35,52]
Oleic acid	Seed		[35,52]
Palmitic acid	Seed		[35,52]
Valine	Seed		[35,52]

8. Pharmacological activity

Over the years, Mucuna has been investigated for a number of pharmacological effects. According to the pharmacological data, Mucuna serves as one of the main ingredients in compositions of polyherbal extracts used to treat a variety of diseases. Following, just several modern examples are described in Table 6.

8.1. Anti-Parkinson activity

Even before the time of Christ, the clinical syndrome of Parkinsonism was recognized in ancient India and was given rigorous treatment. According to "Bhasavarajyam," the administration of powdered *M. pruriens* seed containing 4 to 6% levodopa was used to cure

Parkinsonism (Ovallath, 2013). When compared to equivalent doses of L-dopa, the *Mucuna pruriens* extract used for ant Parkinson's disease (MPE) is known to contain 12.5% L-dihydroxyphenyl alanine (L-dopa), among other ingredients(Kasture, 2007). While L-dopa was equally efficacious only at doses of 6 mg/kg, acute administration of MPE at a dose of 16 mg/kg (including 2 mg/kg of L-dopa) consistently offset the deficit in latency of step commencement and adjusting step caused by a unilateral 6-hydroxydopamine lesion. MPE dramatically improved forelimb placement when vibrissae were triggered at the same dosage, indicating a considerable antagonistic effect on both motor and sensory-motor impairments. Additionally, the turning behavior test and the generation of aberrant involuntary movements (AIMs) following acute or sub chronic injection were used to study the effects of MPE. As delivered at a dose of 48 mg/kg, MPE immediately caused a considerably stronger counter lateral turning behavior than L-dopa (6 mg/kg) when compared to that dose. Both MPE (48 mg/kg) and L-dopa (6 mg/kg) sensitized contralateral turning behavior upon sub chronic administration; however, L-dopa alone also caused a simultaneous sensitization in AIMs, suggesting that *M. pruriens'* dyskinetic potential is lower than that of L-dopa. *M. pruriens* (48 mg/kg) was also successful in

inhibiting tacrine-induced tremulous jaw movements, a reliable test replicating Parkinsonian tremor. Additionally, *M. pruriens* failed to elicit any compartment preference in the location preference test, demonstrating the absence of components in the extract that have rewarding effects. Finally, in a sub-chronic mouse model of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine hydrochloride (MPTP)-induced dopamine neuron degeneration, MPE did not demonstrate the ability to prevent either the decrease in tyrosine hydroxylase caused by MPTP or the activation of astroglia or microglia as determined by glial fibrillary acidic protein (GFAP) and CD11b immunohistochemistry theant Parkinson's activity of MPE is strongly supported by its characterization. Additionally, another study that tested the neurorestorative effects of *M. pruriens* cotyledon powder on the nigrostriatal tract of rats with 6-hydroxyl dopamine (6-OHDA) lesioning demonstrated the plant's neuroprotective properties (Manyam, 2004). The findings showed that, 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. However, *M. pruriens* cotyledon powder treatment did not affect the total monoamine oxidase activity (in vitro). The *M. pruriens* cotyledon powder included coenzyme Q-10 and nicotine adenine dinucleotide (NADH), both of which have been demonstrated to be beneficial in treating Parkinson's disease. A treatment with *M. pruriens* reduces Parkinson's disease symptoms, according to earlier investigations. Increased complex-I activity, the availability of NADH, and coenzyme Q-10 may all contribute to the additional observation that *M. pruriens* cotyledon powder has neurorestorative effects on the substantia nigra's degenerating dopaminergic neurons.

8.2. Antiglycaemicactivity

The existence of D-chiro-inositol and its two galacto-derivatives, which have antiglycaemic effects, was shown in *M. pruriens* seed using a combination of chromatographic and NMR techniques (Donati, 2005).

8.3. Hypoglycemic activity

In normal, glucose load conditions and diabetic rats treated with streptozotocin (STZ), the aqueous extract of the seeds of *M. pruriens* was studied for its hypoglycemic effects. The aqueous extract of the seeds of *M. pruriens* (100 and 200 mg/kg body weight) effectively lowered the blood glucose levels in normal and STZ diabetic rats two hours after oral administration of the seed extract. After 21 days of daily oral administration of the extract, it also considerably reduced the blood glucose in STZ diabetic rats. Thus, the possibility that *M. pruriens* could be a source of hypoglycemic chemicals was demonstrated clearly (Bhaskar A, 2008).

8.4. Aphrodisiac activity

Aphrodisiac is the second most likely effect for this Mucuna. The mounting frequency, intromission frequency, and ejaculation latency were all significantly increased and the mounting latency, intromission latency, post-ejaculatory interval, and inter-intromission interval were all significantly decreased after administration of the *Mucuna pruriens*, ethanolic extract to either sex rats. The potency test markedly improved overall reflex, quick flips, extended flips, and erection. When compared to the control, the ethanolic extracts of *M. pruriens* seed significantly and persistently increased the sexual behavior of healthy male rats at a specific dose (200 mg/kg) (Suresh, 2009).

8.5. Productiveness activity

By affecting the hypothalamus-pituitary-gonad axis, mucuna pruriens increases male fertility. A study on the effects of *M. pruriens* medication on infertile males found that it dramatically increased their serum levels of testosterone, luteinizing hormone, dopamine, adrenaline, and noradrenaline and decreased their levels of follicle stimulating hormone (FSH) and prolactin hormone (PRL). Infertile men's sperm count and motility

greatly improved (Shukla, 2009). After treating the case with *M. pruriens* seed powder at 5 g/day orally, the quality of seminal alterations brought on by psychological stress was evaluated. Semen samples were taken twice for morphological and biochemical investigation, once prior to the initiation of the treatment and once again three months later. The findings showed that participants who were experiencing psychological stress had lower sperm counts and motility. Additionally, it was discovered that there were raised levels of serum cortisol and seminal plasma lipid peroxide, as well as decreased glutathione (GSH), ascorbic acid, and superoxide dismutase (SOD) and catalase contents and activities. Treatment with *M. pruriens* dramatically reduced levels of seminal plasma lipid peroxidation, psychological stress, and increased sperm motility and count. SOD, catalase, GSH, and ascorbic acid levels in the seminal plasma of infertile males were also restored by the treatment. *M. pruriens* helps infertile men handle stress and enhances the quality of their sperm in addition to reactivating their antioxidant defense system (Shukla, 2010). Investigations on *M. pruriens'* effects on male Guinea pig gonads revealed that it may be a viable male antifertility agent, even at a lower dosage of 70 mg/kg (Udoh, 2001).

8.6. Anti- diabetic activity

There have been numerous reports of the antidiabetic properties of Mucuna. Maximum activity was seen at week six with a dose of 200 mg/kg/day of *M. pruriens* ethanolic extract in alloxan-induced rats and streptozotocin-induced mice (Rathi, 2002). A comparison of the hypoglycemic effects of an aqueous extract of M. pruriens seeds under normal, glucose-loading circumstances and in diabetic rats caused by streptozotocin was conducted. The findings demonstrated that the aqueous extract of M. pruriens seeds administered orally at doses of 100 and 200 mg/kg body weight significantly (p 0.001) decreased the blood glucose levels following an oral glucose load from 127.5 3.2 to 75.6 4.8 mg% 2 hours later. Additionally, after 21 days of treatment, it drastically reduced the blood glucose in streptozotocin-induced diabetic rats from 240.5 7.2 to 90.6 5.6 mg% (p 0.001). The study concludes that M. pruriens has an antihyperglycemic effect and may be a source of chemicals that lower blood sugar (Bhaskar, 2008). In an alloxan-induced diabetes model, the hypoglycemic activity of a few ethanolic extracts of Indian medicinal plants was compared, and the plants are listed below in decreasing order of their significant blood glucose-lowering activities in the following 24 samples: *Gymema sylvester*, *Trigonellafoenum-graecum, Tragiain volucrate, Coccinia indica, Pterocarpus marsupium Vinca rosea, Premna integrifolia, Mucuna prurita, Terminalia bellirica, Sesbeniaaegyptiaca, Azadirachta Indica*, *Dendrocala mushamiltonii, Zingiber officinal, Aegle marmelos, Cinnamomum Tamala, Trichosanthes cucumerina,* and *Ocimum sanctum* are some (Kar, 2003).

8.7. Anti-oxidant activity

Both healthy and unhealthy cell metabolism can result in the production of free radicals, which are atoms with one or more unpaired electrons. Free radicals and reactive oxygen species (ROS) react quickly, resulting in the creation of new radicals. Antioxidants shield living things from the harm brought on by unchecked ROS production and the ensuing lipid peroxidation, protein damage, and DNA strand breaks. Studies are being done on a number of natural products that have been shown to contain antioxidants. By scavenging free radicals like peroxide, hydroperoxide, or lipid peroxyl, anti-oxidant substances such phenolic acids, polyphenols, and flavonoids suppress oxidative processes. Because of their capacity to neutralize free radicals and in vivo biological functions, polyphenols are significant phytochemicals(Bravo, 1998). Using the Folin-Ciocalteau reagent, the overall polyphenolic content was calculated. Simple phenolic molecules known as flavonoids have been shown to exhibit a variety of biochemical features, such as anti-oxidant, anti-mutagenic, and anti-carcinogenic action(Beta, 2005). The ability of the M. pruriens methanol extract to donate hydrogen was assessed in the presence of the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical. In a recent study, Kottai Muthu et al. (2010) discovered that the whole M. pruriens plant's ethyl acetate and methanolic extract (MEMP), which is rich in phenolic compounds, has strong anti-oxidant and free radical-scavenging properties. These in vitro tests show that this plant extract provides a considerable source of antioxidants naturally, which

could be helpful in reducing the effects of various oxidative stressors. According to Ujowundu et al. (2010), methanolic extracts of M. pruriens leaves exhibit a wide range of biochemical and physiological functions and contain chemicals that have medicinal value(Lampariello, 2012).

8.8. Antisnake venom activity

In fact, M. pruriens seeds are used in traditional medicine to avoid the harmful consequences of snake bites, which are mostly brought on by powerful toxins such neurotoxins, cardiotoxins, cytotoxins, phospholipase A2 (PLA2), and proteases(Guerranti, 2002). Traditional healers in Plateau State, Nigeria, recommend the seed as a preventative oral anti-snakebite treatment, and it is said that when the seeds are ingested whole, the person is shielded for a whole year from the symptoms of any snake bite(Guerranti, 2001). In a study examining the impacts of Echiscarinatus venom, the mechanisms of the protective effects produced by *kmm.,* seed aqueous extract (MPE) were thoroughly examined (Guerranti, 2002). Mice used in in vivo tests were protected against the poison 24 hours (short term) and 1 month (long term) after MPE injection(Guerranti R, 2008). A multiform glycoprotein found in MPE is an immunogenic component that promotes the formation of antibodies that cross-react with (bind to) specific venom proteins(Guerranti, 2004). This glycoprotein, known as gpMuc, is made up of seven distinct isoforms with molecular weights ranging from 20.3 to 28.7 kDa and pIs ranging from 4.8 to 6.5(Patrizi LD, 2006). That's probable that first or even more gpMuc isoforms resemble venom PLA2 in terms of fundamental structure. Regarding MP seeds and snake venom, the existence of at least one common epitope has been proven. These cross-reactivity studies demonstrate that specific plant species do indeed have PLA2-like proteins, which are helpful for plant growth and are engaged in significant activities (Lee, 2005).

8.9. Antimicrobial activity

Certain plants are known to have compounds in various portions that can be employed as either medicinal agents or as building blocks for the creation of beneficial medications. Further study of plant-based anti-microbials is required since they offer a substantial untapped supply of medications. Plant-based antimicrobials have a huge medicinal promise. According to reports, certain plants' anti-microbial effects are caused by phytochemical substances(Mandal P, 2005). Although bioactive substances are frequently isolated from whole plants, the concentration of such substances in the various plant sections varies. For medicinal purposes, it is advisable to use the parts that are known to have the maximum concentration of the chemicals. To stop the life processes of bacteria, especially pathogens, some of these active ingredients work alone, while others work together. In experimental conditions, crude methanolic extracts of *M. pruriens* leaves have been demonstrated to exhibit modest activity against various bacteria. This is likely because phenols and tannins are present in the extracts. To identify the bioactive elements in charge of the apparent anti-microbial activity, more research is needed(Ogundare AO, 2007).*M. pruriens* extracts demonstrated strong antifungal action against *Curvularia lunata, Fusarium oxysporum, Penicillium expansum, Rhizoctonia solani, Tiarosporella phaseolina,* and *Ustilagopomaydis*. The studied organisms are significantly inhibited to varying degrees by *M. pruriens* extracts (Rayavarapu, 2011).

Table 6: Pharmacological activity of *Mucuna pruriens* and its compounds

Pharmacological activities	Plant component	Extract	Material/ Compound	Reference
Anti-venom	Plant seeds	Water	Proteins(gpMuc)	[88,91]
Anti-microbial	Plant leaves	Methanol	Tannins, alkaloids, L-dopa	[1,96,97]

Neuroprotective	Plant seeds Whole plant	Ethanol/Water (1:1)	L-dopa, amino acids, alkaloids	[22]
Anti-diabetic	Plant seeds	Ethanol/Water (1:1)	Cyclitols, oligosaccharides	[35]
Anti-oxidant	Plant seeds and leaves, Whole plant	Methanol	Phenols, tannins	[84,85]

8.10. Neuroprotection activity

The seeds of *M. pruriens* have long been used in India as an aphrodisiac to promote male virility and as a nervine tonic. The seeds are anti-inflammatory, while the pods are anthelmintic. The anti-parkinsonism properties of powdered seeds may be caused by the presence of L-dopa (a precursor of neurotransmitter dopamine). Dopamine is a neurotransmitter, which is a well-known fact. When the conversion of tyrosine to L-dopa is inhibited, the amount of dopamine in brain tissue decreases. L-Dopa, the dopamine precursor, can pass through the blood-brain barrier and turn into dopamine, reestablishing neurotransmission (Lampariello, 2012). With EtOH-H2O (1:1) and ascorbic acid as a protector, *M. pruriens* seeds can yield significant amounts of L-dopa. The best results in neuroprotective tests involving the proliferation and survival of DA neurons in culture are produced by an n-propanol extract of *M. pruriens* seeds. Interestingly, complete extracts of *M. pruriens* seeds may be more effective than pure L-dopa for treating parkinsonism because they have more neuroprotective activity than n-propanol extracts, which contain very little L-dopa(Misra, 2004).

8.11. Dermatitis activity

A number of external insults, including cigarette smoke, UV radiation, and oxygen, all have the skin as one of its primary targets and all cause oxidative stress, which is harmful (Valacchi G, 2000). Numerous skin conditions like etc.

Zema, psoriasis, and dermatitis are linked to elevated levels of oxidative stress and ROS generation (Briganti, 2003). Research into novel natural substances having antioxidant properties is a growing area of study. As was already noted, several chemicals produced from plants have played a significant role in conventional treatments for a variety of disorders. These compounds have also drawn a lot of attention in recent years due to their varied pharmacological properties.

The expression of all proteins is downregulated in human keratinocytes after treatment with a methanolic extract from MP leaves, according to recent preliminary research from our team. Additionally, MP therapy markedly reduced the baseline levels of 4HNE found in human keratinocytes (Lampariello, 2012). According to this new inquiry, future research targeted at elucidating the processes underlying such benefits as well as analyzing the potential impacts of topical MP methanolic extract treatment on skin conditions would be beneficial

8.12. Antidepressant activity

The effects of M. pruriens' antidepressant action on both acute and chronic models of depression were investigated. Treatment of M. pruriens in the forced swim test (FST), tail suspension tests (TST), and olfactory bulbectomy (OB) for 14 days each was used in the psycho-pharmacological experiment. Mucuna (10–20 mg/kg i.p.) considerably improved the antidepressant effects of bupropion and fluoxetine in the mice FST and TST, respectively. At the same dose level, potentiation of the 5-hydroxytryptophan-induced head twitches response in mice and reversal of the reserpine-induced hypothermia in rats were seen. Furthermore, continuous mucuna administration reduced the abnormal behaviors seen in olfactory bulbectomized rats (OBX), as seen in open field experiments(Verma, 2014).

8.13. Antiprotozoal activity

After being treated with baths of plant extracts containing 200 mg/liter, *Mucuna pruriens* leaf extract in methanol has the ability to completely eradicate Lichthyophtiriusmultifils infection (90%) in gold fish, and parasite-induced fish mortality was dramatically decreased(Ekanem AP, 2004).

8.14. Tumor-fighting activity

Mucuna pruriens seed methanolic extract's antitumor effects were investigated in Swiss albino mice that had the ErlichAcites Carcinoma. Effects of *M. pruriens* seed methanolic extract on delayed hypersensitivity reaction, primary and secondary antibody response, and in vivo mobilization of inflammatory leucocytes in mice. Consequently, it is likely that *M. pruriens* can affect mice's immunological responses(Verma, 2014).

8.15. Antiproliferative activity

Female albino rats that had been given DMBA to generate breast cancer were used to test the antiproliferative capability of *Mucuna pruriens'* aqueous leaf extract. In Huh-7 cells, the MP seed extracts in ethyl acetate and methanol both demonstrated an antiproliferative impact. Later, using MTT reagent to conduct a cytotoxicity assay on THLE-2 cells, it was discovered that the ME extract expressed decreased toxicity on normal human hepatocytes(Yadav, 2015). Using a human hepatic cancer cell line, the extracted M1 (6,7-dimethoxy-1,2,3,4-tetrahydroisoquinoline-3- carboxylic acid) from *M. pruriens* seeds exhibits antiproliferative properties (Huh-7 cells). To begin with, docking tests were carried out to determine the binding affinities of M1 to caspase-3 and 8 enzymes. On Huh-7 cells, M1 had antiproliferative activity (EC 50=13.97mu M) and decreased the activity of the caspase-8 enzyme, signifying the process of apoptosis. M1 was effective against Huh-7 cells that could be used to treat hepatic cancer in the future(Kumar, 2016).The anticancer activity of various *M. Pruriens* seed extracts in vitro against Sertoli (GC) prostate cancer and ZR-75 breast cancer cell lines was compared in this work. In terms of cytotoxicity, cell viability count, and growth inhibition of both cell lines at various concentrations of each extract, or half maximum inhibitory concentration (IC50). When used against GC cells, MEMP and PEMP were found to be more cytotoxic than AEMP (IC50-16.64 g) however when used against ZR-75 cells, MEMP and AEMP were shown to be more cytotoxic than PEMP (IC50-16.63 g) (Soni, 2013). The findings indicate tropical methanolic extract of *M. pruriens* seeds and acute systematic toxicity on albino mice and rabbits, respectively(Ahmed, 2011).

9. Conclusion

A unique plant is *Mucuna pruriens.* Due to its high level of crude fibre, necessary fats, carbohydrates, as well as some essential amino acids it is a good food source on the one hand. However, it also has a number of anti-nutritional components, including protease inhibitors, total phenolics, oligosaccharides (raffinose, stachyose, and verbascose), as well as certain cyclitols having anti-diabetic properties.

Declaration

AS: Writing manuscript, AY: Investigational analysis, ZN: Visualization and supervision, AW: Crirtical review.

Conflict of interest

The author (s) have no conflict of interest

Ethical Approval

Not applicable

Consent to participate

Not applicable

Consent to publication

Not applicable

Availability of data and material

Not applicable

Funding Copyright
None

Acknowledgements
The authors acknowledge the Director Dr A.K. Rai, Pranveer Singh Institute of Technology (Pharmacy), to encourage this review work.

References

1. Ahmed, S., Qureshi, B., Hasan, M., &Azhar, I. (2011). Toxicity assessment of Mucuna pruriens Linn seeds. *Int Res J Pharm*, *2*, 133-5.
2. Amin, K. M. Y., Khan, N., Zillur-Rehman, S., & Khan, N. A. (1996). Sexual function improving effect of Mucuna pruriens in sexually normal male rats. *Fitoterapia*, *67*(1), 53-58.
3. Awang D, Buckles D, ArnasonJT. (1997). The phytochemistry, toxicology and processing potential of the cover crop velvetbean {[cow (h) age, cowitch] MucunaAdans. Spp, Fabaceae}. InInternational Workshop on Green Manure-Cover Crop Systems for Smallholders in Tropical and Subtropical Regions (pp. 6-12).
4. Balandrin, M. F., Klocke, J. A., Wurtele, E. S., & Bollinger, W. H. (1985). Natural plant chemicals: sources of industrial and medicinal materials. *Science*, *228*(4704), 1154-1160.
5. Beta, T., Nam, S., Dexter, J. E., &Sapirstein, H. D. (2005). Phenolic content and antioxidant activity of pearled wheat and roller-milled fractions. *Cereal chemistry*, *82*(4), 390-393.
6. Bhaskar, A., Vidhya, V. G., & Ramya, M. (2008). Hypoglycemic effect of Mucuna pruriens seed extract on normal and streptozotocin-diabetic rats. *Fitoterapia*, *79*(7-8), 539-543.
7. Bhaskar, A., Nithya, V., & Vidhya, V. G. (2011). Phytochemical evaluation by GC-MS and antihyperglycemic activity of Mucuna pruriens on streptozotocin induced diabetes in rats. *J. Chem. Pharm. Res*, *3*(5), 689-696.
8. Bravo, L., Siddhuraju, P., &Saura-Calixto, F. (1998). Effect of various processing methods on the in vitro starch digestibility and resistant starch content of Indian pulses. *Journal of Agricultural and Food Chemistry*, *46*(11), 4667-4674.
9. Bressani, R. (2002). Factros influencing nutritive value in food legumes, Mucuna compared to other grain legumes. *Food and feed mucuna: Current use and the way forward. Proceedings of an international work shop on food and feed from mucuna: current uses and the way forward. Tegucigalpa Honduras April 26-29, 2000*, 164-188.
10. Briganti, S., & Picardo, M. (2003). Antioxidant activity, lipid peroxidation and skin diseases. What's new. *Journal of the European Academy of Dermatology and Venereology*, *17*(6), 663-669.
11. Chaudhri, R. D. (1996). Herbal drugs industry: a pratical approach to industrial pharmacognosy. In *Herbal drugs industry: a pratical approach to industrial pharmacognosy* (pp. 648-648).
12. D'mello, J. P. F. (1995). Anti-nutritional substances in legume seeds. *Tropical legumes in animal nutrition.*, 135-172.
13. Donati, D., Lampariello, L. R., Pagani, R., Guerranti, R., Cinci, G., &Marinello, E. (2005). Antidiabetic oligocyclitols in seeds of Mucuna pruriens. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, *19*(12), 1057-1060.
14. Ekanem, A. P., Obiekezie, A., Kloas, W., & Knopf, K. (2004). Effects of crude extracts of Mucuna pruriens (Fabaceae) and Carica papaya (Caricaceae) against the protozoan fish parasite Ichthyophthiriusmultifiliis. *Parasitology Research*, *92*, 361-366.
15. Farooqi, A. A. (1993). *Production technology of medicinal and aromatic crops*. Indian Herbs Research & Supply Company.
16. Ghosal, S., Singh, S., & Bhattacharya, S. K. (1971). Alkaloids of Mucuna pruriens chemistry and pharmacology. *Planta Medica*, *19*(01), 279-284.

17. Gupta, M., Chakrabarti, S., Bhattacharya, S., &Rath, N. (1997). Anti-epileptic and anti-cancer activity of some indigenous plants. *Indian Journal of Physiology and Allied Sciences*, *51*, 53-56.
18. Gurumoorthi, P., Kumar, S. S., Vadivel, V., &Janardhanan, K. (2003). Studies on agrobotanicalcharecters of different accessions of velvet bean collected from Western Ghats, south India. *Tropical and subtropical Agroecosystems*, *2*(3), 105-115.
19. Guerranti, R., Aguiyi, J. C., Errico, E., Pagani, R., &Marinello, E. (2001). Effects of Mucuna pruriens extract on activation of prothrombin by Echiscarinatus venom. *Journal of Ethnopharmacology*, *75*(2-3), 175-180.
20. Guerranti, R., Aguiyi, J. C., Neri, S., Leoncini, R., Pagani, R., &Marinello, E. (2002). Proteins from Mucuna pruriens and Enzymes fromEchiscarinatus Venom: CHARACTERIZATION AND CROSS-REACTIONS. *Journal of Biological Chemistry*, *277*(19), 17072-17078.
21. Guerranti, R., Ogueli, I. G., Bertocci, E., Muzzi, C., Aguiyi, J. C., Cianti, R., ... & Pagani, R. (2008). Proteomic analysis of the pathophysiological process involved in the antisnake venom effect of Mucuna pruriens extract. *Proteomics*, *8*(2), 402-412.
22. Guerranti, R., Aguiyi, J. C., Ogueli, I. G., Onorati, G., Neri, S., Rosati, F., ... &Marinello, E. (2004). Protection of Mucuna pruriens seeds against Echiscarinatus venom is exerted through a multiform glycoprotein whose oligosaccharide chains are functional in this role. *Biochemical and Biophysical Research Communications*, *323*(2), 484-490.
23. Hishika, R., Shastry, S., Shinde, S., &Guptal, S. S. (1981). Preliminary phytochemical and anti-inflammatory activity of seeds of Mucuna pruriens. *Indian J. pharmacol*, *13*(1), 97-98.
24. Houngnandan, P., Sanginga, N., Okogun, A., Vanlauwe, B., Merckx, R., & Van Cleemput, O. (2001). Assessment of soil factors limiting growth and establishment of Mucuna in farmers' fields in the derived savanna of the Benin Republic. *Biology and fertility of soils*, *33*, 416-422.
25. Hussian, G., &Manyam, B. V. (1997). Mucuna pruriens proves more effective than L-DOPA in Parkinson's disease animal model. *Phytotherapy Research: An International Journal Devoted to Medical and Scientific Research on Plants and Plant Products*, *11*(6), 419-423.
26. Jeyaweera DM. Medicinal plants used in Ceylon Colombo. National Science Council of Sri Lanka, Lanka. 1981.
27. Kar, A., Choudhary, B. K., & Bandyopadhyay, N. G. (2003). Comparative evaluation of hypoglycaemic activity of some Indian medicinal plants in alloxan diabetic rats. *Journal of ethnopharmacology*, *84*(1), 105-108.
28. Kasture, S., Pontis, S., Pinna, A., Schintu, N., Spina, L., Longoni, R., ... & Morelli, M. (2009). Assessment of symptomatic and neuroprotective efficacy of Mucuna pruriens seed extract in rodent model of Parkinson's disease. *Neurotoxicity research*, *15*, 111-122.
29. Kavitha, C., & Vadivel, E. (2006). Effect of organic manures and inorganic fertilizers on growth characters of Mucuna pruriens (L.). *Plant Archives*, *6*(1), 197-200.
30. Kavitha, C., & Vadivel, E. (2008). Effect of organic manures and inorganic fertilizers on dry matter production and L-Dopa content of Mucuna pruriens (L.) DC. –A leguminous medicinal plant. *Legume Research-An International Journal*, *31*(1), 44-47.
31. Kavitha C, Thangamani C.(2014) Amazing bean âMucunaprurienså€: A comprehensive review. Journal of Medicinal Plants Research. 8(2):138-43.
32. Katzenschlager, R., Evans, A., Manson, A., Patsalos, P. N., Ratnaraj, N., Watt, H., ... & Lees, A. J. (2004). Mucuna pruriens in Parkinson's disease: a double blind clinical and pharmacological study. *Journal of Neurology, Neurosurgery & Psychiatry*, *75*(12), 1672-1677.
33. Khare, C. P. (2004). *Indian herbal remedies: rational Western therapy, ayurvedic, and other traditional usage, Botany*. Springer science & business media.
34. Khory, N. R., &Katrak, N. N. (1999). Materia medica of India and their therapeutics 380. *BDH Printers, New Delhi*.

35. Kumar, P., &Saha, S. (2013). An updated review on taxonomy, phytochemistry, pharmacology and toxicology of Macuna pruriens. *Journal of Pharmacognosy and Phytochemistry*, *2*(1), 306-314.
36. Kumar, P., Rawat, A., Keshari, A. K., Singh, A. K., Maity, S., De, A., ... &Saha, S. (2016). Antiproliferative effect of isolated isoquinoline alkaloid from Mucuna pruriens seeds in hepatic carcinoma cells. *Natural product research*, *30*(4), 460-463.
37. Lampariello, L. R., Cortelazzo, A., Guerranti, R., Sticozzi, C., &Valacchi, G. (2012). The magic velvet bean of Mucuna pruriens. *Journal of traditional and complementary medicine*, *2*(4), 331-339.
38. Cortelazzo, A., Lampariello, R. L., Sticozzi, C., Guerranti, R., Mirasole, C., Zolla, L., ... &Valacchi, G. (2014). Proteomic profiling and post-translational modifications in human keratinocytes treated with Mucuna pruriens leaf extract. *Journal of ethnopharmacology*, *151*(2), 873-881.
39. Lee, H. Y., Bahn, S. C., Shin, J. S., Hwang, I., Back, K., Doelling, J. H., & Ryu, S. B. (2005). Multiple forms of secretory phospholipase A2 in plants. *Progress in lipid research*, *44*(1), 52-67.
40. Mandal, P., Babu, S. S., & Mandal, N. C. (2005). Antimicrobial activity of saponins from Acacia auriculiformis. *Fitoterapia*, *76*(5), 462-465.
41. Manyam, B. V., Dhanasekaran, M., & Hare, T. A. (2004). Neuroprotective effects of the antiparkinson drug Mucuna pruriens. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*, *18*(9), 706-712.
42. Misra, L., & Wagner, H. (2004). Alkaloidal constituents of Mucuna pruriens seeds. *Phytochemistry*, *65*(18), 2565-2567.
43. Muralia, S., & Pathak, A. K. (2003). Database of medicinal plant used in ayurveda. *Medicinal and aromatic plants cultivation and uses*, 185-187.
44. Nadkarni, A. K., & Nadkarni, A. K. (1982). Indian material medica, popular prakashanpvt ltd. *Bombay India*, *1*, 1199.
45. Natarajan, K., Narayanan, N., & Ravichandran, N. (2012). Review on "mucuna"-the wonder plant. *Int J Pharm Sci Rev Res*, *17*(1), 86-93.
46. Ogundare, A. O., &Olorunfemi, O. B. (2007). Antimicrobial efficacy of the leaves of Dioclearеflexa, Mucuna pruriens, Ficusasperifolia and Tragiaspathulata. *Research Journal of Microbiology*, *2*(4), 392-396.
47. Oudhia P. My experiences with world's top ten Indian medicinal plants: Glimpses of research at farmer's field in Chhattisgarh (India). InAbstract. Workshop cum Seminar on Sustainable Agriculture for 21st Century, IGAU, Raipur, India 2001 Jan (pp. 20-21).
48. Oudhia, P., & Tripathi, R. S. (2001, April). The possibilities of commercial cultivation of rare medicinal plants in Chhattisgarh (India). In *Abstract. VII National Science Conference, Bhartiya Krishi AnusandhanSamittee, Directorate of Cropping System Research, Meerut, India* (Vol. 12, p. 14).
49. Ovallath, S., & Deepa, P. (2013). The history of parkinsonism: descriptions in ancient Indian medical literature. *Movement Disorders*, *28*(5), 566-568.
50. Patrizi, L. D., Rosati, F., Guerranti, R., Pagani, R., Gerwig, G. J., &Kamerling, J. P. (2006). Structural characterization of the N-glycans of gpMuc from Mucuna pruriens seeds. *Glycoconjugate journal*, *23*, 599-609.
51. Rajeshwar, Y., Kumar, G. S., Gupta, M., &Mazumder, U. K. (2005). Studies on in vitro antioxidant activities of methanol extract of Mucuna pruriens (Fabaceae) seeds. *Eur Bull Drug Res*, *13*(1), 31-39.
52. Rakshit, S., & Majumdar, D. N. (1956). Mucuna pruriens DC. Part V. Alkaloidal constituents and their characterization. *Indian J Pharm*, *18*, 285-287.
53. Rathi, S. S., Grover, J. K., & Vats, V. (2002). The effect of Momordica charantia and Mucuna pruriens in experimental diabetes and their effect on key metabolic enzymes involved in carbohydrate metabolism. *Phytotherapy research*, *16*(3), 236-243.
54. Rayavarapu, A. K., & DSVGK, K. (2011). Evaluation of antimicrobial activity of Mucuna pruriens on plant pathogens. *Asian Journal Biochemical and Pharmaceutical Research*, *2*, 593-600.

55. Ross IA. Mucuna pruriens. InMedicinal Plants of the World 2003 (pp. 305-314). Humana Press, Totowa, NJ.
56. Sahaji, P. S. (2011). Acute oral toxicity of Mucuna pruriens in albino mice. *Int. Res. J. Pharm*, *2*(5), 162-163.
57. Sathiyanarayanan, L., &Arulmozhi, S. (2007). Mucuna pruriens Linn. -A comprehensive review. *Pharmacognosy Reviews*, *1*(1).
58. Sharma, B. K., Ahmad, S., Singh, R., Verma, R. K., & Kumar, N. (2012). A review on Mucuna pruriens: Its phyto constituents and therapeutic uses. *Novel Science International Journal of Pharmaceutical Science*, *1*(6), 308-312.
59. Shukla, K. K., Mahdi, A. A., Ahmad, M. K., Shankhwar, S. N., Rajender, S., &Jaiswar, S. P. (2009). Mucuna pruriens improves male fertility by its action on the hypothalamus–pituitary–gonadal axis. *Fertility and sterility*, *92*(6), 1934-1940.
60. Shukla, K. K., Mahdi, A. A., Ahmad, M. K., Jaiswar, S. P., Shankwar, S. N., & Tiwari, S. C. (2010). Mucuna pruriens reduces stress and improves the quality of semen in infertile men. *Evidence-Based Complementary and Alternative Medicine*, *7*(1), 137-144.
61. Siddhuraju, P., Vijayakumari, K., &Janardhanan, K. (1996). Chemical composition and protein quality of the little-known legume, velvet bean (Mucuna pruriens (L.) DC.). *Journal of Agricultural and Food Chemistry*, *44*(9), 2636-2641.
62. Soni, S., Vaidya, S., Jain, A. K., & Sharma, A. (2013). A comparative study on anticancer potential of different extracts of Mucuna pruriens Linn. seeds against sertoli (GC) and ZR-75 cell lines. *IJPCBS*, *3*(2), 305-314.
63. Sridhar, K. R., & Bhat, R. (2007). Agrobotanical, nutritional and bioactive potential of unconventional legume–Mucuna. *Livestock Research for Rural Development*, *19*(9), 126-130.
64. Suresh, S., Prithiviraj, E., & Prakash, S. (2009). Dose-and time-dependent effects of ethanolic extract of Mucuna pruriens Linn. seed on sexual behaviour of normal male rats. *Journal of ethnopharmacology*, *122*(3), 497-501.
65. Udoh, P., &Ekpenyong, J. (2001). Effect of Mucuna urens (horse eye bean) on the gonads of male guinea-pigs. *Phytotherapy Research*, *15*(2), 99-102.
66. Ushie, O. A., Iyen, S. I., Abeng, F. E., Azuaga, T. I., Okpaegbe, U. C., &Aikhoje, E. F. (2019). Quantification of Alkaloids, Flavonoids and Saponins in Physalis angulata and Mucuna pruriens. *Records of Chemical Sciences*, *1*(2), 86-89.
67. Valacchi, G., Weber, S. U., Luu, C., Cross, C. E., & Packer, L. (2000). Ozone potentiates vitamin E depletion by ultraviolet radiation in the murine stratum corneum. *FEBS letters*, *466*(1), 165-168.
68. Verma, D. M., Balakrishnan, N. P., & Dixit, R. D. (1993). Flora of Madhya Pradesh Botanical Survey of India. *Calcutta. Vol. I*.
69. Verma, S. C., Vashishth, E., Singh, R., Pant, P., &Padhi, M. M. (2014). A review on phytochemistry and pharmacological activity of parts of Mucuna Pruriens used as an ayurvedic medicine. *World J Pharm Res*, *3*(5), 138-158.
70. Yadav, R. K., Singh, M., Sarkar, S., Maity, S., &Saha, S. (2015). Cytotoxicity of different extracts of Mucuna pruriens seeds on hepatoma cells but not on normal hepatic cells. *Pharmacognosy communications*, *5*(1).