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Potential Benefits of an Ethanopharmacological Herb: A Systematic Analysis on Velvet Bean (*Mucuna pruriens* L.)

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ABSTRACT: The plant *Mucuna pruriens*, also known as cow-age, cowitch, velvet bean is belongs to the family of the leguminosae and has been used in Indian medicine for centuries. The plant is known for its therapeutic properties and has been used to treat various ailments such as Parkinson's disease, infertility, and sexual dysfunction. It contains high levels of L-DOPA, a precursor to the neurotransmitter dopamine, which plays a crucial role in regulating mood, motivation, and movement. L-DOPA, an amino acid that serves as a direct precursor to the neurotransmitter dopamine, which is widely used to treat Parkinson's disease, can be found naturally in *M. pruriens* seed (PD). In addition to L-DOPA, *M. pruriens* also contains the chemicals serotonin, oxitriptan, nicotine, N,N-DMT, and bufotenine. Mucuna is regarded as a potent aphrodisiac, geriatric tonic, and vermifuge in ancient Ayurveda literature. Additionally, it is used to treat other conditions like tuberculosis, edema, constipation, fever, and irregular menstruation. *Mucuna pruriens* is also grown as a green manure crop, an ornamental plant, living mulch, and a food crop. This review provides an overview of *M. pruriens'* botany, applications, phytochemical components, and pharmacological properties.

Keywords: *Mucuna pruriens,* Photochemistry, Behavioural changes, Ethanopharmacological Benefits, Antidiabetic, Antianxiety, Anti venom, Aphrodisiac, Adverse Drug Reactions.

INTRODUCTION

The two most significant variables endangering human kind's chances of surviving on Earth seem to be a shortage of food and illnesses. Humans have performed experiments with a number of methods as well as approaches to heal themselves of illnesses. The first evidence-based experiments were conducted with plants as well as plant-based goods because it was convenient to access the wide range of plants rising nearby the location where one lives (Ekor, 2014). Approximately 75–80% of the population, predominantly in emerging regions, even now relies on herbal remedies as their foremost source of fundamental health care because of their superior suitability with the human body systems and fewer adverse reactions. According to (Yu Shi *et al.,* 2021). Herbal remedies have been utilised in India to treat a wide range of diseases. Conventional medicine, as defined by the WHO, is a synthesis of the therapeutic knowledge of earlier generations of indigenous healthcare systems. Only conventional medications, which mainly employ medicated plant preparations for treatment, are considered ayurvedic substances. Based on the studies conducted (Keerthana Kalla 2021). Many countries consider these preparations throughout the world to date back about 5,000 years. The Vedas, among the earliest mythological stories in India, have been written between 4500 and 1600 BC, so they contain the very first reference to humans making use of traditional medicines. *Mucuna Pruriens* (L.) DC ranks among the most significant and underutilised traditional medicines (Thyaga, 2017). *Mucuna Pruriens* has been employed as a treatment for Parkinson's disease (PD) since over 4500 years ago, beginning with doctors in the Vedic Period. One of the most intriguing synthetic states on the entire planet can be found in this plant (Keerthana Kalla, 2021), Mucuna is the source of a variety of intriguing alkaloids with significant impacts on the nervous system of humans. The tropical legume *M. pruriens* is also known as velvet bean, cowitch, cowhage, or alkushi. One of the most well-liked herbal plants from India, the active ingredients of mucuna are the key materials in more than 200 locally produced

pharmaceutical preparations. Only after the discovery of L-3,4-dihydroxyphenyl alanine (L-DOPA), an anti-disease Parkinson's drug, in the Mucuna seeds did the demand for Mucuna increase dramatically in both the Indian and international drug markets (Farooqi *et al.,* 1999).

PLANT TAXONOMY

Mucuna is a genus of climbing shrubs and creepers in the Leguminosae family. It is common all over the globe, particularly in tropical African Continent, Asia, and the Caribbean forests (DeFilipps and Krupnick 2018). Twining annual scrub *M. pruriens* can grow as long as 10-15 metres, with fuzzy hairs nearly completely covering it. The petioles are lengthy and soft to the touch, and the leaves are trifoliate, the twining ternate, or spiralled out of control. Blossoms come in hanging racemes and are dark purple, white, or lavender in colour. Fruits are 10 cm in length and have curved longitudinal pods with 4-6 seeds (DeFilipps and Krupnick 2018). They have thick, enduring, golden yellow or greyish terpenes covering them, which, when in proximity to the skin, can form an abrasive burning sensation. Mucunain, a protein, and serotonin are responsible for the irritation (DeFilipps and Krupnick 2018) Fig. 1 projects the different parts of the plant of *Mucuna Pruriens.*

A: Seeds, B: Flowers, C: Dried seeds, D: Dried seeds with Fuzzy hair (responsible for itching) and Powder, E: Leaves.

Fig. 1. Different parts of *Mucuna Pruriens.*

AGRONOMY

In India, Mucuna is cultivated as an autumn crop, with seeds sown at a rate of 50 kg per hectare and plants spaced 60–60 cm apart. For growth and yield increases of up to 25%, support is necessary. Application of P2O5 significantly increased seed yield, yield components, and growth (Lampariello *et al.,* 2012). A nutrient omission trial revealed that the absence of N and P significantly reduced biomass production of Mucuna, now a days Mucuna is produced with both organic and inorganic nutrients (Jemo *et al.,* 2007). The length of the growing season and the fertility of the soil affect biomass yield. In regions with a longer growing season, Mucuna biomass production was seen, and phosphorus in soil plays a significant role. Organic manures and inorganic fertilisers combined with harvesting at the dry pod stage had a positive effect on the production of dry matter. The amount of seed produced varied depending on whether the crop was rain fed or irrigated, and well-managed irrigated crops with stakes have produced yields of up to 5000 kg/ha (Singh *et al.,* 1995).

PHYTONUTRIENT AND BENEFITS

Pruriens seeds contain high amounts of L-DOPA, beta-sitosterol, lecithin, gallic acid, and other amino acids, as well as nicotine, 5-hydroxytryptamine, dimethyl tryptamine, bufotenine, 5-MeO-DMT, and beta-carboline. 0.5% L-DOPA, 0.006% dimethyl tryptamine, and 0.0025% 5-MeO-DMT are found in the leaves. L-DOPA is a precursor to dopamine, which is essential for proper brain function and can help improve mood, memory, and focus. Additionally, the presence of 5-MeO-DMT in the leaves may have psychoactive effects (Thyaga, 2017) *Mucuna Pruriens* has favourable therapeutic qualities across its various parts and is used to manage an array of diseases, including PD (Singh *et al.,* 1995), edoema, pyrexia, tuberculosis, ulcers, as well as urinary tract, neurobiological, and menstruation disorders, and helminthiases like elephantiasis (Mukesh *et al.,* 2017) *Mucuna Pruriens* is a legume that is grown for medicine, feed, dryland, and organic manure. If taken in significant quantities as food, it is hazardous to non-ruminant mammals, including humans. It contains L-DOPA, a precursor to dopamine that can be converted to Dopamine in the brain using DDC. L-DOPA concentrations in Mucuna seeds ranged from 3.9 to 6.2%, according to HPLC analyses.

SYNTHETIC PRODUCTION

L-DOPA is in high demand, so in vitro production of the drug using cell cultures is now widely used to meet that demand. It has been documented that *M. pruriens* callus and cell suspension cultures contain L-DOPA. Thin-layer chromatography (TLC) and high-performance liquid chromatography (HPLC) (Raghavendra *et al.,* 2012). To show that L-DOPA was present in the cell suspension cultures of M. pruriens. Addition of 2,4-D to the M. pruriens cell suspension culture medium inhibited the production of L-DOPA (Sanjay *et al.,* 2010). *M. pruriens* f. pruriens cell cultures produced L-DOPA at a noticeably higher rate than single-stage cultures did (Raghavendra *et al.,* 2012). High yields of L-DOPA were related to the accurate control of pH, an adequate concentration of Indole-3-Acetic Acid (IAA), and a yellowish or brown cell colour that indicated melanin production (Pugalenthi and Vaidvel 1997). The best medium for inducing callus was Murashige and Skoog (MS) medium with 2 mg/L 2,4-D. L-DOPA accumulation was more pronounced in cell suspension culture in liquid MS medium with 4% sucrose, 1 mg/L IAA, and 1 mg/L BA (Khanpour *et al.,* 2015). The findings of this study could have important implications for the

production of L-DOPA, which is used in the treatment of Parkinson's disease. Further research could focus on optimising the production process and scaling up to industrial levels.

PHARMACOLOGY

Anti-Parkinson's activity: The clinical syndrome of Parkinsonism was recognised in ancient India and given methodical treatment. The administration of powdered *M. pruriens* seed containing 4–6% levodopa was used to treat it (Cilia *et al.,* 2017). *M. pruriens* displayed twice the anti-Parkinsonian activity of synthetic L-DOPA for the same dose. role of L-DOPA in the recovery of PD, followed by Ayurvedic treatment, it is also found that 30 g of a preparation made from mucuna seed powder acts on Parkinson's patients much more quickly than traditional drugs like levodopa or carbidopa (Ghazala Hussain *et al.,* 2015). These researchers hypothesised that a natural source of L-DOPA might be superior to traditional medications in the long-term management of PD.

Antiglycaemic effect: D-chiro-inositol and its two galacto-derivatives, which have an antiglycemic effect, were found in *M. pruriens* seeds using chromatographic and NMR techniques (Donati *et al.,* 2005). This finding suggests that M. pruriens seeds may have potential as a natural remedy for managing blood sugar levels, particularly in individuals with diabetes or at risk of developing the condition. Further research is needed to determine the optimal dosage and potential side effects of these compounds.

Antidiabetic activity: The aqueous extract of the seeds of *M. pruriens* was studied for its hypoglycaemic effects in normal, glucose-loaded, and STZ-induced diabetic rats. The extract significantly lowered blood glucose levels in normal and STZ diabetic rats 2 hours after oral administration and after 21 days of daily oral administration (Bhaskar *et al.,* 2008). This suggests that *M. pruriens* could be a source of hypoglycaemic compounds. This finding suggests that *M. pruriens* could potentially be used as a natural remedy for managing diabetes. Further research is needed to identify the specific compounds responsible for the hypoglycaemic effects and to determine their safety and efficacy in humans.

Antioxidant activity: This *M. pruriens* plant extract, which was made from ethyl acetate and methanol and contains a significant amount of phenolic compounds, demonstrated strong antioxidant and free radical-scavenging properties in almost all of its components (Altemimi *et al.,* 2017). Significant amount of naturally occurring antioxidants was present in these plant extracts, which could be helpful in reversing the effects of various oxidative stresses (Indla *et al.,* 2023). Free radicals are extremely reactive molecules that can harm cells and cause ageing and disease. Antioxidants are essential in preventing this cell damage. Therefore, the *M. pruriens* extract's antioxidant activity may have potential health advantages.

Antianxiety Activity: A study on the leaves of *Mucuna Pruriens* of antianxiety activity on wistar albino rats conducted gave a promising results without producing any adverse drug reactions, according to this study, the standard drug Diazepam and the MP-200 & 400 were used as a test compound on wistar albino rats, after the comparison of the results of standard drug with the control and test compounds - Mucuna 200 & 400mg/kg, it was observed a promising improvement in controlling anxiety tested on Elevated Plus maze. This study also providing the novel information that most of the drugs used in the treatment of anxiety causes Sedation as their adverse drug reactions, but no sedation was noted throughout this study this is a very good observation made. Further studies may be needed to find out the potential mechanism of action of MP extract and the target which are involved in reducing anxiety.

Anti-venom activity: Research on *M. pruriens* seeds' effects against Naja species has revealed their potential for use in the prophylactic treatment of snakebites. Aqueous extracts of *M. pruriens* seeds were tested for a number of pharmacological effects, including lethality, phospholipase activity, edema-forming activity, fibrinolytic activity, and haemorrhagic activity of cobra and krait venoms. The lethal activity of 2LD50 cobra and krait venoms was completely neutralised by 0.16 mg and 0.19 mg of *M. pruriens* seed extracts, respectively. By neutralising the venom toxins, rats pre-treated with *M. pruriens* seed extract showed protective effects against the lethal and cardiovascular depressant effects of Naja sputatrix venoms (Tan *et al.,* 2009).

Antimicrobial activity: Plant metabolites are isolated from pathogenic bacteria and fungi using *M. pruriens.* It has high antifungal activity against plant microbial as well as humans like *Fusarium oxysporum*, *Pencillium expansum,* and Rhizopus, as well as high antibacterial activity against Erwinia carotovora, *Curvularia lunata,* Pseudomonas syringae, Pseudomonas marginalis, Pseudomonas acruginosa, and *Xanthomonas campestris* (F) (Mastan *et al.,* 2009).

Aphrodisiac activity: The oral administration of 5 g of Mucuna seed powder once daily reduced psychological stress, elevated levels of seminal plasma liquid peroxide, and increased sperm motility and count. The study came to the additional conclusion that *M. pruriens* activates the antioxidant defense system, aids in stress management, and enhances semen quality (Shukla *et al.,* 2010).

CONCLUSIONS

M. pruriens is an intriguing herb with numerous applications in pharmacological preparation; the antioxidants that are present in *Mucuna Pruriens* have a great role in managing neurobehavioral conditions. In addition to its antifungal and antibacterial, aphrodisiac, antiparkinsonian, hypoglycaemic, and anti-venom properties, *M. pruriens* has potential applications in pharmacological preparations due to its intriguing properties. Further research is needed to fully understand the effects of the antioxidants present in *M. pruriens* on managing neurobehavioral conditions and their potential to impact on the Central Nervous System.

FUTURE SCOPE

This review raises awareness of *Mucuna pruriens* and the various therapeutic benefits of its parts. As a result, researchers can concentrate on conducting and evaluating pharmacological activities and analysing the active molecules responsible for a proper understanding of its mechanisms, particularly in the therapeutic area of the Central nervous system.

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Conflict of Interest. None.

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