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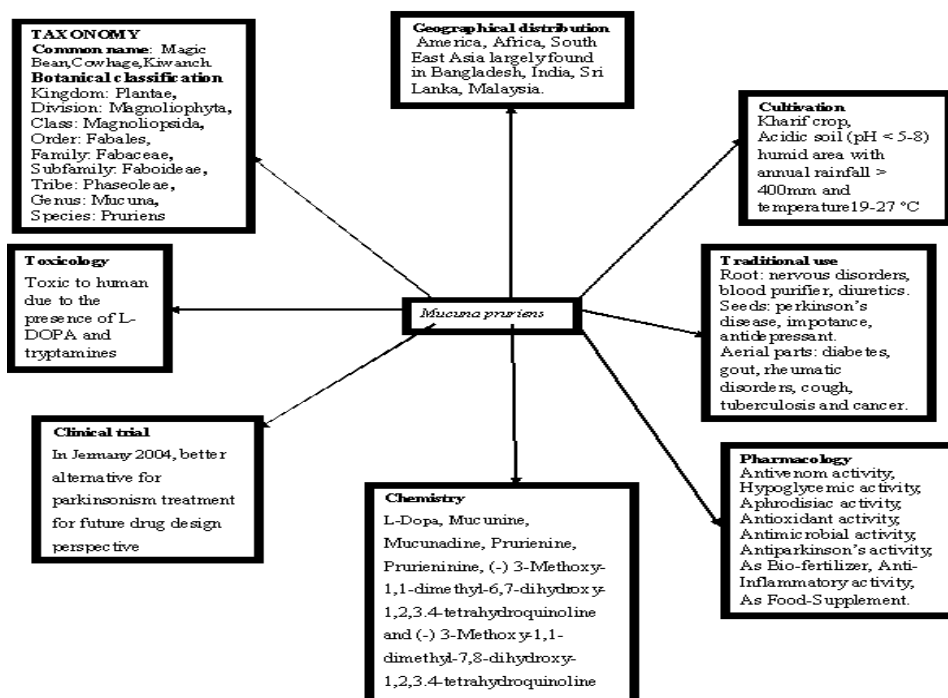
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An updated review on Taxonomy, Phytochemistry, Pharmacology and Toxicology of *Macuna pruriens*

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Abstract:



Keyword: *Macuna pruriens*, Ethnobotany, Pharmacology, Phytochemistry

1. Introduction

Human beings have relied on natural products as a resource of drugs for thousands of years. Plant-based drugs have formed the basis of traditional medicine systems that have been used for

centuries in many countries such as Egypt, China and India^[1]. Today plant-based drugs continue to play an essential role in health care. It has been estimated by the World Health Organization that 80% of the population of the world rely mainly

on traditional medicines for their primary health care^[2]. Currently at least 119 chemicals, derived from 90 plant species, can be considered as important drugs in one or more countries^[3]. Besides their direct medicinal application, natural products can also serve as pharmacophores for the design, synthesis or semi-synthesis of novel substances for medical uses. The discovery of natural products is also important as a means to further refine systems of plant classification.

Mucuna pruriens (*M. pruriens*) Linn. belongs to the family Fabaceae, is the most popular drug in Ayurvedic system of medicine^[4-9]. All parts of *M. Pruriens* are generally used to treat impotence^[10], diabetes mellitus^[11] and cancer^[12] whereas the seeds have multi-diversified functions like several free radical mediated diseases management, rheumatoid arthritis, diabetes, atherosclerosis, nervous disorders, analgesic, antipyretic activity and in the management of Parkinsonism^[13]. The most important of these bioactive compounds of plants are alkaloids, flavonoids, tannins and phenolic compounds^[14]. The chemical constituents may be used for the various purposes such as activity against pathogenic bacteria^[15].

Due to its multiple pharmacological uses and presence of medicinally active phytoconstituents allow us to write this review article and give medicinal values of this plant to scientific communities.

2. Taxonomy and Botanical descriptions:

2.1 Common name:

It is popularly 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), Poonaikkaali (Tamil), Alkushi (Bengali), Khaajkui (Marathi)^[16].

2.2 Botanical classification:

Family : Fabaceae
Subfamily : Faboideae
Tribe : Phaseoleae
Genus : *Mucuna*
Species : *Pruriens*^[16].

It has another two subspecies namely *Mucuna deeringiana*, *Mucuna gigantean* and various varieties like *Hirsuta*, *Sericophylla*, *Utilis*^[16].

2.3 Geographical Distribution

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].

2.4 Cultivation

It is cultivated any types of soil and environment in rainy seasons. It is successfully grown in acidic soil (pH<5-8) humid area with annual rainfall > 400mm and annual temperature 19-27°C^[18].

2.5 Ethnobotanical Description:

M. Pruriens is an annual, climbing shrub with 15m length. The fuzzy hairs are available in young state but it is completely hairless during old age. The leaves are ovular in shape and leaflets are 2-3 mm long. The flower heads are take form of axially arrayed panicles with 15-32 mm long and have 2-3 or many flowers with lavender, white or purple colours. In the fruit ripening stage, a 4 to 13 cm long and 1 to 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 to 1.9 cm long, 0.8 to 1.3 cm wide and 4 to 6.5 cm thick. Its seed pods are about 10 cm long^[19] and are covered in loose orange hairs that cause a severe itch if they come in contact with skin. The chemical compounds responsible for the itch are a protein, mucunain^[19] and serotonin^[15].

3. Traditional uses:

- **Root:** It is used for the treatment of nervous disorders. Traditionally, the decoction of root is for blood purifier, diuretics.
- **Seeds:** This is used as CNS stimulant like coffee bean. It has several functions like to treat parkinson's disease, impotence, worms, diuretic, aphrodisiac, nerve tonic. Sometimes, it has antidepressant activity.
- **Aerial parts:** In Ayurvedic system of Medicine, the whole plant has been used for remedying diabetes, gout, rheumatic

disorders, cough, tuberculosis and cancer^[20].

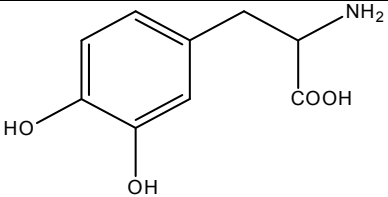
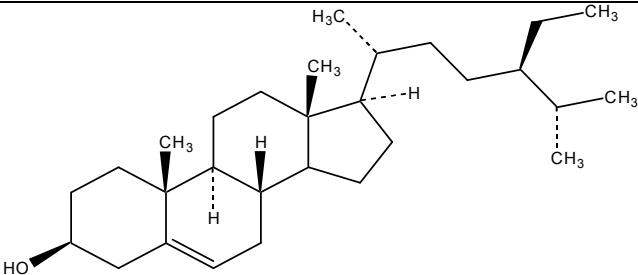
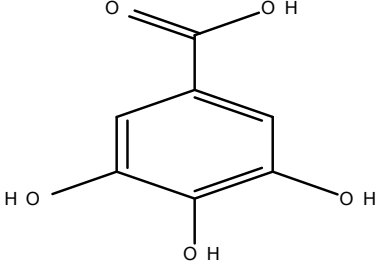
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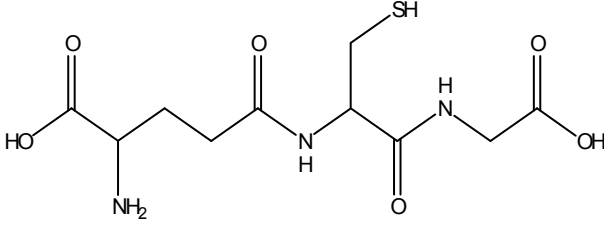
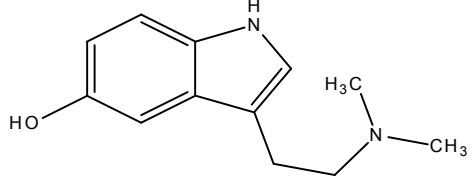
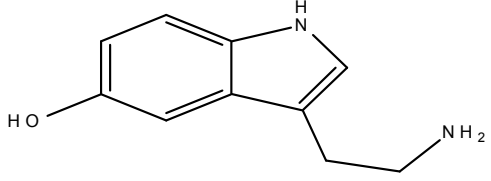
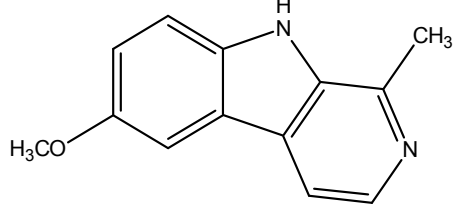
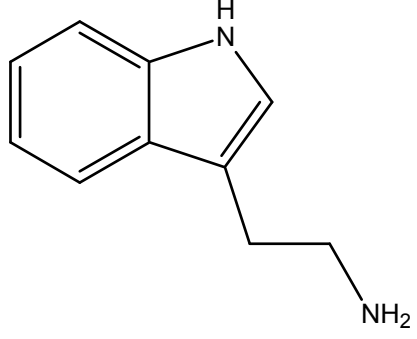
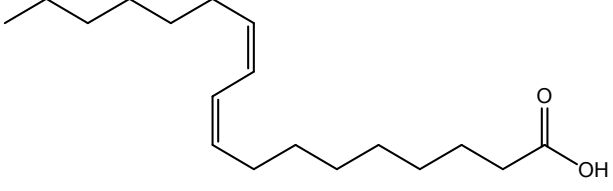
This plant has no such toxicological consensus but has several limitations. It is toxic to human and animal due to the presence of L-DOPA and tryptamines. Trypsin enzyme activity has been inhibited by seed. The undried leaves have hairy substances which has itching capacity^[18].

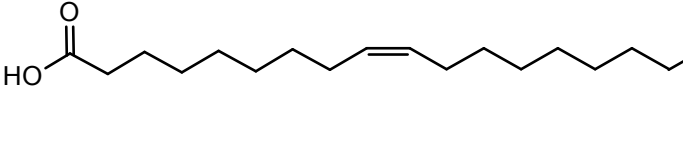
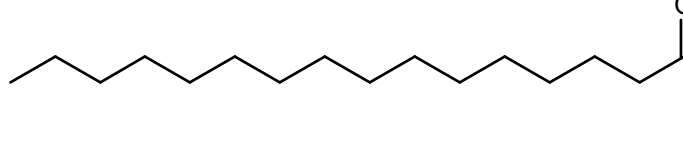
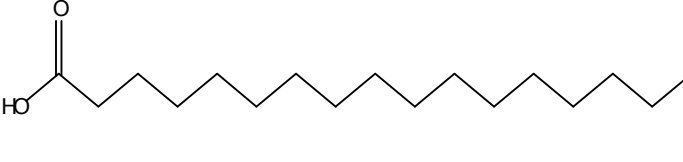
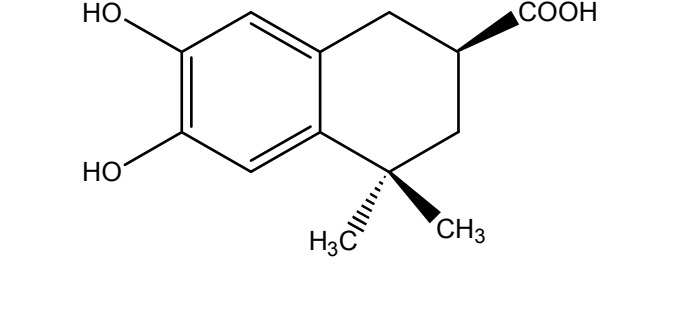
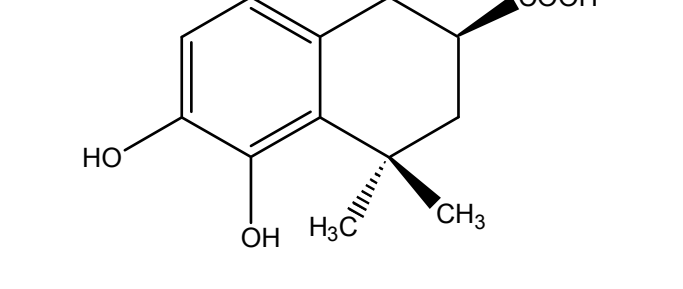
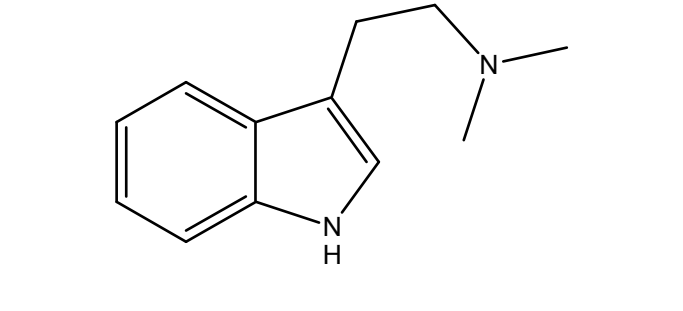
5. Clinical Trials:

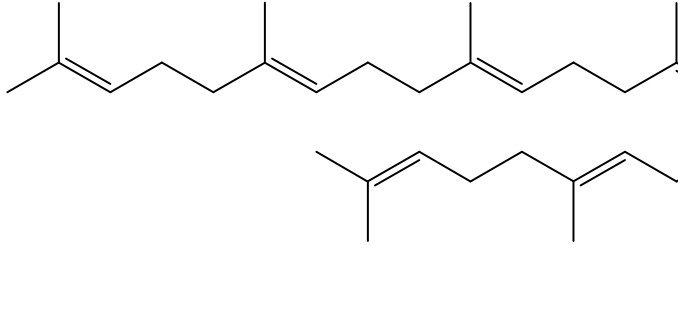
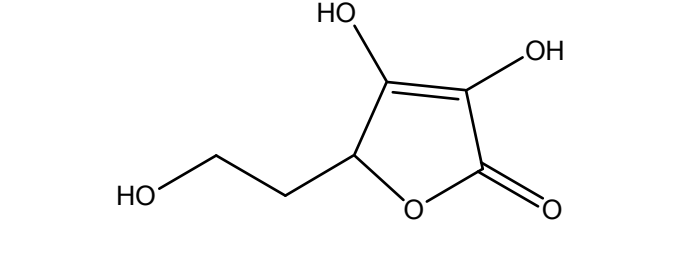
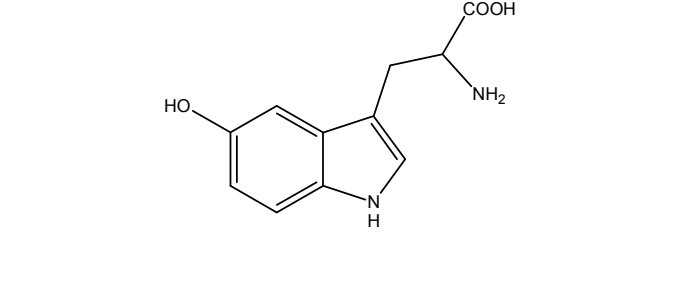
Due to its multiple use, the seed powder of this plant was underwent clinical trial in Germany in 2004. The human subjects were given 15 and 30 g of seed powder once, respectively and other groups took L-DOPA/Carbidopa capsule which served as control. Researchers measured the L-DOPA concentration in blood at various time points in one compartment model. They found out that plasma profile of seed powder was almost similar like standard L-DOPA which. They proposed that the seeds of this plant might be better alternative for parkinsonism treatment for future drug design perspective^[21].

Table 1: Structure of all chemical components of *Macuna pruriens*

NAME	STRUCTER
L-DOPA	
Beta -sitosterol	
Gallic acid	

Glutathione	
Bufotenine	
5-Hydroxytryptamine (Serotonin)	
6-Methoxyharman	
Tryptamine	
Linoleic acid	

<p>Oleic acid</p>	
<p>Palmitic acid (n-Hexanoic acid)</p>	
<p>Stearic acid (Octadecanoic acid)</p>	
<p>3-methoxy-1,1-dimethyl-6,7-dihydroxy-1,2,3,4-tetrahydroquinoline</p>	
<p>3-methoxy-1,1-dimethyl-7,8-dihydroxy-1,2,3,4-tetrahydroquinoline</p>	
<p>indole-3-alkylamines-N, N-dimethyltryptamine</p>	

<p style="text-align: center;">Squalene</p>	
<p style="text-align: center;">Ascorbic acid</p>	
<p style="text-align: center;">5-Hydroxytryptophane</p>	

6. Phytochemistry:

Seeds of velvet beans are known to produce the unusual nonprotein amino acid 3-(3,4-dihydroxyphenyl)-l-alanine (L-DOPA)^[4]. It also contains glutathione, gallic acid and beta-sitosterol. It has unidentified bases like mucunine, mucunadine, pruriene, prurieninine. Other bases isolated from the pods, seeds, leaves and roots include indole-3-alkylamines-N, N-dimethyltryptamine. Leaves also gave 6-methoxyharman. Serotonin is present only in pods^[5]. The seeds also contains oils including palmitic, stearic, oleic and linoleic acids^[6].

GC-MS analysis showed the presence of phytochemicals like n-hexadecanoic acid (48.21%), Squalene (7.87%), Oleic acid (7.62%), ascorbic acid (3.80%) and Octadecanoic acid (6.21%) were present in the extract^[13].

The seed also contains two tetrahydroquinoline alkaloids namely (-) 3-methoxy-1,1-dimethyl-6,7-dihydroxy-1,2,3,4-tetrahydroquinoline and (-) 3-

methoxy-1,1-dimethyl-7,8-dihydroxy-1,2,3,4-tetrahydroquinoline^[22].

It also contains serotonin (5-hydroxy tryptamine, 5-HT), 5-hydroxy tryptophane (5-HTP), nicotine, N,N-dimethyl tryptamine (DMT), bufotenine, and 5-methoxy-N,N-dimethyl tryptamine (5-MeO-DMT) 5-methoxy-N,N-dimethyl tryptamine-n-oxide (5-MeO-DMT-n-oxide). The mature seeds of the plant contain about 3.1-6.1% L-DOPA, with trace amounts of serotonin, nicotine, Bufotenine, 5-MeO-DMT-n-oxide, and beta-carboline. The leaves contain about 0.5% L-DOPA, 0.006% DMT, 0.0025% 5-MeO-DMT and 0.003% DMT n-oxide^[23]. Structures of the active constituents were tabulated in Table 1.

7. Pharmacology:

The pharmacology of *Macuna pruriens* was summarized in Table 2.

7.1 Antivenom Activity:

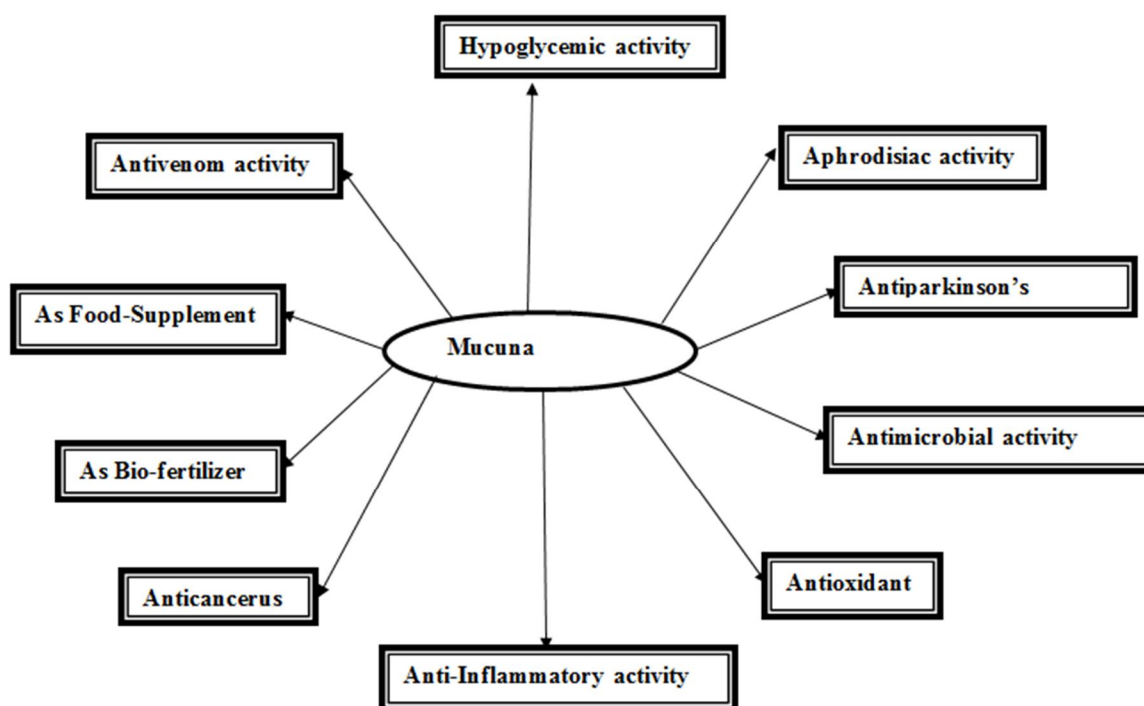
Fung et al (2010) investigated antivenom activity of seeds where there was reduction in neuromuscular and cardiovascular depressant effects of *Naja Sputatrix* venom in rats which was pretreated with *M. Pruriens* seed^[17].

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^[24]. Seed part showed strong antivenom activity which might be due to presence of higher amount of phytochemicals.

7.2 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^[25]. 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^[26].

Table 2: Summary of all pharmacological actions of *Macuna pruriens*



7.3 Aphrodisiac Activity:

A clinical trial was conducted on 60 subjects, related to aphrodisiac activity of *M. Pruriens*

where the powder was administrated 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^[27]. All these parameters suggested that *M. Pruriens* has strong aphrodisiac activity.

7.4 Antioxidant Activity:

The various parts of this plant contain total phenols which might have antioxidant activity. The similar findings were observed for this plant where free radical scavenging activity was evaluated via nitric oxide scavenging method. The alcohol extract showed significant antioxidant activity which was comparable with standard ascorbate and total phenol content^[28].

7.5 Antimicrobial Activity:

The methanolic extract at whole plant had antimicrobial properties against both gram +ve and gram -ve organism^[29]. This extract is mainly effective against *Escherichia coli*, *Salmonella typhi*, *Bacillus subtilis* and *Shigella dysenteriae*. The antimicrobial potency was evaluation by zone of inhibition (ZI) where *Escherichia coli* showed higher ZI (2.8cm) than *Bacillus subtilis* ZI (2.1cm)^[15].

7.6 Antiparkinson's Activity:

Clinical trials had been performed on its parkinsonism action. Where 8 patients were treated with 15 and 30 gm at *M. Pruriens* seed powder preparation for once in a week for 3 week. L-DOPA/Carbidopa was given in as combination dose of 200/50mg once which served as standard. The longer duration of action of seed powder suggested that this might be advantages for perkinson disease for those patients those have toxic effects to synthetic drugs^[30].

7.7 As Bio-fertilizer:

M. Pruriens is used as green manure^[31]. This plant is from legume family so it contains nitrogen fixing bacteria which absorbed N₂ gas from air. So, the powder is mixed with other fertilizer for improve the soil content^[16].

7.8 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^[32].

7.9 As Food-Supplement:

The seed contains 30-40% crud fiber, 20-25% crud protein. It is also used as substitute of coffee^[16].

8. Conclusion:

The plants grown in rubbish and waste places, this plant has important medicinal property and wide range of pharmacological activity. In view of the widespread uses, more clinical trials are also necessary to investigate other importance of this plant.

9. Conflict of interest:

The authors declare that they have no conflict of interest.

10. Acknowledgement:

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