



# A COMPARATIVE REVIEW OF THE PHARMACOLOGICAL PROFILES OF *MUCUNA PRURIENS L.* AND *CAMELLIA SINENSIS L.*

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## ABSTRACT:

*Mucuna pruriens L.* (also known as velvet bean) and *Camellia sinensis L.* (the tea plant) are well-known medicinal plants used for centuries in traditional medicine. This review compares their natural compounds and health benefits. *Mucuna pruriens L.* is rich in L-DOPA, a substance that supports brain health and is used in treating Parkinson's disease. On the other hand, *Camellia sinensis L.* contains powerful antioxidants like EGCG, which help protect the body from damage, reduce inflammation, and support heart health. Both plants show many potential benefits, such as protecting the brain, fighting oxidative stress, and helping with metabolic conditions. Even though they work through different active compounds, they may complement each other when used together. This article highlights the importance of these plants in natural medicine and encourages more research to explore their full potential.

**Keywords:** L-DOPA (Levodopa L-3,4-dihydroxyphenylalanine), EGCG (Epigallocatechin gallate), COMT (Catechol-O-methyltransferase), BBB (Blood-Brain Barrier), CNS (Central Nervous System), GC-MS (Gas Chromatography-Mass Spectrometry), GABA (Gamma-Aminobutyric Acid), PD (Parkinson's Disease), HPLC (High-Performance Liquid Chromatography), LDL (Low-Density Lipoprotein), HDL (High-Density Lipoprotein), VLDL (Very Low-Density Lipoprotein)

## INTRODUCTION

### 1. *Mucuna pruriens L.*:

*Mucuna pruriens L.*, also known as velvet bean, is a tropical legume of the Fabaceae family valued for its high L-DOPA content, a dopamine precursor, which justify its use in traditional Ayurvedic medicine<sup>[1][2]</sup>. It comprises around 150 species globally, with 15 identified in India. The L-DOPA content varies between 3–6%, contributing to its role in treating Parkinson's disease<sup>[3]</sup>. In Ayurveda, it's used for managing various ailments such as vata and pitta imbalances, constipation, nephropathy, and more<sup>[4]</sup>. Nutritionally, it provides 23–35% protein and has

digestibility similar to other pulses. Varieties differ in pod hair characteristics, with "cowitch" causing dermatitis due to mucunain, while "velvet bean" types are non-stinging <sup>[5]</sup>. Its seeds contain diverse bioactive compounds and minerals, supporting multiple medicinal properties like anthelmintic, aphrodisiac, hypoglycemic, antibacterial, and immune-modulating effects. In Nigeria, it serves as both food and feed <sup>[6]</sup>.

### Scientific Classification of *Mucuna pruriens* L.

- **Kingdom:** *Plantae*
- **Subkingdom:** *Viridaeplantae*
- **Phylum:** *Magnoliophyta*
- **Infraphylum:** *Angiospermae*
- **Class:** *Magnoliopsida*
- **Subclass:** *Rosidae*
- **Order:** *Fabales*
- **Family:** *Fabaceae*
- **Genus:** *Mucuna*
- **Species:** *Mucuna pruriens*
- **Bionomical name:** *Mucuna pruriens* (L.) DC. <sup>[6]</sup>

### 2. *Camellia sinensis* L.

*Camellia sinensis* L., an evergreen shrub from the Theaceae family, is native to East Asia and the source of green tea, a widely consumed beverage with medicinal value in systems like Ayurveda, Unani, and Homoeopathy <sup>[22, 24]</sup>. All tea varieties—green, black, white, oolong, Pu'erh, and Rooibos—originate from this plant, differing in processing methods that affect taste and health benefits. *Camellia sinensis* L. is known for reducing cholesterol, blood pressure, and stroke risk <sup>[23]</sup>. It contains bioactive compounds like caffeine, flavonoids, tannins, polyphenols, and vitamin C, offering antioxidant and antitumor effects <sup>[24, 27]</sup>.

*Camellia sinensis* L. is especially rich in catechins (about 70% of its polyphenols), with EGCG (Epigallocatechin gallate) being the most potent, providing significant antioxidant action. A cup contains 20–200 mg of EGCG, contributing to benefits in managing diabetes, cancer, hepatitis, infections, and skin inflammation <sup>[25, 26]</sup>. Unlike black tea, which has fewer catechins, green tea also supports metabolism, fat burning, and iron regulation with minimal side effects, although caffeine-sensitive individuals may opt for caffeine-free options <sup>[27]</sup>. Additionally, it supports healthy skin by regulating cell turnover and reducing inflammation, benefiting both skin and scalp <sup>[28]</sup>.

### Scientific Classification of *Camellia Sinensis* L.

- **Kingdom:** *Plantae*
- **Subkingdom:** *Tracheobionta*
- **Phylum:** *Tracheophyta*
- **Class:** *Magnoliopsida*
- **Order:** *Theales*
- **Family:** *Theaceae*
- **Genus:** *Camellia*

- **Species:** *C. sinensis*
- **Binomial name:** *Camellia sinensis* (L.) Kuntze <sup>[29]</sup>

## GEOGRAPHICAL DISTRIBUTION

### 1. *Mucuna pruriens* L.

- **Growth:** An annual climbing legume, *Mucuna pruriens* L. can grow between 3–18 meters in height.
- **Native Range:** It originates from tropical regions of Africa, Asia, and the West Indies. In India, it is widespread across plains and foothills, especially in states like Madhya Pradesh, Karnataka, Kerala, Andhra Pradesh, Uttar Pradesh, and the Western Ghats of Maharashtra.<sup>[7]</sup>
- **Current Distribution:**
  - **Africa:** Common in tropical and subtropical zones.
  - **Asia:** Present in India, Sri Lanka, and Southeast Asia.
  - **West Indies:** Cultivated across various Caribbean islands and parts of Central America.<sup>[7]</sup>

### 2. *Camellia sinensis* L.

- **Growth:**
  - **China type:** Large shrub, 1–2 meters tall, with thick, leathery leaves and sunken veins.
  - **Assam type (*C. assamica*):** A small tree reaching 10–15 meters, with a strong branching system.
  - **Southern type (*C. assamica*):** Grows 6–10 meters tall, with nearly equal-sized upright branches.<sup>[29]</sup>

- **Current Distribution:**

Native to southern China, northeastern India, and Southeast Asia.

- **China:** Leading global producer and exporter.
  - **India:** Cultivated mainly in Darjeeling, Assam, and increasingly in the Nilgiri Hills.
  - **Japan:** Known for distinctive green tea varieties.
- Also grown in Sri Lanka, Europe, North Africa, and parts of the U.S. due to global demand.<sup>[29]</sup>

## MORPHOLOGY

### 1. *Mucuna pruriens* L.: *Mucuna pruriens* L. is a fast-growing, woody climber with distinct morphological features:

- **Leaves:** Broadly ovate to elliptical leaflets, unequal at the base, with lanceolate shapes.<sup>[7]</sup>
- **Flowers:** White or dark purple flowers grow in clusters and are mainly pollinated by bees and butterflies.
- **Pods:** Long, cylindrical, and densely hairy pods (10–15 cm long, 1–2.5 cm wide) turn brown upon maturity and contain 6–8 seeds; the hairs can cause skin irritation.
- **Seeds:** Large, ovate, hard, glossy seeds in colours like brown, black, or white, weighing between 0.5–2.7 g; these are the primary part used for medicinal and nutritional applications.<sup>[8]</sup>

### 2. *Camellia sinensis* L.: *Camellia sinensis* L. is a large evergreen shrub or small tree, typically pruned for harvesting:

- **Leaves:** Elliptical, pointed, glossy green leaves measuring 8–20 cm long and 3.5–7.5 cm wide.
- **Flowers:** White or pale pink with 5–6 petals and 7–8 sepals, blooming in fall or winter.<sup>[29]</sup>
- **Fruit:** A capsule containing seeds, though these are not used in tea production.<sup>[22]</sup>

## PHYTOCHEMISTRY

### 1. *Mucuna pruriens* L.

*Mucuna pruriens* L. seeds are rich in bioactive compounds that hold significant pharmacological potential. The most notable among them is L-DOPA, a direct precursor to dopamine, which makes *Mucuna pruriens* L. particularly valuable in the treatment of Parkinson's disease. The plant also contains a range of alkaloids such as mucunadine, mucunine, prurienidine, and prurienine<sup>[7]</sup>, along with two tetrahydroquinoline alkaloids—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. GC-MS analysis has identified several phytochemicals in the seed extract, including n-hexadecenoic acid (48.21%), squalene (7.87%), oleic acid (7.62%), ascorbic acid (3.80%), and octadecanoic acid (6.21%)<sup>[9]</sup>. Additionally, the seeds contain essential amino acids like alanine, arginine, aspartic acid, and phenylalanine, as well as fatty acids such as oleic, palmitic, and linoleic acids. Other compounds contributing to its medicinal and nutritional value include  $\beta$ -carboline,  $\beta$ -sitosterol, bufotenine, choline, cystine, tryptamine, gallic acid, glutathione, lecithin, riboflavin, and saponins. Furthermore, the presence of trace compounds like n,n-dimethyltryptamine, nicotine, inorganic phosphorus and iron, and various polysaccharides enhances its therapeutic profile. Notably, serotonin is present only in the pods<sup>[6,7,9]</sup>.

### 2. *Camellia sinensis* L.

*Camellia sinensis* L., the source of green tea, contains numerous compounds that contribute to its health-promoting properties. The major bioactive constituents include catechins such as catechin (C), epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG), and especially epigallocatechin gallate (EGCG), which has potent anti-cancer and anti-viral effects. The plant is also rich in flavonoids, including flavanol glycosides like myricetin, quercetin, and biphenyl glycosides, with anthocyanins contributing to its bitterness. In terms of alkaloids, *Camellia sinensis* L. contains caffeine (2–5%), theophylline, and theobromine, which are responsible for its stimulating effects. Amino acids such as theanine, glutamic acid, arginine, serine, and aspartic acid are present, with theanine and GABA ( $\gamma$ -aminobutyric acid) offering protective effects on the nervous system. Carbohydrates in the plant include small amounts of glucose, fructose, galactose, and sucrose, although most are water-insoluble polysaccharides. Its distinctive aroma is due to volatile aromatic compounds, though these are present in very small amounts (0.005%–0.020%). The plant also contains over 40 organic acids, including acetic and butyric acid, contributing to tea's flavor and scent. Mineral content includes phosphorus, potassium, calcium, magnesium, iron, manganese, and trace elements like zinc and copper. Additionally, green tea contains essential vitamins (B, C, E), enzymes (such as glucosidases and lipoxidases), and chlorophyll, further enhancing its nutritional and medicinal profile<sup>[26]</sup>.

## NUTRITIONAL INFORMATION

### 1. *Mucuna pruriens* L.

*Mucuna pruriens* L. seeds are recognized as a rich source of essential nutrients, offering a well-rounded nutritional profile beneficial for both therapeutic and dietary applications. They contain substantial amounts of proteins, carbohydrates, fats, vitamins, and minerals. The protein content of the seeds varies from 21.0% to 30.3%, depending on genetic and environmental conditions in the tropical and subtropical regions where they are cultivated. The crude fat content typically ranges between 2.8% and 4.9%, while the crude fiber content is relatively high, ranging from 5.3% to 11.5%, making it a valuable source of dietary fiber. Ash content in the seeds lies between 2.9% and 4.4%, indicating the presence of various minerals. Notably, *Mucuna pruriens* L.

seeds are rich in essential minerals such as potassium, copper, iron, and zinc, all of which play key roles in human nutrition. Additionally, the seeds contain essential amino acids like leucine, lysine, and valine, enhancing their value as a high-protein legume <sup>[10]</sup>.

## 2. *Camellia sinensis* L.

*Camellia sinensis* L. possesses a complex and rich chemical composition that contributes to its nutritional and therapeutic value. It contains proteins (15–20% of dry weight), amino acids (1–4%), carbohydrates (5–7%), lipids, sterols, and essential vitamins such as B, C, and E. It also includes xanthic bases like caffeine and theophylline, pigments such as chlorophyll and carotenoids, and a wide range of volatile compounds including aldehydes, alcohols, esters, lactones, and hydrocarbons. Minerals and trace elements constitute around 5% of the dry weight, with significant amounts of calcium, magnesium, iron, and zinc. One of the most important groups of compounds in green tea is polyphenols, particularly flavonoids. Among these, catechins are the most abundant, especially epigallocatechin-3-gallate (EGCG), which accounts for about 59% of the total catechin content. *Camellia sinensis* L. also contains other phenolic compounds such as gallic acid and chlorogenic acid, along with flavanols like kaempferol, myricetin, and quercetin. The mineral content of green tea can vary significantly depending on its origin, and studies have highlighted notable differences between green and black tea, especially in elements such as aluminum and fluoride. Due to its high polyphenol concentration, green tea is widely regarded as a valuable dietary source of antioxidants and health-promoting compounds <sup>[30,31]</sup>.

### TRADITIONAL USES

#### 1. *Mucuna pruriens* L.

*Mucuna pruriens* L. is widely recognized for its medicinal applications in traditional medicine systems, particularly across India and Africa. Various parts of the plant—seeds, leaves, and roots—are employed in the treatment of numerous ailments. The seeds, flowers, and leaves are traditionally used for managing snake bites, as uterine stimulants and aphrodisiacs, and for conditions such as bone fractures, cough, madness, ulcers, syphilis, and scorpion stings. Leaves are also known to help with leucorrhea, spermatorrhea, and serve as nerve tonics, as well as being effective in treating pleuritis, pain, and ringworm. In some regions, the leaves are even consumed as food. The roots are valued for their bitter, thermogenic, emollient, stimulant, purgative, aphrodisiac, diuretic, and tonic properties, and are useful in treating ailments such as constipation, nephropathy, elephantiasis, neuropathy, ulcers, helminthiasis, fever, and particularly Parkinson's disease. In Ayurveda, *M. pruriens* L. is used to balance the vata and pitta doshas. Its wide therapeutic range is attributed to a variety of phytochemicals, including alkaloids, flavonoids, saponins, tannins, glycosides, phenols, and steroids. These contribute to the plant's known anti-diabetic, antifungal, antimicrobial, antiepileptic, and anti-inflammatory properties. The seeds, which are high in protein, are also used as food and animal feed, and are valued for their aphrodisiac, anthelmintic, hypoglycemic, and analgesic effects. Additionally, they are employed in the treatment of fertility disorders, dysentery, tuberculosis, and fever. The leaves are especially effective for ulcers, inflammation, and general debility, and in some traditional practices, dried leaves are smoked or incorporated into ointments as local stimulants <sup>[4,6]</sup>.

## 2. *Camellia sinensis L.*

Green tea has been used for centuries in traditional medicine in China, Japan, and other parts of Asia. It has a variety of uses:

- **Health Tonic:** In traditional Chinese medicine, green tea was used to aid digestion, improve energy, and alleviate fatigue.
- **Cognitive Function:** Green tea has traditionally been consumed to improve mental clarity and alertness.
- **Anti-inflammatory:** The antioxidants in green tea have been used in traditional practices to reduce inflammation and treat conditions such as arthritis.
- **Detoxification:** Green tea has been used to support the body's natural detox processes.
- **Skin Health:** In ancient practices, green tea was applied topically as a remedy for skin irritations, burns, and other ailments. <sup>[32]</sup>

## PHARMACOLOGICAL PROPERTIES

### 1. *Mucuna pruriens L.*

**Table No. 2.1: Pharmacological Activities of *Mucuna pruriens L.***

Pharmacological Activity	Extract used	Dose	Route	Model/Species	Reference
Anti-Parkinson	Aqueous extract of the seeds	100 mg/kg	p.o.	Paraquat induced Parkinson in mice	Singh, et al.2013 <sup>[11]</sup>
Anti-Inflammatory	Methanolic extract of the seeds	50mg/kg	p.o.	Carrageenan & formalin induced paw edema test in rats	Uchegbu, et al.2016 <sup>[12]</sup>
Anti-Bacterial	Methanolic extract of the seeds	75 µg/ml	(Invitro)	(MIC)Minimum inhibitory concentration assay against bacterial pathogens	Shanmugavel, et al.2015 <sup>[13]</sup>
Anti-Tumor	Methanolic extract of the seeds	250mg/kg	i.p.	Ehrlich ascites carcinoma in mice	Rajeshwar, et al.2005 <sup>[14]</sup>
Anti-Oxidant	Methanolic extract of the seeds	100 µg/ml	(Invitro)	Invitro DPPH free radical scavenging activity and reducing power method	Mazumdar U.K, et al. 2005 <sup>[15]</sup>
Anti-Venom	Aqueous extract of	21mg/kg	i.p.	Malayan cobra venom induced	Tan, et al. 2009 <sup>[16]</sup>

	the seeds			in rats	
<b>Anti-Diabetic</b>	Ethanollic extract of the seeds	100mg/kg	p.o.	Alloxan induced diabetes in rats	Adeyemi, et al.2016 <sup>[17]</sup>
<b>Aphrodisiac</b>	Ethanollic extract of the seeds	200mg/kg	p.o.	Mating behavior, test for libido & potency test in rats	Seppan, et al. 2009 <sup>[18]</sup>
<b>Anti-Depressant</b>	Hydroalcoholic extract of the seeds	200mg/kg	p.o.	Haloperidol & bromocriptine induced depression in mice	Galani, et al. 2014 <sup>[19]</sup>
<b>Analgesic</b>	Hydroalcoholic extract of the seeds	200mg/kg	p.o.	Eddy's hot plate model in mice	Shankar, et al. 2015 <sup>[20]</sup>
<b>Anti-Protozoal</b>	Methanollic extract of the leaves	200mg/l	(Invitro)	<i>Ichthyophthirius multifiliis</i> parasite induced protozoal model in goldfish	Ekanem, et al. 2004 <sup>[21]</sup>

### 1. Anti-Parkinson activity

The study focused on the aqueous extract of *Mucuna pruriens L.* seeds in a Parkinson's disease (PD) mouse model induced by paraquat (a neurotoxin). The most effective dose was 100 mg/kg body weight. The active chemical constituents in the seeds extract, particularly L-DOPA, work through antioxidant properties. The mechanism of action (MOA) involves reducing oxidative stress, improving dopaminergic neuron survival, and increasing tyrosine hydroxylase (TH) expression, which helps in the production of dopamine, protecting against neurodegeneration in PD. <sup>[11]</sup>

### 2. Anti-inflammatory activity

Methanollic extract of *Mucuna pruriens L.* seeds was tested for anti-inflammatory activity. Two types of inflammation were induced in the rats: acute inflammation using carrageenan and chronic inflammation using formalin. The rats were given oral doses of methanollic extract of *Mucuna pruriens L.* seeds, and the results were compared to diclofenac potassium, a known anti-inflammatory drug. For acute inflammation, the seeds showed a 9.8% inhibition at 10 mg/kg and 47.8% inhibition at 50 mg/kg. For chronic inflammation, the seeds showed a 6.6% inhibition at 10 mg/kg and 38.8% inhibition at 50 mg/kg. Hence, *Mucuna pruriens L.* has significant anti-inflammatory activity. <sup>[12]</sup>

### 3. Anti-bacterial activity:

*Mucuna pruriens L.* seeds were tested for their antibacterial activity using ethanol and methanol extracts against ten different bacterial strains. The study used the disc diffusion method, with erythromycin as a positive control.

The methanolic extract showed the strongest antibacterial effect, especially against *Vibrio harveyi* (16.8 mm inhibition zone) and *Vibrio cholera* (9.4 mm). It also showed moderate activity against *E. coli* (4.1 mm) and *S. aureus* (3.4 mm), but limited effect on *S. typhi*, *K. pneumonia*, and *P. aeruginosa*. In the Minimum Inhibitory Concentration (MIC) test, the methanolic extract showed the strongest activity against *V. harveyi* with a MIC of 25 µg/ml, followed by *V. cholera* at 75 µg/ml. The effectiveness is due to bioactive compounds like alkaloids, terpenoids, and tannins in the seed extract.<sup>[13]</sup>

#### 4. Anti-tumor Activity:

The methanol extract of *Mucuna pruriens L.* seeds showed strong antitumor effects in Ehrlich Ascites Carcinoma (EAC) tumor-bearing mice. At doses of 125 and 250 mg/kg, it significantly reduced tumor volume, lowered viable tumor cell count, and improved blood parameters, such as red blood cell count. It also inhibited lipid peroxidation and boosted antioxidant levels, including glutathione (GSH), superoxide dismutase (SOD), and catalase (CAT). The extract slowed tumor growth, reduced ascitic fluid (which supports tumor growth), and increased the lifespan of the mice. Its antitumor action is linked to its antioxidant properties, which protect cells by reducing oxidative stress and free radicals.<sup>[14]</sup>

#### 5. Anti-oxidant Activity

The methanol extract of *Mucuna pruriens L.* seeds shows strong antioxidant activity, effectively neutralizing harmful free radicals like DPPH, hydroxyl, nitric oxide, superoxide anions, and hydrogen peroxide. It also demonstrated a strong reducing power. At 100 µg/ml, the extract achieved 90.16% DPPH radical inhibition, highlighting its potent antioxidant potential. Compared to standard antioxidants such as BHT, L-ascorbic acid, curcumin, quercetin, and  $\alpha$ -tocopherol, it showed comparable effectiveness. The high phenolic content (33.04 mg/g) in the extract contributes significantly to these effects.<sup>[15]</sup>

#### 6. Anti-venom Activity

The aqueous seed extract of *Mucuna pruriens L.* seeds showed protective effects against Malayan cobra (*Naja sputatrix*) venom in rats. In this study, rats pretreated with 21 mg/kg MPE for three weeks survived a normally lethal venom dose, while those without *Mucuna pruriens L.* seeds extract treatment did not. Histological analysis revealed that aqueous seed extract of *Mucuna pruriens L.* protected heart and liver blood vessels from venom-induced damage. This traditional Nigerian use of *Mucuna pruriens L.* seeds for treating snake bites suggests its potential as a natural antidote, especially protecting heart tissue.<sup>[16]</sup>

#### 7. Anti- diabetic Activity

The crude ethanolic seed extract of *Mucuna pruriens L.* seeds showed strong blood sugar-lowering effects in alloxan-induced diabetic rats. When given orally at doses from 5 to 100 mg/kg, it reduced blood glucose levels in a dose-dependent way, with up to 55.4% reduction in 8 hours. After 12 weeks, the reduction reached up to 83.6%, which was comparable to glibenclamide, a standard antidiabetic drug. Among the different fractions, methanol and ethanol fractions were the most effective. The extract was also shown to improve body weight in diabetic rats, which typically lose weight. Though mostly safe, high doses caused mild side effects like hyperventilation and reduced movement. So, the *Mucuna pruriens L.* seed extract has strong antidiabetic potential, especially at doses 50 mg/kg and 100mg/kg.<sup>[17]</sup>

## 8. Aphrodisiac Activity

The ethanolic seed extract of *Mucuna pruriens L.* seeds was tested in male rats for its effects on sexual function. Doses of 150, 200, and 250 mg/kg were given daily for 45 days orally, and results were compared with Sildenafil citrate (5 mg/kg). The 200 mg/kg dose showed the best results, improving mating behavior (like frequency and ejaculation time), increasing testosterone levels, and enhancing sperm quality (count, motility, and testicular weight). It also increased penile reflexes, indicating stronger sexual performance. The effects were comparable to Sildenafil, with no side effects or ulcers observed. The sexual benefits are believed to work through the dopaminergic pathway, confirming its traditional use as a natural aphrodisiac. <sup>[18]</sup>

## 9. Anti-depressant Activity

The hydroalcoholic extract of *Mucuna pruriens L.* seeds showed strong antidepressant effects in mice at 100 mg/kg and 200 mg/kg doses over 7 days. Tested using the Forced Swim Test (FST) and Tail Suspension Test (TST), MPE reduced depression-like behavior. Its effects were enhanced by bromocriptine (a dopamine D2 agonist) and blocked by haloperidol (a D2 antagonist), confirming that hydroalcoholic extract of *Mucuna pruriens L.* works through the dopaminergic system. It did not affect general movement, suggesting a targeted antidepressant action. These were comparable to imipramine, highlighting hydroalcoholic extract of *Mucuna pruriens L.* potential as a natural antidepressant, especially helpful in Parkinson's-related depression, due to active compounds like L-dopa and alkaloids. <sup>[19]</sup>

## 10. Analgesic Activity

Analgesic (pain-relieving) activity of *Mucuna pruriens L.* seeds using the Eddy's hot plate test in mice. *MP* extracts at doses of 200 mg/kg and 400 mg/kg showed a significant increase in response time to thermal pain, indicating central analgesic activity. The results were compared to Tramadol, a standard pain reliever, which also showed pain relief, though Tramadol had a stronger effect. It suggests that *Mucuna pruriens L.* contains alkaloids responsible for its analgesic action, and the extract may work through both central and peripheral mechanisms. The potential benefits of *Mucuna pruriens L.* as an analgesic, though further animal studies and clinical trials are needed to confirm its therapeutic use for pain relief. <sup>[20]</sup>

## 11. Anti-Protozoal Activity

The methanolic extract of *Mucuna pruriens L.* seeds was tested for its effects on the ciliate parasite *Ichthyophthirius multifiliis* (commonly known as "Ich") in goldfish. When infected fish were treated with bath solutions of the extract for 72 hours, there was a dose-dependent reduction in parasite load, with up to 92% fewer trophonts at 200 mg/L and fish mortality dropped from 65% to 20%. In vitro, the extract caused 100% parasite mortality at 150–200 mg/L within 6 hours. The methanolic extract of *Mucuna pruriens L.* was highly effective in killing the parasite and protecting fish. <sup>[21]</sup>

2. *Camellia sinensis L.*Table No 2: Pharmacological Activities of *Camellia sinensis L.*

Pharmacological Activity	Extract used	Dose	Route	Model/Species	Reference
Anti-Parkinson	Aqueous extract of leaf	50mg/kg	p.o.	Haloperidol induced Parkinson disease in rats	Ittiyavirah, et al.2014 <sup>[33]</sup>
Anti-Oxidant	Aqueous extract of leaf	100mg/kg	p.o.	Exhausting training exercise in mice	Sun Hongmei, 2010 <sup>[34]</sup>
Anti-Depressant	Aqueous extract of leaf	50mg/kg	i.p.	Ketamine induced post stroke depression in mice	Daglia, et al.2015 <sup>[35]</sup>
Hyperleptinemia or Hypertension	Aqueous extract of leaf	50mg/kg	i.p.	Olanzapine induced metabolic syndrome in rats	Hosseinzadeh, et al. 2017 <sup>[36]</sup>
Anti-Diabetic	Ethanollic extract of leaf	150mg/kg	p.o.	Streptozotocin induced diabetes in rats	Sachdanandam , et al. 2013 <sup>[37]</sup>
Anti-Microbial	Aqueous extract of leaf	300µl	(Invitro)	Streptococcus mutans microbial growth activity	Gopal, et al.2016 <sup>[38]</sup>
Anti-Inflammatory	Ethanollic extract of leaf	0.07g/kg & 0.14g/kg	p.o.	Carrageenan induced in mice model	Lima Mota, et al.2015 <sup>[39]</sup>
Anti-Proliferative	Hydroalcoholic extract of leaves	800µg/ml	(Invitro)	Anticancer activity in Caco-2 Colorectal Cancer Cell Line	Esghaei, et al. 2018 <sup>[40]</sup>
Hepatoprotective activity	Aqueous extract of leaf	100mg/kg	p.o.	Tetrachloride and olive oil induced liver damage in rats	Sengottuvelu, et al. 2008 <sup>[41]</sup>
Anti-Hyperlipidemic	Aqueous extract of leaf	200mg/kg	p.o.	Triton induced hyperlipidemic induced in rats	Kumar, et al.2008 <sup>[42]</sup>

## 1. Anti-Parkinson Activity

The aqueous extract of *Camellia sinensis L.* leaves demonstrated notable anti-Parkinson activity in a study using haloperidol-induced Parkinsonism in male Wistar rats. Haloperidol, a dopamine antagonist, is known to induce symptoms similar to Parkinson's disease such as catalepsy, muscular rigidity, and bradykinesia. In this model, rats treated orally with 50 mg/kg of *Camellia sinensis L.* extract showed a significant reduction in these symptoms, indicating a protective effect. The extract likely exerted its neuroprotective action through its rich content of natural L-DOPA, flavonoids, and alkaloids, which help restore dopamine levels and reduce oxidative stress. Comparatively, other herbal treatments such as *Plumbago zeylanica* and a combination with *Camellia sinensis L.* also showed promising results, with the combination therapy being as effective as the standard drug Syndopa. The benefits are likely due to antioxidant and dopamine-enhancing compounds like flavonoids and alkaloids, suggesting *Camellia sinensis L.* and related herbs can serve as natural alternatives to synthetic anti-Parkinson drugs, without causing side effects like dyskinesia.<sup>[33]</sup>

## 2. Antioxidant Activity

The aqueous extract of *Camellia sinensis L.* (tea) leaves showed strong antioxidant activity in mice subjected to exhausting training exercises. Given orally at a dose of 100 mg/kg, the extract significantly reduced malondialdehyde (MDA) levels, an indicator of oxidative stress, in the blood, heart, and liver. It also boosted antioxidant enzymes like superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) in a dose-dependent manner. These results suggest that *Camellia sinensis L.* polysaccharides help protect the body from oxidative damage by enhancing the natural antioxidant defense system. This highlights their potential use in managing oxidative stress and diseases linked to reactive oxygen species (ROS), such as diabetes complications.<sup>[34]</sup>

## 3. Anti-depressant Activity

The aqueous extract of *Camellia sinensis L.* (green tea) leaves, administered intraperitoneally at 50 mg/kg, showed strong antidepressant effects in mice with ketamine-induced post-stroke depression using the bilateral common carotid artery occlusion (BCCAO) model. The extract, especially the GABA-enriched green tea (GGT), improved depressive symptoms such as reduced sucrose intake and immobility in behavioral tests like the tail suspension and despair swim tests. GABA-enriched green tea was more effective due to its higher content of active compounds like caffeine, epicatechins, theanine, and GABA. These compounds are known to enhance mood and provide neuroprotection, suggesting that *Camellia sinensis L.* leaf extract, can be a promising natural antidepressant for post-stroke depression.<sup>[35]</sup>

## 4. Hyperleptinemia or Hypertension activity

The aqueous extract of *Camellia sinensis L.* (green tea) leaves, administered intraperitoneally at 50 mg/kg, demonstrated significant protective effects against olanzapine-induced metabolic syndrome in rats. Olanzapine, an antipsychotic, commonly causes hyperleptinemia, weight gain, and hypertension. In this study, green tea extract effectively countered these effects by reducing body weight gain, food and water intake, and plasma leptin levels. It also improved lipid profiles, lowered fasting blood glucose, and reduced systolic blood pressure. Furthermore, extract of *Camellia sinensis L.* reversed the olanzapine-induced reduction in locomotor activity. These beneficial effects are attributed to green tea's bioactive compounds, particularly epigallocatechin gallate (EGCG), which supports glucose regulation, insulin sensitivity, and fat metabolism.<sup>[36]</sup>

## 5. Anti-diabetic Activity

The ethanolic extract of *Camellia sinensis L.* (green tea) leaves, administered orally at 150 mg/kg, exhibited significant anti-diabetic effects in streptozotocin-induced diabetic rats. Rich in catechins—primarily Epicatechin (EC), Epicatechin Gallate (ECG), Epigallocatechin (EGC), and Epigallocatechin Gallate (EGCG)—along with caffeine, green tea extract demonstrated potent therapeutic activity. HPLC analysis confirmed that catechins made up 90% of the bioactive content, contributing to its strong antioxidant and anti-diabetic properties. In diabetic rats, green tea extract significantly lowered blood glucose levels and enhanced insulin secretion, with effects most prominent at higher doses (up to 300 mg/kg), comparable to the standard anti-diabetic drug metformin. Treatment with ethanolic extract of *Camellia sinensis L.* improves body weight, food and water intake, and normalized haemoglobin and HbA1C levels.<sup>[37]</sup>

## 6. Anti-microbial Activity

Anti-streptococcal properties of various green tea leaf extracts and their particles at different centrifuge speeds (5000 rpm, 10000 rpm, and 20000 rpm) against *Streptococcus mutans*, a dental pathogen. Six concentrations (0µL, 50µL, 100µL, 200µL, 300µL, and 500µL) of green tea extracts were tested, and it was found that a 300µL concentration showed optimal antibacterial activity. The study also compared green tea extracts with removed particles (5K-S, 10K-S, and 20K-S) and found that removing larger particles (5K-S) marginally increased the antibacterial effect, while the removal of smaller particles (20K-P) led to a significant decrease in activity. Green tea, rich in catechins like EGCG, was found to exhibit strong antibacterial properties. The results highlighted that the bioactivity of green tea is a combination of both the extract's EGCG content and the particles present, particularly the smaller nanometric particles (20K-P), which enhance the antimicrobial effect. Removing these particles reduced the antibacterial activity, suggesting their crucial role in the green tea's bioactivity.<sup>[38]</sup>

## 7. Anti-inflammatory Activity

The ethanolic extract of green tea *Camellia sinensis L.* leaves showed significant anti-inflammatory effects in Swiss mice. When administered either orally (gavage) or by subcutaneous injection at doses of 70 mg/kg and 140 mg/kg, the extract reduced abdominal pain and inflammation induced by acetic acid. Subcutaneous injection proved more effective, likely due to better absorption. The anti-inflammatory effects are attributed to bioactive compounds like catechins (especially EGCG) and flavonoids, which inhibit COX-2 and iNOS enzymes, reduce vascular permeability, and modulate immune cytokines such as IL-17 and IL-10. Although indomethacin showed stronger effects, green tea extract demonstrated promising natural anti-inflammatory potential.<sup>[39]</sup>

## 8. Antiproliferative activity

The hydroalcoholic extract of green tea *Camellia sinensis L.* leaves demonstrated significant cytotoxic effects on Caco-2 colorectal cancer cells, inhibiting their viability at concentrations of 800 µg/ml. This effect was comparable to Cisplatin, a conventional anticancer drug. The extract, rich in polyphenols like catechins and terpenoids such as palmitic acid and hexahydro farnesyl acetone, appears to have anticancer and antimicrobial properties. Importantly, no significant cytotoxicity was observed in the L929 normal cell line.<sup>[40]</sup>

## 9. Hepatoprotective Activity:

The aqueous extract of green tea *Camellia sinensis L.* leaves was tested for its hepatoprotective effects in rats treated with carbon tetrachloride (CCl<sub>4</sub>), a substance that induces liver damage. At doses of 100 mg/kg and 200

mg/kg, the green tea extract significantly reduced liver enzyme levels (ALT, AST, and ALP) and lipid peroxidation, indicating protection against liver damage. It also increased antioxidant enzyme levels (GSH, SOD, and CAT), which were depleted in the CCl<sub>4</sub>-treated rats. Histopathological studies showed reduced liver damage and improved cell regeneration in the treated rats. Hepatoprotective effects of *Camellia sinensis L.* are due to its antioxidant properties, supporting its potential as a therapeutic agent for liver protection. <sup>[41]</sup>

## 10. Antihyperlipidemic activity:

The aqueous extract of green tea *Camellia sinensis L.* leaves was tested for its anti-hyperlipidemic effects in rats induced with hyperlipidemia using Triton. At a dose of 200 mg/kg, the extract significantly reduced serum levels of cholesterol, triglycerides, LDL, and VLDL while increasing HDL levels. Specifically, it lowered total cholesterol by 69.72%, LDL by 30.31%, and increased HDL by 24.11%, showing effects similar to the reference drug, fenofibrate. The hypolipidemic effects are likely due to the polyphenolic compounds in green tea, such as flavonoids and anthocyanins, which have antioxidant and anti-atherogenic properties. These results suggest that *C. sinensis L.* could be a natural and effective treatment for hyperlipidemia. *Camellia sinensis L.* showed significant promise as a natural, effective treatment for hyperlipidemia, with no adverse effects observed. <sup>[42]</sup>

## CONCLUSION

*Mucuna pruriens L.* and *Camellia sinensis L.* are two medicinal plants with well-documented therapeutic benefits, supported by both traditional use and modern scientific research. While *Mucuna pruriens L.* is particularly noted for its neuroprotective effects due to its high L-DOPA content, *Camellia sinensis L.* is widely valued for its strong antioxidant and anti-inflammatory properties, mainly attributed to catechins like EGCG. Despite their differences in bioactive compounds and mechanisms of action, both plants contribute to the prevention and management of various health conditions, including neurodegenerative, metabolic, and inflammatory disorders. This comparative review highlights their unique strengths as well as potential complementary roles in integrative medicine. Further research, particularly well-designed clinical trials and mechanistic studies, is essential to fully understand their therapeutic potential and to support their safe and effective use in evidence-based herbal formulations.

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**Compliance with ethical standards**

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