ORIGINAL ARTICLE

Official Journal of the
Neuroscience Society of Nigeria
(NSN)

https://doi.org/10.47081/njn2019.10.2/008
ISSN 1116-4182

AMELIORATIVE EFFECT OF *Mucuna pruriens* AND *Camellia sinensis* ON PARKINSON DISEASE

Ademola A. Oremosu[1], Philip L. Ugbem[1,2], Eunice O. Ajayi[1], Olufunke O. Dosumu[1]

[1]Department of Anatomy, Faculty of Basic Medical Sciences, University of Lagos, Nigeria.
[2]Department of Anatomy and Forensic Anthropology, Faculty of Basic Medical Sciences, Cross River University of Technology, Okuku Campus, Nigeria.

Received: …… April 2019
Accepted: …… August 2019

ABSTRACT

Mucuna pruriens (Mp) and *Camellia sinensis* (GT) are used in folklore practice in the management of persons presenting with movement disorders with claims of improvement in these conditions. This study was carried out to investigate the motor function potentials of *Mucuna pruriens* and *Camellia sinensis* in parkinsonian mice models. Thirty mice were divided into six groups, namely; control, D2, Mp, GT, D2+GT and D2+Mp groups. Haloperidol was administered for 14 days, and subsequently treated with extracts of *Mucuna prupriens* and *Camellia sinsensis*. Motor function test was performed via parallel bar and rotarod tests. On administration of 15 mg/kg haloperidol (D2), decline in motor function was established. Latency of turn time (25 sec) and PBT time (120 sec) were significant ($p < 0.001$ and $p < 0.05$) in haloperidol treatment groups -D2, and –D2 and GT, respectively. There was no significant difference in rotarod test in the entire groups. Significant increase ($p < 0.05$) was observed in oxidative stress and lipid peroxidation in post haloperidol treatment (-D2 + Mp; -D2 + GT) and Mp (alone) treatment groups, compared with control. Lipid peroxidation was significantly ameliorated in GT and –D2 +Mp treatment. Histopathological studies revealed mild pyknosis and patchy intima erosion in the blood vessels in the D2 group. Findings from this study indicate that Mp and GT have the potential to restore motor activities and ameliorate oxidative stress and lipid peroxidation. Therefore, *Mucuna pruriens* and *Camellia sinsensi* treatment may be possible for amelioration of parkinsonism..

Key words: *Parkinson disease, Mucuna pruriens, Camellia sinensis, Parallel bar test, Rotarod test.*

INTRODUCTION

Parkinson's disease (PD), also known as idiopathic or primary parkinsonism, hypokinetic rigid syndrome, or paralysis agitans is a degenerative disorder of the central nervous system mainly affecting the motor system. PD is the second most common neurodegenerative disorder, primarily characterized by bradykinesia, rigidity, resting tremor, and postural instability. These motor signs are mainly due to progressive degeneration of dopaminergic neurons in the substantia nigra pars compacta (SNpc) (Chaudhuri and Schapira 2009). PD could be triggered by chemical, environmental, genetic and neurotrophic factors in which dopaminergic neurons are lost and there is de-pigmentation in the substantia nigra (SN) (Atasoy et al. 2004; Da et al. 2006). The prevalence increases exponentially with age between 65 and 90 years. The mean age of onset is about 65 years. However 5-10% of people who develop PD experience symptoms before the age of 40 (young onset), and juvenile onset is when people experience these symptoms before the age of 20. (Dave 2008).
The motor symptoms are collectively called

Correspondence: Philip L. Ugbem, MSc, Department of Anatomy and Forensic Anthropology, Faculty of Basic Medical Sciences, Cross River University of Technology, PMB 1123, Okuku Campus, Nigeria., Nigeria. Email:;: uhinekwamelile@gmail.com

parkinsonism or parkinsonian syndrome. The degeneration and loss of pigmented dopaminergic neurons of the SNc of the basal ganglia on midbrain is recognized to be the principal pathological characteristic of PD. Parkinsonian symptoms start to appear when 50-60% of SNc dopaminergic neurons and 70-80% of striatal nerve terminals are lost (Chaudhuri and Schapira 2009).

Haloperidol is a widely prescribed antipsychotic that acts as a dopamine D2 receptor antagonist. Haloperidol may result in a movement disorder after prolonged treatment as tardive dyskinesia which may be permanent. Parkinsonism usually appears days to weeks after starting antipsychotics. *In vivo* studies in medicated patient have shown that the treatments with traditional antipsychotic compounds such as haloperidol consistently induce 70-80% occupancy of the straital D2 receptors (Martinot Paillere-Martinot 1990).

Mucuna pruriens (Mp) is a tropical legume native to Africa and tropical Asia and widely naturalized and cultivated, The plant is notorious for the extreme itchiness it produces on contact (Andersen et al. 2015), particularly with the young foliage and the seed pods. *M. pruriens* seeds contain high concentrations of levodopa 1-3,4-dihydroxyphenylalanine (L-DOPA), an unusual non protein amino acid, and a direct precursor to the neurotransmitter, dopamine, an important brain chemical involved in mood, sexuality and movement (Erowid 2002). Mp has shown anti-parkinsonian activity with less dyskinesia potency in PD animal models (Kasture et al. 2009; Lieu et al. 2012). Anecdotal evidence also suggested that MP could be useful in PD treatment (Vaidya et al. 1978).

Camellia sinensis is a species of evergreen shrub whose leaves and leaf buds are used to produce tea. Among age-associated pathologies and neurodegenerative diseases, green tea has been shown to afford significant protection against Parkinson's disease, Alzheimer's disease, and ischemic damage (Mandel and Youdim 2004).

The present study therefore investigated the possible improvement of the motor function potentials of *Mucuna pruriens* and *Camellia sinensis* in parkinsonian mice models.

MATERIALS AND METHODS

Plant Material

Fresh seeds of *Mucuna pruriens* were procured from the Department of Pharmacology and Pharmacognsy, College of Medicine University of Lagos, Idi-Araba. Green tea and haloperidol were procured from Julie Pharmacy. The seeds and tea were identified in the Department of Botany, University of Lagos, Nigeria.

Mucuna Pruriens Seed Extract Preparation

Fresh seeds of *Mucuna pruriens* were removed from the pods and pounded using mortar and pestle. 244 g of coarse powder of the seeds was packed into a thimble and inserted to the Soxhlet extractor. The Soxhlet was inserted into the quick fit bottom flask containing solvent; when the solvent boils, it vaporizes through the vapour tubes to the condenser. As the vapour gets to the condenser, it dropped as liquid. As soon as a colourless liquid showed in the capillary tube, this indicated completion of the extraction. The *Mucuna prupriens* extract was transferred to a water bath to allow evaporate the solvent. The final product was transferred into a sterile container.

Camellia sinensis Extract Preparation

A hundred gram coarse powder of *Camellia sinensis* was packed into a thimble and inserted to the Soxhlet extractor. The Soxhlet was inserted into the quick fit bottom flask containing solvent; when the solvent boils, it vaporizes through the vapour tubes to the condenser. As the vapour gets to the condenser, it dropped as liquid. As soon as a colourless liquid showed in the capillary tube, this indicated completion of the extraction. The *Camellia sinensis* extract was transferred to a water bath to evaporate the solvent. The final product was transferred into a sterile container.

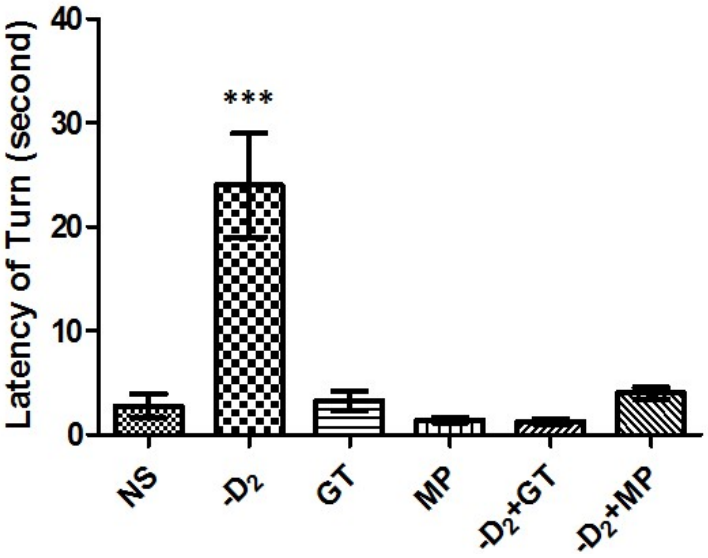

Figure 1: The Latency of turn of experimental animals. *** –D2 is significantly higher than other groups at $p < 0.001$. No statistical significant difference was observed when other groups were compared with control and each other. Values are the mean ± SEM $p < 0.001$.

Animals

Thirty female healthy mice weighing between 25-35 g were used for this research. They were housed in well-ventilated plastic cages, kept and maintained

under laboratory conditions of temperature, humidity and light. At the time of procurement, they were weighed between 15-20 g. The mice were allowed to acclimatize for a period of two weeks and were fed growers mash. They were also given tap water at pleasure using water bottles. At the end of two weeks, the mice were weighed and randomly assigned to six different groups namely: control, parkinson's model, *Mucuna pruriens*, *Camellia sinensis*, Parkinson and *Camellia sinensis*, Parkinson and *Mucuna pruriens*.

Experimental Design

For the experiment, the animals were randomly divided into six groups of five animals each. The animal's average weight was 30 g.

Control group: Animals in this group received distilled water throughout the course of the experiment.

Parkinsonian group: Animals each were given fifteen milligram per body weight (15 mg/kg) of haloperidol daily for fourteen days.

Extract group (*Mucuna pruriens*): Each mouse was administered twenty milligram per kilogram body weight (20 mg/kg) of *Mucuna pruriens* daily for fourteen days.

Extract group (*Camellia sinensis*): Each mouse was administered twenty five milligram per body weight (25 mg/kg) daily for fourteen days.

Therapeutic group (PD and *Mucuna pruriens*): Mice in this group received fifteen milligram per body weight (15 mg/kg) of haloperidol each for fourteen days, and later each of them was administered

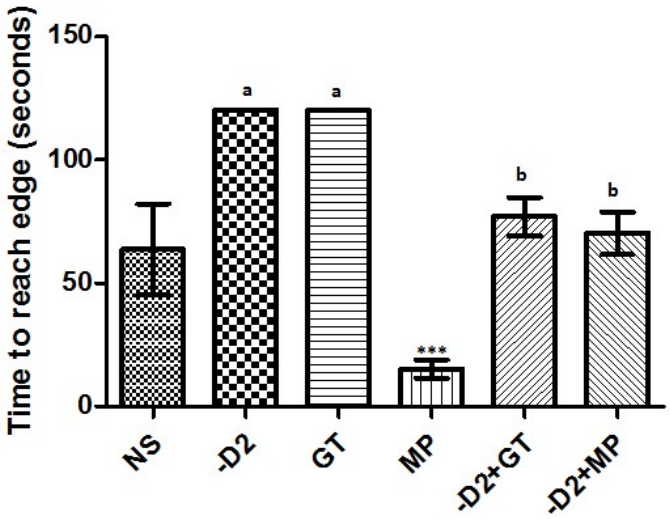

Figure 2: The Time Taken for the Animals to Reach Either Edge of the Bar. [a]–D2 and GT are significantly higher than the control at $p < 0.05$, [b]-D2+GT and –D2+MP is significantly lower than –D2 and GT $p < 0.05$), ***MP is significantly lower against all other groups at $p < 0.001$. Values are the mean ± SEM $P< 0.05$.

twenty milligram per kilogramme body weight (20 mg/kg) of *Mucuna pruriens* for fourteen days making twenty one 21 days.

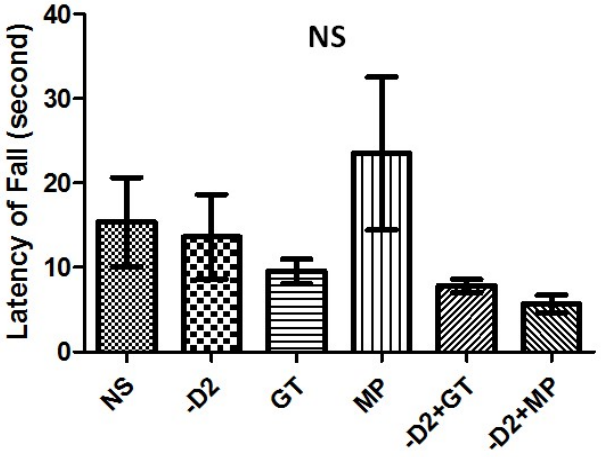

Figure 3: Latency of fall (LOF) as Recorded in Rotarod Test for Motor Function. No significant difference in all groups.

Therapeutic group (PD and *Camellia sinensis*): Mice in this group received fifteen milligram per body weight (15 mg/kg) of haloperidol each for fourteen days, and later each of them was administered twenty five milligram per kilogram body weight (25 mg/kg) of *Camellia sinensis* for fourteen days making twenty eight days.

Preparation of Parkinsonian Mice Model

Induction of parkinsonism was carried out through intraperitoneal route using syringe and cannula.

Motor Function and Coordination

At the end of the treatment phase (day 28 for control, day 14 for -D2, day 28 for D2 + Mp, day 28 for D2 + GT), the animals were examined in various tests for motor. All animals were familiarized with the behavioural tools during the treatment phase and were moved to the testing area 72 hours before the commencement of the tests.

Parallel Bar Test

Motor coordination was accessed on two raised 1m long (1 mm) parallel bars (3 cm apart) mounted on the 60cm high wooden frame. The mice was placed at the 0.5 m mark (centre of the raised bars) and allowed to roam freely on the bar. The duration taken for the mice to make 90° turn was recorded as the latency of turn (LOT) for a 3 minutes trial.

Rotarod Test

The test involved one trial (T1) of 5 minutes for each mouse. The time spent on the rotarod in T1 was determined and averaged to determine the latency of fall (LOF) for each group. The passive rotation of each mouse was also noted.

Animal Sacrifice

The animals were sacrifice through cervical dislocation. Subsequently, the animals were perfused (transcardial) through the left ventricle with a fixative (150 mL of saturated picric acid + 150 mL of 10% formalin). Subsequently, the skull was opened to harvest the whole brain following which it was fixed in the perfusion fixative overnight. After overnight fixation, the brain was taken for tissue processing and biochemical assay.

Biochemical Assay

Estimation of Oxidative Stress and Lipid Peroxidation Markers

Whole brain tissue was kept in cold 0.25M sucrose at 4°C and homogenized using a mortar and pestle. Subsequently, the tissue homogenates were centrifuged at 3000 rpm and the supernatant was collected for colorimetric assay of total protein (TP), superoxide dismutase (SOD) and malondialdehyde (MDA) using the appropriate kits. SOD activity was determine by the method of Mistra et al. (1972), while MDA was measure spectrophotometrically (Colado et al. 1995). Lipid peroxidation was determined by measuring MDA formed by thiobarbituric acid (TBAR). All assay protocols were in accordance with the manufacturer's specifications and guidelines.

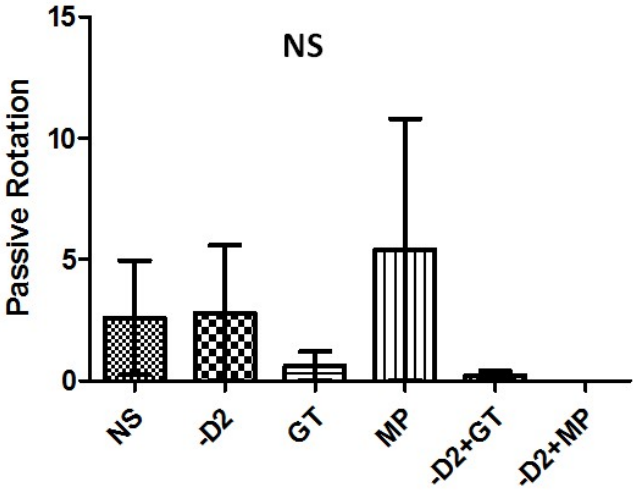

Figure 4: Passive Rotation. No significant difference was observed.

Tissue Processing for Heamatoxylin and Eosin

At the end of the 21 days of the administration, the mice were sacrificed cervical dislocation. Brain tissues were carefully harvested out of the mice, trimmed to remove any blood. The tissues were immediately fixed in neutral buffered formalin. After 72 hours, 2-3 mm in thickness were dissected out and post fixed in another freshly prepared neutral buffered formalin and then transferred to a graded series of alcohol.

On day 1, they were placed in 70% alcohol for 7 hours, then transferred to 90% alcohol and left in the latter overnight. On day 2, the tissues were passed through three changes of absolute alcohol for an hour each then cleared in xylene.

Table 1: The Effects of *Mucuna prupriens* (20 mg/kg) and *Camellia sinensis* (Green Tea, 25 mg/kg) Administration in Experimental and Parkinsonian Mice Model

	TP (g/dl)	MDA (10^{-6}) (nmol/ml)	SOD (%)
Control	0.88± 0.01^{a}	2.38± 0.27^{a}	90.79±0.29^{a}
D_2	0.23±0.03^{a}	8.51± 0.43^{c}	88.14±1.99^{a}
GT	1.43± 0.07^{b}	1.30± 0.01^{a}	85.20±1.03^{a}
Mp	0.58± 0.04^{a}	5.27± 0.18^{b}	99.25±0.19^{b}
D_2 + GT	0.37± 0.02^{a}	5.62± 0.27^{b}	95.03±0.66^{b}
D_2 + Mp	1.07± 0.05^{b}	1.79± 0.03^{a}	95.53±0.09^{b}

Values are presented as means ± SEM. In TP, D2 +Mp and GT (alone) is significantly higher ($p < 0.05$) than control and rest of the group; MDA, -D2 significantly higher ($p < 0.05$) than (MP and -D2 + GT) higher than control and rest of the groups ($p < 0.01$); SOD, -D2+Mp,-D2 +GT & Mp (only) significant ($p< 0.05$) against control and rest of the group.

Once cleared, the tissues were infiltrated in molten paraffin wax in the oven at 58°C. Three changes of molten paraffin wax at one-hour intervals were made, after which the tissues were embedded in wax and blocked out. Prior to embedding, it was ensured that the mounted sections to be cut by the rotary microtome were orientated perpendicularly. Serial sections of 5 µm in thickness from a solid block tissue, fixed on clean albuminized slides to prevent sections coming off the slides and later stained with haematoxylin and eosin staining techniques, after which they were passed through ascending grade of alcohol, cleared in xylene and mount in DPX mountant, allowed to dry at room temperature and observed under the digital light microscope.

Ethical Considerations

Ethical approval was obtained from the Department of Anatomy, University of Lagos Committee on use and care of animals. All animal experiments were carried out in line with the guidelines of Institutional Animal Ethical Committee.

Statistical Analysis

Data were presented as mean ± standard error of mean; analysed using SPSS, one way analysis of variance and Tukey's post-hoc test. Statistical significance was taken at $p < 0.05$.

RESULTS

Motor Function Tests

Parallel Bar Test

In parallel bar test, the time it took the animals to make 900 turn on the bar termed as latency of turn (LOT) and time to reach either of the edge of the bar; all in seconds were recorded.

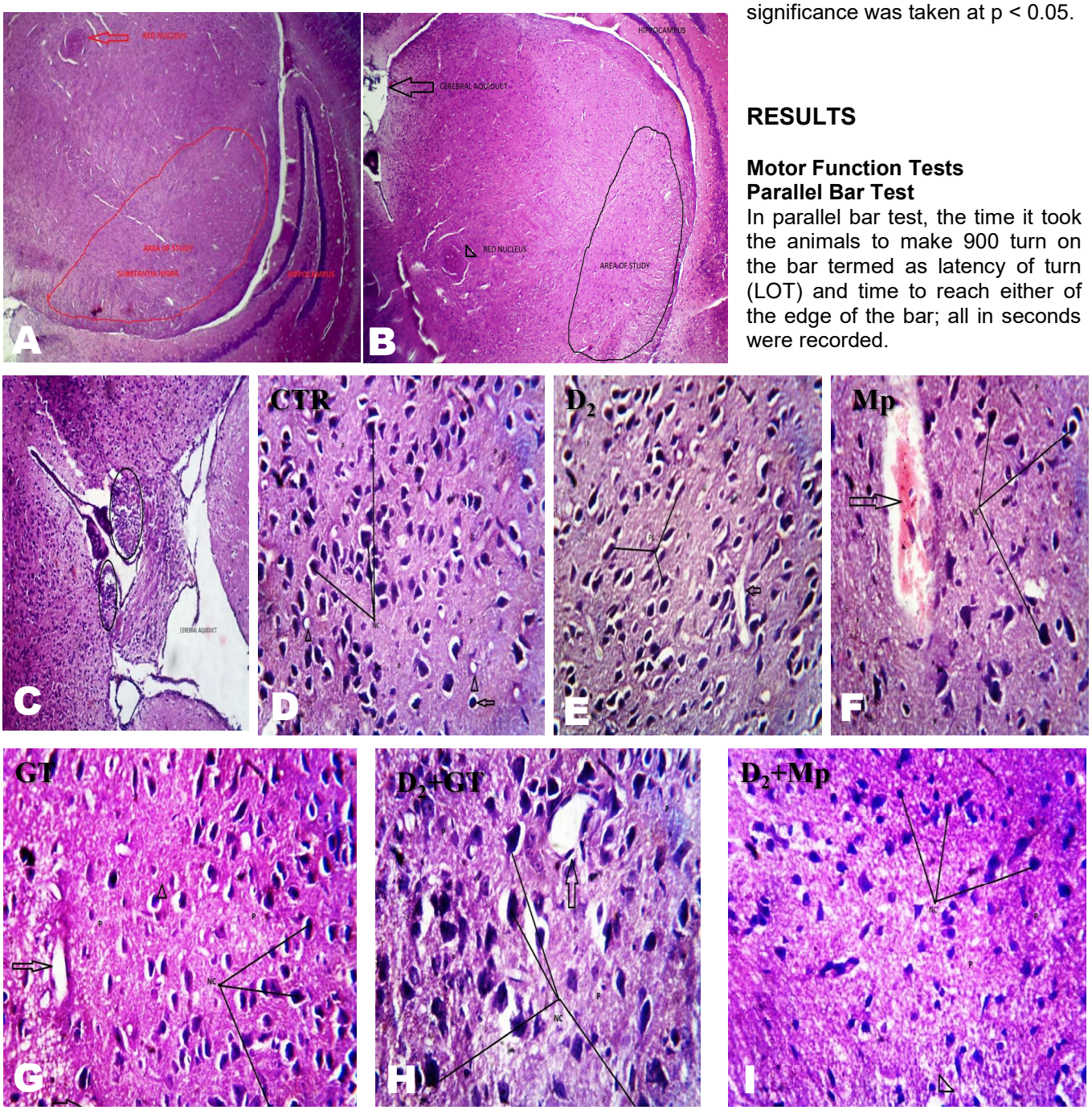

Figure 5: Photomicrographs show sections of the substantia nigra. ×400, H&E. A and B: shows mapping of study area with Histology Relations. C. D2 group with mild pyknosis of neurons compared with that of control. The neuropil and parenchyma appear normal. Patchy intimal erosion observed in blood vessels. Section revealed peri choroidal infiltrates (circle). D: CTR group shows clusters of neuromelalin contained neurons (NC). The glia cells (arrow), parenchyma (P) and capillaries (arrow head) appear normal and unremarkable. Section is free from collections, inflammatory cells and no arteriovenous malformation observed. E: D2 group shows mild pyknosis (PK) of neurons compared with that of control. The neuropil and parenchyma (p) appear normal. Patchy intimal erosion observed in blood vessels (arrow). F: MP group shows clusters of neuromelalin contained neurons (NC). The glia cells (arrow), parenchyma (P) and capillaries (arrow head) appear normal and unremarkable. Section revealed intracapillary collection. G: GT group shows clusters of neuromelalin contained neurons (NC). The glia cells (arrow head), parenchyma (P) and capillaries (arrow) appear normal and unremarkable. H: D2+GT group shows clusters of neuromelalin contained neurons (NC). The glia cells, parenchyma (P) and capillaries (arrow head) appear normal and unremarkable. Fewer flattened neuron appear compared to D2 group. I: D2+MP group shows moderate reduction in neuronal pigment (NC), parenchyma (P) and capillaries (arrow head) appear normal and unremarkable. No marked evidence of neuronal degeneration.

Latency of Turn (LOT)
A significant increase in LOT scores were considered as abnormal motor coordination when the treatment groups were compared against the control. Haloperidol treatment group (-D2) had the highest LOT time (25 sec), indicating motor coordination impairment which is statistically higher than the control (NS) and other treated groups (GT, MP, -D2+GT and –D2+Mp) ***p < 0.001. Other treated groups show no significant difference compared with the control or with each other p > 0.05 (Figure 1).

Time to Reach Edge
The time that the animal took to reach either of the edges were also recorded. –D2 and GT show highest value (120 sec). –D2 and GT were significantly higher than the control, which indicates less motor activity (a = p < 0.05 Vs. NS). Group that was given GT and Mp intervention (-D2+GT, -D2+Mp) was significantly lower than –D2 and GT alone (b = p < 0.05 vs. –D2 and GT) indicating high motor activity. Mp alone group shows lowest time in reaching the edge (10s) which is statistically significant compared to all other experimental groups (***p < 0.001). This indicates better motor activity. No statistical significant was observed when the intervention group was compared to control. No statistical significant was also observed when –D2 group was compared with GT (Figure 2).

Rotarod Test
In this test, the time it took the animal to fall off the rotating bar termed as latency of fall (LOF) in seconds and the number of time the animal rotate with the rotating bar termed as passive rotations were recorded.

Latency of Fall
No statistical significant difference was observed in the LOF of all the experimental groups. Mp has the highest value indicating better motor activity followed by the control. The intervention group have the lowest value showing that they did not perform well on the rotarod test (Figure 3).

Passive Rotation
No statistical significant difference was observed when all the groups were compared. Mp had the highest value showing that they grip more on the bar to stay longer on the bar than other groups. The intervention group has the lowest value showing not much grip on the bar (Figure 4).

Biochemical Assay
Oxidative Stress
SOD increase significantly (p < 0.05), in post Haloperidol (-D2 + Mp; -D2 + GT) treated group as well as Mp (alone) treatment, compared with control and rest of the group (Table 1).

Total Protein
Post haloperidol treatment D2+ Mp group and GT (only) treatment group showed significant increase (p < 0.05) in the total protein (TP) content of the brain tissue homogenate compared to control and the rest of the groups (Table 1)..

Lipid Peroxidation
Significant increase was observed in MDA per mg protein when parkinsonian group (D2) was compared with control (p < 0.05). Mp (only) treatment group and post haloperidol treatment D2+GT showed significant (p < 0.01) increase in the extent of lipid peroxidation when compared with the control and rest of the groups (Table 1).

Histopathological Studies
The result of histopathological investigation on substantial nigra of the parkinsonian mice models showed that haloperidol induces histopathological changes in the substantial nigra of the parkinsonian mice models, though no marked neuronal degeneration. In the haloperidol post treatment groups (Figure 5).

DISCUSSION

Hunger and disease are the two extremely vital phenomena which threaten the very survival of mankind in mother earth. To cure himself off the diseases, mankind has tried various methods and strategies. Due to the easy access to the number of plants growing around the dwelling place, the initial empirical attempts were made with plants and plant products. To date, the herbal medicine is still the mainstay of about 75 to 80% of the world population, mainly in the developing countries, for primary health care because of better compatibility with the human body and lesser side effects (Kamboj 2000). Biswas et al. (2004) reported that herbal medicine is used for treatments to cure various diseases.
Mucuna pruriens is a popular medicinal plant of India, which has long been used in Ayurvedic system of medicine. Numbers of studies have shown beneficial effects of *Mucuna pruriens* as aphrodisiacs, anti-parkinsonism, hyperglycaemic, antioxidant, antibacterial, antifungal, and anticancer agents (Rajeshwar and Gupta 2005; Bhaskar and Vidhya 2008; Shukla and Mahdi 2010). Phytochemical evaluation of the seeds revealed the presence of 5-indolic compounds, especially tryptamine and 5-hydroxytryptamine, and alkaloids like flavonoids, mucunine, mucunadine, prurine and prurienine (Girija et al. 2002; Havsteen 2002).
The present study showed that *Mucuna pruriens* and *Camellia sinensis* improved motor function activity in experimental and parkinsonian mice models. The

parallel bar test in this study showed that Mp and GT significantly restored motor deficiency in parkinsonism when compared with their LOT, which is similar to control with no significant difference. GT and Mp intervention group were found statistically insignificant than the –D2 and GT alone group indicating high motor activity. This revealed that GT and Mp possess potentials in improving motor activity in parkinsonism, which is in line with Mandel and Youdim (2004), who reported that among age-associated pathologies and neurodegenerative diseases, green tea has been shown to afford significant protection against Parkinson's and Alzheimer's diseases, and ischemic damage.

The result of this present study further indicates that Mp alone is the best in enchasing motor function activity, when experimented with time in reaching the edge. This is in agreement with Kasture et al. (2009) and Lieu et al. (2012), whose reported that Mp alone has shown anti-parkinsonian activity with less dyskinesia potency in PD animal models. Anecdotal evidence and formulations of the Mp seed powder also suggested that Mp could be useful in the management and treatment of PD (Vaidya et al. 1978; Chamakura 1994).

This present study further test the motor function activity of the animals using rotarod test, and found that Mp value was significantly higher, which ascertain better motor activity followed by the control. This result is similar with the work of Nagashayana et al. (2000) and Ovallath and Deepa (2013), who reported that L-DOPA, a constituent of Mp contributes significantly in the recovery of PD followed by Ayurveda medication. Seed powder of 20 mg/kg of *Mucuna pruriens* used in this study has shown its activeness in the treatment of PD animal models. This result is similar to Katzenschlager et al. (2004), who report that 30 g *Mucuna* seed powder preparation has considerable faster action in treating PD patients than conventional standard drugs such as, Levodopa or Carbidopa, and suggested that natural source of L-DOPA might possess advantages over conventional drugs in long term management of PD. The work of Choi et al. (2002) reported that green tea and electrocardiogram significantly prevented pathologies in animal models. And further reported that oral doses of 25 mg/kg, prevented loss of dopaminergic neurons in the substantia nigra and preserved striatal levels of dopamine.

Comparing the groups, this study found that intervention group had the lowest value, which ascertains poor performance in the rotarod test. Mp has the highest value which showed better performance (by griping more on the bar to stay longer on the bar than other groups). The lowest value of intervention group may be due to muscle weakness. The result of this study is similar to the work of Levites et al. (2001), who reported that animal models of Parkinson's disease, neurotoxins 1-methyl-4-phenyl-1, 2, 3, 4-tetrahydropyridine (MPTP) and 6-hydroxydopamine (6-OHDA) induce dopaminergic cell death and accumulation of Lewy bodies, mediated through several mechanisms involving oxidative stress.

Findings from this study showed that SOD significantly increase, in post haloperidol treatment of 15 mg/kg of D2 for 14 days, which agreed with reports by Guidetti et al. (2001), Kanski et al. (2002), Adedeji et al. (2014) and Ismail et al. (2016), who reported that haloperidol increase the production of free radicals. In our study subsequent treatment with 25 mg/kg of GT for 14 days and (-D2 + GT) group, as well as Mp (alone) of 20 mg/kg for 14 days, significantly suppresses oxidative stress and improve the enzyme activities, as well as TP and MDA values which was almost similar to control group. This is in line with Guidetti et al (2001), Kanski et al. (2002), Adedeji et al (2014) and Ismail et al (2016) who reported that antioxidants reduces oxidative stress in neuronal damage: experimented in cell culture models.

Several studies have indicated that increased oxidative damage and reduced antioxidant activities may be responsible for the onset and progression of PD (Ihara et al. 1999; Abraham et al. 2005; Chen et al. 2009). Therefore, the activation of antioxidant enzymes is one of the strategies to counteract the detrimental effects of reactive oxygen species and restore the normal cellular redox balance (Moosmann and Behl 2002).

Our result showed a frequent increased in total protein content of GT and -D2+ GT when compared with control and rest of the treatment groups. GT and –D2 +Mp treatment groups was found to ameliorate lipid peroxidation, while -D2+GT and Mp groups indicated deteriorative effect on lipid peroxidation. This result is similar with that of Gerlach et al (2003), who reported that excess iron accumulation in the brain leads to free radical formation via the Fenton reaction, contributing to oxidation damage of lipids and protein, and promoting cell death. Gorell et al. (1995) and Atasoy et al. (2004) further reported that iron elevation observed in the substantia nigra of PD patients showed the critical role of iron in PD progression.

Due to wide benefits of the traditional medicine to mankind, many studies have shown the importance of the *Mucuna pruriens* and *Camellia sinensis*. Haloperidol induced parkinsonism led to an increase in ROS formation and lipid peroxidation and treatment with *Mucuna pruriens* and *Camellia sinsensi* revealed possible ways of ameliorating parkinsonism.

Histopathological studies showed mild pyknosis occurred in the parkinsonian group; this could be as a result of necrosis in the substantial nigra caused by haloperidol. Patchy intima erosion was also observed in the blood vessels. This could be as a result of toxicity properties of *Mucuna pruriens. Mucuna spp*.

has been reported to contain the toxic compounds L-Dopa and hallucinogenic tryptamines and anti-nutritional factors such as phenols and tannins. Because of the high concentrations of L-Dopa (7%), velvet bean is a commercial source of this substance, used in the management of Parkinson's disease. However, L-Dopa can also produce a confused state of mind and intestinal disruptions in humans.

In GT treatment group, section was seen to be free from collections, inflammatory cells and no arteriovenous malformation observed; in D2+ GT group, fewer flattened neuron were seen. In same manner, D2+Mp group showed moderate reduction in neuronal pigment.

Dymock and Warden (1980) reported that the presence of L-DOPA, a precursor of dopamine in the seeds of *M. pruriens* made the plant valuable in the treatment of PD.

Conclusion

In summary, we deduced from this study that haloperidol treatment (15 mg/kg) for 14 days resulted in motor dysfunction and muscle weakness of parkinsonian mice models. The observed decline in motor function was attributed to change in extracellular calcium hyperpolarization current after haloperidol induced PD. Upon the intervention of Mp and GT there was restoration of motor activities and amelioration of oxidative stress and lipid peroxidation. Therefore, *Mucuna pruriens* and *Camellia sinsensi* revealed possible ways of ameliorating parkinsonism.

Conflict of Interest

None declared.

REFERENCES

Abraham, S., Soundararajan, C.C., Vivekanandhan, S. and Behari, M. (2005) Erythrocyte antioxidant enzymes in Parkinson's disease. Indian Journal of Medical Research. 121:111-115.

Adedeji, H.A., Ishola, I.O., Adeyemi, O.O. (2014) Novel action of metformin in the prevention of haloperidoi-induced catalepsy in the mice: Potential in the treatment of Parkinson's disease? Progress in the Neuropsychopharmacology and Biological Psychiatry. 48:245-251.

Andersen, H.H., Jesper, E. and Arendt-Nielsen, L. (2015) Human surrogate models of histaminergic and non-histaminergic itch. Acta Dermato-Venereologica. 95 (7),771-779.

Atasoy, H.T., Nuyan, O., Tunc, T., Yorubulut, M., Unal, A.E. and Inan, L.E. (2004) T2-weighted MRI in Parkinson's disease; substantia nigra pars compacta hypointensity correlates with the clinical scores. Neurology India. 52:332-337. https://tspace.library.utoronto.ca/bitstream/1807/3794/1/ni04110.pdf.

Bhaskar, A. and Vidhya, V.G. (2008) Hypoglycemic effect of Mucuna pruriens seed extract on normal and streptozotocin-diabetic rats. Fitoterapia. 79(7):539-543.

Biswas, T.K., Maity, L.N. and Mukherjee, B. (2004) Wound healing potential of Pterocarpus santalinus: a pharmacological evaluation. International Journal of Low Extreme Wounds. 3:143-150.

Chamakura, R. P. (1994) Bufotenine – a hallucinogen in ancient snuff powders of South America and a drug of abuse on the streets of New York City. Forensic. Science Review. 6(1):1-18.

Chaudhuri, K.R. and Schapira, A.H. (2009) Nonmotor symptoms of Parkinson disease: dopaminergic pathophysiology and treatment. Journal of Lancet Neurology. 85:464-474.

Chen, C.M., Liu, J.L., Wu, Y.R., Chen, Y.C., Cheng, H.S., Cheng, M.L. and Chiu, D.T. (2009) Increased oxidative damage in peripheral blood correlates with severity of Parkinson's disease. Neurobiology of Disease. 33:429-435. http://dx.doi.org/10.1016/j.nbd.2008.11.011.

Choi, J.Y., Park, C.S., Kim, D.J., Cho, M.H., Jin, B.K., Pie, J.E. and Chung, W.G. (2002) Prevention of nitric oxide-mediated 1-methyl-4-phenyl-1,2,3,6-tetrahydro pyridine-induced Parkinson's disease in mice by tea phenolic epigallocatechin 3-gallate. Neurotoxicology. 23(3):367-374.

Da Cunha, C., Silva Marcio, H.C.; Wietzikoski, S., Wietzikoski, E.C., Ferro, M.M., Kouzmine, I. and Canteras, N.S. (2006) Place learning strategy of substantia nigra pars compacta-lesioned rats. Behavioral Neuroscience 120(6):1279-1284. doi:10.1037/0735-7044.120.6.1279.

Dave, C.A. (2008) A review of Parkinson's disease.

Dave, C.A. (2008) A review of Parkinson's disease.British Medical Bulletin . 86(1):109-127.

Dymock, W. and Warden, C.J. (1980) Mucuna. Pharmacogr. Indica 1:477-480.

Erowid (2002). Mucuna pruriens. Created 2002-APR-22. International legume database and information service. Genus Mucuna. Version 10.01.

Gerlach, M., Double, K.L., Ben-Shachar, D., Zecca, L., Youdim, M.B. and Riederer, P. (2003) Neuromelanin and its interaction with iron as a potential risk factor for dopaminergic neurodegeneration underlying Parkinson's Disease. Journal of Neurotoxicity Research.5:35-44.

Girija, K., Kannappa Reddy, M. and Viswanathan, S. (2002). Antinociceptive effect of synthesized dihydroxy flavones, possible mechanism. Indian Journal Experimental Biology. 20(1):4013-4015.

Gorell, J.M., Ordidge, R.J., Brown, G.G., Deniau, J.C., Buderer, N.M. and Helpern, J.A. (1995) Increased iron-related mri contrast in the substantia nigra in Parkinson's disease. Neurology. 45:1138-1143. http://dx.doi.org/10.1212/WNL.45.6.1138.

Guidetti, C., Paracchini, S., Lucchini, S., Cambieri, M. and Marzatico, F. (2001) Prevention of neuronal cell damage induced by oxidative stress in-vitro: effect of

different ginkgo biloba extracts. Journal of Pharmacy and Pharmacology. 53:387-392. http://dx.doi.org/10.1211/0022357011775442.

Havsteen, B.H. (2002) The biochemistry and medical siginificance of the flavonoids. Pharmacology and Theraoeutics. 96(2): 67-202.

Ihara, Y., Chuda, M., Kuroda, S. and Hayabara, T. (1999) Hydroxyl radical and superoxide dismutase in blood of patients with Parkinson's disease: relationship to clinical data. Journal of the Neurological Sciences, 170:90-95. http://dx.doi.org/10.1016/S0022-510X(99)00192-6

Ismail, Z., Luiz, A.O., Henry, B., Eric, E.S., Qween,S., Yonas, G. and Constantine, G. (2016) Neuropsychiatric symptoms as early manifestation of emergent dementia. Provisional diagnostic criteria for mild behavioral impairment.Journal of Alzheimer's. 12(2).195-202.

Kamboj, V.P. (2000) Herbal medicine. *Journal of Current Science*. 78(1):35-39.

Kanski, J., Aksenova, M., Stoyanova, A. and Butterfield, D.A. (2002) Ferulic acid antioxidant protection against hydroxyl and peroxyl radical oxidation in synaptosomal and neuronal cell culture systems in vitro: structure-activity studies. The Journal of Nutritional Biochemistry. 13:273-281.

Kasture, S., Pontis, S., Pinna, A., Schintu, N., Spina, L., Longoni, R., Simola, N., Ballero, M. and Morelli,M. (2009) Assessment of symptomatic and neuroprotective efficacy of mucuna pruriens seed extract in rodent model of Parkinson's disease. Neurotoxicology Research. 15:111-122.

Katzenschlager, R., Evans, A. and Manson, A .(2004) Mucuna pruriens in Parkinson's disease: a double blind clinical and pharmacological study.Journal of Neurology Neurosurgery Psychiatry. 75:1672-1677.

Levites, Y., Weinreb, O., Maor, G., Youdim, M.B., Mandel, S. (2001) Green tea polyphenol (−)-epigallocatechin-3-gallate prevents N-methyl-4-phenyl-1,2,3,6 tetrahydropyridine- induced dopamin-ergic neurodegeneration. Journal of Neurochemistry. 78(5):1073-1082.

Lieu,C.A., Venkiteswaran, K., Gilmour, T.P., Rao, A.N., Petticoffer, A.C., Gilbert, E.V., Deogaonkar, M., Manyam, B.V. and Subramanian, T. (2012) The antiparkinsonian and antidyskinetic mechanisms of Mucuna pruriens in the MPTP-Treated Nonhuman Primate. Evidence Based Complement of Alternative.Medicine. 840247:1-10.

Mandel, S., Weinreb, O., Amit, T. and Youdim, M.B., (2004) Cell signalling pathways in the neuroprotective actions of the green tea polyphenol (−)-epigallocatechin-3-gallate: implications for neurodegenerative diseases. Journal of Neurochemistry. 88(6):1555-1569.

Martinot, J.L. and Paillere-Martinot, M.L. (1990) Central D2 receptor blockade and antipsychotic effects of neuroleptics.Preliminary study with PET. Psychiatry and Psychobiology. 5:231-240.

Moosmann, B. and Behl, C. (2002) Antioxidants as treatment for neurodegenerative disorders. Expert Opinion on Investigational Drugs. 11:1407-1435. http://dx.doi.org/10.1517/13543784.11.10.1407.

Nagashayana, N., Sankarankutty, P., Nampoothiri, M.R., Mohan, P.K. and Mohan, K.K.P. (2000) Association of L-DOPA with recovery following Ayurveda medication in parkinson's disease. Journal of Neurological Science. 176(2):124-127..

Ovallath, S. and Deepa, P. (2013) The history of parkinsonism: descriptions in ancient Indian medical literature. Journal of Movement Disorder. 28(5):566-568.

Rajeshwar, Y. and Gupta M (2005). In vitro lipid peroxidation and antimicrobial activity of Mucuna pruriens seeds. Iranian Journal of Pharmacology and Therapeutics. 4(1):32-35.

Shukla, K.K. and Mahdi, A.A. (2010) Mucuna pruriens reduces stress and improves the quality of semen in infertile men. Advance Access Publication. 7(1): 137-144.

Vaidya, A.B., Rajagopalan, T.G., Mankodi, N.A., Antarkar, D.S., Tathed, P.S., Purohit, A.V. and Wadia, N.H. (1978) Treatment of Parkinson's disease with the cowhage plant-Mucuna pruriens Bak. Neurol. India 26: 171-176.