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Effects Of *Mucuna Pruriens* On Neurobehavioral And Motor Functions In *Maximal Electroshock* Exposed *Pregnant* Female Albino Wistar Rat's Pups

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Abstract

Background

Over 50 million individuals worldwide suffer from epilepsy, a neurological condition marked by spontaneous seizures. A major clinical problem is its chronic nature and long-term predisposition for seizures. Antiepileptic drugs (AEDs) during pregnancy provide a major clinical issue since they have to strike a balance between the growing fetus's possible health concerns and the mother's capacity to control seizures. It is important to consider teratogenecity, or the fetus's susceptibility to congenital defects. Mucuna pruriens (MP), a tropical herb with noteworthy pharmacological characteristics, has being studied for possible epilepsy treatment benefits. L-DOPA, an antioxidant and neuroprotective molecule that functions as a precursor to dopamine and modifies dopaminergic neurotransmission is one of the bioactive chemicals obtained from MP. Preclinical studies have demonstrated that MP can reduce seizure frequency, lower seizure severity, and raise seizure threshold.

Main body of abstract

The goal of the current study was to evaluate the neurobehavioral activity of Mucuna pruriens in an experimental rat pup model by means of motor function tests, in comparison to the standard drug Lamotrigine (20 mg/kg) and control (Normal Saline). This study investigates safer substitutes that can be supplied to expectant mothers or used as an addition to current therapies that may lessen teratogenecity.

Conclusion

Assessing the *Mucuna pruriens* extract to the usual medication used in the experimental paradigm, notable improvements were seen in the motor and behavioral domains.

Key words: *Mucuna pruriens*, Maximal Electroshock, Neurobehavioral, motor functions

1. Introduction

Epilepsy is a complex neurological disorder that is characterized by unprovoked seizures, which can affect individuals of all ages, with a special emphasis on the elderly and very young. It is the fifth most common neurological condition worldwide and affects over 50 million people. Those who experience recurrent seizures are more likely to have physical and psychological co-morbidities, higher rates of healthcare utilization, and excess mortality compared to the general population. The chronic nature of epilepsy, as evidenced by the long-term propensity for seizures independent of any direct damage to the central nervous system, and the neurological, cognitive, psychosocial, and social consequences of seizure recurrences, are key features of the disorder. Antiepileptic medications (AEDs) during pregnancy pose a substantial clinical challenge because they need to strike a balance between the mother's ability to manage convulsions and the developing fetus's potential health risks. Teratogenecity, or the fetus's vulnerability to congenital abnormalities, is a concern. Children who use some AEDs, such as Sodium valproate, are more likely to suffer neurodevelopment difficulties. AED withdrawal or tapering may result in fetal development restriction, which can cause low birth weight or tiny for gestational age babies. In instances where AEDs have been discontinued or reduced close to birth, neonatal withdrawal syndrome may develop. AED use during pregnancy may be linked to miscarriage and stillbirth.

The World Health Organization (WHO) reports that 60% of the world's population and over 80% of people living in low-income nations receive primary healthcare through herbal medicine. Many clinically beneficial medications for the treatment of acute and chronic illnesses have been developed as a result of Phytochemical and their chemical analogs, and more research is being done on therapeutic compounds derived from medicinal plants.

Mucuna pruriens (MP), famiy - fabaceae is a tropical plant with significant pharmacological properties is known by its common names “velvet bean” and “cowhage”. Whilst investigations on its antiepileptic effects are still in its infancy, interest in its possible therapeutic advantages for epilepsy is growing. Bioactive compounds derived from *Mucuna pruriens* include L-DOPA, an antioxidant and neuroprotective molecule that acts as a precursor to dopamine. Furthermore, it modulates dopaminergic neurotransmission, which aids in its antiepileptic capabilities. In animal models of epilepsy, preclinical research has demonstrated that *Mucuna pruriens* extracts can enhance seizure threshold, decrease frequency, and lessen the severity of seizures. To determine its effectiveness, safety, and therapeutic potential in the therapy of epilepsy, more research is necessary as the current clinical evidence is minimal.

This study investigated the effect of *Mucuna pruriens* (MP) extract on neurobehavioral changes in infant rat pups of female albino wistar rats who were subjected to Maximal electroshock method during pregnancy. MP can enhance seizure threshold, decrease frequency, and lessen the severity of seizures. We hypothesized that MP potential adjunctive therapy for epilepsy due to its antioxidant, neuroprotective, dopaminergic modulating, and anticonvulsant properties. However, further research, including clinical trials, is necessary to establish its efficacy, safety, and therapeutic potential in the management of epilepsy.

2. Material and Methods

2.1. Experimental Animals

18 young albino wistar pups male and female (3-4 weeks old, weighing 10-30 g) were included in the investigation. The rat pups were offsprings of Female albino wistar rats which were subjected to Maximal Electroshock test and efficacy of *Mucuna pruriens (100 mg/kg)* was assessed as compared to *Lamotrigine* (20 mg/kg) and Normal Saline. During the adaptation and experimental periods, all animals were housed in plastic cages under ambient controlled conditions (25 ± 1◦C, 50 ± 10% humidity, and 12 h light/dark cycle). According to the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), all experiments were conducted as per Good Laboratory Practice (GLP) and CCSEA (earlier known as CPCSEA) guidelines. The Institutional Animal Ethical Committee (IAEC) of Subharti Medical College Delhi-Haridwar by Pass Road Meerut, Uttar Pradesh - 250005, INDIA approved the study with reference no. (1204/Po/Re/S/08/CPCSEA/23-01).

2.2. Experimental Design

Every rat pup was tracked for weight gain from the time of birth until postnatal day 21, as well as postnatal criteria like the day the ear pinna detached, the day the eye opened, and the day the teeth erupted. After that, the pups' motor abilities were assessed from postnatal day 22 to day 25. The pups were divide into three groups of 6 each as follows-

- Control Group: Normal saline was administered to the mother of these pups during gestation (peroral)
- Test Group: *Mucuna pruriens* treated group (100 mg/kg - Peroral)
- Standard Group: Lamotrigine treated group (20 mg/kg - Peroral)

2.3. Dose Selection

The dose of *Mucuna pruriens* (100 mg/kg) was selected on the basis of study conducted by Champatisingh, et al., 2011.

2.4. Rota Rod method:

The rotarod test is a well-established way of assessing muscular tone and strength. This device, which consists of revolving wooden rods of varying diameters for rats of different ages (3.5 cm for post-weaning rats), will be powered by a motor capable of rotating the rod at a maximum speed of 15 rpm. Circular cardboard discs will be used to divide the rod into six parts, each measuring 15.25 cm long. During the training process, every rat that falls off the rod will be quickly returned to the rod. Repeated falls barred an animal from participating in additional studies. Each rat will be forced to hold the rotating rod until it fails to hold and falls down. Total time it could hold was noted. Each rat will be given 4 trials with an inter trial interval of 15 minutes.

2.5. Tail Suspension Test:

The immobility demonstrated by mice when exposed to inevitable and inescapable stress has been theorized to reflect behavior despair, which may reflect depressive disorders in humans. Clinically effective antidepressants diminish mice's immobility following a vigorous and unsuccessful escape attempt while dangling by their tails. This test is a variation on the behavioral despair test in which immobility is achieved by merely dangling a rat by its tail. Rats will be hanged on a plastic rope 75cm above the table top, with adhesive tape positioned ~1cm from the tip of the tail. Immobility will be recorded for 6 minutes (Figure 1). Animals shall be regarded immobile only if they hang passively and motionlessly.

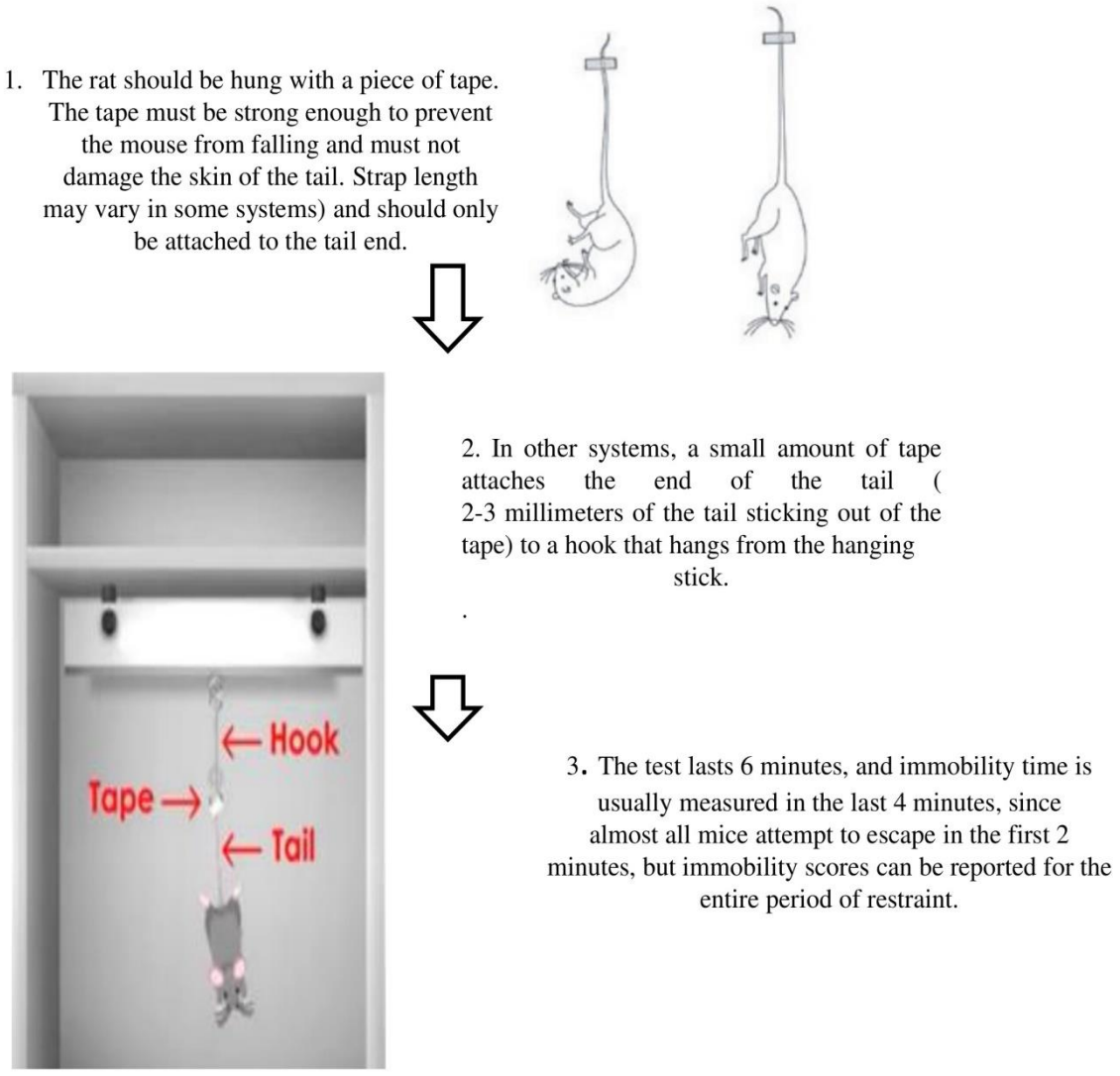

Figure1. Depict the behavioranalysis by using the method of *tail suspension method*.

2.6. Statistical Analysis

One-way analysis of variance (ANOVA) was used to evaluate all data using GraphPad Prism software. Tukey's post hoc test was used to compare various groups. At $p < 0.05$, data were deemed statistically different

3. Results

3.1. Rota rod Test Results –

The effects of *Mucuna pruriens* on motor coordination and balance were assessed using the rotarod test. The mean latency period to fall from the rotarod apparatus was measured and compared between the treatment groups. The results showed that *Mucuna pruriens* significantly increased the mean latency period compared to both the control and Lamotrigine groups (Table 1). Specifically, the mean latency period for the *Mucuna pruriens* group was 33.83 seconds (± 3.49), whereas it was 48.67 seconds (± 4.41) for the control group and 35 seconds (± 2.57) for the Lamotrigine group. Statistical analysis using one-way ANOVA followed by Tukey's test confirmed significant changes in the mean latency period ($P < 0.05$).

Groups	**Latency Period to Fall (**Mean ± SEM)
Control	48.67 ± 4.41
Test Group (*M. pruriens-100mg/kg*)	33.83 ± 3.49
Standard Group (Lamotrigine - 20 mg/kg)	35 ± 2.57

**P*<0.05, one-way ANOVA followed by Tukey's *t*-test, *n*=6 in each group

Table 1 : Comparison of Latency period of pre-exposed pregnant albino wistar rats's off springs to *Rota rod apparatus* to evaluate motor coordination and balance in the experimental groups (*Mucuna pruriens 100mg/kg*) compared to the control (*Normal Saline 10g/kg*) and standard group (*Lamotrigine 20 mg/kg*).

3.2. Tail Suspension Test

The effects of *Mucuna pruriens* on depressive-like behavior and motor activity were evaluated using the tail suspension test. The mean immobility time period and mobility were measured and compared between the treatment groups. The results revealed that *Mucuna pruriens* significantly reduced the mean immobility time period compared to both the control and Lamotrigine groups. Specifically, the mean immobility time period as mentioned in table 2 for the *Mucuna pruriens* group was 288.17 seconds (± 2.52), whereas it was 310.50 seconds (± 2.12) for the control group and 314.33 seconds (± 1.05) for the Lamotrigine group. Statistical analysis using one-way ANOVA followed by Tukey's test confirmed significant changes in the mean immobility time period ($P < 0.0001$).

Additionally, the motor activity and behavioral response in terms of mobility were assessed, with the results showing significantly higher mobility in the *Mucuna pruriens* group compared to both the control and Lamotrigine groups. The mean mobility for the *Mucuna pruriens* group was 71.83 units (± 2.52), whereas it was 47.83 units (± 0.98) for the control group and 45.67 units (± 1.05) for the Lamotrigine group.

Groups	**Immobility**	**Mobility**
Control	310.50 ± 2.12	47.83 ± 0.98
Test Group (*M. pruriens*)	288.17 ± 2.52	71.83 ± 2.52
Standard Group (Lamotrigine)	314.33 ± 1.05	45.67 ± 1.05

Table -2 Comparison of Immobility and Mobility periods of pre-exposed pregnant albino wistar rats's off springs to *Tail suspension* to evaluate motor coordination and balance in the experimental groups (*Mucuna pruriens 100mg/kg*) compared to the control (*Normal Saline 10g/kg*) and standard group (*Lamotrigine 20 mg/kg*).

4. Discussion

The rotarod test showed that *Mucuna pruriens* administration improved motor coordination and balance compared to the control and Lamotrigine groups. This improvement is attributed to the presence of bioactive compounds, such as L-DOPA, which enhances dopamine levels in the brain, improving motor function. *Mucuna pruriens* also has antioxidant and neuroprotective properties, potentially reducing oxidative stress and neuroinflammation. This suggests potential therapeutic benefits beyond traditional use, but further research is needed to understand its mechanisms and long-term efficacy in motor disorders.

Mucuna pruriens has also been shown to have neuroprotective and antioxidant qualities, which may help explain why it helps with motor coordination. *Mucuna pruriens* has antioxidant activity that may help reduce oxidative stress and neuroinflammation, which are linked to the pathophysiology of motor impairments and enhance motor function.
When compared to Lamotrigine, a common antiepileptic medication, the improvement in motor coordination seen with *Mucuna pruriens* treatment indicates possible therapeutic benefits of *Mucuna pruriens* beyond its traditional application. To clarify the underlying mechanisms and evaluate its long-term efficacy and safety profile in motor disorders, more research is necessary.

L-DOPA (levodopa), a precursor of dopamine synthesis found in *Mucuna pruriens*, is recognized to have a function in the pathophysiology of depression. Depressive illnesses have been linked to dopamine malfunction, and raising dopamine levels may have antidepressant effects. *Mucuna pruriens* may have modulated dopaminergic neurotransmission, which would have improved mood and decreased depressive-like behavior, as evidenced by the reduction in immobility seen in that group.

Additionally, increased motor activity and behavioral reaction may be indicated by the *Mucuna pruriens* group's higher mobility when compared to the control and Lamotrigine groups. This

result is in line with dopamine's stimulatory effects on movement and motor performance. The increased mobility shown in the *Mucuna pruriens* group suggests that the plant may have antidepressant-like properties and could be a sign of general mood improvement.

5. Conclusion

Mucuna pruriens supplementation enhances motor coordination and balance in experimental animals, as demonstrated by the rotarod test and tail suspension test. This suggests possible therapeutic value in the treatment of motor deficits. It also implies that taking Mucuna pruriens internally could boost motor activity and have effects similar to those of an antidepressant. The potential for a natural supplement to be used as a therapeutic option is an interesting development, considering the complexity of mood disorders and the wide range of reactions to existing medications. To completely understand the efficacy and safety profile of Mucuna pruriens in both motor and mental disorders, however, comprehensive clinical trials must be conducted. This will ensure that any therapeutic claims are supported by credible evidence. Studies have indicated that Mucuna pruriens have neuroprotective qualities. This could provide a comprehensive treatment strategy for neurodegenerative illnesses, which frequently manifest as both mood and motor abnormalities.

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Conflict Of Interest

All authors had declared no conflict of interest

Abbreviations

AEDs – Anti-Epileptic Drugs
MES - Maximal Electro Shock
LMT - Lamotrigine
MP - *Mucuna pruriens*
ED - Effective Dose
L-Dopa - l-3,4-dihydroxyphenylalanine

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