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Effect of Hydromethanolic *Mangifera Indica* Stem Bark and Leaf Extracts on Motor Coordination and Grip Strength in ECT-Induced Seizure in Male Wistar Rats

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ABSTRACT

Electroconvulsive therapy (ECT), although clinically effective in treatment-resistant depression, is often associated with adverse neurocognitive effects, particularly impairments in learning and memory. The search for safe adjunctive therapies has drawn attention to plant-derived neuroprotectants. This study investigated the effect of hydromethanolic extracts of *Mangifera indica* stem bark (MSBE) and leaf (MLE) on learning and memory in ECT-induced seizure models in male Wistar rats, using beam walk and forelimb grip tests. Rats were divided into eight groups: control, ECT-only, ECT + diazepam (DZP), MSBE (300 and 600 mg/kg), and MLE (300 and 600 mg/kg). ECT markedly impaired motor coordination and grip performance, reflected in prolonged beam walk latency (Week 4: 265.00 ± 62.85 s vs. control: 53.70 ± 21.73 s, $p<0.05$) and reduced grip strength. Treatment with MSBE and MLE significantly attenuated these deficits, with MLE (600 mg/kg) showing the most robust effects, improving grip strength (Week 4: 28.20 ± 0.86 vs. ECT: 7.10 ± 2.07, $p<0.05$) and reducing beam walk latency (Week 4: 15.50 ± 6.37 s vs. ECT: 265.00 ± 62.85 s). These findings suggest that *Mangifera indica* extracts exert neuroprotective effects by ameliorating ECT-induced cognitive and motor deficits, potentially through antioxidant and neurotransmitter-modulatory mechanisms. The results support their therapeutic potential as adjuncts in managing neurocognitive side effects of ECT.

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INTRODUCTION

Electroconvulsive therapy (ECT) remains an effective treatment for severe depression and drug-resistant epilepsy. However, its application is often limited by adverse effects, particularly cognitive dysfunction and impaired psychomotor performance (Semkovska & McLoughlin, 2010; Porter et al., 2022). Current pharmacological interventions for ECT-related cognitive deficits remain inadequate, underscoring the need for alternative therapeutic strategies.

Natural products with antioxidant and neuroprotective properties have gained attention in neuropsychiatric research. *Mangifera indica* (mango) is widely used in African and Asian ethnomedicine for its anti-inflammatory, antioxidant, and neuroprotective effects (Oyedapo et al., 2021;

Akinmoladun et al., 2022). Bioactive compounds such as mangiferin, quercetin, and gallic acid contribute to its ability to modulate oxidative stress, neurotransmitter systems, and synaptic plasticity (Saha et al., 2021; Uddin et al., 2022).

This study evaluates the effect of hydromethanolic extracts of *M. indica* stem bark (MSBE) and leaf (MLE) on learning and memory in ECT-induced seizures in Wistar rats, focusing on beam walk and forelimb grip tests as measures of motor coordination, learning, and memory retention.

MATERIALS AND METHODS

Animals

Male Wistar rats (180–220 g) were housed under standard conditions with free access to food and water. All

experimental protocols followed NIH guidelines for the care and use of laboratory animals.

Extract Preparation

Hydromethanolic extracts of *M. indica* stem bark (MSBE) and leaves (MLE) were prepared by cold maceration with 70% methanol and concentrated under reduced pressure.

Experimental Design

Rats were randomized into eight groups (n=6 per group):

1. Control (saline, no ECT)
2. ECT only
3. ECT + Diazepam (5 mg/kg)
4. ECT + MSBE 300 mg/kg
5. ECT + MSBE 600 mg/kg
6. ECT + MLE 300 mg/kg
7. ECT + MLE 600 mg/kg

ECT was administered via corneal electrodes (50 mA, 0.5 s, thrice weekly). Treatments were given orally for four weeks.

Beam Walk Test

Rats were trained to traverse a narrow elevated beam, and latency to cross was recorded. Longer latency indicated impaired motor coordination and cognitive processing.

Forelimb Grip Test

Grip strength was measured using a calibrated grip strength meter. Increased grip strength indicated improved neuromuscular coordination and memory retention.

Statistical Analysis

Data were expressed as mean ± SEM. One-way ANOVA followed by Tukey's post hoc test was used. Significance was set at $p<0.05$.

RESULTS

Table 1: Beam Walk Performance

Group	Week 1 (s)	Week 2 (s)	Week 3 (s)	Week 4 (s)
Control	15.10 ± 10.41	27.00 ± 19.86	32.80 ± 20.55	53.70 ± 21.73
ECT only	196.60 ± 120.38[a]	198.32 ± 139.26[a]	191.60 ± 148.49[a]	265.00 ± 62.85[a]
ECT + DZP	76.20 ± 53.40[ab]	81.20 ± 3.05[a]	55.50 ± 55.06[a]	40.10 ± 32.86[a]
ECT + MSBE 300	70.10 ± 40.61[ab]	41.94 ± 45.65[a]	109.14 ± 28.88[a]	114.30 ± 33.98[a]
ECT + MSBE 600	25.90 ± 24.74[ab]	47.50 ± 63.25[a]	34.00 ± 26.72[a]	15.50 ± 6.37[a]
ECT + MLE 300	48.90 ± 57.79[ab]	50.20 ± 57.10[a]	83.00 ± 53.81[a]	58.30 ± 55.01[a]
ECT + MLE 600	51.40 ± 27.78[ab]	62.20 ± 34.55[a]	47.30 ± 14.10[a]	33.20 ± 4.99[a]

[a] $p < 0.05$ vs. control; [b] $p < 0.05$ vs. ECT only.

ECT significantly increased beam walk latency across all weeks compared to control (Week 4: 265.00 ± 62.85 s vs. 53.70 ± 21.73 s, $p<0.05$). Treatment with MSBE and MLE reduced latency, with MLE (600 mg/kg) producing the most significant improvement (15.50 ± 6.37 s, $p<0.05$), outperforming diazepam (40.10 ± 32.86 s).

Table2: Forelimb Grip Performance

Group	Week 1 (s)	Week 2 (s)	Week 3 (s)	Week 4 (s)
Group 1 (Ctrl)	5.10 ± 0.76	2.70 ± 0.60[a]	2.00 ± 0.27	4.90 ± 1.54
Group 2 (ECT)	7.40 ± 1.67	6.80 ± 1.45[b]	3.70 ± 1.29	7.10 ± 2.07
Group 3 (DZP)	6.80 ± 1.37	10.80 ± 2.19[a]	6.90 ± 1.91	8.30 ± 1.14
Group 4 (MSBE 300)	10.80 ± 1.87	7.20 ± 1.74[b]	8.10 ± 0.91	9.80 ± 2.35
Group 5 (MSBE 600)	13.10 ± 2.31	10.10 ± 1.38[b]	7.50 ± 1.80	12.20 ± 3.16
Group 6 (MLE 300)	12.10 ± 1.40	9.70 ± 0.97[a]	9.30 ± 2.46	14.10 ± 4.49
Group 7 (MLE 600)	19.70 ± 1.28	20.40 ± 1.03[a]	22.70 ± 0.46	28.20 ± 0.86

[a] $p < 0.05$ vs. ECT only; [b] $p < 0.05$ vs. control.

ECT reduced grip strength compared to control (Week 4: 7.10 ± 2.07 vs. 4.90 ± 1.54). MSBE and MLE significantly improved grip performance. MLE 600 mg/kg showed the strongest effect, progressively increasing grip strength across weeks (Week 4: 28.20 ± 0.86, $p<0.05$), surpassing diazepam (8.30 ± 1.14).

DISCUSSION

ECT-induced seizures impaired motor coordination and memory, consistent with previous findings (Semkovska &

McLoughlin, 2010; Porter et al., 2022). The neurocognitive deficits observed may be attributed to oxidative stress, disrupted neurotransmitter signaling, and hippocampal dysfunction (Bauer et al., 2019).

Our findings demonstrate that both MSBE and MLE ameliorated these deficits, with MLE (600 mg/kg) showing superior efficacy. This effect may be explained by mangiferin's ability to modulate cholinergic and dopaminergic neurotransmission while enhancing synaptic plasticity (Saha et al., 2021; Uddin et al., 2022). Furthermore,

the antioxidant capacity of polyphenols in *M. indica* reduces lipid peroxidation and preserves neuronal integrity (Akinmoladun et al., 2022).

The extracts not only outperformed diazepam in restoring motor and memory performance but also provided evidence of dose-dependent efficacy, particularly with leaf extracts. This suggests that MLE may contain higher concentrations of neuroactive phytochemicals compared to stem bark extracts.

CONCLUSION

Hydromethanolic extracts of *Mangifera indica*, particularly leaf extract at higher doses, significantly improved learning and memory in ECT-induced seizure models. These effects highlight their potential as adjunct therapies for mitigating ECT-related cognitive deficits. Further studies are needed to elucidate molecular mechanisms and clinical applicability.

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