



Antidepressant activity of *Mucuna pruriens* in prolonged chronic mild stress induced depression in *Drosophila melanogaster*

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Abstract

Oxidative stress is known to impact neurological changes in the brain, predisposing an individual to brain disorders. This study explores the antidepressant potential of *Mucuna pruriens* (MP) through modulation of oxidative stress and cholinergic pathways, suggesting its potential as a therapeutic drug for mitigating depression induced by prolonged chronic mild stress (CMS) in *Drosophila melanogaster*. The efficacy of MP methanolic (MP-Meth) and aqueous (MP-Water) extracts was compared with two commercial antidepressants, Fluoxetine (FLX) and Amitriptyline (AMP). CMS was induced by exposing the flies to varying adverse conditions for 24 h. Fifty flies per group, with three replicates for each of the four regimens, were fed a standard feed and treated with 5 mg/ml/body weight for 5 days. Survival rate analysis was done and the antidepressant effect of *M. pruriens* was evaluated by measuring biochemical parameters. Under heat stress, AMP reduced catalase activity (90.8%) and G-S-T levels significantly (96.5%), whereas MP-Meth had the most ameliorating effect on catalase activity (94.2%). MP-Water notably increased AchE activity under both heat (61.8%) and cold stress (97%). AMP showed the highest decrease in lipid peroxidation under heat stress (2.7%), and MP-Water had the most significant decrease under cold stress (19.3%). However, the analysis indicated that both extracts of MP have their peculiarity and efficacy across biochemical markers and stress variations. These findings emphasize the significance of novel, innovative treatments to address the multifaceted nature of depression, therefore, recommending comprehensive exploration of aqueous and methanol extracts from *M. pruriens* as promising therapeutics for enhancing depression management.

Keywords Depression · *Mucuna pruriens* · *Drosophila melanogaster* · Chronic Mild Stress (CMS) · Antidepressant · Oxidative stress · Acetylcholinesterase

Introduction

Chronic mild stress (CMS) is a primary cause of depressive mood disorders, leading to various physiological brain changes such as altered corticosterone regulation via the hypothalamic–pituitary–adrenal HPA axis, impaired neurogenesis, dysfunctional synapses, and altered gene expression [1]. CMS also induces depressive-like behaviour, reduced reward response, and sleep disruptions, with decreased sucrose consumption indicating anhedonia [2]. Animal models of chronic mild stress have been instrumental in studying depressive neuropathology and testing potential therapeutic targets [3].

Depression is a debilitating mental illness affecting approximately 20% of the global population, often presenting asymptomatic in its early phases [4]. It is a leading cause of mortality and disability worldwide, associated with increased risk of criminal behaviour, substance abuse, and suicide [5]. In Nigeria, depression is prevalent, particularly among young adults, with approximately 7.1% incidence rates reported in various regions [6, 7].

Oxidative stress plays a crucial role in the pathogenesis of depression, linked to processes like brain lipid peroxidation, nitric oxide, and cyclooxygenase-2 (COX-2) activity [8]. High levels of reactive oxygen species (ROS) contribute to neuroinflammation, neurotransmitter imbalance, and disrupted neurogenesis/synaptic plasticity [9]. Depression has also been associated with changes in acetylcholinesterase (AChE) activity. Some studies suggest increased AChE activity as a compensatory mechanism for excess acetylcholine, while others report decreased AChE activity, highlighting the complexities of the AChE-depression relationship [10, 11].

Antidepressants, while effective, often require prolonged administration and are recommended alongside psychotherapies for moderate to severe depressive illnesses [12, 13]. *Mucuna pruriens* has shown neuroprotective action by restoring endogenous monoamine levels, including dopamine, through its L-dopa content, which crosses the blood–brain barrier and converts to dopamine [14, 15]. The findings from Karege et al. [16] imply that *Mucuna pruriens* can facilitate neuron growth and survival, which provides insight into some of its antidepressant properties.

Drosophila melanogaster, with its 60% genomic similarity to humans [17], is a valuable model organism for studying human diseases due to its short lifespan, prolific reproduction, and extensive genetic tools [18]. Despite anatomical differences, fundamental molecular pathways are highly conserved [19], making it a viable disease model [20]. Given the side effects and limitations of current antidepressant treatments, this study investigates the antidepressant activity of methanolic and aqueous extracts of *Mucuna pruriens* spicules. This herbal treatment approach aims to offer a more accessible option with potentially fewer side effects compared to pharmacological antidepressants. The study evaluates the ability of *M. pruriens* extracts to reverse CMS-induced depression in *Drosophila melanogaster* by examining their interaction with the nervous system through survival rate and biochemical assays.

Materials and methods

Chemicals

Standard drugs (Fluoxetine and Amitriptyline), Cornmeal, Sucrose, Yeast, Agar–Agar, Methyl paraben, Methanol, Potassium Phosphate Monobasic (KHPO₄), Potassium Phosphate Dibasic (K₂HPO₄), Reduced glutathione (GSH), 1-Chloro-2, 4-dinitrobenzene (CDNB) hydrogen peroxide (H₂O₂), butylhydroxytoluene, thiobarbituric acid, O-phosphoric acid, 5,5'-dithiobis-2-nitrobenzoic acid (DTNB), Acetylthiocholine, Lead acetate (10%), Wagner's reagent, Chloroform, Conc. sulphuric acid (H₂SO₄), Ferric chloride (10%), NaOH (1 M, 10%), Biuret reagent, Tannic acid, Folin-Ciocalteu's reagent, Sodium carbonate (7.5%), Acetic acid (10%), Ethanol, Ammonium hydroxide, Aluminum chloride (10%).

Fly stocks

The wild-type (Harwich strains) of male and female *Drosophila melanogaster* were acquired from Prof. Lucia Prieto-Godino in Neural Circuits and Evolution Laboratory, The Francis Crick Institute, London, England. The breeding environment maintained a temperature of 24 ± 2 °C, and 60% humidity, with 12 h day/night cycles, the experiment and breeding of the flies took place at the Clinical Biochemistry Research Laboratory of the Department of Chemical Sciences at Fountain University Osogbo, Osun State, Nigeria. To culture and nourish the flies, a cornmeal-based medium was utilized, with hygienic adaptations based on the protocols of Folarin et al. [21].

Plant source

Dry pods containing *Mucuna pruriens* seeds were harvested from Gbolasere farm, Mowe, Ogun State, Nigeria. The spicules from the pods of the *Mucuna pruriens* plant were identified and authenticated by the laboratory technician in the Clinical Biochemistry Research Laboratory of the Department of Chemical Sciences at Fountain University Osogbo, Osun State, Nigeria.

Preparation of *Mucuna pruriens* extracts

The bioactive metabolites of *Mucuna pruriens* spicules was extracted using the maceration method. 1 g of *Mucuna pruriens* spicules was weighed into two separate conical flasks. 100 ml of absolute methanol and distilled water were added respectively. Both were then subjected to intermittent shaking at 150 rpm for 72 h to yield a brownish extract. The resulting mixture was filtered through a cell strainer (40 μ M), and the solvent was removed using a freeze dryer [22]. The extracts were stored in sterile bottles at 4°C until further use. The net yield for the aqueous extract was 2%, while that of the methanol extract was 13%.

Phytochemical screening

The liquid extracts were used for qualitative phytochemical screening for compounds, including tannins, alkaloids, terpenoids, phenols, steroids, flavonoids and protein content following the described methods:

Test for tannins using lead acetate

100 μ l of both extracts were picked using a micropipette into a microcentrifuge tube, and then 3 drops of lead acetate (10%) were added. A yellow precipitate indicates the presence of tannins [23].

Test for alkaloids

300 μ l of both extracts were picked using a micropipette into a microcentrifuge tube, and then a few drops of Wagner's reagent were added. A brownish-to-yellowish precipitate indicates the presence of alkaloids [24].

Test for terpenoids

500 μ l of the extracts were mixed with 200 μ l of chloroform and 300 μ l of concentrated sulphuric acid, which was gently added to form a layer. A reddish-brown colour at the interface indicates the presence of terpenoids [24].

Test for phenols

200 μ l of the extracts were picked, and 200 μ l of distilled water was added. Then, 200 μ l of 10% ferric chloride was also added. A blue black colour indicates the presence of phenols [24].

Test for steroids

100 μ l of the extracts were picked inside a test tube and dissolved with 100 μ l of chloroform. An equal volume of concentrated sulphuric acid was added to the test tube side by side. The upper layer of the test tube turned red, and the sulphuric layer turned yellow with green fluorescence, indicating the presence of steroids in the plant [24].

Test for flavonoids

200 μ l of the extracts were picked inside the test tube, and 100 μ l of 10% NaOH was mixed gently. A yellow colour indicates the presence of flavonoids. Few drops of diluted acid was then added and the solution turned colourless [23].

Test for protein using biuret test

200 μ l of the extracts were picked, and 200 μ l of biuret reagent was added. The mixture was allowed to stand for 5 min. A violet colour indicates the presence of protein [25].

Induction of depression in *Drosophila melanogaster*

The procedure for prolonged CMS-induced depression in *D. melanogaster* was adopted by Araujo et al. [26], with slight adjustments. For cold stress, a cold bath of ice was prepared in a styrofoam and a group of about 50 flies were placed in 10 plastic vials containing standard feed and immersed in the cold bath. The temperature was monitored regularly, and the flies were left in the cold bath for 24 h. After 24 h, the vials were removed from the cold bath, and the flies were allowed to recover at room temperature. For heat stress, a group of approximately about 50 flies was transferred into 10 vials containing standard feed, then placed in a water bath at a constant temperature of 36°C and the flies were monitored for 24 h. After the stress induction process, the flies were subjected to survival rate analysis and biochemical assays.

Survival rate analysis

This was carried out to determine the efficacy of the different antidepressants (*M. pruriens* extracts, Fluoxetine, and Amitriptyline) employed for the treatment of CMS Induced depression in *D. melanogaster*. To achieve this, 1 to 3-day-old control and CMS Induced flies were divided into groups containing fifty (50) flies, with three (3) replicates for each group. Throughout the experiment, the survival of the flies was monitored by recording the number of dead flies daily during the entire 5-day exposure period. The treatment groups of flies were fed the standard diet mixed with the different treatments, while the control group was fed only the standard diet. After the treatment period, the data was analyzed, and the results were plotted using line graphs as the percentage of surviving flies.

Preparation of samples for biochemical assays

The CMS and Control fly groups were subdivided into sets of fifty (50) flies, each in three (3) replicates, and subjected to a 5-day treatment with *Mucuna pruriens* extracts and the standard drugs. During the 5-day treatment, the survival rate of each fly group was monitored and recorded after which the flies were then anaesthetized using ice, followed by weighing and homogenization in a 0.1 M phosphate buffer at pH 7.0 (in a ratio of 1 mg: 10 µl). This homogenate was subsequently centrifuged in an ultracentrifuge at 4000 rcf for 10 min at 4°C. The resulting supernatants were carefully separated from the pellets and then transferred into labelled microfuge tubes for further analysis of biochemical parameters.

Determination of catalase activity

Catalase activity was assessed using the Aebi method and the loss in absorbance was monitored using the UV/Visible spectrophotometer. The protocol was adapted from Adedara et al. [27] with little modifications, the reaction mixture comprised 50 mM phosphate buffer (pH 7.0), 300 mM H₂O₂, and the sample (diluted 1:50). The decrease in H₂O₂ absorbance was observed at 240 nm over 2 min at 10 s intervals using a UV/Visible spectrophotometer. The results were used to calculate catalase activity and expressed as µmol of H₂O₂ consumed/min/mg protein.

Determination of Glutathione-S-Transferase (GST) activity

The glutathione-S-transferase activity was determined using the method of Habig and Jacoby with 1-chloro-2, 4-dinitrobenzene (CDNB) as the substrate. The assay mixture containing 500 µL of 0.1 M potassium phosphate buffer, pH 7.0, 200 µL of 10 mM GSH, 50 µL of the sample (diluted 1:5), and 150 µL of 10 mM CDNB was prepared. The reaction mixture was then observed at 340 nm for 5 minutes at 10-s intervals using a UV/Visible Spectrophotometer reader. The results were subsequently expressed as µmol/min/mg protein [27].

Determination of acetylcholinesterase (AChE) activity

The method of Ellman et al. was used to determine the activity of acetylcholinesterase (AChE). The assay mixture comprised 650 μL 100 mM potassium phosphate buffer (pH 7.4), 100 μL of 10 mM 5,5'-dithiobis-2-nitrobenzoic acid (DTNB), 100 μL of sample supernatant, and 10 μL of 0.075 M acetylthiocholine as the initiator. Subsequently, the reaction was observed for 5 min at 15 s intervals and absorbance was measured at 412 nm using a UV/Visible spectrophotometer. The enzyme activity was estimated as μmol of acetylthiocholine hydrolyzed/min/mg protein [27].

Lipid peroxidation assay

The assay was performed as described by Ohkawa et al. and the absorbance was measured using a UV/Visible spectrophotometer after incubation of the reaction solution. The reaction mixture was composed of 5 μL of 10 mM butylhydroxytoluene, 200 μL of 0.67% thiobarbituric acid, 600 μL of 1% O-phosphoric acid, 105 μL of distilled water, and 90 μL whole fly homogenate. This mixture was incubated at 90 °C for 45 min. Subsequently, absorbance measurements were taken at 600 nm and 535 nm for each sample, and changes in absorbance were used to calculate lipid peroxidation and expressed as μmol of malondialdehyde (MDA) formed/ml [27].

Statistical analysis

The datasets acquired were analysed using Microsoft Excel and GraphPad Prism 5.0. For survival rate, line graphs provided visual representations of how the flies responded to the different antidepressant treatments. In contrast, bar plots with error bars showed the variation in biochemical markers using the standard error of the mean (SEM). Analysis of Variance (ANOVA) compared differences between the groups. A confidence interval of 95% and a significance threshold with a p-value of 0.05 determined statistical significance.

Results

This study shows a comprehensive examination of the phytochemical analysis of *Mucuna pruriens* extract and the effects of standard antidepressant drugs, Amitriptyline (AMP) and Fluoxetine (FLX), in comparison to plant extracts, MP-Water and MP-Meth, on *Drosophila melanogaster* under different stress-induced depression conditions. The results encompass phytochemical analysis, survival rates, catalase activity, G-S-T activity, AChE activity, and lipid peroxidation levels.

Phytochemical analysis of *Mucuna pruriens* extract

The qualitative analysis showed that saponins were absent in both extracts. Tannins, alkaloids, terpenoids, steroids, phenol, and protein were present in both extracts. However, only the aqueous extract contained flavonoids, as shown in Table 1.

Survival rate

Fig. 1

Catalase activity

- Under heat stress (A), the initial catalase activity was **0.1596 μmol of H_2O_2 /min/mg protein**. AMP significantly reduced activity to **0.0796 μmol of H_2O_2 /min/mg protein**, showing the most pronounced reduction among treatments. MP-Meth followed with **0.095 μmol of H_2O_2 /min/mg protein**, while FLX exhibited a moderate reduction

Table 1 Qualitative Profiling for Crude Methanolic and Aqueous *M. pruriens* Macerate

PHYTOCHEMICAL PARAMETERS	METHANOLIC EXTRACT	AQUEOUS EXTRACT
Tannin	Present	Present
Alkaloids	Present	Present
Terpenoids	Present	Present
Saponin	Absent	Absent
Phenol	Present	Present
Steroid	Present	Present
Flavonoid	Absent	Present
Protein	Present	Present

to **0.1537 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein**. MP-Water also resulted in **0.1561 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein**, indicating similar efficacy to FLX.

- **Under cold stress (B)**, the initial catalase activity was **0.0759 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein**. MP-Meth had the highest ameliorating effect with **0.0406 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein**, while MP-Water reduced catalase activity to **0.0443 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein**. AMP reduced catalase activity to **0.0511 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein** and FLX resulted in a slight decrease to **0.0603 μmol of $\text{H}_2\text{O}_2/\text{min}/\text{mg}$ protein** Fig. 2.

Glutathione-S-Transferase Activity

- **Under heat stress (A)**, G-S-T activity was initially **0.8616 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. AMP reduced G-S-T activity significantly to **0.030 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, while FLX decreased it moderately to **0.4688 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. MP-Meth caused a smaller reduction to **0.5016 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, and MP-Water had a strong effect, lowering it to **0.0347 $\mu\text{mol}/\text{min}/\text{mg}$ protein**.
- **Under cold stress (B)**, the initial G-S-T activity was **0.7013 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. AMP led to a reduction to **0.4256 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, while FLX decreased G-S-T activity significantly to **0.0788 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. MP-Water reduced the activity to **0.3544 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, and MP-Meth resulted in **0.1294 $\mu\text{mol}/\text{min}/\text{mg}$ protein** Fig. 3.

Acetylcholinesterase (AChE) activity

- **Under heat stress (A)**, AChE activity was initially reduced to **0.0087 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. MP-Water led to a significant increase, restoring AChE activity to **0.0228 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. AMP also elevated AChE activity to **0.0197 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, while FLX had a smaller effect, increasing it to **0.0106 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. MP-Meth raised AChE activity slightly to **0.0108 $\mu\text{mol}/\text{min}/\text{mg}$ protein**.
- **Under cold stress (B)**, AChE activity was reduced to **0.0004 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. AMP restored AChE activity to **0.0226 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, close to baseline levels. FLX increased AChE activity to **0.0126 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, while MP-Water led to **0.0132 $\mu\text{mol}/\text{min}/\text{mg}$ protein**, and MP-Meth resulted in **0.0128 $\mu\text{mol}/\text{min}/\text{mg}$ protein** Fig. 4.

Lipid peroxidation

- **Under heat stress (A)**, lipid peroxidation was initially **5.48×10^{-9} $\mu\text{mol}/\text{ml}$** . AMP reduced lipid peroxidation to **5.33×10^{-9} $\mu\text{mol}/\text{ml}$** , while FLX slightly increased it to **5.80×10^{-9} $\mu\text{mol}/\text{ml}$** . MP-Water showed a higher increase to **6.88×10^{-9} $\mu\text{mol}/\text{ml}$** , and MP-Meth exhibited the highest level at **8.18×10^{-9} $\mu\text{mol}/\text{ml}$** .

Fig. 1 Survival rate analysis of CMS induced depression in *D. melanogaster* after 5 days of treatment. **(A)** Effect of FLX on Cold and Heat Induced depression in flies compared to Control. **(B)** Effect of AMP on Cold and Heat Induced depression in flies compared to Control. **(C)** Effect of MP-Water on Cold and Heat Induced depression in flies compared to Control. **(D)** Effect of MP-Meth on Cold and Heat Induced depression in flies compared to Control

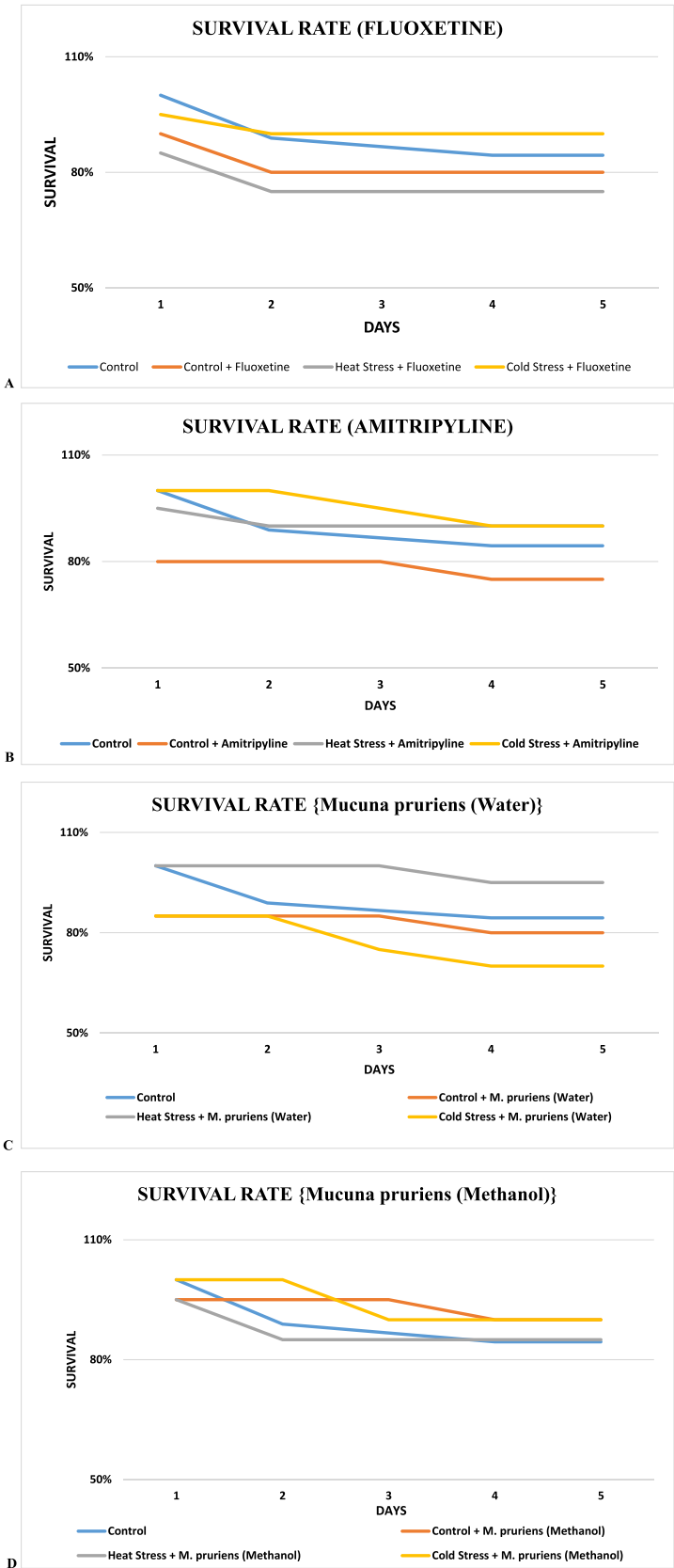
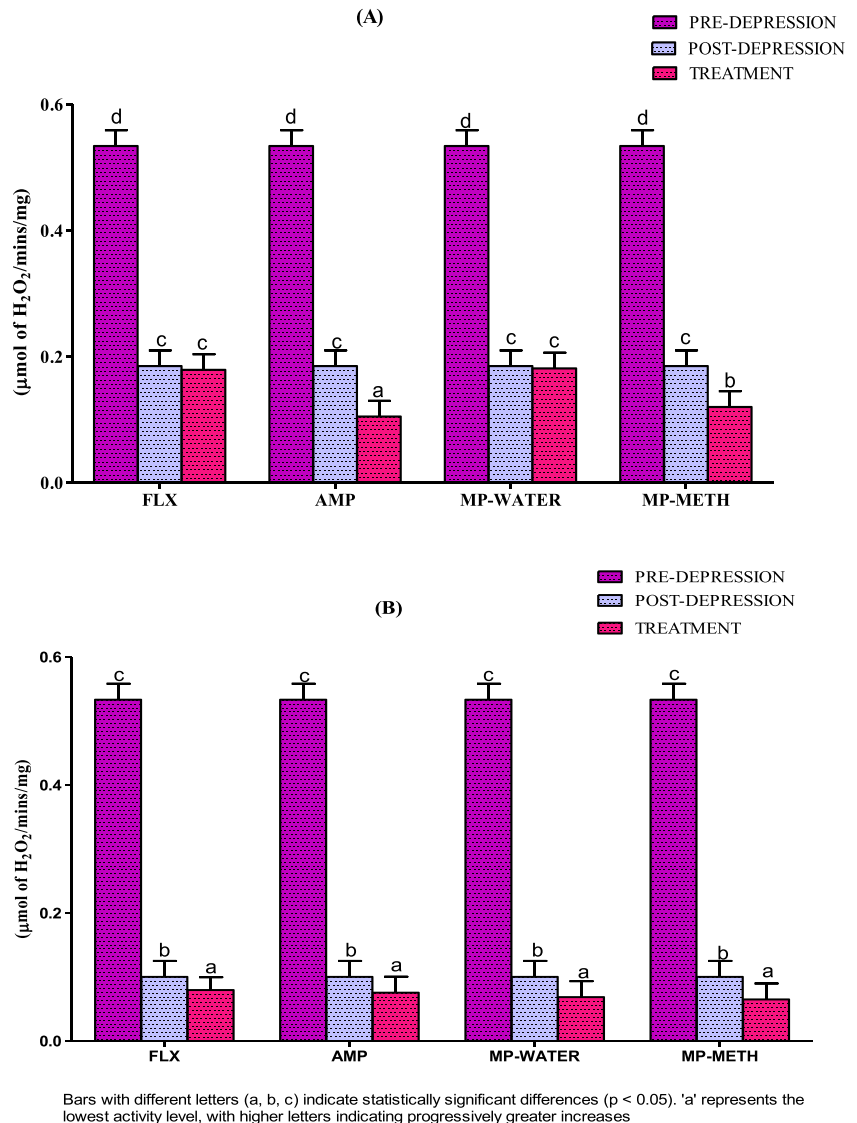


Fig. 2 Effect of different antidepressant on the Catalase activity of CMS Induced Depression in *D. melanogaster* in comparison to control ($p < 0.05$). Baseline catalase activity in the control group was **0.5087 $\mu\text{mol of H}_2\text{O}_2/\text{min/mg}$ protein** under both stress conditions. After CMS induction:



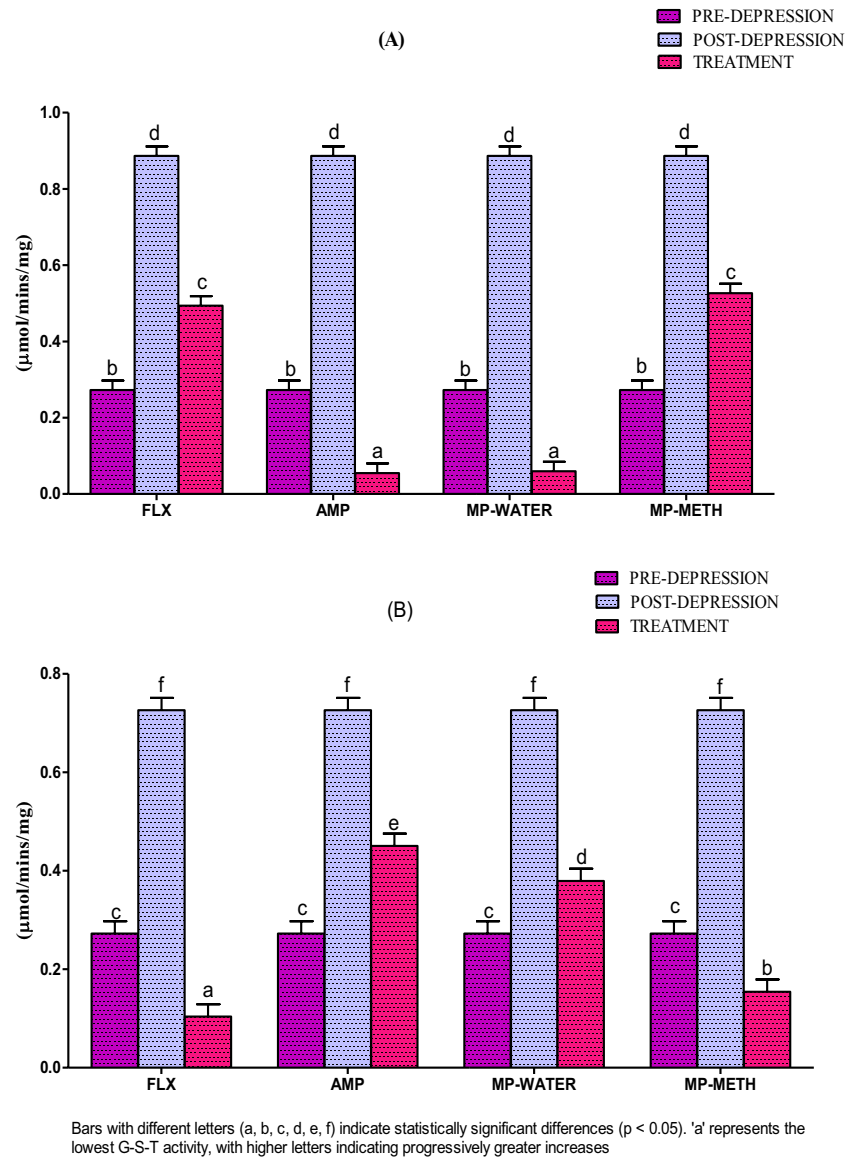
- Under cold stress (B), lipid peroxidation was $4.46 \times 10^{-9} \mu\text{mol/ml}$ at baseline. MP-Water reduced lipid peroxidation to $3.60 \times 10^{-9} \mu\text{mol/ml}$. AMP slightly increased lipid peroxidation to $4.57 \times 10^{-9} \mu\text{mol/ml}$, FLX increased to $5.29 \times 10^{-9} \mu\text{mol/ml}$, while MP-Meth showed the highest increase to $5.90 \times 10^{-9} \mu\text{mol/ml}$ Fig. 5.

Discussion

Phytochemical analysis

Mucuna pruriens is a medicinal plant known for its rich secondary metabolites, particularly alkaloids, vital to its neuroprotective properties. Salim et al. [28] reported that *M. pruriens* seed extract contains several bioactive compounds, including alkaloids, phenols, flavonoids, terpenoids, steroids, and tannins. Similarly, the qualitative analysis confirmed the presence of these compounds in both methanolic and aqueous extracts, except for saponins [29]. These phytochemicals have significant antioxidant and neuroprotective effects, contributing to the therapeutic potential [30].

Fig. 3 Effect of different anti-depressant on the G-S-T activity of CMS Induced Depression in *D. melanogaster* in comparison to control with ($p < 0.05$). Baseline G-S-T activity in the control group was $0.2475 \mu\text{mol/min/mg}$ protein. After CMS induction:



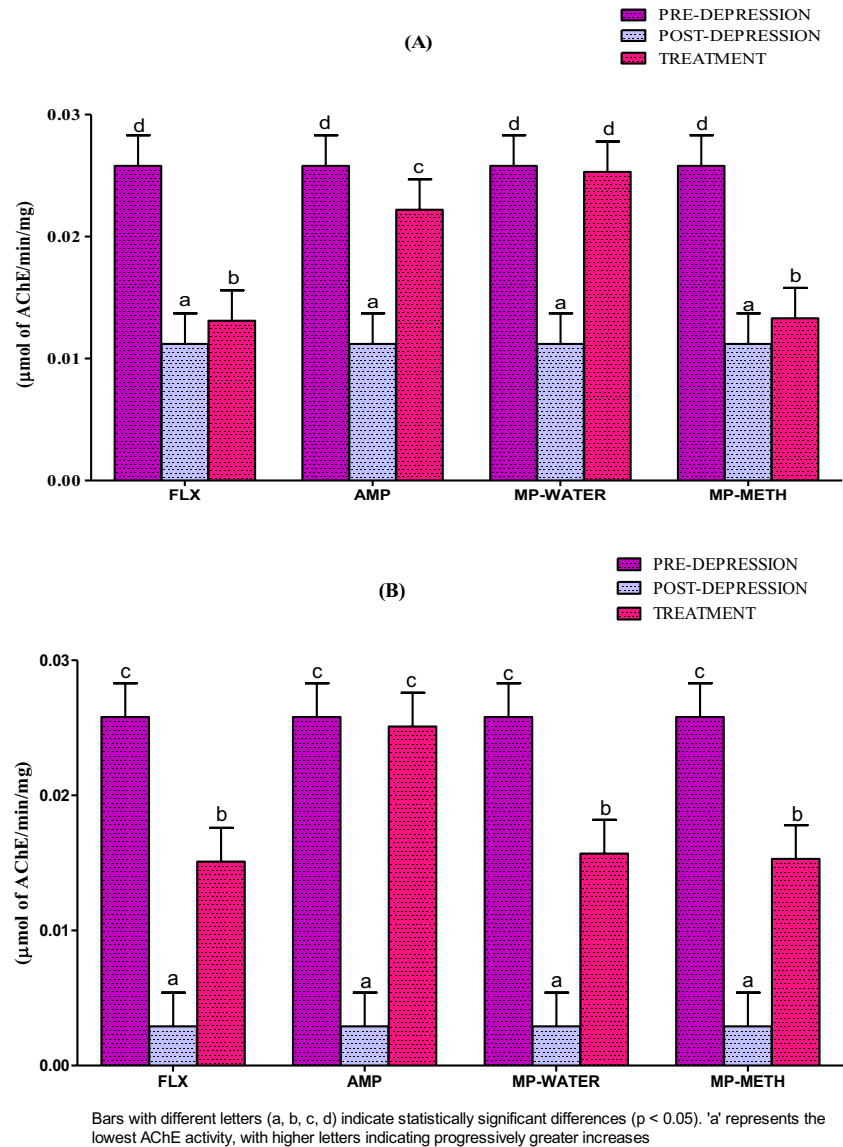
Survival rate

The survival rate analysis under cold and heat stress indicated that the treatments had different effects. Fluoxetine (FLX) increased survival under cold stress but negatively affected control flies, while Amitriptyline (AMP) improved survival in both cold and heat stress. MP-Water was effective under heat stress, and MP-Meth under cold stress, suggesting that the neuroprotective effects of *M. pruriens* are stressor-specific.

Catalase activity

Catalase is an essential antioxidant enzyme that mitigates oxidative stress by converting hydrogen peroxide to water and oxygen [31]. Depression is often associated with oxidative stress, leading to altered catalase activity [32]. In this study, AMP and MP-Meth significantly reduced catalase activity under heat and cold stress, respectively, suggesting that these treatments effectively modulate oxidative stress. The presence of phenolic compounds in *M. pruriens* is responsible for this antioxidant properties [33].

Fig. 4 Effect of different antidepressant on the AChE activity on CMS Induced Depression in *D. melanogaster* in comparison to control. All the treatment increased the AChE activity with ($p < 0.05$). The baseline AChE activity in the control group was **0.0233 $\mu\text{mol}/\text{min}/\text{mg}$ protein**. After CMS induction:



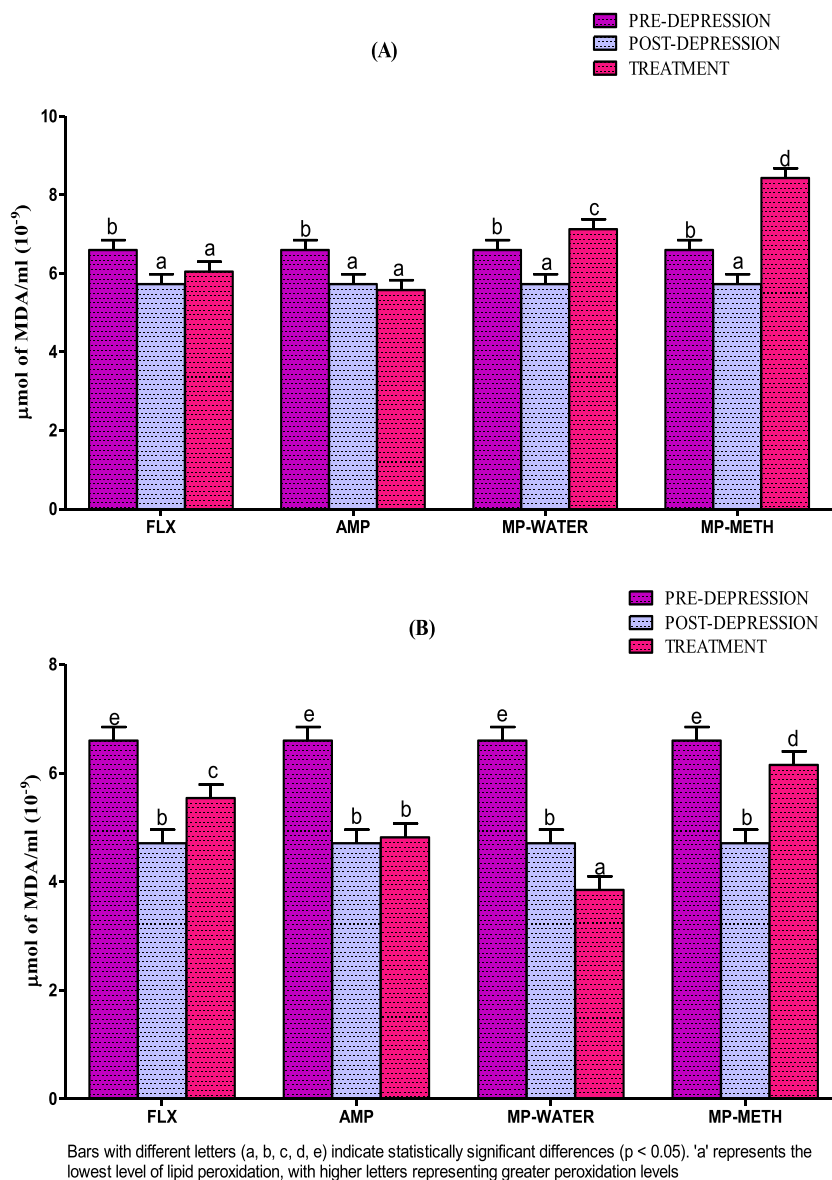
Glutathione-S-Transferase activity

Glutathione (GSH) plays a crucial role in detoxifying reactive oxygen species [8]. Depression is linked to reduced GSH levels, contributing to oxidative stress [34]. In this study, all treatments reduced G-S-T activity in both stress conditions, with AMP showing the highest reduction in heat stress and MP-Meth in cold stress. This reduction suggests that *M. pruriens* extracts, particularly MP-Meth, effectively ameliorates oxidative stress, due to high alkaloid and flavonoid content [35].

Acetylcholinesterase activity

Acetylcholinesterase (AChE) is involved in the breakdown of acetylcholine, a neurotransmitter crucial for cognitive function and mood regulation [36]. Increased AChE activity has been observed in depression, as a compensatory mechanism (Dulawa et al. 2002). In this study, all treatments increased AChE activity under stress conditions, with AMP

Fig. 5 Effect of different antidepressant on the Lipid Peroxidation of CMS Induced Depression in *D. melanogaster* in comparison to control with ($p < 0.05$). The baseline lipid peroxidation level in the control group was 6.35×10^{-9} μmol of malondialdehyde (MDA) formed/ml. After CMS induction:



restoring AChE activity to near pre-depression levels under cold stress and MP-Water showing the highest increase under heat stress. These findings suggest that *M. pruriens* extract, particularly MP-Water, modulate cholinergic pathways and may protect against stress-induced neurodegeneration [37].

Lipid peroxidation

Lipid peroxidation, a process where ROS damage cell membranes, is indicated in the pathophysiology of depression [38]. Although lipid peroxidation levels did not increase under the stress conditions in this study, AMP and MP-Water reduced lipid peroxidation under heat and cold stress, respectively. These findings align with the antioxidant properties of *M. pruriens*, particularly its phenolic and flavonoid content, which are known to inhibit lipid peroxidation [39].

Conclusions

The findings suggest that the phytochemical constituents of *Mucuna pruriens* contribute to its antidepressant effects, potentially through modulation of oxidative stress and cholinergic pathways. Both *M. pruriens* extracts demonstrated unique efficacy across various biochemical markers and stress conditions, emphasizing their potential as innovative treatments for depression. There should be further exploration of the aqueous and methanol extracts from *Mucuna pruriens* as promising therapeutic agents for enhancing depression management.

Recommendation

Further research is needed to elucidate the specific molecular mechanisms underlying the observed effects of standard antidepressant drugs and plant extracts on *Drosophila melanogaster* under stress-induced depression conditions. Clinical studies should also assess whether the effects observed in *Drosophila* translate to humans, with a particular focus on the potential therapeutic benefits and risks of *Mucuna pruriens* extracts compared to standard antidepressant drugs. Also, a combination therapy between both extracts is recommended for better treatment as each has its peculiarity.

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Authors' contributions MES wrote the manuscript and, together with MAA, conducted the study. NBAB principally supervised the project and edited the manuscript. ROY and SIA co-supervised the project. KFN performed the phytochemical screening. ROO, KTGW and WS assisted with biochemical assay evaluation.

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Availability of data and materials All the data for this study are included in the manuscript and are available for the readers.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare that they have no competing interests.

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