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Anti-Stress Properties of Mojeaga Herbal Remedy® using an Unpredictable Mild Stress Animal Model

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ABSTRACT

Mojeaga herbal remedy® (Mojeaga) is a mixture of the herbs *Alchornea laxiflora, Pennisetum purpureum, and Sorghum bicolor*. It is used to manage anaemia, boost the immune system, and protect cells from damage. This study evaluated the antistress property of Mojeaga on mice. Twenty-four mice were randomly allotted to six groups: Group 1 received 10 mL/kg of distilled water without any stress. Groups 2–4 received Mojeaga extract (5, 10, and 20 mg/kg), group 5 received fluoxetine 20 mg/kg, and group 6 received distilled water orally for 7 days. With the exception of group 1 mice, the mice in groups 2-4 were subjected to various stressors for 7 days. In the forced swimming and tail suspension tests, the Mojeaga extract at doses of 10 and 20 mg/kg, along with fluoxetine at 20 mg/kg, reduced the time of immobility compared to the stress control group ($p < 0.05$). The level of cortisol was reduced by Mojeaga extract at 5, 10, and 20 mg/kg and fluoxetine (20 mg/kg) when compared with stress control ($p < 0.01$). The Mojeaga extract at doses of 10 and 20 mg/kg increased the activities of superoxide dismutase and catalase, and at doses of 5 and 10 mg/kg, it lowered the level of malondialdehyde compared to the stress control group. The extract had no effect on the activity of glutathione peroxidase and glutathione reductase. Mojeaga possesses antistress activity.

Keywords

Stress, Antioxidant, Anti-stress, Mojeaga Herbal Remedy®

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INTRODUCTION

From time immemorial, nature has been central to the survival and advancement of humankind, providing essentials such as food, clothing, and medicine. Among the components of nature, plants play a particularly crucial role due to their ability to sustain life through diverse functions, including medicinal applications (Petrovska, 2012). The World Health Organisation derives approximately 11% of its essential medicines from plants, underscoring their therapeutic importance (WHO, 2002; Veeresham, 2012; Usman *et al*., 2014; Akinyemi *et al.,* 2018). Ancient civilisations, such as the Egyptians, Greeks, and Chinese, originated the use of medicinal plants, passing down knowledge of their benefits through generations (Pan *et al*., 2014). Aladejana (2023) says that the healing effects of medicinal plants come from secondary metabolites like alkaloids, flavonoids, and polyphenols. These have strong anti-inflammatory, antimicrobial, and antioxidant properties. In modern practices, combining multiple herbs into polyherbal formulations has gained popularity due to their enhanced efficacy, reduced toxicity, and broader therapeutic range (Aslam *et al*., 2016). This synergy amplifies their beneficial effects, including improved bioavailability and therapeutic outcomes (Jansen *et al*., 2021).

Mojeaga Herbal Remedy® is a polyherbal formulation containing *Alchornea laxiflora*, *Pennisetum purpureum*, and *Sorghum bicolor*. Currently, people use it to manage anaemia, boost the immune system, and act as an antioxidant agent. *A. laxiflora* belongs to the family Euphorbiaceae (Pax and Hoffmann, 1931). In African traditional medicine, *A. laxiflora is* widely used for its antibacterial, antifungal, and antioxidant properties (Akinpelu *et al.,* 2015). Ugbogu and Chukwuma (2019) reported that the stem of *A. laxiflora* is used as a chewing stick and to preserve perishables, while its leaves are used to treat stress, ageing, malaria, and inflammation. The roots and bark are used for ailments such as fibroids, haemorrhoids, menstrual disorders, and infectious diseases (Oyeyemi *et al*., 2019). *A. laxiflora* is used in traditional medicine to treat bacterial and fungal infections.

Pennisetum purpureum (*P. purpureum*) or elephant grass, is a member of the Poaceae family and is mostly found in tropical grasslands in Africa, while it is also found in many tropical and subtropical areas (Reddy *et al*., 2012; Budiyanto *et al*., 2024). These grass species are used as cattle feed in Indonesia because of their sturdy perennial stems, which need very few nutrients to grow and can reach heights of over three metres. They also have the highest biomass yield of any herbaceous plant (Nugroho *et al*., 2020; Setiani *et al*., 2022). It has long been used in folk medicine to cure a variety of conditions, including wounds, rheumatism, and fever. Its potential to cure oxidative stress- and inflammation-related disorders, like diabetes and cancer, has been investigated recently (Budiyanto *et al*., 2024). *Sorghum bicolor* (L.) is one of the various species of sorghum grasses raised mainly for grain. The plant is native to tropical and subtropical regions, and it is one of the major grain crops cultivated for human food in Africa and other tropical regions of the world (Mutegi *et al*., 2010; Ademiluyi et al., 2014). According to Ademiluyi *et al*. (2014), the inhabitants of southwest Nigeria typically ferment the grains to make gruels, which are used as weaning meals for infants. In addition, sorghum leaf sheaths (dried leaves and stems) and extracts have been used as insecticides, antimalarials, and anthelmintics, as well as an infusion, colourant, or dye for the treatment of sickle cell disease and anaemia (Ilori and Odukoya, 2005; Okpuzor et al., 2008; Ademiluyi et al., 2014). According to Awika and Rooney (2004), S. bicolor is utilised to lower inflammation and free radicals. The leaf of S. *bicolor* has antioxidative, anti-neuroinflammatory, and neuroprotective qualities (Umukoro *et al*., 2015).

Mojeaga has gained wide recognition in Nigeria and is sold in pharmacies for the management of anaemia, boosting the immune system, and as an antioxidant agent. Research has shown that stress reduces iron, and iron deficiency is a common cause of anaemia (Wei *et al*., 2008; Biyik *et al*., 2020). This study aimed to evaluate the antistress property of the Mojeaga.

MATERIALS AND METHODS

Procurement of Mojeaga Powder

Mojeaga Herbal Remedy® (Mojeaga, BN:00003) was obtained from the manufacturers at Mojeaga International Ventures Ltd, 2A, Erhuomase Street, Idumwomwina, Ikpoba Okha Local Government Area, off Auchi/Benin Road, Benin City, Edo State, Nigeria.

The composition includes leaves of *A. laxiflora, P. purpureum, and S. bicolor*. Mojeaga Herbal Remedy® Powder contained the component plants in the same ratios as in the final liquid preparation (1:1:1).

Preparation of Mojeaga Powder

Mojeaga powder (500 g) was weighed and mixed with 2,000 mL of distilled water and left to stand for 72 h. It was filtered and freeze-dried (model FD-10S, China) before storing in an amber bottle at 4℃ prior to its use.

Experimental Animals

Healthy male adult Swiss mice (20–30 g) were obtained from a commercial animal house in Ibadan, Oyo state, Nigeria, and housed in the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, under standard laboratory conditions with a 12-h light/dark cycle. The animals were acclimatised for two weeks and fed standard animal pellets. All procedures adhered to the National Institutes of Health (NIH) guidelines for the care and use of laboratory animals. This study was approved by the Life Sciences Research Ethical Committee with reference number LS20316.

Experimental Design

The mice were randomly allotted to six groups of four mice in each group as follows:

Group 1: Normal control (distilled water, 10 mL/kg, p.o.); Group 2: Mojeaga extract (5 mg/kg, p.o.); Group 3: Mojeaga extract (10 mg/kg, p.o.); Group 4: Mojeaga extract (20 mg/kg, p.o.); Group 5: Administered fluoxetine (20 mg/kg, p.o.), Group 6: Stress control (distilled water, 10 mL/kg, p.o.).

Except for group 1, daily treatments were followed by exposure to various stressors for seven days (Patel, 2011; Tiwari *et al*., 2015), as follows:

1. Introducing a predator (rat) into the cage: A rat was placed in the cages of the mice for 30 min. This was done on the first day (Iniaghe *et al*., 2018).
2. Food deprivation: The animal feed was removed for 24 h. This stressor was done on the second day (Iniaghe *et al*., 2018).
3. Water deprivation: Water was removed from the animals in the cages for a 24-h period. The third day saw the implementation of this measure (Iniaghe *et al*., 2018).
4. Tail suspension test: On the fourth, each mouse was suspended and fastened with adhesive tape by the tail from the edge of a shelf 60 cm above a tabletop. The time of immobility was observed and recorded for a duration of 30 min (Porsolt *et al*., 1977; Lam *et al*., 2018; Uwaya *et al*., 2024).
5. Forced swimming test: On the fifth day, each mouse was placed in a transparent cylindrical container (45 × 40 × 30 cm) filled with water to the level of 20 cm and a temperature of 25°C, and the time of immobility was observed and recorded for 30 min (McKinney and Bunney, 1969; Iniaghe *et al*., 2018; Uwaya *et al*., 2024).

6. Animal Isolation: The mice were separated individually into different mouse restrainers for 2 h. This was done on the sixth day (Iniaghe *et al*., 2018).
7. Cold restraint stress test: On the seventh day following administration, the animals' limbs were tied, and they were refrigerated at 4°C for 2 h (Patel *et al*., 2011; Uwaya *et al*., 2024).

Biochemical Assays
Blood and brain samples were collected post-treatment on the 7th day. The mice were placed in a container containing chloroform (anaesthesia), and their abdominal region was opened up. Blood was collected via the abdominal aorta into a plain container for cortisol analysis and was centrifuged at 3,000 rpm for 10 min. The brains of the mice were harvested, and the harvested brains were homogenised in 5 mL of cold normal saline and centrifuged at 3000 revolutions per minute (rpm) for 10 min. The sera and brain homogenates were collected and stored at -20°C. Activities of antioxidants (superoxide dismutase, catalase), glutathione reductase, glutathione peroxidase and cortisol level, and malondialdehyde (MDA) concentration were analysed using colourimetric methods (Idu *et al*., 2016; Uwaya *et al*., 2024).

Determination of Cortisol Level
The method of Katyare and Pandya (2005) with slight modification was used. Prewashed and sterilised test tubes were labelled as blank or test. Serum (100 µl) was pipetted into test tubes labelled 'test', and distilled water (100 µl) was pipetted into test tubes labelled 'blank'. A freshly prepared chloroform:methanol (2:1 v/v) mixture, 200 µL, was added to all the test tubes, followed by 3,000 µl of chloroform. Next, 300 µL of 0.1N sodium hydroxide and 3,000 µL of sulphuric acid were added to each test tube. The test tubes were incubated for 45 min in the dark room at room temperature. Absorbance was read at 533 nm using a ultraviolet spectrophotometer (Model: T80 + UV/VIS). A standard curve of hydrocortisone (Ahmed *et al*., 2024; Koh *et al*., 2020) absorbent against concentration was plotted, from which the concentrations of cortisol were extrapolated.

Determination of Superoxide Dismutase (SOD) Activity
The assay is based on the reaction developed by Misra and Fridovich (1980), with modifications made by Idu *et al*. (2016). Two steps were required for the assay of SOD. The first was the reference tube, which was prepared by mixing 0.2 mL of distilled water with 2.5 mL of carbonate buffer. This step was quickly followed by the addition of 0.3 mL of freshly prepared adrenaline solution, which was rapidly mixed. The sample tubes were prepared by introducing 2.5 mL of carbonate buffer into the test tubes. This was followed by the addition of 80 µL of the test samples and 120 µL of adrenaline solution. This was very rapidly mixed and read at 420 nm absorbance every 30 to 120 s with a UV-visible spectrophotometer (Model: T80 + UV/VIS), and distilled water was used to zero the machine (Luck, 1965; Misra and Fridovich, 1980; Idu *et al*., 2016; Uwaya *et al*., 2024).

Determination of Catalase Activity
Distilled water was measured into the blank test tubes while 0.5 mL of the sample was measured into labelled test tubes. A quantity (2.5 mL) of 30 M hydrogen peroxide was added into the labelled sample test tubes and blank test tubes. After 3 min, 1 mL of 6 M H_2SO_4 and 3.5 mL of 0.01 M potassium permanganate were added to the test and blank tubes. Absorbance was read within 30-60 s. A spectrophotometric standard was prepared by adding 3.4 mL of 0.01 M potassium permanganate to a mixture of 5.5 mL of 0.05 M phosphate buffer pH 7.0 and 1.0 mL of sulphuric acid solution. The spectrophotometer (Model: T80 + UV/VIS) was zeroed using distilled water (Luck, 1965; Misra and Fridovich, 1980; Idu *et. al*., 2016; Uwaya *et al*., 2024).

Determination of Glutathione Peroxidase Activity
Test tubes were filled with sodium phosphate buffer in the following amounts: 1,500 µL for test tubes labelled 'sample', 1900 µL for test tubes labelled 'control', 1,900 µL for test tubes labelled 'standards', and 2,000 µL for test tubes labelled 'blank'. Quantities (100 µL) of the tissue homogenates were added to the sample and control, while 200 µL of reduced glutathione was added to the sample and standard. 200 µL of hydrogen peroxide were added to the sample and standard to start the reaction. The test tubes were combined and heated at 37°C for 10 min. The addition of 0.5 mL of 8% trichloroacetic acid (TCA) stopped the process. The test tubes were then centrifuged at 3,000 rpm for 15 min. In brand new test tubes, naked sample, standard, control, and blank, 1 mL of the supernatant was added to 3 mL of the working reagent. After 30 min, the absorbance was measured at 450 nm against a blank. Activity of glutathione peroxidase (GPx) was determined by using the formula: (A test - A control) ÷ (A standard) × Concentration of standard (Ahmed *et al*., 2021).

Determination of Glutathione Reductase Activity
A volume of 0.5 mL of TCA (5%) was added to test tubes, and 1.5 mL of blood sample was added to each test tube. A precipitate was formed. Each test tube was then centrifuged for 10 min. After centrifuging, 0.5 mL of Eliman's reagent was added to another set of glass test tubes. 1.5 mL of glutathione phosphate buffer was added to the new set of glass test tubes. 2.5 mL of the already centrifuged blood sample was then added to the new set of glass test tubes. This was then read at 416 nm wavelength in comparison with the standard (which did not have a blood sample included in it) using a spectrophotometer (Model: T80 + UV/VIS) (Ellman, 1959; Iniaghe *et al*., 2018; Uwaya *et al*., 2024).

Determination of MDA Concentration
MDA concentration was estimated by the method modified by Idu *et al*. (2016). A volume (0.6 mL) of the tissue homogenates was added to 3 mL of (1:1 v/v) trichloroacetic acid-thiobarturic acid-hydrochloric acid (TCA-TBA-HCl) reagent and mixed. Solutions were heated for 15 min in a boiling water bath. The solution was cooled and centrifuged at 1,000 rpm for 10 min. The absorbance of the supernatant was measured against a reference blank at 535

nm using a spectrophotometer (Model: T80 + UV/VIS) (Buege, 1978; Idu *et al*., 2016; Iniaghe *et al*., 2018).

Statistical Analysis

The data are presented as the mean ± standard error of the mean (SEM), with 'n' indicating the number of mice in each experimental group. A one-way analysis of variance (ANOVA) was conducted, followed by the Tukey's test. GraphPad Prism software version 9 was used for all data analysis. $P < 0.05$ indicated significant differences between compared data.

RESULTS

Effect of Extract on Forced Swim and Tail Suspension

The results of the Mojeaga extract on the tail suspension test and forced swimming endurance are depicted in Figures 1 and 2. When compared to the stress control group, the Mojeaga extract at 10 and 20 mg/kg and fluoxetine at 20 mg/kg decreased the duration of immobility ($p < 0.05$; $p < 0.001$). When compared to stress control, the Mojeaga extract at 10 mg/kg, 20 mg/kg, and fluoxetine at 20 mg/kg) decreased the duration of immobility ($p < 0.05$; $p < 0.01$; $p < 0.001$).

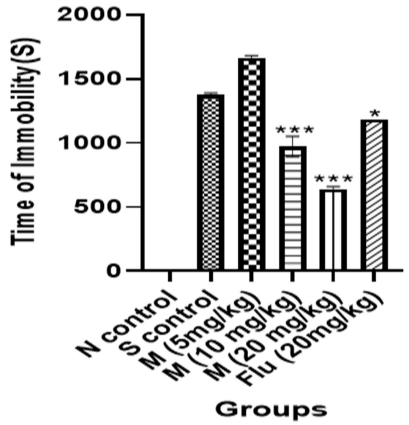

Fig. 1: Effect of Mojeaga extract on a swimming endurance test**.** The Mojeaga extract at 10 and 20 mg/kg and fluoxetine at 20 mg/kg decreased the duration of immobility when compared to the stress control group (*P < 0.05; ***P < 0.001). Flu: Fluoxetine, S control: stress control. The data are reported as the mean ± S.E.M., n = 4.

Effect of Mojeaga Extract on Cortisol Level

The effects of a Mojeaga extract on cortisol levels are depicted in Figure 3. When compared to stress control, the Mojeaga extract at 5, 10, and 20 mg/kg, as well as fluoxetine at 20 mg/kg, decreased the level of cortisol ($p < 0.01$). The level of cortisol was higher in stress control than in normal control ($p < 0.01$).

Effect of Mojeaga on MDA Concentration

The effect of the Mojeaga extract on the MDA concentration is depicted in Figure 4. In comparison to stress control, Mojeaga extract at 5 and 10 mg/kg decreased MDA levels ($p < 0.05$, $p < 0.001$). The level of MDA reduced in normal control when compared with stress control ($p < 0.01$). However, the levels of MDA in the normal control did not differ from those in the 5, 10, and 20 mg/kg groups ($p > 0.05$).

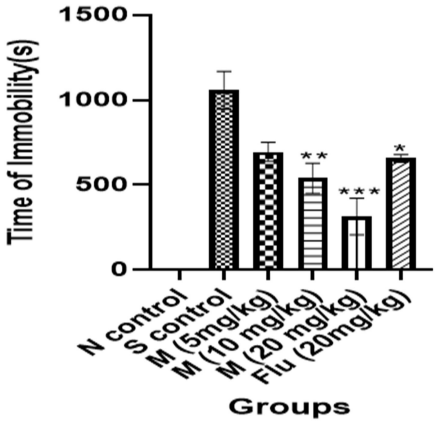

Fig. 2: Effect of aqueous extract of Mojeaga on the tail suspension test. The Mojeaga extract at 10 mg/kg, 20 mg/kg, and fluoxetine at 20 mg/kg decreased the duration of immobility when compared to the stress control (*p < 0.05, p < 0.01; *p < 0.001). Flu: Fluoxetine, S control: stress control. Data were reported as the mean ± S.E.M., n = 4.

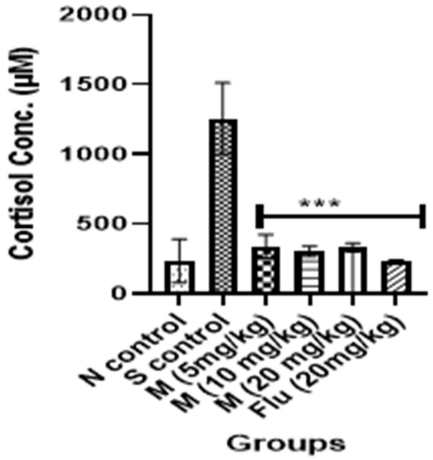

Fig. 3: Effect of aqueous extract of Mojeaga on cortisol level. The Mojeaga extract at 5, 10, and 20 mg/kg, as well as fluoxetine at 20 mg/kg, decreased the level of cortisol when compared to stress control (**P < 0.01). Flu: Fluoxetine, S control: stress control, N control: normal control. The data are reported as the mean ± S.E.M., n = 4.

Effect of Mojeaga on Antioxidant Level

The Mojeaga extract at 10 mg/kg and 20 mg/kg increased SOD activity compared to the stress control group ($p < 0.01$, $p < 0.001$), as shown in Figure 5. Compared to stress control, SOD levels were increased in normal control ($p < 0.01$). However, there was no difference in the level of SOD in Mojeaga extract at 10 mg/kg and 20 mg/kg compared with the normal control ($p > 0.05$).

The activity of catalase was higher in the Mojeaga at 5, 10, and 20 mg/kg compared to the stress control, as shown in Figure 6. When comparing normal control to stress treatment, the amount of catalase increased ($p < 0.01$). However, there was no difference in the activity of catalase in the normal control when compared with 5, 10, and 20 mg/kg ($p > 0.05$).

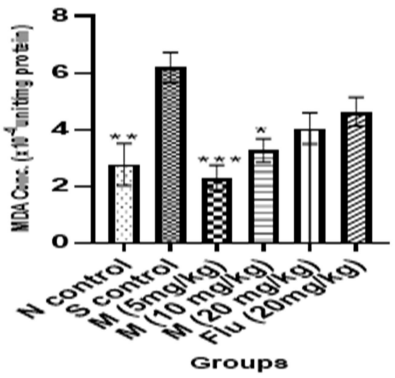

Fig. 4: Effects of the Mojeaga extract on MDA. Mojeaga extract at 5 and 10 mg/kg decreased MDA levels, in comparison to stress control (*P < 0.05; ***P < 0.001). Flu: Fluoxetine, S control: stress control, N control: normal control. The data were reported as the mean ± S.E.M., n = 4.

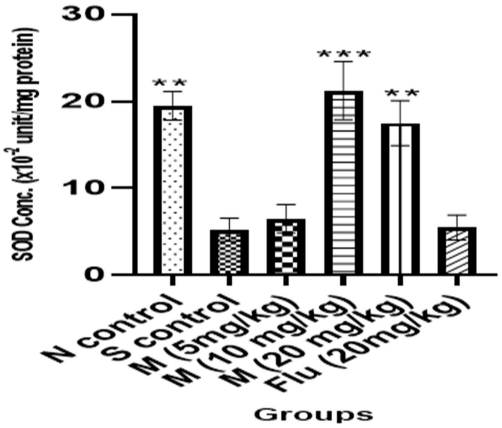

Fig. 5: Effect of aqueous extract of Mojeaga on the activity of SOD. The aqueous extract of Mojeaga at 10 mg/kg and 20 mg/kg increased the activity of SOD compared to the stress control group (**P < 0.01; ***P < 0.001). Flu: Fluoxetine, S control: stress control, N control: normal control. The data were reported as the mean ± S.E.M., n = 4.

Glutathione peroxidase and glutathione reductase activity were unaffected by Mojeaga and fluoxetine (20 mg/kg) in comparison to stress control and normal control (P > 0.05) as shown in Figures 7 and 8.

DISCUSSION

The forced swimming test measures the rodent's vulnerability to negative mood and represents an animal's sense of helplessness (Maier and Seligman, 2016; Uwaya *et al*., 2024). The tail suspension test, on the other hand, induces a state of immobility in animals facing an inescapable situation, and it represents behavioural despair, which in turn may reflect depressive disorders and stress situations in humans (González-Trujano *et al*., 2016). The Mojeaga herbal remedy was tested against depressive-like conditions at doses of 5, 10, and 20 mg/kg, and a standard drug, fluoxetine, at 20 mg/kg. In the forced swimming endurance test and tail suspension test, Mojeaga significantly reduced the animals' immobility time compared to the stress control. The ability of the Mojeaga to reduce the time of immobility in forced swimming endurance tests and tail suspension tests shows that the combination possesses antidepressant and antistress-like properties.

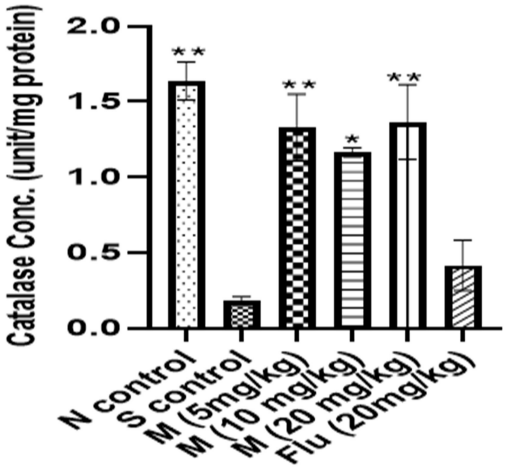

Fig. 6: Effect of Mojeaga extract on catalase activity. The aqueous extract of mojeaga at 10 mg/kg and 20 mg/kg increased the activity of catalase compared to the stress control group (*P < 0.05; **P < 0.01). Flu: Fluoxetine, S control: stress control, N control: normal control. The data were reported as the mean ± S.E.M., n = 4.

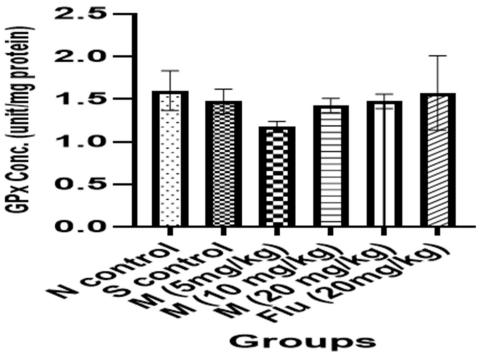

Fig. 7: Effect of Mojeaga extract on glutathione peroxidase. Glutathione peroxidase activity was unaffected by mojeaga and fluoxetine (20 mg/kg) in comparison to stress control and normal control (P > 0.05). Flu: Fluoxetine, S control: stress control, N control: normal control, GPx: glutathione peroxidase. The data were reported as the mean ± S.E.M., n = 4.

A significant increase in cortisol levels occurred in mice treated with acute stress. Research has shown that an increase in cortisol is a sign of stress (Iniaghe *et al*., 2018; Sentari *et al*., 2019; Uwaya *et al*., 2024). In this research, exposure to the standard drug (fluoxetine 20 mg/kg) and the Mojeaga herbal remedy at doses of 5, 10, and 20 mg/kg significantly decreased cortisol levels. The outer section of the suprarenal gland cortex releases cortisol, a steroid-structured hormone with glucocorticoid effects (Cay *et al*., 2018). Cortisol follows a daily pattern of release, peaking most times in the morning to support alertness and gradually decreasing afterward (Hannibal and Bishop, 2014; Ok *et al*., 2024). Beyond its crucial role in daily functioning, cortisol plays a vital role in the stress response. When confronted with a physical or mental threat, cortisol levels rise to provide the necessary energy and materials

to handle stress-inducing stimuli or evade danger (Jankord and Herman, 2008). Acute stress prompts heightened cortisol release, potentially leading to depression, digestive problems, insomnia, muscle tension and pain, loss of focus, and anxiety (Qin *et al*., 2014; Shields *et al*., 2017). By reducing the cortisol level after applying various stressors for seven days, Mojeaga demonstrates its anti-stress properties, suggesting its potential use in managing stress-induced symptoms such as high blood pressure, stroke, heart attack, headache, weight gain, anxiety, and depression.

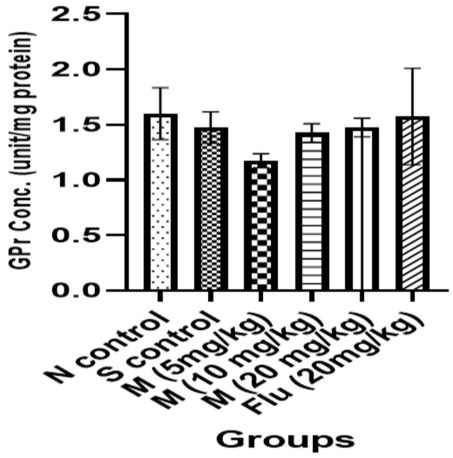

Fig. 8: Effect of Mojeaga extract on glutathione reductase. Glutathione reductase activity was unaffected by mojeaga and fluoxetine (20 mg/kg) in comparison to stress control and normal control ($p > 0.05$). Flu: Fluoxetine, S control: stress control; N control: normal control; GPr: glutathione reductase. The data were reported as the mean ± S.E.M., n = 4.

SOD and catalase are essential antioxidant enzymes present in almost all aerobic life forms (Nandi *et al*., 2019). SOD facilitates the elimination of superoxide radicals, thereby reducing oxidative stress and lowering the likelihood of conditions such as cancer, depression, digestive disorders, insomnia, muscle pain, cognitive impairment, anxiety, and diabetes (Rosa *et al*., 2021; Liu *et al*., 2023). SOD is widely regarded as a critical component of the antioxidant defence system, serving as the first line and primary mechanism for mitigating the toxicity of superoxide radicals ($-O_2$). By catalysing the conversion of two molecules of O_2 into hydrogen peroxide and molecular oxygen (O_2), SOD effectively reduces the availability of superoxide radicals and limits their harmful effects (Rosa *et al*., 2021). A reduction in SOD activity has been strongly correlated with increased oxidative stress, which significantly elevates the risk of developing various conditions, including hypertension, hypercholesterolaemia, atherosclerosis, diabetes, heart failure, stroke, and other neurological disorders such as sleep disturbances, anxiety, insomnia, and impaired cognitive reasoning (Rosa *et al*., 2021). Catalase serves as a therapeutic tool against various diseases associated with oxidative stress, such as headache, muscle tension, and sleep disturbances (Nandi *et al*., 2019). In this study, Mojeaga at dose levels of 10 mg/kg and 20 mg/kg increased the activity of SOD when compared with stress control. Similarly, Mojeaga at dose levels of 5, 10, and 20 mg/kg increased the activity of catalase. The ability of Mojeaga to increase SOD and catalase levels shows that the polyherbal formulation possesses antioxidant activity, which may help neutralise free radicals during stressful conditions. However, deficiency in catalase could be dangerous and life threatening, and it is often associated with diseases such as hypertension, anaemia, Alzheimer's disease, bipolar diseases, diabetes mellitus, some dermatological disorders, and schizophrenia (Nandi *et al*., 2019).

In this study, the activity of MDA decreased significantly in the groups exposed to Mojeaga at doses of 5 and 10 mg/kg. This was in contrast to the stress control group, whose level went up significantly. This indicates that exposure to rigorous stress increases the activity of MDA. The Mojeaga's ability to lower MDA levels after a week of intense stress shows that it can help reduce stress and has antioxidant properties. Elevated MDA activity reflects damage to lipids in cell membranes, resulting in compromised membrane integrity. This can impair cellular functions such as signalling, transport, and energy production. MDA also reacts with proteins and nucleic acids, forming adducts that disrupt their structure and function, contributing to apoptosis or necrosis (Cordiano *et al*., 2023; Mikuteit *et al*., 2023). There was no effect on the level of glutathione reductase and glutathione peroxidase. The antistress activity of Mojeaga may be a result of the antioxidant present.

Conclusion

Mojeaga's Herbal Remedy® possesses antistress activity due to its ability to reduce time of immobility in forced swimming and tail suspension tests as well as reducing cortisol levels. The remedy's antioxidants, like superoxide dismutase and catalase, may be responsible for its antistress activity.

DECLARATION

Acknowledgement

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Conflict of Interest

None declared.

Ethical Approval

This study was approved by Life Sciences Research Ethical Committee with reference number LS20316.

Consent to Participate and Publish Data

Not applicable.

Author's Contribution

RIO – conception; DOU - design of research; DEA and DOU - data collection, analysis, and interpretation of the results; DOU and JCA - statistical analysis; DEA and DUO - draft manuscript preparation. DUO, RIO, DEA and JCA reviewed the results and approved the manuscript.

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