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Original Research Article

ASSESSMENT OF THE IMPACT OF METHANOL ROOT EXTRACT OF *Andropogon gayanus* (GAMBA GRASS) ON SOME INDICES OF TOXICITY IN WISTAR RATS

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ABSTRACT

The root of Andropogon gayanus (gamba grass) has long been used in traditional medicine as a remedy for certain human diseases. However, despite its ethnomedicinal relevance, scientific data on its safety profile remain limited, raising concerns over its suitability for therapeutic use. This study therefore aimed to evaluate the toxicological effects of oral administration of the methanol root extract of Andropogon gayanus on selected biochemical and haematological indices in Wistar rats. Freshly harvested roots of A. gayanus were air-dried, ground into fine powder, and extracted with methanol. Twenty adult male Wistar rats were randomly assigned into four groups of five rats each. Group I served as the control and received 2 ml/kg of distilled water daily. Groups II, III, and IV received 250, 500, and 1000 mg/kg of the extract, respectively, administered orally once daily for 28 consecutive days. Body weights of the animals were recorded weekly. On day 28, all animals were sacrificed, and blood samples were collected for haematological and biochemical analyses. A progressive increase in body weight was observed across all groups during the study period. However, administration of the extract resulted in a significant elevation of liver enzyme activities in the treated groups compared to the control. In addition, key haematological parameters including PCV, Hb, and MCHC were significantly reduced in rats that received the extract. The findings suggest that prolonged oral administration of Andropogon gayanus root extract may adversely affect liver function and haematological parameters. While these results indicate potential toxicity risks, definitive conclusions on its safety require further detailed investigations, including histopathological and mechanistic studies

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INTRODUCTION

The importance of assessing the toxicological implications of ingesting a newly developed therapeutic substance in the body, which typically requires animal models, cannot be overstated. The data obtained can serve as the basis for either approving or disapproving the substance's use in humans [1].

Herbs have been used therapeutically since the beginning of human civilization and have evolved alongside it [2]. For thousands of years, local healers worldwide have utilized native plants and herbs to treat a variety of illnesses, showcasing their distinct pharmacological properties [3]. Traditionally, administration of plant-based therapeutics was delivered as tinctures, poultices, powders, as well as teas, progressing to more refined formulations and eventually to isolated chemicals. Knowledge about the medicinal plants and uses has endured through generations in what appears like local traditions passed down within families, tribes, and cultures. Humans have been utilizing medicinal plants or their extracts for centuries to address various health issues, resulting in the discovery of valuable medications that have been applied widely to treat various ailments [4].

Andropogon gayanus, commonly known as gamba grass and locally referred to as Kalawal, Tsaure, Eruwa ako, or Ikpo among the Fulfulde, Hausa, Yoruba, and Igbo speaking peoples of Nigeria, is a perennial leafy grass native to the tropics. It is renowned for its impressive drought and fire-resistant qualities. Morphologically, *A. gayanus* is a tall tufted grass reaching heights of about 2.5 m. It typically has around 450 culms per plant, which are straight and glaucous. The leaf blades, often narrowing at the base, are linear and can vary in length from 4-20 mm wide and up to 60 cm long[1].

In Nigeria, like many other African countries, *A. gayanus* is used as fodder for animals and as a medicine for treating various diseases [5]. Locally, extracts derived from the root of *A. gayanus* have been successfully used to treat post-partum pain, cough, bronchitis, and other ailments [6], However, research efforts have not yet revealed the potential dangers that this practice may pose to certain cellular structures. Therefore, conducting this study is necessary to investigate any potential risks.

MATERIALS AND METHODS

Plant sourcing

Sourcing and identification of *Andropogon gayanus* leaf were performed in Ahmadu Bello University Zaria, Kaduna State, (11°03'60.00" N 7°41'59.99" E), a voucher number “ABU0247” was assigned

Plant extraction

A. gayanus root was chopped off and cleaned in water, and afterwards air dried for two weeks. Using a mortar and pestle, the dried root sample was processed into a powdered form. Powdered plant sample measuring up to 2000 g was introduced in a flask containing a mixture of water methanol (70:30) and subsequently allowed to stand for 48 hours and shaken intermittently. The mixture was sieved, and filtrate gotten dried by evaporation at 40°C resulting in the production of a dark greenish semi-solid extract.

Acute toxicity test

The experiment which was biphasic involved three groups of three rats each in the first phase and three groups of one rat each in the second phase. Precisely 10, 100, and 1000 mg/kg of the extract were separately given to rats in the first phase, the groups were orally administered with 10, 100, and 1000 mg/kg of the extract separately. Observation on the animals lasted for 24 hours for signs of toxicity. As there were no deaths in any of the groups, the next phase was characterised by the administration of 1600, 2900, and 5000 mg/kg of the extract separately to the rats. The animals were observed for 48 hours for signs of toxicity in accordance with the method of Lorke [8].

Experimental animals

The Animal House of the Department of Pharmacology, University of Nigeria Nsukka was the source of the male Wistar rats used in the study. The rats which weighed between 120–150 g were were housed in properly ventilated plastic cages in the laboratory, maintained at ambient temperature and relative humidity, fed rat chow and were never denied water while being acclimatized for 14 days. The ethical committee Medical College of Gregory University Uturu, Abia State issued ethical clearance for the study to hold. The rats were bred in compliance with the guidelines set by the institutional Animal, Medical Ethics, Bio-safety, and Bio-security committee (IAMEBBC) (no.33/320/IAMEBBC/IBBC).

Experimental design

Four groups of five rats were used in this study as follows:

1st Group: rats received 2 mL of distilled H_2O by oral.

2nd group: rats received 250 mg/mL of *Andropogon gayanus* root extract by oral.

3rd group: rats were given 500 mg/mL of *Andropogon gayanus* root extract by oral.

4th group: rats received 1000 mg/mL of *Andropogon gayanus* extract by oral.

Administration of the extract was terminated on the 28th day from the day of commencement of study, during which the weight of the animals was determined weekly. Blood sample was obtained from treated animals, which had been sacrificed

humanely and placed in plain and EDTA bottles for haematological and biochemical analysis, respectively.

Biochemical Analysis

Blood plasma for enzyme assay was obtained by centrifuging the collected blood sample for 5 minutes at 3000 rpm. Liver enzymes; ALT, AST, and ALP activity was determined using standard laboratory kits from Randon Laboratories Limited, following the manufacturer's instructions.

Haematological Analysis

Haematological parameters such as Packed Cell Volume (PCV), Haemoglobin concentration (Hb), White Blood Cell (WBC), platelet count, neutrophil count, and lymphocyte count were measured using an automated haematology analyzer (2800 haematology auto-analyzer) [9].

The mean corpuscular haemoglobin concentration (MCHC) was calculated using the formula

$$MCHC(g/dL) = \frac{hemoglobin}{hematocrit} \quad \text{.....eqn 1}$$

Statistical Analysis

Results from this study were obtained by analyzing raw data with the aid of the Statistical Package for the Social Sciences (SPSS) Version 23. The difference in the mean values obtained across groups was tested with ANOVA. Comparison of mean differences was conducted with Tukey's post hoc test. p-values below 0.05 were said to be significant.

RESULTS

Table 1 displays the weekly body weight of animals administered with methanol root extract of *Andropogon gayanus*, showing a consistent weight increase in 2nd–4th groups for three consecutive weeks. However, while a further increase was observed in week 4, No significant change ($p>0.05$) in body weight recorded at week 3 and 4 for second group. For 1st group (normal control), the body weight recorded at week 2 was not significantly different ($p>0.05$) from that reported for weeks 1 and 3 but significantly lower ($p<0.05$) than that reported for week 4.

Figure 1 illustrates the enzyme activity in rats treated with methanol root extract. The activities of alanine aminotransferase (ALT), aspartate transferase (AST), and alkaline phosphatase (ALP) reported for the groups administered with MAGRE were significantly higher ($p<0.05$) than those reported for the control group.

Table 2 presents the haematological parameters of rats treated with methanol root extract of *Andropogon gayanus*. The PCV value for 2nd group was significantly ($p<0.05$) higher than that for third group, which, in turn, was significantly ($p<0.05$) lower than that for 4th group but still lower than the normal control. Similar observations were made for Hb levels. WBC counts for second and third groups were not significantly different ($p>0.05$) but were significantly lower than those for 2nd group, which, in turn, were significantly lower than those for the normal control. Neutrophil counts for second and third groups were significantly higher than those for the fourth group but lower than those for the 1st group. Lymphocyte counts for 2nd group were not significantly different from those for third group but were significantly higher than those for 4th group, which, in turn, were not significantly different from those for 3th group but were significantly higher than those for the normal control (1st group).

Table 1: Body Weight of Wistar Rats Administered Methanol Root Extract of *Andropogon gayanus*

Groups & Treatments	Wk 1	Wk 2	Wk 3	Wk 4
First Group (Normal Control)	130.23±1.20^{a}	133.31±1.10^{ab}	135.12±1.00^{b}	136.34±0.90^{c}
Second Group (MEAG 250 mg/kg)	130.23±1.00^{a}	135.09±0.70^{b}	143.23±1.20^{c}	145.909±1.10^{cd}
Third Group (MEAG 500 mg/kg)	131.07±1.10^{a}	145.06±0.34^{b}	150.23±1.10^{c}	159.76±1.00^{d}
Fourth Group (MEAG 1000 mg/kg)	130.26±24.09^{a}	148.07±0.76^{b}	157.89±2.09^{c}	164.23±1.20^{d}

Results are expressed as mean ± standard deviation of three determinations. Values with the same superscript in a column are not significantly ($p<0.05$) different

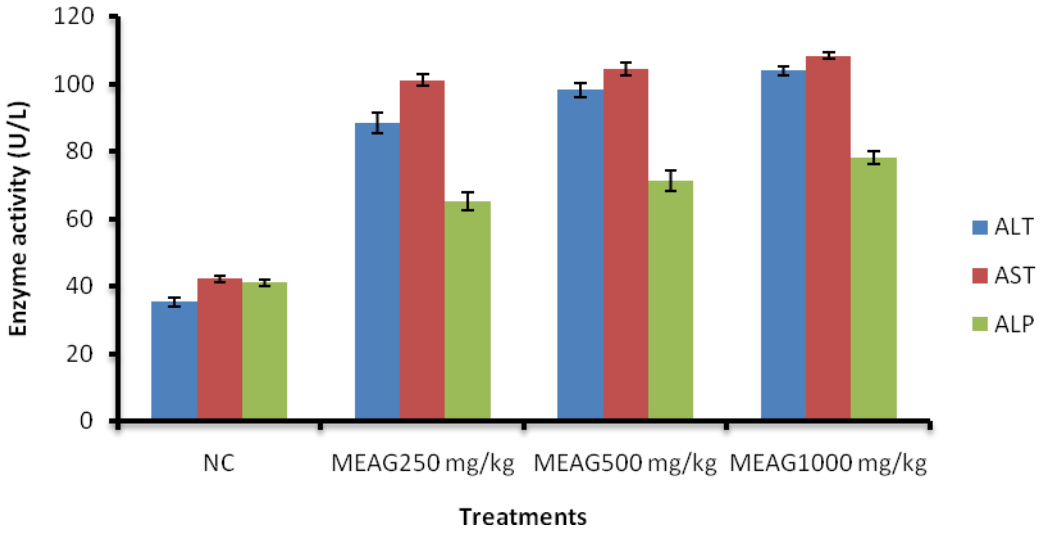

Figure 1: Activity of liver enzymes in rats administered methanol extract of *Andropogon gayanus*

Table 2: Haematological Parameters of Rats administered Methanol Root Extract of Andropogon gayanus

Groups & Treatments	PCV (%)	Hb (g/dL)	WBC (x 109/L)	NEUT (%)	LYMP (%)
1st Group (Normal Control)	34.38±2.53d	131.72±0.38d	14.04±1.13c	19.20±2.74c	73.03±3.63a
2nd Group (MEAG 250 mg/kg)	33.88±0.93c	130.80±3.77c	8.08±1.51b	18.78±2.98b	74.25±3.44b
3rd Group (MEAG 500 mg/kg)	32.28±0.58b	125.00±2.27b	6.10±1.42a	18.28±1.44b	75.13±1.60bc
4th Group (MEAG 1000 mg/kg)	31.04±1.45a	121.00±4.38a	6.68±0.34a	15.50±2.78a	77.33±2.69c

Results are expressed as mean ± standard deviation of three determinations. Values with the same superscript in a column are not significantly different ($p < 0.05$)

DISCUSSION

Intake of a toxic substance can have a negative impact on body weight, and a decrease in body weight in such cases may indicate a significant exposure to a toxicant [9]. Table 1 displays the weekly body weight of rats treated with methanol root extract of *Andropogon gayanus*, showing a consistent weight increase in all groups throughout the treatment period. This aligns with the results of Ajiji *et al*. [10], who found that gamba grass hay supplemented with acacia pods at 20% DM intake led to a significant increase in body weight. Liver enzymes are primarily membrane-bound and leak into the bloodstream when there is liver damage, making them a preferred biomarker for diagnosing liver disease. Figure 1 illustrates the enzyme activity in rats treated with methanol root extract, indicating that the activities of alanine aminotransferase (ALT), aspartate transferase (AST), and alkaline phosphatase (ALP) in the treated groups were significantly ($p<0.05$) higher than those in the control group. The increase in enzyme activity was observed to be dose-dependent. While our study's results contradict those of Oraebosi and Elendu [6], who reported a dose-dependent improvement in experimentally induced hepatic damage with gamba grass leaf extract, the increased liver enzyme activity in our study may be attributed to variations in the active ingredients present in the different plant parts. Examining haematological indices can help establish the harmful effects of toxicants on blood components [11 - 12]. Table 2 presents the hematological parameters of rats treated with methanol root extract of *Andropogon gayanus*, showing a significant ($p<0.05$) reduction in PCV, Hb, WBC, and neutrophils compared to the values recorded for the normal control for each parameter. However, a different observation was noted for lymphocytes. This finding contradicts the results of Ibrahim *et al*. [13], who demonstrated that including 15% gamba forage in the diet increased PCV, Hb, and MCHC values in rabbits.

CONCLUSION

While the liver enzyme activities were found to be high in this study, it is not advisable to draw definitive conclusions regarding the safety of the extract until all potential avenues of toxicity have been thoroughly explored. Therefore, further research on the root of A. gayanus is recommended to assess its safety as a therapeutic source.

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AUTHORS' CONTRIBUTION

EMU: Conceptualized the problem and designed the study. **EO:** drafted the manuscript. **EDC:** performed statistical analysis on the generated data. **OC**: Proofread the manuscript before final submission.

CONFLICT OF INTEREST

Authors hereby declare that no conflict of interest exists.

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