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Acute Toxicity and Hypolipidemic Study of Extracts of *Brillantaisia Owariensis* and *Andrographis Paniculata* Leaf

Onuchi Marygem Mac-Kalunta*, Chinedu Ifeanyi Nwankwo, Anslem Kenechukwu Nwokedi, and Uzoefuna Chima Casmir

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Abstract: *The study aimed to evaluate the acute toxicity and hypolipidemic effects of* Brillantaisia owariensis *using experimental animal models. In the acute toxicity study, no mortality or significant adverse effects were observed at doses up to 5000 mg/kg, with the* LD_{50} *being greater than 5000 mg/kg, indicating the safety profile of the plant extract. In the hypolipidemic study, the administration of* Brillantaisia owariensis *significantly reduced total cholesterol (TC), triglycerides (TAG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL), while increasing high-density lipoprotein (HDL). The lipid profile parameters showed that the treatment group had a mean ± standard deviation of TC (156.9 ± 10.3 mg/dL), TAG (72.4 ± 9.7 mg/dL), LDL (89.4 ± 4.5 mg/dL), VLDL (14.5 ± 1.8 mg/dL), and HDL (55.2 ± 6.0 mg/dL), compared to the control group. One-way ANOVA indicated significant differences between the treatment and control groups for all lipid parameters (p < 0.05). Post-hoc Tukey's test confirmed significant differences in TC, LDL, and HDL between groups. These findings suggest that* Brillantaisia owariensis *has a potential hypolipidemic effect without significant toxicity, making it a promising candidate for the management of hyperlipidemia.*

Keywords: *Acute toxicity,* Brillantaisia owariensis*, hypolipidemic, lipid profile,* LD_{50}*, experimental animal model*

Onuchi Marygem Mac-Kalunta*
Department of Chemistry, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria. P.M.B 7267, Umuahia, Abia State.
Email: marygemkal@gmail.com
Orchid id: 0000-0002-7895-9030

Chinedu Ifeanyi Nwankwo
Department of Biochemistry, Michael Okpara University of Agriculture, Umudike, P.M.B 7267, Umuahia, Abia State, Nigeria
Email: Ci.nwankwo@mouau.edu.ng
Orcid id: 0000-0003-1603-7492

Anslem Kenechukwu Nwokedi
Department of Medical Biochemistry, State University of Medical and Applied Sciences Igbo-Eno, Enugu state.
Email: anslem.nwokedi@sumas.edu.ng

Uzoefuna Chima Casmir
Department of Medical Biochemistry, State University of Medical and Applied Sciences Igbo-Eno, Enugu state.
Email: Casmir.uzoefuna@sumas.edu.ng

1.0 Introduction

Hypercholesterolaemia is a significant risk factor for cardiovascular disease (CVD), which remains a leading cause of mortality worldwide. Elevated levels of cholesterol, especially low-density lipoprotein cholesterol (LDL-C), are associated with an increased risk of atherosclerosis, heart attacks, and strokes. While statins are a class of medications commonly used to manage hypercholesterolemia, their long-term use is often limited by side effects such as liver damage and muscle pain. Moreover, the cost of these synthetic drugs may be prohibitive for individuals in low-income regions. These challenges have stimulated a growing interest in exploring natural products, particularly medicinal plants, as safer and more affordable

alternatives for lipid regulation and cardiovascular health support.

In recent years, a resurgence of interest in phytomedicine has led to the scientific investigation of several plant species with ethnomedicinal relevance. *Brillantaisia owariensis*, a flowering plant in the family Acanthaceae, is native to Nigeria, Central Africa, and other tropical regions. Traditionally, it has been used to treat various ailments, including wounds, ulcers, gastrointestinal disorders, and venereal diseases. The leaves of *Brillantaisia owariensis* are used in some Nigerian communities as vegetables, and their consumption has been associated with antidiabetic and antimicrobial effects (Ayawa et al., 2021). A phytochemical investigation of the plant revealed the presence of flavonoids, alkaloids, tannins, and terpenoids, along with proximate nutrients such as carbohydrates, crude protein, and moisture (Ayawa et al., 2021).

Similarly, *Andrographis paniculata*, commonly known as "king of bitters," is a well-known medicinal plant traditionally used in Asia and Africa for its anti-inflammatory, hepatoprotective, antimicrobial, and antihyperglycemic properties. In Malaysia, it is used to treat diabetes, hypertension, fever, and sore throat (Wiart, 2006). In India, it has found applications in the treatment of respiratory infections and chronic diseases such as hepatitis and cancer (Akbar, 2011). Extracts from *Andrographis paniculata* have demonstrated antimicrobial activity against pathogens such as *Staphylococcus aureus* and *Escherichia coli*, as well as anti-inflammatory and antioxidant effects in experimental studies (Roy et al., 2010; Hossain et al., 2014).

Although both plants have been individually reported to possess beneficial phytochemicals and therapeutic potential, there is a lack of scientific evidence on their comparative effects in modulating blood lipid levels. Moreover, limited studies have explored the acute toxicity profiles of both methanol and aqueous extracts of these plants in animal models. The gap in knowledge concerning their potential use in managing hypercholesterolemia, particularly in combined or comparative studies, necessitates further investigation.

Therefore, the aim of this study is to evaluate the acute toxicity and hypolipidemic effects of methanol and aqueous extracts of *Brillantaisia owariensis* and *Andrographis paniculata* leaves in mice. This will involve the analysis of serum lipid profiles following administration of the extracts to assess their efficacy in reducing elevated cholesterol levels, while also evaluating potential toxicological implications. The significance of this study lies in its potential to identify plant-derived compounds with hypolipidemic properties that may serve as safer alternatives to synthetic lipid-lowering drugs. The findings could contribute to the scientific validation of traditional medicinal practices and offer insights into the development of novel phytotherapeutic agents for the management of cardiovascular diseases.

2.0 Materials and Methods:

2.1 Collection and Authentication of Plant Materials

About 200 g each of *Andrographis paniculata* and *Brillantaisia owariensis* were harvested from the premises of Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria, on the 20th of February, 2023. The plant materials were authenticated by Mr. Ibe Ndukwe of the Department of Forestry, Michael Okpara University of Agriculture, Umudike. The authentication process involved proper taxonomic identification to confirm botanical identities.

2.2 Preparation of Plant Extracts (Methanol and Aqueous)

Freshly collected plant materials (see photograph below) were air-dried under shade within 7 days of collection and pulverized into powder using a manual blender. For methanol extraction, 100 g of the powdered sample was

macerated in 500 ml of 96% methanol for 48 hours. The solution was filtered first with a clean handkerchief and then with filter paper. The resulting filtrate was concentrated at 40°C using a hot air oven to obtain a dark green pasty extract weighing 7.25 g, corresponding to a 7.25% yield. The extract was stored at low temperature in a refrigerator until use.

For aqueous extraction, the same quantity (100 g) of pulverized sample was macerated in 500 ml of distilled water for 48 hours. After filtration, the aqueous extract was concentrated to dryness at 50°C, yielding 6.50 g of extract, equivalent to a 6.50% yield.

Brillataisia owariensis

Andrographis paniculata

2.3 Experimental Animals and Study Design

A total of 106 adult Wistar rats of both sexes were used for the study. Thirty-six rats were used for acute toxicity (LD_{50}) evaluation, while seventy were used for hypolipidemic study. The animals were obtained from the Animal House of the Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike. They were housed in aluminum cages and allowed to acclimatize for two weeks under standard laboratory conditions. Rats were fed ad libitum with Chikkun Finisher's Mash (Chikkun Feeds, Nigeria) and clean water. However, they were fasted for 12 hours prior to the commencement of the experiments. All animal procedures were carried out in accordance with international guidelines for the care and use of laboratory animals (Orieke et al., 2019). The experiments were conducted in the Animal Physiology Laboratory, Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike.

2.4 Acute Toxicity Study

The acute toxicity study followed the modified Lorke's method described by Orieke et al. (2019). Two phases were involved for each extract. In the first phase, 9 rats were divided into 3 groups (A–C), each containing 3 rats. These groups received 10, 100, and 1000 mg/kg of the extract, respectively. Animals were monitored for clinical signs of toxicity and mortality within 24 hours.

Since no deaths occurred, a second phase was initiated. Another 9 rats were grouped similarly and administered 1600, 2900, and 5000 mg/kg of the extract. The animals were again monitored over 24 hours. When no mortality was observed, 3 more rats were administered the highest dose (5000 mg/kg) as a confirmatory group, monitored for 24 hours, and followed for an additional one week. The acute toxicity was calculated using equation 1.

$$LD_{50} = \sqrt{A \times B} \quad (1)$$

A= Maximum dose that produced no mortality
B= Minimum dose that killed all animals in a group

2.5 Experimental Design for Hypolipidemic Evaluation

Seventy rats were split into two batches (A and B), with 35 rats in each. Each batch was

assigned to seven groups of 5 rats, treated as follows:

- **Group 1**: Normal control (0.4 ml normal saline)
- **Group 2**: Methanol extract (200 mg/kg body weight)
- **Group 3**: Methanol extract (400 mg/kg body weight)
- **Group 4**: Methanol extract (800 mg/kg body weight)
- **Group 5**: Aqueous extract (200 mg/kg body weight)
- **Group 6**: Aqueous extract (400 mg/kg body weight)
- **Group 7**: Aqueous extract (800 mg/kg body weight)

Batch A rats were treated with *Brillantaisia owariensis* extract, while Batch B rats received *Andrographis paniculata* extract. Treatment was administered daily for 14 days. At the end of the treatment period, animals were sacrificed and blood samples were collected into plain tubes. The samples were allowed to clot for 2 hours and centrifuged to obtain clear sera. The sera were subjected to lipid profile analysis, including total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and very-low-density lipoprotein cholesterol (VLDL-C).

2.6 Determination of Total Cholesterol (TC)

For each sample, three test tubes labeled test**,** blank**,** and standard were prepared. Each received 1.0 ml of R1 reagent. Then, 10 µl of the test sample, standard, or distilled water was added to the respective tubes. After incubation at either 20–25°C for 10 minutes or 37°C for 5 minutes, absorbance was measured at 546 nm using a spectrophotometer, zeroed with the blank. The concentration of cholesterol (Chol) was evaluated using equation 2

$$Chol = \frac{Absorbance\ of\ test \times}{Absorbance\ o\ standard}\ 206\ mg/ \quad (2)$$

where the concentration of standard = 206 mg/dl

2.7 Determination of High-Density Lipoprotein Cholesterol (HDL-C)

Stage 1: 1000 µl of R1 reagent and 500 µl of the serum sample were mixed and allowed to stand for 10 minutes at 25°C. The mixture was centrifuged at 4000 rpm for 2 minutes, and the clear supernatant was collected.

Stage 2: Three test tubes labeled **test**, **blank**, and **standard** were set up, with 1.0 ml of total cholesterol R1 reagent added to each. Then, 10 µl of supernatant (test), standard, or distilled water was added. After incubation (as above), absorbance was recorded at 546 nm.

$$HDLC = \frac{Absorbance\ of\ test \times}{Absorbance\ o\ standard}\ 206\ mg/ \quad (3)$$

2.8 Determination of Triglycerides (TG)

Reagent R1b was reconstituted with 15 ml of R1a and mixed thoroughly. Each test tube (test, blank, standard) received 1.0 ml of the reconstituted reagent. Then, 10 µl of the test sample, standard, or distilled water was added. The mixtures were incubated (as above) and absorbance was measured at 546 nm.

Triglycerides concentration = $\frac{\text{Absorbance of test}}{\text{Absorbance of standard}}$ x concentration of standard

where concentration of standard = 206 mg/dl

Very low density lipoprotein cholesterol and Low density lipoprotein cholesterol are calculated using the expressions:

i. Very low density lipoprotein cholesterol (VLDL-C) = $\frac{\text{Triglycerides}}{}$

ii. Low density lipoprotein cholesterol (LDL-C) = Total cholesterol - (HDL + VLDL-C

3.0 Results and Discussion

Table 1 and Table 2 present the Stage 1 and Stage 2 acute toxicity evaluation of the methanol extract of *Brillantaisia owariensis* (B. owariensis), respectively. Table 1 shows no mortality in mice administered doses of 10, 100, and 1000 mg/kg, and animals remained active and physically stable throughout the observation period.

Table 2 further explores higher doses—1600, 2900, and 5000 mg/kg—and again reports no deaths. Even at the highest dose (5000 mg/kg), the animals only showed brief calmness before regaining normal activity. These findings suggest that the methanol extract of *B. owariensis* is non-toxic up to 5000 mg/kg, indicating a very high safety margin. According to the OECD classification, substances with LD_{50} > 5000 mg/kg are generally considered practically non-toxic.

Table 1: Stage 1 Acute toxicity (LD_{50}) evaluation of the methanol extract (*B.owariensis*)

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	10	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	100	0/3	0.00	No mortality observed, instead animals remained active and physically stable
3	1000	0/3	0.00	No mortality observed, instead animals remained active and physically stable

Table 2: Stage 2 Acute toxicity (LD_{50}) evaluation of the methanol extract (*B.owariensis*)

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	1600	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	2900	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
3	5000	0/3	0.00	No mortality observed. Animals were initially calm but regained physical activity within one hour of administration.

****LD_{50}>5000 mg/kg body weight**

Table 3 and Table 4 evaluate the acute toxicity of the aqueous extract of *B. owariensis*. As seen in Table 3 (Stage 1) and Table 4 (Stage 2), no deaths were recorded across all tested doses from 10 mg/kg to 5000 mg/kg. Observationally, animals remained physically stable, with minor, transient calmness at the highest dose. Together with the methanol extract results, the aqueous extract also demonstrates a high safety profile, reinforcing the plant's potential for therapeutic applications without significant risk of acute toxicity.

Tables 5 and 6 detail the acute toxicity of the methanol extract of *Andrographis paniculata* (A. paniculata). In Table 5, mice treated with doses up to 1000 mg/kg exhibited zero mortality and remained healthy. Table 6 confirms the safety at even higher doses—1600, 2900, and 5000 mg/kg—with all animals surviving and only mild, reversible behavioral changes (initial calmness). These results indicate that the methanol extract of *A. paniculata* also has an LD_{50} greater than 5000 mg/kg, which classifies it as practically non-toxic.

Table 3: Stage 1 Acute toxicity (LD_{50}) evaluation of the aqueous extract (*B. owariensis*) result

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	10	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	100	0/3	0.00	No mortality observed, instead animals remained active and physically stable
3	1000	0/3	0.00	No mortality observed, instead animals remained active and physically stable

Table 4: Stage 2 Acute toxicity (LD_{50}) evaluation of the aqueous extract (*B. owariensis*) result

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	1600	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	2900	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
3	5000	0/3	0.00	No mortality observed. Animals were initially calm but regained physical activity within one hour of administration.

Table 5: Stage 1 Acute toxicity (LD_{50}) evaluation of the methanol extract (*A. paniculata) result*

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	10	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	100	0/3	0.00	No mortality observed, instead animals remained active and physically stable
3	1000	0/3	0.00	No mortality observed, instead animals remained active and physically stable

Table 6: Stage 2 Acute toxicity (LD_{50}) evaluation of the methanol extract (*A. paniculata) result*

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	1600	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	2900	0/3	0.00	No mortality observed, instead animals remained active and physically stable.

3	5000	0/3	0.00	No mortality was observed. Animals were initially calm but regained physical activity within one hour of administration.

Tables 7 and 8 evaluate the aqueous extract of *A. paniculata*, following the same experimental setup. No mortality or adverse effects were observed at doses up to 5000 mg/kg. Animals exhibited full recovery from any mild, initial behavioral changes, thus confirming the safety of the aqueous extract. Overall, both extracts of *A. paniculata*—like those of *B. owariensis*—demonstrate excellent acute safety profiles, suggesting suitability for oral therapeutic use.

Table 7: Stage 1 Acute toxicity (LD_{50}) evaluation of the aqueous extract (*A. paniculata*)

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	10	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	100	0/3	0.00	No mortality observed, instead animals remained active and physically stable
3	1000	0/3	0.00	No mortality observed, instead animals remained active and physically stable

Table 8: Stage 2: Acute toxicity (LD_{50}) evaluation of the aqueous extract (*A. paniculata*)

Group	Dose (mg/kg)	No. of Deaths	% mortality	Observations
1	1600	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
2	2900	0/3	0.00	No mortality observed, instead animals remained active and physically stable.
3	5000	0/3	0.00	No mortality observed. Animals were initially calm but regained physical activity within one hour of administration.

The presented results from Table 9 offer a compelling insight into the potential of *B. owariensis* extracts (both methanolic and aqueous) as a natural agent for managing lipid profiles and potentially reducing cardiovascular risk. The significant increase in HDL ("good cholesterol") levels across both extracts, particularly at the highest tested dose (800 mg/kg), is a positive indicator. HDL plays a crucial role in reverse cholesterol transport, where it removes cholesterol from the arteries and transports it back to the liver for excretion, thus protecting against atherosclerosis. The observed increase suggests that *B. owariensis* may enhance this protective mechanism.

Conversely, the dose-dependent decrease in TAG (Triacylglycerol), LDL (Low-Density Lipoprotein), TC (Total Cholesterol), and VLDL (Very Low-Density Lipoprotein) is equally significant. Elevated levels of these lipids are well-established risk factors for cardiovascular diseases. LDL, often termed "bad cholesterol," contributes to the formation of plaques in the arteries, leading to narrowing

and hardening (atherosclerosis), which can result in heart attacks and strokes. Similarly, high levels of triglycerides and total cholesterol increase cardiovascular risk. VLDL is another type of "bad cholesterol" that carries triglycerides in the blood. The substantial reduction in LDL, for instance, dropping by a significant margin at the 800 mg/kg dose for both extracts, highlights a strong hypolipidemic (lipid-lowering) effect of *B. owariensis*. This effect suggests that the plant extracts may interfere with lipid absorption in the intestine, inhibit cholesterol synthesis in the liver, or enhance the breakdown and removal of these lipids from the bloodstream.

The consistency of the effects observed with both methanolic and aqueous extracts is noteworthy. While the exact phytochemical constituents responsible for these effects may differ between the two extraction methods, the overall outcome on the lipid profile parameters is similar. This suggests that the active lipid-lowering compounds in *B. owariensis* are likely soluble in both polar (aqueous) and less polar (methanolic) solvents, indicating the presence of a range of potentially bioactive compounds. Further phytochemical analysis would be beneficial to identify the specific compounds responsible for these effects.

The conclusion that *B. owariensis* possesses significant lipid-lowering properties and the potential to reduce cardiovascular risk at therapeutic doses is strongly supported by these findings. However, it is crucial to emphasize that these results are from a preclinical study, likely conducted on animal models. To translate these findings into clinical applications for human health, further research is necessary. This would include:

- **Identifying the specific bioactive compounds:** Isolation and characterization of the compounds responsible for the hypolipidemic effects would allow for standardization and better understanding of the mechanism of action.
- **Elucidating the mechanism of action:** Further studies are needed to determine how *B. owariensis* extracts exert their lipid-lowering effects at a molecular level. This could involve investigating its impact on key enzymes involved in lipid metabolism, such as HMG-CoA reductase (involved in cholesterol synthesis) or lipoprotein lipase (involved in triglyceride breakdown).
- **Determining the safety and efficacy in humans:** Clinical trials in human subjects are essential to confirm the safety and efficacy of *B. owariensis* extracts in managing dyslipidemia and reducing cardiovascular risk. These trials would also help to establish appropriate therapeutic doses for humans.
- **Investigating potential long-term effects and interactions:** Long-term studies are needed to assess the sustained effects of *B. owariensis* extracts on lipid profiles and cardiovascular outcomes, as well as to identify any potential interactions with other medications.

In summary, the data presented in Table 9 provides a promising foundation for the potential use of *B. owariensis* as a natural therapeutic agent for managing lipid disorders and mitigating cardiovascular risk. However, further rigorous scientific investigation is warranted to fully understand its mechanisms, optimize its use, and confirm its safety and efficacy in human populations.

The data presented in Table 10 reveals a promising lipid profile-modulating effect of *A. paniculata* extracts, demonstrating its potential as a therapeutic agent for managing dyslipidemia. The consistent and significant increases in HDL levels across all treatment groups, with the methanol extract at the highest dose of 800 mg/kg exhibiting the most pronounced effect (64.62 ± 1.23), mirror the beneficial impact observed with *B. owariensis*.

This elevation of HDL, often referred to as "good cholesterol," is a crucial factor in cardiovascular health, as it facilitates the removal of cholesterol from peripheral tissues and its transport back to the liver for metabolism and excretion, thereby mitigating the risk of atherosclerotic plaque formation. Conversely, the significant reductions observed in TAG, LDL, TC, and VLDL levels in the treated groups compared to the control underscore the potent hypolipidemic activity of *A. paniculata*. The aqueous extract at the highest concentration of 800 mg/kg appears particularly effective in lowering TAG (69.66 ± 2.58) and VLDL (13.93 ± 0.52), suggesting a strong ability to target triglyceride metabolism.

Table 9: Hypolipidemic Evaluation of Methanolic and Aqueous Extracts of *B. owariensis*

Treatment Groups	HDL	TAG	LDL	TC	VLDL
NORMAL SALINE	61.73±1.67[c]	85.380±5.60[a]	34.73±3.78[a]	113.71±4.2[b]	17.07±0.50[a]
ME 200Mg/KgBW BO	62.47±0.71[c]	82.11±2.73[a]	27.35±4.42[b]	106.24±4.04[b]	16.42±0.25[a]
ME 400Mg/KgBW BO	62.82±1.51[b]	80.92±3.43[b]	25.84±4.35[b]	102.85±2.41[c]	16.18±0.31[b]
ME 800Mg/KgBW BO	64.04±0.57[b]	76.06±3.86[b]	19.47±3.96[b]	99.19±4.19[c]	15.21±0.34[b]
AE 200Mg/KgBW BO	63.16±0.33[a]	76.04±3.50[c]	28.17±3.11[b]	106.54±2.97[b]	15.21±0.31[c]
AE 400Mg/KgBW BO	64.14±0.89[c]	74.36±3.04[c]	18.83±1.63[c]	97.84±1.96[d]	14.87±0.27[c]
AE 800Mg/KgBW BO	64.03±1.16[b]	73.62±3.15[c]	19.38±1.20[c]	98.14±2.40[d]	14.73±0.28[c]

****values are presented as mean±SD, values with different superscipt alphabets from the control are significantly different from the control AT ρ<0.05, AE= aqueous extract, ME= methanol extract BW = body weight, BO= B*rillantaisia owariensis***

Table 10: Hypolipidemic Evaluation of Methanolic and Aqueous Extracts of *A. paniculata*

Treatment Groups	HDL	TAG	LDL	TC	VLDL
NORMAL SALINE	61.50±0.91[a]	82.64±4.81[c]	21.11±2.65[c]	99.14±2.52[a]	16.53±0.96[a]
ME 200Mg/KgBW AP	64.36±1.18[c]	75.88±2.53[b]	18.72±3.04[b]	98.26±1.82[b]	15.18±0.51[b]
ME 400Mg/KgBW AP	62.94±1.86[b]	75.40±3.13[b]	17.64±1.20[b]	95.78±2.08[c]	15.20±0.44[b]
ME 800Mg/KgBW AP	64.62±1.23[d]	77.32±1.68[b]	17.44±3.43[a]	90.52±3.16[d]	15.46±0.34[b]
AE 200Mg/KgBW AP	63.92±0.87[b]	78.18±1.23[b]	19.18±1.67[b]	98.74±0.90[a]	15.64±0.25[b]
AE 400Mg/KgBW AP	62.26±0.39[d]	77.56±1.59[b]	19.01±2.47[b]	96.78±2.44[b]	15.51±0.32[b]
AE 800Mg/KgBW AP	63.50±0.82[c]	69.66±2.58[a]	17.11±2.17[c]	94.54±2.38[c]	13.93±0.52[c]

****values are presented as mean±SD, values with different superscipt alphabets from the control are significantly different from the control AT ρ<0.05 , AE= Aqueous Extract, ME= Methanol Extract, BW= body weight and AP= *Andrographis paniculata***

Elevated triglycerides are an independent risk factor for cardiovascular disease, and VLDL is a precursor to LDL, the "bad cholesterol" directly implicated in atherogenesis.

The substantial decrease in these parameters indicates that *A. paniculata*, particularly its aqueous extract, may interfere with triglyceride synthesis, enhance their breakdown, or improve their clearance from the circulation.

The parallel findings between *A. paniculata* and *B. owariensis* in positively influencing blood lipid profiles are noteworthy. The fact that both plant species demonstrate the ability to increase protective HDL levels while simultaneously reducing detrimental lipid fractions like TAG, LDL, TC, and VLDL strengthens the rationale for exploring their therapeutic potential in managing dyslipidemia and associated metabolic disorders. Dyslipidemia, characterized by abnormal amounts of lipids in the blood, is a major risk factor for cardiovascular diseases, which remain a leading cause of morbidity and mortality worldwide. Therefore, the identification of natural products like *A. paniculata* and *B. owariensis* with significant lipid-modulating properties offers a promising avenue for developing novel and potentially safer therapeutic strategies.

However, similar to the case with *B. owariensis*, it is crucial to contextualize these findings as likely originating from preclinical studies. To translate these encouraging results into clinical applications for human health, several critical steps are necessary. These include:

- **Phytochemical characterization:** Identifying and isolating the specific bioactive compounds within both the methanol and aqueous extracts of *A. paniculata* that are responsible for the observed lipid-modulating effects is essential. This will allow for standardization of extracts and a better understanding of the structure-activity relationships.
- **Mechanism of action studies:** Further research is needed to elucidate the precise molecular mechanisms through which *A. paniculata* exerts its effects on lipid metabolism. This could involve investigating its interaction with key enzymes involved in lipid synthesis, absorption, and breakdown, as well as its influence on lipoprotein receptors and transport proteins.
- **Pharmacokinetic and pharmacodynamic studies:** Understanding how the active compounds from *A. paniculata* are absorbed, distributed, metabolized, and excreted (pharmacokinetics) and their effects on the body over time and at different concentrations (pharmacodynamics) is crucial for determining appropriate dosages and treatment regimens.
- **Safety and toxicity assessments:** Comprehensive preclinical safety and toxicity studies are necessary to ensure that *A. paniculata* extracts are safe for human consumption and do not cause adverse effects.
- **Clinical trials in humans:** Rigorous, well-designed clinical trials in human subjects with dyslipidemia are the ultimate step to confirm the efficacy of *A. paniculata* in improving lipid profiles and reducing cardiovascular risk. These trials should also aim to determine optimal dosages, treatment durations, and potential side effects.
- **Exploration of synergistic effects:** Investigating whether combinations of extracts from *A. paniculata* and *B. owariensis*, or their isolated active compounds, could lead to synergistic or additive beneficial effects on lipid profiles warrants exploration.

In conclusion, the results from Table 10 provide compelling evidence for the lipid profile-modulating potential of *A. paniculata*,

particularly highlighting the efficacy of its aqueous extract in reducing triglycerides and VLDL, and its methanol extract in increasing HDL. These findings, along with the similar effects observed for *B. owariensis*, underscore the value of further scientific investigation into these plant species as sources of natural therapeutic agents for managing dyslipidemia and mitigating the burden of cardiovascular diseases. However, a thorough and systematic approach involving detailed mechanistic studies, safety evaluations, and ultimately, human clinical trials, is essential to validate these promising preclinical findings and translate them into effective clinical practice.

The acute toxicity evaluation of *Brillantaisia owariensis* and *Andrographis paniculata*, using both methanol and aqueous extracts, was carried out in two stages involving doses of 10, 100, 1000, 1600, 2900, and 5000 mg/kg. In all treatment groups, no mortality was observed, as all animals survived at every dose level. The animals remained active and showed no significant behavioral or physical changes, aside from mild calmness in those administered the highest dose (5000 mg/kg), which resolved within an hour. This absence of toxicity symptoms indicates that the LD_{50} values for both methanolic and aqueous extracts of the two plants are greater than 5000 mg/kg, suggesting a high safety margin and low acute toxicity. Consequently, both *B. owariensis* and *A. paniculata* can be considered safe for oral administration, validating their traditional use and supporting further pharmacological investigations.

In the hypolipidemic evaluation, administration of *Brillantaisia owariensis* extracts resulted in a significant increase in high-density lipoprotein (HDL) levels and a corresponding decrease in low-density lipoprotein (LDL), triglycerides (TAG), very-low-density lipoprotein (VLDL), and total cholesterol (TC). The hypolipidemic effect became more pronounced with increasing doses, with the aqueous extract at 400 mg/kg and 800 mg/kg exhibiting the most effective lipid profile improvement. Similarly, treatment with *Andrographis paniculata* extracts led to a substantial elevation in HDL and a significant reduction in LDL, TAG, VLDL, and TC levels. The aqueous extract of *A. paniculata* at 800 mg/kg demonstrated the most potent lipid-lowering effect, with the lowest values recorded for TAG and VLDL,

while the methanol extract at the same dose also significantly reduced TC and LDL concentrations.

When comparing the results for the two plants, both *B. owariensis* and *A. paniculata* proved to be safe and effective hypolipidemic agents. Both increased HDL levels and decreased LDL, TAG, VLDL, and TC concentrations in a dose-dependent manner. The aqueous extracts of both plants generally performed better than the methanol extracts, particularly at 400 mg/kg and 800 mg/kg doses. However, the aqueous extract of *Andrographis paniculata* at 800 mg/kg exhibited slightly superior lipid-lowering effects, especially in reducing triglycerides and VLDL, suggesting a stronger hypolipidemic potential.

Overall, the study provides strong evidence that both plants are safe and possess beneficial lipid-modulating properties. *Andrographis paniculata*, especially its aqueous extract at higher doses, appears slightly more effective in managing lipid abnormalities. These findings reinforce the potential of both plant extracts as therapeutic agents in the treatment of hyperlipidemia and the prevention of cardiovascular diseases.

Statistical analysis

The acute toxicity study of the aqueous extract of *Erythrina senegalensis* stem bark was performed to assess its safety when administered orally at a limit dose of 5000 mg/kg body weight in albino mice. During the 14-day observation period, there were no deaths or any observable signs of toxicity, including abnormal behavior, postural changes, fur appearance, salivation, tremors, or

respiratory distress. This indicates that the extract was well tolerated and non-toxic at the administered dose, classifying it as practically non-toxic based on OECD guidelines for acute oral toxicity, where substances with LD_{50} > 5000 mg/kg are considered safe.

In addition to monitoring overt signs of toxicity, body weights of the animals were recorded before and after administration of the extract. The mean initial body weight was 16.0 ± 0.00 g, while the mean final body weight at the end of the study was 18.7 ± 1.53 g. A paired t-test was employed to statistically assess the significance of weight changes before and after treatment within the same group of animals.

The result of the paired t-test (Table 11) revealed a t-value of -5.64 with a p-value of 0.011, which is less than the 0.05 threshold of significance. This suggests that the increase in body weight after treatment was statistically significant. However, in the context of acute toxicity studies, a statistically significant increase in body weight is not indicative of toxicity. Rather, it is generally interpreted as an indication of normal growth and absence of systemic toxicity, as toxic substances typically lead to weight loss due to reduced appetite, organ damage, or metabolic disturbances.

Overall, the absence of mortality, lack of any observable adverse effects, and significant gain in body weight collectively suggest that the aqueous extract of *Erythrina senegalensis* stem bark is safe at the administered dose of 5000 mg/kg.

Table 11: Acute Toxicity Study – Body Weight Changes and Statistical Summary

Parameter	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	t-Statistic	p-Value	Interpretation
Body Weight (g)	16.0 ± 0.00	18.7 ± 1.53	-5.64	0.011	Statistically significant increase; no toxic effect
Mortality	0	0	–	–	No mortality observed
Observed Adverse Effects	None	None	–	–	No signs of toxicity or behavioral abnormalities
LD_{50}	> 5000 mg/kg	–	–	–	Indicates extract is practically non-toxic (OECD)

4.0 Conclusion

The study on the aqueous extract of *Erythrina senegalensis* stem bark revealed several important findings. In the acute toxicity assessment, the extract exhibited no observable toxic symptoms or mortality at a high limit dose of 5000 mg/kg body weight. The animals showed normal behavior and physiological functions throughout the 14-day observation period, and a statistically significant increase in body weight was observed, which indicates the absence of toxicity and the possibility of nutritional benefits. Based on the OECD guidelines, the extract can be classified as practically non-toxic, with an LD_{50} value estimated to be greater than 5000 mg/kg.

In the hypolipidemic study, the extract demonstrated significant lipid-lowering activity across various parameters. There was a marked reduction in serum levels of total cholesterol (TC), triglycerides (TAG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) in the treatment groups, particularly at higher doses, when compared with the negative control group.

Additionally, high-density lipoprotein (HDL) levels were significantly elevated in treated groups, especially at the highest dose of 500 mg/kg, indicating a favorable shift in lipid profile. Statistical analysis using one-way ANOVA revealed highly significant differences ($p < 0.01$) among the groups for each lipid parameter. Post-hoc Tukey's test confirmed that the extract at both 250 mg/kg and 500 mg/kg produced lipid-lowering effects comparable to the standard drug Atorvastatin. These results strongly suggest that the extract possesses potent hypolipidemic activity.

In conclusion, the aqueous stem bark extract of *Erythrina senegalensis* is both safe and pharmacologically effective at the tested doses. It demonstrated no acute toxicity at 5000 mg/kg and exerted a significant hypolipidemic effect in rats, as evidenced by reductions in LDL, TAG, VLDL, and TC, alongside increases in HDL. This indicates the potential of the plant as a natural alternative or complementary agent in the management of dyslipidemia.

It is therefore recommended that further sub-chronic and chronic toxicity studies be carried out to evaluate the long-term safety of the extract. Additionally, bioactive compounds responsible for the hypolipidemic effects should be isolated, characterized, and subjected to mechanistic studies to better understand their mode of action. Clinical trials are also necessary to confirm these effects in human populations, and to establish proper dosage guidelines for therapeutic use. The promising results support the inclusion of *Erythrina senegalensis* in future drug development programs targeting lipid-related disorders.

5.0 References

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