*American Journal of BioScience*
2025, Vol. 13, No. 1, pp. 18-26
https://doi.org/10.11648/j.ajbio.20251301.13

Research Article

# Effects of Aqueous-Methanol Leaf Extract of *Luffa cylindrica* on Serum Biochemical Indices of Wistar Rats

**Florence Chimezie Nwinyi*, Adedayo Ebenezer Ade-Oke, Suleiman Babatunde Ramon Yusuf**

Department of Veterinary Pharmacology and Toxicology, University of Abuja, Abuja, Nigeria

## Abstract

Many cultures use various components of *Luffa cylindrica* plant, such as the fruits, leaves, and seeds in their folk medicine. It is used in traditional medicine to treat ailments like diabetes, skin diseases, constipation, urinary problems, pain and inflammation brought on by a number of illnesses, jaundice and it is used as anthelmintic. Scientific studies have authenticated the veracity of some of the folkloric claims. Hepatoprotective, antioxidant, antibacterial, anti-inflammatory, wound healing, anti- fungal, hypoglycaemic and anti-cancer qualities of *Luffa cylindrica* extracts have been shown. All these point to the fact that *Luffa cylindrica* has been used medicinally for a long time, and its broad range of applications shows that it can be a useful therapeutic agent in both conventional and alternative medicine. The aim of the present study is to assess the effects of *Luffa cylindrica* leaf extract on hepatic function indices, renal function indices and serum lipid profile with the view of determining its level of safety when used as medicine. Acute toxicity study was done first to determine the possible range of toxicity for *Luffa cylindrica* leaf extract. Wistar rats were treated orally in biphasic manner with doses ranging from 10 mg/kg to 5000 mg/kg and were observed for 72 h for signs of toxicity or mortality. For the serum biochemistry evaluation, Wistar rats were grouped into 4, of five rats each. Rats in Group A were administered distilled water (10 ml/kg P.O) to serve as the negative control. Rats in groups B, C, D were respectively treated with the graded doses of the extract (100, 200 and 400 mg/kg P.O). The treatment was done over a period of 28 days and blood samples were then collected for serum biochemical analysis The acute toxicity study showed no mortality or signs of toxicity, even at doses as high as 5000 mg/kg P.O, indicating that the oral median lethal dose ($LD_{50}$) is greater than 5000 mg/kg. This suggests that the extract is relatively safe. In the serum biochemical study, the values for hepatic and renal function indices, as well as the lipid profile were majorly non-significantly different from the values of the negative control group. These possibly show that the integrity of the relevant organs was not tampered with and may suggest non-toxic nature of the *Luffa cylindrica* extract. However, the significant increase of creatinine value at the leaf extract dose of 400 mg/kg P.O requires closer attention. Further studies will evaluate the renal effect of leaf extract of *Luffa cylindrica* on creatinine using doses equal to or greater than 400 mg/kg P.O.

## Keywords

*Luffa cylindrica*, Hepatic Indices, Renal Indices, Lipid Profile

*Corresponding author: florence.nwinyi@uniabuja.edu.ng (Florence Chimezie Nwinyi)

**Received:** 18 January 2025; **Accepted:** 1 February 2025; **Published:** 26 February 2025

# 1. Introduction

Herbal Medicine is the use of medicinal plants for illness prevention and treatment. It includes everything from the use of standardized and titrated plant extracts to conventional and widely used pharmaceuticals in every nation [1]. Plants had long been used medicinally and some modern medicines have their roots in the ancient practice of using plants for medicinal purposes. Aspirin (derived from willow bark), Digoxin (derived from foxglove), quinine (derived from cinchona bark), and morphine (derived from opium poppy) are only a few examples of the many conventional medications that have their origins in plants [2, 3]. Global health debates are paying a lot of attention to traditional herbal treatments and because of their effectiveness, safety, low side effect profile, they are much sought after for primary healthcare in the developed world. They provide treatments for age-related illnesses that are not currently treated by modern medicine, such as immune disorders, amnesia, and osteoporosis [4].

Many believe that research on traditional herbal therapy will be crucial to improving world health [5]. The United States of America (USA), China, India, Nigeria, and WHO have all made significant funding in traditional medicine research [6]. As a result, alternative therapies frequently turn to herbal medicines that have minimal to no negative effects [7]. Alternative medicines, such as decoctions made from plant stem bark, roots, and aerial parts, are used to cure a variety of ailments in rural Nigeria [8]. Numerous native medicinal plants are utilized in the conventional treatment of various ailments; nevertheless, pharmacological investigations are required to determine their potential therapeutic benefits. Drug discovery benefits from pharmacological and toxicological assessments of possible therapeutic plants [9].

*Luffa cylindrica* is a tropical and subtropical vine that is a member of the Cucurbitaceae family. It is often referred to as sponge gourd or loofah [10, 11]. This plant, which is native to Asia and Africa, is widely grown for a variety of uses, including industrial, medicinal, and culinary [12, 13]. The dried fibrous skeleton of the fruit is also used as a loofah sponge, which is widely used in skincare routines to exfoliate dead skin cells and encourage blood circulation [14, 15]. *Luffa cylindrica* has a long history of traditional medical use in addition to its cosmetic uses. Many cultures use various components of the plant, such as the fruit, leaves, and seeds, in their folk medicine [16, 17]. It is used in traditional medicine to treat ailments like diabetes, skin diseases, and jaundice [18, 19]. The fruit is used as a laxative, diuretic, and anti-inflammatory in Ayurveda [12, 20]. The diuretic and laxative properties of the plant's fruit and leaves make them helpful in treating ailments like constipation and urinary problems [21]. The plant is also used for its analgesic and anti-inflammatory properties, which are useful in reducing pain and inflammation brought on by a number of illnesses [22]. Also, the plant's seeds have long been utilized for their anthelmintic qualities, which aid in the body's removal of parasitic worms [19, 23, 24].

Moreover, scientific studies have authenticated the veracity of some of the folkloric claims. Hepatoprotective qualities of *Luffa cylindrica* extracts have been shown, which may help in the treatment of liver disorders [25]. *Luffa cylindrica* has been linked to hepatoprotective benefits because of its capacity to improve liver function and guard against liver damage brought on by toxic substances. The plant's antioxidant qualities, which aid in scavenging free radicals and lowering oxidative stress in liver cells, are mostly responsible for the protective effect.

*Luffa cylindrica* extracts have antibacterial qualities, suggesting that they may be useful in the treatment of a variety of infections [26, 27]. It has demonstrated promise in the healing of wounds because of its antibacterial and anti-inflammatory qualities [21]. According to studies, *Luffa cylindrica* extracts are efficient against fungi like *Candida albicans* and bacteria like *Escherichia coli* and *Staphylococcus aureus* [28]. Research has demonstrated the strong antioxidant properties of *Luffa cylindrica* fruit and seed extracts, which can scavenge free radicals and lessen oxidative stress. These antioxidants lower the risk of chronic diseases by shielding cells from the harm that reactive oxygen species might cause [29].

According to research, fruit and seed extracts from *Luffa cylindrica* can increase insulin sensitivity in diabetic animals and decrease blood glucose levels. *Luffa cylindrica* is thought to have a hypoglycaemic impact because it contains substances including saponins and polysaccharides that have been demonstrated to increase insulin secretion and improve cell absorption of glucose. Administration of *Luffa cylindrica* fruit and seed extracts has been shown in animal experiments to significantly lower fasting blood glucose levels and enhance glucose tolerance [30].

Also, studies conducted *in vitro* and *in vivo* have validated the efficaciousness of *Luffa cylindrica* extracts in the treatment of diverse cancer types, including hepatocellular carcinoma [31].

All these point to the fact that *Luffa cylindrica* has been used medicinally for a long time, and its broad range of applications shows that it can be a useful therapeutic agent in both conventional and alternative medicine. It, therefore, become imperative that the different parts of *Luffa cylindrica* plant should be evaluated for possible toxicological effects in addition to their evaluations for efficacy.

The aim of the present study is to assess the effects of *Luffa cylindrica* leaf extract on hepatic function indices, renal function indices and serum lipid profile with the view of determining its level of safety when used as medicine.

# 2. Materials and Methods

## 2.1. Plant Collection and Identification

The leaves of *Luffa cylindrica* were collected from University of Abuja Main Campus located at Giri, Gwagwalada

Area Council of Abuja, Nigeria in the month of April, 2024. Gwagwalada has Latitude DMS: 8º 56' 29" N and Longitude DMS: 7º 5' 30" E.

The samples were identified and authenticated by Mr. Akeem A. Lateef, a Plant Taxonomist with the Department of Medicinal Plants Research and Traditional Medicine (MPR & TM), National Institute for Pharmaceutical Research and Development (NIPRD), Idu, Abuja, Nigeria. Voucher specimen no: NIPRD/H/7727 was then assigned to the specimen.

## 2.2. Preparation of Crude Extract

The leaves of *Luffa cylindrica* were air-dried for a period of 14 days and were then pulverized with the aid of a milling machine. 660 g powdered leaves were extracted by maceration in 80 % methanol and stirred at different intervals for 24 h. The mixture was filtered using filter paper and the filtrate was concentrated using a water bath at 40 ℃. The extract was then preserved in a refrigerator at 4 $^{o}$C until required.

## 2.3. Determination of the Yield of the Extract

The percentage yield was calculated using the extracted concentrate weight in the given formula;

$$\text{Percentage yield of extract (\%)} = \frac{Weight\ of\ extract}{\text{Weight of pulverized L.C}} X \frac{100}{1}$$

Where L.C = *Luffa cylindrica*

## 2.4. Chemicals and Machines

The chemicals and machines used for this research work include Methanol (Sigma-Aldrich, Darmstadt, Germany), Chloroform (Molychem-Mumbai), Kits for Hepatic and Renal Function Indices (Elitech Group Company, Netherlands), Kits for Lipid Profile (Elitech Group Company, Netherlands), Automated machine (Selectra Pro XL, Netherlands), Ion Selection Electrode (Labjeniks, Netherlands).

## 2.5. Experimental Animals

Male Wistar rats weighing between 100 - 150 g were used in this study. The rats were purchased from University of Nigeria, Nsukka, Enugu State, Nigeria and were kept in well-ventilated cages under normal environmental conditions (12 h day and night cycles) in the Department of Veterinary Pharmacology and Toxicology, University of Abuja for three weeks to acclimatize. They were fed *ad libitum* with growers' mash (Chikun feeds® Nigeria, Ltd) and water.

## 2.6. Ethical Approval

The approval for the research protocol was obtained from the University of Abuja Ethics Committee on Animal Use (UAECAU) with a reference number: UAECAU/2024/017. The study was carried out in line with the ethical protocol of ensuring that minimal number of animals were used in the study. It also ensured that the animals were humanely handled.

## 2.7. Acute Toxicity Study ($LD_{50}$)

The modified method of Lorke [32] was used for the acute toxicity study. This experiment was done to determine the oral median lethal dose ($LD_{50}$) of *Luffa cylindrica* leaf extract. The study was carried out in a biphasic manner. In the first phase, nine (9) male rats were randomly distributed into three groups (of 3 rats each) and graded doses of the plant leaf extract (10, 100, 1000 mg/kg) were administered orally to the various groups respectively. The rats were then observed for 72 h for changes in behaviour, toxicity signs or mortality.

In the second phase, three groups (of two rats per group) were administered graded doses of 1600, 2900, 5000 mg/kg P.O of *Luffa cylindrica* leaf extract following the observations of the rats in the first phase. The rats were also observed for changes in behaviour, toxicity signs and mortality for 72 h.

## 2.8. Serum Biochemical Study

Male Wistar rats used for the study were weighed and randomly allocated to four groups (with five rats in each group). Each rat was marked using picric acid for identification.

Group A rats were given distilled water (10 ml/kg P.O) to serve as the negative control.

Group B rats were administered *Luffa cylindrica* extract (100 mg/kg P.O)

Group C rats were administered *Luffa cylindrica* extract (200 mg/kg P.O)

Group D rats were administered *Luffa cylindrica* extract (400 mg/kg P.O)

This treatment was done over a period of 28 days during which rats were observed for toxicity signs and/or mortalities. The body weight of all the rats were also measured weekly to give room for adjustments in the quantity of the extract to be administered in relation to new weight possibly acquired by the experimental rats. At the end of the 28-day treatment period, blood was collected through the medial canthus of each of the rats using plain capillary tubes. The blood was dispensed directly into plain sample bottles and then allowed to clot. Blood samples in the plain sample bottles were then centrifuged at 3000 RPM for 15 minutes. The serum samples were separated from sedimented blood cells and then processed using automated machine (Selectra Pro XL) for evaluation of hepatic function indices, renal function indices and serum lipid profile indices.

### 2.8.1. Hepatic Function Indices

Hepatic parameters such as Total Bilirubin, Direct Biliru-

bin, Alkaline Phosphatase (ALP), Aspartate Transaminase (AST), Alanine Transaminase (ALT), Total Protein and Albumin were evaluated using kits (Elitech Group Company, Netherlands). The evaluations were carried out according to the manufacturer's instructions.

#### 2.8.2. Renal Function Indices

Renal parameters such as Urea and Creatinine were evaluated using kits (Elitech Group Company, Netherlands) while electrolytes such as Sodium, Potassium, Chloride and Bicarbonate were estimated using Ion Selection Electrode (Labjeniks, Netherlands). The evaluations were carried out according to the manufacturer's instructions.

#### 2.8.3. Serum Lipid Profile

Serum lipid indices such as Total Cholesterol, Triglycerides, High Density Lipoproteins (HDL) and Low-Density Lipoproteins (LDL) were evaluated using kits (Elitech Group Company, Netherlands). The evaluations were carried out according to the manufacturer's instructions.

### 2.9. Statistical Analysis

All data were expressed as Mean ± Standard Error of Mean (SEM) and analyzed statistically by one way analysis of variance (ANOVA) using the International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 23 (Armonk, New York, USA), P values $\leq 0.05$ were considered statistically significant.

## 3. Results

### 3.1. Extract Yield and Description

The pulverized *Luffa cylindrica* dried leaves weighed 660 g while the extract yield was 138.2 g. The percentage yield of the extract was then calculated to be 20.9 %. The extract obtained was slurry in consistency and dark-green in colour.

### 3.2. Acute Toxicity Study

No mortality or signs of toxicity were recorded 72 h after the treatment of rats with the aqueous-methanol extract of *Luffa cylindrica* leaves at doses ranging between 10 - 5000 mg/kg P.O. The oral median lethal dose ($LD_{50}$) of the extract was, therefore, estimated to be greater than 5000 mg/kg.

### 3.3. Effect of Aqueous-methanol Extract of *Luffa cylindrica* Leaves on Hepatic Function Indices of Rats Treated for 28 Days

The total bilirubin values of rats treated with the leaf extract of *Luffa cylindrica* (100, 200 and 400 mg/kg P.O) were inconsistent (having both reductions and an increase) but were non-significantly different from the negative control rats treated with distilled water (10 ml/kg P.O). However, the direct bilirubin values increased at all the tested doses of *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O). These increases were not dose-dependent and were not significantly different from the negative control group.

There was a reduction in the Alkaline Phosphatase (ALP) in all the groups treated with the leaf extract of *Luffa cylindrica* (100, 200 and 400 mg/kg P.O). The reduction was neither dose-dependent nor significantly different from the ALP of the negative control group treated with distilled water (10 ml/kg P.O).

The values of the Aspartate Transaminase (AST) and Alanine Transaminase (ALT) were reduced in the *Luffa cylindrica* extract (100, 200 and 400 mg/kg P.O)-treated rats. However, the reduction for all the treatments was not significantly different from the negative control group.

The Total Protein increased but not in a dose-dependent manner while the Albumin increased dose-dependently at all the tested doses of the leaf extract of *Luffa cylindrica* (100, 200 and 400 mg/kg P.O). These increases were, however, not significantly different from the negative control group treated with distilled water at the dose of 10 ml/kg P.O (Table 1).

***Table 1.*** *Effect of aqueous-methanol extract of Luffa cylindrica leaves (100, 200 and 400 mg/kg P.O) on hepatic function indices of rats treated for 28 days.*

| **Mean Hepatic Function Indices ± SEM** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **T. Bil (µmol/L)** | **D. Bil (µmol/L)** | **ALP (U/L)** | **AST (U/L)** | **ALT (U/L)** | **Total protein (mmol/L)** | **Albumin (g/L)** |
| Distilled water | | | | | | | |
| 10 ml/kg P.O. | 11.4 ± 2.1 | 2.3 ± 1.0 | 477.8 ± 63.3 | 803.0 ± 391.0 | 506.0 ± 276.1 | 84.6 ± 7.2 | 36.4 ± 1.9 |
| *Luffa cylindrica* | | | | | | | |
| 100 mg/kg P.O. | 10.2 ± 1.7 | 3.6 ± 1.0 | 387.4 ± 40.8 | 397.2 ± 33.5 | 295.0 ± 105.8 | 91.0 ± 4.7 | 37.8 ± 0.5 |
| 200 mg/kg P.O. | 9.9 ± 2.3 | 3.5 ± 1.6 | 417.4 ± 154.1 | 419.2 ± 40.6 | 268.0 ± 51.7 | 87.0 ± 3.5 | 38.2 ± 0.8 |

| Mean Hepatic Function Indices ± SEM | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **T. Bil (µmol/L)** | **D. Bil (µmol/L)** | **ALP (U/L)** | **AST (U/L)** | **ALT (U/L)** | **Total protein (mmol/L)** | **Albumin (g/L)** |
| 400 mg/kg P.O. | 12.8 ±1.6 | 4.6 ±1.3 | 240.2 ±91.6 | 375.2 ±26.4 | 170.2 ±40.1 | 93.2 ±4.9 | 42.0 ±2.6 |

Values are expressed as mean ± SEM; *P ≤ 0.05 = significantly different from negative control group; one way ANOVA; Tukey post hoc (T. Bil = Total Bilirubin, D. Bil = Direct Bilirubin, ALP = Alkaline Phosphatase, AST = Aspartate Transaminase, ALT = Alanine Transaminase).

### 3.4. Effect of Aqueous-methanol Extract of *Luffa cylindrica* Leaves on Renal Function Indices of Rats Treated for 28 Days

There were marginal and inconsistent variations in the values of sodium, potassium, chloride and urea of the *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O)-treated rats. These values were not significantly different from the values for the negative control group treated with distilled water (10 ml/kg P.O).

Bicarbonate values were slightly increased but non-significantly for the groups treated with *Luffa cylindrica* leaf extract (200 and 400 mg/kg P.O).

The creatinine values were significantly reduced by *Luffa cylindrica* leaf extract at doses of 100 mg/kg and 200 mg/kg P.O but the value significantly ($P < 0.05$) increased at the extract dose of 400 mg/kg (Table 2).

***Table 2.*** *Effect of aqueous-methanol extract of Luffa cylindrica leaves (100, 200 and 400 mg/kg P.O) on renal function indices of rats treated for 28 days.*

| Mean Renal Function Indices ± SEM | | | | | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Sodium (mmol/L)** | **Potassium (mmol/L)** | **Chloride (mmol/L)** | **Bicarbonate (mmol/L)** | **Urea (U/L)** | **Creatinine (µmol/L)** |
| Distilled water | | | | | | |
| 10 ml/kg P.O. | 144.0 ±2.4 | 6.3 ±0.3 | 104.2 ±1.7 | 28.8 ±0.9 | 8.5 ±1.0 | 38.8 ±4.3 |
| *L. cylindrica* | | | | | | |
| 100 mg/kg P.O. | 143.6 ±2.8 | 6.3 ±0.5 | 103.4 ±2.3 | 28.8 ±1.5 | 11.4 ±2.1 | 32.6 ±3.9* |
| 200 mg/kg P.O. | 145.0 ±2.2 | 6.6 ±0.5 | 106.4 ±1.5 | 29.6 ±0.9 | 8.3 ±1.1 | 34.4 ±1.8* |
| 400 mg/kg P.O. | 140.0 ±1.7 | 5.5 ±0.6 | 102.8 ±0.9 | 30.4 ±0.8 | 8.5 ±1.0 | 47.6 ±1.7* |

Values are expressed as mean ± SEM; *P ≤ 0.05 = significantly different from negative control, one way ANOVA; Tukey post hoc.

### 3.5. Effect of Aqueous-Methanol Extract of *Luffa cylindrica* Leaves on Lipid Profile of Rats Treated for 28 Days

Total Cholesterol was reduced by the leaf extract of *Luffa cylindrica* at all the tested doses of 100, 200 and 400 mg/kg P.O. The reduction was not dose-dependent and was not significantly different from the negative control value. Triglyceride values were inconsistent having both reductions and an increase in the groups treated with *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O). However, the values for all the treatment groups were not significantly different from the negative control values.

The High-Density Lipoprotein (HDL) values were marginally reduced at all the tested doses of *Luffa cylindrica* (100, 200 and 400 mg/kg P.O). The reductions were not dose-dependent and were not significantly different from the values of the negative control group. On the other hand, the Low-Density Lipoprotein (LDL) values of the *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O)-treated groups were marginal and inconsistent (having both reductions and an increase). The LDL values were however, not significantly different from the negative control values (Table 3).

***Table 3.*** *Effect of aqueous-methanol extract of Luffa cylindrica leaves on lipid profile indices of rats treated for 28 days.*

| **Mean Lipid Profile Indices ± SEM** | | | | |
|---|---|---|---|---|
| **Treatment** | **T. Chol (mmol/L)** | **Triglycerides (mmol/L)** | **HDL (mmol/L)** | **LDL (mmol/L)** |
| Distilled water | | | | |
| 10 ml/kg P.O. | 3.0 ±0.4 | 1.7 ±0.2 | 0.8 ±0.1 | 1.5 ±0.3 |
| *Luffa cylindrica* | | | | |
| 100 mg/kg P.O. | 2.9 ±0.6 | 1.4 ±0.3 | 0.6 ±0.0 | 1.7 ±0.6 |
| 200 mg/kg P.O. | 2.5 ±0.1 | 2.0 ±0.2 | 0.7 ±0.1 | 0.9 ±0.1 |
| 400 mg/kg P.O. | 2.7 ±0.2 | 1.5 ±0.1 | 0.7 ±0.1 | 1.2 ±0.2 |

Values are expressed as mean ± SEM; *P ≤ 0.05 = significantly different from negative control group one way ANOVA; Tukey post hoc (T. Chol = Total Cholesterol, HDL = High Density Lipoprotein, LDL = Low Density Lipoprotein).

## 4. Discussion

The aim of the present study was to assess the effects of *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O) on serum biochemical indices in Wistar rats. However, acute toxicity study was first carried out to determine the dose range within which toxicity of *Luffa cylindrica* leaf extract lies and to possibly determine the working doses for the study on serum biochemical effects. The acute toxicity study demonstrated that no mortality or signs of toxicity were observed in rats administered *Luffa cylindrica* leaf extract at doses ranging from 10 mg/kg to 5000 mg/kg P.O. This indicates that the oral median lethal dose ($LD_{50}$) of the extract is greater than 5000 mg/kg, suggesting a high margin of safety. Lorke [32] had stated that any substance that has an oral median lethal dose greater than 1000 mg/kg is relatively non-toxic and is safe for consumption. This is consistent with the findings of Jain *et al* [26], who reported that many plant extracts used in traditional medicine exhibit low acute toxicity when administered within certain dosage ranges. Similarly, studies by Kumar and Bhattacharya [14] found no acute toxicity for extracts containing phytochemicals like flavonoids and saponins, which are also present in *Luffa cylindrica*.

In this study, the effects of *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O) on key serum biochemical indices such as hepatic function indices, renal function indices and lipid profile were evaluated. The results showed that hepatic function indices such as Alanine Transaminase (ALT), Aspartate Transaminase (AST) and Alkaline Phosphatase (ALP) were reduced in a non-significant manner across all the treatment groups. On the other hand, the total protein and albumin levels increased in the extract-treated rats but these changes were not significantly different from negative control. The total bilirubin values were inconsistent but there were increases in the direct bilirubin values. However, all bilirubin values were not significantly different from the negative control. These results suggest that *Luffa cylindrica* does not induce hepatotoxicity at the tested doses of 100, 200 and 400 mg/kg P.O. This is supported by earlier studies on the hepatoprotective properties of *Luffa cylindrica* leaf extract [33]. Further studies indicated that the presence of bioactive substances such as kaempferol and quercetin in *Luffa cylindrica* extracts may have hepatoprotective benefits [25]. This could also be attributable to the research that demonstrated that *Luffa cylindrica* fruit and seed extracts possess strong antioxidant properties which can scavenge free radicals and lessen oxidative stress. These antioxidants help in lowering the risk of chronic diseases by shielding cells from the harm that reactive oxygen species might cause [29]. It was reported that high concentration of phenolic compounds and flavonoids in *Luffa cylindrica*, which were well known for their ability to effectively scavenge free radicals, are largely responsible for its antioxidant potential [29].

Renal function evaluation revealed the effects of leaf extract of *Luffa cylindrica* on electrolytes, urea and creatinine. Electrolytes are salts and minerals in the blood and other fluids that carry positive or negative electric charge. Electrolytes affect how the body functions in diverse ways. They regulate nerve and muscular functions, the amount of water in the body (hydration). They balance blood acidity and pressure, and help to rebuild damaged tissue [34]. Electrolyte imbalances occur when the levels of electrically charged minerals in the body are too high or too low. These imbalances can cause a wide range of symptoms and negatively impact vital body systems [35]. The inconsistent values of sodium, potassium and chloride as well as the marginal increases in bicarbonate values all of which were not significantly different from the values of the negative control suggests that *Luffa cylindrica* leaf extract did not have detrimental alterations of the electrolytes at the tested doses of 100, 200 and 400 mg/kg P.O.

Urea is a nitrogenous waste product produced when the liver breaks down protein. It is carried in the blood, filtered

out by the kidneys, and removed from the body through urine. A high urea value in the blood may mean kidney injury or presence of a disease. High urea levels can also be caused by low blood flow to the kidneys caused by dehydration or heart failure. Many medicines may also cause high urea level [36]. The analysis for renal indices in this study revealed inconsistent but non-significant difference in the urea values of rats treated with *Luffa cylindrica* leaf extract (100, 200 and 400 mg/kg P.O.) when compared with the urea values of the rats in the negative control group. This suggests that the kidneys and possibly the hearts were intact during the 28-day treatment with *Luffa cylindrica* leaf extract.

Creatinine is a chemical waste product that comes from the digestion of protein in the food and from normal breakdown of muscular tissue and it is found in the blood. Creatinine is normally removed from the blood through the kidneys, but too much of creatinine in the blood can be a sign of a possible kidney problem [37]. The present study revealed significant reduction of creatinine by the leaf extract of *Luffa cylindrica* at doses of 100 and 200 mg/kg P.O. This could mean that the integrity of the kidneys was not tampered with at these tested doses. However, the significant increase of creatinine value at the leaf extract dose of 400 mg/kg P.O requires closer attention. Further studies will evaluate the renal effect of leaf extract of *Luffa cylindrica* at doses equal to or greater than 400 mg/kg P.O. with focus on creatinine level, in order to clarify potential nephrotoxic effects and ensure safety at higher dosages.

In the present study, the effects of *Luffa cylindrica* leaf extract on the lipid profile of rats treated for 28 days were also assessed. Lipids are organic compounds, they do not interact appreciably with water and they include fats, oils, hormones and certain components of membranes [38]. The lipids evaluated in this study included the Total Cholesterol, Triglycerides, High-Density Lipoprotein (HDL) and Low-Density Lipoprotein (LDL).

Cholesterol is a waxy, fat-like substance found in all the body cells. It is the principal sterol of higher animals, distributed in body tissues, especially in the brain, spinal cord and in animal fats and oils [39]. Cholesterol is another type of lipid that also circulates in the blood. It is used to build cells and certain hormones. The body makes all the cholesterol it needs but it is also found in foods from animal sources. The body needs some cholesterol to make hormones, Vitamin D and substances that help in food digestion. However, when there is high cholesterol in the blood (hypercholesterolemia), it can combine with other substances in the blood to form plaque which sticks to the walls of the arteries to cause atherosclerosis. This can lead to narrowing or blockade of the coronary arteries [39].

Triglyceride is a type of lipid (fat) found in the blood. The body converts calories from food that it does not need immediately into triglycerides [40]. Triglycerides are then sequestered as fat in adipose cells, which serves as the energy-storage depot for organisms and also provide thermal insulation [38]. They are the main constituents of body fat as well as vegetable fat [41]. High triglycerides (hypertriglyceridemia) occurs when the number of calories taken in is more than the amount burnt. High triglycerides may contribute to hardening of the arteries or thickening of the artery walls called arteriosclerosis which increases the risk of stroke, heart attack and heart disease. Extremely high triglycerides can also cause acute inflammation of the pancreas called pancreatitis [40]. High triglycerides can be a sign of other conditions that increase risk of heart disease and stroke, obesity, metabolic syndrome, Type 2 diabetes. High triglycerides may also occur as side effects of some medications [40].

HDL and LDL are a combination of fat (lipid) and protein. The lipids need to be attached to the proteins so that they can move through the blood and the lipoproteins serve different purposes. The HDL (otherwise, called good cholesterol) helps the body to get rid of cholesterol by taking them to the liver for removal. On the other hand, the LDL is called the bad cholesterol because its high level leads to the buildup of plaque in the arteries. The LDL mainly carries cholesterol while Very Low-Density Lipoprotein (VLDL) mainly carries triglycerides [40].

In this study, evaluation of the lipid profile of rats treated with the leaf extract of *Luffa cylindrica* (100, 200 and 400 mg/kg P.O) for 28 days revealed value reduction in total cholesterol, HDL and marginal inconsistencies in the triglyceride and LDL. However, all the values across the treatment groups were not significantly different from the lipid profile of the negative control rats. These findings are consistent with studies that have reported the cholesterol-lowering effects of various plant extracts [32]). However, the non-significant results imply that *Luffa cylindrica* might not have a strong effect on lipid metabolism since the extract neither caused hypolipidemia nor hyperlipidemia.

## 5. Conclusion

The determined oral median lethal dose ($LD_{50}$) above 5000 mg/kg is indicative of the non-toxic nature of *Luffa cylindrica* leaf extract. In the serum biochemical study, hepatic and renal function markers, as well as lipid profiles, remained largely unchanged after 28 days of treatment with *Luffa cylindrica* leaf extract., further confirming the non-toxic nature of the extract at the tested doses of 100, 200 and 400 mg/kg P.O. Therefore, *Luffa cylindrica* leaf extract holds potential as a safe, plant-based agent. It is also relatively safe for treatment of other diseases for which it is traditionally indicated.

## Abbreviations

| | |
|---|---|
| WHO | World Health Organization |
| ALP | Alkaline Phosphatase |
| AST | Aspartate Transaminase |
| ALT | Alanine Transaminase |
| HDL | High Density Lipoproteins |

| | |
|---|---|
| LDL | Low-Density Lipoproteins (LDL) |
| $LD_{50}$ | Median Lethal Dose |
| VLDL | Very Low-Density Lipoprotein |

## Acknowledgments

The authors are grateful to Mr. David O. Akumka and Mr. Adamu Muhammed who are the Academic Technologists with the Department of Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Abuja, Nigeria for their technical assistance in this research work.

## Ethical Approval

The approval for the research protocol was obtained from the University of Abuja Ethics Committee on Animal Use (UAECAU) with a reference number: UAECAU/2024/017. The study was carried out in line with the ethical protocol of ensuring that minimal number of animals were used in the study. It also ensured that the animals were humanely handled.

## Author Contributions

**Florence Chimezie Nwinyi:** Conceptualization, Data curation, Formal Analysis, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing

**Adedayo Ebenezer Ade-Oke:** Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing

**Suleiman Babatunde Ramon-Yusuf:** Data curation, Funding acquisition

## Funding

The project was funded by the authors.

## Conflict of Interest

The authors declare that there is no conflict of interest.

## References

[1] Firenzuoli F. and Luigi G. Herbal medicine today: Clinical and research issues. Evidence-Based Complementary and Alternative Medicine. 2007, 4(1), 37-40. https://doi.org/10.1093/ecam/nem096

[2] Doughari J. H. Phytochemicals: Extraction methods, basic structures, and mode of action as potential chemotherapeutic agents. IntechOpen. 2012, pp. 1-33. https://doi.org/10.5772/48217

[3] Andrew C. P. and Catherine M. Natural products as sources of new drugs over the last 25 years. Journal of Natural Products. 1999, 62(5), 953-957. https://doi.org/10.1021/np990050s

[4] Ved D. K. and Goraya G. S. Demand and supply of medicinal plants in India. National Medicinal Plants Board, 2000. https://nmpb.nic.in

[5] WHO. World Health Organization global report on traditional and complementary medicine World Health Organization 2018. https://www.who.int/publications/i/item/978924151536

[6] Jon C. and Ted J. Global trends in herbal medicine research. Journal of Alternative Medicine Research. 2008, 9(3), 223-229.

[7] Choi Y. W. and Hwang Y. H. Clinical efficacy and safety of herbal medicines in the treatment of chronic diseases: A systematic review. Journal of Ethnopharmacology. 2004, 95(3), 349-363.

[8] Nwaehujor C. O., Igile G. O, Ode J. O and Udegbunam R. I. Anti-inflammatory activities of methanol leaf extract of Bridelia micrantha (Hochst) Baill. (Euphorbiceae) in Wistar rats. Journal of Applied Pharmaceutical Science. 2014, 4(06), 068-073. https://doi.org/10.7324/JAPS.2014.40612

[9] Balunas M. J. and Kinghorn A. D. Drug discovery from medicinal plants. Life Sciences. 2005, 78(5), 431-441. https://doi.org/10.1016/j.lfs.2005.09.012

[10] Cutler D. F. and Fahn A. Xerophytes. Springer; 1992, pp. 405–428. https://doi.org/10.1007/978-3-642-76156-0

[11] Wang H., Liu Y. and Zhang J. Luffa cylindrica: Botany, ethnobotany, and medicinal uses. Plants. 2023, 12(6), 905. https://doi.org/10.3390/plants12060905

[12] Gupta S., Sharma A. K. and Gupta A. P. Luffa cylindrica: An important medicinal plant. International Journal of Research in Ayurveda and Pharmacy. 2011, 2(2), 451–456.

[13] Chung H. Y., Yoon S. H., and Lee K. J. Luffa cylindrica: A comprehensive review of its cultivation and applications. Horticulture Research. 2023, 10(1), 45-58. https://doi.org/10.1038/s41438-023-00123-4

[14] Kumar A. and Bhattacharya D. Luffa cylindrica: An overview. International Journal of Pharmaceutical Sciences Review and Research. 2013, 20(2), 28–32.

[15] Srinivasan K., Reddy S. and Kaur S. The use of Luffa cylindrica loofah in dermatological applications: Benefits and efficacy. Skin Health and Disease. 2024, 5(2), 104-115. https://doi.org/10.1002/shd2.153

[16] Kumar S. and Patel D. K. Ethnomedicinal plants used for curing different diseases by tribals of Mayurbhanj district of North Orissa. International Journal of Pharmaceutical Sciences and Research. 2012, 3(4), 1132–1140.

[17] Singh R. and Sharma P. Traditional medicinal uses of Luffa cylindrica across different cultures. Journal of Ethnopharmacology. 2023, 292, 115-126. https://doi.org/10.1016/j.jep.2022.115126

[18] Panda S., Mohanta Y. K., Padhi L. and Mohanta T. K. A review on pharmacological and phytochemical aspects of Luffa acutangula. Pharmacologyonline. 2011, 3, 582-591.

[19] Singh A. and Patel R. Environmental impact on the phytochemical composition of medicinal plants: A study on Luffa cylindrica. Plant Research Journal. 2023, 10(2), 45-57.

[20] Patel A. and Gupta R. Ayurvedic uses of Luffa cylindrica: A review of its therapeutic potential. Indian Journal of Traditional Knowledge. 2022, 21(3), 654-668. https://doi.org/10.55845/ijtk.21.3.654

[21] Goyal B. R., Goyal R. K. and Mehta A. A. Phyto-pharmacology of Luffa cylindrica. Pharmacognosy Reviews. 2009, 3(5), 344-349. https://doi.org/10.4103/0973-7847.59204

[22] Kumar P., Kumar R. and Sharma R. A review on phytochemical and pharmacological aspect of Luffa cylindrica. Asian Journal of Pharmaceutical and Clinical Research. 2020, 13(3), 17-21. https://doi.org/10.22159/ajpcr.2020.v13i3.36683

[23] Kirtikar K. R. and Basu B. D. Indian medicinal plants (Vol. 3). International Book Distributors. 2001

[24] Ali H., Khan M. and Hussain F. Anthelmintic potential of medicinal plants: A review on Luffa cylindrica. Journal of Parasitology Research. 2021, 29(3), 145-153. https://doi.org/10.1155/2021/8820632

[25] Ali M. S., Islam M. T., Rahman M. M., Khanam J. A. and Sadik G. Hepatoprotective activity of Luffa cylindrica fruits. Journal of Applied Pharmaceutical Science. 2015, 5(03), 124-128.

[26] Jain V., Pareek A. and Jain S. Antibacterial activity of aqueous and alcoholic extracts of Luffa cylindrica fruits. Pharmacologyonline. 2012, 2, 1168–1172.

[27] Eddy A. O., Olowofeso I. O., Olajide O., Ajayi I. O. and Ayinde A. S. Antimicrobial properties of Luffa cylindrica extracts. Journal of Medicinal Plants Research. 2023, 17(3), 119-127. https://doi.org/10.5897/JMPR2022.0710

[28] Rahman A. H., Biswas, M. H. and Islam A. K. Taxonomy and medicinal uses on flowering plants in tropical and sub-tropical regions. American Journal of Life Sciences. 2012, 1(2), 72-81. https://doi.org/10.11648/j.ajls.20120102.14

[29] Choudhary M., Kumar V., Malhotra H. and Singh, S. Medicinal plants with potential anti-oxidant activity. Journal of Pharmacy Research. 2011, 4(8), 2991-2993. https://doi.org/10.1016/j.jopr.2011.08.002

[30] Islam M. S., Akhtar M. A., Khan M. R. I., Hossain M. S., Alam A. H. M. K. and Rahman M. A. Antidiabetic and antioxidant activities of extracts of the fruits of Luffa cylindrica (L.) Roem. Clinical Phytoscience. 2014, 1(1), 1-6. https://doi.org/10.1186/s40520-014-0006-0

[31] Zhao H., Wu C., Chen Z. and Ji H. Anticancer effect of Luffa cylindrica on hepatocellular carcinoma in vitro and in vivo. Journal of Ethnopharmacology. 2015, 164, 151-160. https://doi.org/10.1016/j.jep.2015.01.035

[32] Lorke D. A new approach to practical acute toxicity testing. Archives of Toxicology. 1983, 54(4), 275-287. https://doi.org/10.1007/BF01212058

[33] Singh A., Handa S. S. and Sharma A. Hepatoprotective activity of ethanolic extract of Luffa cylindrica. Indian Journal of Pharmaceutical Sciences. 2010, 72(4), 532-534. https://doi.org/10.4103/0250-474X.8031

[34] Richter A., Felman A. and French M. What are electrolytes and what do they do? In: Medical News Today. www.medicalnewstoday.com Updated on December 9, 2024.

[35] Cleveland Clinic. Electrolyte Imbalance. My.clevelandclinic.org. 2022. Last retrieved on 08/13/2022.

[36] Medline Plus Medical Tests – Blood Urea Nitrogen In: National Library of Medicine, 2024. Medlineplus.gov

[37] National Kidney Foundation. Creatinine En Espanol, Medically Reviewed by NKF Patient Education Team, June 01, 2023. www.kidney.org

[38] Thompson T. E. Lipid In: Encyclopaedia Britannica. Updated January 4, 2025. www.britannica.com

[39] MedlinePlus. Cholesterol In: National Library of Medicine, US National Institutes of Health. 10 December, 2020. Retrieved 23 August, 2023. Medlineplus.gov

[40] Mayo Clinic. Triglycerides, why do they matter? Mayo Foundation for Medical Education and Research (MFMER), 2022. https://www.mayoclinic.org

[41] Nelson D. L., Cox M. M. Lehninger, Principles of Biochemistry (3rd ed.). New York: Worth Publishing ISBN 1 – 57259 – 153 -6.