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(RESEARCH ARTICLE)

# The effect of methanolic extract of *Corchorus olitorius* on some kidney and liver functional indices of Albino rats

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## Abstract

The use of medicinal plants has over the years gained wide acceptance among the populace globally and *Corchorus olitorius* is inclusive. This study is aimed at evaluating the effect of methanolic extract of *Corchorus olitorius* on some Kidney and Liver functional indices of albino rats. Through the exhaustive maceration technique, 80 % methanolic extract of this plant was prepared and used throughout the study. The acute and subacute effects of the extract following oral administration in the animal were studied. The $LD_{50}$ of the extract was estimated to be higher than 5000 mg/kg. Oral administration of 100, 1000, 1600, 2900 and 5000 mg/kg doses daily for 14 days did not produce any mortality among the rats. There was no significant difference at $P>0.05$ in weight before and after administration of the methanolic extract. However, there was a significant ($P<0.05$) and dose-dependent increase in the haematological, renal and liver biochemical parameters supported by histological evidence like mild periportal inflammation and mild congestion of the liver as well renal tubular necrosis by *Corchorus olitorius* at 5000 mg/kg body weight dose. From this study, *Corchorus olitorius* has a high degree of safety at a low concentration and the plant is relatively safe for consumption.

**Keywords:** *Corchorus olitorius*; Median Lethal Dose ($LD_{50}$); Acute; Subacute; Safety.

## 1. Introduction

*Corchorus olitorius* is commonly known as a jute plant [1], and bush okra in Nigeria and some other countries in West Africa [2]. In Nigeria, it is a common delicacy in many households and the indigenous tribes have different names for it. The Yorubas know it as Ewedu, Ahihara in Igbo, Oyoyo in Hausa, and Ikpeikpe among the Edos [3]. It is a species of shrub in the family *Malvaceae*. The young fruits and leaves are used to form vegetable soup, while the dried leaves are used as a soup thickener and for tea [4].

*Corchorus olitorius* leaves are rich in β-carotene, proteins, calcium, iron, folic acid, vitamin B, amino acid and essential minerals [5], as well as a wide range of phytochemicals such as Phenol, Flavonoid, Alkaloids, Steroid, Quinones, Terpenoid, Saponin, and Tannins [6]. Its rich nutritional advantages and biological properties have made the plant of immense importance among native herbal practitioners [7]. The use of herbal medicines like *Corchorus olitorius* continues to expand rapidly across the world with many people now resorting to these products for treatment of various health challenges [8, 9, 10].

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The liver and the kidneys are important organs in the body responsible for the regulation of the body's metabolism. The liver maintains the body's homeostasis such as the metabolization of lipids, proteins, carbohydrates, and other exogenous compounds like drugs [11]. Due to this, the liver is continually at the risk of injury majorly induced by hepatotoxic metabolites formed during metabolism [12]. Drug-induced liver injury can be caused by food supplements, drugs, and herbal medicines [13, 14]. The kidney, however, is a foremost clearance organ of the body system responsible for the removal of many xenobiotics such as plant constituents, various prescription drugs, and endogenous metabolites that are important to maintain physiological balance, toxins, and nutritive materials [15]. The adverse toxicological effect of many herbal plants is well documented in the literature and the safety of herbal supplements has become a major concern globally in national and international health authorities due to increasing adverse effects [16, 17, 18]. The liver and the kidneys are important organs of the body system responsible for the regulation of the body's metabolism and estimation of their function are key indicators of wellness and disease status. Hence this study is aimed at evaluating the effect of the methanolic extract of *Corchorus olitorius* on some kidney and liver functional indices of albino rats to establish its level of toxicity and the margin of safety.

**Figure 1** *Corchorus olitorius* Linn Plant

## 2. Material and Methods

### 2.1. Methanol extract

The fresh *Corchorus olitorius* Linn plant was collected from a farm in Bassa, Jos, Plateau State of Nigeria. A sample of the plant was deposited at the Herbarium of the Department of Plant Science and Biotechnology, Faculty of Natural Sciences, University of Jos, Nigeria. It was identified by a Botanist and a voucher number was given. The fresh plant was washed in running water and air-dried at room temperature for six weeks. It was later crushed into powder and exhaustive maceration was carried out using 80 % methanol according to the method described by Zhang et al. [19].

#### *2.1.1. Preparation of Extracts and Animals for Toxicity Studies.*

The acute toxicity test was carried out with the methanolic extract of *Corchorus olitorius.* The plant extract was re-suspended in distilled water at various concentrations as required in the experiments and given orally to both sexes of the albino rats (weighing between 158-220 g) in a volume of 1 ml/kg body weight. The rats, housed in a controlled environment with access to water and food, were maintained on a 12-hour light-dark cycle. Ethical approval for the study was obtained from the University of Jos Ethics Committee for animal handling and experimental procedure. The Guide for the Care and Use of laboratory animals published by the United States National Institutes of Health was strictly followed. Animals were deprived of food for twelve hours before behavioural testing was conducted between 8 a.m. in the morning and 4 p.m. in the afternoon.

### 2.2. Acute Toxicity Test

Acute toxicity was carried out according to Lorke's method [20], using albino rats. In Phase 1 of the test, twelve animals divided into 3 groups of four rats each were used. Doses of 100 mg/kg for group 1, 1000 mg/kg for group 2, and 1600 mg/kg body weight for group 3 of the plant extract were orally administered to the rats to determine the range of doses that will produce any toxic effect. Distilled water was administered to each of the control animals in each group. The behavioural pattern of the rats was observed after 1 hour, then intermittently every 4 hours for 24 hours. The observation lasted for two weeks after treatment for any behavioural changes or signs of toxicity and death.

**Phase 2:** This second phase involved the use of nine animals, which were distributed into 3 groups of 3 animals each. The animals were administered higher doses (2900 mg/kg and 5000 mg/kg body weight) of the plant extracts. Distilled water was administered to the control group and then observed after 24 hours for behavioural changes and mortality checks. The behavioural pattern of the rats was observed after 1 hour, then intermittently every 4 hours throughout 24 hours. The observation lasted for two weeks after treatment for any behavioural changes or toxicity signs and deaths [20].

According to the Acute Toxicity test result it was discovered that even at the highest concentration of 5000 mg/kg body weight dose, no mortality was recorded in the test animals. A confirmatory test was then carried out to further establish the $LD_{50}$ of the extracts. This was done by administering a dose of 5000 mg/kg body weight to two animals according to Chinedu et al. [21]. After administration, observation was done for 1 hour and after 10 minutes every 2 hours intervals for 24 hours.

### 2.3. Subacute Toxicity Study

Male and female albino rats weighing between 157-212 g were divided into three groups. (n=3). The groups received 100, 1600, and 5000 mg/kg body weight of the extract in distilled water daily for two weeks. The control group received distilled water only throughout the two weeks. The animals were monitored closely for signs of toxicity. At the end of the two weeks, the rats were euthanized with chloroform and blood was collected into tubes, while vital organs such as the kidney and liver were dissected and immediately preserved in 10 % formalin for histopathological assessments.

### 2.4. Blood analyses

Haematological analyses were performed on whole blood collected into tubes with ethylenediaminetetraacetic acid (EDTA). Platelets, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), Red blood cells (RBC), Packed cell volume (HCT), Hemoglobin (HGB), White blood cell total count (WBC), Neutrophils, Lymphocytes, Monocytes, Eosinophil and Basophil were determined by an automatic analyzer Cobas C III. The non-anti-coagulated blood was then centrifuged at 3,000 rpm for ten minutes and serum was separated into cryovials. Levels of the liver enzymes such as alanine aminotransferase (ALT), aspartate transaminase (AST), alkaline phosphatase (AP) as well as total protein, albumin, total bilirubin and conjugated bilirubin were determined using an automatic analyzer. Analysis for blood urea, creatinine, sodium, potassium, chloride and bicarbonate was also performed using an automatic analyzer, Mindray (BG-5300).

### 2.5. Histopathology analyses

The two kidneys and liver for each of the experimental animals were fixed and preserved in 10 % formaldehyde before the tissue processing procedures for preparation of a permanent mount for histopathological analysis as described by Sofowora [22]. Iron hematoxylin and eosin (H&E) stains were used to stain the tissues. Canada balsam was applied in mounting the tissues [23]. The slides were viewed under the ×40 and x100 objectives of the light microscope and photographed with the aid of a digital eyepiece camera (Model 582, Oplenic optronic Kina) to capture the tissue images.

### 2.6. Statistical Analysis of the Results

The data were expressed as mean ± standard deviation (STD). The differences between the groups were determined by two-way analysis of variance (ANOVA). Values less than 0.05 were set as the level of significance. The statistical analysis was performed by the GraphPad Prism software version 5.00 for Windows.

## 3. Results

Table 1 showed Phase 1 of the acute toxicity test at a graded concentration of 100 mg/kg body weight, 1000 mg/kg body weight and 1600 mg/kg body weight. Assessment of acute toxicity studies revealed that the test plants did not result in any mortality nor any significant change in the general rat behaviour. In phase 2, a concentration of 2900 mg/kg

and 5000 mg/kg body weight doses of the test plant extracts were administered. The results did not also result in any mortality or any significant change in the general rat behaviour. The data of acute toxicity in Phase 1 (Table 1) and Phase 2 (Table 2), recorded no death in the test and control groups.

According to the Acute Toxicity test result it was discovered that even at the highest concentration of 5000 mg/kg body weight dose, no mortality was recorded in the test animals. The $LD_{50}$ confirmatory test carried out to further establish the $LD_{50}$ of the extracts recorded no mortality. According to establish protocols and standards, this is a confirmation of the $LD_{50}$ of the test plants. At this final stage of testing and the confirmatory test where no mortality was recorded, the $LD_{50}$ of the test substance can be said to be greater than 5000 mg/kg and hence the plant extract has a high degree of safety.

Concerning the weight of the animals, statistically, at a 95 % confidence level $p>0.05$, thus, there was no significant statistical difference in the weight of the animals before administration of the extracts and after as revealed in Tables 1 and Table 2.

**Table 1** Phase 1 of the Acute Toxicity Test for *Corchorus olitorius* Extract at 100 ,1000, and 5000 mg/kg Body Weight

| Groups | Doses (mg/kg) | Initial Weight (g) | Weight After (g) | Volume Administered (ml) | Observation |
|---|---|---|---|---|---|
| A | 100 | 188.48±45.04 | 185.50±40.82 | 1.8 | No Death |
| B | 1000 | 183.30±14.75 | 198.77±10.49 | 1.8 | No Death |
| C | 1600 | 162.73±5.63 | 173.47±10.03 | 1.6 | No Death |
| Control | | 197.07±4.41 | 198.57±2.70 | 1.9 | No Death |

At 95 % confidence level, $p>0.05$, which shows a non-significant difference in weight difference before and after treatment.
*± Standard Deviation, n=3;

**Table 2** Phase 2 of the Acute Toxicity Test of *Corchorus olitorius* Extract at 2900 and 5000 mg/kg Body Weight

| Groups | Doses (mg/kg) | Initial Weight (g) | Weight After (g) | Volume Administered (ml) | Observation |
|---|---|---|---|---|---|
| A | 2900 | 169.6±20.61 | 173.30±19.58 | 1.7 | No Death |
| B | 5000 | 174.03±27.39 | 173.30±19.58 | 1.7 | No Death |
| Control | | 191.03±11.61 | 193.67±10.82 | 1.9 | No Death |

At 95 % confidence level, $p>0.05$. It shows a non-significant difference in weight difference before and after treatment. *± Standard Deviation, n=3.

Table 3 showed the effect of the methanolic extract of *Corchorus olitorius* on the Haematological parameters of Wistar albino rats treated for two weeks. Values are expressed as mean ± STD. From the analyses, Neutrophil, Hemoglobin, MCV, MCH, and MCHC values increased with increasing concentration of the extracts. However, there was a significant statistical difference at a 95 % confidence level in the values of the parameters at the different concentrations compared with the control (Table 3).

The renal function results of the Wistar Albino rats administered with graded concentrations of *Corchorus olitorius* methanolic extract over 2 weeks was shown in Table 4. It was observed that the values of Potassium, Sodium and Bicarbonate parameters increased with increasing concentrations of the extracts, however, there was no significant statistical difference between the values of these electrolytes with the control (Table 4).

**Table 3** Effect of Methanolic Extract of *Corchorus olitorius* on Hematological Parameters in Wistar Albino Rats Treated for Two Weeks. Values are expressed as Mean ± STD (n=3)

| | **DOSES in mg/kg** | | | |
|---|---|---|---|---|
| **Hematological Parameters** | **100 mg/kg** | **1600 mg/kg** | **5000 mg/kg** | **Control** |
| WBC x $10^9$/L | 7.50 ± 0.35a | 7.10 ± 0.17a | 8.45 ± 0.25b | 7.69a |
| Neut % | 21.40 ± 0.17a | 22.50 ± 0.67a | 23.70 ± 0.23b | 23.90b |
| Lym % | 76.70 ± 0.21a | 74.00 ± 0.85b | 73.33 ± 0.27b | 74.10b |
| Mon % | 0.37 ± 0.08a | 0.77 ± 24b | 0.60 ± 0.17b | 0.40a |
| Eos % | 1.27 ± 0.07a | 2.10 ± 0.12b | 1.90 ± 0.41b | 1.00a |
| Bas % | 0.30 ± 0.06a | 0.60 ± 0.12b | 0.60 ± 0.06b | 0.60b |
| RBC x $10^{12}$/L | 6.87 ± 0.14a | 7.40 ± 0.03b | 7.30 ± 0.07b | 6.84a |
| HGB g/dl | 13.40 ± 0.72a | 13.40 ± 0.24b | 14.10 ± 0.09b | 12.90b |
| HCT % | 37.57 ± 0.69a | 41.47 ± 2.79b | 43.30 ± 0.55b | 42.90b |
| MCV fL | 56.20 ± 0.74a | 56.60 ± 0.81a | 59.70 ± 0.55b | 57.30a |
| MCH pg | 18.10 ± 0.39a | 18.40 ± 0.34a | 19.10 ± 0.17b | 18.80a |
| MCHC g/dL | 33.50 ± 0.37a | 34.80 ± 0.55a | 33.70 ± 0.69a | 34.50a |
| PLT x $10^9$/L | 626.00 ± 3.84a | 594.00 ± 5.46b | 702.00 ± 3.77c | 625.00a |

Values with different superscripts are significantly different at $p<0.05$. *WBC = White Blood Cells; Neut = Neutrophils; Lym = Lymphocytes; Mon = Monocytes; Eos = Eosinophils; Bas = Basophils; RBC = Red Blood Cells; HGB = Hemoglobin; HCT = Hematocrit; MCV = Mean Cell Volume; MCH = Mean Corpuscular Hemoglobin; MCHC - Mean Corpuscular Hemoglobin Concentration; PLT = Platelets.

**Table 4** Effect of Methanolic Extract of *Corchorus olitorius* on Renal Function Parameters of Wistar albino Rats Treated for Two Weeks. Values are expressed as Mean ± STD (n=3)

| | **DOSES in mg/kg** | | | |
|---|---|---|---|---|
| **Biochemical Index** | **100 mg/kg** | **1600 mg/kg** | **5000 mg/kg** | **Control** |
| Sodium (mmol/L) | 139.00 ± 0.88a | 140.00 ± 1.16a | 141.00 ± 033a | 140.00a |
| Potassium (mmol/L) | 5.00 ± 0.12a | 4.60 ± 0.29a | 4.70 ± 0.33a | 4.80a |
| Bicarbonate (mmol/L) | 25.00 ± 0.16a | 26.00 ± 1.33a | 27.00 ± 2.19a | 28.00a |
| Chloride (mmol/L) | 100.00 ± 0.33a | 102.00 ± 1.45a | 101.00 ± 0.58a | 104.00a |
| Urea (mmol/L) | 3.60 ± 0.03a | 4.30 ± 0.15b | 3.40 ± 0.18a | 3.80c |
| Creatinine (umol/L) | 66.00 ± 1.20a | 71 ± 4.67b | 68.00 ± 6.07a | 58.00c |

Values with different superscripts are significantly different at $p<0.05$

Table 5 showed the Liver function of the Wistar Albino rats administered with varying concentrations of *Corchorus olitorius* methanolic extract over 2 weeks. It was observed that the liver enzymes which are the Alkaline phosphatase, and the transaminases (ALT and AST) as well as the liver pigments (Total and Conjugated Bilirubin) values increased as the concentration of the extracts increased. It was observed that there was no statistical significance at a 95 % confidence level between the values of the extracts at 100 mg/kg and 1600 mg/kg body weight administration of the extracts and the control (Table 5). However, a statistically significant difference was observed with the highest concentration (5000mkg body weight) of the extract.

**Table 5** Effect of Methanolic Extract of *Corchorus olitorius* on Liver Function Parameters of Wistar Albino Rats Treated for Two Weeks. Values are expressed as Mean ±STD (n=3).

| | DOSES in mg/kg | | | |
|---|---|---|---|---|
| **Biochemical Index** | **100 mg/kg** | **1600 mg/kg** | **5000 mg/kg** | **Control** |
| Protein (g/L) | 75.00 ± 2.33a | 72.00 ± 2.65a | 80.00 ± 0.58b | 72.00a |
| Albumin (g/L) | 38.00 ± 1.20a | 38.00 ± 1.73a | 43.00 ± 1.73b | 39.00a |
| Alk Phosphatase (U/L) | 102.00 ±1.20a | 130.00 ± 3.53b | 133.00 ± 2.91b | 108.00c |
| ALT(GPT) (U/L) | 65.00 ± 0.88a | 75.00 ± 3.71b | 79.00 ± 2.33b | 53.00c |
| AST(GOT) (U/L) | 219.00 ±0.88a | 328.00± 0.88b | 324.00 ± 4.10b | 215.00a |
| Total Bilirubin (umol/L) | 13.50 ± 0.29a | 17.50 ± 3.44a | 21.60 ± 0.64b | 17.10a |
| Conj. Bilirubin (umol/L) | 6.80 ± 0.09a | 10.10 ± 0.13b | 10.80 ± 0.33b | 8.60c |

Values with different superscripts are significantly different at $p<0.05$

### 3.1. Histological analysis

Below are photomicrographs showing liver and kidney sections of Wistar Albino rats after 14-day treatment with a graded dose of the methanolic extract of *Corchorus olitorius.*

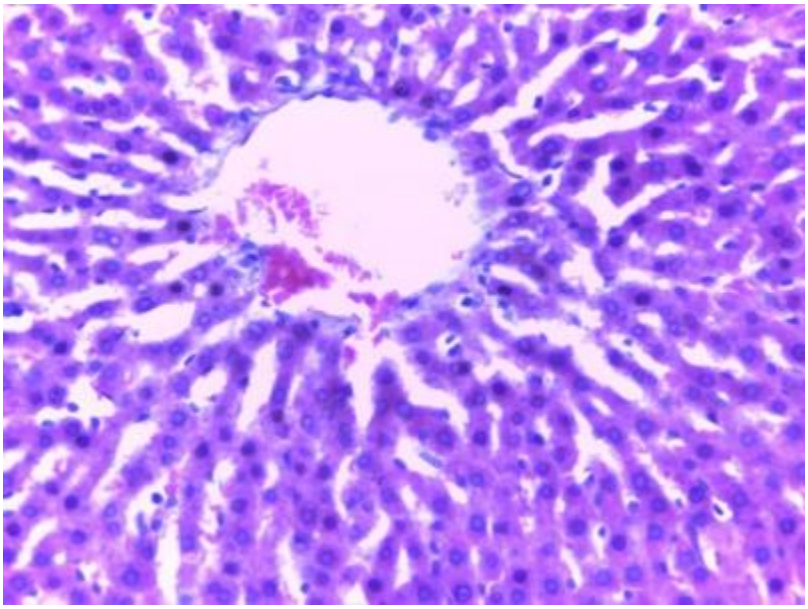

**Figure 2** Mild Periportal Inflammation of the Liver by *Corchorus olitorius* at 5000 mg/kg (H&E 100x)

Figure 2 showed mild Periportal Inflammation of the liver by *Corchorus olitorius* at 5000 mg/kg body weight dose.

Figure 3 showed mild Congestion of the liver by *Corchorus olitorius* at 5000 mg/kg body weight dose.

Figure 4 showed a section of the liver of Wistar albino rats from the Control group showing normal hepatocytes, central vein and blood vessels.

Figure 5 showed normal kidney tubules and glomeruli from the control group.

Figure 6 showed normal Kidney Tubules and Glomeruli as seen with *Corchorus olitorius* Extract at 100 mg/kg dose for Albino rats.

Figure 7 showed normal Kidney tubules and glomeruli with some areas of tubular cellular oedema seen with *Corchorus olitorius* extract at 1600 mg/kg dose for Albino rat.

Figure 8 showed a focal area of tubular necrosis casts within tubules and tubular cell detachment from the basement membrane for *Corchorus olitorius* extract at 5000 mg/kg dose for Albino rat

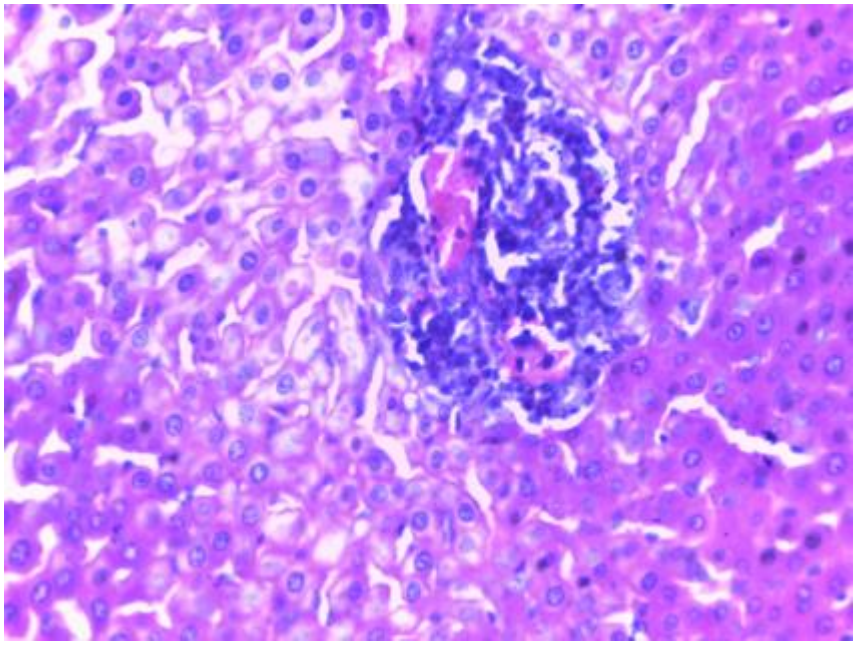

**Figure 3** Mild Congestion of the Liver by *Corchorus olitorius* at 5000 mg/kg (H&E 100x)

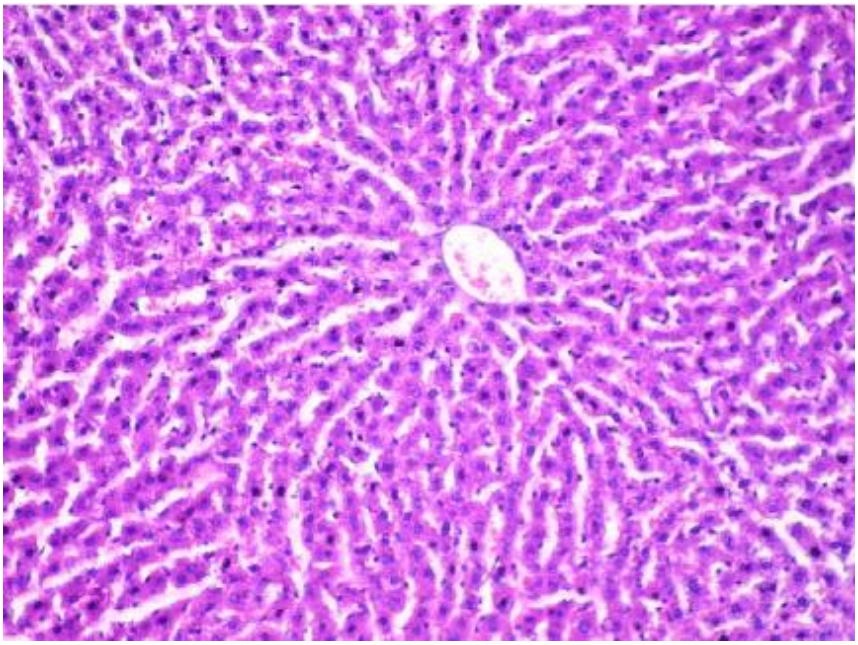

**Figure 4** Section of the Liver of Wistar albino rats (Control group) Showing Normal Hepatocytes, Central Vein and Blood Vessels (H&E 40x).

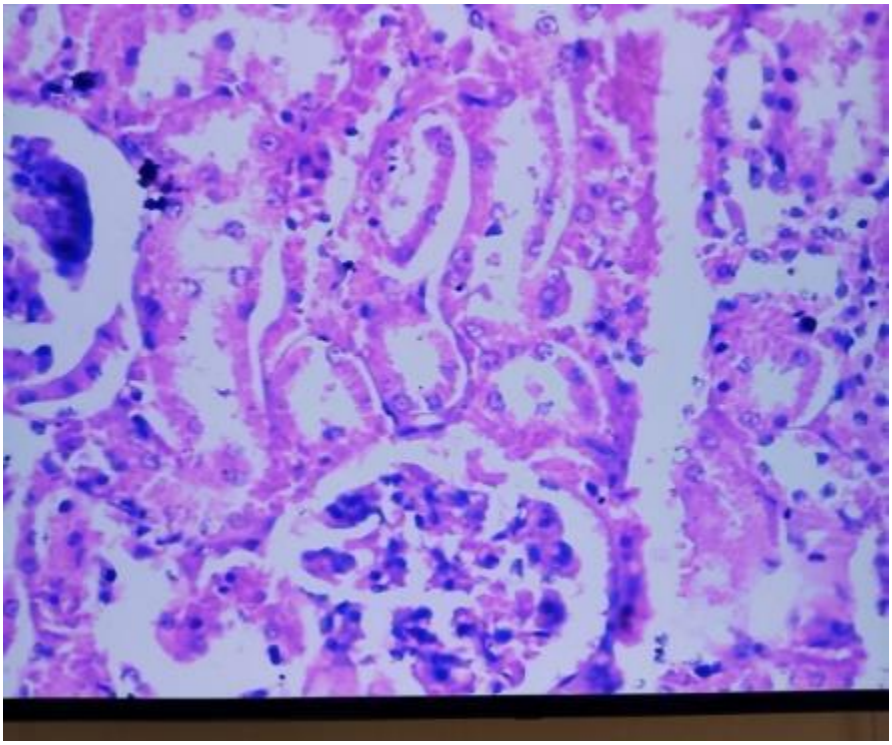

**Figure 5** Normal Kidney Tubules and Glomeruli from the Control Group (H&E 100x).

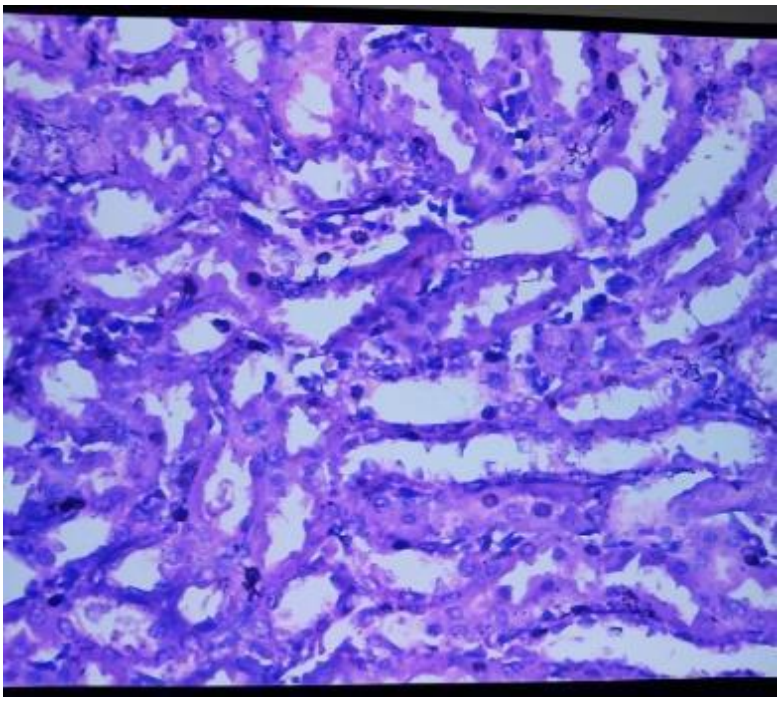

**Figure 6** Normal Kidney Tubules and Glomeruli as Seen with *Corchorus olitorius* Extract at 100 mg/kg Dose for Albino Rats (H&E 100x).

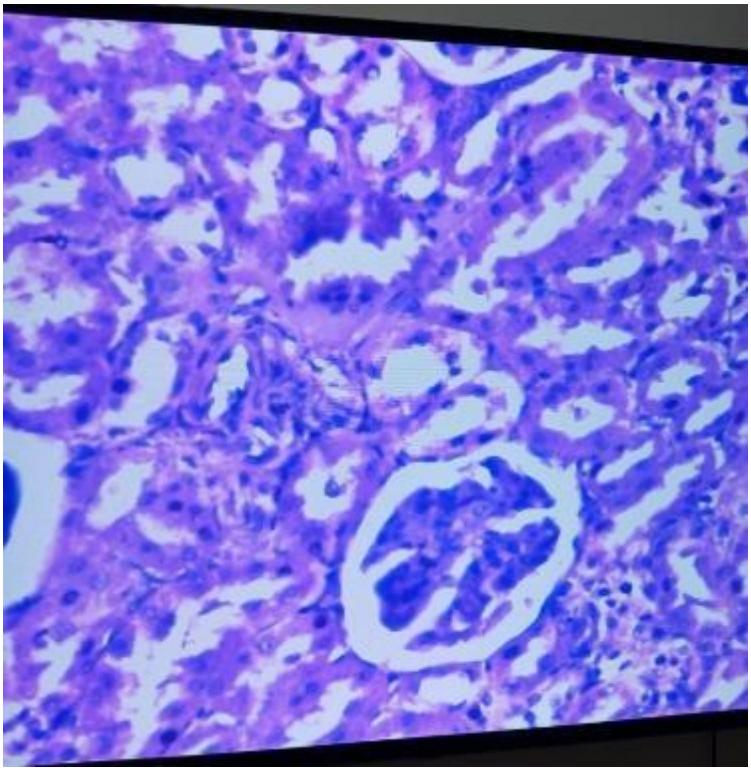

**Figure 7** Normal Kidney Tubules and Glomeruli with Some Areas of Tubular Cellular Oedema Seen with *Corchorus olitorius* Extract at 1600 mg/kg dose for Albino Rat (H&E 100x).

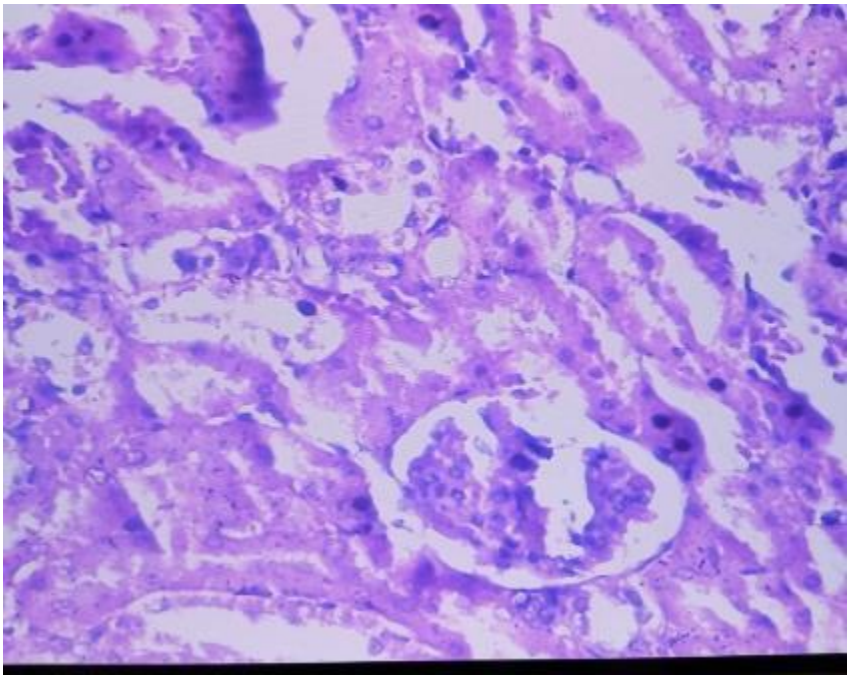

**Figure 8** Focal Area of Tubular Necrosis Casts Within Tubules and Tubular Cell Detachment from Basement Membrane for *Corchorus Olitorius* Extract at 5000 mg/Kg Dose for Wistar Albino Rat (H&E 100x)

## 4. Discussion

Medicinal plant usage among the populace has recently been on the increase because of a generally precepted view of their being effective, economical, within reach and quite safe in comparison to allopathic medications [24]. Converging empirical evidence, however, suggests the development of unwanted allergic reactions to many of the herbal preparations as well as some toxic fatal reactions experienced in the body signifying the need for extensive toxicity assessments [25, 16]. Cytotoxicity in this study was measured by acute toxicity test and subacute toxicity test on Wistar Albino rats. Assessment of acute toxicity from this study revealed that *Corchorus olitorius* methanol extracts did not result in any significant change in the general rat behaviour or death even at the highest concentration of 5000 mg/kg. This suggested that the extracts have low acute toxicity and a wide margin of safety. An earlier study [26], observed that substances whose $LD_{50}$ were 50-100 mg/kg in rats should be viewed as very toxic, the ones whose $LD_{50}$ are 500 mg/kg are classified as moderately toxic, while the substances whose $LD_{50}$ in rats are 1000 mg/kg are considered very safe or of low toxicity.

The result of this study was in tune with Orieke *et al*. [27], who in their study observed that *Corchorus olitorius* is non-toxic at the acute toxicity analytic stage of their study. They reported that no toxicity behaviours and mortality were observed during the acute toxicity study period that lasted for 24 hours and a further 7 days in groups treated with 500-6000 mg/kg of the extract. Roy *et al.* [28], in their study, reported that the highest dose of 3000 mg/kg body weight administered did not lead to any mortality or changes in the general behaviour of their test animals. These results further indicate the safety of oral administration of the extracts as exemplified in this study.

From this study, the experimented albino rats survived till the end of the experimental exercise at all the levels of treatment. This is an indication that there was no disturbance in fat, protein, or carbohydrate metabolism [29]. The methanol extracts of *Corchorus olitorius* can therefore be considered non-toxic at the doses tested and the $LD_{50}$ of the test substance can be said to be greater than 5000 mg/kg hence the plant extract has a high degree of safety.

Also, during the subacute phase, there was no significant statistical difference in the weight of the animals before and after administration of the extracts. Organ swelling due to inflammation and hypertrophy could result in increased weight of the albino rats. In contrast, atrophy leads to a reduction in weight. Ordinarily, a loss of more than 10 % of the initial body weight in treated animals is an indication of adverse effects [30, 31]. Though the body weight gradually increased in control and treated groups in all the extracts, there was no statistically significant difference in mean body weight amongst the different treated groups and the control which indicated that the methanol extracts of the tested plants at the doses used did not produce damage in the form of organ swelling, atrophy or hypertrophy in the treated animals. This negligible level of toxicity in the growth of the animals was also observed in earlier studies. [32, 33].

The haematopoietic system is an important index of physiological and pathological status in human and animals [34], and a sensitive target for toxic compounds [35]. Results of the study indicated that *Corchorus olitorius* generally had no significant effect on the majority of the haematological parameters tested at 100 mg/kg body weight, that is, at a lower dose of the extracts and therefore barring any species differences is unlikely to present toxicity to blood and its cellular elements, even though there is a statistically significant difference at $P<0.05$ between the extracts tested at 1600 mg/kg and 5000 mg/kg body weight and the control.

In herbal toxicity studies, whenever there is an elevation in WBC, Lymphocytes and Neutrophils levels, it may be a pointer that the plant extract has induced the immune response of the treated animals [36]. However, a significant ($P<0.05$) decrease in the values of leucocytes in the blood may be an indication that the production of leucocytes is compromised, thus making the body susceptible to varying disease and infectious agents due to the body's inability to effectively fight infections. Thus, the haematological analysis of the study revealed a significant ($P<0.05$) increase in the level of Lymphocyte, Eosinophil, Monocyte and Basophil at 100, 1600 and 5000 mg/kg when compared to the control. These results suggest that the plant extract of *Corchorus olitorius* possesses a chemical constituent capable of increasing the production of leucocytes or encouraging its activity [37].

In earlier studies [38, 39], Haematocrit (HCT), or parked cell volume (PCV), haemoglobin (HGB), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), are major indices for evaluating circulatory erythrocytes and are significant in the diagnosis of anaemia and serve as a useful pointer for bone marrow capacity to produce red blood cells in mammals. The effect of *Corchorus olitorius* showed a significant ($P<0.05$) increase in RBC and HCT, but no significant difference in HCT, MCV and MCHC in the treated Albino rats as compared to the control group. These results revealed that the plant *Corchorus olitorius* may have caused no remarkable toxic effect on the red blood cells and blood parameters analyzed at the respective doses. It also suggests that since the immune producers are not suppressed, animals may not be at risk of developing an ailment such as anaemia.

Body organs such as the kidney and liver are particularly susceptible to toxicity. This is because they are the sites of toxin filtration and metabolic breakdown in the system, thus playing a crucial role in assessing changes in the body's biochemical parameters [40]. In this study, there is a significant ($P<0.05$) increase in ALP, ALT and AST at doses 100, 1600 and 5000 mg/kg which indicates liver injury from damaged or inflamed liver. Although, it is said that in clinical practice, observing an elevated level of AST and ALT in non-hepatic conditions like myocardial infarction is not out of place. The significant ($P<0.05$) increase may be due to heart attack or injury to the hepatic cells, and it may also have been induced by the presence of some phytochemicals in the plant extract [41]. ALP is distinctively known as a marker enzyme for the endoplasmic reticulum and the plasma membrane [42]. The ($P<0.05$) significant increase in ALP could be attributed to inflammatory conditions and renal damage. The elevation of ALP as seen in this study can be attributed to the presence of some phytochemicals in the plant extract of *Corchorus olitorius.* However, AST did not change appreciably in the treated groups at 100 mg/kg body weight as compared to the control, indicating that *Corchorus olitorius* does not affect this biochemical parameter at lower concentrations. This finding is in agreement with the results of a similar study [43], who reported that alterations in the liver biochemical parameters by the extract of *Corchorus olitorius* may have no significant impact on liver function normally.

Bilirubin is an important metabolic product of blood with biological and diagnostic values [44]. The non-significant and non-specific pattern of effect on the bilirubin from this study could suggest a physiological response as a result of exposure to the extract which is not part of the normal diet and is most likely not to be toxicologically relevant. This finding was also in agreement with the results of similar studies [43, 45]. From this study, no significant pattern was produced except in the administration of the highest dose at 5000 mg/kg body weight.

From this study, significant changes in creatinine, urea, bicarbonate and chloride ions of treated animals compared to the control groups were observed. This suggests an impairment of renal function, which contradicts the findings of reported in a similar study [43], which reported that no consistent pattern in the kidney, serum bilirubin levels, and ALP activity. To confirm the observations from this study, the photomicrographs prepared from kidney sections of treated and control animals were examined. No alterations suggesting kidney damage in the groups treated with *Corchorus olitorius* extract at 100 mg/kg body weight concentration were found.

Overall, this study has shown that apart from the potential hepatotoxicity of *Corchorus olitorius* at higher concentrations of the extracts (1600 mg/kg and 5000 mg/kg) depicted by eosinophilia, lymphocyte aggregation and pyknosis of microscopic sections of the liver, mild peritoneal inflammation and congestion of the liver, it is generally non-toxic to Albino rats at the lower dose of 100 mg/kg body weight.

## 5. Conclusion

This study has shown that *Corchorus olitorius has a high degree of safety and low toxicity when administered at a low concentration. It could thereby be concluded that the plant is relatively safe for consumption.*

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare no conflict of interest of any sort for this study

### *Statement of ethical approval*

Institutional Ethical Approval with reference number UJ/FPS/F17/-00379 was obtained from the Ethical Committee Animal Experimental Unit of the Faculty of Pharmaceutical Sciences, University of Jos, Nigeria.

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