

# Evaluation of the Effect of Anacardium Occidentale Cashew Apple Juice on Kidney of Gentamicin Induced Injury in Albino Rats

Joseph Oyepata Simeon <sup>1\*</sup>, Joseph Opeyemi Tosin <sup>2</sup>, Sabastine Aliyu Zubairu <sup>3</sup>

<sup>1</sup> Department of Pharmacology and Toxicology, Faculty of Pharmaceutical Sciences, Federal University, Oye-Ekiti, Ekiti State, Nigeria.

<sup>2</sup> Department of Pharmacy, University College Hospital, Ibadan, Oyo State, Nigeria.

<sup>3</sup> Department of Pharmacology and Therapeutics, Faculty of Pharmacy, Gombe State University, Gombe State, Nigeria.

**\*Corresponding Author:** Joseph Oyepata Simeon, Department of Pharmacology and Toxicology, Faculty of Pharmaceutical Sciences, Federal University, Oye-Ekiti, Ekiti State, Nigeria.

**Received Date:** April 13, 2023 | **Accepted Date:** April 27, 2023 | **Published Date:** May 10, 2023

**Citation:** Joseph O. Simeon., Joseph O. Tosin., Sabastine A. Zubairu. (2023), Evaluation of the Effect of Anacardium Occidentale Cashew Apple Juice on Kidney of Gentamicin Induced Injury in Albino Rats, *Journal of Clinical and Laboratory Research*. 6(1); DOI:10.31579/2768-0487/100

**Copyright:** © 2023, Joseph Oyepata Simeon. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

## Abstract

**Background and Objective:** With worldwide research in ethnopharmacology, some herbal medicines have been translated into modern remedies. There are many forms in which herbs can be administered. Anacardium occidentale is a plant with several benefits. The aim of this work is to Evaluate the effect of Anacardium occidentale cashew apple juice on kidney of Gentamicin Induced Injury in Albino Rats.

**Method:** For this study, a total of thirty rats were employed. The positive control in Group 1 was given saline as usual. Groups 3, 4, and 5 each received 10, 20, and 40 ml/kg of the extract, whereas Group 2 received normal saline for eight days. Animals in groups 2 through 5 received gentamicin 100 mg/kg bw orally on the eighth (8th) day. On the ninth day, 20 hours after the previous dose, all animals were weighed once more and sacrificed using diethylether.

**Result:** When compared to the paracetamol group, the extract significantly ( $P < 0.05$ ) raised RBC, PCV, Hb, platelet, and WBC values. When compared to the gentamicin group, there was no significant improvement in the weight to body size ratio of rats in the extracts group ( $P < 0.05$ ) when compared to the gentamicin group. The levels of urea were significantly improved ( $P < 0.05$ ) while creatinine level did not significantly reduce when compared to gentamicin group. Additionally, histological study supports biochemical parameters.

**Conclusion:** The findings imply that Anacardium occidentale cashew apple may be useful in managing some renal disorders as well as protecting the kidney against some hazardous pollutants.

**Key words:** anacardium occidentale; cashew apple; kidney; paracetamol; rats; blood

## Introduction

In general, plants with savory or fragrant traits that are used for flavoring and garnishing food, for medical purposes, or for fragrances are referred to as herbs. This excludes vegetables and other plants ingested for macronutrients (1). The cashew seed and the cashew apple accessory fruit are produced by the cashew tree (*Anacardium occidentale*), an evergreen tropical tree (1-2). The tree can reach a height of 14 m (46 ft), although dwarf varieties, which can only reach 6 m (20 ft), are more productive and yield more money. The cashew seed is frequently used as a snack nut (cashew nut) and can be consumed on its own, cooked with other ingredients, or made into cashew cheese or cashew butter. The nut is frequently referred to simply as cashew,

like the tree (3-5). Tree nut proteins, which are frequently left behind or unaffected by cooking, are what cause cashew allergies. The kidney- or boxing-glove-shaped drupe that develops at the end of the cashew apple is the actual fruit of the cashew tree. The cashew apple forms after the pedicel expands from the developing drupe on the tree (6-9). The actual fruit only has one seed, which is frequently referred to as a nut in the sense of food. A double shell comprised of the allergenic phenolic resin anacardic acid surrounds the seed. Anacardic acid shares a chemical affinity with the more notorious and toxic allergic oil urushiol, which is found in related poison ivy and lacquer tree species and is a potent skin irritant (10-12). It is thought that

medicinal plants are a significant source of novel chemicals with potential therapeutic benefits (13-16). The cashew tree (*A. occidentale*) belongs to the Anacardiaceae genus of flowering plants. There are 600 species in the family, divided among 73 genera. Eight species of *Anacardium*, all endemic to tropical America, are present, with the cashew being by far the most economically significant. It is an Amazonian tree with multiple uses that can reach heights of 15 meters (17). It has a thick, twisted trunk and tangled branches that frequently touch the ground. The cashew tree yields a variety of materials and goods. The leaves and bark have therapeutic uses. The cashew nut is popular worldwide and has a high market value as food. Due to its high phenol content, even the oil in the nut's shell is utilized medicinally and has industrial uses in the plastics and resin sectors (18). The pseudo-fruit, which is a sizable pulpy and juicy portion, is also known as the "cashew fruit" or the "cashew apple" and has a great sweet flavor. The Wayapi tribe of Guyana uses cashew leaf and bark tea as a douche for vaginal discharge and a typical diarrhea treatment, as do the Tikinia in northwest Amazona and the Peruvian herbal medicine (19-23). Skin conditions associated with syphilis, such as eczema, psoriasis, scrofula, dyspepsia, genital problems, bronchitis, coughing, intestinal colic, and leishmaniasis are some conditions it is used to treat in Brazil. Europeans used Brazil cashew fruit and juice to heal fever, freshen breath, and "conserve the stomach" in the sixteenth century. It is used as a diuretic, stimulant, and aphrodisiac in addition to treating syphilis (24). The cashew fruit is not only delicious but also a great source of vitamins, minerals, and other nutrients. It includes a significant number of mineral salts and up to five times as much vitamin C as oranges. Cashew fruit is used as a catalyst in the treatment of early aging of the skin because of its high level of vitamin C and mineral salts (25). Anacardiac acid is a component of cashews, with the highest concentration in the nutshells (27). Several clinical studies have shown that anacardiac acid is present in cashews, with the highest concentration in the nutshells (28-32). Tyrosinase activity inhibits the ageing process by darkening skin, and anacardiac acid is toxic to some cancer cells (33-35). However, dietary anacardiac acid has the potential to reduce body fat deposition for dietary conditions. The interest in medicinal plants has grown over the past 20 years, and so has the number of studies into how they affect both humans and animals biologically. Even though hazardous plants are common, up to 80% of people in impoverished nations use herbal therapy (36). Brazil also uses the leaves and/or bark to treat eczema, psoriasis, scrofula, dyspepsia, genital issues, and venereal diseases as well as impotence, bronchitis, cough, intestinal colic, leishmaniasis, and skin conditions linked to syphilis. Additionally, against the hepatocarcinogenesis brought on by aflatoxin B1 in Winstar rats, a considerable antioxidant capability was seen (37). According to preclinical research, cashew tree bark metabolites showed an antipyretic effect for anacardiac acid (38). Using vegetable oil derived from cashew nuts, scientists performed mutagenic studies on *Salmonella thyphimurium*, which demonstrated mutagenicity with or without the activation of the S9 portion (39). It has been established that the tannic acid in cashews inhibits the *Salmonella thyphimurium* TA98 lineage's ability to mutate. The bark and leaves of the cashew tree are a rich source of tannins, a group of plant chemicals with documented biological effects (40). Numerous clinical investigations have demonstrated that tannins have the ability to treat some cancer cells as well as slow the darkening effects of age by decreasing tyrosinase activity (41-42). The aim of this work is to Evaluate the effect of *Anacardium occidentale* cashew apple juice on kidney of Gentamicin Induced Injury in Albino Rats.

## Materials and Method:

Plants collection Fresh *Anacardium occidentale* fruit were harvested from the adjacent Oye village in Ekiti State, Nigeria, which is the plant's natural habitat. The Department of Botany at Federal University in Ekiti State, Nigeria, verified the authenticity of the plant. A voucher number of FUFPP 3001 was assigned

## Extraction

The orange-reddish cashew apple plant material was collected in Nigeria's Ekiti State's Oye Local Government. In a lab setting, cashew apple fruits were peeled, sliced, and crushed. The juice was then extracted from the resulting mash using a press.

## Animals

Adult albino rats, both male and female, were bought from the Bingham University animal sanctuary. They were fed typical animal pellets and had unrestricted access to water. Animal research were permitted and approved by the College of Health Sciences Animal Ethics committee at Federal University in Oye Ekiti, Ekiti State, Nigeria.

## Animal treatment

For this study, a total of thirty rats were employed. The positive control in Group 1 was given saline as usual. While groups 3, 4, and 5 received 10, 20, and 40 ml/kg of the extract, respectively, groups 2 received normal saline. Groups 2-6 received gentamicin 100mg/kg bw daily for 8 days while also receiving the aforementioned medication. All animals were weighed again and sacrificed under low diethyl ether vapor 24 hours following the previous dose.

## Hematological study:

After the rats were slain under diethylether anesthesia, blood samples from each one was drawn and placed into EDTA-coated sample bottles for analysis. The blood samples were drawn using 21-gauge (21 G) needles mounted on a 5 ml syringe. Full blood count (FBC), hemoglobin (Hb), packed cell volume (PCV), platelet concentration (PLC), total and differential white blood cell count are hematological measures (WBC). The automated hematology system was used to examine these parameters.

## Chempathology analysis

The remaining blood was drawn into a clear bottle, allowed to coagulate, and then centrifuged at 300 rpm for 10 minutes. The collected serum was used to estimate several biochemical parameters.

## Histological study:

A portion of each kidney was surgically removed, weighed, and fixed in 10% formaldehyde for histology processing.

## Statistical analysis

The mean and standard error of the mean were used to express the data (SEM). One-way Analysis of Variance (ANOVA) was used to statistically assess the data before Dunnett's post hoc test.

## Result:

### Effect of *A. occidentale* fruit juice on gentamicin-induced toxicity's haematological parameters

Compared to the, organotoxic group, the fruit juice extract from *Anacardium occidentale* significantly increased ( $P<0.05$ ) the levels of RBC, WBC, PCV,

platelets, and eosinophils. Additionally, gentamicin did not significantly change the level of hemoglobin. (Table 1).

**Effect of A. occidentale fruit juice on body weight ratio of gentamicin induced toxicity**

When compared to the paracetamol group, there was no significant improvement in the weight to body size ratio of rats in the extracts group (P<0.05) (Table 2).

**Effect of A. occidentale fruit juice on kidney parameters of gentamicin induced toxicity**

The levels of urea were significantly improved (P<0.05) while creatinine level did not significantly reduce when compared to paracetamol group (Table 2).

Group	RBC (X 10 <sup>12</sup> /l)	PCV (%)	Hb (g/dl)	WBC (X 10 <sup>9</sup> /l)	Platelet count	Monoc ytes (%)
Normal saline	7.4±1.11*	44.00±1.87*	13.46±0.87*	6.4±1.43*	350±3.42*	4.13±1.81*
GENT 100 mg/Kg	2.86±0.98	16.92±2.17	9.57±0.34	2.52±1.00	148±4.12	2.90±1.62
GENT + 10ML OA	6.11±0.43*	43.77±1.20*	10.44±0.38	3.08±1.11	215±2.22*	6.11±1.61*
GENT+ 20ML AO	6.65±0.36*	44.4±1.34*	12.19*±0.37	3.58±1.43	233±3.15*	7.56±1.33*
GENT+ 40ML AO	7.43±0.43*	44.22±1.8*	13.23*±0.34	3.17±1.10	260±3.81*	8.27±1.35*

**Table 1:** Effect of A. occidentale fruit juice on haematological parameters of paracetamol induced toxicity.

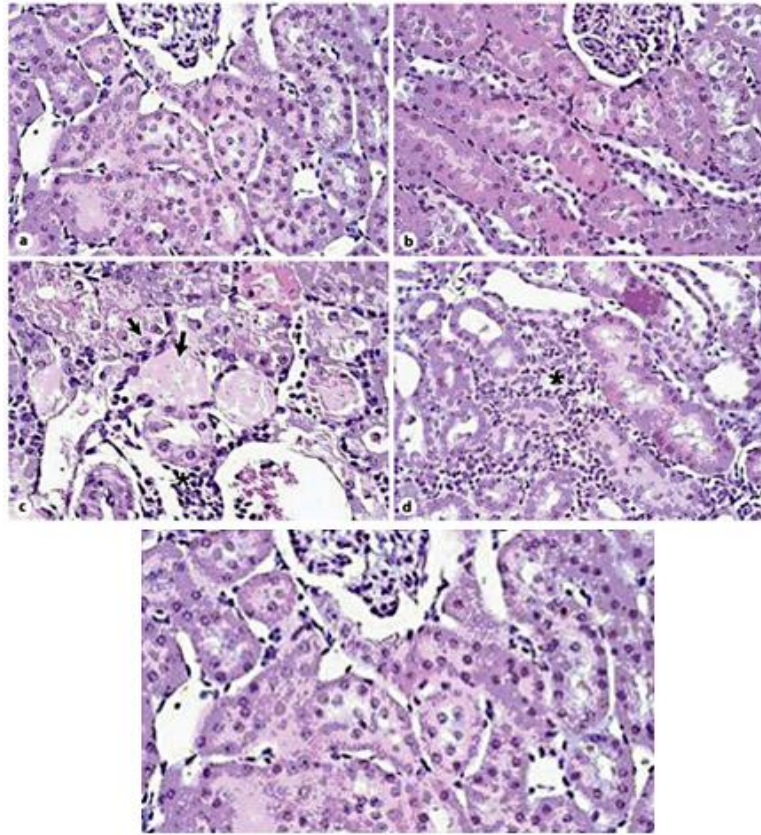
\*Significantly different from the distilled water (DW) control at p<0.05. (Data presented as Mean ± SEM: n = 6, MCV = mean corpuscular volume, DW = distilled water (WBC = white blood cells, RBC = red blood cells, HGB = hemoglobin, HCT = hematocrit, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration, PLT = platelet, LYM = lymphocyte, NEUT = neutrophils, EOSI = eosinophils, BASO = basophils).

Group	Body weight ratio
Normal saline	0.79±0.51
GENT 100 mg/Kg	0.92±0.43
GENT + 10ML OA	0.80±0.87*
GENT+ 20ML AO	0.67±0.99*
GENT+ 40ML AO	0.60±0.67*

**Table 2:** Effect of A. occidentale fruit juice on body weight ratio of gentamicin induced toxicity

Group	UREA mg/dL	Creatinine (umol/l)	Potassium (mmol/L)	Sodium (mmol/L)
Normal saline	46.22±25	48.24±13	8.30±0.52	122.00±2.38
GENT 100 mg/Kg	56.67±12	98±21	8.30±0.52	167.27±2.68
GENT + 10ML OA	32.98±11*	75.13±54	9.43±0.52	154.00±2.11*
GENT + 20ML AO	30.67±54*	78.65±44	7.20±0.81	155.00±2.17
GENT + 40ML AO	30.21±83*	70.88±12	7.15±0.19	154.25±1.81

**Table 3:** Effect of A. occidentale fruit juice on kidney parameters of gentamicin induced toxicity



**Figure 1:** Histological sections of Kidneys of rats treated with Normal saline 10 ml/kg (1), Gent 100 mg/kg (2), Gent 100mg/kg and AO 10ml bw (3) and Gent100 mg/kg and AO 20 (4), Gent 100 mg/kg and AO 40 (5), at magnification A (x100) and B(x400) stained with H&E Technique.

## Discussion

In general, plants with savory or fragrant traits that are used for flavoring and garnishing food, for medical purposes, or for fragrances are referred to as herbs. This excludes vegetables and other plants ingested for macronutrients. Vitamin C, antioxidants (41), and sugars (42) are all abundant in cashew apple juice. Brazil, India, Nigeria, and other countries eat a lot of it. In processed meals, cashew apple juice has the potential to serve as a natural supply of sugar and vitamin C. Although cashew apple juice has been used for many years for therapeutic and recreational purposes, little research has been done on its capacity to preserve the body's systems. For both humans and animals, hematological characteristics are significant indicators of the physiological and pathological status [43-46]. While there were no changes in the value of WBC, *Anacardium occidentale* significantly increased the values of RBC, PCV, Hb, and monocytes. Red blood cells and the elements that affect them are important indicators for assessing circulatory erythrocytes, important in the diagnosis of anemia, and also helpful indicators of the ability of mammalian bone marrow to manufacture RBC (47-48). The considerable increase in RBC and PCV after administration of *A. occidentale* may be a clue that the juice extract of the plant stimulates erythropoiesis. The rate of erythropoietin release in the kidney, the humoral regulator of RBC production, may have increased or been stopped from decreasing by the extract. A platelet count can be used to diagnose a number of illnesses and conditions that may interfere with blood clot formation (49-50). It could be applied as a component of the examination for a bone marrow condition, excessive clotting disorder, or bleeding disorder (51). When anything prompts the bone marrow to produce an excessive number of platelets, a high platelet count might result (52-54). It is referred to as

primary or essential thrombocytosis when there is no recognized cause. Secondary thrombocytosis is the term used to describe extra platelets brought on by an illness or another condition (55-56). A person is at risk of experiencing heavy bleeding if they have a low platelet count, which can make it difficult for the blood to clot. The cause might be a genetic propensity to create insufficient platelets, but it could also be undetermined. Other times, an underlying medical problem is at blame (57). In this study, gentamicin-induced thrombocytopenia was reduced in all groups by cashew fruit juice.

An aminoglycoside antibiotic called gentamicin is frequently used to treat bacterial infections, particularly those brought on by aerobic Gram-negative bacilli (58). Clinically, its nephrotoxicity is a serious problem (59-60). According to estimates, more than one-third of patients receiving gentamicin for a prolonged period of time (at least 7 days) exhibit symptoms of renal impairment (61). Gentamicin's renal toxicity plays a role in its capacity to trigger apoptosis in renal tissue. Mesangial cells and renal proximal tubule cells are the principal sites of gentamicin-induced nephrotoxicity (62-63). When gentamicin interacts with mitochondria, oxidative stress results, which triggers necrosis and apoptosis (64). Gentamicin causes tubular damage with the loss of the epithelial cells' brush-like edge. Without treatment, acute tubular necrosis results from tubular damage (65). Serum creatinine and blood urea nitrogen levels, as well as histopathologic and morphometric assays, can be used to assess the renal damage caused by gentamicin. In the current study, paracetamol toxic group (group 2) rats who received a nephrotoxic dose of the drug had significantly higher serum levels of urea and creatinine than the control group. These findings concur with those made by Simeon et al (60) who observed that rats given 1 g/kg b.w. of paracetamol



had higher blood urea and creatinine levels. The increase in urea and creatinine levels was explained by the presence of a substantial association between nephrotoxicity and oxidative stress by Oyepata et al. (66) and Opeyemi et al. (67). The increased synthesis of H<sub>2</sub>O<sub>2</sub> and O<sub>2</sub> changes the filtration surface area and filtration coefficient, which both have the potential to reduce glomerular filtration and cause an accumulation of urea and creatinine in the blood (63). When compared to the normal group, the paracetamol control group (group 1) had significantly higher potassium and salt concentrations than the normal group (group 2). In the groups who got *A. occidentale*, this effect was markedly reduced. This outcome is consistent with the findings of Sebastine et al. (67), who noted elevated potassium (K<sup>+</sup>) and sodium (Na<sup>+</sup>) levels in rats given gentamicin. A useful predictor of renal function is the serum creatinine levels. In this investigation, the extract of *A. occidentale* was employed as a potential repair agent against toxicity brought on by gentamicin, a drug known to be toxic to the kidneys. The dried fruit of *A. occidentale* has been reported to contained alkaloids, tannins, anthraquinones, glycosides, and phenols in both the ethanol and the aqueous extracts (65-69). The abundance of secondary metabolites in medicinal plants has been linked to their pharmacological activities (70-73). Generally speaking, plants create a large number of secondary metabolites, which are a significant source of microbicides, antioxidants, insecticides, and many pharmaceutical medications (74-76). Histological analysis is congruent with hematological and biochemical indicators.

## Conclusion

The findings imply that *Anacardium occidentale* cashew apple may be useful in managing some renal disorders as well as protecting the kidney against some hazardous pollutants.

Author's contributions: JOS, JOT conceptualized and designed the study; JOS, JOT and SAZ carried out the experiments. JOS, JOT and SAZ- Writing of the article. The entire study was supervised by JOS. All authors read the manuscript and approved its submission

## Conflict of Interest:

Authors declare that there is no conflict of interest

## Acknowledgement

The authors of this work wish to thank everyone who has contributed to the success of this work.

## Reference

- Solomon, I.P., Oyebadejo, S.A., Ukpo E.M. and Joseph, O.S. (2015). Changes in serum electrolyte, creatinine and urea of fresh Citrus limon juice administered to growing rabbits (*Oryctolagus cuniculus*). *International Journal of Agricultural Science Research*. Vol. 4(8), pp. 180-183.
- Ojochegebe, A.B., Adejoh, D.P., Boniface, M.T., Duniya, S.V. and Iyaji, A. (2019) Activity of Methanol Extract of *Leptadenia hastata* Leaves in Alcohol-Induced Liver Injury. *American Journal of Biomedical Sciences & Research*, 4, 142-146.
- Solomon, I.P., Oyebadejo, S.A., Ukpo E.M. and Joseph, O.S. (2015). Effect of Fresh Citrus limon Juice on Liver Histomorphology of Growing Rabbits (*Oryctolagus cuniculus*). *Scholars Journal of Agriculture and Veterinary Sciences*.2 (5):347-351.
- Aprioku JS, Joseph OS, Obianime AW (2016). Quantification of Antinociceptive and Anti-Inflammatory Potentials of Different *Ocimum gratissimum* Linn. Leaf Extracts in Whistar Albino Rats. *European Journal of Medicinal Plants*. Volume 17(3). Page 1-8.
- Okokon JE., Joseph OS. and Umoh EE. (2016). Nephroprotective activity of *Homalium letestui* stem extract against paracetamol induced kidney injury. *Journal of Experimental and Integrative Medicine*. Volume 6 (1): 38-43.
- Okokon JE. O, Joseph OS. and Umoh EE. (2016). Hepatoprotective activity of *Homalium letestui* stem extract against paracetamol liver injury. *Avicenna Journal of Phytomedicine*. 13(4): 87 – 92.
- Timothy S.Y., Wazis C.H., Midala T.A. S, Joseph O.S., Sebastine A.Z. et al. (2017). Evaluation of Anti-Diarrhoeal Activity of Different Bark Extracts of *Faidherbia albida* (Delile) A (Chav) in Albino Rats. *Bima Journal of Science and Technology* Vol. 1 (2). Pg. 122-130.
- Joseph O. S. and Joseph O. T. (2018). Hepatoprotective activity of ethanol stem extract of *Homalium letestui* against thioacetamide-induced liver injury. *The Nigerian Journal of Pharmacy*. Vol. 52 (1). Page 67-74.
- Joseph O. S., Jude E.O and Joseph O. T. (2018). Hepatoprotective activity of extract of *Homalium Letestui* stem against carbon tetrachloride-induced liver injury. *Advance Herbal Medicine*. Vol 4(4), Page 1-11.
- Gaitonde DY (15 December 2017). "Chronic Kidney Disease: Detection and Evaluation". *Am Fam Physician*. 12 (96): 776–783.
- Joseph O. S., Jude E.O and Joseph O. T. (2018). Effect of ethanol stem extract of *homalium Letestu* on gentamicin-induced kidney Injury in rat. Vol. 4(2). *Advanced Herbal Medicine*. Page 51-64.
- Romer AS, Parsons TS (1977). *The Vertebrate Body*. Philadelphia, PA: Holt-Saunders International. pp. 367–376. ISBN 978-0-03-910284-5.
- Oluwakanyesola A. S., Joseph O. S., Jacob A., Rebecca S. M. and Joseph O. T. (2018). Sub-acute haematological toxicity study of safi® blood purifier on wister rats. *The Nigerian Journal of Pharmacy*. Volume 52 (20).
- Tosin JO, Wolfe OA, Iyeopu SM, Simeon JO, Chinwe A, et al. (2019). Clinical study on the effect of *Moringa oleifera* on serum level of glucose and tryglyceride in subjects taken tenofovir, lamivudine and efavirenz combination regimen. *European Scientific Journal*. Vol.15, (.21). Page 280 -293.
- Simeon JO, Builders M, Haruna WC, Tosin JO, Zubairu SA, et al. (2019). Effect of administration ethanol leaf extract of *terminalia chebula* on liver of wister rat. *International Journal of Research and Scientific Innovation*. Volume VI (Issue VII). Page 91- 97.
- Molina DK, DiMaio VJ (September 2015). "Normal Organ Weights in Women: Part II-The Brain, Lungs, Liver, Spleen, and Kidneys". *The American Journal of Forensic Medicine and Pathology*. 36 (3): 182–187.
- Emamian SA, Nielsen MB, Pedersen JF, Ytte L (January 1993). "Kidney dimensions at sonography: correlation with age, sex, and habitus in 665 adult volunteers". *AJR. American Journal of Roentgenology*. 160 (1): 83–86.

18. Boron WF (2004). *Medical Physiology: A Cellular and Molecular Approach*. Elsevier/Saunders. ISBN 978-1-4160-2328-9.
19. Simeon JO, Modupe B, Haruna WC, Zubairu SA, Lubo MT, et al. (2019). Histological study of effect of ethanol stem extracts of *Homalium letestui* on thioacetamide - induced injury in albino rat, using various staining techniques. *International Journal of Research and Scientific Innovation*. Volume VI (Issue VII). Page 77 – 85.
20. Sabastine AZ, Musa TL, Joseph OS, Builders M, Joseph OT. (2019). Histological study of effect of ethanol stem extracts of *Homalium letestui* in paracetamol induced injury in albino rat, using various staining techniques. *American Journal of Biomedical Science & Research*. 4(2). Page 82 – 89.
21. Joseph OS, Builders M, Joseph OT, Ariahu EC, Zubairu SA, et al. (2019). Toxicity study of ethanol leaf extract of *ocimum canum* on heart and lipid profile of wister rats. *International Journal of Current Advanced Research*. Volume 8. (Issue 05). Page 18800 – 18803.
22. Samson AO, Joseph OS, Samson OA, Emem RA. (2019). Effect of Citrus Linton Juice and Tamoxifen on the oxidative activities of MCF-7 cell induced Breast Cancer in Sprague Dawley Rats. *Saudi Journal of Biomedical Research*. Volume 8 (7). Page 76-92.
23. Simeon JS, Builders M, Deborah IR, Zubairu SA, Lubo MT, et al. (2019). Sub-Acute Toxicity Study of Ethanol Leaf Extract of *Terminalia chebula* On Brain, Stomach and Spleen of Wister Rats. *American Journal of Biomedical Science & Research*. 3(3). Page 277-282.
24. Joseph O.S., Builders M., Joseph O, T., Zubairu S. A., Musa T. (2019). Sub-Acute Toxicity Study of Ethanol Leaf Extract of *Ocimum Canum* on Liver of Wister Rats. *International Journal of Research and Scientific Innovation*. Volume VI (V). Pp. 364-369.
25. Oyebadejo S. A, Joseph O. S, Adesite S. O and Omorilewa A.O. (2019). Effect of Citrus Limon Juice and Tamoxifen on the Tumour growth mass Indices, Cell Proliferation, Cell Viability and Cytogenetic (Mitotic Index) of Sprague Dawley Rats Induced MCF-7 Breast Cancer Cells. *Saudi Journal of Biomedical Research*. (4). Pg. 216 - 225.
26. Modupe IB, SOyepata SJ, Akpobome RV (2019). Effect of *Parkia biglobosa* extract on open skin wound healing in dexamethasone - induced hyperglycaemia and histological assessment in rats. *African Journal of Pharmacy and Pharmacology*. Vol. 13(8), pp. 84-89.
27. Builder MI, Anzaku SA, Joseph SO (2019). Effectiveness of intermittent preventive treatment in pregnancy with sulphadoxine-pyrimethamine against malaria in northern Nigeria. *International Journal of Recent Scientific Research* Vol. 10 (05), pp. 32295-32299.
28. Joseph OS, Builders M, Joseph OT, Sabastine AZ, Musa Tl et al. (2019). Sub-acute toxicity study of ethanol leaf extract of *Ocimum canum* on the kidney of wistar rats. *African Journal of Pharmaceutical Research & Development*. Vol. 11 No.1. Page 1-7.
29. Joseph OS, Builders M, Joseph OT, Sabastine AZ, MUSA TL et al. (2019). Sub-acute toxicity study of ethanol leaf extract of *Ocimum canum* on brain, lungs, stomach and spleen of wister rats. *African Journal of Pharmaceutical Research & Development*. Vol. 11 No.1. Page 35-42.
30. Joseph O. S., Joseph O. T., Musa T. L and Oyepata P. J. (2019). Histological evaluation of the nephroprotective activity of the ethanol stem extracts of *Homalium letestui* in Gentamicin – induced albino rats’ injury, using various staining techniques. *Global Scientific Journal*. Volume 7, Issue 8. Page 1065-1087.
31. Eknoyan G, Marketos SG, De Santo NG, eds. (January 1997). *History of Nephrology 2*. Karger Medical and Scientific Publishers. p. 235. ISBN 978-3-8055-6499-1. International Association for the History of Nephrology Congress, Reprint of *American Journal of Nephrology*; v. 14, no. 4–6.
32. Joseph O.S., Builders M., Emem E. Uand Joseph O.T. (2019). Effect of ethanol leaf extract of *cassia angustifolia* extract on liver of wister rats. *Global Scientific Journal*. Volume 8, Issue 9. Page 1112-11120.
33. Joseph O.S., Builders M., Emem E. Uand Joseph O.T. (2019). Effect of ethanol leaf extract of *Cassia angustifolia* extract on kidney of Wister Rats. *Global Scientific Journal*. Volume 7, Issue 10. Page 106-122.
34. Haruna WC, Simeon JO, Builders M, Tosin JO (2020). Effect of ethanol leaf extract of *cassia angustifolia* extract on heart and lipid profile of wister rats. *African Journal of Pharmaceutical Research & Development*. Vol. 12 No.1. Page 1-8.
36. Haruna WC, Builders M, Simeon JO, Tosin JO (2020). Toxicological Study of the Effect of Ethanol Leaf Extract of *Pterocarpus santalinus* Extract on Liver of Wister Rats. *Nigeria biomedical Science Journal*. Page 17-29.
37. Wazis CH, Joseph OS, Modupe B, Joseph OP (2020). Effect of Ethanol Leaf Extract of *Pterocarpussantalinus* Extract on Kidney of Wister Rats. *Nigerian Biomedical Science Journal* Vol. 17 No 1. Page 35-47.
38. Builder M.I., Joseph S.O, Olugbemi T.O. and Akande, T (2020). Toxicity. Studies of extract of African Mistletoe: *Agelanthus Dodoneifolius* Polh and Wiens in Rats. *Nigeria biomedical Journal*. Page 113-130
39. Builders M. I., Joseph S.O., Bassi PU. (2020). A Survey of Wound Care Practices by Nurses in a Clinical Setting. *International Journal of Healthcare and Medical Sciences*. Vol. 6, Issue. 5, Page 74-81.
40. Joseph O. S., Builders M., Joseph O. T. (2020). Effect of Caffeine on Diazepam - Induced Sedation and Hypnosis in Wister Rat. *Global Scientific Journal*. Vol. 8, Issue 9. Page 451-466
41. Joseph O. S., Builders M., Joseph O. T., Sabastine A.Z. (2020). Assessing differential impacts of COVID-19 on African countries: A comparative study. *International Journal of Research and Innovation in Applied Science*. Vol. 5, Issue 5. Page 197-203
42. Simeon JO., Lubo MT., Tosin JO., Irabor I. (2020). The Dynamics of Differential Impacts of COVID-19 on African Countries Compared to Other Parts of the World. *International journal of multidisciplinary research and analysis*. Volume 03 Issue 11. Page 185-198.

43. Builders MI, Simeon JO, Ogundeko TO, Builders P. (2020). Antimalarial Drugs and COVID -19. *Sumerianz Journal of Medical and Healthcare*. Vol. 3, No. 12, pp. 111-116.
44. Zubairu SA, Simeon JO, Tosin JO (2021). Effect of ethanol leaf extract of Terminalia chebula extract on kidney of wister rats. *Global scientific Journal*. Volume 9, Issue 2. Page 514-526.
45. Joseph OS, Builders M, Joseph O T, Famojuro TI, Ogira JO, et al. (2021). Effect of the Demographic of Covid-19 on Different Countries; Using the USA for Comparism. *International journal of multidisciplinary research and analysis*. Volume 04 Issue 02. Page 193-203.
46. Nahon I, Waddington G, Dorey G, Adams R (2011). "The history of urologic surgery: from reeds to robotics". *Urologic Nursing*. 31 (3): 173–180. PMID 21805756
47. Joseph SO, Opeyemi JT. (2021). Effect of Clinical Study of Moringa oleifera on Body mass index, Low density lipoprotein and Triglyceride level in Patients on Tenofovir/lamivudine/efavirenz Combination Therapy. *Advanced Herbal Med*. Vol. 6. Issue 1. Page. 14-27
48. Zubairu SA, Festus OA, Simeon JO, Irabor I, Tosin JO. (2021). Effect of Anacardium occidentale Fruit Juice Extract on Haematological Parameters and Spleen of Paracetamol Induced Injury in Albino Rats. *Global Scientific Journal*. Volume 9, Issue 7. Page 1640-1654.
49. Sabastine AZ, Joseph OS, Joseph OS, Famojuro TI, Olorunfemi AF. (2021). Effect of Cashew apple juice (Anacardium occidentale L.) on Hematology and Spleen of Gentamicin Induced Injury in Albino Rats. *Global Scientific Journal*. Volume 9, Issue 7. Page 3686-3698.
50. Tosin JO, Zubairu SA, Simeon JO. (2021). Clinical Effect of Moringa oleifera on Body Mass Index, Triglyceride and High-Density Lipoprotein in Subjects Taken Tenofovir Combination Regimen. *European Journal of Biology and Medical Science Research*. Vol.9, No.4, pp.6-19.
51. Smeon JO, Zubairu SA, Tosin JO. (2021). Global Implication of Differential Impacts of Covid-19 on Different Countries Using the USA as A Comparism Factor. *Journal of Nursing and Health Science*. Volume 10, Issue 5. PP 36-44.
52. Simeon JO, Simeon JO, Zubairu SA, Adegbeniga AD (2021). Concomitant administration of ethanol leaf extract of Thymus vulgaris on Diazepam– induced Sedation and Hypnosis in Wister Rat. *Journal of Nursing and Health Science*. Volume 16, Issue 5. PP 04-09.
53. Simeon JO, Zubairu SA, Tosin JO (2021). Clinical evaluation of the potential benefits of taking Moringa oleifera on blood triglyceride and cholesterol level in patient taking Tenofovir/Lamivudine/Efavirenz (TLE) combination. *Journal of Pharmaceutical Science & Research*. Vol. 13(10), 623-629.
54. Oyepata JS. (2021). The Earth: A Lost Planet from another Universe. *International Journal of Multidisciplinary Research and Analysis*. Volume 04 Issue 12. Page 1795-1797
55. Simeon JO, Tosin JO, Adegbeniga AD. (2021). The Relative Global Consequences of Cumulative Distribution of Covid-19, Using the USA as Comparism Factor and Cumulative Covid -19 Data of 31st October 2021. *International Journal of Multidisciplinary Research and Analysis*. Page 1906 -1917.
56. Weinstein AM (1994). "Mathematical models of tubular transport". *Annual Review of Physiology*. 56: 691–709. PMID 8010757
57. Joseph O.T., Joseph O. S., Chinwe A. F. (2021). Clinical Study on the Effect of Moringa oleifera on Body mass index, Serum Level of High-density lipoprotein and Triglyceride in Subjects Taken Tenofovir, Lamivudine and Efavirenz Combination Regimen. *J RNA Genom* Volume S04 Issue 004. Page 1-6.
58. Zubairu SA, Simeon JO, Tosin JO (2022). Analysis and understanding the progress, trend and consequences of Covid -19 pandemic over a seven days period across different countries of the world. *International Journal of Advances in Engineering and Management (IJAEM)*. Volume 4, Issue 2 pp: 1588-1598.
59. Kalantar-Zadeh K, Jafar TH, Nitsch D, Neuen BL, Perkovic V (August 2021). "Chronic kidney disease" (PDF). *Lancet*. 398 (10302): 786–802.
60. Simeon JO, Tosin JO, Zubairu SA, Oyepata JS (2022). Studying the trend and progress on Covid-19 pandemic from 29th January to 4th of February 2022 across different countries of the world. *International Journal of Research and Innovation in Social Science (IJRISS) |Volume VI, Issue II*. Page 499-505.
61. Simeon JO, Tosin JO, Zubairu SA, Daniel MF. (2022). Toxicological evaluation of Lavandula stoechas on heart and blood of wistar rat. *International Journal of Advances in Engineering and Management (IJAEM)*. Volume 4, Issue 4 Apr 2022, pp: 1233-1241.
62. Simeon JO, Zubairu SA, Tosin JO, Sunday SB. (2022). Update report and analysis on the global trends and progress of Covid -19 pandemic on 18th January, 2022 across different countries of the world. *International Journal of Research and Innovation in Applied Science (IJRIAS) |Volume VII, Issue IV*. Page 58 -66.
63. Novick AC, Gill IS, Klein EA, Rackley R, Ross JH, (2006). "Operative Urology at the Cleveland Clinic". *Urology Annals*. Totowa, NJ: Humana Press. 8 (Suppl 2): S102–S108. ISBN 978-1-58829-081-6. PMC 4869439.
64. Joseph O. T., Olorunfemi A. F., Sabastine A. Z., Sebastine B. S., Joseph O. S. (2022). Understanding the cumulative distribution, implication and progress on Covid -19 pandemic as at 7th of February 2022 across different countries of the world: An update report. *International Journal of Research and Innovation in Social Science (IJRISS) |Volume VI, Issue IV*. Page 691-699.
65. Thomas SR (2005). "Modelling and simulation of the kidney". *Journal of Biological Physics and Chemistry*. 5 (2/3): 70–83.
66. Simeon, J.O., Tosin, J.O., Zubairu, S.A. (2022). Cumulative evaluation of demography and distribution of COVID-19 around the globe: An update report of COVID-19 until 17th February 2022. *Int J Epidemiol Health Sci*;3(6): e34
67. Oyepata JS, Simeon JO. (2022). The Earth: An Alien Planet in Another Universe. *Global Journal of Science Frontier Research: A Physics and Space Science*. Volume 22 Issue 1. Page 55-57.
68. Maton A, Hopkins J, McLaughlin CW, Johnson S, Warner MQ, et al. (1993). *Human Biology and Health*. Englewood Cliffs, New Jersey, USA: Prentice Hall. ISBN 978-0-13-981176-0.
69. Joseph O. S., Sabastine A. Z, Joseph O. T., Adegbuyi T. A. (2022). An Analysis of Daily distributive effect of COVID-19 Pandemic across the Globe Using the USA as a Comparism Factor: An update report of 17th of February,

70. Simeon JO, C Ariahe Emmanuel, Tosin JO, Zubairu SA. (2022). Virological and immunological consequences of Covid -19 pandemic distribution across different countries; A seven days update study. *International Journal of Advances in Engineering and Management (IJAEM)* Volume 4, Issue 8. pp: 871-883.
71. Kalantar-Zadeh K, McCullough PA, Agarwal SK, Beddhu S, Boaz M, et al. (June 2021). "Nomenclature in nephrology: preserving 'renal' and 'nephro' in the glossary of kidney health and disease". *Journal of Nephrology*. 34 (3): 639–648.
72. Tosin JO, Simeon JO. (2022). Mathematical and demographic understanding on the effect Covid 19 across the country of the world; An update report of cases and death from 2nd to 8th of August, 2022. *International Journal of Advances in Engineering and Management (IJAEM)* Volume 4, Issue 8. pp: 891-903.
73. Modupe BI, Simeon JO, Tosin JO. Toxicological study of ethanol extract of *Lavandula stoechas* on Liver of Wistar rat. (2022). *International Journal of Advances in Engineering and Management (IJAEM)* Volume 4, Issue 9. pp: 892-901.
74. Cotran RS, Kumar V, Fausto N, Robbins SL, Abbas AK (2005). *Robbins and Cotran pathologic basis of disease*. St. Louis, MO: Elsevier Saunders. ISBN 978-0-7216-0187-8.
75. Modupe BI, Simeon JO, Oyepata JS, Tosin JO. (2022). Update report on comparism and analysis on the progress made in cases and death of COVID-19: A seven days study. *International Journal of Advances in Engineering and Management (IJAEM)* Volume 4, Issue 9 Sep. 2022, pp: 902-915
76. Joseph Oyepata Simeon. (2022). UFOs and Human: Understanding the Relevance, Purpose and Humofunctional Implication. *International Journal of Research Publication and Reviews*, Vol 3, no 9, pp 1304-1308.
77. Builders Ireliola M, Joseph Oyepata S, Joseph Opeyemi T. (2022). Toxicological Study of Ethanol Extract of *Lavandula Stoechas* on Kidney of Wistar Rat. *International Journal of Research Publication and Reviews*, Vol 3, no 9, pp1290-1298.
78. Lote CJ (2012). *Principles of Renal Physiology*, 5th edition. Springer. p. 21.
79. Joseph Oyepata Simeon, Joseph Opeyemi Tosin, Moses Femi Daniel, Ariahe Emmanuel C. (2022). COVID-19 Cases and Mortality Report Across Countries of the World, using USA as a Comparism Factor: An Update Report 18th to 24th of August, 2022. *International Journal of Research Publication and Reviews*, Vol 3, no 9, pp 1262-1272.
80. Kalantar-Zadeh K, McCullough PA, Agarwal SK, Beddhu S, Boaz M, et al. (June 2021). "Nomenclature in nephrology: preserving 'renal' and 'nephro' in the glossary of kidney health and disease". *Journal of Nephrology*. 34 (3): 639–648. PMID 33713333.
81. Etuk IC, Udobang JA, Daniel AO, Ekong O, Okokon JE. et al. (2023). Effect of leaf extract and fractions of *Solanum anomalum* on oxidative stress markers, kidney function indices and histology of alloxan-induced diabetic rats. *Journal of Current Biomedical Research*. Vol 3. Page 783-799.



This work is licensed under Creative Commons Attribution 4.0 License

To Submit Your Article Click Here:

[Submit Manuscript](#)

DOI:10.31579/2768-0487/100

#### Ready to submit your research? Choose Auctores and benefit from:

- fast, convenient online submission
- rigorous peer review by experienced research in your field
- rapid publication on acceptance
- authors retain copyrights
- unique DOI for all articles
- immediate, unrestricted online access

At Auctores, research is always in progress.

Learn more <https://auctoresonline.org/journals/journal-of-clinical-and-laboratory-research->