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Evaluation of the Effect of Ethanol Leaf Extract of *Solanum torvum* (Egg Plant) on Renal Health Using Wistar Rats

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ABSTRACT: The widespread belief among users of plant-derived medicines that they are unlikely to cause harm has resulted in a lack of caution in their usage, underreporting of toxicity information, and potential abuse of these substances. Therefore, the aim of this study was to investigate the potential effects of ethanol leaf extract of *Solanum torvum* (eggplant) on renal health in Wistar rats using standard techniques. Twenty adult male Wistar rats were divided into four groups of five rats each. The data obtained showed that there was a less than 50% increase in body weight across all groups investigated. Rats that received 400 mg/kg of *S. torvum* ethanol leaf extract had the highest level of creatinine, while those given 300 mg/kg of *S. torvum* ethanol leaf extract had the highest level of urea. The results revealed that ethanol leaf extract of *S. torvum* did not impede growth but distorted kidney's histological structure.

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Solanum torvum SW (Solanaceae), commonly known as Turkey berry, is a small shrub that grows abundantly in Thailand, although it originates from Africa and is widely cultivated in the West Indies. It is a well-branched, evergreen, and erect shrub that can grow up to about 4 meters tall (Adjanohoun *et al*., 1996). The fruits of *S. torvum* can be eaten as a vegetable (Putri*et al.*, 2023).

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S. torvum is not only considered a food source but also holds a significant place in African traditional medicine. It has been successfully used to treat various diseases such as cough, wounds, liver diseases, and tooth decay (Satyanarayana *et al*., 2022). Additionally, it is known for its effectiveness in treating hypotension, gastric ulcers, providing analgesic effects, and acting as an antioxidant (Darkwah and Nkoom, 2019). The leaf and other parts of *S. torvum* are rich in phytochemicals and nutrients that offer significant health benefits (Darkwah and Nkoom, 2019).

Plant-derived medications have been used for centuries to treat various diseases. However, despite the fact that approximately 80% of the world's population relies on plants for primary health care, there are risks associated with plant-based therapies. These therapies have been linked to numerous diseases, including cardiovascular diseases, liver diseases, psychiatric-neurological disorders, haematologic issues, and renal toxicity (Ernst, 2003; Okiemute *et al*., 2024). The misconception that plant-based therapies are entirely safe can lead to negligence regarding potential adverse health effects and underreporting of such effects, especially in third-world countries. This lack of reporting contributes to the scarcity of data on the toxicity of plant-based medications (Vidushi, 2013). The kidneys are one of the major organs affected by metabolic reactions triggered by toxic substances and are therefore a key focus for toxicological investigations following exposure to xenobiotics (Omorodion*et al*., 2023). Hence, the objective of this study is to investigate the potential effects of ethanol leaf extract of *S. torvum* on renal health.

MATERIALS AND METHODS

Collection and processing of plant

Preparation of extract: Freshly harvested leaves of *Solanum torvum* was thoroughly washed with clean tap water. The leaves were then air-dried before being ground into a powder. The powdered sample was sieved to obtain a fine powder and subsequently extracted with 90% (v/v) ethanol using a Soxhlet apparatus at 60°C. The solvent was removed from the extract through evaporation under pressure, while water was eliminated by freeze-drying.

Animals: Twenty mature male Wistar rats weighing between 160 and 240 g were obtained from the animal house of the Department of Human Anatomy at Nnamdi Azikiwe University in Awka, Anambra. The rats were housed in transparent plastic cages and fed standard pellets (Niger feed). They were allowed to acclimatize for three weeks in a well-ventilated room with a 12/12-hour light/dark cycle and ambient temperature.

LD_{50} determination: The material was tested for acute toxicity using Lorke's (1983) technique. This involved nine (9) male adult Wistar rats divided into three groups of three rats each. They were orally administered doses of 10 mg/kg, 100 mg/kg, and 1000 mg/kg of the plant extract. The animals were monitored for signs of toxicity for 24 hours. Subsequently, three sets of three rats each were given doses of 1600 mg/kg, 2900 mg/kg, and 5000 mg/kg of the extract. These animals were observed for 48 hours to assess the effects.

Animal grouping and treatment: Group I (Normal control): administered 2 ml/kg of distilled water
Group II: Rats were administered 100 mg/kg of ELST
Group III: Rats were administered 200 mg/kg of ELST
Group IV: Rats were administered 300 mg/kg of ELST
The animals were administered the extract daily for a period of 21 days. The body weight of the rats was measured at the start and end of the study.
Subsequently, the rats were euthanized, blood samples were collected, and their kidneys were extracted for analysis.

Sample preparation: Precisely 2 mL blood sample was collected in an EDTA tube for the analysis of serum renal function indicators. The sample was then centrifuged at 4,000 rpm for 15 minutes, and the resulting plasma was used for biochemical analysis.

Serum urea determination: Urea was determined using Henry's (1974) technique. The urea enzyme reagent was reconstituted following the manufacturer's instructions. 1.5 mL of urea enzyme reagent was pipetted into labeled test tubes and allowed to equilibrate at room temperature. 10 µL of the sample was transferred to the appropriate tube, with water serving as the sample reagent blank. All tubes were then incubated for five minutes at 37°C. Subsequently, 1.5 mL of urea colour developer was added and carefully mixed, followed by five-minute incubation at 37°C. The spectrophotometer was zeroed using a reagent blank at 630nm, and the absorbance of the samples was measured and recorded.

Serum creatinine determination: Creatinine was determined using the method described by Henry (1974). To begin, 3 ml of the working reagent (a 1:1 ratio of Creatinine picric acid reagent and creatinine

buffer reagent) was pipetted into test tubes. Next, 0.1 ml (100 µL) of the sample was added to each tube and thoroughly mixed. Distilled water served as the reagent blank. The test tubes were then heated in a water bath at 37°C for 15 minutes. The wavelength was set to 510 nm, and the absorbance of each tube was measured and recorded. The spectrophotometer was calibrated using a reagent blank and set to 510 nm for measurement. Finally, the absorbance of each tube was recorded.

Histopathological studies: The harvested organs were fixed in a 4% formaldehyde solution, embedded in paraffin wax, and sliced. The sliced pieces were then mounted on slides and stained with H&E. Arokiasamy *et al*. (2015) utilized a microscope (×10) to examine the tissue sections and analyze cell changes.

Data analysis: Data were reported as Mean ± Standard Deviation using SPSS (Ver. 23). The data were analyzed using one-way ANOVA. Mean differences were compared using the Tukey test. *P-values* less than 0.05 were considered statistically significant.

RESULTS AND DISCUSSIONS

The misconception that herbal medicine is safe has led to the misuse of such substances, often resulting in fatal consequences (Vidushi, 2013). Body weight is negatively affected by the ingestion of toxic substances, and a decrease in body weight after consuming a substance may indicate exposure to a toxicant (Nirogi *et al*., 2014). The body weight of Wistar rats given ethanol leaf extract of *Solanum torvum* is depicted in Figure 1, showing an increase in body weight which however was less than 50% across all groups. This contradicts a study by Asante *et al*. (2024), which found that *Solanum torvum* Berries extract caused significant weight loss in rats. The increase in body weight could be associated with feed consumption, influenced by certain secondary metabolites that play a role in hormonal appetite control (Sayan and Soumya, 2007). The higher body weight in rats could be due to the absence of certain appetite-inhibiting phytochemicals in the leaf of *S. torvum*, this is consistent with a study by Sambo *et al*. (2012) which showed increased body weight in rats given an aqueous extract of *Solanum incanum*, a member of the *Solanaceae* family to which *S. torvum* belongs. Serum creatinine and urea levels in rats administered ethanol leaf extract of *S. torvum* are presented in Figure 2, indicating significantly higher levels of serum creatinine and urea in groups II-IV compared to the normal control group ($p<0.05$).

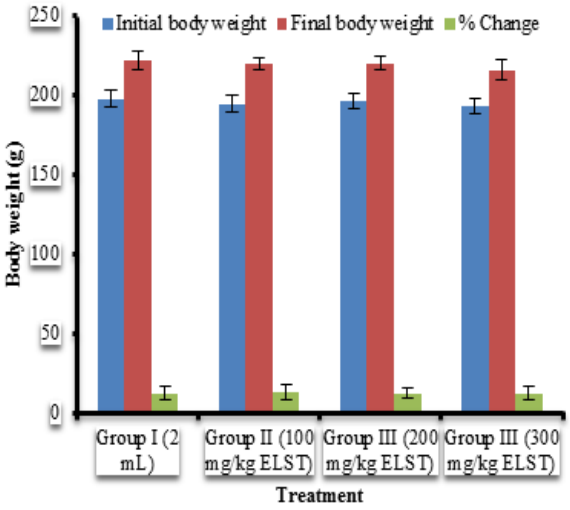

Fig.1: Body weight of Wistar rats administered ethanol leaf extract of *Solanum torvum*

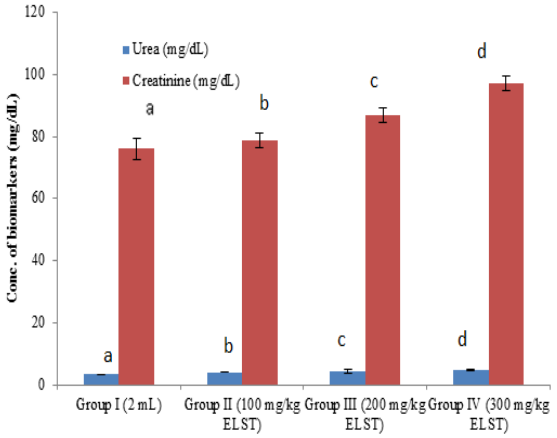

Fig. 2: Renal function markers of Wistar rats administered ethanol leaf extract of *Solanum torvum*

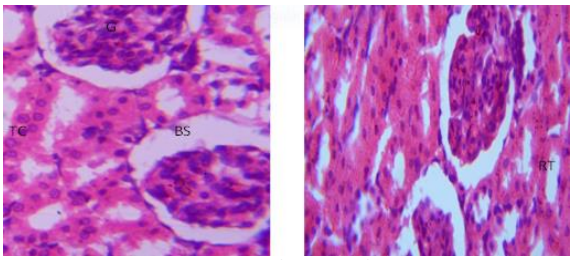

Plate 1: Photomicrograph of kidney of normal control rats showing normal renal architecture (×400)
Hint [RT: Renal tubules, TC: Tubular cell, G: Glomeruli, BS: Bowman space]

The increase in creatinine and urea levels in the treated groups was dose-dependent, possibly due to the nephrotoxic effects of certain phytochemicals. This aligns with the findings of Tuem *et al*. (2021), who reported lethality with 5000 mg/kg of *Solanum aethiopicum* extract, another member of the *Solanaceae* family. Research has affirmed that

phytochemicals generally offer health benefits following moderate ingestions. However, excessive intake can translate to health hazards. The histoarchitectural distortions and aberrations observed on the kidney of rats administered *S. torvum* (Plates2-4) could be attributed to ingestion of high doses of *S. torvum* leaf extract.

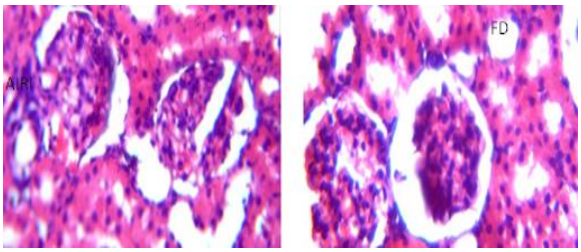

Plate 2: Photomicrograph of kidney of rats administered 100 mg/kg of *Solanum torvum* extract showing mild aggregate of intra renal inflammation (IRI) around the glomeruli and fat deposit (FD) (×400).

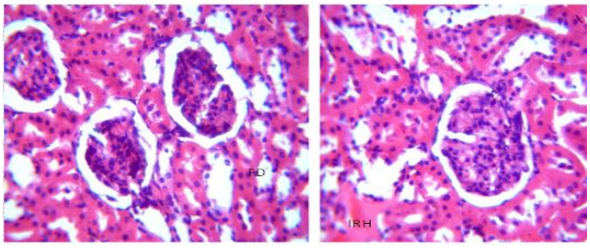

Plate 3: Photomicrograph of kidney of rats administered 300 mg/kg of *Solanum torvum* leaf extract showing well perfused renal tissue with mild Intra Renal Haemorrahage (IRH) and mild fatty deposit (FD) otherwise normal.

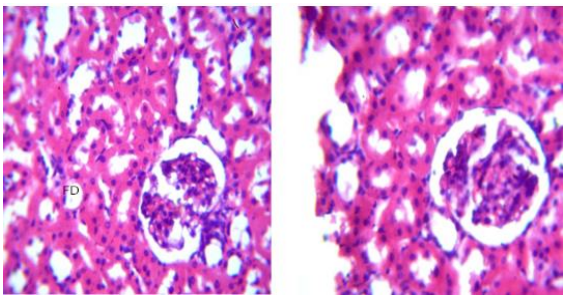

Plate 4: Photomicrograph of kidney of rats administered 600 mg/kg of *Solanum torvum* leaf extract showing mild otherwise normal with good perfusion.

Although this contradicts the finding of a study by Asante *et al*. (2024) which demonstrated that freeze-dried boiled and raw berries of *Solanum nigrum* and *S. torvum* exhibited nephroprotective effect, an observation which was supported by microscopic examination of the kidney (Asante *et al*., 2024), it aligns with the findings made by Bouslamti *et al*. (2024) which showed that 2000 mg/kg of *Solanium elaeagnifolium*, another member of the *Solanaceae* family elicited signs of toxicity and also induced histological alteration in the kidney of treated rats.

Conclusion: The study evaluated the effect of ingesting leaf extract of Solamum torvum on renal health. It revealed that the body weight of rats that ingested *S. torvum* extract was not affected. However, it did show that different levels of kidney injury occurred as a result of the treatment. This implies that more research efforts needs to be invested to determine safe therapeutic doses of different diseases which have been reportedly treated with extract of *Solanum torvum.*

Declaration of Conflict of Interest: The authors declare no conflict of interest.

Data Availability: Data are available upon request from the corresponding author.

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