WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comparative Nephroprotective Effect of *Telfaria occidentalis* Leaf Extracts

Seyifunmi Oyedele Elliot

Affliation: Department of Science Laboratory Technology, Biochemistry Unit, Faculty of Applied Sciences, Rufus Giwa Poluytechnic, PMB 1019, Owo, Ondo State, Nigeria.

DOI: https://doi.org/10.55248/gengpi.4.923.92509

ABSTRACT

The kidneys play a vital role in the excretion of waste products and toxins such as urea, creatinine and uric acid, regulation of extracellular fluid volume, serum osmolality and electrolyte concentrations, as well as the production of hormones like erythropoietin and 1,25 dihydroxy vitamin D and renin. In this study, the nephroprotective effect of *Telfaria occidentalis* leaf extract against oxidative stress-induced kidney damage with 2,4-dinitrophenyl hydrazine in Albino rats was investigated. Male rats received 40 mg/kg body weight of 2,4-DNPH except the negative contol. The resulting oxidative stressed kidney damaged rats were pre-treated with ethanol and aqueous leaf extracts of *Telfaria occidentalis* for 21 days. After the period of treatments, hematological evaluations were carried out on the serum of the animals. Results showed significant elevated serum creatinine, urea, bilirubin, ammonia but a decrease in bicarbonate and erythropoietin levels when compared with the normal control rats. But an increase in serum serum creatinine, urea, bilirubin, ammonia was ameliorated in groups pretreated with the same concentrations of ethanol and aqueous leaf extracts of *Telfaria occidentalis*. Also, the decrease in serum levels of bicarbonate and erythropoietin in 2,4-DNPH-intoxicated rats was significantly (p<0.0001) elevated in groups pretreated with the same concentrations of ethanol and aqueous leaf extracts of *Telfaria occidentalis* when compared with the positive control group. There was no significant (p<0.0001) difference in the pharmacological effect of both ethanol and aqueous leaf extracts of *Telfaria occidentalis* in the treated animals and this further support the oral consumption of fluted pumpkin leaf. The serum kidney function parameters indicate that the toxicant actually caused serious oxidative damage but treatment with extract help to remedy the observed damage. This implies that the leaf extract of *Telfaria occidentalis* helps to mitigate the oxidative damage caused by 2,4-dinitophenyl hydrazine. This result implies that fluted pumpkin consumption can help to heal oxidative damage condition and protect against deleterious effect of oxidative stress on the kidney.

Keywords: Nephropathy, Telfaria occidentalis, Kidney, 2,4-Dinitrophenyl hydrazine

1.0 INTRODUCTION

The plant kingdom constitutes exhaustive resources which mankind can use directly or manipulate to suit her various purposes. The use of herbal plants as ethnopharmacological intervention and prognosis for combating ailing heath has been on the increase in Africa especially in Nigeria [1]. The use of plants to make poultries, infusions and concoction as herbal remedies to tackle health challenges in traditional way has been on from time immemorial [2]. Scientific investigations to ascertain the validity and regulate the use of medicinal plants are a worthwhile exercise as part of the holistic approach to ensure the good health and wellbeing of the populace [3]. A medicinal plant is any plant which one or more of its organs contain substances that can be used for the synthesis of useful drug [4].

Most of the fruits, vegetables and spices contain some bioactive components which have some health benefits to mankind or his livestock [5]. *Telfaria occidentalis* (fluted pumpkin) is one of the most preferred vegetables being cultivated and consumed across West Africa. The high acceptance of this vegetable derives from its palatable taste, high mineral content, robust phytochemical compositions, rich antioxidant profile and favorable organoleptic pattern [6] [7]. Several research works have been done on *Telfaria occidentalis* to attest to its relevance as nutrition vegetable ethnopharmacologically.

Telfaria occidentalis leaf has been reported to exhibit haematopoietic effect mediated by cytokines [8]. The aqueous leaf extract of fluted pumpkin is known to be a blood booster and has hepatoprotective property [9] [10]. Fluted pumpkin methanol leaf extract is said to possess antioxidant activities capable of protecting against lipid peroxidation and cell damage in the ovary of female Albino rats. The ethanol leaf extract of fluted pumpkin is rich in bioactive compounds of pharmacological importance such as tannins, flavonoids, saponins, alkaloids, terpenoids and cardiac glycosides which act to reduce blood glucose level in diabetic rats [11] [12]. *Telfaria occidentalis* is reported to be used in ethnobotany as antidiabetic, antitumor, antihypertensive, antiparasitic and antibacterial [13]. The aqueous extract of *Telfaria occidentalis* has also been shown to possess inhibitory effect on butylcholinesterase and acetylcholinesterase, the two key enzymes linked to some major neurodegenerative diseases such as Alzheimer's disease [14] [15]. The consumption of highly processed and increasing industrialization which impact negatively on the environment is causing kidney diseases in larger number of city dwellers (Avesani *et al.,* 2022), hence the need to evaluate the likely curative effect of *Telfaria occidentalis* on kidney cells so as to proffer solution to the increasing kidney failures through nutritional intake of vegetable.

2.0 MATERIALS AND METHODS

2.2.1 PLANT MATERIALS AND PREPARATION OF EXTRACT

Fresh green leafy vegetable of *Telfaria occidentalis* were purchased at Oja Oba market in Owo Ondo State, Nigeria. The leaf was identified at Environmental Biology Unit, Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo. The leaves were detached from the stalk and then gently washed with distilled water before being spread under shade for drying. Shaking and observation continued for three weeks and then the leaves initially grated into bits before milled into powdered form. The powdered leaf (500g) was soaked with 5.0 litres of ethanol (99.8%) with occasional shaking for 72 hours. The mixture was filtered with muslin cloth and the filtrate was subjected to rotary evaporator to obtain a blue-green sticky substance that was reconstituted into 20 mg/mL extract solution using saline water.

2.2.2 EXPERIMENTAL ANIMALS

Male Albino rats (180 - 200g) were procured from the University College Hospital animal house Ibadan and kept in wooden cage for about three weeks for acclimatization. These rats were provided with pelletized feed and portable water in strict compliance with animal care ethics.

2.2.3 EXPERIMENTAL DESIGN

Twenty four male Albino rats were selected and randomly distributed into four groups. Each group contains six animals. Group one serves as a control, the animals were given distilled water and feed only. Group two, three and four animals were induced with 40 mg/kg body weight of 2,4-dinitrophenyl hydrazine, but group three and four animals were pre-treated with 200 mg/kg body weight of ethanol and aqueous leaf extract of *Telfaria occidentalis* respectively at an interval of 48 hours repeatedly as treatment against oxidative stress-induced kidney damage and the treatment lasted for twenty one days.

2.2.4 BLOOD COLLECTION

The rats were fasted overnight on 21st day of the experiment and then sacrificed the next day by chloroform anesthesia. Blood were collected by cardiac puncture into appropriate bottles and serum made for the estimation of blood urea, creatinine, serum ammonia levels, bilirubin, bicarbonate and erythropoietin (EPO).

3.0 DETERMINATION OF PARAMETERS

3.3.1 DERTERMINATION OF CREATININE

Creatinine was determined using Randox kits, Randox Laboratories, England. The parameter was measured according to the manual that accompanied the kits.

3.3.2 DETERMINATION OF HCO^-_3, UREA AND AMMONIA

These parameters were assessed with the aid of SK3001 Semi-auto Chemistry Analyser made in China,

3.3.3 DTERMINATION OF ERYTHROPOIETIN (EPO)

EPO was measured spectrophotometrically using enzyme-linked immunosorbent assay (ELISA) with Elabscience Biotechnology Co. Ltd. Wuham, China in compliance with the kits instruction in the manual.

4.0 RESULTS AND DISCUSSION

4.1 RESULTS

There was a significant elevation in serum urea, creatinine, ammonia and ammonia levels in 2,4-dinitrophenyl hydrazine-induced groups compared to the negative control group as shown in figures 1, 2, 3 and 4. However, increase in these hematological indices was significantly reduced in groups pre-treated with 200 mg/kg ethanol and aqueous *Telfaria occidentalis* leaf extracts respectively. More so, there was a significant decrease in serum bicarbonate and erythropoietin levels in 2,4-dinitrophenyl hydrazine-induced groups compared to the negative control group as depicted in figures 5 and 6. However, the decrease was significantly elevated in groups pre-treated with 200 mg/kg ethanol and aqueous *Telfaria occidentalis* leaf extracts respectively.

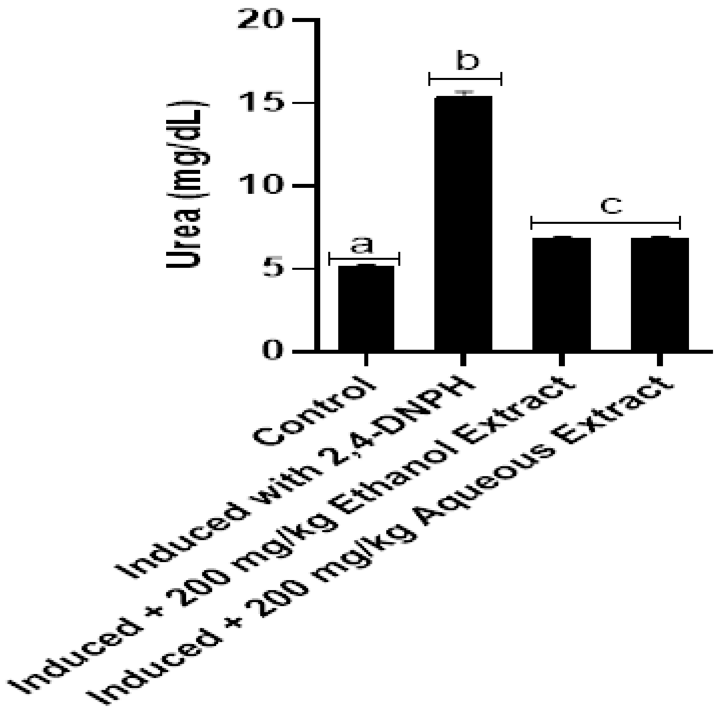

Figure 1: Effects of *Telfaria occidentalis* leaf extract pre-treatment on serum urea level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly (p<0.0001) different from the positive control 'b' while groups with 'c' are significantly (p<0.0001) different from the positive control group.

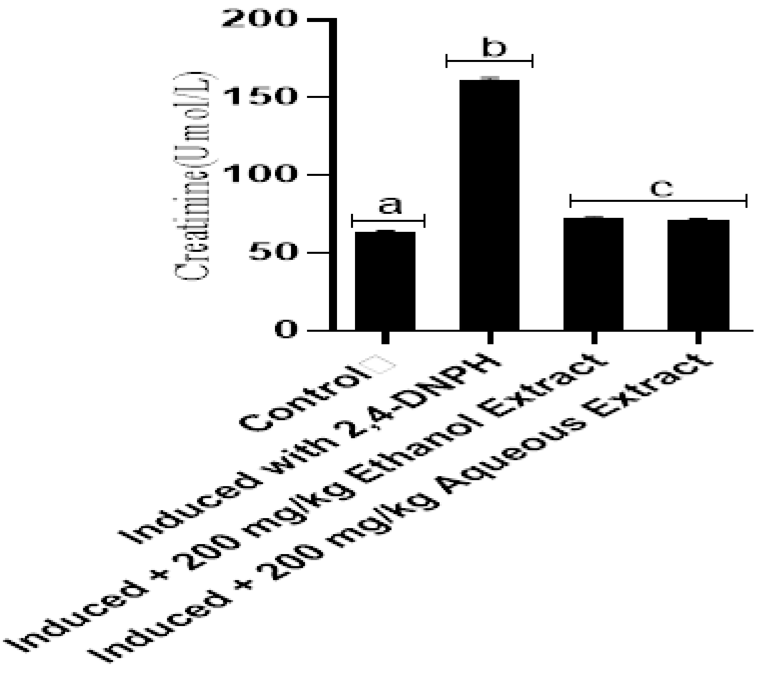

Figure 2: Effects of *Telfaria occidentalis* leaf extract pre-*treatment* on serum creatinine level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly (p<0.0001) different from the positive control 'b' while groups with 'c' are significantly (p<0.0001) different from the positive control group.

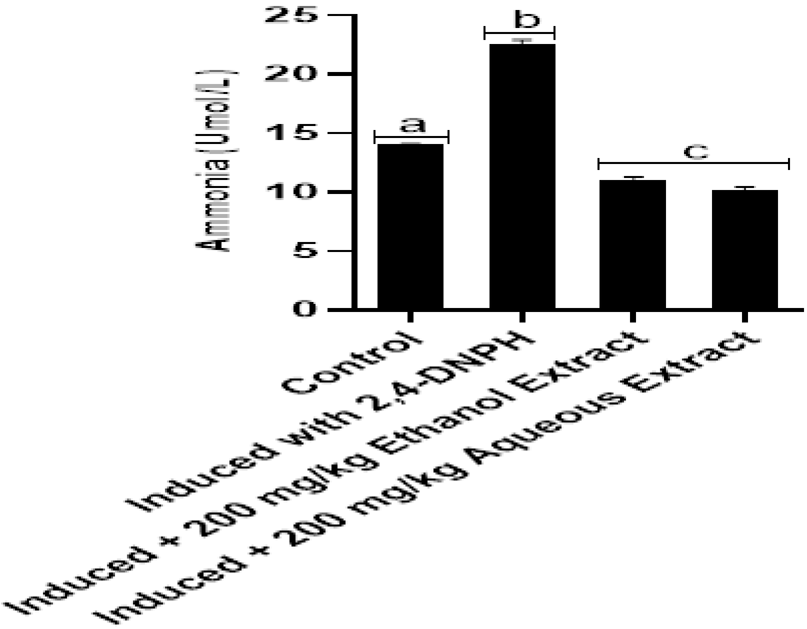

Figure 3: Effects of *Telfaria occidentalis* leaf extract pre-treatment on serum ammonia level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly (p<0.0001) different from the positive control 'b' while groups with 'c' are significantly (p<0.0001) different from the positive control group.

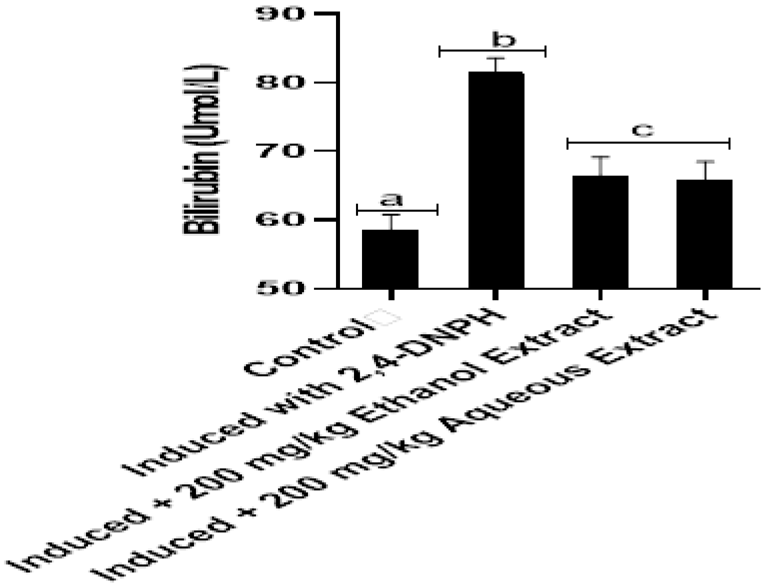

Figure 4: Effects of *Telfaria occidentalis* leaf extract pre-treatment on serum bilirubin level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly (p<0.0001) different from the positive control 'b' while groups with 'c' are significantly (p<0.0001) different from the positive control group.

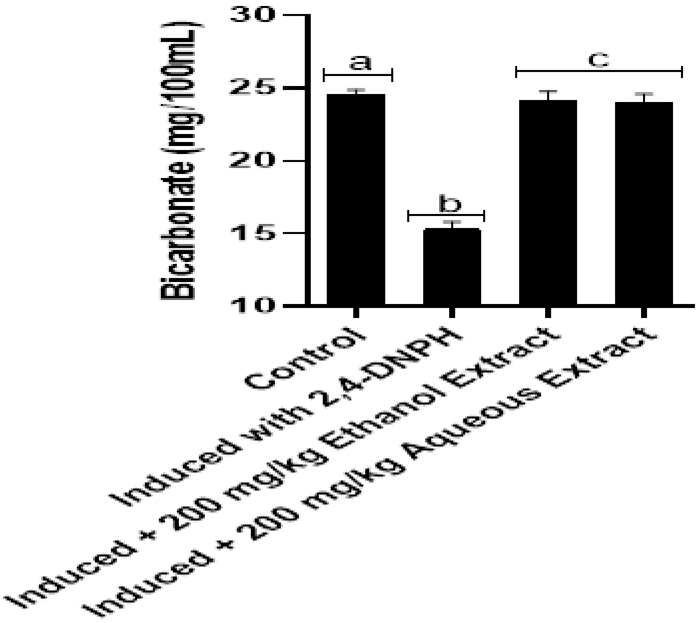

Figure 5: Effects of *Telfaria occidentalis* leaf extract pre-treatment on serum biocarbonate level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly ($p<0.0001$) different from the positive control 'b' while groups with 'c' are significantly ($p<0.0001$) different from the positive control group.

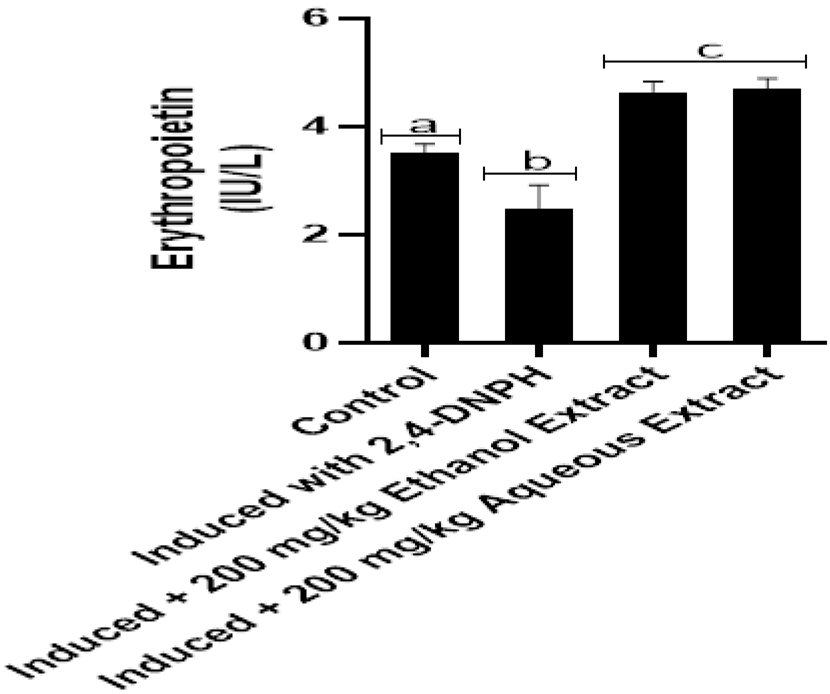

Figure 6: Effects of *Telfaria occidentalis* leaf extract pre-treatment on serum erythropoietin level of 2,4-dinitrophenyl hydrazine-induced oxidative kidney damaged rats. Results are expressed as mean ± SD (n=6). Group with 'a' is significantly ($p<0.0001$) different from the positive control 'b' while groups with 'c' are significantly ($p<0.0001$) different from the positive control group.

4.2 DISCUSSION

2,4-dinitrophenyldrazine-induced kidney damage can result in decreased renal function caused by aggressive production of oxidative stress and alteration in the mesengial cell function [17]. Progression of nephropathy leads to decline in glomerular filtration rate and may be due to expansion of the mesangial matrix [18]. This study evaluated the nephroprotective effect of *Telfaria occidentalis* leaf extracts against oxidative stress-induced kidney damage with 2,4-dinitophenyl hydrazine in Albino rats.

Elevation of plasma urea, creatinine, ammonia and bilirubin levels and decrease in biocarbonate and erythropoietin levels can indicate dysfunction in glomerular filtration rate [19]. The evaluations of these biomarkers are specific to kidney damage [19]. Urea, which is generated in the liver during catabolism of surplus amino acids and other nitrogenous metabolites, is normally excreted into the urine by the kidneys as rapidly as it is produced [20]. When renal function is impaired, increasing concentrations of blood urea will steadily accumulate [21]. However, if the kidneys are unable to effectively get rid of urea due to kidney damage as shown in this study, it leads to a buildup of ammonia in the blood [21] [22]. Creatinine is the by-product of creatine phosphate in muscles, and it is produced at a constant rate by the body. For the most part, creatinine is cleared from the blood entirely by the kidney [23]. Decreased clearance by the kidney results in increased blood creatinine. Bilirubin is a well-known neurotoxin in newborn infants; however, higher serum bilirubin concentration is associated with kidney failure in susceptible individuals [24]. In this study, urea, creatinine, ammonia and bilirubin biomarkers increased markedly in 2,4-DNPH-treated rats compared to normal control rats but the concentrations were lowered significantly ($p \leq 0.0001$) in 2,4-DNPH-intoxicated pre-treated rats with both aqueous and ethanol leaf extracts of *Telfaria occidentalis* when compared with 2,4-DNPH-intoxicated rats. This result is in tandem with previous reports.

Bicarbonate keeps our blood from becoming too acidic. Healthy kidneys help keep the bicarbonate levels in balance [25]. As renal function declines, the kidneys progressively lose the capacity to synthesize ammonia and excrete hydrogen ions [26]. Consequently, this would lead to low bicarbonate levels and these are more common in patients with lower estimated glomerular filtration rate and this is associated with kidney damage, if this is not managed, it can lead to a worsen kidney disease [26].

When the kidneys are damaged, they produce less erythropoietin (EPO), a hormone that signals the bone marrow, which is the spongy tissue inside most of the bones to make red blood cells [27] [28]. With less EPO, the body makes fewer red blood cells, and less oxygen is delivered to the organs and tissues of the body [29]. Thus, the decrease levels of serum bicarbonate and EPO in 2,4-DNPH-intoxicated rats in this study was significantly ($p \leq 0.0001$) elevated in 2,4-DNPH-intoxicated pre-treated rats with both aqueous and ethanol leaf extracts of *Telfaria occidentalis* in comparison with 2,4-DNPH-treated rats. This result is in full agreement with previous reports.

Conclusion

This present study established that, 2,4-DNPH-treated rats caused kidney damage in rats, which was attenuated by treatment with both aqueous and ethanol leaf extracts of *Telfaria occidentalis*, they also significantly decreased renal dysfunction observed in the serum creatinine, urea, ammonia and albumin levels, bicarbonate and EPO and improved glomerular damage in 2,4-DNPH –intoxicated rats. The renal protective effect of *Telfaria occidentalis* leaf could be attributed to the antioxidant activity of the major bioactive compounds. Free radical scavenging ability and nephroprotective efficacy of *Telfaria occidentalis* makes it suitable for protection from the development or progression of kidney damage.

References

[1] Sharaibi, O. J., Oluwa, O. K., and Omolokun, K. T. (2022). Traditional plant based medicines used for the treatment of COVID-19 symptoms by AWORI tribe in OJO local community of Lagos State, Nigeria. *Journal of Medicinal Plants*, *10*(6), 57-62.

[2] Das, C., Banerjee, A., Saha, M., and Chatterjee, S. (2022). A Review of the Health Benefits of Tea: Implications of the Biochemical Properties of the Bioactive Constituents. *Current Research in Nutrition and Food Science Journal*, *10*(2), 458-475.

[3] Chakrabarti, A., Geurts, L., Hoyles, L., Iozzo, P., Kraneveld, A. D., La Fata, G., and Vauzour, D. (2022). The microbiota–gut–brain axis: pathways to better brain health. Perspectives on what we know, what we need to investigate and how to put knowledge into practice. *Cellular and Molecular Life Sciences*, *79*(2), 80.

[4] Ahad, B., Shahri, W., Rasool, H., Reshi, Z. A., Rasool, S., and Hussain, T. (2021). Medicinal plants and herbal drugs: An overview. *Medicinal and Aromatic Plants: Healthcare and Industrial Applications*, 1-40.

[5] AL-Masoodi, H., Hussein, H. J., and Al-Rubaye, A. F. (2020). Antifungal activity of the two medicinal plants (Curcuma longa L. and Boswellia carteri Birdwood) against Fusarium species isolated from maize seeds. *International Journal of Pharmaceutical Research*, *12*(3), 408-414.

[6] Ukom, A. N., and Obi, J. A. (2018). Comparative evaluation of the nutrient composition and phytochemical content of selected vegetables consumed in Nigeria. *International Letters of Natural Sciences*, (71).

[7] Karrar, E., Sheth, S., Wei, W., and Wang, X. (2019). Gurum (Citrullus lanatus var. Colocynthoide) seed: lipid, amino acid, mineral, proximate, volatile compound, sugar, vitamin composition and functional properties. *Journal of Food Measurement and Characterization*, *13*, 2357-2366.

[8] Salman, T. M., Iyanda, M. A., Alli-Oluwafuyi, A. M., Sulaiman, S. O., and Alagbonsi, A. I. (2021). Telfairia occidentalis stimulates hepatic glycolysis and pyruvate production via insulin-dependent and insulin-independent mechanisms. *Metabolism Open*, *10*, 100092.

[9] Obeagu, E. I., Chikelu, I. M., Obarezi, T. N., Ogbuabor, B. N., and Anaebo, Q. B. N. (2014). Haematological effects of fluted pumpkin (Telfairia occidentalis) leaves in rats. *International Journal of Life Sciences Biotechnology and Pharma Research*, *3*(1), 172-182.

[10] Toma, I., Victory, N. C., and Kabir, Y. (2015). The effect of aqueous leaf extract of fluted pumpkin on some hematological parameters and liver enzymes in 2, 4-dinitrophenylhydrazine-induced anemic rats. *African Journal of Biochemistry Research*, *9*(7), 95-98.

[11] Njoku, R. C. C., and Abarikwu, S. O. (2021). Antifertility and profertility effects of the leaves and seeds of fluted pumpkin: Sperm quality, hormonal effects and histomorphological changes in the testes of experimental animal models. *Journal of integrative medicine*, *19*(2), 104-110.

[12] Irene, O. B., Idara, A. O., Justin, A. B., Elizabeth B. U., and Daniel U. O. (2022). Aqeuous Leaves Extract of *Telfairia occidentalis* (Fluted Pumpkin) Protects Against Gastric Ulcer and Inhibits Intestinal Motility in Wistar Rats. *Journal of Applied Sciences*, 22: 92-99.

[13] Haruna, N. A., Erhabor, O., Erhabor, T., and Adias, T. C. (2021). Review of Some Herbs with Haemato-Therapeutic Properties in Use in Nigeria. *Sokoto Journal of Medical Laboratory Science*, *6*(4).

[14] Imoseni, I. O. (2018). Review of the toxicity, medicinal benefits, pharmacological actions and morphological effects of *Telfairia occidentalis* hook. F. *European Journal of Pharmaceutical and Medical Research*, *6*(7), 22-32.

[15] Tuzimski, T., and Petruczynik, A. (2022). Determination of anti-Alzheimer's disease activity of selected plant ingredients. *Molecules*, *27*(10), 3222.

[16] Avesani, C. M., Cardozo, L. F., Wang, A. Y. M., Shiels, P. G., Lambert, K., Lindholm, B., and Mafra, D. (2022). Planetary health, nutrition, and chronic kidney disease: connecting the dots for a sustainable future. *Journal of Renal Nutrition*.

[17] Yaribeygi, H., Farrokhi, F. R., Rezaee, R., and Sahebkar, A. (2018). Oxidative stress induces renal failure: A review of possible molecular pathways. *J Cell Biochem*. 119(4):2990-2998.

[18] Li, X., Yang, S., Yan, M., Guan, N., Li, J., Xie, Q., and Hao, C. (2020). Interstitial HIF1A induces an estimated glomerular filtration rate decline through potentiating renal fibrosis in diabetic nephropathy. *Life sciences*, *241*, 117109.

[19] Sharkey, L. (2017). Kidney Function Tests. *Interpretation of Equine Laboratory Diagnostics*, 39-43.

[20] Levitt, D. G., and Levitt, M. D. (2018). A model of blood-ammonia homeostasis based on a quantitative analysis of nitrogen metabolism in the multiple organs involved in the production, catabolism, and excretion of ammonia in humans. *Clinical and experimental gastroenterology*, 193-215.

[21] Thome, T., Kumar, R. A., Burke, S. K., Khattri, R. B., Salyers, Z. R., Kelley, R. C., and Ryan, T. E. (2021). Impaired muscle mitochondrial energetics is associated with uremic metabolite accumulation in chronic kidney disease. *JCI insight*, *6*(1).

[22] Rampursat, Y., Bhimma, R., Naicker, E., Peer, F., and Gounden, V. (2018). Evaluation of the revised Schwartz creatinine-based glomerular filtration rate estimating equation in Black African children in KwaZulu-Natal, South Africa. *Annals of Clinical Biochemistry*, *55*(4), 505-508.

[23] Asejeje, F. O., Ighodaro, O. M., Asejeje, G. I., and Adeosun, A. M. (2020). Protective role of apple cider vinegar (APCV) in CCl4-induced renal damage in wistar rats. *Metabolism Open*, *8*, 100063.

[24] Creeden, J. F., Gordon, D. M., Stec, D. E., and Hinds Jr, T. D. (2021). Bilirubin as a metabolic hormone: The physiological relevance of low levels. *American Journal of Physiology-Endocrinology and Metabolism*, *320*(2), E191-E207.

[25] Hopkins, E., Sanvictores, T., and Sharma, S. (2022). Physiology, acid base balance. In *StatPearls [Internet]*. StatPearls Publishing.

[26] Wesson, D. E., Buysse, J. M., and Bushinsky, D. A. (2020). Mechanisms of metabolic acidosis–induced kidney injury in chronic kidney disease. *Journal of the American Society of Nephrology: JASN*, *31*(3), 469.

[27] Mitkowski, P. J., and Mitkowski, P. J. (2021). Dynamics of the Red Blood Cell System. *Mathematical Structures of Ergodicity and Chaos in Population Dynamics*, 7-11.

[28] Chen, Y. H., Jeng, S. S., Hsu, Y. C., Liao, Y. M., Wang, Y. X., Cao, X., and Huang, L. J. (2020). In anemia zinc is recruited from bone and plasma to produce new red blood cells. *Journal of Inorganic Biochemistry*, *210*, 111172.

[29] Srole, D. N., and Ganz, T. (2021). Erythroferrone structure, function, and physiology: Iron homeostasis and beyond. *Journal of cellular physiology*, *236*(7), 4888-4901.