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# Reno-protective effects of extract of *Tephrosia bracteolata* leaves on lead acetate-induced toxicity in male Wistar Rats

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## Abstract

Lead, a toxic heavy metal, induces several health complications through oxidative stress. *Tephrosia bracteolata* a traditional medicinal plant used in the treatment of various diseases reportedly exhibits potent antioxidant activity. This study investigated the protective effects of flavonoid rich extract of *T. bracteolata* (FRETB)on the renal function in rats exposed to lead acetate poisoning. Twenty male Wistar rats were distributed into five groups with four animals each. Group 1 served as normal control and were administered 5 ml/kg of distilled water. Renal toxicity was induced by intraperitoneal administration of Lead acetate-PbA (50 mg/kg) in groups 2 to 5 and treated as follows. Group 2 (PbA only), Group 3 (PbA+5 mg/kg FRETB), Group 4 (PbA+10 mg/kg FRETB) and Group 5 (PbA+50 mg/kg Ascorbic acid) (standard control). PbA was administered once per week while FRETB and Ascorbic acid were administered daily throughout the duration (28 days) of the study. The protective effects of FRETB on the kidney were investigated by evaluating the serum electrolyte levels, urea and creatinine concentration as well as histological studies on the kidney tissues. Induction of lead acetate showed significant ($p<0.05$) increase in serum electrolyte levels, urea, creatinine, and histological signs of kidney congestion. However, FRETB at 10 mg/kg significantly ($p < 0.05$) ameliorated the harmful effects of lead administration on serum electrolyte levels, urea and creatinine. This finding suggests that the flavonoid-rich extract of *Tephrosia bracteolata* leaves may hold therapeutic potential in mitigating lead-induced renal toxicity.

 

**Keywords:** Flavonoid-rich, *Tephrosia bracteolata*, lead acetate, renal toxicity, Wistar Rats

## Introduction

Lead is a biotoxic environmental and industrial pollutant, which accumulates in almost all body tissues such as the liver, lung, bones, kidneys, reproductive organs, and the immune system (Sudjarwo *et al*., 2017). The physiological, biochemical, and behavioral effects of this toxic lead in animals has been reported, including disorders of central and peripheral nervous systems, cardiovascular system, kidney, liver, and the reproductive system (Mohamed *et al*., 2015). The mechanism for lead nephrotoxicity is an imbalance between the scavenging capacity of antioxidants and the generation of reactive oxygen species (ROS) in the kidney. Mervat *et al*. (2022) have reported that antioxidant activity or inhibition of generation of free radicals plays a crucial role in protection against heavy metal induced nephrotoxicity. So, it has been claimed that protective agents against free radicals, such as plant based- antioxidants, may be useful for ameliorating heavy metal- induced toxicity in the kidneys (Sudjarwo *et al*., 2017).

One of the plants that have been extensively studied for its antioxidant capacity is *Tephrosia bracteolata* Guill. & Perr. (Leguminosae-Papilionoideae), which is a globous shrub, ranging from 2 to 8 feet in height, with long straight thinly silky branches and bright pink or purple flowers. The fruits are narrowly linear, about 5 to 6 long and 4 mm broad, appearing erect and usually curved upwards. The seeds are found in pods, and the leaflets are 4 to 8 cm long, 3 to 5 cm broad, linear, silky, and pubescent beneath, with bracteoles broadly ovate, 5 mm enclosing the buds (Egharevbaa *et al*., 2019). A study conducted by Egharevba *et al*. (2019) confirmed the presence of phytocompounds, such as alkaloids, steroids, tannins, flavonoids, and terpenoids, in the n-hexane and ethyl acetate extracts of *T. bracteolata* leaves. The presence these beneficial compounds in the plant's leaves positions it as a potential nephroprotective agent and making it candidate for further scientific investigation and validation.This study was therefore aimed at investigating Ameliorative Effects of Flavonoid-rich extract of *Tephrosia bracteolata* leaves on lead acetate-induced renal toxicity in male Wistar Rats

## Materials and Methods

### Materials

All chemicals used were of analytical grade.

### Methods

#### *Plant material*

The leaves of *T. bracteolata* were collected from its natural habitat and authenticated by an ethnobotanist.

#### *Extraction*

Fresh leaves of *T. bracteolata* were rinsed with distilled water to remove all debris, shade-dried for seven days and subsequently pulverized using an electric blender. A known quantity (1.5 kg) of the powder was macerated in 7.5 L of absolute ethanol. After 72 h, the suspension was filtered using a mesh, and then Whatman No 1 filter paper. This procedure was repeated twice and all the filtrates were concentrated in a rotary evaporator set at 45 °C to obtain the crude ethanol extract of *T. bracteolata*leaves. The flavonoid-rich extract of *T. bracteolata*leaves was prepared according to the method previously described Chu *et al*., (2002). Exactly 9 g of the crude extract was dis- solved in 60 ml of 10% $H_2SO_4$ and was hydrolysed by heating on a water bath for 30 min at 100 °C. Thereafter, the mixture was placed on ice for 15 min to allow the precipitation of flavonoids and aglycones. The precipitate (flavonoids/aglycones mixture) was dissolved in 50 ml of 95% ethanol (warmed to 50 °C) in 100 ml volumetric flask and thereafter made up to the

 

mark with the 95% ethanol. This was centrifuged, filtered and the filtrate collected was concentrated using a rotary evaporator to obtain the flavonoid-rich extract of *T. bracteolate* leaves (FRETB) that was stored in an airtight lightproof container at 4 °C until used.

### *Experimental animals*

Twenty male Wistar rats (200-250 grams) were accommodated in well-ventilated cages in the Animal House Unit of the Depart of Biochemistry, Prince Abubakar Audu University, Anyigba, with constant 12-h light 12-h dark cycle. The animals had free access to standard pelletized rat feed and clean water *ad libitum* and were allowed one week of acclimatization.

### *Experimental design*

The animals were weighed and randomly shared into five groups of four animals each. Group 1 served as normal control and were administered5 ml/kg of distilled water. Reproductive toxicity was induced intraperitoneal by administration of Lead acetate-PbA (50 mg/kg) in groups 2 to 5 and treated as follows. Group 2 (PbA only), Group 3 (PbA+5 mg/kg FRETB), Group 4 (PbA+10 mg/kg FRETB) and Group 5 (PbA+50 mg/kg Ascorbic acid) (standard control). PbA was administered once per week while FRETB and Ascorbic acid were administered daily throughout the duration (28 days) of the study.

### *Sacrifice and Sample Collection*

The rats were sacrificed on the 29th day by intraperitoneal injection of 120 mg/kg of sodium thiopentone anesthesia. Blood samples for serum assay were collected from each animal via cardiac puncture into the plain bottle

### *Estimation of Serum Urea and Creatinine Concentration*

Serum urea concentration was determined according to Urease-Berthelot method Weatherburn, (1967) while creatinine concentration was determined using the method of Perone *et al.*(1992).

### *Estimation of Serum electrolytes*

The serum electrolytes were analyzed using electrolyte analyzer (OPTI® LION electrolyte analyzer, OPTIMedical Systems Inc. Georgia, USA).

### *Histopathological examination of the Kidney*

The effect of treatment on the histology of the kidney of the rats was microscopically evaluated following Hematoxylin and Eosin stain. The organs were fixed in 10% formalin and histopathological examination was carried out according to the method of Drury *et al.* (1967).

### Statistical Analysis

All data were expressed as mean ± standard deviation, and statistical differences between means were determined by one- way ANOVA followed by Duncan's post–hoc test for multiple comparison tests using SPSS version 20. Values were considered significant at $P \leq 0.05$.

## Results

### Effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum electrolytes in lead acetate-induced renal toxicity in male Wistar Rats

The effect of flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum electrolytes in lead acetate-induced renal toxicity in male Wistar Rats is shown in Table 3. The result showed significant ($p<0.05$) increases in serum electrolytes ($Na^+$, $K^+$, and $HCO^-_3$) of the negative control (group 2 rats) when compared to the normal control. Administration of FRETB led to significant ($p<0.05$) decrease in the concentration of these renal function parameters in the treated groups (group 3 and 4). Most importantly, the 10mg/kg FRETB and ascorbic acid treated group (group 5 and 6) recorded the most potent effect as it displayed serum ($Na^+$, $K^+$, $Cl^-$ and $HCO^-_3$) concentration which is comparable to the normal control group.

**Table 1: Effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum electrolytes in lead acetate-induced renal toxicity in male Wistar Rats**

| Group/ Treatment | $K^+$ (µmol/L) | $Na^+$ (µmol/L) | $Cl^-$ (µmol/L) | $HCO_3^-$ (µmol/L) |
|---|---|---|---|---|
| **Group 1 (5 ml/kg Dist. $H_2O$)** | 3.53±0.11 [a] | 131.52±5.37[a] | 106.26±3.58[a] | 28.15±1.26[a] |
| **Group 2 (50 mg/kg PbA)** | 5.21±0.15[c] | 150.19±6.27[c] | 105.50±2.59[a] | 32.11±2.44[c] |
| **Group 3 (50 mg/kg PbA+5 mg/kg FRETB)** | 4.46±0.29[b] | 140.05±5.08[b] | 102.00±3.11[a] | 30.11±1.00[b] |
| **Group 4 (50 mg/kg PbA+10 mg/kg FRETB)** | 3.44±0.61 [a] | 128.50±3.21[a] | 104.31±3.43[a] | 28.28±1.30[a] |
| **Group 5 (50 mg/kg PbA+50 mg/kg AA)** | 3.56±0.34 [a] | 131.26±3.44[a] | 103.82±4.22[a] | 27.17±1.51 [a] |

Mean values having different lowercase alphabets as superscripts are consideredsignificant ($p<0.05$) along the columns. PbA= Lead acetate, FRETB=Flavonoid-rich extract of *Tephrosia bracteolata* leaves, AA= Ascorbic acid

### Effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum concentration of urea and creatinine in lead acetate-induced renal toxicity in male Wistar Rats

Table 2 shows the effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum concentration of urea and creatinine in lead acetate-induced renal toxicity in male Wistar Rats. From the data obtained, there was a significant ($p<0.05$) increase in urea and creatinine concentration of the lead acetate-induced untreated group (group 2) when compared to the normal control. However, Treatment with FRETB and standard drug decreased the urea and creatinine concentration when compared to lead acetate-induced untreated group (group 2).

 

**Table 2: Effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on serum concentration of urea and creatinine in lead acetate-induced renal toxicity in male Wistar Rats**

| Group/ Treatment | Urea (µmol/L) | Creatinine (µmol/L) |
|---|---|---|
| **Group 1(5 ml/kg Dist. $H_2O$)** | 2.88±0.26[a] | 59.34±3.22[a] |
| **Group 2 (50 mg/kg PbA)** | 5.23±0.41[a] | 70.56±5.14[b] |
| **Group 3 (50 mg/kg PbA+5 mg/kg FRETB)** | 3.15±0.22[a] | 69.18±4.28[b] |
| **Group 4 (50 mg/kg PbA+10 mg/kg FRETB)** | 2.19±0.12[a] | 55.55±3.31[a] |
| **Group 5 (50 mg/kg PbA+50 mg/kg AA)** | 2.46±0.39[a] | 56.28±4.28[a] |

Mean values having different lowercase alphabets as superscripts are consideredsignificant ($p<0.05$) along the columns. PbA= Lead acetate, FRETB=Flavonoid-rich extract of *Tephrosia bracteolata* leaves, AA= Ascorbic acid

**Effect of Flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on histology of the kidney in lead acetate-induced renal toxicity in male Wistar Rats**

Plates 1 to 5 shows the result of the histopathological assessment of the kidney tissues of the treated lead acetate-exposed Wistar rats.

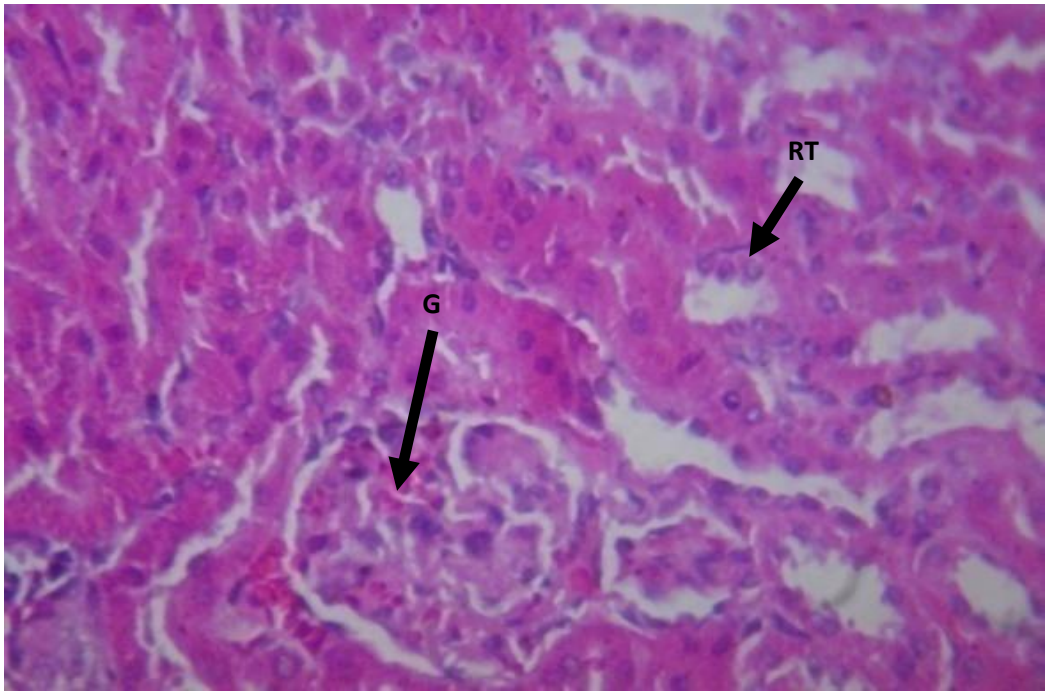


**Plate1.** Histologic section of kidney tissue of distilled water (5 ml/kg)- treated rat (normal control) showing normocellular glomerular tufts disposed on a background containing renal tubules. No abnormalities are seen.(HE x 250). RT=Renal tubule, G= Glomerulus

 

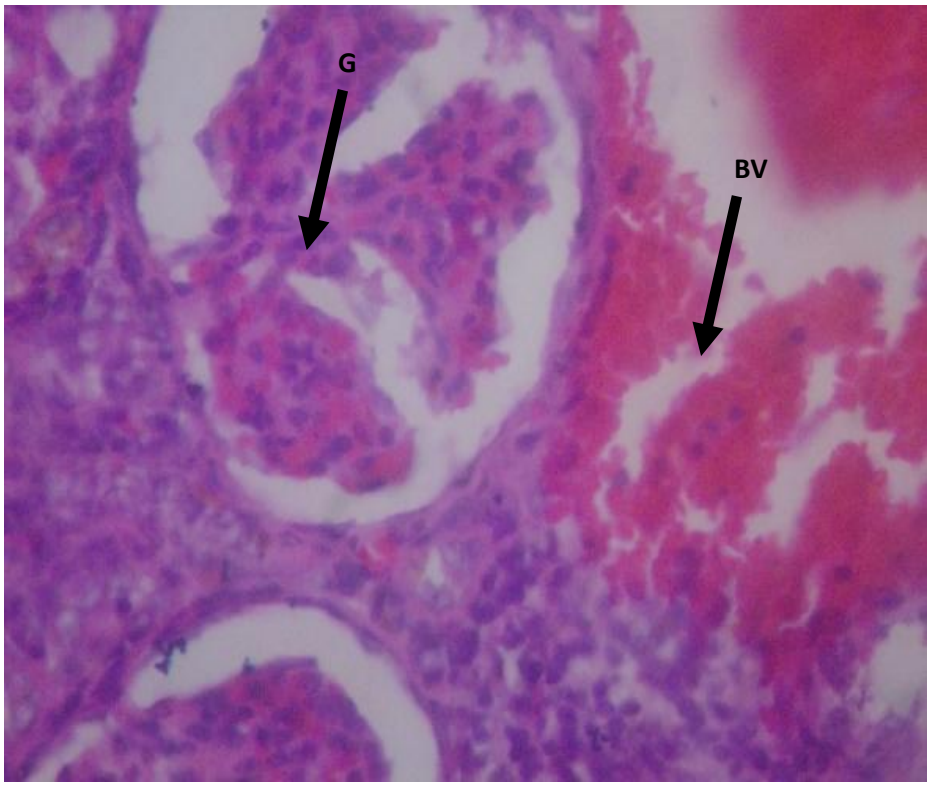


**Plate 2.** Histologic section of kidney tissue of PbA (50 mg/kg)- treated rat showing normocellular glomerular tufts disposed on a background containing viable tubules. Massive congested blood vessels (vascular congestion) are seen. (HE x 250). RT=Renal tubule, BV= Blood vessels, PbA= Lead acetate

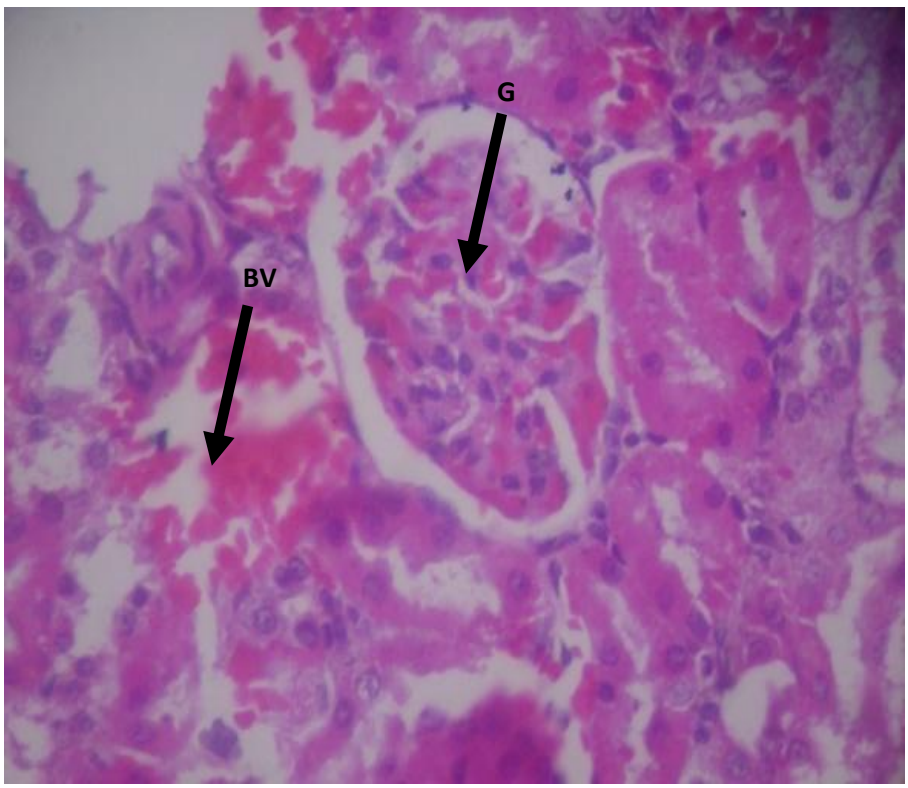


**Plate 3.** Histologic section of kidney tissue of PbA (50 mg/kg)+ FRETB (5 mg/kg)- treated rat showing normocellular glomerular tufts disposed on a background containing viable tubules. Mild congested blood vessels (vascular congestion) are seen. (HE x 250). RT=Renal tubule, BV= Blood vessels,PbA= Lead acetate, FRETB=Flavonoid-rich extract of *Tephrosia bracteolata* leaves

 

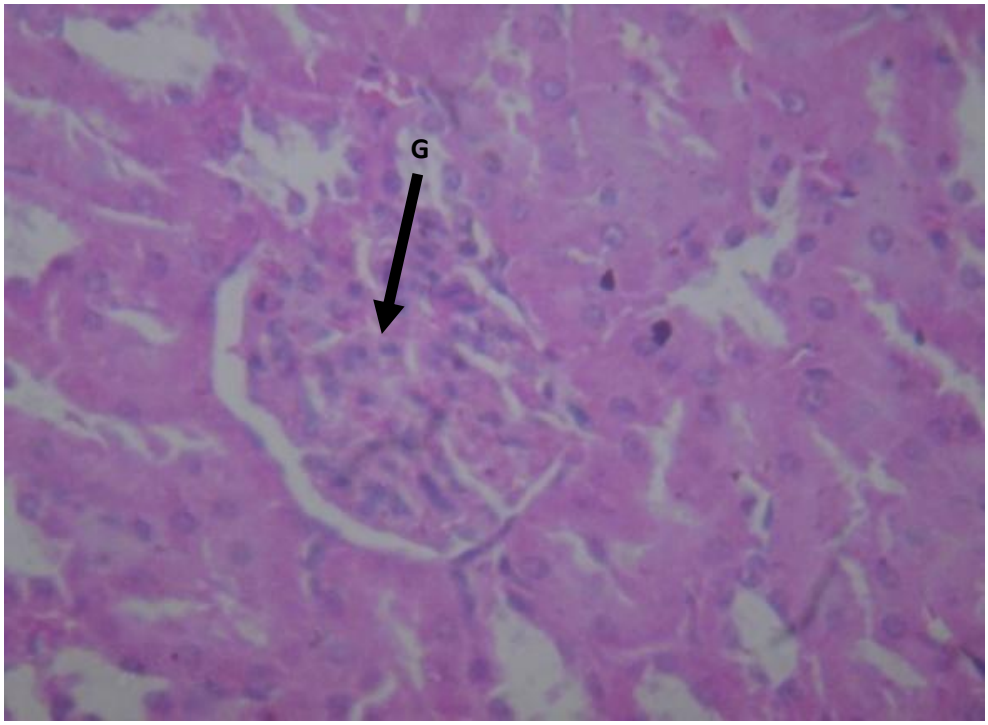


**Plate 4.** Histologic section of kidney tissue of PbA (50 mg/kg) + FRETB (10 mg/kg)- treated rat showing normocellular glomerular tufts disposed on a background containing renal tubules. No abnormalities are seen. (HE x 250). G= Glomerulus,PbA= Lead acetate, FRETB=Flavonoid-rich extract of *Tephrosia bracteolata* leaves

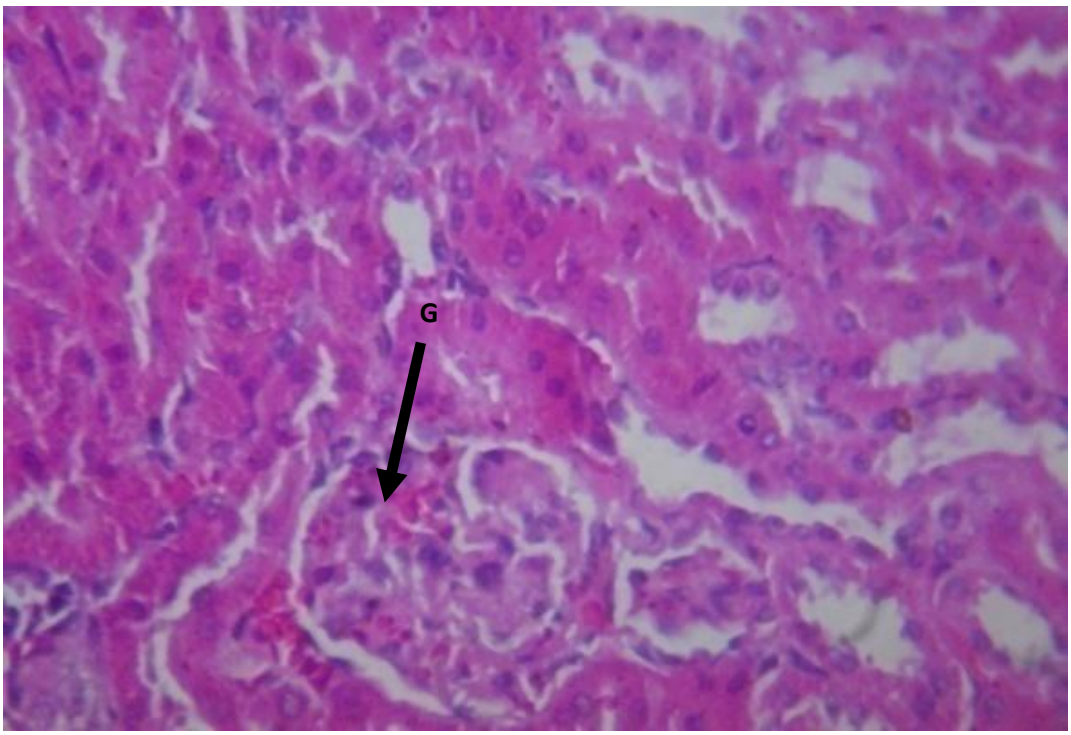


**Plate 5.** Histologic section of kidney tissue of PbA (50 mg/kg) + AA (5 mg/kg)- treated rat (standard control) showing normocellular glomerular tufts disposed on a background containing renal tubules. No abnormalities are seen. (HE x 250), G= Glomerulus,PbA= Lead acetate, AA= Ascorbic acid

 

## Discussion

Kidney is a target organ for lead toxicity. The toxic effects of Pb on the kidney appear to be primarily localized in the kidney tubule and are manifested as excessive urinary excretion of amino acids, glucose and phosphate, natriuresis, kaliuresis and intranuclear bodies inclusion (Jadhav, 2017). These changes may be related to one or more factors, including increased serum levels of Pb or decreased Pb reabsorption by alteration in tubular transport mechanisms, as well as structural lesions in the nephron (Murata *et al*., 2009). The kidneys are vital organs responsible for filtering blood, removing waste products, and maintaining electrolyte balance. Their intricate system of nephrons filters blood and selectively reabsorbs or excretes electrolytes to keep their concentrations within narrow physiological ranges (Ramachandran, 2016).

Electrolytes are important for the normal functioning of many bodily processes ranging from control of fluid levels, acid-base balance (pH), nerve conduction, and blood clotting to muscle contraction. An imbalance in electrolyte concentrations usually results from kidney failure, dehydration, fever, and vomiting, all of which have also been implicated as some of the culprits responsible for complications that are usually associated with renal toxicity and other endocrine disorders. The link between kidney failure and serum electrolytes is intricate and also a function of other factors such as age and associated conditions (Shah *et al*., 2011). The test for electrolytes includes the measurement of sodium, potassium, chloride, and bicarbonate for both diagnosis and management of renal, endocrine, acid-base, water balance, and many other conditions. Potassium used as a most convincing electrolyte marker of renal failure. The combination of decreased filtration and decreased secretion of potassium in distal tubule during renal failure cause increased plasma potassium. Hyperkalemia is the most significant and life-threatening complication of renal failure (James and Mitchel, 2016).

From the results obtained in this study, significant ($p<0.05$) increases in serum $K^+$, $Na^+$, and $HCO_3^-$ concentrations of the lead acetate –induced untreated group (group 2) when compared to normal control group was observed but the serum concentration of $Cl^-$ was not significantly affected (Table 3.1). This could be due to the intoxication of lead acetate which is majorly responsible for serum electrolyte imbalance. One mechanism by which lead acetate can increase serum electrolyte level is by impairing the renal tubules ability to reabsorb electrolyte like sodium $K^+$, $Na^+$, and $Cl^-$. These findings are also in agreement with results of previous investigations by Lin *et al*. (2013) who recorded an increase in electrolyte concentration after environmental exposure to lead (Pb). Lead-induced renal toxicity through oxidative stress disrupts the delicate balance of serum electrolytes. According to Mervat *et al*. (2012 lead can impair the functioning of renal tubules, leading to increased excretion of essential ions like calcium, magnesium, and phosphate. Simultaneously, it may result in the reabsorption of harmful ions like lead, further exacerbating the toxic effects. An increase in serum electrolyte levels, known as hypernatremia (elevated sodium), hyperkalemia (elevated potassium), hypercalcemia (elevated calcium), is a condition that can result from several factors, including oxidative stress (Veldurthy *et al*., 2016).

Sodium regulation occurs in the kidneys. The proximal tubule is where the majority of sodium reabsorption takes place. In the distal convoluted tubule, sodium undergoes reabsorption. Sodium transport occurs via sodium-chloride symporters, controlled by the hormone aldosterone (Palmer and Schnermann, 2015). These imbalances can have detrimental effects on the body's functionality and, in some cases, be life-threatening. Understanding the causes and implications of these elevated levels is crucial for effective therapeutic intervention and prevention (kraut and Medias, 2017).

Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and the body's ability to

 

counteract their harmful effects. ROS, including free radicals and peroxides, are highly reactive molecules that can damage lipids, proteins, and DNA within cells (Mohammed *et* al., 2015). This oxidative damage is a hallmark of various diseases, aging, and exposure to environmental toxins, making it a critical area of study in modern medicine. Oxidative stress can influence sodium levels in the body through several mechanisms. One of the key ways this occurs is by ROS-mediated damage to the renal tubules. The kidneys play a vital role in regulating sodium balance, and when oxidative stress impairs their function, sodium excretion may become compromised. This can lead to hypernatremia, a condition characterized by elevated serum sodium levels, which can result in symptoms like dehydration, confusion, and muscle twitching (Sudjarwo *et al*., 2017).

Maintaining a delicate balance of electrolyte concentrations is essential for overall health. The body has intricate mechanisms to control the levels of these ions in the blood, ensuring that they remain within narrow ranges. This balance is maintained through the coordination of various organs, including the kidneys, which filter and excrete excess electrolytes, and hormone-regulated processes that influence electrolyte absorption and secretion in the intestines and renal tubules. Any disruption in this equilibrium can lead to severe health consequences (Kraut and Madias, 2017).

The result of this study however, showed that rats in the FRETB-treated groups registered significantly ($p<0.05$) lower serum K+, Na+, Cl −, and $HCO_3$− concentrations relative to the untreated control. This effect could be attributed reno-modulatory effect of FRETB which resulted in an improvement in electrolyte homeostasis leading to reduction in fluid and electrolyte loss (Tajudeen *et al*, 2019). The ameliorative effects observed can be explained by the flavonoid rich extract ability to counteract the disruption of renal function caused by lead-acetate toxicity. This include reducing oxidative stress, inflammation and renal cell damage, ultimately leading to the restoration of normal electrolyte balance in the rats (Idakwoji *et al*., 2021). Flavonoids are one of nature's antioxidants. They play a crucial role in counteracting the harmful effects of free radicals. Flavonoids possess a unique chemical structure that enables them to neutralize free radicals. Their multiple phenolic rings allow them to donate electrons to stabilize these radicals. Flavonoids act as scavengers by intercepting and neutralizing free radicals, preventing them from damaging cellular components such as DNA, lipids, and proteins. They are particularly effective in scavenging hydroxyl radicals, one of the most reactive and damaging types of free radicals in the body (Egharrevba *et al*., 2021). This compound also exhibits the ability to scavenge superoxide anions, which are another class of harmful free radicals. Some flavonoids can chelate metal ions like iron and copper, reducing their ability to catalyze the formation of free radicals through Fenton reactions. Flavonoids often work in synergy with other antioxidants, such as vitamin C and vitamin E, enhancing the overall antioxidant capacity of the body. They help protect cells from oxidative damage, maintaining their structural and functional integrity (Egharrevba *et al*., 2021).

Flavonoids also exhibit anti-inflammatory properties, which contribute to their ability to combat oxidative stress. The consumption of flavonoid-rich foods and beverages has been linked to a reduced risk of chronic diseases, including cardiovascular disease, cancer, and neurodegenerative disorders. Flavonoids may protect the brain from oxidative stress, potentially reducing the risk of cognitive decline and neurodegenerative diseases like Alzheimer's. Flavonoids play a crucial role in scavenging free radicals and protecting the body from oxidative stress. Their widespread presence in the plant kingdom and numerous health benefits make them an essential component of a healthy diet and lifestyle. Further research is ongoing to explore their full potential in disease prevention and management (Ekaluo *et al*., 2014).

Urea is a nitrogenous end product of protein catabolism and is a waste product of the body passed into the bloodstream for onward removal

 

by the kidneys through urine, while creatinine is a waste product formed from spontaneous dehydration of the kidneys and is usually produced in proportion to body mass (Thakran *et al.*, 2004). Elevated level of urea and creatinine in the blood can indicate impaired kidney function. This occur due to damage to the renal tubules or reduced glomerular filtration rate (GFR), which means kidney are less effective in filtering these waste products from the blood. The determination of serum urea and creatinine concentrations are useful markers for assessing the function of the kidney (Idakwoji *et al*., 2021).

Urea and creatinine are two important biochemical markers in the human body that play a significant role in assessing kidney function and overall health (Corbett, 2018). Urea is filtered out of the blood by the kidneys and excreted in urine. Creatinine is a waste product of muscle metabolism and is also excreted by the kidneys. Together, these substances provide valuable information about kidney function and overall health. Urea and creatinine levels are commonly measured through blood tests to assess kidney function. Elevated levels can indicate problems with the kidneys' ability to filter and excrete waste products, suggesting possible kidney disease or dysfunction (Pagana, 2022).

The lead acetate significantly increased creatinine and urea levels, which can be an indicator of impaired renal function in nephrotoxicity. The serum creatinine and urea are recommended for the assessment of kidney injury in preclinical studies as it is considered a more specific and sensitive indicator of kidney damage. Low levels of serum creatinine and urea are normally found in the blood, but when the kidney is damaged or diseased, creatinine and urea levels go up. Most increases in serum creatinine and urea levels are caused by kidney damage (Moussa and Bashandy, 2018).

The present study shows significant ($p<0.05$) increases in serum urea and creatinine concentrations following lead acetate administration, thus indicating an impairment in kidney function. A similar observation was reported by Hussein *et al*., (2014) who reported that lead acetate treatment induced significant elevation of serum creatinine urea activities. The kidneys are particularly vulnerable to lead-acetate toxicity due to their role in filtering blood. Lead can accumulate in the kidneys, disrupting their normal function and leading to kidney damage. Elevated levels of urea and creatinine are often observed in cases of lead poisoning (Banfi *et al*., 2016). This is primarily because lead-induced kidney damage impairs their ability to filter and excrete waste products effectively. Urea useful in differential diagnosis of acute renal failure and pre renal condition where blood urea nitrogen–creatinine ratio is increased (Corbett, 2018). Urea clearance is a poor indicator of glomerular filtration rate as its overproduction rate depends on several non-renal factors, including diet and urea cycle enzymes. Increased blood urea nitrogen (BUN) is seen associated with kidney disease or failure, blockage of the urinary tract by a kidney stone, congestive heart failure, dehydration, fever, shock and bleeding in the digestive tract. The high BUN levels can sometimes occur during late pregnancy or result from eating large amounts of protein-rich foods. When the BUN level is higher than 100 mg/dL it points to severe kidney damage whereas decreased BUN is observed in fluid excess. Low levels are also seen in trauma, surgery, opioids, malnutrition, and anabolic steroid use (Pagana, 2022).

Also, the creatinine clearance test is used to monitor the progression of renal disease. The diagnosis of renal failure is usually suspected when serum creatinine is greater than the upper limit of the "normal" interval. In chronic renal failure and uremia, an eventual reduction occurs in the excretion of creatinine by both the glomeruli and the tubules (Edmund *et al*., 2015*).* Creatinine values may alter as its generation may not be simply a product of muscle mass but influenced by muscle function, muscle composition, activity, diet and health status (Banfi *et al*., 2016). The increased tubular secretion of creatinine in some patients with kidney dysfunction could give false negative value (Branten *et al*., 2015). Lead can affect the

 

glomerular filtration rate (GFR), reducing the kidneys' ability to filter blood efficiently. This leads to the retention of urea and creatinine in the bloodstream. The oxidative stress caused by lead-acetate toxicity can directly damage kidney cells, exacerbating kidney dysfunction and further contributing to high urea and creatinine levels (Edmund and David, 2016).

Following treatment with the extract, FRETB-treated groups recorded significant ($p<0.05$) dose-dependent declines in urea and creatinine concentrations relative to the untreated group (group 2). This finding could be accrued to the presence of pharmacologically active phytoconstituents such as phenols, tannins, and flavonoids, which are highly detected in flavonoid rich extract of *Tephrosia bracteolate* and are known to protect the kidney tissues from the damaging effects of radical species generated by lead-acetate. (Idakwoji *et al.*, 2021). Additionally, FRETB may safeguard the structural integrity of the kidneys, thereby facilitating the restoration of normal renal function. This suggest that flavonoid rich extract of *Tephrosia bracteolate* has potential therapeutic benefit in counteracting lead acetate-induced renal toxicity.

## Conclusion

This study investigated the ameliorative effects of the flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) on lead acetate-induced renal toxicity in male Wistar rats. Lead acetate exposure was shown to induce renal toxicity in the male Wistar rats, manifesting in elevated serum electrolyte levels, urea, creatinine, and histological signs of kidney congestion. These observations underscored the detrimental impact of lead acetate on renal health. However, the administration of the flavonoid-rich extract of *Tephrosia bracteolata* leaves (FRETB) proved to be a promising therapeutic intervention exhibiting a notable reversal of the adverse effects induced by lead acetate. These findings hold great promise for the potential use of *Tephrosia bracteolata* leaf extract rich in flavonoids as a natural therapeutic agent to counteract the renal toxicity associated with lead exposure.

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