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Protective potential of ethanol leaf extract of *Vernonia amygdalina* against aluminium chloride induced renal toxicity in male Wistar rats

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Abstract
Background: *Vernonia amgdalina* Del. is used in traditional medical practice for the treatment of various ailments including kidney disorders.
Objective: To evaluate the protective potential of ethanol leaf extract of *Vernonia amygdalina* against aluminium chloride induced renal damage in male rats so as to provide some evidence for its ethno medicinal application in the treatment of renal disorder.
Methodology: Male Wistar rats weighing 180-220 g were treated with 100 mg/kg bw of aluminium chloride and 400 mg/kg bw of ethanol leaf extract of *Vernonia amygdalina* for 21 days. Assay for some indices of renal damage in serum and histopathological examination of the kidney were carried.
Results: Treatment with aluminium chloride induced a significant increase (p<0.05) in serum levels of urea, creatinine, bicarbonate and chloride which became significantly reduced (p<0.05) in the presence of ethanol leaf extract of *Vernonia amygdalina*. Histopathological alterations in tissue sections were also reversed by the leaf extract.
Conclusion: The results demonstrated the protective properties of ethanol leaf extract of *Vernonia amygdalina* aganst aluminium chloride induced damage to the kidney of male Wistar rats.

Keywords: Aluminium chloride, kidney, nephroprotective, *Vernonia amygdalina*

1. Introduction
Aluminium is one of the most extensively distributed elements on earth [1]. It is a component of industrial products such as cosmetics, cookware, food additives and toothpaste [2] as well as pharmaceutical products including antacids, buffered aspirin, vaccines and injectable allergens [3, 4, 5]. Aluminium is often found in drinking water as a consequence of its being utilized in water purification process [6]. Aluminium is a major component of industrial waste especially in cement producing factories [7]. Furthermore, food substances such as corn, yellow cheese, salt, herbs, spices and tea have been reported to contain aluminium [8]. Human exposure to aluminium is inevitable because of its abundance [9]. Daily normal intake of aluminium for adults has been reported to be within 1-10 mg [10]. Ingestion of high levels of aluminium predisposes to increased deposition of this metal in the heart, kidneys, brain and the liver [11, 12]. This may result in cardiotoxicity, nephrotoxicity, neurotoxicity and hepatotoxicity [13, 14].
Medicinal plants have been used by man since ancient times to treat diverse ailments [15, 16]. Currently, a significant number of persons in third world countries still rely on plants for medicinal purposes [17]. One of such medicinal plants with an increasing role in herbal medicine is *Vernonia amygdalina* Del [18]. This plant is commonly called 'bitter leaf' because of its bitter taste. It is a shrub or small tree that can attain a height of 2-5 m when fully grown. It belongs to the family Asteraceae and thrives in most parts of Tropical Africa. The leaves are petiolate, about 6 mm in diameter, elliptical in shape with characteristic color and taste [19] *Vernonia amygdalina* has been domesticated in many parts of Africa. In Nigeria, it has a variety of local names such as 'Etidot' in Ibibio, 'Ewuro' in Yoruba, 'Onugbo' in Igbo and 'Chusa-doki' in Hausa [20]. Almost all the parts of this plant have been found to be pharmacologically important [21]. In ethnomedicine, *Vernonia amygdalina* is used to treat a wide variety of ailments including fevers, hiccups, kidney problems and abdominal discomfort [22]. Many of the traditional medicinal applications of this plant have been confirmed scientifically [18, 23]. Various phytochemical compounds are present in this plant such as

saponins, sesquiterpenes, lactones and flavonoids, vernoniosides A1, A2, A3, A4, B1 B2 and B3 [23]. The therapeutic benefits of *Vernonia amygdalina* have been attributed to its rich content of bioactive compounds [24]

The protective values of some medicinal plants and plant based products against aluminium toxicity have been reported [13, 25, 26, 27]. There is paucity of information on the protective potential of *Vernonia amygdalina* against aluminium induced toxicity [28] Therefore, the present study was carried out to assess the effect of ethanol leaf extract of *Vernonia amygdalina* on some indices of renal function in male Wistar rats exposed to toxic dose of aluminium chloride.

2. Materials and methods

2.1 Chemicals and reagents

Aluminium chloride was obtained from Guangdong Guanghua Sci-Tech Company Limited, Shantou, Guandong, China. All other chemicals used for this study were of analytical grade. Working solutions were prepared with distilled water.

2.2 Collection and preparation of leaf extract

Fresh leaves of *Vernonia amygdalina* were purchased from a local market in Uyo, Akwa Ibom State, Nigeria. They were authenticated by a Taxonomist in the Department of Botany and Ecological Studies, Faculty of Science, University of Uyo, Uyo, Akwa Ibom State where a voucher specimen was deposited. The leaves were washed with clean water to remove dust particles. They were air dried for two weeks. The dried leaves were pulverized using a manual grinder. The powdered sample (600 g) was macerated in 1.5 L of 70% ethanol for 48 hours with intermittent shaking. The mixture was filtered with white muslin cloth and subsequently with Whatman No 1 filter paper. The filtrate was evaporated to dryness in vacuo using a Rotary Evaporator. The weight of the resulting extract was 30.54 g; yield=5.09%. The crude extract was reconstituted in distilled water to appropriate concentrations for administration during the experiment.

2.3 Experimental animals

Male Wistar rats weighing 180-220 g were used for the study. The animals were obtained from the Animal House, Faculty of Basic Medical Sciences, University of Uyo, Uyo. The rats were housed in standard cages and were maintained on a standard pelleted feed. They were allowed free access to food and drinking water. They were kept in a well-ventilated room at a temperature of 25±2 degrees Celsius and under a 12 h light/ 12 h dark cycle. The care and use of the animals were in accordance with the National Institute of Health Guide for the Care and Use of Laboratory Animals [29]. Approval for the study was obtained from the College of Health Sciences Animal Ethics Committee, University of Uyo, Uyo, Nigeria. The rats were allowed to acclimatize for a period of two weeks prior to commencement of the experiment.

2.4 Experimental design

A total of twenty (20) rats were randomly selected into four (4) groups with 5 rats in each group. Group 1 served as the control group and was administered water 10 mL/kg body weight. Groups 2 and 3 were respectively administered with 100 mg/kg body weight of aluminum chloride and 400 mg/kg body weight of ethanol leaf extract of *Vernonia amygdalina*. Group 4 received concomitantly, 100 mg/kg body weight of aluminum chloride and 400 mg/kg body weight of ethanol leaf extract of *Vernonia amygdalina*. Aluminium chloride and ethanol leaf extract of *Vernonia amygdalina* were administered by oral gavage daily (between 8 and 10 am) for a period of 21 days.

2.5 Collection of serum sample

At the end of the experimental period, the animals were fasted overnight, placed under ketamine anesthesia (100 mg/kg body weight) and blood sample was obtained through cardiac puncture. The blood sample (5 mL) was dispensed into plain sample bottles and allowed to clot. Serum was obtained by centrifugation in a bench top centrifuge (MSE Minor, England) at 3000 rpm for 15 minutes. The serum was stored frozen at −20 °C. The kidneys were surgically removed and preserved in 10% buffered formalin for histological studies.

2.6 Determination of indices of renal function

Serum concentrations of urea, creatinine and electrolytes were measured using the automated Clinical Chemistry Analyzer (BS-200E). The analyses were based on standard procedures described in the respective assay kits.

2.7 Histopathological analysis

The kidneys were processed and embedded in paraffin wax. Sections of 5 µm thickness were prepared, stained with haematoxylin and eosin (H&E) and examined for histopathological changes using a light microscope [30]

2.8 Data analysis

Data obtained were expressed as Mean ± SEM and analyzed using the one way ANOVA. Post hoc analysis (comparison across groups) was carried out using the least significant difference (LSD). Values of $p < 0.05$ were considered to be statistically significant.

3. Results

3.1 Effect of ethanol leaf extract of *Vernonia amygdalina* on some parameters of renal function in Wistar rats treated with Aluminium chloride

The effect of ethanol leaf extract of *Vernonia amygdalina* on some parameters of renal function in Wistar rats treated with aluminium chloride is presented in Table 1. Administration of aluminium chloride resulted in a significant increase ($p<0.05$) in the serum concentrations of urea, creatinine, chloride and bicarbonate. Administration of ethanol leaf extract of *Vernonia amygdalina* alone did not induce any significant difference ($p>0.05$) in the parameters of renal function when compared to the control. The administration of ethanol leaf extract of *Vernonia amygdalina* and aluminium chloride concomitantly produced a significant decrease ($p<0.05$) in the serum concentration of urea, creatinine, potassium, chloride and bicarbonate when compared to the aluminium chloride treated group. The values in this case were comparable to those of the control group.

Table 1: Effect of ethanol leaf extract of *Vernonia amygdalina* on some indices of renal function in male Wistar rats treated with aluminium chloride

Groups	Urea (mg/dl)	Creatinine (mg/dl)	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)	HCO_3 (mmol/L)
Control	28.58±0.46	69.92±0.83	98.42±0.99	7.11±0.52	100.03±0.61	21.87±1.09
$AlCl_3$	34.58±1.52[a]	85.62±2.11[a]	100.55±0.71	7.17±0.79	105.71±1.93[a]	34.09±2.06[a]
Extract	27.92±0.87[b]	71.62±1.34[b]	95.09±1.27	6.66±0.33	102.34±2.16	25.44±2.67[b]
$AlCl_3$ +Ex	28.77±0.23[b]	70.34±0.29[b]	97.05±1.19	5.15±0.39[a,b]	96.74±0.57[b]	14.19±0.50[a,b]

Data presented as Mean ± Standard Error of Mean (SEM). a = significantly different when compared to Group 1; b = significantly different when compared to Group 2; c = significantly different when compared to Group 3.

3.2 Effect of ethanol leaf extract of *Vernonia amygdalina* on the histology of the kidney of male Wistar rats treated with aluminuim chloride

The effect of ethanol leaf extract of *Vernonia amygdalina* on the histology of the kidney of male Wistar rats treated with aluminuim chloride is presented in Figure 1. Kidney of control group and *Vernonia amygdalina* treated group showed normal renal tissue histoarchitecture. Administration of aluminuim chloride caused congested capillaries in some of the glomeruli which were reversed by co-administration of ethanol leaf extract of *Vernonia amygdalina*.

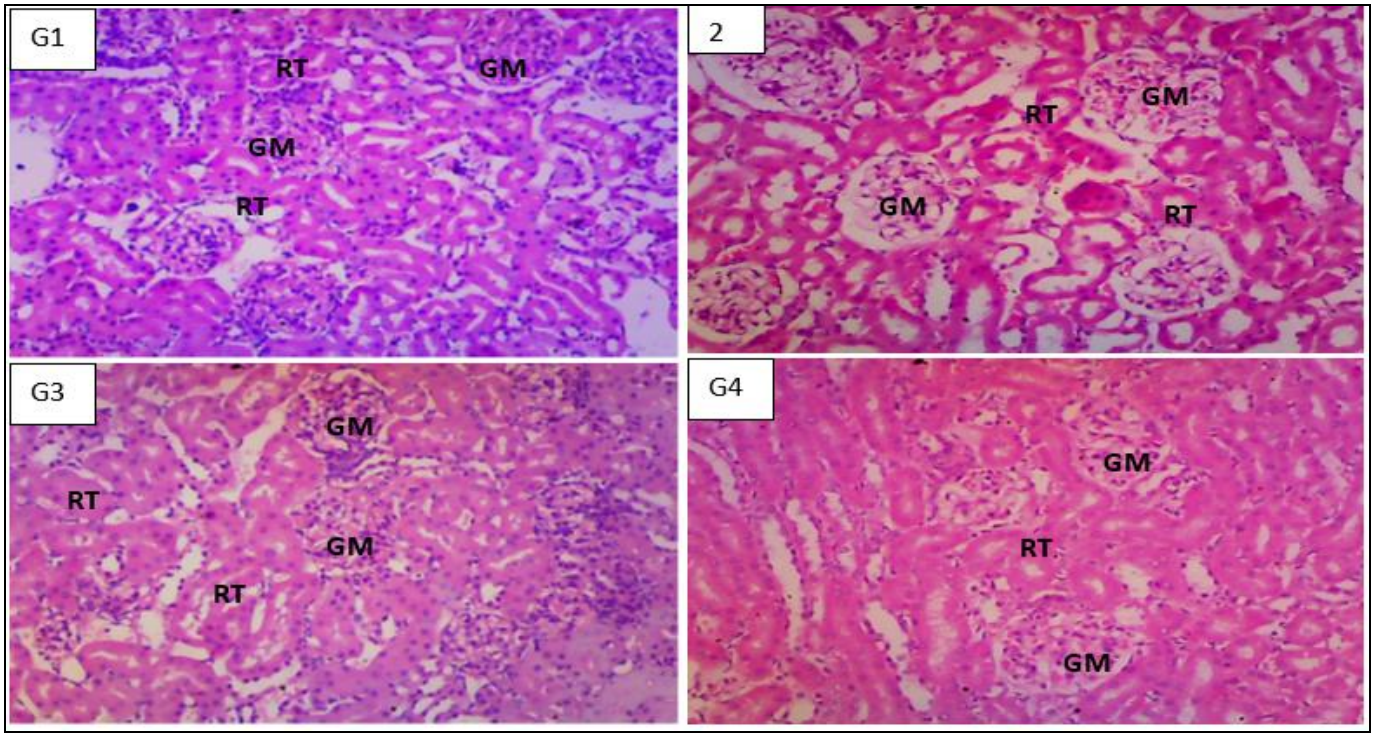

Fig 1.0: Photomicrograph of Kidney of Group 1 (Control) showed normal renal tissue histology architecture evidenced with normal glomeruli (GM) and renal tubule (RT); Group 2 (administered aluminum chloride) showed glomeruli (GM) with reduced cellularity and renal tubule (RT). There is evidence of congested capillaries in some of the glomeruli**;** Group 3 (administered *Vernonia amygdalina*) evidenced with normal glomeruli (GM) and renal tubule (RT); Group 4 (concomitantly administered aluminum chloride and *Vernonia amygdalina*) evidenced with normal glomeruli (GM), renal tubule (RT).

4. Discussion

The present study evaluated the protective potential of ethanol leaf extract of *Vernonia amygdalina* against aluminium chloride induced toxicity to the kidney in male Wistar rats.

The kidney is an important physiological organ that plays a vital role in the regulation of intracellular fluid volume, electrolyte and acid-base balance as well as the excretion of waste products of metabolism. Renal functions are compromised when there is toxic injury. Such damage is associated with abnormalities in biomarkers such as serum urea, creatinine and electrolytes [31]. Creatinine and urea are non-protein nitrogenous metabolites that are normally cleared by the body following glomerular filtration [32]. Consequently, the serum concentrations of these two compounds will increase when the functional capacity of the kidney is impaired [33]. In the present study, administration of aluminium chloride precipitated a significant increase in the serum concentrations of urea and creatinine compared to the control. This is an indication of toxic injury to the kidneys induced by aluminium chloride. Other authors have also reported renal toxicity of aluminium characterized by a significant increase in serum levels of these biomarkers [34, 35, 36, 37].

The kidney also plays a major role in the regulation of body fluids and electrolytes [38]. An imbalance in electrolyte levels could have a negative impact on human health [39]. In this study aluminium chloride was observed to cause derangement in electrolyte concentrations characterized by significant increase in serum levels of bicarbonate and chloride ions. Chloride is the major anion in extracellular fluid where it plays a crucial role in water distribution, osmotic pressure acid base balance. Increased plasma concentrations of chloride ions may occur in various conditions including acute renal failure [40]. Bicarbonate constitutes the second largest fraction of plasma anions. The bicarbonate ions act as buffer to maintain the normal levels of acidity in blood and other

fluids [38]. Conditions that affect the kidneys can influence acid base balance of body fluids [41]

Administration of ethanol leaf extract of *Vernonia amygdalina* was found to reduce the serum concentrations of urea, creatinine, chloride and bicarbonate ions even in the absence of the toxicant. This is an indication of the nephroprotective potential of the leaf extract of *Vernonia amygdalina.* Methanol extract of *Vernonia amygdalina* had earlier been observed to significantly reduce the elevated concentrations of urea and creatinine in sodium chloride induced hypertension [42]. Also a significant reduction in the elevated serum concentrations of urea and creatinine in alloxan induced diabetic rats following the administration of methanol extract of *Vernonia amygdalina* [43]. Incidentally, *Vernonia amygdalina* has been found to be rich in phytochemicals such as flavonoids, alkaloids and polyphenols [23]. The ameliorative activities of ethanol leaf extract of *Vernonia amygdalina* could, therefore, be attributed to its rich content of these bioactive compounds [24, 42].

The histology of the kidney tissues added credence to the nephrotoxic effects of aluminium chloride. Interestingly, the ethanol leaf extract of *Vernonia amygdalina* effectively restored these histopathological alterations to normal. Histopathological changes in renal tissues induced by aluminium chloride but reversed by the administration of camel's milk, *Lipidium sativum* and naringenin respectively have been documented by other authors [36, 44, 45]

5. Conclusion

The present study has demonstrated the protective potentials of ethanol leaf extract of *Vernonia amygdalina* against aluminium chloride induced renal impairment. The results have also provided experimental evidence for the ethno medicinal use of this plant in the management of renal disorders.

6. Conflict of interest

The authors declare that there is no conflict of interest

7. References

1. Camargo MM, Fernandes MN, Martinez CB. How aluminium exposure promotes osmoregulatory disturbances in the neotropical freshwater fish *Prochilus lineatus.* Aquatic Toxicology. 2009; 94(1):40-46.
2. Malekshah AK, Torabizadeh Z, Naghshwar F. Developmental toxicity of aluminium from high doses of aluminium chloride in mice. The Journal of Applied Research, 2005; 5(4):575-579.
3. Cannatta J, Briggs J, Junor R, Fell S. Aluminium hydroxide intake: real risk of aluminium toxicity. British Medical Journal, 1983; 286:1937-1938.
4. Lione A. Aluminium toxicity and the aluminium containing medications. *Journal of* Pharmacology and Therapeutics, 1985; 29:255-285.
5. Kaehny W, Hegg A, Alfrey A. Gastrointestinal absorption of aluminium from aluminium containing antacids. New England Journal of Medicine. 1997; 296:1389- 1390.
6. Newairy AS, Salama AF, Hussien HM, Yousef M. Propolis alleviates aluminium induced lipid peroxidation and biochemical parameters in male rats. Food and Chemical Toxicology. 2009; 47:1093-1098.
7. Fatima SK, Prabhavathi PA, Pradmarathi P, Reddy PP. Analysis of chromosomal aberrations in men occupationally exposed to cement dust. Mutation Research. 2001; 490:179-186.
8. Pennington JA, Schoen SA. Estimation of dietary exposure to aluminium. Food Additives and Contaminants. 1995; 12(1):119-128.
9. Kumar V, Gill, KD. Aluminium neurotoxicity: Neurobehavioral and oxidative aspects. Archives of Toxicology. 2009; 83:965-978.
10. Greger JL, Goetz W, Sullivan D. Aluminium levels in foods cooked and stored in aluminium pans, trays and foil. Journal of Food Protection. 1985; 48(9):772-777.
11. Zhang K, Zhou Q. Toxic effects of aluminium based coagulants on Brassica chinensis and Raphanus sativus growing in acid and neutral conditions. Environmental Toxicology. 2005; 199:47-57.
12. Al-Kahtani MA. Renal damage mediated by oxidative stress in mice treated with aluminium chloride: Protective effect of taurine. Journal of Biological Sciences. 2010; 10(7):584-595.
13. Kumar P, Singh P. *Tribulus terrestris* ameliorates aluminium chloride induced alterations in oxidative status and functional biomarkers of the liver, kidney, brain and testis of the laboratory mouse. Indian Journal of Biochemistry and Biophysics. 2016; 53:179-186.
14. Ekong MB, Ekpo MM, Akpanyung EO, Nwaokonko DU. Neuroprotective effect of *Moringa oleifera* leaf extract on aluminium induced temporal cortical degeneration. Metabolic Brain Disease. 2017; 32(5):1437-1447.
15. Rasonavivo P, Petitjean A, Ratsimamanga P, Urverg S, Pakoto RA. Medicinal plants used to treat malaria in Madagascar. Journal of Ethnopharmacology. 1992; 37:117-127.
16. Ahmed IF, Owais M. Modern Phytomedicine. In: Turning Medicinal Plants into Drugs. 4th Edition, John Wiley and Sons, England, 2010, 2-24.
17. Ozioma EJ, Chinwe OAN. Herbal medicines in African traditional medicine, 2019. http://dx.doi.org/10.5772/intechopen.80348
18. Egharevba C, Osayemwenre E, Imieje V, Ahomafor J, Akinyuli C, Udu-cosi AA *et al*. Significance of bitter leaf (*Vernonia amygdalina*) in Tropical Diseases and beyond: A review. Malaria Chemotherapy, Control and Elimination. 2014; 3(1): http://dx.doi.org.10.4172/2090-2778.1000120.
19. Singha SC. Medicinal plants in Nigeria. National Press Limited. Apapa. Nigeria, 1966.
20. Egedigwe CA. Effect of dietary incorporation of *Vernonia amygdalina* and *Vernonia colorata* on blood lipid profile and relative organ weights in albino rats. 2010; MSc dissertation. Michael Okpara University of Agriculture, Umuahia, Nigeria.
21. Airaodion AI, Ekenjoku JA, Ogbuagu U, Airaodion EO. Antihaemolytic effect of ethanolic leaf extract of *Vernonia amygdalina* in Wistar rats. International Journal of Bio-Science and Bio-Technology. 2019; 11(7):173-178.
22. Burkill HM. The Useful Plants of West Tropical Africa (2nd edn). Royal Botanical Gardens, Kew, Vol. 1, Ainslie J. R., "List of Plants Used in Native Medicine in Nigeria". Imperial Forestry Institute, Oxford, 1985.
23. Ijeh II, Ejike CECC. Current perspectives on the medicinal potential of *Vernonia amygdalina* Del. Journal of Medicinal Plants Research. 2011; 5(7):1051-1061.
24. Farombi EO, Owoeye O. Antioxidative and chemopreventive properties of *Vernonia amygdalina* and *Garcinia biflavonoid.* International Journal of

Environmental Research and Public Health. 2011; 8(6):2533-2555.
25. Mahor G, Ali A. An update on the role of medicinal plants in amelioration of aluminium toxicity. Bioscience Biotechnology Research Communication. 2015; 8(2):175-188.
26. Onyegeme-Okerenta BM, Anacletus FC. Hepatoprotective and ameliorative effects of selected antioxidants on aluminium induced toxicity in on Wistar rats. European Journal of Advanced Research in Biological and Life Sciences. 2016; 4(2):24-34.
27. Cheraghi E, Roshnaei K. The protective effect of curcumin against aluminium chloride induced oxidative stress and hepato-toxicity in rats. Pharmaceutical and Biomedical Research. 2019; 5(1):11-18.
28. Akpanyung EO, Bassey UE, Noah UT, Effiong GS. Effect of ethanol leaf extract of *Vernonia amygdalina* on some indices of liver function, oxidative stress and lipid profile in aluminium chloride intoxicated male wistar rats. Biokemistri. 2020; 32(1):11-22.
29. National Research Council. Guide for the Care and Use of Laboratory Animals. National Academies Press (US), 1996.
30. Bancroft JD, Gamble M. Theory and Practice of Histological Techniques. 8th edition. Churchill Livingstone, China, 2018.
31. Dasofunjo TM, Nwodo OFC, Yakubu OE, Ejoba R, Ukpanukpong RU, Ipav SS *et al*. Toxicological implication of ethanol leaf extract of *Piliostigma thonningii* on renal function indices of male wistar albino rats. European_Journal of Experimental Biology. 2013; 3(3):652-655.
32. Nwankpa P, Ekweogu CN, Egwurugwu JN, Chukwuemeka OG, Etteh CC, Ugwuezumba PC *et al*. Assessment of kidney function indices in male albino wistar rats administered ethanol stem extract of *Dennettia tripetala* (pepper fruit). Biochemistry and Pharmacology. 2018; 7(1):1-4.
33. Devlin TM. Textbook of Biochemistry with Clinical Correlations. 6th edition. Wilegliss. New Jersey, 2011, 753-756.
34. Al-Hashem F. Camel's milk protects against aluminium chloride induced toxicity in the liver and kidney of white albino rats. American Journal of Biochemistry and Biotechnology. 2009; 59(3):98-109.
35. Al-Dera HS. Protective effect of resveratrol against aluminium chloride induced nephrotoxicity in rats. Saudi Medical Journal, 2016; 37(4):369-378.
36. Balgoon MJ. Assessment of the protective role of *Lipidium sativum* against aluminium chloride induced liver and kidney effects in albino rats. Biomedical Research International, 2019. http://doi.org/10.1155/2019/4516730.
37. Muselin F, Doma AO, Cristina RT, Degi J, Moruzi R, Dumitrescu E. Some serum parameters changes in rats exposed to aluminium and resveratrol. Lucrari Stiintifice Medicina Veterinara, 2019; LII(3):59-65.
38. Afolabi BA, Obafemi TO, Akinola TT, Adeyemi AS, Afolabi OB. Effect of ethanolic extract of *Alstonia boonei* leaves on serum electrolyte levels in Wistar albino rats. Pharmacology Online. 2014; 3:85-90.
39. Baniata A, Manse K, Aburjai T, Adeeb S, Al-Gazzawi M. Biochemical factors relevant to kidney functions among Jordanian top athletes. International Journal of Urology and Nephrology. 2019; 7(1):001-006.
40. Burtis CA, Ashwood ER, Bruns DE. Tietz Fundamentals of Clinical Chemistry. (6th Edition). Elsevier Publishers, New Delhi, 2008, 322-329.
41. Guyton AC, Hall JE. Textbook of Medical Physiology.11thedition. Elsevier Publishers New Delhi, 2006.
42. Onyema-iloh OB, Meludu SC, Iloh EO, Dioka CE, Obi-Ezeani CN. Effects of methanolic extract of *Vernonia amygdalina* on electrolytes and renal biomarkers in NaCl-induced hypertensive male Wistar rats. Journal of Pharmaceutical Research International, 2018; 23(1):1-7.
43. Adeoye AT, Oyagbemi AA, Omobowale TO, Adedapo AD, Ayodele AE, Yakubu M T *et al*. Nephroprotective Effects of *Vernonia amygdalina* in Alloxan induced diabetes in rats. International Journal of Biochemistry Research and Reviews, 2018; 21(1):1-15.
44. Abdolhaleem HA, Elaziz MA, Bashandy MM, Mikhail WZA. Impact of camel's milk on aluminium chloride induced toxicity in rats. Biosciences Biotechnology Research Asia. 2019; 16(3):669-679.
45. Imam TS, Khalifa HA, Hussrin MMA, Ali HA. Aluminium induced oxidative stress and hepato-renal impairment in male albino rats: possible protective trial with naringenin. Life Science Journal. 2019; 13(1s):93-104.