Medical Laboratory Journal
Online ISSN: 2538-4449
Golestan University of Medical Sciences

Liver synthetic ability and hematological profile changes by *Telfairia* occidentalis in carbon-tetrachloride-induced toxicity in rats

Usunobun Usunomena[1]* , Ambrose Emuobonuvie Akpovona [2]

1. Department of Biochemistry, Faculty of Basic Medical Sciences, Edo State University Uzairue, Edo State, Nigeria
2. Department of Biological and Chemical Sciences, Faculty of Natural and Applied Sciences, Michael and Cecilia Ibru University, Agbarha-Otor, Ughelli, Delta State, Nigeria
* Correspondence: Usunobun Usunomena. Department of Biochemistry, Faculty of Basic Medical Sciences, Edo State University Uzairue, Edo State, Nigeria. Tel: +2348034174871; Email: usunobun.usunomena@edouniversity.edu.ng

Abstract

Background: *Telfairia occidentalis* is among the most popular vegetable crops propagated in the West African rainforest zone for its green leafy vegetable and ellipsoidal fruit, which are highly nutritious. This study investigated the liver's synthetic ability and hematological profile potential of *T. occidentalis* against carbon tetrachloride-induced toxicity in Wistar rats.

Methods: Five experimental groups of rats were used in this study. One group received distilled water and served as the normal control. The second group received carbon tetrachloride (CCl_4) alone for four days. The third and fourth groups received CCl_4 for four days prior to treatment with 200 mg/kg and 400 mg/kg *T. occidentalis* aqueous extract for six days, respectively. The last group received CCl_4 for four days prior to treatment with silymarin (100 mg/kg) for six days. With the exception of normal control rats, all rats received a mixture of freshly prepared CCl_4 in olive oil (1 ml/kg, 1:1 intraperitoneally) for four days. The activities of liver synthetic molecules, such as total protein, albumin, and total bilirubin, as well as hematological parameters, were measured in the blood.

Results: CCl_4 exposure and toxicity caused a significant ($P < 0.05$) increase in total bilirubin and white blood cells and a significant decrease in total protein, albumin, hemoglobin, hematocrit, red blood cells, and platelets. However, treatment with *T. occidentalis* aqueous extract significantly ($P < 0.05$) ameliorated the levels of these markers toward normal values.

Conclusion: *T. occidentalis* aqueous extract exhibited enhancement of liver synthetic ability and hematological profile in CCl_4-induced toxicity.

Article History

Received: 23 March 2023
Received in revised form: 5 August 2023
Accepted: 12 September 2023
Published online: 7 September 2024
DOI: 10.29252/mlj.18.5.1

Keywords

Antioxidants
Oxidative stress
Telfairia occidentalis

Article Type: Original Article

Introduction

Leafy vegetables, including *Telfairia occidentalis*, are rich sources of phytochemicals that can contribute to improved human health. *T. occidentalis*, popularly called fluted pumpkin or ugwu leaf, remains one of the most consumed leafy vegetables used by nearly all ethnic groups and regions in West Africa, especially Nigeria, for various dishes and side dishes. *T. occidentalis* is consumed in different parts of Nigeria because of its numerous nutritional and medicinal attributes (1), including its traditional usage in the treatment of diseases such as convulsions, gastrointestinal disorders, malaria, and anemia (2,3). *T. occidentalis* is also useful in the management of hypercholesterolemia, liver problems, and impaired immune defense system, as well as in treating heart disease, hypertension, diabetes, and cases of meningitis (4).

CCl_4 treatment is known to invigorate lipid peroxidation, reactive oxygen species generation, and centrilobular necrosis and steatosis (5,6). The toxicity of CCl_4 is dependent on the formation of the trichloromethyl radical ($CCl_3^{\cdot}$) which, in the presence of oxygen, is converted to the trichloromethyl peroxyl radical ($CCl_3O_2^{\cdot}$) which is more lethal than trichloromethyl radicals (7). By interacting with lipids, proteins, and DNA, these radicals cause peroxidative degeneration in a variety of tissues. Therefore, this study was carried out to ascertain the effect of *T. occidentalis* aqueous extract on liver synthetic ability and hematological index in CCl_4-induced toxicity in Wistar albino rats.

Methods

Silymarin, hydrogen peroxide, $KMnO_4$, epinephrine, thiobarbituric acid, and carbon tetrachloride were purchased from Sigma-Aldrich (USA). Biochemical assay kits were obtained from Randox Diagnostics (Randox, United Kingdom). All other chemicals and reagents were of analytical grade.

Fresh leaves of *Telfairia occidentalis* will be purchased in Benin City, Edo State, Nigeria, and identified. The fresh leaves will be thoroughly rinsed and air-dried at room temperature (24ºC) and then pulverized, crushed into a fine powder using a manual blender, and weighed. An aqueous extract of the plant will be prepared by soaking 1000 g of the dry powdered plant material in 5 liters of double-distilled water and then keeping it at room temperature for 48 hours (For thorough extraction). At the end of the 48 hours, the extracts will be filtered first through Whatman filter paper No. 42 (125 mm) and then through cotton wool. The filtrate will be concentrated using a rotary evaporator with the water bath set at 40ºC to one-tenth of its original volume and then finally with a freeze-drier. The dried residue (Crude extract) will then be stored at 4ºC. Aliquot portions of the crude plant extract residue will be weighed and dissolved in normal saline for use on each day of the experiments.

Adult male albino rats were purchased and allowed to acclimatize for seven days and were maintained under standard conditions, provided with pelleted grower's mash (Containing 18% crude protein and 2600 Kcal/kg metabolizable energy, Guinea Feed, Nigeria PLC) and drinking water *ad libitum*. A daily cycle of 12 hours of light and 12 hours of darkness was provided for the animals. The study was conducted on forty healthy Wistar male albino rats weighing 190-200 g, randomly assigned to five treatment groups of eight (8) rats each. The study was carried out in accordance with the guidelines for ethical conduct in the care and use of nonhuman animals in research (8).

One group received distilled water and served as the normal control. The second group received carbon tetrachloride (CCl_4) alone for four days. The third and fourth groups received CCl_4 for four days prior to treatment with 200 mg/kg and 400 mg/kg *T. occidentalis* aqueous extract for six days, respectively. The last group received CCl_4 for four days prior to treatment with silymarin (100 mg/kg). With the exception of the normal control rats, all rats received a mixture of freshly prepared CCl_4 in olive oil (1 ml/kg, 1:1 intraperitoneally) for four days. *T. occidentalis* at doses of 200 mg/kg and 400 mg/kg was chosen based on previous studies (9,10).

Twenty-four hours after the last administration, rats from each group were sacrificed by cervical dislocation, and blood samples were obtained through heart puncture via a syringe into sample bottles containing no anticoagulant or into EDTA containers for hematology assessment. The blood samples collected in sample bottles were allowed to clot and were subsequently centrifuged at 5000 rpm for 20 minutes at room temperature to obtain serum for biochemical assays.

Total protein was determined using a Randox kit (United Kingdom) according to the method of Lowry *et al*. (1951) (11). Albumin was determined using a Randox kit (United Kingdom) according to the method of Doumas *et al*. (1971) (12), while total bilirubin was determined using a Randox kit (United Kingdom) according to the method of Jendrassik and Grof (1938) (13).

Hematological analyses of hemoglobin (Hb), white blood cells (WBC), red blood cells (RBC), platelets (PLTs), and hematocrit (HCT) were carried out using a fully automated blood cell counter, PCE-210N, at the Irrua Specialist Teaching Hospital, Irrua, Edo State, Nigeria.

Data obtained from this study were expressed as mean value ± standard deviation. Differences between means of groups were determined by one-way ANOVA using the Statistical Package for Social Sciences. The mean differences

were compared using the Duncan multiple range test. A probability level of less than 5% ($P < 0.05$) was considered significant.

Results

The effect of the aqueous leaf extract of *T. occidentalis* on CCl_4 mediated alteration in serum protein, albumin, and total bilirubin levels in experimental rats is presented in Table 1. The results showed that following CCl_4 induction, there was a significant ($p < 0.05$) reduction in both serum albumin and total protein levels and a significant increase in total bilirubin when compared to the control and extract-treated groups. However, CCl_4-induced rats treated with 200 mg/kg, 400 mg/kg, and silymarin displayed a significant decrease in total bilirubin levels and a significant increase in albumin and total protein when compared to untreated CCl_4 rats. Treatment with 400 mg/kg *T. occidentalis* extract or 100 mg/kg silymarin led to a further significant decline in total bilirubin and a significant increase in albumin and total protein compared to CCl_4-induced rats given 200 mg/kg *T. occidentalis* extract.

Values are expressed as Mean ± Standard Deviation. Values with different superscripts (a, b, c, d) down the column differ significantly at ($p < 0.05$). CCl_4: Carbon Tetrachloride.

The results of hematological parameters shown in Table 2 indicate that CCl_4 significantly decreased ($p < 0.05$) RBC, Hb, PLTs, and HCT levels and increased WBC in the CCl_4-alone treated rats compared to the control and extract-treated rats. However, *T. occidentalis* administration significantly increased and attenuated ($p < 0.05$) the RBC, Hb, PLTs, and HCT levels compared to the CCl_4-alone rats.

Discussion

The liver, apart from being the body's major detoxification organ-removing wastes and xenobiotics through metabolic conversion and biliary excretion-is also responsible for the metabolism, synthesis, storage, and redistribution of nutrients, carbohydrates, lipids, and vitamins, thereby playing a key role in metabolic homeostasis (14,15).

Liver cells synthesize various proteins like albumin, fibrinogen, haptoglobin, transferrin, and antitrypsin. The blood levels of these proteins decrease in cases of extensive liver damage. The liver is the main organ responsible for protein synthesis and the maintenance of protein homeostasis. Hence, liver injury results in impaired protein synthesis. In this study, we observed a significant decrease in total protein and albumin in CCl_4-alone rats compared to control and *T. occidentalis*-treated rats, indicating that CCl_4 toxicity compromised protein synthesis due to liver damage and/or impaired hepatic function. Albumin is important in reducing the bioavailability and toxicity of many substances by binding them. During hypoalbuminemia, the binding potential of albumin to xenobiotics is reduced, leading to the blockage of binding sites by various metabolites (16). However, following *T. occidentalis* treatment in CCl_4-induced rats, the observed increase in serum protein and albumin compared to CCl_4-alone rats suggests the restoration of hepatic function, stimulation of protein synthesis, and/or protection against CCl_4-impaired protein synthesis. This effect can be attributed to bioactive agents, including flavonoids, previously reported in our studies (17). The ability of *T. occidentalis* to restore serum protein and albumin toward normal levels aligns with previous related works (5,18,19). Bilirubin, the end product of hemoglobin catabolism (20), is a biomarker of hepatic and blood disorders. The significant increase in serum bilirubin levels observed following CCl_4 administration in rats compared to control and *T. occidentalis*-treated rats indicates the occurrence of liver disease. In this study, the increase in total bilirubin in CCl_4-alone rats suggests interference of CCl_4 toxicity with the liver's transport function. However, treatment with the aqueous extract of *T. occidentalis* at doses of 200 mg/kg and 400 mg/kg restored the abnormalities in total bilirubin levels, with 400 mg/kg *T. occidentalis* extract exhibiting higher activity, comparable to the standard drug silymarin. This finding is consistent with previous related works (5,18,19).

The blood contains several constituents and metabolites that, when assessed, can provide information on the toxicity of drugs and medicinal plants (21,22,23). Hematological measurement is a recognized method for assessing the health status of humans and animals (24). All vertebrate red blood cells and some invertebrate tissues contain hemoglobin, an iron-containing oxygen transport metalloprotein. It transports oxygen from the lungs to the rest of the body, where it is released to oxidize nutrients and supply energy to regulate the organism's functions (25). In the present study, HCT, PLTs, Hb, and RBC levels were found to be significantly lower ($p < 0.05$) in the CCl_4-alone group when compared to the normal and *T. occidentalis*-treated groups, similar to the findings of a previous related study (26). The decreased RBC, PLTs, HCT, and Hb levels following CCl_4 induction may suggest free radical generation from CCl_4 metabolism and toxicity, which affected the hematopoietic, erythropoietic, and thrombopoietic processes in the bone marrow (27). PCV, also known as HCT, is the volume percentage of red blood cells in the blood, and its value depends on the number and size of red blood cells. An abnormally low HCT may indicate anemia (28). However, rats treated with *T. occidentalis* extract following CCl_4 induction showed an improved hematoprotective effect compared to the CCl_4 alone group, similar to previously reported findings (29), as there was a significant difference ($p < 0.05$) in the values of RBC, PLTs, HCT, and Hb upon *T. occidentalis* treatment compared to the CCl_4 alone group. The reduction in red blood cell count and packed cell volume, also known as HCT, following CCl_4 induction may be due to hematopoiesis impairment, RBC destruction, and shrinkage (30). Meanwhile, the increase in these parameters following treatment with 200 mg/kg and 400 mg/kg *T. occidentalis* indicates a restoration in the oxygen-carrying capacity of red blood cells (31).

Table 1. Effects of aqueous leaf extract of *telfairia occidentalis* on liver synthetic molecules in carbon tetrachloride (CCl_4)-induced wistar rats

Treatment groups	Albumin (g/dl)	Tot. Protein (g/dl)	Tot. Bilirubin (mg/dl)
Control	3.88^{a}± 0.04	7.85^{a}±0.19	0.67^{a}±0.11
CCl_4 alone	1.19^{b}±0.08	2.11^{b}±0.11	3.97^{b}±0.32
T. occidentalis (200mg/kg) + CCl_4	2.02^{c}±0.08	4.97^{c}±0.20	1.34^{c}±0.10
T. occidentalis (400mg/kg) + CCl_4	2.65^{d}±0.10	5.43^{d}±0.22	1.06^{d}±0.05
Silymarin (100mg/kg) + CCl_4	2.73^{d}±0.11	5.78^{d}±0.15	1.02^{d}±0.09

Table 2. Effects of *telfairia occidentalis* aqueous leaf extract on Hb, WBC, HCT, RBC, and PLTs in carbon tetrachloride (CCl_4)-induced wistar rats

Treatment groups	HB (g/dl)	WBC ($x10^3$/ul)	HCT (%)	RBC ($x10^9$/L)	PLTS ($x10^9$/L)
Control	14.05^{a}±0.48	9.91^{a}±0.39	48.10^{a}±1.01	8.09^{a}±0.57	312.37^{a}±10.43
CCl_4	10.01^{b}±0.32	15.87^{b}±0.26	31.32^{b}±2.01	4.08^{b}±0.21	165.74^{b}±9.76
T. occidentalis (200mg/kg) + CCl_4	12.11^{c}±0.36	12.01^{c}±0.20	38.45^{c}±1.53	6.04^{c}±0.32	208.81^{c}±10.01
T. occidentalis (400mg/kg) + CCl_4 Silymarin (100mg/kg) + CCl_4	13.86^{a}±0.44 13.79^{a}±0.51	10.12^{a}±0.38 10.65^{a}±0.35	40.76^{c}±1.50 40.07^{c}±2.07	7.89^{a}±0.41 7.63^{a}±0.60	241.01^{d}±9.64 259.43^{d}±8.65

Values are expressed as Mean ± Standard Deviation. Values with different superscripts down the column (a, b, c, d) differ significantly ($p < 0.05$). Hb: Hemoglobin; WBC: White Blood Cell; HCT: Hematocrit; RBC: Red Blood Cell; PLTs: Platelets

Conclusion

T. occidentalis administration enhanced liver synthetic ability and hematological index following CCl_4-induced toxicity and damage, which can be attributed to the bioactive agents present in *T. occidentalis*, such as flavonoids, saponins, tannins, and phenols

Acknowledgement

Special thanks to the management of Edo State University Uzairue and TETFUND for the release of funds for the project. We also thank the staff of the animal house of Edo State University Uzairue for their technical assistance.

Funding sources

This research was funded by the Tertiary Education Trust Fund (TETFUND), Nigeria, through the 2020 Institution-Based Research (IBR) Grant awarded to Edo State University Uzairue (EDSU), Edo State.

Ethical statement

The study was carried out after approval by the EDSU Institutional IBR Research Committee and in accordance with the *American Psychological Association* (APA) guidelines for ethical conduct in the care and use of nonhuman animals in research.

Conflicts of interest

The authors declare that no conflict of interest exists regarding this work.

Author contributions

Prof. Usunobun carried out animal studies, laboratory analysis, manuscript writing, and proofreading, while Dr. Akpovona conducted statistical analysis, writing, and manuscript proofreading.

References

1. Akwaowo EU, Ndon BA, Etuk EU. Minerals and antinutrients in fluted pumpkin (Telfairia occidentalis Hook f.). Food chemistry 2000;70:235-40. [View at Publisher] [DOI] [Google Scholar]
2. Akoroda M. Ethnobotany of Telfairia occidentalis (cucurbitaceae) among Igbos of Nigeria. Economic Botany. 1990;44:29-39. [View at Publisher] [DOI] [Google Scholar]
3. Eseyin OA, Sattar, MA, Rathore HA. A review of the pharmacological and biological activities of the aerial parts of Telfairia occidentalis Hook. f. (Cucurbitaceae). Tropical Journal of Pharmaceutical Research 2014;13:1761-9. [View at Publisher] [Google Scholar]
4. Arowosegbe S, Olanipekun MK, Kayode J. Ethnobotanical survey of medicinal plants used for the treatment of diabetes mellitus in Ekiti-State Senatorial District, Nigeria. Eur. Journal of Botany, Plant Science and Phytology. 2015;2(4):1-8. [View at Publisher]
5. Usunobun U, Osaigbovo JO, Okolie NP. Hepatoprotective effect of Rhaphiostylis beninensis Ethanol root extract on Carbon-tetrachloride (CCl4)-induced liver attack and damage in Rats. American Journal of Biomedical Science. 2020;12(3):155-63. [View at Publisher] [DOI] [Google Scholar]
6. Hamzah RU, Busari MB, Ankewo E, Mohammed HA, Yahaya AM, Akomolafe AP. Hepatoprotective effect of methanol extract of Senna occidentalis seeds in carbon tetrachloride induced hepatotoxic rats. Biokemistri. 2021;33(4):259-272 [View at Publisher] [Google Scholar]
7. Ali SEM, Abdelaziz DHA. The protective effect of date seeds on nephrotoxicity induced by carbon tetrachloride in rats. Int J Pharm Sci Rev Res. 2014;26(2):62-8. [View at Publisher] [Google Scholar]
8. APA. Guidelines for Ethical Conduct in the Care and Use of Non-Human Animals in Research. American Psychological Association (APA), Washington DC, USA. 2012. [View at Publisher]
9. Saalu LC, Kpela T, Benebo AS, Oyewopo AO, Anifowope EO, Oguntola A. The dose-dependent testiculoprotective and testiculotoxic potentials of Telfairia occidentalis Hook f. leaves extract in rat. Int J Appl Res Nat Prod. 2010;3:27-38. [View at Publisher] [Google Scholar]
10. Akang N, Oremosu AA, Osinubi AA, Dosumu OO, Kusemiju TO, Adelakun SA, et al. Histomorphometric studies of the effects of Telfairia occidentalis onalcohol-induced gonado-toxicity in male rats. Toxicology Reports. 2015;2:968-75. [View at Publisher] [DOI] [PMID] [Google Scholar]
11. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the follin-phenol reagents. J. Biol. Chem. 1951;193:265-75. [View at Publisher] [DOI] [PMID] [Google Scholar]
12. Doumas BT, Watson W, Biggs HC. Albumin standards and the measurement of serum albumin with bromocresol green. Clinica Chimica Acta. 1971;31:87-96. [View at Publisher] [DOI] [PMID] [Google Scholar]
13. Jendrassik L, Grof P. Total and Direct Bilirubin. Biochemical Journal. 1938;297:81-9.
14. Joan O, Barbara AF, Qing X, Samuel WF. The identification of stem cells in human liver diseases and hepatocellular carcinoma. Exp Mol Pathol. 2010;88(3):331-40. [View at Publisher] [DOI] [PMID] [Google Scholar]
15. Mohan H. The liver, biliary tract and exocrine pancreas. In: Text book of Pathology. New Delhi: Jaypee Brothers Medical Publishers (p) ltd. 2002;569-70.
16. Ogunka-Nnoka CU, Amagbe R, Amadi BA, Amadi PU. Biochemical Effects of Telfairia occidentalis Leaf Extracts against Copper-induced Oxidative Stress and Histopathological Abnormalities. Journal of Advances in Medical and Pharmaceutical Sciences. 2017;12(2):1-15. [View at Publisher] [DOI] [PMID] [Google Scholar]
17. Usunobun U, Egharevba E. Phytochemical analysis, proximate and mineral composition and in vitro antioxidant activities in Telfairia occidentalis aqueous leaf extract. Benson Idahosa Journal of Basic and Applied Sciences. 2014;1(1):74-87. [View at Publisher] [Google Scholar]
18. Usunobun U, Osaigbovo JO, Okolie NP. Hepatoprotective and antioxidant effect of Rhaphiostylis beninensis ethanol root extract on Carbon tetrachloride (CCl4)-induced hepatotoxicity and oxidative stress. Animal Research International. 2020;17(2):3781-9. [View at Publisher] [Google Scholar]
19. Usunobun U, Anyanwu GO. Dimethylnitrosamine (DMN) pre-treated rats and protective effect of Vernonia amygdalina post-treatment on liver function. International Journal of Pharmacology and Toxicology. 2016;4(1):74-7. [View at Publisher] [DOI] [Google Scholar]
20. Thapa BR, Walia A. Liver function tests and their interpretation. Indian J Pediatr. 2007;74:663-71. [View at Publisher] [DOI] [PMID] [Google Scholar]
21. Mohammed RK, Ibrahim S, Atawodi SE, Eze ED, Suleiman JB, Malgwi IS. Anti-diabetic and haematological effects of n-butanol fraction of Alchornea cordifolia leaf extract in streptozotocin-induced diabetic wistar rats. Scientific Journal of Biological Sciences 2013;2(3):45-53. [View at Publisher] [Google Scholar]
22. Edet AE, Patrick EE, Eseyin AO. Hematological parameters of alloxan-induced diabetic rats treated with ethanol extracts and fractions of Nauclea lafiloia leaf. European Scientific Journal. 2013;9(27):203-10. [DOI] [Google Scholar]
23. Vinodini NA, Chatterjee PK, Suman VB, Rashmi KS, Nayanatara AK, Anupama N, et al. Effectiveness of Moringa oleifera Extract in Attenuating the Toxic Effect on Platelet Count: An Experiment on Cadmium Exposed Rats. Pharmacognosy Journal. 2019;11(4):689-93. [View at Publisher] [DOI] [Google Scholar]
24. Ugbogu EA, Nwoku CD, Ude VC, Emmanuel O. Evaluating bioactive constituents and toxicological effects of aqueous extract of fermented Pentaclethra macro-phylla seeds in rats. Avicenna J. Phytomed. 2020;10(1):101-13. [View at Publisher] [Google Scholar]
25. Biagioli M, Pinton M, Cesselli D. Unexpected expression of alpha and beta-globin in mesencephalic dopaminergic neurons and glial cells. Proceeding National. Academy of Science USA. 2009;106(36):15454-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
26. Usunobun U, Okugbo TO. Anti-anemic, Anti-necrotic and Anti-fibrotic effect of Vernonia amygdalina post-treatment in Dimethylnitrosamine (DMN)-administered rats. Nigerian Journal of Pharmaceutical and Applied Science Research. 2016;5(2):1-7. [View at Publisher] [DOI] [Google Scholar]
27. Rahmouni F, Hamdaoui L, Badraoui R, Rebai T. Protective effects of Teucrium polium aqueous extract and ascorbic acid on hematological and some biochemical parameters against carbon tetrachloride (CCl4) induced toxicity in rats. Biomed. Pharmacother. 2017;91:43-8. [View at Publisher] [DOI] [PMID] [Google Scholar]
28. Ikese CO, Ubwa ST, Adoga SO, Audu SI, Kuleve MI Okita FO, Okoh A. Effect of Telfaira occidentalis Leaf Extract on Packed Cell Volume in Rats with Malaria-induced Anaemia. S. Afr. J. Chem. 2020;73:51-4. [View at Publisher] [DOI] [Google Scholar]
29. Okezie E, Ifeanyichukwu E, Chidiebere P, Victor CU, Ozioma GE, Solomon NI, et al. Protective effects of coconut water against the intraperitoneal infused carbon tetrachloride-induced toxicity-evaluations of biochemical, haematological and histopathological profiles in rats. Bulletin of the National Research Centre, 2022;46:206. [View at Publisher] [DOI] [Google Scholar]
30. Olusola L, Matthew O, Oluwatosin A. Comparative study on the effects of aqueous extracts of viscum album (mistletoe) from three host plants on hematological parameters in albino rats. African Health Sciences. 2015;15(2):606-12. [View at Publisher] [DOI] [PMID] [Google Scholar]
31. Ashafa AOT, Yakubu MT, Grierson DS, Afolayan AJ. Toxicological evaluation of the aqueous extract of Felicia muricata Thunb. leaves in Wistar rats. African Journal of Biotechnology. 2009;8(6):949-54. [View at Publisher] [Google Scholar]

How to Cite:

Usunobun U, Akpovova AE. Liver synthetic ability and hematological profile changes by Telfairia occidentalis in carbon-tetrachloride-induced toxicity in rats. *Med Lab J.* 2024;18(5):1-3.