RESEARCH ARTICLE

Health Science Research International (HSRI)
DOI: https://doi.org/10.54117/hsri.v1i1.30

1(1): 25-28 (2025)

Phytochemical Analysis and Hematological Effects of Aqueous Stem Extract of *Telfairia occidentalis* in Phenylhydrazine-Induced Anemic Wistar Rats

S. Sulaiman, I. M. Isa and A. A. Ladan

Department of Human Physiology, Faculty of Basic Medical Sciences, Sa'adu Zungur University Bauchi State, Nigeria.
*Corresponding author's email: salihusulaiman100@gmail.com, Tel.: +2347032285030; iimuhammad@sazu.edu.ng, Tel.: +2347031308856

Received: 25 Sept 2025 **Accepted:** 02 Oct 2025 **Published :** 23 Oct 2025

ABSTRACT

Anaemia is a medical condition characterized by a decrease in the number of red blood cells and the amount of haemoglobin in the blood leading to inadequate oxygen delivery to tissues and organs. *Telfairia occidentalis* is a dietary leafy vegetable with phytochemicals that are beneficial to human health. This study investigated the phytochemical constituents and hematological effects of the aqueous stem extract of T. occidentalis in a phenylhydrazine (PHZ)-induced hemolytic anemia model in rats. Sixteen male adults Wistar rats were divided into four groups: Normal control group, Negative Control group (PHZ-induced anemic), and two treatment groups receiving PHZ + stem extract at (100 and 200 mg/kg) respectively. Anemia was induced via intraperitoneal injection of PHZ (40 mg/kg) for two days and subsequently the treatment groups administered the aqueous stem extract orally for 14 days. Phytochemical screening was conducted using standard qualitative methods. At the expiration of the study, blood samples were taken from the animals for evaluation of hematological parameters (RBC, WBC, Hb, PCV, MCH, MCHC) and body weight were assessed. Phytochemical analysis revealed the presence of alkaloids, terpenoids, flavonoids, steroids, glycosides, and saponins. Anthraquinones were absent. The anemic control group showed a significant reduction ($p < 0.05$) in RBC, Hb, and PCV. Treatment with the stem extract, particularly at 200 mg/kg, caused a highly significant ($p < 0.001$), dose-dependent amelioration of these parameters, elevating them above normal control levels. A significant increase in WBC count and body weight was also observed in the treatment groups. The aqueous stem extract of *Telfairia Occidentalis* may possesses significant hematopoietic and growth-promoting properties in PHZ-induced anemic rats, attributed to its rich array of bioactive compounds. This could validate its ethnomedicinal use and suggests its potential as a natural, cost-effective intervention for anemia management.

How to cite this article
Sulaiman, S., Isa, I. M., & Ladan, A. A. (2025). Phytochemical Analysis and Hematological Effects of Aqueous Stem Extract of Telfairia occidentalis in Phenylhydrazine-Induced Anemic Wistar Rats. *Health Science Research International*, *1*(1), 25–28. https://doi.org/10.54117/hsri.v1i1.30

Keywords
Anemia, phenylhydrazine, Telfairia occidentalis, phytochemicals and hematological parameters

Open Access article

License: CC BY 4.0

Introduction

Anemia is a pervasive global health challenge, characterized by a reduction in red blood cell count or hemoglobin concentration, impairing oxygen transport to tissues (World Health Organization [WHO], 2021). It affects an estimated 1.6 billion people worldwide, with the highest prevalence in developing countries where nutritional deficiencies and infectious diseases are common (Cappellini *et al.*, 2020). Hemolytic anemia, marked by the accelerated destruction of red blood cells, represents a significant manifestation often induced by oxidative stress (Ganz & Nemeth, 2012). Phenylhydrazine (PHZ) is a well-established chemical agent used experimentally to induce hemolytic anemia. It generates reactive oxygen species that cause oxidative damage to erythrocytes, leading to hemoglobin denaturation, Heinz body formation, and subsequent hemolysis (Jain & Hochstein, 1978; Rees *et al.*, 1999). This model is invaluable for evaluating the therapeutic potential of antioxidant and hematopoietic agents.

The search for affordable and accessible treatments has renewed interest in medicinal plants. Telfairia occidentalis Hook. f. (Cucurbitaceae), commonly known as fluted pumpkin or "Ugwu," is a tropical vine widely cultivated in West Africa. Its leaves and seeds are nutritionally and medicinally valued, particularly for treating anemia, diabetes, and liver disorders (Oboh *et al.*, 2014; Fasuyi, 2006). Ethnobotanical records and scientific studies have confirmed the hematinic potential of its leaf extracts (Ifeanyi *et al.*, 2014; Nwangwa, 2012). However, the stem, often discarded as waste, remains underexplored despite anecdotal evidence of its medicinal value. Preliminary analyses indicate it contains bioactive compounds like flavonoids, alkaloids, and saponins (Akinmoladun *et al.*, 2010; Iyekowa, 2025). Therefore, this study aimed to analyze the phytochemical constituents of the aqueous stem extract of T. occidentalis and evaluate its effects on key hematological parameters in Wistar rats with PHZ-induced anemia.

Materials and Methods

Materials

Beakers (100ml, 250ml, 1000ml), Measuring cylinder, Test tubes, Reagent Bottles, Spatula, wooden racks, filter papers, Markers, Masking tapes, Hand towels, Cotton wool, Motor and Pestle, Micropipettes, Stirrer, Electronic Weighing balance (METTLER, United States), Refrigerator, Water bath, Hot air Oven, (Eppendorf-Germany, Model AG, 5227 R), Syringe and Needles, Insulin syringes, EDTA tubes, Automated Hematology Analyzer (RT-7200 Auto Hematology Analyzer 23-parameter RT-7200).

Reagents

Potassium iodide (KI) + iodine solution (I_2) (Wagner's reagent), Concentrated Sodium hydroxide solution (NaOH), Distilled Water (H_2O), Ferric chloride solution ($FeCl_3$), 10% lead acetate solution ($Pb(CH_3COO)_2$), Glacial acetic acid (CH_3COO), Concentrated Sulfuric acid (H_2SO_4), Chloroform ($CHCl_3$), Acetic anhydride ($(CH_3COO)_2O$), and Phenylhydrazine hydrochloride ($C_6H_5NHNH_2$-HCl). Phenylhydrazine hydrochloride is the hydrochloride salt form of phenylhydrazine. Phenylhydrazine (base): Molecular formula: $C_6H_5NHNH_2$, Phenylhydrazine Hydrochloride (salt): Molecular formula: $C_6H_5NHNH_2 \cdot HCl$ is formed by reacting phenylhydrazine with

Health Science Research International (HSRI)
DOI: https://doi.org/10.54117/hsri.v1i1.30
1(1): 25-28 (2025)

hydrochloric acid, where the $–NHNH_2$ group accepts a proton (H^+), forming.

Ethical Consideration
Ethical approval was obtained from the Animal Ethics Committee in the Department of pharmacology, Faculty of Basic Medical Sciences, Sa'adu Zungur University Bauchi, following the guidelines set by the National Institutes of Health (NIH, 2011) for the care and use of laboratory animals.

Plant Material Collection and Extraction
Fresh stems of Telfairia occidentalis were obtained from Azare Market, Bauchi State, Nigeria, and authenticated at the Department of Botany, Sa'adu Zungur University. The stems were washed, shade-dried for 10–14 days, and ground into a coarse powder. 200g of the powder was macerated in 1.5L of distilled water for 72 hours at 4–7°C. The mixture was filtered and the filtrate concentrated using a rotary evaporator at 40°C. The dried extract was stored at 4°C until use.

Phytochemical Screening
Qualitative phytochemical analysis of the aqueous stem extract was performed using standard procedures (Harborne, 1998; Trease & Evans, 2002) to test for alkaloids (Wagner's test), flavonoids (alkaline reagent test), tannins (ferric chloride test), saponins (frothing test), terpenoids, cardiac glycosides (Keller-Killiani test), and steroids.

Anemia Induction
The Rats in groups II–IV were injected intraperitoneally with phenylhydrazine (40 mg/kg) for 2 consecutive days to induce anemia (Oboh & Rocha, 2007). After anemia confirmation (by Day 3), rats in groups III–V received the respective doses of extract orally via gavage for 14 days.

Experimental Animals and Design
Sixteen male adults Wistar rats (150–250g) were obtained from the Animal House of Bayero University Kano. They were acclimatized for 14 days under standard conditions (25±2°C, 12-hour light/dark cycle) with free access to rat pellets and water. Ethical approval was granted by the Animal Ethics Committee of Sa'adu Zungur University. The Rats were randomly divided into four groups(n=4/group):

Group I (Normal Control): Normal rats, no treatment.
Group II (Negative Control): Rats induced with anemia (PHZ, 40 mg/kg i.p. for 2 days).
Group III (Low Dose): Anemic rats treated with 100 mg/kg of stem extract orally for 14 days.
Group IV (High Dose): Anemic rats treated with 200 mg/kg of stem extract orally for 14 days. Anemia was confirmed on day 3 post-PHZ injection.

Sample collection and Hematological Analysis
After expiration of the treatment, blood was collected via cardiac puncture into EDTA tubes under light anesthesia using chloroform. Hematological parameters (RBC, WBC, Hb, PCV, MCH, MCHC) were analyzed using an automated hematology analyzer (RT-7200).

Determination of Hematological Parameters
The RT-7200 is a fully automated hematology analyzer for complete blood count (CBC) including a 3-part WBC differential (i.e. distinguishing granulocytes, lymphocytes, monocytes). It provides histograms (frequency distributions) for WBC, RBC, and PLT, and can operate with whole blood, anticoagulated peripheral blood, or pre-diluted blood samples (Rayto, 2017; Medicalequipment-MSL, 2025).

Principle(s) of measurement: Electrical impedance ("Coulter principle") for counting and sizing
This method is used for counting WBC, RBC, and PLT. The blood cells pass through an aperture/orifice; when a cell traverses, it displaces electrolyte and causes a change in electrical resistance (impedance). Each pulse is counted and sized, and from the sizing, the device can derive parameters like cell volume such as MCV (mean corpuscular volume), Packed Cell Volume or Hematocrit (PCV) (Medicalequipment-MSL, 2025; Guyton & Hall, 2021).

Hemoglobin measurement: The RT-7200 uses a colorimetric method for hemoglobin (HGB). Many newer hematology analyzers, including the RT-7200, employ a cyanide-free method, which is safer than the traditional cyanmethemoglobin method (MedUnion, 2025; Bain, 2015).

Data Analysis
Data were expressed as mean± standard error of mean (SEM). Statistical significance was determined using one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test with GraphPad Prism version 8.0.2. A p-value of < 0.05 was considered statistically significant.

Results

Phytochemical Constituents of Aqueous Stem Extract of Telfairia Occidentalis
The qualitative analysis of the Phytochemical Constituents revealed the presence of alkaloids, terpenoids, flavonoids, steroids, glycosides, and saponins. Anthraquinones were absent (Table 1).

Table 1: Phytochemical Constituents of Aqueous Stem Extract of Telfairia Occidentalis

Phytochemicals	Inference
Alkaloids	+
Terpenoids	+
Flavonoids	+
Steroids	+
Glycosides	+
Saponins	+
Anthraquinone	—

Keys= Present (+), and Absent (--)

Health Science Research International (HSRI)
DOI: https://doi.org/10.54117/hsri.v1i1.30
1(1): 25-28 (2025)

Effect of Aqueous Stem Extract of Telfairia Occidentalis on Hematological Indices of PHZ-Induced Anemic Wistar Rats

Table 2 Shows the effect of aqueous Stem Extract of Telfairia Occidentalis on hematological indices of PHZ-Induced Anemic Wister Rats. The result showed that, there was a significant decreased ($p<0.01$) in the RBC, Hb, and PCV (3.80 ± 0.53, 93.5 ± 1.29, 27.8 ± 1.93) in the negative control group, when compared to the Normal Control group (5.30 ± 0.21, 98.5 ± 0.58, 37.1 ± 0.65) respectively. While, there was a significant high increased in the RBC, Hb, and PCV (7.32 ± 0.24, 145.5 ± 1.29,43.5 ± 0.57) and (7.88 ± 0.17, 143.3 ± 1.71, 45.4 ± 1.02) in the group III and IV respectively, when compared with the other groups.

For WBC, the high dose extract (Group IV) appeared to have significant increased ($p<0.001$) in WBC (7.74 ± 0.41) when compared to all other groups. The effect is clearly dose-dependent. The high dose (Group IV) resulted in a much larger increase in WBC than the low dose (Group III).

MCH and MCHC, these parameters relate to the hemoglobin content within each red blood cell. Groups III and IV showed significantly increased ($p < 0.05$) when compared to both Group I and Group II.

Table 2: Effect of Aqueous Stem Extract of *Telfairia occidentalis* on Hematological Indices of PHZ-Induced Anemic Wistar Rats

Parameters	Group I	Group II	Group III	Group IV
RBC ($\times10^{12}$/L)	5.30 ± 0.21	3.80 ± 0.53	7.32 ± 0.24	7.88 ± 0.17*†††
WBC ($\times10^{9}$/L)	3.91 ± 0.24	3.74 ± 0.64***	4.96 ± 0.45*†††	7.74 ± 0.41*†††
Hb (g/L)	98.5 ± 0.58	93.5 ± 1.29*	145.5 ± 1.29*†††	143.3 ± 1.71*†††
PCV (%)	37.1 ± 0.65	27.8 ± 1.93***	43.5 ± 0.57*†††	45.4 ± 1.02*†††
MCH (Pg)	19.6 ± 0.57	18.1 ± 0.87*	20.5 ± 0.64†	21.1 ± 0.80**††
MCHC (g/L)	302.3 ± 2.22	299.5 ± 7.93	334.0 ± 1.83*†††	339.3 ± 9.18*††

Data was analyzed as Mean ± Standard error of mean (SEM). Statistical significance was determined by Repeated Measures One-Way ANOVA followed by Tukey's post-hoc test. *$p < 0.001$, **$p < 0.01$, $p < 0.05$ compared to Normal Control; ††† $p < 0.001$, †† $p < 0.01$ compared to Negative Control. F-value and overall P-value from the ANOVA are reported for each parameter.

Discussion

This study demonstrates that the aqueous stem extract of Telfairia occidentalis may possesses significant hematopoietic properties, effectively ameliorating phenylhydrazine-induced hemolytic anemia in Wistar rats. The phytochemical profile confirmed the presence of key bioactive compounds, including flavonoids, alkaloids, saponins, and terpenoids, known for their antioxidant and therapeutic activities (Oboh *et al.*, 2014; Sparg *et al.*, 2004). The drastic reduction in RBC, Hb, and PCV in the PHZ-only group confirms the successful induction of hemolytic anemia, consistent with the known mechanism of PHZ, which involves oxidative damage leading to erythrocyte destruction (Jain & Hochstein, 1978; Rees *et al.*, 1999). The remarkable, dose-dependent recovery of these parameters in treated rats suggests that the stem extract stimulates erythropoiesis and protects red blood cells from oxidative damage. The values exceeding those of the normal control group indicate a potent rebound effect, potentially due to the extract's high nutrient and phytochemical content.

The significant increase in WBC count, particularly at the high dose, suggests an immunostimulatory effect, which could be attributed to alkaloids and saponins known to modulate immune function (Okafor *et al.*, 2020; Olatunji *et al.*, 2019). The improvement in MCH and MCHC indicates that the new erythrocytes produced are hemoglobin-rich, pointing to high-quality erythropoiesis. The observed weight gain in treated animals, reversing the growth-stunting effect of anemia, further underscores the extract's restorative and nutritive value. These findings align with previous studies on T. occidentalis leaf extracts (Ifeanyi *et al.*, 2014; Salman *et al.*, 2018) and confirm that the stem, an often-discarded part, holds comparable, if not superior, medicinal potential. The effects are likely mediated through a combination of mechanisms: provision of essential nutrients (iron, folate), antioxidant action of flavonoids scavenging PHZ-generated free radicals, and potential stimulation of erythropoietin (Salman *et al.*, 2018).

Conclusion and Recommendation

The aqueous stem extract of Telfairia occidentalis is rich in bioactive compounds and exhibits potent anti-anemic and hematopoietic activities in a PHZ-induced model. It significantly improved all assessed hematological parameters and body weight in a dose-dependent manner. This study provides scientific validation for the traditional use of T. occidentalis and highlights the therapeutic potential of its underutilized stem. The stem could be developed into a low-cost, natural remedy for managing anemia, especially in resource-poor settings.

Acknowledgements

The authors acknowledge the technical support provided by the Department of Human Physiology, Faculty of Basic Medical Sciences, Sa'adu Zungur University, and the Animal House of Bayero University Kano.

References

Adedapo, A. D., Olorunnisola, O. S., & Fapohunda, O. (2022). *Mechanisms of phenylhydrazine-induced hemolytic anemia and protective effects of natural antioxidants*: A review. Toxicology Reports, 9, 544–553.

Akanbi, A. O., Adegbite, O. A., & Oladele, T. O. (2021). *Hematological benefits of Telfairia occidentalis*. Journal of Physiology & Nutrition, 18(2), 45–60.

Akinmoladun, F. O., Akinrinlola, B. L., & Komolafe, T. O. (2010). *Phytochemical analysis and antioxidant activity of Telfairia occidentalis stem extract*. African Journal of Plant Science, 4(10), 350–355.

Cappellini, M. D., Motta, I., & Musallam, K. M. (2020). *Anemia in clinical practice—Definition and classification: Does hemoglobin change with aging*? Hematology/Oncology Clinics of North America, 34(2), 229–241.

Cheesbrough, M. (2006). *District laboratory practice in tropical countries (2nd ed.). Cambridge University Press.*

Ejoh, R. A., Nkonga, D. V., Inocent, P. N., & Djuikwo, V. N. (2007). *Nutritional phytochemical characteristics of some wild plants used as spices in Cameroon*. Pakistan Journal of Nutrition, 6(5), 570–575.

Erukainure, O. L., Ebuehi, O. A. T., Choudhary, M. I., & Hafizur, R. M. (2016). *Telfairia occidentalis suppresses hyperglycemia and hepatic oxidative stress in streptozotocin-induced diabetic rats*. Journal of Ethnopharmacology, 192, 498–505.

Eseyin, O. A., Ebong, P., Ekpo, A., Igboasoiyi, A., & Oforah, E. (2014). *A review of the pharmacology and phytochemistry of Telfairia occidentalis.* Journal of Pharmacognosy and Phytochemistry, 3(2), 16–20.

Ezekwe, M. O., Umeh, C. C., & Chukwu, N. O. (2019). *Bioactive compounds and health benefits of Ugwu*. International Journal of Herbal Medicine, 14(3), 89–101.

Fasuyi, A. O. (2006). *Nutritional potential of fluted pumpkin leaf meal in diets*. African Journal of Biotechnology, 5(1), 49–53.

Francis, G., Kerem, Z., Makkar, H. P. S., & Becker, K. (2002). *The biological action of saponins in animal systems:* A review. British Journal of Nutrition, 88(6), 587–605.

Ganz, T., & Nemeth, E. (2012). *Iron homeostasis in host defense and inflammation. Nature Reviews Immunology*, 12(10), 695–709.

Harborne, J. B. (1998). *Phytochemical methods: A guide to modern techniques of plant analysis (3rd ed.). Chapman and Hall.*

Ifeanyi, O. E., Okoye, F. B. C., & Eze, N. O. (2014). *Effects of aqueous leaf extract of Telfairia occidentalis on haematological parameters and liver enzymes in male Wistar rats.* Journal of Medical and Pharmaceutical Allied Sciences, 3(2), 1–6.

Iyekowa, O. (2025). *Comparative phytochemical and mineral analysis of methanol extracts of Telfairia occidentalis leaves, roots and stems. PhilArchive.* https://philarchive.org/archive/IYECPA-2

Jain, S. K., & Hochstein, P. (1978). *Generation of superoxide radicals by phenylhydrazine and its role in the hemolysis of red blood cells. Archives of Biochemistry and Biophysics*, 191(2), 705–711.

Kassebaum, N. J., Jasrasaria, R., Naghavi, M., Wulf, S. K., Johns, N., Lozano, R., ... & Murray, C. J. (2014). *A systematic analysis of global anemia burden from 1990 to 2010. Blood*, 123(5), 615–624.

National Institutes of Health. (2011). *Guide for the care and use of laboratory animals (8th ed.). National Academies Press.*

Newman, D. J., & Cragg, G. M. (2020). *Natural products as sources of new drugs over the nearly four decades from 01/1981 to 09/2019.* Journal of Natural Products, 83(3), 770–803.

Njoroge, S. W., & Chhabra, R. (2021). *Hemolytic anemia. In StatPearls. StatPearls Publishing.*

Nwangwa, E. O. (2012). *Haematological and biochemical studies of aqueous extract of Telfairia occidentalis leaves in rats*. Journal of Medical Sciences, 12(3), 101–105.

Nwanna, E. E., Oboh, G., & Oloruntola, O. D. (2021). *Nutritional and medicinal significance of Telfairia occidentalis: A review.* Journal of Medicinal Food, 24(9), 927–936.

Obeagu, E. I., Chikelu, I. M., Obarezi, T. N., Ogbuabor, B. N., & Anaebo, Q. B. (2014). *Haematological effects of fluted pumpkin (Telfairia occidentalis) leaves in rats.* International Journal of Life Sciences Biotechnology and Pharma Research, 3(1), 1–11.

Oboh, G., Ademiluyi, A. O., & Akinyemi, A. J. (2014). *Telfairia occidentalis (fluted pumpkin) leaf: A potential source of functional ingredients for food and pharmaceutical industries*. Journal of Food Biochemistry, 38(1), 1–10.

Okafor, I. J., Obasi, K. A., & Nwachukwu, P. U. (2020). *Effects of leafy vegetables on hematological parameters.* African Journal of Physiology, 35(4), 112–123.

Olatunji, T. J., Omoyele, O. J., & Oduwole, S. O. (2019). *Nutrient composition and potential toxicity of excessive Ugwu consumption*. Journal of Food Science & Toxicology, 7(3), 112–128.

Olson, K. R., Whitfield, N. L., & Beaver, R. W. (2019). *Oxidative stress and red blood cell destruction by phenylhydrazine. Free Radical Biology & Medicine*, 143, 144–152.

Rees, D. C., Williams, S. E., & Gladwin, M. T. (1999). *Phenylhydrazine-induced hemolytic anemia: A model for studying the pathophysiology of hemolytic anemia. Blood*, 94(11), 3898–3907.

Salman, T. M., Oyeyemi, O. T., & Oyelowo, O. T. (2018). *Telfairia occidentalis Hook.f.-associated haematopoietic effect is mediated via erythropoietin and iron metabolism.* Journal of Ethnopharmacology, 215, 1–7.

Sofowora, A. (1993). *Medicinal plants and traditional medicine in Africa (2nd ed.). Spectrum Books Ltd.*

Sparg, S. G., Light, M. E., & Van Staden, J. (2004). *Biological activities and distribution of plant saponins. Journal of Ethnopharmacology*, 94(2–3), 219–243.

Trease, G. E., & Evans, W. C. (2002). Pharmacognosy (15th ed.). Saunders Publishers.

Uti, D. E., Uai, G. U., Uno, P. A., et al. (2022). *Antioxidant and anti-anemic effects of ethanol leaf extracts of Telfairia occidentalis and Mucuna poggei in PHZ-induced anemia.* Ibn Sina Journal of Medicine and Biomedical Sciences, 14, 116–126.

Williams, R. J., Spencer, J. P., & Rice-Evans, C. (2004). *Flavonoids: antioxidants or signalling molecules? Free Radical Biology and Medicine*, 36(7), 838–849.

World Health Organization. (2021). *Anaemia. Retrieved from https://www.who.int/news-room/fact-sheets/detail/anaemia*.