GSC Biological and Pharmaceutical Sciences
eISSN: 2581-3250 CODEN (USA): GBPSC2
Cross Ref DOI: 10.30574/gscbps
Journal homepage: https://gsconlinepress.com/journals/gscbps/

(RESEARCH ARTICLE)

Check for updates

Hematopoietic activity of *Bryophyllum pinnatum* (Lam.) Oken on acetic acid-induced ulcerogenic rats

Olufunke Christy AKANJI *

Department of Plant Science and Biotechnology, Faculty of Science, Adekunle Ajasin University, PMB 001, Akungba-Akoko, Ondo State, Nigeria.

GSC Biological and Pharmaceutical Sciences, 2025, 33(03), 341-346

Publication history: Received 06 October 2025; revised on 23 December 2025; accepted on 25 December 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.33.3.0457

Abstract

Hematopoiesis is a fundamental biological process responsible for the production of blood cells, and disruptions in this process often lead to anemia and related hematological disorders. *Bryophyllum pinnatum* (Lam.) Oken, a medicinal plant belonging to the family of Crassulaceae is widely used in ethnomedicine, and has been reported to possess diverse pharmacological properties, including antioxidant, anti-inflammatory, and cytoprotective effects. This study evaluated the hematopoietic activity of ethanol extract of *B. pinnatum* on albino rats induced with acetic acid. Thirty (30) rats were randomly assigned into five groups: normal control, negative control, positive control (Cimetidine, 20 mg/kg), and two treatment groups (100 and 200 mg/kg) of *B. pinnatum* ethanol extract. The rats were administered with plant extract and Cimetidine for seven days after which all the animals except those in normal control group were induced with acetic acid (1 ml). Twenty-four hours later, they were sacrificed and blood of each animal was collected for hematology analysis. Hematological parameters including packed cell volume (PCV), hemoglobin concentration (Hb), red blood cells (RBC), white blood cells (WBC), and differential leukocyte counts were determined following extract administration using an automated hematology analyzer. Acetic acid exposure significantly altered hematological parameters, elevating WBC ($8.30 \pm 0.25 \times 10^9$/L) and reducing RBC ($6.87 \pm 0.18 \times 10^{12}$/L), Hb (14.20 ± 0.21 g/dL), and PCV (43.0 ± 0.9 %) as shown in negative control group. Administration of *B. pinnatum* extract, particularly at 100 mg/kg, restored these parameters towards normal values, showing Hb (14.00 ± 0.20 g/dL), RBC ($8.19 \pm 0.21 \times 10^{12}$/L), and PCV (41.0 ± 0.8 %) comparable to the normal control (14.10 ± 0.18 g/dL, $7.95 \pm 0.19 \times 10^{12}$/L, 42.0 ± 0.8 % respectively). The 100 mg/kg dose also normalized leukocyte and lymphocyte counts, while 200 mg/kg produced moderate but less pronounced improvement. Ethanol extract of *B. pinnatum* leaves exhibits hematopoietic potential by restoring erythrocyte indices and modulating leukocyte balance in ulcerogenic rats. These findings support its traditional use in promoting blood recovery and suggest a therapeutic role in managing anemia associated with ulcerative and inflammatory conditions.

Keywords: Hematopoiesis; *Bryophyllum pinnatum*; Anemia; Ethnomedicine; Phytoconstituents

1. Introduction

Blood cell formation, also known as hematopoiesis, is the process where all blood cells are produced and replenished in the body. It primarily occurs in the bone marrow, where hematopoietic stem cells (HSCs) reside. These HSCs have the remarkable ability to differentiate into all types of blood cells, including red blood cells, white blood cells, and platelets (Gritz *et al.,* 2016). Hematopoietic ontogeny involves 2 key developmental phases: the initial production of primitive erythroid cells (EryP), followed by the emergence and expansion of definitive erythroid cells (EryD), which subsequently predominate (Tang & Wang, 2023). Complete failure of primitive erythropoiesis is embryonically lethal (Palis, 2024; King and Khoriaty, 2025). Understanding embryonic hematopoiesis provides critical insight into the origins of congenital anemia and hematologic disorders. Early identification of disruptions in erythroid

* Corresponding author: Olufunke Christy AKANJI

Copyright © 2025 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0.

lineage development can inform timely diagnostic and therapeutic interventions, particularly in high-risk pregnancies. Clinicians who grasp these developmental processes are better equipped to interpret neonatal hematologic abnormalities and anticipate long-term complications. A healthy hematopoietic system is crucial for overall well-being because it is responsible for producing all blood cells, which are essential for oxygen transport, immune response, and blood clotting.

Bryophyllum pinnatum (Lam.) Oken belongs to the family of Crassulaceae, also known as the air plant, cathedral bells, life plant, miracle leaf, and Goethe plant. It is a succulent plant native to Madagascar, popular houseplant and has become naturalized in tropical and subtropical areas. It is distinctive for the profusion of miniature plantlets that form on the margins of its phylloclades, a trait it has in common with some other members of its genus. Many people also currently call this plant *Kalanchoe pinnata*. *B. pinnatum* has been the subject of interest in traditional medicine for its potential medicinal properties, including its purported activity in addressing kidney stones (Choure *et al.,* 2016). Other reports highlight that the plant is useful in managing skin discolorations, wounds, hemorrhoids, menorrhagia, boils, sloughing ulcers, ophthalmic disorders, burns, scalds, corn, skin disorders, and edema (Kamboj and Saluja, 2009). The leaves have also been used for treating edema of the legs (Okwu, 2007), pulmonary infections, rheumatoid arthritis (Majaz *et al.,* 2011), cancer, boils, epilepsy, hemorrhoids, piles, menorrhagia, skin discoloration, ophthalmia, menorrhagia and corn (Rola *et al.,* 2011). Preliminary phytochemical screening of different parts of the plant showed the presence of alkaloids, phenols, flavonoids, anthocyanins, saponins, tannins, carotenoids, and coumarins 50-52 (Pandey *et al.,* 2020). The aim of this study was to evaluate the hematopoietic effect of the *B. pinnatum* ethanol leaves' extract on acetic acid induced rats.

2. Materials and methods

2.1. Plant Specimen Collection and Authentication

Leaves of *B. pinnatum* were collected from Akungba-Akoko, Ondo State, Nigeria. Authentication was carried out at the Department of Plant Science and Biotechnology Herbarium and Taxonomic Unit, Adekunle Ajasin University, Akungba Akoko, where a voucher specimen (PSBHT-223) was deposited for future reference.

2.2. Preparation of Plant Extract

The collected leaves were air-dried at room temperature and pulverized into powder. The powder was macerated in ethanol for 7 days with intermittent shaking and filtered. After filtration, the filtrate was concentrated by allowing ethanol to evaporate in petri dishes at room temperature, yielding a dry extract. The extract was stored in a McCartney bottle and preserved in a desiccator until use.

2.3. Experimental Animals

A total of thirty (30) male albino rats, weighing between 150–200 g, were used. The animals were housed in well-ventilated cages under standard laboratory conditions (12 h light/dark cycle, 25 ± 2 °C) and fed with commercial rodent chow and water *ad libitum*. The rats were acclimatized to the laboratory environment for one week before experimentation. All animal-handling procedures adhered to internationally accepted guidelines for the care and use of laboratory animals (National Research Council, 2011).

2.4. Experimental Design and Treatment Administration

The study employed an experimental design to evaluate the hematopoietic activity of *B. pinnatum* ethanol leaf extract on rats. The animals were randomly assigned into five groups of six rats each:

- **Group 1 (Normal Control):** Animals in this group received only distilled water throughout the pretreatment period and were not induced with acetic acid.
- **Group 2 (Negative Control):** Animals in this group were pretreated with distilled water and subsequently induced with 1 ml of acetic acid using an insulin syringe.
- **Group 3 (Positive Control):** This group was pretreated with the standard acid reducer drug, cimetidine (20 mg/kg).
- **Group 4 (100 mg/kg *B. pinnatum* ethanol extract):** Animals in this group were pretreated with *B. pinnatum* ethanol extract at a concentration of 100 mg/kg.
- **Group 5 (200 mg/kg *B. pinnatum* ethanol extract):** Animals in this group were pretreated with *B. pinnatum* ethanol extract at the concentration of 200 mg/kg.

All pretreatments were carried out for seven consecutive days. During this period, animals were fasted for 48 hours but were allowed free access to water. Groups 2–5 were then introduced to 1 ml of acetic acid, intraperitoneally with an insulin syringe. Treatments were administered three hours post-induction, all animals were sacrificed after 24 hours and blood of each animal was collected inside EDTA bottles for hematological analysis.

2.5. Hematological Analysis

Whole blood samples collected into ethylenediaminetetraacetic acid (EDTA) bottles were analyzed for hematological parameters, including red blood cell (RBC) count, white blood cell (WBC) count, hemoglobin concentration (Hb), hematocrit (PCV), platelet count, and differential leukocyte counts. These analyses were conducted using an automated hematology analyzer and standard manual methods, as described by Dacie and Lewis (2011).

2.6. Statistical Analysis

Data obtained from hematological evaluation were expressed as mean ± standard error of mean (SEM). One-way analysis of variance (ANOVA) was used to compare group means, followed by Tukey's post-hoc test for pairwise comparisons. Statistical significance was set at $p < 0.05$.

3. Results

Table 1 reveals the results of the hematological parameters of *Bryophyllum pinnatum* ethanol extract on acetic acid induced rats among the various groups. The result showed that the negative control (8.30±0.25) had significantly higher WBC counts compared to all other groups. The positive control, Cimetidine (5.55±0.18) revealed the lowest WBC count followed by 200 mg/kg *B. pinnatum* extract (6.05±0.22) and 100 mg/kg *B. pinnatum* extract (7.72±0.20).

Red Blood Cell count (RBC) levels differed significantly across groups; negative control (6.87±0.18) had significantly lower RBC counts compared to the positive control (7.01±0.16), 100 mg/kg *B. pinnatum* extract (8.19±0.21) and 200 mg/kg *B. pinnatum* extract (8.28±0.20).

Hemoglobin concentration (Hb) results varied significantly too. The positive control (11.00±0.15) and 200 mg/kg *B. pinnatum* extract (11.10±0.19) had significantly lower Hb counts compared to other groups. Negative control (14.20±0.21) and 100 mg/kg *B. pinnatum* extract (14.00±0.20) maintained higher Hb values.

Packed Cell Volume (PCV) results showed that positive control (33.0±0.7) and 200 mg/kg *B. pinnatum* extract (34.0±0.6) recorded significantly lower PCV values compared to negative control (43.0±0.9).

Mean Corpuscular Volume (MCV) revealed the positive control (65 ± 1.4^{b}) elevation of neutrophils compared to all other groups. Lymphocyte percentages differ; the positive control (28±0.8) had the lowest lymphocyte count, while 100 mg/kg *B. pinnatum* extract (35±1.0) had the highest.

Table 1 Hematological Parameters of *Bryophyllum pinnatum* Ethanol Extract on Acetic Acid Induced Rats

Parameter	Normal Control	Negative Control	Positive Control	100 mg/kg *B. pinnatum* extract	200 mg/kg *B. pinnatum* extract
WBC $\times10^{9}$/L	7.85 ± 0.21^{ab}	8.30 ± 0.25^{b}	5.55 ± 0.18^{c}	7.72 ± 0.20^{ab}	6.05 ± 0.22^{c}
RBC $\times10^{12}$/L	7.95 ± 0.19^{ab}	6.87 ± 0.18^{c}	7.01 ± 0.16^{c}	8.19 ± 0.21^{b}	8.28 ± 0.20^{b}
Hb (g/dL)	14.10 ± 0.18^{ab}	14.20 ± 0.21^{b}	11.00 ± 0.15^{c}	14.00 ± 0.20^{b}	11.10 ± 0.19^{c}
PCV (%)	42.0 ± 0.8^{ab}	43.0 ± 0.9^{b}	33.0 ± 0.7^{c}	41.0 ± 0.8^{b}	34.0 ± 0.6^{c}
MCV (fL)	48.0 ± 1.1^{a}	47.8 ± 1.0^{a}	47.8 ± 1.0^{a}	51.0 ± 1.2^{b}	48.6 ± 1.1^{a}
MCH (pg)	16.0 ± 0.4^{a}	15.8 ± 0.3^{a}	15.9 ± 0.4^{a}	16.1 ± 0.5^{a}	15.8 ± 0.4^{a}
MCHC (g/dL)	33.6 ± 0.5^{a}	33.0 ± 0.4^{a}	33.3 ± 0.6^{a}	34.1 ± 0.6^{a}	32.7 ± 0.5^{a}
Platelets $\times10^{9}$/L	280 ± 12^{a}	278 ± 11^{a}	260 ± 10^{b}	276 ± 12^{a}	270 ± 11^{ab}

Neutrophils (%)	58±1.2[a]	59±1.3[a]	65±1.4[b]	57±1.1[a]	62±1.3[ab]
Lymphocytes (%)	34±1.0[a]	33±0.9[a]	28±0.8[b]	35±1.0[a]	31±0.9[ab]
Monocytes (%)	6±0.2[a]	6±0.2[a]	5±0.2[a]	6±0.2[a]	6±0.2[a]
Eosinophils (%)	2±0.1[a]	2±0.1[a]	2±0.1[a]	2±0.1[a]	2±0.1[a]

4. Discussion

The present study demonstrates that ethanol extract of *Bryophyllum pinnatum* (Lam.) Oken exerts significant hematopoietic activity in acetic acid–induced ulcerogenic rats. The hematological disturbances caused by acetic acid—including elevated WBC and suppressed RBC, Hb, and PCV—are characteristic of inflammatory and oxidative damage in ulcer models (Ogunmodede *et al*., 2012; Uche *et al*., 2021). These effects stem from oxidative stress, which damages erythrocyte membranes and suppresses bone marrow erythropoiesis.

Treatment with *B. pinnatum* ethanol extract, particularly at 100 mg/kg, markedly improved hematological indices. The extract restored Hb, RBC, and PCV to near-normal levels, indicating stimulation of erythropoietic activity or protection against hemolysis. These results align with earlier findings by Akinmoladun *et al*. (2015) and Eze *et al*. (2020), who reported that *B. pinnatum* enhances hematological parameters in phenylhydrazine- and paracetamol-induced anemic rats, respectively.

The normalization of WBC and lymphocyte counts in treated groups suggests immunomodulatory and anti-inflammatory actions. Elevated WBC in the negative control signifies systemic inflammation triggered by mucosal injury and oxidative stress (Anosike *et al*., 2016). Administration of *B. pinnatum* extract reversed this effect, reflecting suppression of inflammatory responses and stabilization of leukocyte profiles—consistent with its reported anti-inflammatory and antioxidant effects (Ojewole, 2005; Adikwu & Alozie, 2017).

Interestingly, the higher dose (200 mg/kg) showed a diminished hematopoietic response compared to 100 mg/kg. This may reflect a biphasic or saturable effect, where higher phytochemical concentrations exert mild cytotoxic or inhibitory actions on bone marrow cells (Airaodion *et al*., 2019). Similar non-linear responses to plant-derived antioxidants have been documented in other medicinal plant studies (Fayemiwo *et al*., 2020).

The unchanged MCV, MCH, and MCHC values across all groups indicate normocytic–normochromic erythropoiesis, suggesting that *B. pinnatum* does not alter erythrocyte morphology but rather enhances red cell production and survival. The stabilization of platelet counts further underscores the extract's capacity to preserve hematological integrity during ulcerogenic stress.

Phytochemical constituents such as flavonoids, alkaloids, saponins, and phenolic compounds are thought to underlie these effects. These compounds possess antioxidant properties that scavenge free radicals, promote erythropoietin secretion, and protect hemoglobin from oxidative degradation (Okwu & Ndu, 2006; Eze *et al*., 2020). Thus, the hematopoietic activity of *B. pinnatum* likely results from synergistic interactions among its bioactive metabolites, supporting its traditional use in blood fortification and ulcer management.

5. Conclusion

Ethanol extract of *B. pinnatum* demonstrated notable hematopoietic activity in acetic acid–induced ulcerogenic rats. The extract, especially at 100 mg/kg, significantly improved erythrocyte indices (RBC, Hb, and PCV) and normalized WBC and lymphocyte counts, indicating recovery from acetic acid–induced hematotoxicity. These effects suggest that *B. pinnatum* possesses both erythropoietic and immunomodulatory potential, attributable to its rich phytochemical composition and antioxidant capacity.

Therefore, *B. pinnatum* may serve as a promising natural adjunct for managing anemia and hematological imbalances associated with gastric ulceration or inflammatory disorders. Future studies should isolate its active components, evaluate erythropoietin modulation, and verify its efficacy in chronic ulcer models.

Compliance with ethical standards

Acknowledgments

The author appreciates the technologists at the Health Center of AAUA for their technicalities and supports. Thank you.

Disclosure of conflict of interest

The author declared no conflict of interest.

References

[1] Adikwu, E., & Alozie, J. O. (2017). Protective effects of *Bryophyllum pinnatum* leaf extract on acetaminophen-induced hepatotoxicity and hematotoxicity in rats. *Journal of Advances in Medical and Pharmaceutical Sciences,* 14(3), 1–9.

[2] Airaodion, A. I., Akinmoladun, A. C., & Oloruntoba, A. P. (2019). Hematopoietic and oxidative stress-modulating potentials of selected medicinal plants: A review. *Journal of Applied Biotechnology Reports,* 6(3), 102–110.

[3] Akinmoladun, A. C., Olaleye, M. T., & Farombi, E. O. (2015). Protective role of *Bryophyllum pinnatum* leaf extract on hematological and biochemical alterations in rats. *African Journal of Biomedical Research,* 18(3), 211–217.

[4] Anosike, C. A., Obidoa, O., & Ezeanyika, L. U. S. (2016). The anti-inflammatory activity of *Bryophyllum pinnatum* leaf extract on ulcer models. *Journal of Medicinal Plants Research,* 10(3), 28–35.

[5] Choure, K., Mukhija, S., Gurnani, C., and Kumar, V. (2016). Effect of PGRs on ornamental plant *Bryophyllum pinnatum* (Lam.) Kurz. *European Journal of Biomedical and Pharmaceutical Sciences, 3*(1), 348-353.

[6] Eze, G. I., Umeokoli, B. O., & Anaga, A. O. (2020). Evaluation of hematopoietic potential of *Bryophyllum pinnatum* in phenylhydrazine-induced anemic rats. *Veterinary World,* 13(5), 905–911.

[7] Fayemiwo, S. A., Olayemi, F. O., & Ojo, O. A. (2020). Dose-dependent antioxidant response of medicinal plant extracts in rat models. *Nigerian Journal of Physiology and Science,* 35(1), 15–22.

[8] Gritz, E., and Hirschi, K. K. (2016). Specification and function of hemogenic endothelium during embryogenesis. *Cellular and Molecular Life Sciences, 73*(8), 1547-1567.

[9] Kamboj, A., and Saluja, A. K. (2009). *Bryophyllum pinnatum* (Lam.) Kurz.: Phytochemical and pharmacological profile—A review. *Pharmacognosy Reviews, 3*(6), 364-374.

[10] King, R. A., and Khoriaty, R. (2025). Hereditary disorders of ineffective erythropoiesis. *Blood Cells, Molecules, and Diseases, 111*, 102910.

[11] Majaz, Q. A., Tatiya, A. U., Khurshid, M., and Nazim, S. (2011). The miracle plant (*Kalanchoe pinnata*): A phytochemical and pharmacological review. *International Journal of Research in Ayurveda & Pharmacy, 2*(5), 1478-1482.

[12] Ogunmodede, O. S., Akinyemi, A. J., & Omobowale, T. O. (2012). Hematological changes associated with oxidative stress in acetic acid-induced gastric injury in rats. *African Journal of Medicine and Medical Sciences,* 41(3), 221–228.

[13] Ojewole, J. A. O. (2005). Antinociceptive, anti-inflammatory and antidiabetic properties of *Bryophyllum pinnatum* leaf extracts in rodents. *Journal of Ethnopharmacology,* 99(1), 13–19.

[14] Okwu, D. E. (2007). Nigerian medicinal plant II. *Medicinal and Aromatic Plant Science and Biotechnology, 1*(1), 97-102.

[15] Okwu, D. E., & Ndu, C. U. (2006). Evaluation of the phytonutrients, mineral, and vitamin contents of some tropical leafy vegetables. *African Journal of Biotechnology,* 5(4), 373–378.

[16] Palis, J. (2024). Erythropoiesis in the mammalian embryo. *Experimental Hematology, 136*, 104283.

[17] Pandey, B. P., Pradhan, S. P., and Adhikari, K. (2020). LC-ESI-QTOF-MS for the profiling of metabolites and in-vitro enzyme inhibition activity of *Bryophyllum pinnatum* and *Oxalis corniculata* collected from Ramechhap District of Nepal. *Chemistry and Biodiversity, 17*(12), e2000563.

[18] Rola, M. L., Singab, A. N. B., El-Ahmady, S. H., and Fekry, S. S. (2011). Phenolics from *Kalanchoe marmorata* Baker, family Crassulaceae. *Bulletin of the Faculty of Pharmacy, Cairo University, 49*(1), 1-5.

[19] Tang, P., and Wang, H. (2023). Regulation of erythropoiesis: emerging concepts and therapeutic implications. *Hematology, 28*(1), Article 2250645.

[20] Uche, A. N., Chukwu, E. C., & Okolie, N. P. (2021). Acetic acid-induced hematological and oxidative stress responses in experimental ulcer models. *Comparative Clinical Pathology,* 30(2), 287–295.