Review Article

# Ethnopharmacological Review of Traditional Medicinal Plants Found as an Astounding Remedy to Anemia

**Divya Sree MS[1*], Rajasekaran S[2]**

[1] Research Scholar, Faculty of Pharmacy, Bhagwant University, Ajmer, Rajasthan, India.

[2] Faculty of Pharmacy, Bhagwant University, Ajmer, Rajasthan, India.

***Corresponding author's E-mail:** fytopharmshama@gmail.com

**Received:** 23-09-2021; **Revised:** 17-11-2021; **Accepted:** 26-11-2021; **Published on:** 20-12-2021.

**ABSTRACT**

Iron deficiency is the predominant cause of anemia, which is a recurrent type of nutritional problem. Medicinal herbs have proven to be efficient in the treatment of a variety of ailments in developing countries, including anemia. Anemia is generally treated by hematinics in the form of tablets, capsules and syrup and sometimes injection. Long term intake of hematinics produces some side effects like Gastritis, tooth staining, etc. Many medicinal plants have the ability to treat anemia. Sorghum bicolor stem bark, *Brillantasia nitens* leaves, Tectona grandis, and Allium ascalonicum are just a few of the plants that have traditionally been used to treat anaemia. The current review aims to list out such medicinal plants along with their ethnopharmacological status in treating anemia.

**Keywords:** Anemia, medicinal plants, hematinics, tablets, iron deficiency.

**QUICK RESPONSE CODE →**

**DOI:** 10.47583/ijpsrr.2021.v71i02.011

**DOI link:** http://dx.doi.org/10.47583/ijpsrr.2021.v71i02.011

## INTRODUCTION

Anemia is a public health issue in both developing and industrialized countries. It is one of the oldest, most frequent, and pervasive blood disorders [1,2]. Preschool children and women of reproductive age are the most vulnerable population groupings, despite the fact that anaemia affects everyone at all stages of life[3]. The main cause of anemia is iron deficiency, which can be traced back to a low intake of bioavailable iron from food [4]. It has been estimated that 60% of all anemia cases are because of iron deficiency in the malaria-free area, while 50% are due to malaria in malaria endemic area [5]. While deficiency of iron contributes to most cases of anemia, other causes such as hookworm infections, schistosomiasis, malaria and HIV, deficiencies in other micronutrients, trauma and blood loss[3] has to be recognized.

However, Iron deficiency anemia (IDA) is considered to be very important factor in the global burden of disease[6]. It additionally has reflective consequences on socio-economic development. Adults and adolescents with anemia have diminished physical capability and work performance[7]. IDA has been well-known to negatively affect behavior, cognitive performance and physical growth in infants, preschool and school-going children. Additionally, it has been identified as the important risk factor for mortality of mother and child as well as affect negatively immune system and increase morbidity due to infections in every age group [8,3].

Iron deficiency results in anemia, which is a symptom rather than a disease itself. It is designated by headaches, general tiredness, breathlessness and dizziness. IDA is one of the major prevalent nutritional problems in the world which is preventable, despite of the steady implementation of programs for its control globally.

Deficiency in nutrients and certain vitamins and minerals which are necessary for the production of hemoglobin, might also be a cause of anemia. Hemoglobin is the pigment which makes blood cells red. Lack of hemoglobin will cause the cells to look paler in color, leading to the term hypo chromic which means lacking in color. The most common root of anemia in adults is iron deficiency[9]. The empirical usage of medicinal plant preparations in the treatment of anemia dates from time immemorial. Though the iron supplementation has high efficacy and effectiveness, there are certain disadvantages like gastrointestinal side effects such as nausea, vomiting, constipation and staining of teeth[10]. The goodness and healing properties of herbal plants were explored by people since ancient time. Herbs are the nature's gift for living beings and as medicine they can be useful in treating anemia. For these reasons, herbs seem like a good alternative. Nutritionists feel that blood nourishing herbs helps in the iron absorption along with providing some more benefits to the blood. It may aid in strengthening the hematopoietic system and immune system of an individual[11].

The choice of treatment for iron deficiency is iron, and it is given orally in necessary quantities to restore the iron to

normal levels, further to achieve the desired elevation of the hemoglobin level. Being a therapeutic agent for anemia, iron supplement is simple, cheap and it is significantly effective in treating anemia. The basic and most effective form of iron is ferrous sulfate which is taken orally. Iron is one of the few therapeutic agents in which oral therapy is highly predictable as well as more effective when compared to the systematically administered forms[12]. There are many other oral iron preparations other than ferrous sulfate, which are not much efficient in elevating the hemoglobin to optimal level. They may, however, be used in some cases instead of ferrous sulfate, in order to minimize adverse effects like gastro-intestinal intolerance, an aspect which has been unduly emphasized in the past [12, 13].

**Adverse effects of Iron**

***Adverse effects of oral iron*:** Epigastric pain, nausea, vomiting, gastritis, metallic taste, constipation (due to astringent effect) or diarrhea (irritant effect) are the usual adverse effects [14] Liquid preparations of iron causes staining of teeth [15].

***Adverse effects on parenteral iron*:** Local- Pain at the site of injection, pigmentation of the skin and sterile abscess are seen. Systemic-fever, headache, joint pain, palpitation, difficulty in breathing, lymph node enlargement, and rarely anaphylaxis is observed [16]. Acute iron poisoning is common in infants and children in the womb, if the pregnant mother consumes about 10 tablets (1-2g). Manifestations include vomiting, abdominal pain, hematemesis, bloody diarrhea, shock, drowsiness, cyanosis, acidosis, dehydration,[17] cardiovascular collapse and coma. Immediate diagnosis and treatment are important as death may occur in 6-12 hours [18].

**Natural foods that level iron deficiency**

There exist many forms of anemia, the most common type being the iron deficiency anemia. Red Blood Cells (RBC) which contains a protein called hemoglobin is full of iron. Without required levels of iron, our body can't produce hemoglobin which is necessary to deliver oxygen-rich blood throughout the body [19]. Folate and vitamin $B_{12}$ deficiency also has impact on the ability to make red blood cells. If the human body is not able to process vitamin $B_{12}$ properly, we may develop pernicious anemia. Hence, natural diet rich in iron and vitamin B helps in treating anemia [20].

A survey conducted by researchers concludes that people preferred natural products over hematinic drugs for their treatment of anemia due its side effects. Majority of the study population preferred daily intake of natural products like green leafy vegetables, nuts, fruits which helps in prevention and also in treating anemia. The study population aged between 16 years and 24 years were mostly affected by anemia, they were advised to take oral hematinics and majority of them gave up hematinics after 2-3 months of treatment due to its adverse effects [21].

This review studies the ethno pharmacological status of various medicinal plants used in the treatment of anemia (Table 1).

**Table 1:** List of medicinal plants used as haematinics

| S. No. | Name of Medicinal Plant (Family) | Plant Part used | Animal model used | Reference |
|---|---|---|---|---|
| 1. | *Khaya senegalensis* (Meliaceae) | Stem bark | Phenylhydrazine induced anemia | 22 |
| 2. | *Sorghum bicolour* (Poaceae) | Stem bark | *Trypanosoma brucei* -induced anemia in rabbit | 23 |
| 3. | *Lamium album* (Lamiaceae) | Aerial part | Phenylhydrazine induced anemia, intragastric butadiene - induced anemia | 24 |
| 4. | *Fagara zandhoxylum* (Rutaceae) | Bark | Traditional use | 25 |
| 5. | *Magniferra indica* (Anacardiaceae) | Bark | Phenylhydrazine induced anemia | 26 |
| 6. | *Telfairia occidentalis* (Cucurbitaceae) | Leaves | Phenylhydrazine induced anemia | 26 |
| 7. | *Amaranthus hybridus* (Amaranthaceae) | Leaves | Phenylhydrazine induced anemia | 26 |
| 8. | *Brillanthisia nitens* (Acanthaceae) | Leaves | Phenylhydrazine induced anemia | 27 |
| 9. | *Tectona grandis* (Lamiaceae) | Leaves | Phenylhydrazine induced anemia | 28 |
| 10. | *Jatropa curcas* (Euphorbiaceae) | Bark, leaves | Traditionally used | 29, 30 |
| 11. | *Flacourtia flavens* (Flacourtiaceae) | Leaves, root bark | Traditionally used | 29, 30 |
| 12. | *Psoraspermum ferbrifugum* (Hypericaceae) | Whole plant | Traditionally used | 29, 30 |
| 13. | *Combratum dolichopetalum* (Combretaceae) | Whole plant | Traditionally used | 29, 30 |
| 14. | *Adenia gummiferra* (Passifloraceae) | Root bark | Traditionally used | 29, 30 |
| 15. | *Allophylus rubifolius* (Sapindaceae) | Stem bark, Root bark | Traditionally used | 31 |
| 16. | *Bracken-ridgea zanguebarica* (Ochnaceae) | Root bark, Stem bark | Traditionally used | 32 |

| | | | | |
|---|---|---|---|---|
| 17 | *Hygrophila spinosa* (Acanthaceae) | Aerial parts | Toad skin toxin induced anemia | 33 |
| 18 | *Annona squamosa* (Annonaceae) | Fruit Pod and Seed | Traditionally used | 34 |
| 19 | *Nardostachys jatamansi* (Caprifoliaceae) | Root | Traditionally used | 35 |
| 20 | *Mucuna pruriens* (Fabaceae) | Leaf | haloperidol induced anemia | 36 |
| 21 | *Moringa oleifera* (Moringacea) | Leaf | Phenylhydrazine induced anemia | 37 |
| 22 | *Eclipta alba* (Asteraceae) | Root | Traditionally used | 38 |
| 23 | *Artocarpus heteropyllus* (Moraceae) | Leaf | Diabetes induced anemia | 39 |
| 24 | *Ipomoea batatas* (Convolvulaceae) | Leaf | Phenylhydrazine induced anemia | 40 |
| 25 | *Murraaya koenigii* (Rutacea) | Fruit | Phenylhydrazine induced anemia | 41 |
| 26 | *Mukia maderaspatana* (Cucurbitaceae) | Whole plant | Phenylhydrazine induced anemia | 42 |
| 27 | *Nelumbo nucifera* (Nelumbonaceae) | Flower | Diabetes induced anemia | 43 |
| 28 | *Picrorrhiza kurroa* (Scrophulariaceae) | Leaf | Phenylhydrazine induced anemia | 44 |
| 29 | *Solanum nigrum* (Solanacea) | Leaf | Phenylhydrazine induced anemia | 45 |
| 30 | *Alternanthera sessilis* (Amaranthaceae) | Leaf | Anemia induced bleeding through tail clipping technique | 46 |
| 31 | *Celosia argentea* (Amaranthaceae) | Stems & leaves | Traditionally used | 47 |
| 32 | *Amaranthus spinosus* (Amaranthaceae) | Whole plant | Traditionally used | 48 |
| 33 | *Digera muricata* (Amaranthaceae) | Whole plant | Traditionally used | 49 |
| 34 | *Sesbania grandiflora* (Leguminacea) | Flower | Traditionally used | 50 |
| 35 | *Hibiscus cannabis* (Malvacea) | Leaf | Phenylhydrazine induced anemia | 51 |
| 36 | *Trigonella foeum-graecum* (Rutacea) | Seeds | Phenylhydrazine induced anemia | 52 |
| 37 | *Bursella rubra* (Basellaceae) | Leaf | Traditionally used | 53 |
| 38 | *Portulaca oleracea* (Portulacaceae) | Leaf | Traditionally used | 54 |
| 39 | *Boerhavia diffusa* (Nyctaginaceae) | Root | Phenylhydrazine induced anemia | 55 |
| 40 | *Coriander sativum Linn* (Umbelliferae) | Leaf | Phenylhydrazine induced anemia | 56 |
| 41 | *Mentha piperita Linn* (Labiatae) | Leaf | Traditionally used | 57 |
| 42 | *Amaranthus paniculate* (Amaranthaceae) | Leaf | Traditionally used | 48 |
| 43 | *Spinacia oleracea Linn* (Amaranthaceae) | Leaf | Phenylhydrazine induced anemia | 58 |
| 44 | *Adansonia digitata L.* (Bombacaceae) | Fruit | Children with iron deficiency anemia | 59 |
| 45 | *Cajanus cajan (L.)* (Fabaceae) | Seed | Sickle cell anemia patients | 60 |
| 46 | *Detarium microcarpum* (Caesalpiniaceae) | Bark | Phenylhydrazine induced anemia | 61 |
| 47 | *Detarium senegalense* (Caesalpiniaceae) | Bark | Traditionally used | 62 |
| 48 | *Faidherbia albida* (Mimosaceae) | Leaf | Traditionally used | 63 |
| 49 | *Ficus platypphylla Del.*(Moraceae) | Bark | Traditionally used | 64 |
| 50 | *Justicia secunda* (Acanthaceae) | Leaves and stems | Phenylhydrazine induced anemia | 65 |
| 51 | Spondias mombin (Anacardiaceae) | Leaves | Phenylhydrazine induced anemia | 66 |
| 52 | *Milicia excels* (Moraceae) | Stem bark | Traditionally used | 67 |
| 53 | *Ricinus communis* (Euphorbiaceae) | Leaves and stems | Traditionally used | 67 |
| 54 | *Stylosanthes erecta* (Fabaceae) | Leaves and stem | Traditionally used | 67 |
| 55 | *Thalia geniculate* (Marantaceae) | Whole plant | Traditionally used | 67 |
| 56 | *Lannea barteri (Oliv.)* (Anacardiaceae) | Stem bark | Traditionally used | 67 |
| 57 | *Lophira lanceolata* (Ochnaceae) | Leaves and stem bark | Traditionally used | 67 |
| 58 | *Opuntia elatior* (Cactaceae) | Fruit | Phenylhydrazine induced anemia | 68 |
| 59 | *Olax subscorpioidea* (Olacaceae) | Roots | Traditionally used | 67 |
| 60 | *Stylosanthes erecta P.* (Fabaceae) | Whole plant | Traditionally used | 67 |
| 61 | *Vitellaria paradoxum C.* (Sapotaceae) | Roots | Traditionally used | 67 |
| 62 | *Waltheria indica L.* (Sterculiaceae) | Leaves and stem | Traditionally used | 67 |
| 63 | *Tapinanthus dodoneifolius (DC.)* (Loranthaceae) | Leaves | Traditionally used | 67 |
| 64 | *Imperata cylindrica var. Africana* (Poaceae) | Whole plant | Phenylhydrazine induced anemia | 67 |
| 65 | *Lannea acida A. Rich* (Anacardiaceae) | Stem bark and Roots | Traditionally used | 67 |
| 66 | *Pterocarpus erinaceus* (Fabaceae) | Stem bark | Traditionally used | 67 |
| 67 | *Phyllanthus amarus* (Euphorbiaceae) | Whole plant | Traditionally used | 67 |
| 68 | *Bridelia ferruginea* (Euphorbiaceae) | Leaves | Traditionally used | 67 |
| 69 | *Anogeissus leiocarpus* (Combretaceae) | Stem bark and Leaves | Traditionally used | 67 |
| 70 | *Hoslundia opposita* (Lamiaceae) | Leaves and stem | Phenylhydrazine induced anemia | 67 |

## CONCLUSION

Anemia, one among the most common blood disorders, occurs due to the decreased levels of healthy red blood cells (RBCs) in the body. Globally as well as in India, anemia has a high incidence and it is expected to elevate in the future. Hence, there is a need to prevent it and also to seek for better and more cost-effective treatment strategies for it. Anemia is most common in the developing world, where the causes are multifaceted. Combating anemia is a global public health challenge in the developing world due to limited resources and complex socioeconomics. Several studies have found a high prevalence of anemia in adolescent boys and girls. Adolescent health is the most important indicator of a country's development. As a result, immediate attention is required in this area. Evidence suggests that combining preventive supplementation with nutrition education may be a more efficient strategy for improving compliance and nutrition status. There hasn't been much research done to far that can establish a natural and safe cure for the ailment. According to certain research, the hemoglobin levels of women in the reproductive age range improved significantly after being treated with *Moringa oleifera* and jaggery. In anemic women, this might be marketed in the community as a preventive and nutritional supplement. The other species mentioned can also be used to create similar cures. In the near future, it will be necessary to develop a complete natural therapy to combat iron deficiency employing these four underutilized species.

According to the findings of this study, plant extracts have considerable hematinic activity in animal models. Even at relatively high concentrations, the extracts are non-toxic. A wide range of herbal products have been reported to have hematinic activity, but it should be noted that substances found in herbal extracts, such as flavonoids and phenols, are responsible for their hematinic activity. Moreover, an anaemia-free population is practicable if the outcomes of anemia, as well as its preventive and curative measures, are promoted among the general public, particularly in the rural people. This widely cited and well-documented review will undoubtedly aid researchers in the development of appropriate anemia treating drugs, the creation of experimental research protocols, and the cross-referencing of published methodologies.

**Acknowledgement**

Authors are thankful to the Head of the Department, Faculty of Pharmacy, Bhagwant University for their support in making this paper.

## REFERENCES

1. WHO - Worldwide Prevalence of Anaemia 1993–2005. In: Brunode Benoist, Erin McLean, InesEgli, MaryCogswell (Eds.). 2008; WHO Global Database on Anaemia, Geneva, Switzerland.
2. Domínguez-Rodrigo M, Pickering TR, Diez-Martín F, Mabulla A, Musiba C, Trancho G, Arriaza C. Earliest porotic hyperostosis on a 1.5-million- year-old hominin, olduvai gorge, Tanzania. PloS one. 2012; 7(10):e46414
3. WHO - Iron Deficiency Anaemia. 2001; WHO Global Database on Anaemia, Geneva, Switzerland.
4. Mc Lean E, Cogswell M, Egli I, Wojdyla D, deBenoist B. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System,1993–2005. Public Health Nutrition. 2009; 12(4):444–454.
5. Stoltzfus RJ. Iron deficiency: global prevalence and consequences. Food and Nutrition Bulletin. 2003; 24 (Suppl4):S99-103.
6. WHO - World health report 2002- Reducing risks, promoting healthy life. 2002; WHO Global Database on Anaemia, Geneva, Switzerland.
7. Edgerton VR, Gardner GW, Ohira Y, Gunawardena KA, Senewiratne B. Iron-deficiency anaemia and its effect on worker productivity and activity patterns. British Medical Journal. 1979; 2 (6204):1546–1549.
8. Theresa O, Scholl MLH. Anemia and iron-deficiency pregnancy anemia: compilation of data on. American Journal of Clinical Nutrition. 1994; 59 (Suppl):492–501.
9. Priyanka KG. Contribution of medicinal plants in treatment of anemia and as a haematinic. World journal of pharmacy and pharmaceutical sciences. 2015; 4(11):687-702
10. Iyswarya S, Visweswaran S, Banumathi V. Hematinic activity of polyherbal siddha formulation Narasinga Rasayanam in rat models. Int. J. Curr. Res. Chem. Pharm. Sci. 2018; 5(2): 13-18
11. Mishra P, Gupta S. Hematinic activity of *Eclipta alba* on *Clarias gariepinus* (burchell). World journal of pharmacy and pharmaceutical sciences. 2015; 4(12):1002-1012.
12. Valk B de, de Valk B, Marx JJM. Iron, Atherosclerosis, and Ischemic Heart Disease. Archives of Internal Medicine. 1999; 1542.
13. Goddard AF. Guidelines for the management of iron deficiency anaemia. Gut. 2011; pp. 1309–1316.
14. Wolf M. Effects of Iron Isomaltoside vs Ferric Carboxymaltose on Hypophosphatemia in Iron-Deficiency Anemia: Two Randomized Clinical Trials. JAMA: The journal of the American Medical Association. 2020; 323(5):432–443.
15. Högberg KG, Lindvall S. The Distribution Of Parenteral Iron Haematinics in nonpregnant, pregnant and lactating rats. British Journal of Pharmacology and Chemotherapy. 1964; 275–288.
16. Tripathi KD. Chapter-06 Adverse Drug Effects', Essentials of Medical Pharmacology. 2013a ; pp. 82–98.
17. Tripathi KD. Chapter-43 Haematinics and Erythropoietin. Essentials of Medical Pharmacology. 2013b;599–612.

18. Vani S, Grover A. Effects of Maternal Iron Deficiency Anemia and Iron Supplementation on Fetus. Textbook of Neonatal Hematology-Oncology. 2003;24–24.

19. Tripathi KD. Haematinics and Erythropoietin. Essentials of Medical Pharmacology. 2008; 579–579.

20. Letsky E. Anaemia and haematinics in pregnancy. Clinical Pharmacology in Obstetrics. 1983; 28–48.

21. Dharsan R, Brundha MP, Lesile Rani. Effects and Alternatives to Haematinics on Anemic Patients-A Questionnaire Study. Biosc Biotech Res Comm. 2020; 13(8):53-58.

22. Sanni FS, Ibrahim S, Esievo KAN, Sanni S. Effect of oral administration of aqueous extract of *Khaya senegalensis* stem bark on phenylhydrazine induced anaemia in rats. Pakistan Journal of Biological Sciences. 2005; 8:255-258.

23. Oladiji AT, Jacob TO, Yakubu MT. Anti-anaemic potentials of aqueous extract of *Sorghum bicolour* (L.) moench stem bark in rats. Journal of Ethnopharmacology. 2007; 111:651-656.

24. Petukhova NM, Buryakina AV, Avenirova EL, Buurakova MA, Drozhzhina EV. Study of biological activity an oil extract of the snake flower *Lamium album*. Pharmaceutical Chemistry Journal. 2008; 42:354-356.

25. Sofowora A. African Medicinal plants: Proceeding of a conference. University of Ife Press, Ife Nigeria. 1979; 3.

26. Ogbe RJ, Adoga GI, Abu AH. Antianaemic potentials of some plant extracts on phenyl hydrazine-induced anaemia in rabbits. Journal of Medicinal Plants Research. 2010; 4:680–684.

27. Akah PA, Okolo EC, Ezike AC. The haematinic activity of the methanol leaf extract of *Brillantasia nitens Lindau* (Acanthaceae) in rats. African Journal of Biotechnology. 2009; 8: 2389-2393.

28. Diallo A, Gbeassor M, Vovor A, Gadegbeku KE, Aklikokou K, Amegnona Agbonon A, Abena A, De Souza C, Akpagana K. Effect of *Tectona grandis* on phenylhydrazine-induced anaemia in rats. Fitoterapia. 2008; 79:332-336.

29. Dina OA, Adedapo AA, Oyinloye OP, Saba AB. Effect of *T. occidentalis* extract on experimentally induced anaemia in domestic rabbits. African Journal of Biomedical Research. 2006; 3:181-183.

30. Alada ARA. The hematological effect of *Telfelria occidentalis* diet preparation. African Journal of Biomedical Research. 2000; 3:185-186.

31. Chhabra SC, Mahunna RLA, Mshiu EN. Plants used in traditional medicine in eastern Tanzania. V. Angiosperms (Passifloraceae to Sapindaceae). Journal of Ethnopharmacology. 1991; 33:143-157.

32. Omolo OJ, Chhabra SC, Nyagah G. Determination of iron content in different parts of herbs used traditionally for anaemia treatment in East Asia. Journal of Ethnopharmacology. 1997; 58:97-102.

33. Gomes A, Das M, Dasgupta SC. Haematinic effect of *Hygrophila spinosa* on experimental rodents. Indian J Exp Biol. 2001; 39(4):381-2.

34. Shirwaikar A, Rajendran K, Kumar CD. In vitro antioxidant studies of *Annona squamosa Linn* leaves. Indian J Exp Biol. 2004; 42(8):803-807

35. Damodara Gowda KM, Lathika Shetty Krishna AP, Suchetha Kumari N, Ganesh Sanjeev Naveen P, Sharada V. Ethanolic extract of *Nardostachys jatamansi* potentiates haematopoietic system in albino wistar rats. NUJHS. 2013; 3:1.

36. Akindele AJ, Busayo FI. Effects of the hydroethanolic extract of *Mucuna pruriens* (L.) DC (Fabaceae) on haematological profile in normal and haloperidol treated rats. Nig Q J Hosp Med. 2011; 21(2):93-8.

37. Adegbite OA, Omolaso B, Seriki SA and Shatima C. Effects of *Moringa Oleifera* Leaves on Hematological Indices in Humans. Ann Hematol Oncol. 2016; 3(8): 1107.

38. Preeti M, Seema G. Haematological evaluation of *Eclipta alba* root extract in catfish, *Carias batrachus* (linnaeus, 1758). Journal of Pharmaceutical and Scientific Innovation. 2014; 3(3):240-244.

39. Okonkwo Agu CV, Njoku Abonyi U, Victor A, Anaduaka EG, Iloabuchi KV, Odo CE. Hypoglycaemic and haematinic properties of ethanol leaf extract of *Artocarpus heterophyllus* in alloxan induced diabetic rats. Afr J Tradit Complement Altern Med. 2015; 12(2):144-148.

40. Benjamin Gabriel O, MacDonald Idu. Nutritional, haematinic and biosafety evaluation of *Ipomoea batata* (L.) Lam. (Solanales: Convolvulaceae) leaf extract on albino rats. Brazilian Journal of Biological Sciences. 2019; 6(13):313-329.

41. Atish Waghmare N, Sachin Tembhurne V, Dinesh Sakarkar M. Anti-Anaemic Potential of *Murraya koenigii* Fruit Extracts In Phenylhydrazine Induced Anaemic Rats. IJAPR. 2015; 6(5): 124 – 127.

42. Saravanan VS, Manokaran S. Anti-anaemic activity of some plants in Cucurbitaceae on phenylhydrazine-induced anaemic rats. Thai Journal of Pharmaceutical Sciences. 2012; 36(4):150-154.

43. Supasorn S, Sanong C, Chusri T, Nopparat B. Effect of Flower Extract from Lotus (*Nelumbo Nucifera*) on Haematological Values and Blood Cell Characteristics in Streptozotocin-induced Diabetic Rats. ARPN Journal of Science and Technology. 2012; 2(11):1049-1054.

44. Turaskar, Sachin Madhusudan, Sheikh R, Jagannath Gadpayale. Inhibitory potential of *Picrorhiza kurroa* Royle ex. Benth extracts on phenylhydrazine induced reticulocytosis in rats. Asian Journal of Pharmaceutical and Clinical Research. 2013; 6:212-213.

45. Umaru HA, Moses MA, Zailani HA. Effect of *Solanum nigrum* Methanol Leaf Extract on Phenylhydrazine Induced Anemia in Rats. Jordan Journal of Biological Sciences. 2018; 11(1):65 – 71.

46. Erna CA, Marina OO. Hematinic activity of *Alternanthera sessilis* (L.) R. Br. (Amaranthaceae) in mice and rats. E-International Scientific Research Journal. 2010; 2(2):110-117.

47. Schleimann, W, Cai Y, Degenkolb T, Schmidt J, Corke H. Betalains of *Celosia argentea*. Phytochemistry. 2001; 58(2):159-165.

48. Kirtikar KR, Basu BD: Indian Medicinal Plants. Uttranchal: Oriental Enterprises; 2001.

49. Pratima M, Sundar SM. Phytochemical and Antimicrobial Activity of *Digera Muricata* (L.) Mart. E-Journal of Chemistry. 2010; 7(1):275-280.

50. Loganayaki N, Suganya N, Manian S. Evaluation of edible flowers of agathi (*Sesbania grandiflora* L. Fabaceae) for in vivo anti-inflammatory and analgesic and in vitro antioxidant potential. Food Sci. Biotechnol. 2012; 21:509-17.

51. Gabriel AA, Julius EO, Jeanne YN. Haematinic activity of *Hibiscus Cannabinus*. African Journal of Biotechnology. 2005; 4(8):833-837.

52. Anand Chourasiya, Rakesh Kumar Sahu, Mohd Azaz Khan. Anti-Anemic and Haemopoietic Evaluation of *Trigonella foenum-graecum* (Fenugreek) in Rodent Model. Journal of Drug Delivery and Therapeutics. 2019; 9(4-s):332-337.

53. Manandhar NP: Plants and People of Nepal.Timber Press, Oregon, 2002.

54. Victoria Chinenye O, Hope Delesi K, Gabriel Agu O. Effect of Chloroform Leaf Extracts of *Portulaca oleracea* Linn. (Purslane) on Haematological Parameters in Albino Wistar Rats. Journal of Complementary and Alternative Medical Research. 2018; 6(3):1-8.

55. Orish Ebere O, Onyenmachi Johnson A. Subchronic toxicity studies of the Aqueous extract of *Boerhavia diffusa* leaves. Journal of health science. 2003; 49(6):444-447.

56. Eguale T, Tilahun G, Debella A, Feleke A, Makonnen E. In vitro and in vivo anthelmintic activity of crude extracts of *Coriandrum sativum* against *Haemonchus contortus*. J Ethnopharmacol. 2007; 110:428–33.

57. Sun Z, Wang H, Wang J, Zhou L, Yang P. Chemical Composition and Anti-Inflammatory, Cytotoxic and Antioxidant Activities of Essential Oil from Leaves of *Mentha piperita* grown in China. Plos One. 2014; 1:15.

58. Luka CD. Abdulkarim M, Adoga GI, Tijjani H, Olatunde A. Anti-anaemic Potential of Aqueous Extract of *Spinacia oleracea* Leaf in Phenylhydrazine-treated Rats. N Y Sci J. 2014; 7(6):14-18.

59. Mohamed Ali MF, Swar MO, Osman AM. Treatment of iron deficiency anaemia with the natural hematinic Carbaodeim. Sudan J Paediatr. 2016; 16(1):37-44.

60. Ekeke GL, Shode FO. Phenylalanine is the predominant antisickling agent in *Cajanus cajan* seed extract. Plant. Med. 1990; 56: 41-43.

61. Gbadamosi IT, Moody JO, Yekini O. Nutritional composition of Ten Ethnobotanicals used for the treatment of Anaemia in Southwest Nigeria. European Journal of Medicinal Plants. 2012; 2(2): 140-150.

62. Ukwubile. Preliminary Phytochemical Screening and In Vitro Anthelminthic activity of *Detarium senegalense* J.f Gmel (Fabaceae) leaf methanol extract. American Journal of Biotechnology and Bioinformatics. 2017; 1:2.

63. Abasse T, Moussa M, Adamou H, Amadou L, John CW. *Faidherbia albida* (Delile) tree dieback effects on crop production in the Parkland Agroforests of Southwestern Niger. International Journal of Forestry Research. 2021; 21:6-9.

64. Adebayo MA, Enitan SS, Owonikoko WM, Igogo E, Ajeigbe KO. Haematinic properties of methanolic stem bark and fruit extracts of *Ficus sur* in rats pre-exposed to phenylhydrazine-induced haemolytic anaemia. Afr. J. Biomed. Res. 2017; 20: 85- 92.

65. Moswa JL, Kapanda N, Mungende DM, Okitolonda W, Mayangi M, Mihigo S, Mbale K. Plants as an Important Source of Iron for the Treatment of Anaemia: Case of *Justicia secunda*. 11th NAPRECA Symposium Book of Proceedings, Antananarivo, Madagascar, 2005; 132-135.

66. Innih SO, Omage SO, Omage K. Hematinic effects of *Spondias mombin* and its protective role against the spleenotoxic effect of phenylhydrazine. Clin Phytosci. 2020; 6:30.

67. Mamidou Koné W, Koffi AG, Bomisso EL, Tra Bi FH. Ethnomedical study and iron content of some medicinal herbs used in Traditional medicine in cote d'ivoire for the treatment of anaemia. Afr J Tradit Complement Altern Med. 2012; 9(1):81-87.

68. Chauhan SP, Sheth NR, Suhagia BN. Hematinic effect of fruits of *Opuntia elatior* Mill. on phenylhydrazine-induced anemia in rats. Ayu. 2015; 36(2):208-13.


**Source of Support:** The author(s) received no financial support for the research, authorship, and/or publication of this article.

**Conflict of Interest:** The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.