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Original Research Article

Formulation and Evaluation of Iron Boosting Polyherbal Syrup for the Management of Anemia

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Abstract: Anemia is a widespread nutritional disorder, primarily caused by iron deficiency, leading to reduced hemoglobin levels and decreased oxygen-carrying capacity of blood. Conventional iron supplements often result in gastrointestinal side effects and poor patient compliance. The present study focuses on the formulation and evaluation of a polyherbal iron-boosting syrup for effective anemia management. The formulation comprises Amla (Emblica officinalis), Punarnava (Boerhavia diffusa), and Sesame seeds (Sesamum indicum), which are known for their hematinic, antioxidant, and iron-enhancing properties. The syrup was prepared using standard extraction techniques followed by incorporation into a suitable syrup base with appropriate excipients. The formulated product was evaluated for physicochemical parameters such as pH, viscosity, clarity, homogeneity, and organoleptic characteristics. The results showed that the formulation possesses acceptable stability, palatability, and uniformity. The herbal combination demonstrated potential to improve hemoglobin levels with minimal side effects.Thus, the developed polyherbal syrup can be considered a safe, cost-effective, and patient-friendly alternative for the management of anemia, with scope for further clinical evaluation.

Keywords: Polyherbal syrup, Anemia, Iron deficiency, Amla, Punarnava, Sesame seeds, Hematinic, Herbal formulation, Iron absorption, Natural therapy

1. Introduction

Anemia is a common health problem that affects the body's ability to reduce oxygen carrying capacity because of low levels of haemoglobin or red blood cells. It is especially common in poorer areas and affects women, young children, and older people a lot. The most frequent type of anemia is caused by not getting enough iron in the diet, poor absorption of iron, or losing blood over a long time Regular iron pills can help, but they often cause stomach upset, constipation, nausea, and people may not take them as regularly as they should. For a long time, people have used natural herbs to treat anemia because they are safer, easier to take, and have fewer side effects.[1]

Some herbs like Punarnava Seeds, Jaggery, and Amla are known to help increase hemoglobin, improve how well the body absorbs iron, and support the production of red blood cells. Using syrup as the form of medicine is better because it is easy to take, gets absorbed quickly, and helps people, especially children and older adults, follow their treatment plan more easily.Anemia is a widespread hematological disorder characterized by a decrease in the number of red blood cells or the hemoglobin concentration in blood, resulting in reduced oxygen-carrying capacity. It is a major public health problem, particularly in developing countries like India, affecting infants, children, adolescents, pregnant women, and elderly populations. The most common form is iron deficiency anemia, which arises due to inadequate dietary intake of iron, poor absorption, increased physiological demand, chronic blood loss, or parasitic infections.[2]

Hemoglobin is an essential component of red blood cells responsible for transporting oxygen from the lungs to body tissues. A deficiency in hemoglobin leads to symptoms such as fatigue, weakness, dizziness, shortness of breath, and impaired cognitive and physical performance. Long-term anemia can result in serious health complications including compromised immunity, delayed growth, and increased maternal and fetal morbidity.[3]

- **Pathophysiology**

Iron is a necessary element in the body and is mainly controlled by how much we eat, how well Our body absorbs it from the intestines, and how much iron is recycled. Dietary iron comes in two Forms: haem iron and non-haem iron. Haem iron is easier for the body to absorb and is found in Foods like meat, poultry, and fish because it comes from haemoglobin and myoglobin. Non-haem Iron is mostly found in plant-based foods but is not as easy to absorb. Certain compounds in plants, Like phytate, oxalate, polyphenols, and tannin, can reduce the amount of non-haem iron the body Takes in. Some medicines, like proton pump inhibitors, can also affect this. On the other hand, Substances such as ascorbic acid, citrate, and stomach acid help the body absorb iron better. In a Normal, balanced diet, a person usually takes in about 5 to 15 milligrams of elemental iron and 1 To 5 milligrams of haem iron each day, but only around 1 to 2 milligrams is actually absorbed Bloodstream, mostly in the duodenum and the beginning part of the jejunum. [4]

- **Types Of Anemia**

Anemia arises as a result of a variety of defects in RBC such as impaired production as seen In Aplastic anemia, impaired maturation deficit in megaloblastic anemia, errors in haemoglobin Synthesis characterized by iron deficiency anemia, genetic defects of haemoglobin maturation Manifested in thalassemia, synthesis of abnormal haemoglobin detected in hemoglobinpathies, Sickle cell anemia and thalassemia and weight loss of RBC's are in hemolytic anemia.4

The following are the different types of anemia

1. Iron- Deficiency Anemia.
2. Sickle cell Anemia
3. Thalassemia.
4. Pernicious Anemia.
5. Hemolytic Anemia.
6. Aplastic Anemia[5]

- **Signs And Symptoms Of Anemia**

1. Pallor
2. Epithelial Changes
3. Nail Changes
4. Pedal Edema
5. Plummer-Vision Syndrome [6]

- **Treatment Of Anemia**

Anemia treatment depends on what's causing it.

A) Iron deficiency anemia
B) Vitamin deficiency anemia
C) Anemia of chronic disease
D) Aplastic anemia [7]

2.Literature review

1. Sukwuttichai et.al., (2026)

The review stated that provides a comprehensive evaluation of the global prevalence of iron deficiency anemia (IDA) among children aged 5–12 years. The study analyzed data from 55 observational studies involving over 2. 1 million children and reported a pooled global prevalence of approximately 9. 4%, indicating that IDA remains a significant public health concern in this age group . The authors highlight that, although global health policies often focus on preschool children and women, school-aged children are also highly vulnerable and frequently overlooked. The review further identifies considerable regional variations, with higher prevalence observed in South Asia and sub-Saharan Africa, as well as in low- and lower-middle-income countries, where nutritional deficiencies and socio-economic factors are more prominent (23)

2. Sunil et.al ., (2025)

Reported that a polyherbal syrup intended for the management of iron deficiency anemia. The formulation was prepared using selected medicinal herbs known for their hematinic and iron-enhancing properties. The developed syrup was evaluated for physicochemical parameters such as pH, viscosity, organoleptic properties, and stability, along with in-vitro iron content and microbial load. The results indicated that the polyherbal syrup was pharmaceutically stable, palatable, and contained appreciable iron levels, suggesting its potential effectiveness as a safe and natural alternative for the treatment of iron deficiency anemia. (11)

3. Ramachandran et.al., (2025)

It review stated that development of an ayurvedic polyherbal liquid formulation targeted for anemia management. The study emphasizes that improved palatability is crucial, especially in liquid dosage forms, since taste and flavor influence patient compliance, particularly in vulnerable populations likechildren and the elderly. The authors outline standardization parameters including physicochemical evaluation, organoleptic assessment, and quantitative estimation of marker compounds. (12)

4. Zaman et al., (2025)

That review highlights provides a comprehensive overview of maternal and childhood iron deficiency, emphasizing its clinical implications and global prevalence trends. The authors highlight that iron deficiency anemia remains one of the most widespread nutritional disorders worldwide, disproportionately affecting pregnant women and children, especially in low- and middle-income countries. The review discusses that maternal iron deficiency during pregnancy significantly influences fetal growth, birth outcomes, and iron status of the newborn, often leading to complications such as low birth weight, impaired immunity, and increased risk of infant anemia. It also emphasizes that children suffering from iron deficiency are more likely to experience delayed cognitive development, reduced physical growth, and increased susceptibility to infections. (17)

5. Jadhao et.al., (2021)

Its review demonstrate that a herbal cough syrup using selected medicinal plant extracts. The authors aimed to develop a stable, palatable, and pharmaceutically acceptable liquid herbal dosage form suitable for respiratory complaints. The formulation process involved selecting botanicals with traditional therapeutic relevance, combining them with appropriate excipients like sweeteners and preservatives to enhance taste and stability. Once prepared, the syrup was subjected to standard evaluation parameters including pH, viscosity, density, and organoleptic properties (taste, color, and odor). (13)

3. Plant profile

1. <u>Amla</u>

Fig. 3.1: Amla

- **Synonyms**

English: Emblic myrobalan,

Indian Goose berry

Sanskrit: Aamalaki

Hindi: Amla

Marathi: Amla

- **Biological source/ family:**

Emblica officinalis Gaerth (*Phyllanthus emblica Linn*.), belonging to family *Euphorbiaceae*.

- **Classification**

Kingdom : Plantae ,Division : *Angiospermae* ,Class : *Dicotyledona*e ,Order : *Geraniales* ,Family : Euphorbiaceae ,Genus : *Emblica* ,*Species* : *officinalis Geartn*.

- **Chemical constituents of Amla**

The fruit Also contains Phyllemblin Activity directed fractionation Revealed the presence of several phytochemicals like gallic Acid, corilagin, furosin and geraniin. Flavonoids like Quercetin, alkaloids like phyllantine and phyllantidine are Found. Along with these, it primarily contains amino acids, Carbohydrates and other compounds. Its fruit Juice contains the highest concentration of vitamin-C (478.56mg/100mL). Vitamin C levels are more than those in Oranges, tangerines and lemons.

- **Use of Amla**

1.Enhancement of Iron Absorption

2. Hematinic (Blood-Forming) Activity

3.Antioxidant Protection

4. Role in Chronic and Inflammatory Anemia [8]

- **Phytoconstituent present in different parts**

1. Fruit (Most important part)

• Vitamin C (Ascorbic acid) – very high content

• Tannins – emblicanin A, emblicanin B, punigluconin, paniculonin

• Phenolic compounds – gallic acid, ellagic acid

• Flavonoids – quercetin, kaempferol

• Amino acids & minerals

2. Seeds

Fixed oils, Fatty acids, linoleic acid, oleic acid, Phospholipids, Proteins

3. Leaves

Flavonoids, Tannins, Alkaloids (trace amounts), Polyphenols

4. Bark

Tannins (high amount), Phenolic compounds, Astringent principles

2. <u>Seasame Seeds</u>

- **Synonyms**

Til (commonly used in India, Hindi/Marathi name)

Sesamum seeds (scientific reference from Sesamum indicum)

Gingelly seeds (used in South India)

Benne seeds (African/Caribbean usage)

Simsim / Semsem (Arabic and African regions)

Fig. 3.2: Seasame seed

- **Biological source/family**:

Sesamum indicum Linn., belonging to the family Pedaliaceae

- **Classsifcation**

Kingdom: Plantae ,Division: Tracheophyta ,Class: Magnoliopsida ,Order: Lamiales ,Family: Pedaliaceae ,Genus: Sesamum ,Species: Indicum

- **Chemical constituents of seaseme seeds**

From seeds and found to exist as their glucosides;

Other lignan glucosides isolated and characterized As pinoresinol-4′-o-ß-D-glucosyl (1-6)-ß-DGlucoside (KPI) and pinoresinol-4′-o′-ß-D-Glucosyl (1-2)-ß-D-glucoside (KP2), another lignan Trigucoside, KP3, isolated from seeds and its Structure established as pinoresinol-4′-o-ß-D Glucosyl 1 (1-2)-o- [ß-Dglucopyranosyl (1-6)]-ß-D-Glucoside, sesamolin and sesamin identified in seed Oil by GC-MS and HPL.

- **Uses of seasem seeds**

1.Enhances Hemoglobin Formation

2.Improves Iron Absorption

3.Acts as a Blood Tonic (Ayurvedic Use)

4.Provides Energy and Reduces Fatigue

- **Phytoconstituent present in different parts**

Seeds (Most important part): Fixed oils (45–55%) – oleic acid, linoleic acid, palmitic acid

Leaves : Flavonoids, Phenolic compounds, Tannins, Mucilage

Roots : Alkaloids (trace amounts), Phenolic compounds,Tannins

Stem :Fibers (cellulose, lignin), Minor phenolics[9]

3.Punarnava

Fig. 3.3: Punarnava

- **Synonyms**

Punarnava (Sanskrit), Gadahpurna or Sothaghna (Hindi) Spreading hogweed (English)

- **Biological source/family**

Boerhavia diffusa Linn., which is belonging to family

Nyctaginaceae

- **Classification**

Kingdom: Plantae ,Division: Magnoliophyta (Angiosperms) ,Class: Magnoliopsida (Dicotyledons) ,Order: Caryophyllales ,Family: Nyctaginaceae

- **Chemical constituents of Punarnava**

Physical variety in Boerhavia diffusa has a great difference in Its phytochemical composition. The high concentration of Alkaloids, mainly punarnavine, boeravinones, and steroids, are The reason for which the most of its therapeutic use are obtained From the roots They are used to protect wounds and heal Infection since the stems and leaves have high concentrations Of tannins, flavonoids and saponins.

- **Uses of Punarnava roots**

1.Improves Hemoglobin Level

2.Enhances Iron Utilization

3.Blood Purification (Raktashodhak)

- **Phytoconstituent present in different parts**

1.Roots (Most important part)

Alkaloids – punarnavine

2. Leaves

Flavonoids, Phenolic compounds, Vitamins (especially Vitamin C), Minerals

3. Stem

Alkaloids (trace), Tannins, Carbohydrates[10]

4.Plan of work

1. Literature Survey
2. Selection of Raw Materials and Herbal Ingredients
3. Processing of Herbal Materials
4. Formulation of Herbal Syrup

a. Extraction of Herbal Drugs

b. Preparation of Syrup Base .

c. Mixing of Extract with Syrup Base

d. Final Adjustment .

5.Material and equipment

A. Material

1)Herbal ingredients

Amla seeds, Sesame seeds, Punarnava roots

2)Sweetning agents

Sugar, Jaggery, Honey

3)Preservatives

Sodium benzoate, Methyl paraben

4)Acidifying agent

Citric acid

5)Solvent

Distilled water

6)Other additives

Flavouring agent ,Colouring agent

B. Equipment

1)Extraction and Processing Equipment

A. Mortar and pestle ,B. Hot plate or heating mantle

2. Filtration and Mixing Equipment

A. Muslin cloth / Filter paper

3. Measurement and Analytical Equipment

A. Weighing balance, B. pH meter ,C. Thermometer

4. Packaging Equipment :A . Amber-colored bottle

6.Methodology

1.Collection and Authentication of Raw Materials

Punarnava roots (Boerhavia diffusa), Amla fruits (Emblica officinalis), and Sesame seeds (Sesamum indicum) are collected from natural or reliable sources. Only fresh, mature, and disease-free plant materials are selected.

2. Washing and Shade Drying

The collected materials are thoroughly washed with clean water to remove dirt and contaminants. They are then shade dried at room temperature (25–30°C).

3. Powdering of Dried Materials

4. Preparation of Herbal Extracts

a.Maceration Method

1.<u>Amla</u>

The extraction method used in this study was maceration at room temperature. An illustration of the amla maceration process is presented in Figure 1. Dried amla (30 g) from each drying method was soaked in 150 mL ethanol 96% for 72 h. Maceration at room temperature (28 ^{O}C) was conducted in an Erlenmeyer flask covered with aluminum foil. The resulting mixture was filtered with Whatman no. 1 filter paper and concentrated using a rotary evaporator in a vacuum at 40 ^{O}C. [11]

Fig. 6.1: Amla Extract

2.Punarnava roots

The extraction of Punarnava (Boerhavia diffusa) roots is carried out by the maceration method. Fresh roots are collected, washed thoroughly, and shade-dried, then cut into small pieces and ground into a coarse powder. About 100–110 g of the powdered drug is first defatted by macerating with approximately 1 L of ether (or petroleum ether) for 24 hours at room temperature with occasional stirring, followed by filtration. The defatted residue is then extracted with 95% ethanol (about 1 L) by maceration for 24–48 hours and filtered to obtain the alcoholic extract. Finally, the remaining residue is macerated with distilled water to obtain the aqueous extract.[12]

Fig 6.2: Punarnava extract

3.Seaseam seeds

Sesame seeds extraction is commonly carried out by solvent extraction method. First, clean and dry the sesame seeds to remove impurities, then grind them into a coarse powder to increase surface area. The powdered material is placed in a container and mixed with a suitable solvent such as hexane or petroleum ether in an appropriate ratio (usually 1:3 w/v). The mixture is kept for maceration with continuous stirring for several hours or left undisturbed for 24–48 hours to allow maximum oil extraction. After extraction, the mixture is filtered to separate the liquid extract from the solid residue. [13]

Fig 6.3: Seasem seed

5. Preparation of Syrup Base

A syrup base is prepared by dissolving sugar, jaggery, or honey in warm purified water.

6. Mixing of Herbal Extracts

The prepared herbal extracts are slowly added to the syrup base.

Continuous stirring is done to ensure uniform mixing. .

7. Addition of Excipients

Citric acid is added to improve taste and adjust pH.

8. Final Volume Adjustment

The volume of the formulation is adjusted to the desired level (e.g., 100 ml) using purified water.

9. Filtration of Syrup

The final syrup is filtered using muslin cloth or Whatman filter paper. This removes any undissolved particles and ensures clarity.

10. Filling and Storage

The prepared syrup is filled into clean, dry, amber-colored bottles to protect from light.

Bottles are tightly closed and properly labeled.The formulation is stored in a cool and dry place.[14]

- **Formulation table (50ml) polyherbal syrup**

Table no 1:- formulation table for polyherbal syrup

Sr no	Ingredients	Category	F1 (mL)	F2 (ml)	F3 (ml)
1	Amla extract	Hematinic	7ml	7ml	7ml
2	Punarnava extract	Blood purifier	5ml	5ml	5ml
3	Sesame seed extract	Iron source	5ml	5ml	5ml
4	Sugar syrup	Sweetening Agent	22ml	24ml	26ml
5	Citric acid solution	Acidifying agent	0.5ml	0.75ml	1ml

6	Honey	Natural sweetener	4ml	5ml	6ml
7	Sodium benzoate solution	Preservatives	0.5ml	0.6ml	0.8ml
8	Flavoring agent	Palatability	0.7 ml	0.8ml	0.9ml
9	Purified water	Vehicle	q.s	q.s	q.s

7.Method of evaluation

1.**Colour**

Observed visually against a white background in daylight

Should be uniform and characteristic of herbal ingredients

Depends on natural pigments like chlorophyll, tannins, flavonoids

Colour is obtained dark brown

Fig 7.1 : Colour

2.**Odour**

Evaluated by smelling a small quantity of syrup

Should be pleasant and characteristic of herbal constituents

Helps in identifying freshness and quality [15]

3.Taste

Assessed by tasting a small quantity carefully

Herbal syrups may be bitter or astringent due to phytochemicals

Sweetening agents (sugar, honey, jaggery) are added to improve taste

4. pH Determination

Measured using a calibrated digital pH meter

Usually maintained between 4 to 7

Ensures stability of active ingredients

Prevents microbial growth

Extreme pH may cause irritation or degradation of formulation

Fig 7.2: pH determination

5.Homogeneity

Indicates uniform distribution of all ingredients

Checked by visual inspection and shaking

No phase separation, sedimentation, or lumps should be present

Ensures uniform dose in each administration

Important for consistency and efficacy[14]

Fig 7.3: Homogenecity

6.Viscosity

Measured using viscometer (Ostwald viscometers)

Determines flow property of syrup

Should be moderate (neither too thick nor too thin)

Affects pourability and ease of administration

Fig 7.4: Viscosity

7.Clarity

Checked by observing syrup against light

Should be clear or slightly translucent

Absence of turbidity and suspended particles indicates purity

Ensures proper filtration of formulation

Turbidity may indicate contamination or precipitation[15]

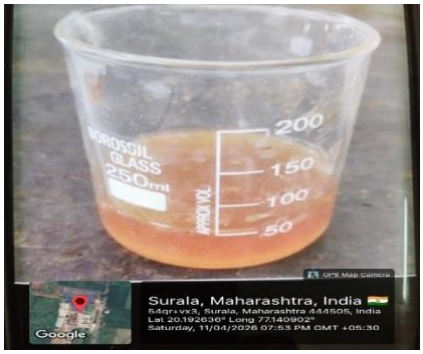

Fig 7.5: Clarity

8.Result And Discussion

The present study was carried out to formulate and evaluate a polyherbal syrup containing Amla (Emblica officinalis), Punarnava (Boerhavia diffusa), and Sesame seeds (Sesamum indicum) for the management of anemia. The developed formulation was subjected to organoleptic, physicochemical, and stability evaluations, and the results indicate that the syrup is pharmaceutically acceptable and therapeutically promising.

The physicochemical parameters were within acceptable limits. The pH of the formulation was maintained between 4 and 7, which ensures stability of active constituents and prevents microbial growth. The viscosity was moderate, allowing easy pouring and administration, while maintaining uniform consistency. The formulation showed good homogeneity without any phase separation, confirming uniform distribution of all ingredients.

Compared to conventional iron supplements, the formulated herbal syrup offers several advantages, including reduced gastrointestinal side effects, improved palatability, better patient compliance, and suitability for long-term use. However, further studies such as clinical trials and advanced formulation techniques are required to validate its efficacy and improve its therapeutic potential

9.Summary And Conclusions

➢ Summary

Anemia is a widespread health condition caused mainly by iron deficiency, leading to reduced hemoglobin levels and oxygen-carrying capacity of blood. Conventional iron therapies, although effective, often produce side effects such as gastrointestinal irritation and poor compliance.

To overcome these limitations, a herbal syrup containing Amla, Punarnava, and Sesame seeds was formulated. These ingredients provide synergistic benefits such as enhanced iron absorption, improved hemoglobin production, antioxidant protection, and better patient compliance.

The formulation process involved extraction of active constituents, preparation of syrup base, incorporation of herbal extracts, and addition of suitable excipients. The final product was evaluated for various physicochemical and organoleptic parameters to ensure quality, stability, and acceptability.

➢ Conclusion

The study successfully demonstrates that a polyherbal syrup can be formulated as a safe, effective, and patient-friendly alternative for the management of anemia. The selected herbs exhibit significant hematinic, antioxidant, and supportive therapeutic properties.

Evaluation results confirm that the formulation meets acceptable pharmaceutical standards in terms of stability, clarity, viscosity, and palatability.

In conclusion, the developed polyherbal syrup represents a cost-effective, patient-friendly, and therapeutically valuable approach for the management of anemia, with strong potential for future research and commercialization.

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