Formulation And Evaluation of Functional Herbal Gummies for Anaemia

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Abstract- Anemia is a widespread global health disorder characterized by decreased hemoglobin concentration and impaired oxygen-carrying capacity of blood, affecting individuals across all age groups, particularly women and children. Conventional iron supplementation, although effective, is often associated with gastrointestinal side effects and poor patient compliance. Therefore, there is a growing need for alternative, safe, and patient-friendly delivery systems.

The present study aimed to formulate and evaluate functional herbal gummies incorporating *Moringa oleifera*, a nutrient-rich plant recognized for its high iron content and antioxidant properties, as a natural therapeutic agent for anemia management. The gummies were prepared using a combination of agar and gelatin as gelling agents, honey as a natural preservative, sugar as a sweetening agent, turmeric as a natural coloring agent, and orange oil for flavor enhancement.

The formulated gummies were subjected to comprehensive evaluation parameters including physical characteristics (color, shape, texture, and weight uniformity), chemical properties (active ingredient content), sensory attributes (taste, flavor, and aroma), and stability studies under accelerated and room temperature conditions. The results demonstrated that the gummies possessed uniform appearance, desirable chewable texture, and acceptable organoleptic properties. The disintegration time was found to be less than 15 minutes, indicating efficient release characteristics. Stability studies revealed that the formulation remained stable for up to 12 months at 25°C with no significant changes in physical parameters.

The findings of this study suggest that *Moringa oleifera*-based herbal gummies can serve as a promising, cost-effective, and patient-compliant alternative to conventional iron supplements. This novel dosage form offers improved palatability, ease of administration, and potential therapeutic benefits, thereby enhancing adherence in long-term anemia management.

Keywords- Anemia; *Moringa oleifera*; Herbal gummies; Iron supplementation; Nutraceuticals; Drug delivery system; Stability studies; Patient compliance; Functional foods; Natural therapeutics

I. INTRODUCTION

Anemia is a common hematological disorder characterized by a reduction in hemoglobin (Hb) concentration, red blood cell (RBC) count, or packed cell volume (PCV), leading to impaired oxygen transport to body tissues. It remains one of the most prevalent global public health challenges, affecting populations across all age groups, particularly women of reproductive age, pregnant women, and children [1]. According to the World Health Organization (WHO), anemia is defined as a condition in which the hemoglobin concentration is insufficient to meet physiological requirements, which vary depending on age, gender, altitude, and pregnancy status [1].

The standard hemoglobin cut-off values used for the diagnosis of anemia are 13.5–18.0 g/dL for adult men, 12.0–15.0 g/dL for adult women, 11.0–16.0 g/dL for children, and greater than 10.0 g/dL during pregnancy. Any reduction below these thresholds is considered indicative of anemia [1]. Clinically, symptoms such as fatigue, weakness, dizziness, shortness of breath, and pallor become more evident when hemoglobin levels fall below 7.0 g/dL, which is categorized as severe anemia and may lead to serious physiological complications due to inadequate tissue oxygenation.

Globally, anemia affects a significant proportion of the population, with recent estimates indicating that approximately 30% of women and 37% of pregnant women are anemic [1]. Iron deficiency remains the most common cause of anemia, accounting for a majority of cases worldwide. Iron plays a critical role in hemoglobin synthesis and erythropoiesis;

therefore, insufficient iron levels result in decreased production of RBCs and reduced oxygen-carrying capacity, leading to microcytic hypochromic anemia. In addition to nutritional deficiencies, anemia can also arise from chronic diseases, infections, genetic disorders, and impaired erythropoietin production.

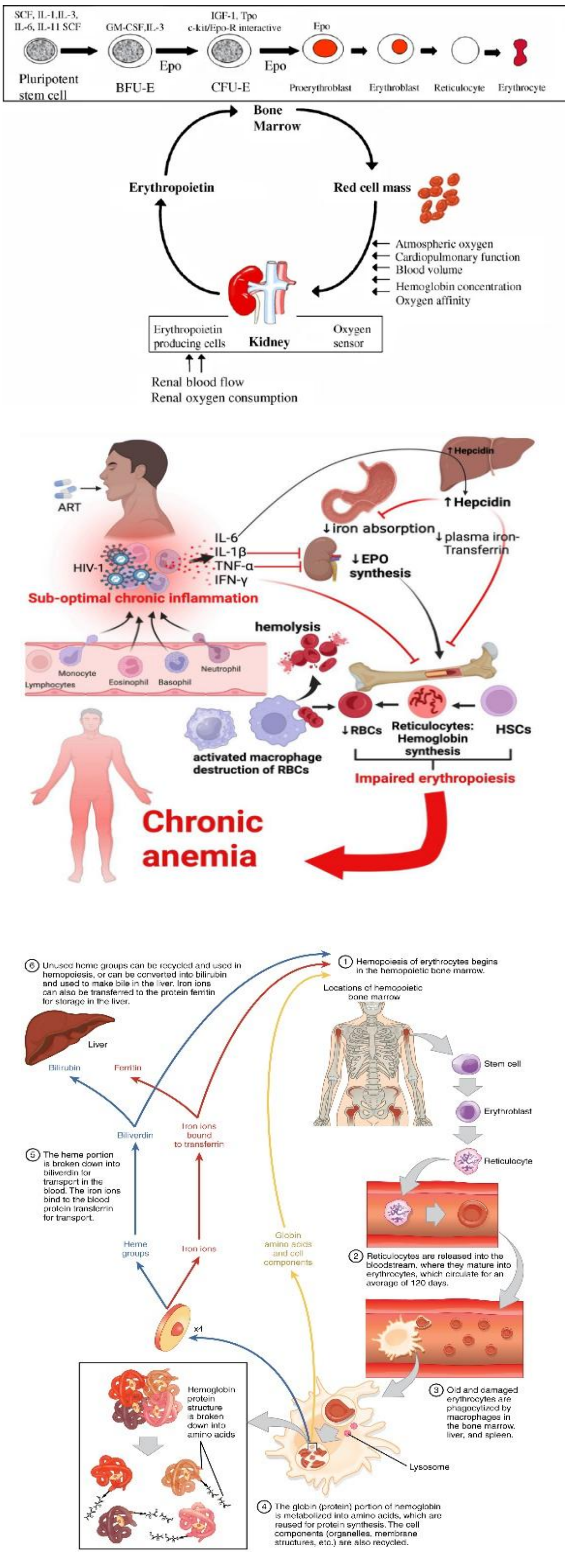
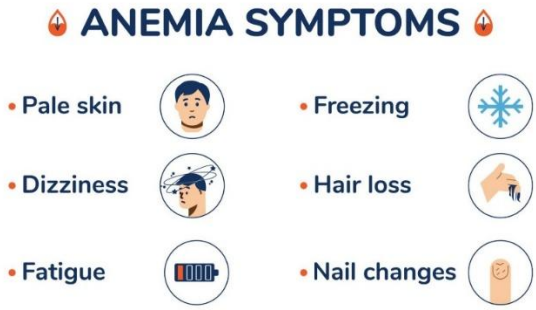


Figure 1: Pathophysiology of Anemia

Conventional management of anemia primarily involves oral or parenteral iron supplementation. Although effective, these therapies are frequently associated with adverse effects such as gastrointestinal discomfort, nausea, constipation, and metallic taste, which often lead to poor patient compliance, particularly during prolonged treatment regimens [2]. Furthermore, accessibility and affordability of synthetic iron formulations remain a concern in low-resource settings, necessitating the exploration of alternative therapeutic strategies.

In recent years, there has been growing interest in the use of herbal and plant-based remedies as safer and cost-effective alternatives for the management of anemia. Among these, *Moringa oleifera*, commonly known as the drumstick tree, has emerged as a promising natural source of iron and essential nutrients. The leaves of *Moringa oleifera* are rich in iron, vitamins (A, C, and B-complex), amino acids, and various bioactive compounds, making them highly beneficial in improving hematological parameters [3]. Notably, *Moringa* leaves contain approximately 28.29 mg of iron per 100 g, which is significantly higher than many commonly consumed plant sources [3].

Recent studies have demonstrated that supplementation with *Moringa oleifera* leads to a significant increase in hemoglobin levels, hematocrit values, and red blood cell indices, thereby supporting its efficacy in anemia management [4]. The presence of vitamin C in *Moringa* further enhances iron absorption and bioavailability, contributing to improved therapeutic outcomes. Additionally, experimental and clinical studies conducted after 2018 have reported statistically significant improvements in hemoglobin concentration ($p < 0.05$) following *Moringa* supplementation, confirming its role as a natural hematinic agent [5].



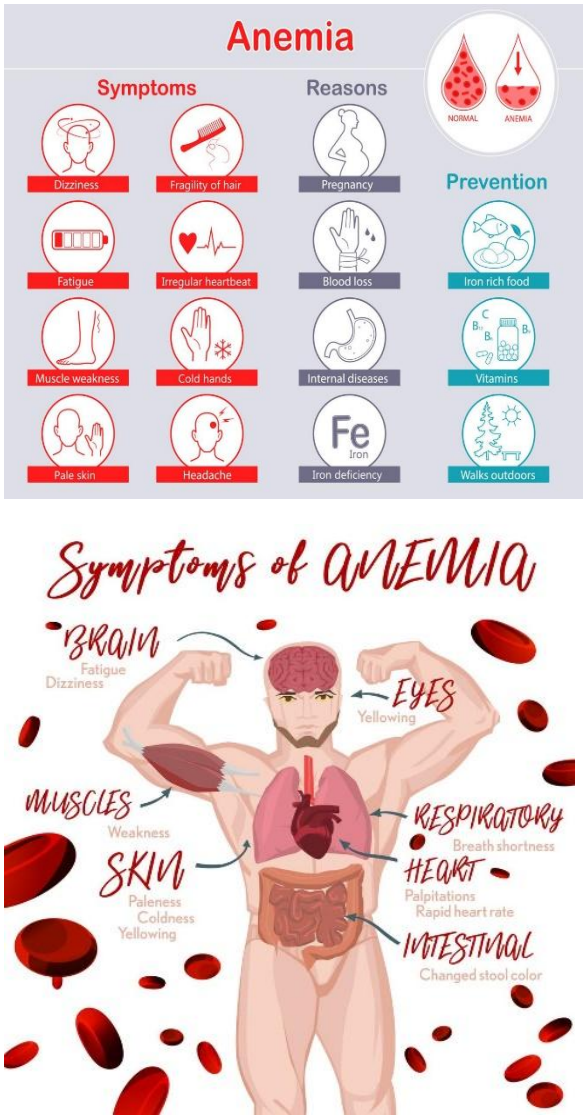


Figure 2: Symptoms of Anemia

Despite its therapeutic potential, the conventional forms of herbal supplementation such as powders, capsules, and decoctions often suffer from poor palatability and reduced patient adherence. To overcome these limitations, the development of novel drug delivery systems such as herbal gummies has gained considerable attention. Gummies offer several advantages, including improved taste, ease of administration, better patient compliance, and suitability for pediatric and geriatric populations.

Therefore, the present study focuses on the formulation and evaluation of functional herbal gummies containing *Moringa oleifera* as a natural iron source for the management of anemia. The study aims to develop a stable, palatable, and effective nutraceutical dosage form that can enhance patient compliance while delivering therapeutic benefits.

II. MATERIALS AND METHODS

2.1 Materials Used

The materials used in the formulation of functional herbal gummies were carefully selected based on their pharmacological activity, functional role in formulation, and suitability for nutraceutical applications. All ingredients were of food or pharmaceutical grade and procured from authenticated local sources.

Moringa oleifera leaf powder was used as the principal active ingredient due to its high iron content and well-established hematinic properties. The leaves of *Moringa* are rich in essential nutrients, including iron, vitamins (A, C, and B-complex), amino acids, and polyphenolic compounds. The iron content of *Moringa oleifera* leaves has been reported to be approximately 28 mg per 100 g, making it a potent natural source for the management of iron deficiency anemia [6]. In addition, the presence of vitamin C enhances iron absorption and bioavailability, thereby improving erythropoiesis and hemoglobin synthesis [7].

Agar agar and gelatin were used as gelling agents to provide the desired consistency and structural integrity to the gummies. Agar, a plant-derived polysaccharide obtained from red algae, is widely used in food and pharmaceutical formulations due to its excellent gel-forming ability, thermal stability, and compatibility with other ingredients [8]. Gelatin, a protein derived from collagen, contributes to elasticity, chewiness, and improved mouthfeel of the gummies. The combination of agar and gelatin ensures optimal texture, firmness, and stability of the final product [9].

Honey was incorporated as a natural preservative as well as a sweetening agent. It possesses antimicrobial and antioxidant properties due to the presence of phenolic compounds, flavonoids, and hydrogen peroxide, which contribute to extending the shelf life of the formulation [10]. Additionally, honey improves palatability and provides a natural alternative to synthetic preservatives, making the formulation more acceptable for long-term consumption.

Sucrose (sugar) was used as a sweetening agent to enhance the taste and acceptability of the gummies. It also plays a crucial role in the development of texture and consistency by contributing to the gel

matrix and reducing water activity, thereby aiding in preservation [11].

Turmeric (*Curcuma longa*) powder was used as a natural coloring agent. It contains curcumin, a bioactive compound known for its antioxidant, anti-inflammatory, and therapeutic properties. Apart from imparting a characteristic yellow color, turmeric also contributes to the overall health benefits of the formulation [12].

Orange oil was added as a flavoring agent to mask the characteristic herbal taste of *Moringa oleifera* and improve the sensory attributes of the gummies. Essential oils such as orange oil are commonly used in nutraceutical formulations due to their pleasant aroma, flavor-enhancing properties, and additional antioxidant activity [13].

Purified water was used as a solvent and vehicle for dissolving and uniformly mixing all ingredients, ensuring homogeneity and proper consistency of the formulation.

2.2 Formulation of Herbal Gummies

The formulation of functional herbal gummies was designed to develop a stable, palatable, and nutritionally enriched dosage form for the management of anemia. The composition was optimized based on the functional role of each ingredient, ensuring appropriate consistency, stability, and therapeutic efficacy. The selected ingredients not only contribute to the structural integrity of the gummies but also enhance their nutritional and organoleptic properties.

Moringa oleifera extract was incorporated as the primary active component due to its high iron content and hematinic activity, which supports hemoglobin synthesis and improves red blood cell production. The quantity of 1250 mg per gummy was selected to provide a significant amount of dietary iron supplementation while maintaining formulation stability [14].

Agar agar and gelatin were used in combination as gelling agents to achieve the desired texture and mechanical strength. Agar provides firmness and thermal stability, whereas gelatin contributes to elasticity and chewiness. The synergistic use of these two gelling agents results in a balanced gel structure suitable for gummy formulations [15].

Honey and sugar were incorporated to enhance palatability and improve patient compliance. Honey also acts as a natural preservative due to its antimicrobial properties, while sugar contributes to the formation of the gel matrix and reduces water activity, thereby increasing shelf life [16].

Turmeric powder was included as a natural coloring agent, providing a characteristic yellow color along with additional antioxidant benefits. Orange oil was used as a flavoring agent to mask the herbal taste of *Moringa* and improve the overall sensory acceptability of the formulation [17].

Purified water (Q.S.) was used as a vehicle to dissolve and uniformly distribute all ingredients, ensuring homogeneity of the mixture.

Table 1: Composition of One Gummy

Ingredient	Quantity	Function
Moringa extract	1250 mg	Iron source
Agar agar	1500 mg	Gelling agent
Gelatin	900 mg	Gelling agent
Honey	600 mg	Preservative
Sugar	360 mg	Sweetener
Turmeric powder	20 mg	Coloring agent
Orange oil	2 ml	Flavoring agent
Water	Q.S	Vehicle

2.3 Method of Preparation

The functional herbal gummies were prepared using a standardized heating and molding technique to ensure uniformity, consistency, and stability of the formulation. The method was optimized to achieve proper gel formation, homogeneity, and desirable organoleptic properties.

Initially, the required quantity of *Moringa oleifera* leaf powder was accurately weighed and dispersed in a small volume of distilled water using a mortar and pestle to obtain a smooth and uniform semi-solid dispersion. This step ensures proper distribution of the active ingredient throughout the formulation and enhances its bioavailability [18].

In parallel, gelatin was soaked in distilled water and allowed to swell, followed by gentle heating with continuous stirring until a clear, viscous gel was formed. Agar agar was separately dissolved in distilled water and heated to a higher temperature to ensure complete solubilization, forming a firm gel matrix. The separate preparation of gelatin and agar is essential to maintain their individual gelling characteristics and to achieve optimal texture when combined [19].

Subsequently, honey and sugar were mixed with distilled water and heated gently to form a homogeneous syrup. This syrup acts as a base for the formulation, contributing to sweetness, preservation, and viscosity. The controlled heating process helps in proper dissolution and prevents caramelization or degradation of sugars [20].

The prepared gelatin and agar solutions were then gradually added to the sugar-honey syrup with continuous stirring to ensure uniform mixing. The previously prepared *Moringa* dispersion was incorporated into the mixture, followed by the addition of turmeric powder as a natural coloring agent and orange oil as a flavoring agent. Continuous stirring was maintained to achieve a homogeneous blend and to prevent phase separation.

The final mixture was subjected to mild heating to ensure complete mixing and to obtain a uniform consistency. The hot viscous mass was then poured into pre-lubricated molds of desired shape and size. Care was taken to avoid air entrapment during pouring, as it may affect the appearance and texture of the final product [21].

The filled molds were allowed to cool and solidify at room temperature. After complete setting, the gummies were carefully removed from the molds and subjected to drying under controlled conditions to remove excess moisture. The dried gummies were then packed in airtight containers and stored in a cool, dry place, protected from light to maintain stability and prevent degradation [22].

Figure 3: Final Herbal Gummies

III. RESULTS AND DISCUSSION

3.1 Physical Characteristics

The formulated herbal gummies were evaluated for their physical properties, including color, shape, size, weight, and texture. These parameters are important indicators of product quality, uniformity, and patient acceptability.

Table 2: Physical Characteristics of Herbal Gummies

Parameter	Observation
Color	Greenish-yellow
Shape	Round
Size	2.5 cm × 1.3 cm
Weight	4 g
Texture	Chewy and smooth

The prepared gummies exhibited a uniform greenish-yellow color, which can be attributed to the presence of *Moringa oleifera* extract and turmeric powder. The round shape and smooth surface indicate proper molding and absence of formulation defects such as air entrapment or uneven setting.

The average size of the gummies was found to be approximately 2.5 cm in length and 1.3 cm in width, demonstrating consistency in molding and uniformity in formulation. The weight of each gummy was approximately 4 g, indicating good content uniformity and reproducibility of the preparation method.

The texture of the gummies was observed to be chewy and smooth, which is a desirable characteristic for gummy formulations. This can be attributed to the combined use of agar and gelatin, which provides an optimal balance between firmness and elasticity. The acceptable texture enhances patient compliance, particularly in pediatric and geriatric populations.

Overall, the physical evaluation results indicate that the developed herbal gummies possess satisfactory organoleptic and mechanical properties, making them suitable for use as a nutraceutical dosage form.

3.2 Disintegration Time

The disintegration time of the formulated herbal gummies was evaluated to determine their ability to break down and release the active ingredients under physiological conditions.

- Observed disintegration time: *Less than 15 minutes*

The formulated gummies exhibited a disintegration time of less than 15 minutes, indicating rapid breakdown and efficient release of the incorporated *Moringa oleifera* extract. This is an important parameter for nutraceutical and oral dosage forms, as it ensures that the active constituents become

available for absorption within a reasonable time frame.

The relatively short disintegration time can be attributed to the hydrophilic nature of the gelling agents, particularly agar and gelatin, which readily absorb moisture and facilitate swelling and breakdown of the matrix. Additionally, the presence of sugar and honey contributes to improved solubility and structural loosening upon contact with aqueous media.

An optimal disintegration time is essential for ensuring therapeutic effectiveness, especially in formulations intended for anemia management, where timely release of iron is crucial for absorption and subsequent hemoglobin synthesis. The observed result falls within the acceptable range for nutraceutical gummy formulations, confirming the suitability of the developed product for oral administration.

Overall, the formulation demonstrates desirable disintegration characteristics, balancing structural integrity during storage with efficient release upon consumption.

3.3 Sensory Evaluation

Sensory evaluation of the formulated herbal gummies was carried out to assess their organoleptic properties, which play a crucial role in determining patient acceptability and compliance, especially in nutraceutical and oral formulations.

Table 3: Sensory Evaluation of Herbal Gummies

Parameter	Result
Taste	Pleasant, slightly sweet
Flavor	Mild herbal
Aroma	Slightly earthy

The formulated gummies exhibited a pleasant and slightly sweet taste, primarily due to the presence of sugar and honey, which effectively masked the inherent bitterness of *Moringa oleifera*. This enhancement in taste is particularly important for improving patient compliance, especially among pediatric and geriatric populations.

The flavor of the gummies was mild and herbal, which can be attributed to the combined effect of *Moringa* and turmeric. The addition of orange oil as a flavoring agent helped in balancing the herbal notes, making the formulation more acceptable.

The aroma was found to be slightly earthy, which is characteristic of herbal formulations containing plant-based ingredients. However, it remained within acceptable limits and did not negatively affect the overall sensory perception of the product.

Overall, the sensory evaluation results indicate that the developed herbal gummies possess acceptable organoleptic properties, making them suitable for routine consumption as a nutraceutical supplement for anemia management.

3.4 Stability Studies

Stability studies of the formulated herbal gummies were carried out to evaluate their physical integrity and quality under different storage conditions. The study was conducted at accelerated conditions (40°C ± 2°C / 75% RH ± 5% RH) and room temperature conditions (25°C ± 2°C / 60% RH ± 5% RH) over a period of one month.

Table 4: Stability Testing Results of Herbal Gummies

Parameter	Initial	40°C / 75% RH	25°C / 60% RH
Colour	Greenish	Slightly greenish	Greenish
Shape	Round	Round	Round
Size	2.5 × 1.3 cm	2 × 1 cm	2 × 1.3 cm
Weight	4 g	3920 mg	3945 mg
Texture	Chewy & smooth	Same	Same

The stability study results indicated that the formulated gummies remained relatively stable under both storage conditions. At room temperature (25°C / 60% RH), no significant changes were observed in color, shape, size, weight, or texture, confirming the physical stability of the formulation.

Under accelerated conditions (40°C / 75% RH), a slight change in color from greenish to slightly greenish was observed, which may be attributed to minor degradation or moisture interaction. A reduction in size (from 2.5 × 1.3 cm to 2 × 1 cm) and weight (from 4 g to 3920 mg) was also noted, possibly due to moisture loss or structural contraction at higher temperature and humidity conditions.

Despite these minor variations, the gummies retained their round shape and chewy texture, indicating that the structural integrity of the formulation was maintained. No signs of

deformation, stickiness, or microbial spoilage were observed during the study period.

Overall, the results suggest that the formulated herbal gummies possess good stability under normal storage conditions and acceptable stability under accelerated conditions. This supports their suitability for long-term storage, with an estimated shelf life of up to 12 months when stored in a cool and dry environment.

3.5 Shelf Life

The shelf life of the formulated herbal gummies was determined based on the results obtained from stability studies conducted under controlled storage conditions.

- Observed shelf life: *Stable for 12 months at 25°C*

The developed formulation demonstrated good stability when stored at room temperature (25°C ± 2°C / 60% RH ± 5% RH), with no significant changes observed in key physical parameters such as color, shape, size, weight, and texture over the study period. The gummies retained their characteristic greenish color, round shape, and chewy texture, indicating preservation of product integrity.

The stability of the formulation can be attributed to the presence of honey, which acts as a natural preservative due to its antimicrobial properties, along with reduced water activity contributed by sugar. Additionally, the optimized combination of agar and gelatin provides a stable gel matrix that resists deformation and maintains structural consistency during storage.

The absence of significant physical or sensory changes suggests that the formulation is resistant to environmental variations under normal storage conditions. Based on these findings, the shelf life of the herbal gummies is estimated to be up to 12 months when stored in a cool and dry place, protected from moisture and direct sunlight.

Overall, the developed formulation demonstrates satisfactory stability and shelf life, making it suitable for commercial production and long-term use as a nutraceutical product for anemia management.

3.6 Dosage

The recommended dosage of the formulated herbal gummies was determined based on the quantity of active ingredient (*Moringa oleifera* extract) present in each unit and general nutraceutical guidelines for daily supplementation.

- Adults: 2–3 gummies per day
- Children: 1–2 gummies per day

Each gummy contains approximately 1250 mg of *Moringa oleifera*, which serves as a natural source of dietary iron and essential nutrients. The suggested dosage ensures an adequate intake of the active component to support hemoglobin synthesis and improve red blood cell production, while maintaining safety and tolerability.

For adults, a dosage of 2–3 gummies per day provides sufficient supplementation to address mild to moderate iron deficiency, whereas a lower dose of 1–2 gummies per day is recommended for children to meet their physiological requirements without the risk of overconsumption.

The chewable nature and pleasant taste of the gummies enhance patient compliance, making them particularly suitable for populations that experience difficulty in swallowing conventional dosage forms such as tablets and capsules. Additionally, the divided dosage regimen allows for better absorption and utilization of nutrients.

Overall, the dosage regimen is designed to ensure effective delivery of iron and other bioactive compounds, supporting the use of herbal gummies as a convenient and patient-friendly approach for the management of anemia.

IV.. DISCUSSION

The present study successfully demonstrated the formulation and evaluation of functional herbal gummies containing *Moringa oleifera* as a natural iron source for the management of anemia. The developed formulation exhibited desirable pharmaceutical and organoleptic properties, indicating its suitability as a nutraceutical dosage form.

The physical evaluation revealed that the gummies possessed uniform color, shape, size, and weight, reflecting good formulation reproducibility and consistency. The average weight of approximately 4 g per gummy indicates uniform distribution of ingredients and proper control during the molding process. The greenish-yellow color observed in the formulation can be attributed to the combined

presence of *Moringa oleifera* extract and turmeric, while the smooth and chewy texture results from the synergistic action of agar and gelatin. These characteristics are essential for enhancing product acceptability and consumer preference.

The disintegration time of less than 15 minutes suggests that the formulation is capable of rapid breakdown and release of active constituents under physiological conditions. This is particularly important for ensuring effective absorption of iron and improving therapeutic outcomes in anemia management. The hydrophilic nature of the gelling agents and the presence of soluble components such as honey and sugar contribute to this efficient disintegration behavior.

Sensory evaluation results indicated that the gummies were pleasant in taste, mildly herbal in flavor, and slightly earthy in aroma, which are acceptable attributes for herbal formulations. The addition of honey and orange oil played a significant role in masking the characteristic bitterness of *Moringa oleifera*, thereby improving palatability and patient compliance. This is especially beneficial for pediatric and geriatric populations, who often face difficulty in consuming conventional solid dosage forms.

Stability studies demonstrated that the formulation remained stable under both room temperature and accelerated conditions, with only minor variations observed at elevated temperature and humidity. The gummies retained their structural integrity, texture, and overall appearance, indicating good formulation robustness. The presence of honey as a natural preservative, along with reduced water activity due to sugar content, contributed to the extended shelf life of the product. The formulation was found to be stable for up to 12 months at 25°C, supporting its suitability for storage and commercialization.

The formulation also showed:

- Consistent weight (~4 g), indicating good content uniformity
- Adequate disintegration (<15 minutes), ensuring effective release
- Stability under accelerated conditions, confirming formulation robustness

Overall, these findings suggest that the developed herbal gummies provide a promising alternative to conventional iron supplements. Unlike traditional formulations, which are often associated with poor palatability and gastrointestinal side effects, the gummy dosage form offers improved taste, ease of administration, and better patient adherence.

Furthermore, the use of *Moringa oleifera* as a natural iron source enhances the therapeutic value of the formulation by providing additional nutrients and antioxidants. This makes the product particularly suitable for long-term use in the management of anemia

V. CONCLUSION

The present study successfully demonstrated the formulation and evaluation of functional herbal gummies incorporating *Moringa oleifera* as a natural source of iron for the management of anemia. The developed formulation exhibited satisfactory physicochemical properties, including uniformity in weight, size, and shape, along with a desirable chewy texture and appealing organoleptic characteristics.

The gummies showed efficient performance in terms of disintegration, with a time of less than 15 minutes, ensuring rapid release of the active constituents. Stability studies confirmed that the formulation remained stable under both room temperature and accelerated conditions, with an estimated shelf life of up to 12 months. The inclusion of natural ingredients such as honey and turmeric further enhanced the stability and therapeutic value of the formulation.

The sensory evaluation indicated good acceptability, with a pleasant taste and mild herbal flavor, which significantly improves patient compliance compared to conventional dosage forms such as tablets and capsules. This makes the formulation particularly suitable for pediatric and geriatric populations, who often face difficulty in swallowing solid oral dosage forms.

Overall, the study highlights that *Moringa oleifera*-based herbal gummies represent a promising, cost-effective, and patient-friendly alternative to traditional iron supplements. The formulation not only ensures effective delivery of iron but also provides additional nutritional and antioxidant benefits. Therefore, such herbal gummy formulations have strong potential for further development and application in nutraceutical and

pharmaceutical fields for the management of anemia.

VI. FUTURE SCOPE

The present study establishes a promising foundation for the development of functional herbal gummies for anemia management; however, further research is required to validate and enhance the applicability of this formulation.

Clinical trials should be conducted to evaluate the efficacy and safety of the developed herbal gummies in human subjects. Such studies would provide scientific evidence regarding their therapeutic potential in improving hemoglobin levels, red blood cell count, and overall hematological parameters in anemic patients.

In addition, detailed bioavailability studies are necessary to assess the absorption, distribution, and utilization of iron derived from *Moringa oleifera* in comparison to conventional iron supplements. These studies will help in understanding the efficiency of the formulation and its potential advantages in terms of reduced side effects and improved nutrient uptake.

Further research should also focus on the optimization and scale-up of the formulation for industrial production. This includes process standardization, quality control, packaging development, and stability testing under long-term conditions. Commercialization of the product would require compliance with regulatory guidelines, safety standards, and validation of manufacturing processes.

Moreover, future investigations may explore the incorporation of additional nutraceutical components such as vitamins (e.g., vitamin B12, folic acid) or other herbal extracts to enhance the therapeutic efficacy of the formulation. Advanced delivery systems and sugar-free or low-calorie variants can also be developed to cater to a wider population, including diabetic patients.

Overall, the developed herbal gummy formulation holds significant potential for further research, clinical application, and commercialization as a novel and patient-friendly approach for anemia management.

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