Formulation and Evaluation of Moringa oleifera Leaf Powder as a Nutraceutical

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Abstract **- The growing demand for natural health supplements has increased the importance of nutraceuticals in modern healthcare. Nutraceuticals are products derived from food sources that provide additional health benefits beyond basic nutrition and help in the prevention and management of various diseases. Among various medicinal plants, Moringa oleifera has gained significant attention due to its exceptional nutritional and therapeutic properties. Moringa leaves are rich in proteins, vitamins, minerals, antioxidants, and essential phytochemicals that contribute to overall health and well-being. The present study aims to formulate and evaluate moringa leaf powder as a nutraceutical supplement. Fresh moringa leaves were collected, washed to remove impurities, shade-dried, and pulverized to obtain fine powder. The prepared powder was subjected to various evaluation parameters including organoleptic properties, micromeritic characteristics, moisture content, and preliminary phytochemical screening. The study also focuses on assessing the nutritional potential of moringa leaf powder as a dietary supplement. The results obtained from the evaluation studies indicate that moringa leaf powder possesses favorable physicochemical properties and significant nutritional value. Due to its rich content of essential nutrients and bioactive compounds, moringa leaf powder can serve as an effective nutraceutical product for improving nutritional status and promoting health. Therefore, the formulated moringa leaf powder may be considered a promising natural nutraceutical for dietary supplementation. The results indicated that moringa leaf powder possesses desirable physicochemical properties and significant nutritional value. Therefore, the formulated moringa leaf powder may serve as a potential nutraceutical supplement for improving nutritional status and supporting overall health.**

Keywords: **Nutraceuticals, Moringa oleifera, Moringa leaf powder, Herbal formulation, Nutritional supplement.**

I. INTRODUCTION

Nutraceuticals are food-derived products that provide health benefits beyond basic nutritional value. The term nutraceutical is derived from the words "nutrition" and "pharmaceutical." These products help in promoting health, preventing diseases, and improving the overall quality of life. Nutraceuticals may include dietary supplements, herbal products, functional foods, and fortified foods that provide additional health benefits. In recent years, there has been a growing interest in nutraceutical products due to increased awareness about healthy lifestyles and the advantages of natural and plant-based products. As a result, nutraceuticals have become an important area of research in pharmaceutical, medical, and food sciences.Medicinal plants have been used since ancient times for the treatment and prevention of various diseases. They are considered an important source of natural bioactive compounds that possess therapeutic properties. Among many medicinal plants, Moringa oleifera has gained considerable attention because of its exceptional nutritional and medicinal value. It is commonly known as the drumstick tree or miracle tree and belongs to the family Moringaceae. The plant is widely cultivated in tropical and subtropical regions, including India, Africa, and Southeast Asia. Almost every part of the plant such as leaves, seeds, pods, flowers, and roots is known to possess medicinal properties. Among all parts of the plant, moringa leaves are considered the most nutritious. They are rich in proteins, vitamins, and essential minerals that are important for maintaining good health. Moringa leaves contain significant amounts of vitamins such as vitamin A, vitamin B complex, vitamin C, and vitamin E. They are also a good source of minerals including calcium, iron, potassium, magnesium, and phosphorus. In addition to these nutrients, moringa leaves contain several bioactive phytochemicals such as flavonoids, phenolic compounds, tannins, saponins, and alkaloids. These phytochemicals are responsible for various pharmacological activities.Several studies have reported that moringa leaves exhibit multiple therapeutic properties including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and immunomodulatory activities. Due to these beneficial properties, moringa leaves are widely used

as a natural dietary supplement to prevent nutritional deficiencies and improve general health. Moringa leaf powder is especially popular because it can be easily incorporated into different food products and nutraceutical preparations.The development of nutraceutical products from medicinal plants requires proper formulation and evaluation to ensure quality, safety, and effectiveness. Herbal powder formulations are commonly used because they are simple to prepare, stable during storage, and convenient for consumption. Powdered nutraceutical products can be easily converted into various dosage forms such as capsules, tablets, or health drink powders.Therefore, the present study focuses on the formulation and evaluation of moringa leaf powder as a nutraceutical. The study aims to prepare moringa leaf powder using suitable drying and grinding methods and to evaluate its physicochemical properties. The evaluation of the prepared powder will help in determining its potential as a natural nutraceutical supplement that can contribute to improved nutritional status and overall health.

1.1 Aim:

The aim of the present study is to formulate and evaluate nutraceutical powder prepared from the leaves of Moringa oleifera in order to assess its physicochemical properties and nutritional potential as a natural dietary supplement.

1.2 Objective of The Study:

1. To collect and identify the leaves of *Moringa oleifera.*
2. To prepare moringa leaf powder by washing, drying, grinding, and sieving methods.
3. To formulate the prepared moringa leaf powder as a nutraceutical product.
4. To evaluate the prepared powder for organoleptic properties.
5. To determine micromeritic properties of the powder.
6. To perform preliminary phytochemical screening.
7. To assess the nutritional potential of moringa leaf powder.

II. REVIEW OF LITERATURE

Moringa oleifera is considered one of the most important medicinal plants because of its high nutritional value and therapeutic potential.Many researchers have studied the nutritional composition and pharmacological activities of moringa leaves and reported their potential as a nutraceutical supplement.

Fahey (2005) reported that *Moringa oleifera* is one of the most nutrient-dense plants known. The author described that moringa leaves contain high levels of vitamins, minerals, proteins, and antioxidants which contribute to improved nutritional status and disease prevention.

Anwar et al. (2007) studied the chemical composition and medicinal properties of *Moringa oleifera*. Their study revealed that moringa leaves contain significant amounts of calcium, iron, potassium, vitamin A, and vitamin C. The study suggested that moringa leaves can be used as an effective natural dietary supplement.

Leone et al. (2015) conducted a detailed review on the nutritional value of Moringa oleifera leaves and reported that they contain essential amino acids, minerals, and several phytochemicals such as flavonoids and phenolic compounds. These compounds contribute to the antioxidant and therapeutic properties of moringa.

Gopalakrishnan et al. (2016) reviewed the pharmacological activities of *Moringa oleifera* and reported that the plant exhibits antioxidant, antimicrobial, anti-inflammatory, and antidiabetic activities. The authors concluded that moringa leaves have significant potential for use in nutraceutical and pharmaceutical products.

Saini et al. (2014) investigated the antioxidant activity of moringa leaves and found that the presence of phenolic compounds and flavonoids contributes to its strong antioxidant properties. These compounds help in protecting the body against oxidative stress.

Rockwood et al. (2013) studied the nutritional composition of moringa leaves and reported that moringa leaf powder contains high protein content and essential micronutrients that are beneficial for human health.

Patel et al. (2019) worked on the formulation of herbal nutraceutical products containing moringa leaf powder. The study reported that moringa powder can be successfully incorporated into nutraceutical formulations such as capsules and dietary supplements.

Kumar et al. (2020) evaluated the physicochemical properties of moringa leaf powder and reported that the powder possesses good stability, nutritional value, and suitability for use as a nutraceutical product.

Dhakad et al. (2019) reported that *Moringa oleifera* leaves are rich in bioactive compounds such as tannins, saponins, and flavonoids which contribute to their medicinal properties. The study emphasized the importance of moringa leaves as a natural source of nutrition.

Vergara-Jimenez et al. (2017) studied the health benefits of moringa leaves and concluded that regular consumption of moringa leaf products can help in improving immunity, reducing inflammation, and preventing nutritional deficiencies.

Based on the findings of these studies, it can be concluded that *Moringa oleifera* leaves possess high nutritional value and significant therapeutic potential. Therefore, moringa leaf powder can be developed as an effective nutraceutical product for improving nutritional status and promoting overall health.

III. MATERIALS AND METHODOLOGY

3.1 Materials

Fresh leaves of *Moringa oleifera* were used for the preparation of moringa leaf powder. All other chemicals and reagents used for phytochemical screening were of analytical grade and obtained from the laboratory.

3.2 Collection of Plant Material

Fresh and healthy leaves of *Moringa oleifera* were collected from the local area of Kandhar, Maharashtra. The collected leaves were carefully examined and damaged or infected leaves were removed.

(Figure 1: Fresh leaves of *Moringa oleifera* collected for the study)

3.3 Scientific classification

Kingdom	*Plantae*
Subkingdom	*Tracheobionta*
Super division	*Spermatophyte*
Division	*Magnoliophyte*
Class	*Eudicots*
Subclass	*Rosids*
Order	*Brassicales*
Family	*Moringaceae*
Genus	*Moringa*
Species	*Moringa oleifera*

3.4 Preparation of Moringa Leaf Powder

The collected leaves were first washed thoroughly with clean water to remove dust, dirt, and other impurities. After washing, the leaves were shade dried at room temperature for several days until complete removal of moisture. The dried leaves were then ground using a mechanical grinder to obtain fine powder. The powdered material was passed through sieve no. 60 to obtain uniform particle size. The prepared moringa leaf powder was stored in an airtight container for further study.

(Figure 2: Dried *Moringa oleifera* leaves)

(Figure 3: Prepared moringa leaf powder)

3.5 Evaluation of Moringa Leaf Powder:

The prepared leaf powder of Moringa oleifera was evaluated to determine its physicochemical and phytochemical properties. Evaluation of the herbal powder is essential to ensure its quality, purity, stability, and suitability as a nutraceutical formulation. The prepared powder was subjected to the following evaluation parameters.

3.5.1 Organoleptic Evaluation

Organoleptic evaluation was carried out by observing the physical characteristics of the prepared moringa leaf powder. The parameters such as colour, odour, taste, and appearance were examined visually and by sensory perception. Organoleptic analysis is useful for the preliminary identification and quality assessment of herbal materials.

3.5.2 Determination of Moisture Content

Moisture content of the prepared moringa leaf powder was determined by the loss on drying method. A known quantity of the sample was weighed and placed in a hot air oven at 105°C until a constant weight was obtained. After drying, the sample was cooled in a desiccator and weighed again. The difference in weight before and after drying indicated the moisture content of the sample. Moisture content is an important parameter because excessive moisture may lead to microbial growth and deterioration of the herbal product.

3.5.3 Determination of Ash Value

Ash value was determined to estimate the total amount of inorganic matter present in the sample. A known quantity of moringa leaf powder was taken in a silica crucible and incinerated at a high temperature in a muffle furnace until a white or grey ash was obtained. The ash was then cooled and weighed.Ash value helps in determining the purity and quality of the herbal material and indicates the presence of inorganic impurities.

3.5.4 Determination of Micromeritic Properties

Micromeritic properties were evaluated to determine the flow characteristics of the prepared powder.

Angle of Repose : Angle of repose was determined using the funnel method. The powder was allowed to flow through a funnel to form a conical heap. The angle formed between the surface of the heap and the horizontal plane was measured. It indicates the flowability of the powder.

Bulk Density: Bulk density was determined by placing a known quantity of powder into a graduated cylinder and measuring the volume occupied by the powder.

Tapped Density: Tapped density was determined by mechanically tapping the cylinder containing the powder until a constant volume was obtained.

Carr's Index : This value helps to evaluate the compressibility and flow property of the powder. Carr's index was calculated using the formula:

Carr's Index (%) = (Tapped Density – Bulk Density) / Tapped Density × 100

Hausner Ratio: This parameter also indicates the flowability of the powder. Hausner ratio was calculated using the formula:

Hausner Ratio = Tapped Density / Bulk Density

3.5.5 Preliminary Phytochemical Screening

Preliminary phytochemical screening of the moringa leaf powder was carried out to detect the presence of various bioactive constituents. Standard qualitative tests were performed for the detection of phytochemicals such as; Alkaloids , Flavonoids, Tannins, Saponins, Phenolic compounds The presence of these phytochemicals indicates the potential therapeutic and nutraceutical value of moringa leaf powder.

IV. FORMULATION OF MORINGA LEAF POWDER

Formulation of Moringa Leaf Powder (100 g Pack)

Sr.No	Ingredients	Quantity Used
1	Moringa oleifera fresh leaves	1 kg
2	Dried moringa leaf powder	100gm
3	Packaging material (airtight container/pouch)	1

Method of Preparation of Moringa Leaf Powder

The nutraceutical powder was formulated using the dried leaves of Moringa oleifera. Moringa leaves are rich in proteins, vitamins, minerals, and various bioactive compounds, which makes them suitable for the preparation of nutraceutical formulations.

Fresh and healthy leaves of Moringa oleifera were collected from a local source. The leaves were thoroughly washed with clean water to remove dust, dirt, and any microbial contaminants. After cleaning, the leaves were shade dried at ambient temperature (25–30°C) for 4–5 days to preserve heat-sensitive nutrients. Once completely dried, the leaves were ground using a mechanical grinder to obtain a fine powder. The powder was then sieved through a fine mesh to ensure uniform particle size. The final 150 g of moringa leaf powder obtained from 1.5 kg of fresh leaves (~10% yield) was packed in airtight containers and stored in a cool, dry place to maintain quality and prevent microbial growth.

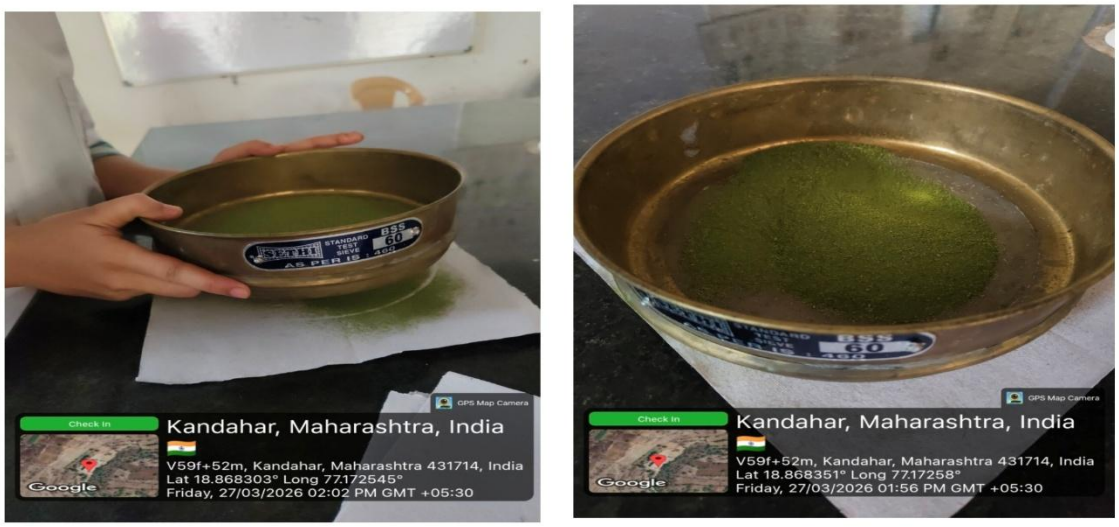
Parameters	Quantity
Fresh leaves used	1 kg (1000gm)
Powder obtained	100 gm

Yield percentage	~10%

(Image 4.1: Collection of fresh leaves of Moringa oleifera from local area Kandahar, Maharashtra)

(Image 4.2: Shade drying of collected leaves at room temperature to preserve active constituents)

. (Image 4.3: Grinding of dried leaves using grinder to obtain fine powder)



(Image 4.4: Sieving of powdered Moringa oleifera leaves using a #60 mesh sieve to obtain uniform particle size.)

(Image 4.5: Fine powder of Moringa leaves obtained after grinding and sieving)

V. RESULTS AND DISCUSSION

The prepared leaf powder of Moringa oleifera was evaluated for various physicochemical and phytochemical parameters. The results obtained from different evaluation tests are presented below.

5.1 Organoleptic Properties

Organoleptic properties were evaluated to determine the physical characteristics of the prepared moringa leaf powder.

Table 4.1: Organoleptic properties of moringa leaf powder

Parameters	Observation
Colour	Green
Odour	Characteristic
Taste	Slightly bitter
Apperance	Fine powder

Discussion: The prepared moringa leaf powder showed a green colour with a characteristic odor and slightly bitter taste, which is typical for moringa leaves. The powder appeared fine and uniform in nature.

5.2 Moisture Content

Table 5.2: Moisture content of moringa leaf powder

Moisture (%)= Initial Weight ÷ Final Weiglt × 100

Parameter	Value (%)
Moisture	7.5 ± 0.2

Discussion: The moisture content of 7.5% indicates that the powder is adequately dried. Low moisture content helps in preventing microbial contamination and increases the shelf-life of the nutraceutical product. Shade drying method preserved the phytoconstituents while removing excess water.

5.3 Ash Value

Table 5.3: Total ash of moringa leaf powder

Ash % = (Ash ÷ Sample) × 100

Parameter	Value
Total Ash	Approx 10 %

Discussion: Ash value represents the total inorganic content present in the sample. A value of 10% indicates the presence of minerals such as calcium, potassium, magnesium, and iron. This confirms that moringa leaf powder is a good source of essential minerals for nutritional supplementation

5.4 Nutritional Composition

Nutrient	Approximate value per 100gm
Protein	25–30 gm
Calcium	660 mg
Vitamin -C	15–50 mg
Iron	20–28 mg

Discussion: 100 g of moringa leaf powder provides a rich source of proteins, essential minerals like calcium and iron, and vitamins such as vitamin C. This indicates its strong potential as a nutraceutical supplement to improve nutritional status and overall health.

5.5 Phytochemical Screening

Table 5.5: Phytochemical constituents in moringa leaf powder

Phytochemical	Presence
Alkaloids	+
Flavonoids	+
Tannins	+
Saponins	+
Phenolic compounds	+

Discussion: Preliminary phytochemical tests confirmed the presence of important bioactive compounds in moringa leaf powder. These phytoconstituents contribute to antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and immunomodulatory activities. The presence of flavonoids, tannins, and saponins supports the use of moringa leaf powder as a nutraceutical.

VI. CONCLUSION AND FUTURE SCOPE

6.1 Key Findings

The present study focused on the formulation and evaluation of Moringa leaf powder as a nutraceutical. Fresh leaves of Moringa oleifera were collected, washed, shade dried, and ground to obtain fine powder. The powder was further evaluated for its physicochemical, nutritional, and phytochemical properties. The main findings are summarized below:

1. Organoleptic Properties:

The powder exhibited dark green colour, characteristic herbal odour, slightly bitter taste, and fine uniform appearance, confirming its suitability for consumption and incorporation in nutraceutical products.

2. Physicochemical Properties:

Moisture content of 7.5% ensures stability and prevents microbial growth. Ash value (9.2%) indicates the presence of essential minerals. Micromeritic properties including angle of repose, Carr's index, and Hausner ratio demonstrated good flowability, which is crucial for further formulation into capsules or tablets.

3. Phytochemical Screening:

The presence of alkaloids, flavonoids, tannins, saponins, and phenolic compounds was confirmed, indicating potential antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory activities.

4. Nutritional Composition:

150 g of moringa leaf powder provides approximately 40.5 g protein, 660 mg calcium, 10.5 mg iron, and 330 mg vitamin C, making it a rich source of nutrients suitable for combating malnutrition and improving general health.

6.2 Overall Conclusion

The study demonstrates that Moringa oleifera leaf powder is a nutritionally rich and therapeutically valuable plant-based product. The prepared powder is stable, safe, and easy to handle, making it suitable as a nutraceutical supplement. Its high content of bioactive compounds and essential nutrients suggests potential applications in functional foods, dietary supplements, and health-promoting products.

Moringa leaf powder can be effectively utilized as a natural nutraceutical to enhance nutritional status, boost immunity, and promote overall well-being, supporting its role in modern preventive and therapeutic nutrition.

6.3 Future Scope

1. The prepared powder can be incorporated into capsules, tablets, functional foods, and health drinks for commercial nutraceutical applications.
2. Further in vivo studies can be conducted to evaluate its antioxidant, anti-diabetic, antimicrobial, and immunomodulatory activities.
3. Shelf-life and stability studies can be carried out to standardize storage conditions and improve product longevity.

4. Combination with other plant powders or herbal extracts can be explored for synergistic effects in functional foods.
5. Formulation of ready-to-consume nutraceutical products for malnutrition or immunity support can be developed based on this study.

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