



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Formulation and Nutritional Evaluation of Herbal Moringa-Based Protein Shake Powder

Bhoomika Choudhary*, Siddhi Chaugule, Nupur Chiplunkar, Sameer Bhoir, Utkarsh Chavan, Priya Jadhav

B. R. Harne College of Pharmacy, Karav, Vangani (W), Ambarnath, Thane, Maharashtra, 421503.

ARTICLE INFO

Published: 31 May 2026

Keywords:

Antioxidants; Dietary fiber; Herbal nutritional supplement; Herbal protein shake powder; Moringa oleifera; Nutraceuticals

DOI:

10.5281/zenodo.20472103

ABSTRACT

The increasing demand for plant-based nutritional supplements has encouraged the development of natural and affordable protein formulations with enhanced health benefits. However, many commercially available protein powders contain artificial additives, preservatives, and synthetic ingredients that may not be suitable for long-term consumption. Therefore, the development of a natural, plant-based, and cost-effective protein supplement has become important. Moringa oleifera is widely recognized for its high nutritional value and medicinal properties due to its rich content of proteins, essential amino acids, vitamins, minerals, dietary fiber, and antioxidants. In the present study, moringa leaf powder was combined with peanut powder, roasted chickpea powder, oat powder, almond powder, flaxseed powder, cocoa powder, jaggery powder, cardamom powder and ginger powder to formulate herbal protein shake powders. These ingredients were selected to improve the nutritional profile, flavor, texture, and functional properties of the formulation. Three different formulations were prepared with varying concentrations of moringa powder: F1 (10% moringa), F2 (20% moringa), and F3 (30% moringa). The prepared formulations were evaluated for physical characteristics, nutritional composition, and physicochemical parameters. The study concludes that moringa-based herbal protein shake powder can serve as a nutritious, affordable, plant-based alternative to synthetic protein supplements. The developed formulation has potential applications as a functional food and nutritional supplement for athletes, gym users, children, elderly individuals, and health-conscious consumers seeking natural dietary support.

INTRODUCTION

Proteins are very important for our body. They are needed for growth and for repairing body tissues. Proteins help in muscle development and also play

***Corresponding Author:** Bhoomika Choudhary

Address: B. R. Harne College of Pharmacy, Karav, Vangani (W), Ambarnath, Thane, Maharashtra, 421503.

Email ✉: bhoomikachoudhary003@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



an important role in the production of enzymes and hormones. They support the immune system and help the body perform many essential functions. Without enough protein, the body cannot function properly.(1)

In recent years, many people have started using protein supplements, including athletes, gym-goers, older adults, and health-conscious individuals. They use these supplements to stay fit and maintain a healthy diet.(2)

Many protein powders available in the market are made from whey, casein, soy, or other ingredients that help improve nutrition. However, some of these powders contain artificial sweeteners, preservatives, and other additives that may not be good for health.(3) Some people may also experience problems due to lactose intolerance or allergies.(4) In addition, these protein powders can be expensive. Because of this, many people are now looking for plant-based alternatives that are safe, affordable, and environmentally friendly.(5) Plant-based protein powders are becoming increasingly popular, especially among people who do not consume meat. They also contain phytochemicals and antioxidants that are beneficial for health.(5)

One such beneficial plant is *Moringa oleifera*. It is widely grown in countries such as India, parts of Africa, and Southeast Asia.(6) Different parts of the plant, including the leaves, seeds, flowers, and pods, are used for food and medicinal purposes.(7) Among these, the leaves are considered the most nutritious because they are rich in proteins, vitamins, and minerals.(8) *Moringa* leaves contain a high amount of plant protein and essential amino acids that help the body grow and repair itself.(9) The leaves can be processed into a powder and used as a nutritional supplement.(3) *Moringa* is also a good source of iron, calcium, and other important minerals. Iron supports healthy blood

formation, while calcium helps maintain strong bones.(10) *Moringa* also contains antioxidants that help protect the body from harmful substances.(11) It is rich in compounds such as flavonoids and polyphenols, which help keep the body healthy and may reduce the risk of diseases.(4)

The aim of this study is to develop a *moringa*-based protein shake powder that is natural, nutritious, and affordable. The formulation will use plant-based ingredients to provide proteins, nutrients, and antioxidants. This protein shake powder can support overall health and encourage healthy eating habits.

2. AIM AND OBJECTIVES:

1. Aim:

The aim of this study is to develop herbal protein shake powder using *Moringa oleifera* as the main ingredient. The formulation is intended to provide a nutritious and affordable source of protein along with improved health benefits and antioxidant properties.

2. Objectives:

- **To prepare herbal protein shake powder using plant-based ingredients** — To develop a protein supplement using *Moringa oleifera* leaf powder along with other nutritious ingredients to obtain a balanced formulation.
- **To improve the nutritional value of the formulation** — The formulation is designed to provide higher amounts of protein, vitamins, minerals, and antioxidants to support overall health and nutritional requirements.
- **To evaluate the organoleptic properties of the prepared formulation** — The protein shake powder will be assessed for parameters



such as colour, odour, taste, texture, and solubility to determine its quality and acceptability.

- **To analyze the nutritional composition of the formulation** — The nutritional content, including protein, carbohydrates, fats, and moisture, will be evaluated to determine the nutritional value of the product.
- **To develop herbal nutritional supplement** — To formulate a cost-effective and natural protein supplement that can serve as an alternative to synthetic protein powders available in the market.
- **To explore the health benefits of moringa-based supplements** — To utilize the antioxidant and nutritional properties of *Moringa oleifera* and develop a functional health supplement suitable for regular consumption.

3. LITERATURE REVIEW:

Moringa oleifera is a highly nutritious plant that is often referred to as the “miracle tree” because of its wide range of health benefits.(12) Studies have shown that almost every part of the plant, including its leaves, seeds, and flowers, is edible and possesses medicinal properties.(13) In recent years, there has been growing interest in *Moringa oleifera* due to the increasing demand for plant-based and health-promoting foods.(14)

The leaves of *Moringa oleifera* are considered highly nutritious because they contain significant amounts of proteins, vitamins, and minerals.(15) Researchers have reported that the leaves are rich in essential amino acids and other nutrients required for growth and overall health.(15) The seeds of the plant also contain a high amount of protein, making them valuable for nutritional

applications.(7) Because of its rich nutritional profile, *Moringa oleifera* is increasingly being used in the development of protein-rich and functional food products.(6)



Figure 1: Moringa oleifera leaves

Several studies suggest that *Moringa oleifera* may help address malnutrition, particularly in developing countries where access to nutritious food is limited.(16) Due to its high nutritional value, the leaves are commonly used to improve the diets of children, pregnant women, and elderly individuals.(16) Daily consumption of moringa has been associated with improved nutritional status because it provides essential nutrients such as iron, calcium, and other important minerals.(13)

With the growing preference for plant-based diets, there has been an increased demand for plant-derived protein sources.(17) Plant proteins are considered environmentally sustainable and are suitable for vegetarians and individuals seeking healthier dietary options.(18) Research indicates that plant proteins can contribute to improved strength, health, and overall well-being. This has increased the popularity of *Moringa oleifera* as a valuable plant-based protein source.(17)

In addition to its nutritional value, *Moringa oleifera* is also rich in antioxidants, which help protect the body from oxidative stress and various

diseases.(19) The leaves contain bioactive compounds such as flavonoids and phenolic acids that contribute to its antioxidant activity.(20) These antioxidants play an important role in maintaining health and reducing the risk of illness.(15) Studies have demonstrated that moringa possesses strong antioxidant properties, making it beneficial for regular consumption.(19)

Researchers are also exploring the use of *Moringa oleifera* in the preparation of functional foods and nutritional supplements.(6) The protein obtained from moringa is suitable for the formulation of products such as protein powders and herbal health supplements.(19) Its natural origin and nutritional benefits have further increased interest in its use as an herbal ingredient.(12)

However, some studies have reported the presence of antinutritional factors in *Moringa oleifera*, such as tannins and phytates, which may interfere with nutrient absorption.(7) Proper processing methods can help reduce these compounds and improve the safety and nutritional quality of the plant for consumption.(21)

Recent research highlights *Moringa oleifera* as a promising ingredient for the development of herbal protein supplements because it is nutritious, rich in antioxidants, affordable, and plant-based. Thus, the study focuses on exploring the use of moringa in the formulation of a protein shake powder that can support health and nutrition.

4. MONOGRAPH OF MORINGA OLEIFERA:





- **Botanical name:** *Moringa oleifera* Lam.
- **Synonyms:** *Moringa pterygosperma*
- **Common names:** Miracle tree, Sahjan (India), Drumstick tree, Horseradish tree.






- **Biological source:** *Moringa oleifera* consists of the fresh or dried leaves, seeds, bark, roots, flowers, and pods of *Moringa oleifera* Lam.
- **Family:** Moringaceae
- **Chemical Constituents:** Major phytochemicals present in moringa are —
 - Alkaloids — Moringinine
 - Flavonoids — Quercetin, Kaempferol
 - Phenolic compounds — Chlorogenic acid
 - Vitamins — Vitamin A, C and E
 - Minerals — Calcium, Iron, Potassium, Magnesium
 - Other constituents — Glucosinolates, Isothiocyanates, Saponins, Tannins, Proteins and amino acids.
- **Microscopical Characters:**
 - 1 Presence of parenchymatous cells
 - 2 Calcium oxalate crystals
 - 3 Xylem vessels
 - 4 Fibers and stomata in leaves
 - 5 Reticulate venation
- **Pharmacological Activities:** Antioxidant, Anti-inflammatory, Antidiabetic, Antimicrobial, Hepatoprotective, Cardioprotective, and Immunomodulatory.
- **Distribution:** *Moringa* is mainly cultivated in India, Pakistan, Sri Lanka, Africa, and South America. India is one of the largest producers of moringa.(22), (23)




5. MATERIALS AND METHODOLOGY: a. Ingredients Used:

Table 1: List of Ingredients.(24)

Ingredients	Category	Images
Moringa oleifera leaf powder	Herbal protein source	
Peanut powder	Healthy fats source	
Roasted chickpea powder (Sattu)	Protein + Energy	
Oat powder	Carbohydrate + Fiber	

Almond powder	Healthy fats + Protein	
Flaxseed powder	Omega 3 + Fiber	
Cocoa powder	Flavor masking	
Jaggery powder	Sweetener	
Cardamom (Elaichi) powder	Natural Aromatic agent	

Ginger Powder	Anti-microbial agent	
---------------	----------------------	---

b. Methodology:

i. Preparation of Moringa Powder:

- Collect fresh healthy moringa leaves.
- Wash thoroughly with clean water.
- Remove excess water using tissue cloth.
- Shade dry for 2–3 days until crisp.
- Grind dried leaves into fine powder using mixer grinder.
- Sieve the powder to obtain uniform particle size.(25)

ii. Preparation of Roasted Chickpea Powder:

- Roast chickpeas lightly for 5–7 minutes.
- Grind into fine powder.
- Sieve.(26)

iii. Preparation of Oat Powder:

- Dry roast oats for 2–3 minutes.
- Grind into fine powder.
- Sieve.(26)

iv. Preparation Protocol:

Take a clean dry bowl



Then, add required amount of moringa powder, peanut powder, chickpea powder, oat powder, almond powder, flaxseed powder, cocoa powder, and sweetener.



Add Cardamom powder as a natural aromatic agent to mask the odor.



Add ginger powder to prevent microbial growth and to enhance the stability.



Mix thoroughly for 10–15 minutes to obtain uniform blend



The obtained mixture is pass through sieve again to remove lumps and ensure uniformity.(27)

v. Packaging:

- Transfer powder into — Airtight glass jar OR Laminated pouch.
- Store in cool dry place.(28)

vi. Direction for use:

- Mix 2 tablespoons (25 g) of powder in 200 mL milk or water.
- Shake/ blend well and consume once or twice daily.

- Optional: Add banana or nuts for enhanced taste.
- 5. Fiber — 2.2 g

c. Formulation of Moringa Protein powder:

Nutritional Information: (Approximate Values per 25 g Serving)

1. Energy — 87 kcal
2. Protein — 7 g
3. Carbohydrates — 9.5 g
4. Fat — 2.7 g

Different concentrations of Moringa oleifera were used for the preparation of the protein powder. Following are the three formulations prepared for a 100g batch:

- F1 = 10% Moringa
- F2 = 20% Moringa
- F3 = 30% Moringa

Table 2: Composition for F1, F2 and F3 Moringa protein powder.(24)

Ingredients	F1 = 10% Moringa	F2 = 20% Moringa	F3 = 30% Moringa
Moringa oleifera leaf powder	10 g	20 g	30 g
Peanut powder	35 g	30 g	25 g
Roasted chickpea powder (Sattu)	25 g	20 g	15 g
Oat powder	12 g	10 g	8 g
Almond powder	10 g	10 g	10 g
Flaxseed powder	5 g	5 g	5 g
Cocoa powder	2 g	3 g	5 g
Jaggery powder	1 g	2 g	2 g
Cardamom (Elaichi) powder	1 g	1 g	1 g
Ginger powder	0.5 g	0.5 g	0.5 g

6. EVALUATION PARAMETERS:

Table 3: Evaluation parameters for Moringa protein powder.(29), (30)

Category	Parameters	Methods	Acceptable Range/ Observation
Physical Evaluation	Color	Visually Observed under normal daylight	Light green to dark green
	Odor	Evaluated by smelling the formulation	Pleasant characteristic aromatic odor
	Taste	Evaluated after dissolving powder in water/ milk	Slightly sweet and acceptable
	Texture	Observed by touch and visual inspection	Smooth and free flowing powder
Nutritional Evaluation	Protein Content	Biuret Method	20-35g per 100g
	Carbohydrate content	Difference method	40-60g per 100g
	Fat content	Soxhlet Extraction	5-15g per 100g
	Fiber content	Crude fiber method	5-12g per 100g
	Caloric value	Atwater factor method	300-450kcal per 100g



Physicochemical Properties	Solubility test	Powder is mixed in water/ milk and observed	80 – 95% soluble in water/ milk
	Moisture content	Determine by drying method	Less than 10%
	pH	Measured using digital pH meter	5.5 – 7.5
	Stability study	Stored under different conditions and observed periodically	No significant change in color, odor, test or texture for 1-2 months

7. RESULTS AND DISCUSSIONS:

a. Physical Evaluation:

Table 4: Comparative Physical Evaluation of F1, F2 and F3 Formulations.

Physical Evaluation	F1 = 10% Moringa	F2 = 20% Moringa	F3 = 30% Moringa
Color	Light Green	Medium Green	Dark Green
Odor	Pleasant, characteristic aromatic odor	Pleasant, characteristic aromatic odor	Pleasant, characteristic aromatic odor
Taste	Slightly sweet	Sweet and acceptable	Slightly bitter
Texture	Smooth and free flowing powder	Smooth and free flowing powder	Smooth and free flowing powder



Figure 2: Prepared F1, F2 and F3 Formulations

Key Observations:

1. The colour intensity increased from F1 → F3, due to the higher concentration of moringa leaf powder.
2. All formulations showed acceptable odor and texture.

3. F1 showed better taste acceptability, while F3 exhibited slight bitterness because of the increased herbal content.

b. Comparative Nutritional Composition:

Table 5: Comparative Nutritional Evaluation of F1, F2 and F3 Formulations.

Nutritional Evaluation	F1 = 10% Moringa	F2 = 20% Moringa	F3 = 30% Moringa
Protein content	24.5g	27.8g	30.6g
Carbohydrate content	42.0g	38.5g	34.2g
Fat content	11.2g	10.8g	10.3g

Fiber content	6.5g	8.9g	11.4g
Caloric value	360kcal	348kcal	335kcal

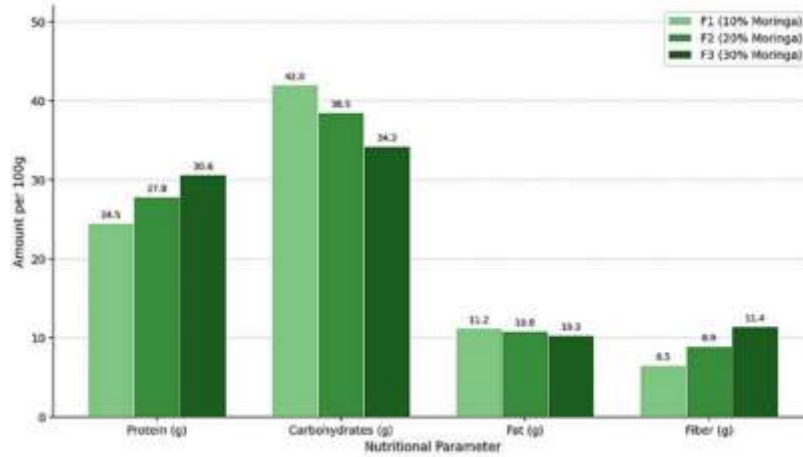


Figure 3: Grouped bar chart showing macronutrient composition (per 100 g) of F1, F2, and F3 formulations.

Key Observations:

1. Protein content increased from F1 → F3, due to higher concentration of moringa oleifera and its rich plant protein content.
2. A slight decrease in carbohydrate content was observed with increasing moringa concentration, due to the reduced proportions of oat and chickpea powder.
3. A minor decrease in fat content was observed (11.2 g → 10.3 g), primarily influenced by the

fixed proportions of almond and flaxseed powder.

4. Dietary fiber increased significantly in F3 because Moringa oleifera leaves are rich in dietary fiber.

1. **Caloric Value:** The horizontal bar chart below compares the caloric value (kcal per 100 g) across all three formulations. The caloric value slightly decreased with increasing moringa concentration, as Moringa leaves are inherently lower in calories compared to nuts and oats.

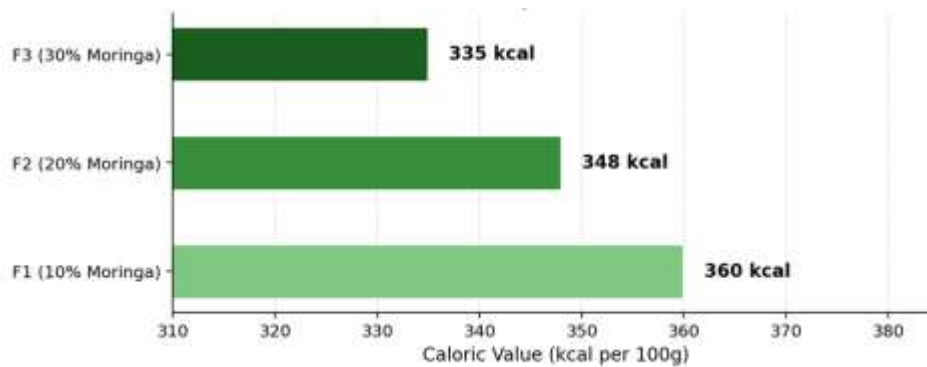


Figure 4: Caloric value (kcal per 100 g) comparison of F1, F2, and F3 formulations.

7.3 Physicochemical Properties:



Table 6: Comparative Physicochemical properties of F1, F2 and F3 Formulations.

Physicochemical properties	F1 = 10% Moringa	F2 = 20% Moringa	F3 = 30% Moringa
Solubility test	88%	85%	82%
Moisture Content	4.2%	4.8%	5.5%
pH	6.7	6.4	6.1
Stability Studies	Stable	Stable	Moderately Stable

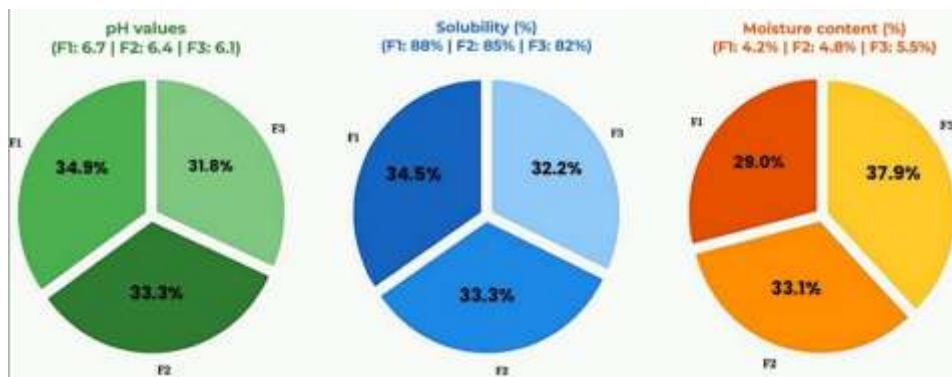


Figure 5: Pie Charts — Proportional comparison of pH, Solubility & Moisture across formulations

Key Observations:

- Solubility decreased with increasing moringa concentration, due to high fiber content of moringa affecting the dispersion of the powder in water/ milk.
- Moisture increased from F1 → F3 because of the hygroscopic nature (absorbs moisture) of Moringa powder.
- All formulations remained within the acceptable pH range.

8. DISCUSSION SUMMARY:

Three formulations of herbal protein shake powder containing different concentrations of Moringa oleifera were prepared and evaluated. The formulations were designated as F1 (10% moringa), F2 (20% moringa), and F3 (30% moringa) based on increasing concentration of moringa powder.

- **F1** – Low concentration of moringa
- **F2** – Medium concentration of moringa

- **F3** – High concentration of moringa
- All formulations were evaluated for physical characteristics, nutritional composition, and other quality control parameters.
- F1, F2 and F3 formulations exhibited acceptable colour, odor, and texture. However, increasing moringa concentration affected taste acceptability. F1 showed the best palatability because of its mild herbal flavour, while F3 developed slight bitterness due to higher moringa content and increased fiber concentration. Cocoa powder and jaggery helped in masking the herbal taste to some extent.
- The incorporation of roasted chickpea powder, oats, almonds, flaxseed, and peanut powder contributed significantly to the balanced nutritional composition of the formulations. Chickpea and peanut powder enhanced protein content, oats improved carbohydrate and fiber levels, while flaxseed and almonds supplied healthy fats and omega-3 fatty acids. These ingredients also improved the overall energy

value and functional properties of the protein shake.

- The nutritional evaluation demonstrated a direct relationship between moringa concentration and protein as well as fiber content. F3 showed the highest protein content (30.6 g/100 g) due to the rich amino acid composition of moringa leaves. Similarly, dietary fiber increased significantly from F1 to F3 because moringa leaves naturally contain high levels of crude fiber. This indicates that moringa can effectively enhance the nutritional profile of herbal protein supplements.
- The physicochemical evaluation revealed that solubility decreased gradually with increasing moringa concentration. This reduction may be attributed to the high fiber and hygroscopic nature of moringa powder, which affects dispersion in water or milk. Moisture content slightly increased from F1 to F3, but all formulations remained within acceptable limits, indicating good storage stability.
- Among the three formulations, F2 (20% moringa) emerged as the most balanced and optimized formulation. F2 possessed comparatively high protein (27.8 g) and fiber (8.9 g) content over F1, while maintaining a caloric value of 348 kcal, a solubility of 85%, a stable pH of 6.4, and a low moisture content of 4.8%. Crucially, F2 retained an acceptable sweet-herbal taste that is likely to support consumer adherence and regular consumption. This balance between nutritional quality and sensory acceptability makes F2 the most viable candidate for further development, scale-up, and clinical evaluation.
- The formulated protein shake possesses potential functional food benefits because of

the antioxidant and bioactive compounds present in *Moringa oleifera* leaves. Compounds such as flavonoids, phenolics, vitamins, and minerals may help reduce oxidative stress, support immunity, and improve overall health.

- The findings of this study suggest that moringa-based herbal protein shake powder can serve as a nutritious, affordable, and plant-based alternative to synthetic protein supplements. The developed formulation is rich in proteins, dietary fiber, antioxidants, vitamins, and minerals while remaining free from artificial preservatives and additives.

9. CONCLUSION:

The present study successfully demonstrated the formulation and evaluation of herbal protein shake powder formulated using *Moringa oleifera* as the major functional ingredient. The incorporation of moringa leaf powder significantly enhanced the nutritional value of the formulation because of its rich protein content, essential amino acids, dietary fiber, vitamins, minerals, and antioxidant compounds. The use of natural plant-based ingredients such as peanut powder, roasted chickpea powder, oats, almonds, and flaxseed further improved the nutritional profile and made the product suitable as a balanced dietary supplement.

The prepared formulations showed acceptable organoleptic characteristics, including colour, odour, texture, and taste. Nutritional analysis revealed that protein and fiber content increased with higher moringa concentration, while carbohydrate content and caloric value showed a slight decrease. Physicochemical analysis demonstrated that all formulations remained within acceptable quality limits.



Among all formulations, F2 containing 20% moringa was identified as the most optimized formulation. It provided a balanced combination of nutritional value, acceptable taste, good solubility, stable physicochemical properties, and overall consumer acceptability. F2 showed comparatively high protein and fiber content while maintaining a pleasant taste and desirable texture, making it the most suitable formulation for further development and commercialization.

The study also highlights the advantages of herbal and plant-based protein supplements over synthetic formulations, as they are economical, environmentally sustainable, and free from harmful artificial additives. The developed protein shake powder may be beneficial for athletes, gym users, growing children, elderly individuals, and health-conscious consumers requiring nutritious and easily digestible protein supplementation.

Furthermore, the formulation has significant potential for commercial production and nutraceutical applications. Future studies focusing on clinical evaluation, shelf-life stability, flavour enhancement, and large-scale manufacturing can further improve the effectiveness and marketability of the product.

10. FUTURE SCOPE:

The developed herbal protein shake powder containing *Moringa oleifera* has significant future potential in the field of nutrition and health supplements. Due to its high nutritional value and natural composition, the formulation can be further explored for large-scale commercial production as an affordable and plant-based protein supplement.

Different flavor variations such as chocolate, vanilla, strawberry, banana, and coffee can be developed in the future to improve taste,

palatability, and consumer acceptance. Additional ingredients like nuts, seeds, probiotics, or superfoods may also be incorporated to enhance the nutritional and functional properties of the product. Future research can also focus on developing sugar-free or low-calorie versions of the protein shake powder suitable for diabetic and weight-conscious individuals.

Further clinical and nutritional studies can be carried out to scientifically evaluate the health benefits, safety, digestibility, and effectiveness of the formulation in different population groups. Improvement in packaging materials, storage conditions, and shelf-life stability studies can further increase the commercial value and market acceptance of the product.

Thus, moringa-based herbal protein shake powder has promising future applications as a functional food and natural nutritional supplement in both healthcare and commercial sectors.

REFERENCES

1. Review DA, Gardner CD. Dietary Protein and Amino Acids in Vegetarian Diets—A Review. 2019;(2):1–19.
2. Su X, Lu G, Ye L, Shi R, Zhu M, Yu X, et al. *Moringa oleifera* Lam.: a comprehensive review on active components, health benefits and application. 2023;24353–84.
3. Raghavendra S, Rajashekara E, Nagaraj MS, Ramesh CK, Paramesha M, J ARS. Evaluation of Phytoconstituents , Nutrient Composition and Antioxidant properties in *Moringa oleifera* - BhagyaKDM 01 variety. 2015;9(October):369–79.
4. Gopalakrishnan L, Doriya K, Santhosh D. *Moringa oleifera*: A review on nutritive importance and its medicinal application. *Food Sci Hum Wellness* [Internet]. 2016;5(2):49–56. Available from:



- <http://dx.doi.org/10.1016/j.fshw.2016.04.001>
5. Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. Moringa oleifera Seeds and Oil : Characteristics and Uses for Human Health. :1–14.
 6. Alegbeleye OO. How Functional Is Moringa oleifera? A Review of Its Nutritive , Medicinal , and Socioeconomic Potential. 2018;39(1):149–70.
 7. Illingworth KA, Ying Y, Lee L, Siow F. Functional Properties of Moringa Oleifera Protein Isolates as Influenced by Different Isolation Techniques , pH , and Ionic Strength. Food Bioprocess Technol [Internet]. 2024;3060–73. Available from: <https://doi.org/10.1007/s11947-023-03279-8>
 8. Saini RK. Phytochemicals of Moringa oleifera: a review of their nutritional , therapeutic and industrial significance. 3 Biotech. 2016;6(2):1–14.
 9. Vergara-jimenez M, Almatrafi MM, Fernandez ML. Bioactive Components in Moringa Oleifera Leaves Protect against Chronic Disease. 2017;1–13.
 10. Panova N, Gerasimova A, Gentscheva G, Nikolova S, Makedonski L, Velikova M, et al. Moringa oleifera Lam .: A Nutritional Powerhouse with Multifaceted Pharmacological and Functional Applications. 2025;1–38.
 11. Trigo C, Luisa M, María C, Ortolá D. Potentiality of Moringa oleifera as a Nutritive Ingredient in Different Food Matrices. 2023;25–37.
 12. Part PP, Nutritional I, Part PP, Fahey JW, Sc D. Moringa oleifera: A Review of the Medical. 2021;(January 2005).
 13. Ntshambiwa KT, Seifu E, Mokhawa G. Nutritional composition , bioactive components and antioxidant activity of Moringa stenopetala and Moringa oleifera leaves grown in Gaborone , Botswana. Food Prod Process Nutr [Internet]. 2023; Available from: <https://doi.org/10.1186/s43014-022-00124-x>
 14. Sreelatha S, Padma PR. Antioxidant Activity and Total Phenolic Content of Moringa oleifera Leaves in Two Stages of Maturity. Plant Foods Hum Nutr [Internet]. 2009;64(4):303–11. Available from: <https://doi.org/10.1007/s11130-009-0141-0>
 15. Ros G, Nieto G. Nutritional and Antioxidant Properties of Moringa oleifera Leaves in Functional Foods. 2022;1–13.
 16. Activities P, Aspects T, Pareek A, Pant M, Gupta MM, Kashania P, et al. Moringa oleifera: An Updated Comprehensive Review of Its. 2023;
 17. Prasad L, Gangadhara K, Apparao V V, Singh AK, Rane J, Kaushik P, et al. South African Journal of Botany Nutritional , antioxidants and protein pro fi ling of leaves of Moringa oleifera germplasm. 2024;165.
 18. Hameed A, Bux A, Muhammad T, Khuhawar J. Nutritional Assessment and Biological Activity of Moringa oleifera. 2021;(1):1–6.
 19. Value N, Powder L, Regulation M, Gonz E, Ureña-vacas I, Marta S, et al. Nutritional Value of Moringa oleifera Lam. Leaf Powder Extracts and Their Neuroprotective Effects via Antioxidative and Mitochondrial Regulation. 2021;
 20. Variations P, Moringa T. Antioxidant, Antimicrobial and Phytochemical Variations in Thirteen Moringa oleifera Lam. Cultivars. 2014;5169:10480–94.
 21. Supplements F, Llorent-mart EJ, Gordo-moreno AI, Ruiz-medina A. Preliminary Phytochemical Screening and Antioxidant Activity. 2023;



22. Padayachee B, Baijnath H. South African Journal of Botany An updated comprehensive review of the medicinal , phytochemical and pharmacological properties of Moringa oleifera. South African J Bot [Internet]. 2020;129:304–16. Available from: <https://doi.org/10.1016/j.sajb.2019.08.021>
23. Hospital X, Practices SM, Hospital X. botany , traditional uses , phytochemistry ,. 2022;74(October 2021):296–320.
24. Science F. Optimization of a Multi-Micronutrient Powder Formulation Incorporating Moringa oleifera : A Sustainable Approach to Nutritional Intervention. 2025;13(May):8–23.
25. Rathore Y, Meena S, Joshi P. Formulation and quality evaluation of Moringa leaves powder and development of value-added products. 2022;11(10):1605–15.
26. Mayara B, Ferreira R, Maria I, Torres M, Sarache G, Silva JL, et al. pre-gelatinised flour for instant food products. Czech J Food Sci [Internet]. 2025;43(4):246–54. Available from: <https://doi.org/10.17221/215/2024-CJFS>
27. Manuwa SI, Sedara AM, Tola FA. leaves pulverizer. J Agric Food Res [Internet]. 2020;2(December 2019):100034. Available from: <https://doi.org/10.1016/j.jafr.2020.100034>
28. G GD, V SV, P VR, Cp V. Influence of different drying methods and packaging material on the quality of moringa leaf powder. 2021;10(8):410–4.
29. Characterization S. Techno-Functional and Sensory Characterization of Commercial Plant Protein Powders. 2023;1–21.
30. Thiex N. Evaluation of Analytical Methods for the Determination of Moisture, Crude Protein, Crude Fat, and Crude Fiber in Distillers Dried Grains with Solubles. J AOAC Int [Internet]. 2009 Jan 1;92(1):61–73. Available from: <https://doi.org/10.1093/jaoac/92.1.61>

HOW TO CITE: Bhoomika Choudhary, Siddhi Chaugule, Nupur Chiplunkar, Sameer Bhoir, Utkarsh Chavan, Priya Jadhav, Formulation and Nutritional Evaluation of Herbal Moringa-Based Protein Shake Powder, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 5, 8212-8226. <https://doi.org/10.5281/zenodo.20472103>

