IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 5, Issue 9, May 2025

Impact Factor: 7.67

Moringa Oleifera Leaf Powder Herbal Biscuit: Forming A Protein-Rich Nutraceutical

Om D. Madane[1], Atul B. Madane[1], Ganesh S. Lokhande[1], Shital N. Kokare[2].

[1]Students, Vidya Niketan College of Pharmacy, Lakhewadi, Pune

[2]Assistant Professor, Department of Pharmaceutics, Vidya Niketan College of Pharmacy, Lakhewadi, Pune

Abstract: *The creation of plant-based functional snacks has emerged as a key area of innovation due to the growing demand for natural, health-promoting foods worldwide. The creation of a protein-rich herbal biscuit enhanced with powdered Moringa oleifera leaves—a nutrient-dense plant renowned for its high protein, vitamin, and mineral content—is the main goal of this study. The objective was to improve the nutritional profile of a classic biscuit without sacrificing its flavor by mixing moringa with chickpea flour and certain seasonings. The biscuits' proximate nutritional content, taste, texture, and antioxidant activity were assessed after they were made with different amounts of moringa powder.*

The biscuit with 10% moringa powder and 20% chickpea flour had the greatest balanced nutritional and acceptability outcomes out of all the formulations. According to this study, moringa herbal biscuits can be a practical, reasonably priced, and successful means of addressing protein-energy malnutrition, particularly in marginalized communities, while also fitting in with contemporary wellness and health trends.

Keywords: Moringa oleifera, Herbal biscuit, Nutraceutical, Antioxidants, Sensory evaluation, Malnutrition prevention, Plant-based nutrition, Food fortification, Dietary supplements, Bioactive compounds, Health-promoting foods

I. INTRODUCTION

Pasta and baked items that are gluten-free (GF) are becoming more and more popular [1]. Commercially available GF cereal-based foods are frequently characterized by lower nutritional quality than their gluten-containing counterparts, having lower dietary fiber, protein, and resistant starch (RS) content, as well as enhanced starch digestion rates and extents, despite the health benefits associated with the GF food category [2]. Therefore, a lot of research has been done to improve the nutritional profile of GF foods, and one potential tactic is to partially substitute new nutrient-dense raw materials for popular GF flours [3].

In order to improve the technological and nutritional profiles of GF baked goods, various inclusion amounts of legume flours, dairy proteins, powdered fruits and vegetables, fiber sources, and other GF materials have been included [4, 5]. In particular, Moringa oleifera L. leaves are completely safe for human consumption and are low in fat, sugars, and total starch while being a good source of proteins, essential amino acids, dietary fiber, vitamins, and minerals [6, 7]. Furthermore, flavonoids, phenolic acids, and lignans are among the groups of polyphenols found in the MOL [8].

Consequently, amala (stiff dough), wheat-based foods (such as bread, cookies, and pasta), dairy products, and soups have all been made with MOL powder (MOLP) [9]. Pasta and wheat-based cooking demonstrations in the past have demonstrated that adding 10–15% MOLP can enhance the total nutritional value [8, 10, 11]. Furthermore, GF-flours made from novel nutrient-dense source materials were described by Rocchetti et al. [8] [3]. In order to improve the technological and nutritional profiles of GF baked goods, various inclusion amounts of legume flours, dairy proteins, powdered fruits and vegetables, fiber sources, and other GF materials have been included [4, 5].

Given this, dried powdered Moringa oleifera L. leaf powder (MOL) may be a viable naturally gluten-free component to include in the creation of gluten-free food products. In particular, Moringa oleifera L. leaves are completely safe for human consumption and are low in fat, sugars, and total starch while being a good source of proteins, essential amino acids, dietary fiber, vitamins, and minerals [6, 7]. Furthermore, flavonoids, phenolic acids, and lignans are among the

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 9, May 2025 Impact Factor: 7.67

groups of polyphenols found in the MOL [8]. Consequently, amala (stiff dough), wheat-based foods (such as bread, cookies, and pasta), dairy products, and soups have all been made with MOL powder (MOLP) [9].
According to earlier research on pasta and wheat-based recipes, adding 10–15% MOLP can help to increase the total nutritional content [8, $10, 11]. Additionally, Rocchetti and colleagues [8] revealed

Why Biscuits?
Now the challenge is: how do we make this superfood part of everyday eating habits? One practical solution is to incorporate moringa into something people already enjoy—like biscuits. Biscuits are one of the most popular snacks worldwide. They're convenient, affordable, and shelf-stable. If we can enrich them with moringa powder and other plant-based proteins like chickpea flour, we have the potential to create a snack that's both tasty and nutritious.
However, using moringa in baked goods comes with some hurdles. Its strong green color and slightly bitter, earthy taste can affect how the final product looks and tastes. So, it's not just about adding nutrition—it's about creating a biscuit people will actually want to eat.

Purpose of This Study:
- Improve the nutritional content of a common snack,
- Explore how well moringa works in biscuit form,
- Evaluate taste, texture, and shelf life,
- And ultimately offer a healthier alternative to regular biscuits, especially for communities facing malnutrition.

Materials and Methods
Collection of sample:
Fresh leaves of Moringa oleifera were collected from Materials Shibpur, Howrah, West Bengal in the month of February for analysis and product formulation.

Chemicals and reagents:
We bought wheat flour, sugar, Amul butter, and vanilla essence from the local market in Kolkata, India. All of the chemicals used, including sodium and ammonium bicarbonate, come from Merck in India.

Ingredients:
- Moringa oleifera leaf powder (dried and ground)
- Wheat flour (refined or whole)
- Baking powder
- Sugar (or honey)
- Margarine or butter
- Eggs (optional)
- Milk or water
- Honey
- Chocolate

IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429 Volume 5, Issue 9, May 2025 Impact Factor: 7.67

Moringa oleifera:

Moringa oleifera, often referred to as the "drumstick tree" or "miracle tree," is renowned for its exceptional nutritional and medicinal properties. The leaves, in particular, are a powerhouse of essential nutrients and bioactive compounds. **Moringa oleifera** is a fast-growing deciduous tree native to India, often referred to as the "miracle tree" due to its exceptional nutritional and medicinal properties. Among its various parts, the **leaves** are most commonly used for food fortification and nutraceutical development. Several formulations were tested with Moringa powder substitutions at 5%, 10%, and 15% of total flour weight. Chickpea flour was added in 20% to increase protein content.

Wheat flour :

One of the most extensively grown cereal crops in the world, Triticum aestivum, yields wheat flour, a finely ground product**.**

. It serves as the **primary structural and carbohydrate base** in most bakery products due to its gluten-forming proteins and functional baking properties.

In nutraceutical product development, wheat flour is valued for:

Its **macronutrient balance** (primarily carbohydrates with modest protein and fiber)

Its role in **energy delivery** and **satiety**

Serving as a **carrier matrix** for bioactive ingredients like moringa

Honey :

As a natural sweetener, honey provides moisture retention and a mild flavor. Its antioxidant properties also contribute to the health benefits of the biscuits. Honey contains fructose, glucose, and small amounts of minerals like calcium, iron, and magnesium. Honey helps balance sweetness and retain moisture, enhancing the textural properties of the biscuit and offering additional nutrients compared to refined sugar.

Baking Powder:

Baking powder is a **chemical leavening agent** that helps baked goods rise by releasing carbon dioxide when mixed with a liquid. This process is crucial for creating light, airy biscuits. Baking powder typically contains **sodium bicarbonate (baking soda)**, an **acidic salt** (like **cream of tartar**), and a **starch** (like **cornstarch**) to prevent premature reactions. It is a key ingredient in recipes that do not use yeast, providing a quick and reliable rise. The dough expands and becomes fluffy as a result of the interaction between the baking powder and the moisture. This ensures the **texture** of the biscuit, contributing to its lightness and mouthfeel.

Sugar :

The most common sugar in baking, acts as a sweetener. It also serves as a moisture-retaining agent, helping to keep the biscuits soft and tender. Sucrose (table sugar) provides calories (about 4 kcal per gram) but lacks essential nutrients. It primarily contributes energy but offers little to no protein, vitamins, or minerals. Sugar also contributes to browning during baking due to Maillard reactions, which provide flavor and colour.

Butter:

Butter, made from cream, is rich in saturated fats, and contributes to taste and texture. It helps to create a crispy and tender texture in the biscuits. Butter is high in saturated fat but provides vitamins such as vitamin A, D, and E. It creates the desired mouthfeel, flavor, and texture, contributing to the richness of the biscuits.

Water:

Water is essential for hydrating the flour and activating the gluten to form dough. It also helps dissolve and integrate dry ingredients. Water interacts with starch and gluten to form the structure of the biscuit, ensuring it is neither too dry nor too wet.

Chocolate :

Chocolate, especially dark chocolate, adds flavour, richness, and a distinctive texture to the biscuits. Dark chocolate is rich in antioxidants (especially flavonoids), iron, magnesium, and fibber. The presence of polyphenols in dark chocolate may offer heart-health benefits and provide an antioxidant boost, making the biscuits more nutritionally beneficial. The addition of chocolate enhances consumer appeal and overall sensory experience.

Preparation of sample

The leaves were first sorted to remove any undesired, overgrown, or insect-affected sections. Then they were thoroughly washed with potassium permanganate solution and dried in a shade at around 25o-30oC. The dried leaves were then crushed into a fine powder and stored in an airtight container at 25°C.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 9, May 2025 Impact Factor: 7.67

The flow chart for the preparation of Herbal

Selection and Weighing of Ingredients
↓
Sifting of Dry Ingredients
(Wheat flour , Moringa Powder , baking powder, salt)
↓
Creaming of Fat and Sugar (or Honey)
(Margarine or butter mixed with sugar and honey until light and fluffy)
↓
Mixing with Water
↓
Addition of Dry Ingredients to Wet Mixture
↓
Kneading the Dough to Uniform Consistency
↓
Rolling the Dough and Cutting into Shapes

To create a homogenous mixture, sieve the refined wheat flour and add the remaining dry ingredients. ′ Sweetened shortening cream was made by combining sugar and vegetable oil. ′ To make dough, dry flour was then gradually combined with shortening cream and water. The dough was made by manual kneading of all the dry and liquid ingredients to attain consistency with properties. desirable visco-elastic ′ After the dough was complete, it was left undisturbed for ten to fifteen minutes before being used to roll out dough balls onto a wooden platform to create sheets. These sheets were cut using a hand-operated metal dye machine, placed on a tray covered with olive oil, and then stored for baking. ′ Three steps are involved in baking in an electric oven. ′ Dough is heated, which causes initial structural changes. ′ The largest moisture loss occurs in the second step. ′ Each lot needs to bake for 25–30 minutes at 180 degrees Celsius. The biscuit's colour transitions to its final, characteristic light brown hue in the third stage.

Analysis of products

Proximate composition Analysis:

Using established techniques, the samples were analyzed in triplicate for moisture, fiber, and ash content. In a centrifuge, the material was defatted by serial solvent extraction using methanol and chloroform in 1:2, 1:1, and 2:1 ratios. The Folin Lowry method was used to determine the protein, and the Anthrone reaction method [12] was used to determine the carbohydrates. The Atwater formula was used to get the energy levels, and the corresponding values for fat, protein, and carbohydrates were 9, 4, and 3.75 Kcal/g [13].

Microbiological Analysis:

In accordance with APHA guidelines, the total microbiological loads of the market biscuit (control) and the Moringa leaf-enriched biscuit samples were measured in freshly made zero and seven days of storage at 25ºC [13]. Total viable organisms, including the aerobic count of bacteria, E. coli, total coliforms, yeast, and molds, were counted in order to assess the microbiological quality of the market biscuit and Moringa leaf enriched biscuit samples. To achieve a 10-1 dilution, 10 grams of biscuit samples were mixed with 90 milliliters of sterile saline (0.85% NaCl) using a CM 101 CYCLO MIXER (REMI) vortex stirrer. The same diluents were used to make additional tenfold serial dilutions until a dilution of 10-8 was achieved. The microbial population was evaluated using the spread plate technique.

For the purpose of counting various organisms, aliquots (0.1 ml) of an appropriate dilution were spread and plated in duplicate onto prepared, sterile, and dried petridishes of appropriate media. The total viable count was determined using plate count agar, and the presence of yeasts and molds was determined using potato dextrose agar. Following inoculation, the plates were shaken, left to harden, then incubated and inverted in an incubator set to 37ºC for 48 hours±2 for all viable counts and 25ºC for three to five days for yeasts and molds. Log10 cfu/ml is the number of colonies counted on the plates after accounting for the dilution effect. Microbiological tests were performed at intervals of one and seven days.

Sensory evaluation of the Biscuit samples:

Until evaluation, the market biscuit (control) and the biscuit enhanced with moringa leaves were maintained at 250C. From the School of Community Science and Technology department of BESU in Shibpur, Howrah, West Bengal, twenty members were selected. The Nine Point Hedonic Scale was used for evaluation. Odor, taste, texture, and general acceptance were evaluated as characteristics. The sensory performance data was presented as follows: 9 = like very, 8 = like very much. 7 = rather Six is like a little, five is neither like nor dislike, four is dislike a little, three is dislike, two is dislike very much, and one is dislike extremely.

Physical and textural characteristics of biscuits:

Table 2 displays the physical attributes of the samples. The spread ratio of biscuits was affected by the GFM and MOLP combination at the maximum substitution level, with the lowest value observed for M15 samples (i.e. 4.1; $p < 0.05$). In general, biscuits with a higher spread ratio are thought to be the best. However, because they retain more water in the dough system and increase dough viscosity, high protein flours can affect biscuit spread ratios [10, 15]. Dachana et al. [10] observed similar results, measuring a significant decrease (about -10%) in the spread ratio of wheat-based biscuits at the recipe's highest MOLP inclusion level (15 w/w).

While the CTR had the lowest hardness value (i.e., 41.9 versus 18.9 N, respectively; $p < 0.05$), the M15 biscuits had the highest. Both the content of the flour and the way the ingredients interact impact how firm biscuits are [14]. Stronger protein-starch adhesion may result in a tougher structure when protein levels are higher [15]. A similar outcome was noted by Dachana et al. [10] in biscuits made with wheat with MOLP replacement. Specifically, the scientists found that adding more MOLP to the mix increased the breaking strength, a textural parameter. Furthermore, as higher fiber levels can condense the dough's structure, their presence in GF biscuits might also affect the texture values [15].

Pasting properties of flours and biscuits:

Fig. 1 displays the pasting profiles of the raw materials (such as GFM and MOLP), as well as the various blends and associated food products. The GFM showed two stages of swelling (blend 0% w/w MOLP: Fig.1a): a speedy increase in viscosity development at around 70 °C, which corresponds to the maximum gelatinization temperature of potato starch (one of the primary ingredients of the commercial mix), and a slower increase at higher temperatures (90 °C), which is explained by the gelatinization peak of rice flour. When rice or maize flours were combined with potato starch, similar results were noted [16].

As the MOLP-enrichment level of the flour blends increased, the strength of the viscosity peak at 90 °C decreased. The low starch content of MOLP (15.4 g/100 g of product) explains the low viscosity values during the heating and cooling phases.The pasting temperature rose from 54.8 to 58.0 °C in the 5% w/w MOLP–GFM mix when MOLP was added to the GFM at varying substitution levels, but there was no rise from 5 to 15% w/w (i.e., 59.0 °C). According to earlier research, adding MOLP had no effect on the bread's in vitro digestion, which was higher during the whole incubation period. [16]

II. RESULTS AND DISCUSSIONS

Comparing the Organoleptic or Sensory Properties of Biscuits: The sample's initial look, color, flavor and fragrance, texture, and overall taste are all taken into consideration while conducting organoleptic tests. The comparison of the biscuits' organoleptic quality characteristics is displayed in Table 2.

Sample Code	Control	Sample A	Sample B	Sample C
Appearance	4.07 ± 0.26	4.08 ± 0.17	3.05± 0.16	3.08± 0.12
Colour	4.27 ± 0.70	4.17 ± 0.05	4.05 ± 0.40	3.17 ± 0.57
Flavour & Smell	3.73 ± 0.80	3.53 ± 0.70	4.13 ± 0.56	3.73 ± 0.65

Texture	4.40 ± 0.74 4	4.20 ± 0.56	4.05 ± 0.14	3.25 ± 0.75
Overall taste acceptance	4.46 ± 0.63	4.43 ± 0.53	4.03 ± 0.43	4.14 ± 0.57

III. CONCLUSION

Given its valuable nutrient composition, which includes a noticeable amount of both macronutrients (carbohydrate, protein, and desired fatty acid) and micronutrients (minerals and antioxidants), moringa leaves can be easily chosen and used as an exceptional food ingredient to formulate a wide range of products. The potential for the bioactive compound-based Moringa leaf to develop into a desirable food ingredient is increased by the presence of heat-stable antioxidants. It is very promising to include moringa in the diet as nutritional supplements or during the food fortification process because it has been reported to have certain therapeutic qualities.

REFERENCES

[1]. Padalino L, Conte A, Del Nobile MA (2016) Overview on the general approaches to improve gluten-free pasta and bread. Foods 5:87
[2]. Giuberti G, Gallo A (2018) Reducing the glycaemic index and increasing the slowly digestible starch content in gluten-free cereal-based foods: a review. Int J Food Sci Technol 53:50–60
[3]. Jnawali P, Kumar V, Tanwar B (2016) Celiac disease: overview and considerations for developments of gluten-free foods. Food Sci Hum Wellness 5(4):160–176
[4]. El Khoury D, Balfour-Ducharme S, Joye IJ (2018) A review on the gluten-free diet: technological and nutritional challenges. Nutri- ents 10:1410. https://doi.org/10.3390/nu10101410
[5]. Ciudad-Mulero M, Fernández-Ruiza V, Cuadrado C, Arribas C, Pedrosa MM, Berrios JDJ, Pan J, Morales P (2020) Novel gluten-free formulations from lentil flours and nutritional yeast: evaluation of extrusion effect on phytochemicals and non-nutri- tional factors. Food Chem 315:126175
[6]. Gopalakrishnan L, Doriya K, Kumar DS (2016) *Moringa oleifera*: a review on nutritive importance and its medicinal application. Food Sci Hum Wellness 5:49–56
[7]. Páramo-Calderón DE, Aparicio-Saguilán A, Aguirre-Cruz A, Carrillo-Ahumada J, Hernández-Uribe JP, Acevedo-Tello S, Tor- ruco-Uco JG (2019) Tortilla added with *Moringa oleifera* flour: physicochemical, texture properties and antioxidant capacity. LWT Food Sci Technol 100:409–415
[8]. Rocchetti G, Rizzi C, Pasini G, Lucini L, Giuberti G, Simonato B (2020) Effect of Moringa oleifera L. leaf powder addition on the phenolic bioaccessibility and on in vitro starch digestibility of durum wheat fresh pasta. Foods 9:628. https://doi.org/10.3390/ foods9050628
[9]. Oyeyinka AT, Oyeyinka SA (2018) *Moringa oleifera* as a food fortificant: recent trends and prospects. J Saudi Soc Agric Sci 17:127–136
[10]. Dachana KB, Rajiv J, Indrani D, Prakash J (2010) Effect of dried moringa (*Moringa oleifera Lam.*) leaves on rheological, micro- structural, nutritional, textural and organoleptic characteristics of cookies. J Food Qual 33:660–677
[11]. Simonato B, Tolve R, Rainero G, Rizzi C, Sega D, Rocchetti G, Lucini L, Giuberti G (2020) Technological, nutritional, and sen- sory properties of durum wheat fresh pasta fortified with Moringa oleifera L. leaf powder. J Sci Food Agric. https://doi.org/10.1002/ jsfa.10807
[12]. Manzi PA, Agguzzi A and Pizzoferrato L 2001. Nutritional mushrooms widely consumed in Italy. Food Chem, 73: 321-325.
[13]. APHA 2005. Standard methods for the Examination of Water and Wastewater, 21st Edition.American Public Health Association, Washington, D.C.
[14]. Gurjal HS, Mehta S, Samra IS, Goyal P (2003) Effect of wheat bran, coarse wheat flour, and rice flour on the instrumental texture of cookies. Int J Food Prop 6:329–340
[15]. Wani AA, Sogi DS, Singh P, Sharma P, Pangal A (2012) Dough- handling and cookie-making properties of wheat flour-watermelon protein isolate blends. Food Bioprocess Technol 5:1612–162

ISSN: 2581-9429

Volume 5, Issue 9, May 2025

Impact Factor: 7.67

[16]. Waterschoot J, Gomand SV, Willebrords JK, Fierens E, Delcour JA (2014) Pasting properties of blends of potato, rice and maize starches. Food Hydrocoll 41:298–308

[17]. Giuberti G, Rocchetti G, Sigolo S, Fortunati P, Lucini L, Gallo A (2018) Exploitation of alfalfa seed (*Medicago sativa* L.) flour into gluten-free rice cookies: nutritional, antioxidant and quality characteristics. Food Chem 239:679–687

[18]. Liu S, Alavi S, Abu Ghoush M (2011) Extruded Moringa leaf-oat flour snacks: physical, nutritional, and sensory properties. Int J Food Prop 14:854–869

DOI: 10.48175/568