Bangladesh Journal of Food and Nutrition
A Journal of the Bangladesh Research Society of Nutrition

eISSN: 3078-6789 Volume-1, Issue-2

Original Research Article DOI: https://doi.org/10.70945/bjfn.2024.v01i02.09

A Study on Biochemical Properties and Nutritional Screening of *Moringa oleifera* Seed Oil from Farmed and Wild Provenance of Bangladesh

Joytun Nahar[1], Meherunnahar[2], Md Habibur Rahman[3], Md Rakibul Islam[4], Shammy Akter[5]*

[1] Department of Applied Nutrition and Food Technology, Islamic University, Kushtia, Bangladesh

Abstract: ***Background****: Moringa oleifera* seed oil, renowned for its nutritional and medicinal properties, is a potential alternative for edible oils due to its high oleic acid content and bioactive compounds. ***Objective****:* This study aims to investigate the biochemical properties, nutritional composition, and antioxidant activity of *Moringa oleifera* seed oil from farmed and wild provenances in Bangladesh. ***Method****: Moringa oleifera* seeds from farmed and wild sources were collected, dried, and processed. Oil extraction was performed using a Soxhlet apparatus with hexane as the solvent. Nutritional composition, fatty acid profile, antioxidant activity, and biochemical parameters were analyzed using standard methods. ***Results****:* The oil yield from wild *Moringa* seeds was 35.6%, while farmed seeds yielded 30.8%. The wild seed oil exhibited a higher oleic acid content (73.22%) compared to farmed seed oil (65.00%). The tocopherol content was higher in farmed oil (140.5 mg/kg) than in wild oil (128.7 mg/kg). Antioxidant activity measured through the total phenolic content was 160.00 µg/g for farmed oil and 145.00 µg/g for wild oil. The saponification value was 183.20 mg KOH/g for farmed oil and 181.4 mg KOH/g for wild oil, indicating high stability. ***Conclusions****: Moringa oleifera* seed oil from both farmed and wild provenances shows excellent potential as a commercial edible oil source due to its high nutritional value and stability.

Keywords: *Moringa oleifera*, seed oil, nutritional composition, antioxidant activity.

Significance: This study highlights the potential of Moringa oleifera seed oil as a sustainable, high-nutrient alternative for commercial use.

OPEN ACCESS

Citation:
Joytun Nahar, Meherunnahar, Md Habibur Rahman, Md Rakibul Islam, Shammy Akter (2024). A Study on Biochemical Properties and Nutritional Screening of *Moringa oleifera* Seed Oil from Farmed and Wild Provenance of Bangladesh. *Bangl J Food Nutr*, 1(2), 66-75.

Received: 14/08/2024
Accepted: 16/09/2024
Published: 29/11/2024

INTRODUCTION

Moringa oleifera, often referred to as the "miracle tree" due to its versatile applications and significant nutritional and medicinal properties, has been utilized for centuries across different cultures, particularly in Africa, Asia, and Latin America [1]. Originally native to the foothills of the Himalayas in northwestern India, *Moringa oleifera* has been successfully cultivated in various tropical and subtropical climates, adapting to a range of environmental conditions from arid to semi-arid regions. The plant has gained considerable global attention for its leaves, pods, seeds, and oil, all of which offer significant nutritional benefits. Among its many components, the seeds are particularly valuable due to their high oil content and favorable fatty acid composition, making *Moringa oleifera* seed oil a promising source of both edible and non-edible oil [2]. The seeds of *Moringa oleifera* are known to contain between 30% and 40% oil, which

is characterized by a high concentration of monounsaturated fatty acids (MUFAs), especially oleic acid [3]. Oleic acid, which constitutes approximately 70% of the oil, is a well-established component of heart-healthy diets. Research has consistently demonstrated that oils rich in oleic acid, such as olive oil, help reduce the risk of cardiovascular diseases by improving lipid profiles and reducing inflammation [4]. Furthermore, the oil is rich in bioactive compounds such as tocopherols (vitamin E) and phytosterols, which provide antioxidant benefits and enhance the oil's stability against oxidative degradation. In many developing countries, including Bangladesh, the demand for edible oils far exceeds domestic production, leading to high reliance on imports [5]. Bangladesh, with its tropical climate and agricultural economy, presents an ideal environment for the cultivation of *Moringa oleifera*. However, despite the plant's adaptability and the growing global interest in its products, the potential for commercial *Moringa oleifera* seed oil production in Bangladesh has not been fully explored. This represents a significant opportunity, as *Moringa oleifera* oil not only has the potential to reduce the country's dependence on imported oils but also offers a sustainable agricultural practice that could improve the livelihoods of farmers by introducing a high-value crop [6].

Several studies have highlighted the nutritional and biochemical properties of *Moringa oleifera* oil, emphasizing its potential in the food industry. The oil's high monounsaturated fat content makes it ideal for cooking, particularly for frying, as it demonstrates excellent thermal stability and resistance to oxidative rancidity [7]. Moreover, its composition of bioactive compounds such as sterols and tocopherols contribute to its functional food status. Sterols, particularly β-sitosterol, are known for their cholesterol-lowering effects, making *Moringa oleifera* oil beneficial for heart health [8]. Additionally, tocopherols serve as powerful antioxidants that protect the oil from oxidative stress, thereby increasing its shelf life and making it a viable option for commercial food processing. Given its biochemical profile, *Moringa oleifera* seed oil has not only attracted interest for its use in the food industry but also for its potential in cosmetics and pharmaceuticals. The oil's emollient properties make it a valuable ingredient in skincare products, where it is used for moisturizing and skin repair [9]. Ancient Egyptians were among the first to recognize the cosmetic value of *Moringa oleifera* oil, using it in preparations for skin and hair care [10]. This historical use continues to be relevant today as the global market for natural and organic cosmetics grows, with *Moringa oleifera* oil positioned as a premium ingredient due to its natural moisturizing properties and its rich antioxidant content, which combats skin aging and damage caused by environmental factors. Despite these promising features, there remains a significant gap in research, particularly concerning the differences in the nutritional and biochemical properties of *Moringa oleifera* seed oil sourced from different provenances. Environmental factors such as soil quality, climate, and agricultural practices can significantly impact the yield and composition of the oil. For instance, wild-sourced *Moringa oleifera* seeds may offer a different fatty acid profile and antioxidant content compared to farmed seeds, potentially making wild seeds a superior source for certain applications [11]. This variability presents a unique opportunity for researchers to explore how cultivation practices and provenance affect the quality and yield of *Moringa oleifera* seed oil, which could have significant implications for optimizing oil production for commercial use.

Bangladesh, with its diverse agro-climatic zones, offers an ideal case study for examining these variations. The wild-growing *Moringa oleifera* trees found in different regions of Bangladesh may exhibit differences in oil yield and quality compared to farmed trees due to natural adaptation to local environmental conditions. Understanding these differences could help establish best practices for cultivating *Moringa oleifera* on a larger, commercial scale, enabling farmers to optimize oil production while maintaining the plant's nutritional and biochemical integrity [12]. This study aims to investigate the biochemical properties and nutritional composition of *Moringa oleifera* seed oil from both farmed and wild provenances in Bangladesh. By comparing the oil extracted from these different sources, the research seeks to identify key differences in oil quality and composition, particularly in terms of fatty acid profiles, tocopherol and sterol content, and antioxidant activity. Furthermore, the study aims to assess the potential of *Moringa oleifera* seed oil for

commercial production in Bangladesh, exploring its viability as a high-value agricultural product that could benefit both local communities and the national economy. Ultimately, this research hopes to inspire further studies into the commercial applications of *Moringa oleifera* oil, promoting its use as a sustainable, health-promoting alternative to conventional vegetable oils.

Aims and Objective

The aim of this study is to analyze the biochemical properties, nutritional composition, and antioxidant activity of Moringa oleifera seed oil from both farmed and wild provenances in Bangladesh. The study seeks to compare these sources and determine the oil's potential for commercial production and broader applications in various industries.

MATERIALS AND METHODS

Study Design

This study was designed as a comparative analysis of the biochemical properties, nutritional composition, and antioxidant activity of *Moringa oleifera* seed oil from both farmed and wild provenances in Bangladesh. The seeds were collected from three different regions and processed under the same controlled laboratory conditions. Standardized methods were used for oil extraction and analysis, including Soxhlet extraction, proximate composition testing, and biochemical property assessments to ensure consistency and reliability across all measurements.

Inclusion Criteria

The inclusion criteria for this study focused on mature *Moringa oleifera* seeds from both farmed and wild trees in Bangladesh. Seeds were selected based on their maturity, determined by visual inspection, and harvested only from healthy trees that had undergone no chemical treatments. Both farmed seeds from agricultural fields and wild seeds from uncultivated areas were included to provide a comprehensive comparison of oil properties across different provenances within the country.

Exclusion Criteria

Seeds that were immature, damaged, or affected by pests were excluded from this study to ensure the integrity of the oil analysis. Additionally, any *Moringa oleifera* seeds from trees that had been exposed to chemical fertilizers or pesticides were omitted, as these treatments could alter the natural biochemical composition of the oil. Seeds that were collected outside the specified regions or not dried within the standard timeframe were also excluded to maintain consistency in the study design.

Plant Material Collection

Moringa oleifera seeds were collected from two sources: farmed seeds from Kushtia, located in the southwestern region of Bangladesh, and wild seeds from mature fruits harvested from three distinct locations across Bangladesh. All seeds were air-dried at room temperature (25°C) for one week to reduce moisture content before processing.

Pre-treatment of Seeds

The collected seeds were cleaned by removing impurities such as chaffs and debris. After thorough cleaning, the seeds were dried in an electric oven at 60°C to further reduce moisture content, enhancing oil extraction efficiency. The dried seeds were then milled into a fine paste using a thermal Willey mill, which breaks the seed's cell walls, enabling better interaction with the extraction solvent.

Oil Extraction Procedure

The oil was extracted using the Soxhlet apparatus. 10.0g of the milled seed paste was placed on a filter paper, folded, and inserted into the extraction chamber. 200ml of hexane was used as the solvent, which was added to a 500ml round-bottom flask. The extraction process was carried out by heating the solvent at 60°C for 5 hours, allowing the hexane to circulate and extract the oil from the seeds. The hexane was later evaporated, leaving behind the extracted oil.

Nutritional Composition Analysis

The proximate composition of the oil, including moisture, crude protein, crude fat, crude fiber, and ash content, was determined using standard methods of analysis. The total carbohydrate content was estimated by subtracting the sum of moisture, fat, protein, and ash from 100.

Biochemical Properties

The biochemical parameters of the extracted oil, such as iodine value, saponification value, refractive index, and unsaponifiable matter, were analyzed according to standard procedures. The acidity was determined as oleic acid percentage, while peroxide and p-anisidine values were assessed to determine the oxidative stability of the oil.

Antioxidant Activity

The total phenolic content was measured to evaluate the antioxidant activity of the oil. Additionally, tocopherol (α, γ, and δ) content was quantified using high-performance liquid chromatography (HPLC).

Fatty Acid Composition

The fatty acid profile of the oil was analyzed using gas chromatography (GC), which provided detailed information about the concentration of oleic, palmitic, stearic, and linoleic acids, among others.

Data Analysis

All analyses were performed in triplicate, and the results were expressed as means ± standard deviation. The statistical significance of differences between farmed and wild oil samples was determined using analysis of variance (ANOVA).

Ethical Considerations

This study adhered to ethical guidelines for environmental conservation and sustainable harvesting. Moringa seeds were collected without causing harm to the environment or depleting natural resources. No endangered or protected species were involved in the research, and all harvesting was done in compliance with local regulations. Ethical approval was not required, as the research involved non-animal, plant-based samples. The study also ensured transparency in data collection, analysis, and reporting to maintain scientific integrity and objectivity.

RESULTS

The results of this study present the biochemical properties, nutritional composition, and antioxidant activity of *Moringa oleifera* seed oil from both farmed and wild provenances in Bangladesh. The data were analyzed to compare the oil yield, nutritional content, and antioxidant levels between the two sources.

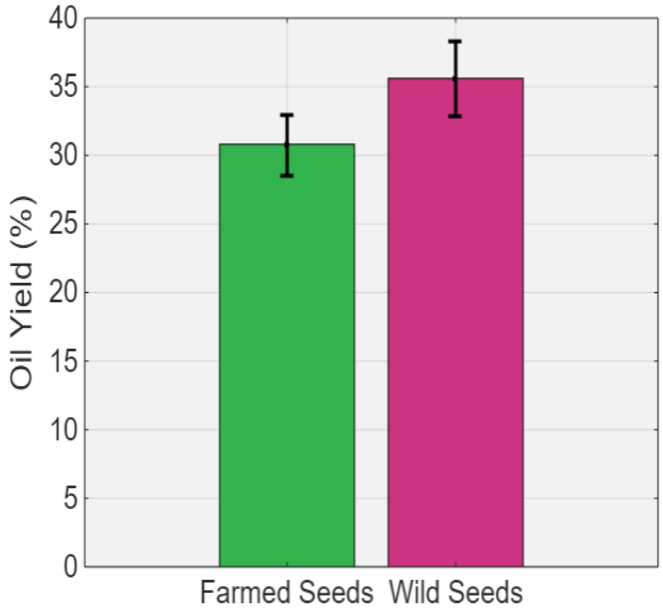

Figure 1: Oil Yield from *Moringa oleifera* Seeds

The oil yield from wild Moringa oleifera seeds (35.6%) was notably higher than from farmed seeds (30.8%). This suggests that wild seeds may offer more oil extraction potential, possibly due to environmental factors or genetic variation.

Table 1: Proximate Composition of *Moringa oleifera* Seed Oil

Composition	Farmed Seeds (%)	Wild Seeds (%)
Moisture	7.9 ± 1.00	7.5 ± 1.10
Crude Protein	38.3 ± 1.03	37.5 ± 1.20
Crude Fat	30.8 ± 2.19	35.6 ± 2.45
Crude Fiber	4.5 ± 0.38	5.2 ± 0.50
Ash	6.5 ± 0.15	6.8 ± 0.20

The proximate composition of Moringa oleifera seed oil shows that wild seeds had higher crude fat (35.6%) and crude fiber (5.2%) compared to farmed seeds (30.8% and 4.5%, respectively). Moisture, crude protein, and ash content were similar between both sources, with minor variations observed.

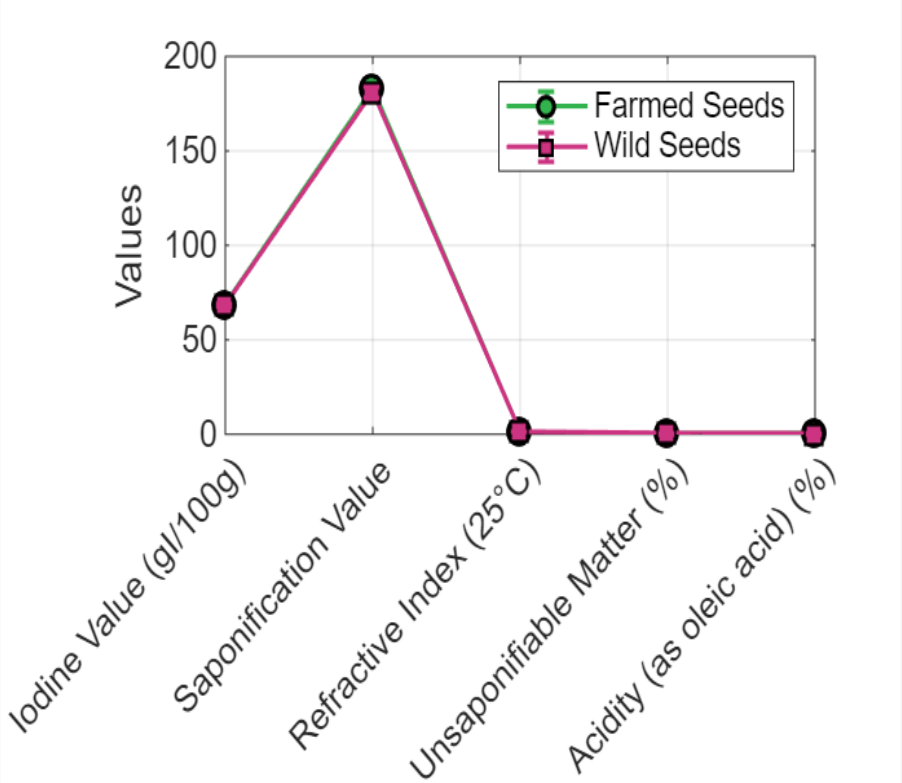

Figure 2: Biochemical Properties of *Moringa oleifera* Seed Oil

The biochemical properties of Moringa oleifera seed oil from both farmed and wild sources were largely similar. However, farmed seed oil exhibited slightly higher acidity (0.81%) compared to wild seed oil (0.60%). This difference could affect the oil's oxidative stability and shelf life.

Table 2: Tocopherol Content of *Moringa oleifera* Seed Oil

Tocopherol Type	Farmed Seeds (mg/kg)	Wild Seeds (mg/kg)
α-Tocopherol	140.5 ± 5.30	128.7 ± 4.90
γ-Tocopherol	63.18 ± 3.50	60.10 ± 3.20
δ-Tocopherol	61.70 ± 2.90	59.45 ± 2.75

The tocopherol analysis shows that farmed Moringa oleifera seed oil had higher levels of all tocopherol types, especially α-tocopherol (140.5 mg/kg), compared to wild seed oil (128.7 mg/kg). This suggests that farmed oil may offer better antioxidant protection, enhancing its stability and potential health benefits.

Table 3: Fatty Acid Composition of *Moringa oleifera* Seed Oil

Fatty Acid	Farmed Seeds (%)	Wild Seeds (%)
Oleic Acid	65.00 ± 1.50	73.22 ± 1.70
Palmitic Acid	12.31 ± 0.90	6.45 ± 0.60
Linoleic Acid	16.00 ± 1.20	10.80 ± 1.10
Stearic Acid	5.10 ± 0.40	5.50 ± 0.55
Palmitoleic Acid	2.10 ± 0.35	1.60 ± 0.30

The fatty acid composition analysis reveals that wild Moringa oleifera seed oil contains a higher proportion of oleic acid (73.22%) compared to farmed oil (65.00%), making it more desirable for heart-healthy applications. Farmed oil, however, shows higher levels of palmitic acid (12.31%) and linoleic acid (16.00%), indicating differences in the fatty acid profiles between the two sources. Both oils have similar stearic and palmitoleic acid content.

Table 4: Antioxidant Activity of *Moringa oleifera* Seed Oil

Provenance	Total Phenolic Content (µg/g)
Farmed Seeds	160.00 ± 5.40
Wild Seeds	145.00 ± 4.90

The total phenolic content analysis shows that farmed Moringa oleifera seed oil had a higher phenolic content (160.00 µg/g) compared to wild seed oil (145.00 µg/g). This suggests that farmed oil possesses stronger antioxidant activity, which could enhance its shelf life and health-promoting properties.

DISCUSSION

The results of this study reveal a detailed comparison of the biochemical properties, nutritional composition, and antioxidant activity of *Moringa oleifera* seed oil from farmed and wild provenances in Bangladesh [13,14]. The findings underscore the potential of *Moringa oleifera* seed oil as a valuable resource for both edible and non-edible applications, particularly within the contexts of the food, cosmetic, and pharmaceutical industries. In this section, we will discuss the significance of the results, compare them with existing literature, and explore their broader implications for the commercial viability of *Moringa oleifera* seed oil.

Oil Yield

One of the most critical parameters for evaluating the economic viability of *Moringa oleifera* seed oil production is the oil yield. In this study, the oil yield from wild seeds was found to be 35.6%, while farmed seeds yielded 30.8%. This difference in oil yield is notable, as it suggests that wild *Moringa oleifera* seeds may have a higher potential for oil extraction. The variation in oil yield can be attributed to several factors, including environmental conditions, soil quality, and the genetic diversity of the trees. Studies have shown that environmental stress can increase oil yield in wild plants, potentially due to the plant's adaptation mechanisms to survive in harsher conditions [15]. The results of this study align with previous findings that indicate variability in oil yield depending on the source of the seeds [16]. The higher oil yield from wild seeds presents an opportunity for further research into the cultivation of wild varieties, as they could provide a more efficient source of oil for commercial purposes.

Proximate Composition

The proximate composition of *Moringa oleifera* seed oil includes moisture, crude protein, crude fat, crude fiber, and ash content. In this study, wild *Moringa oleifera* seed oil exhibited slightly higher crude fat (35.6%) compared to farmed seed oil (30.8%), which correlates with the higher oil yield from wild seeds. Crude fat is an essential parameter for determining the caloric content and overall energy value of the oil, making the wild seeds more attractive from a nutritional standpoint. The moisture content in both farmed and wild seed oils was comparable (7.9% and 7.5%, respectively), which is important for the shelf life and storage stability of the oil, as lower moisture content

generally correlates with longer shelf life [17]. The crude protein content was slightly higher in farmed seed oil (38.3%) than in wild seed oil (37.5%), although the difference is not statistically significant. Protein content in oils is a measure of the residual proteins after oil extraction, and while it is not a primary indicator of oil quality, it provides insight into the nutritional profile of the seed itself. Crude fiber and ash content were also similar between the two sources, with wild seeds showing slightly higher crude fiber (5.2%) and ash content (6.8%) compared to farmed seeds. These results are consistent with previous studies on *Moringa oleifera* seed oil, which have reported similar proximate compositions across different provenances [18].

Biochemical Properties

The biochemical properties of *Moringa oleifera* seed oil, such as iodine value, saponification value, refractive index, and unsaponifiable matter, provide crucial information about the oil's suitability for different applications, including food, cosmetics, and pharmaceuticals. In this study, the iodine value, which measures the degree of unsaturation in the oil, was slightly higher in farmed seed oil (69.01 gI/100g) compared to wild seed oil (68.63 gI/100g). This suggests that both oils are rich in unsaturated fatty acids, particularly oleic acid, making them suitable for use in heart-healthy diets [19]. The iodine values reported in this study are comparable to those found in olive oil, which is known for its high content of monounsaturated fats and health benefits [20]. The saponification value, which indicates the average molecular weight of fatty acids in the oil, was slightly higher in farmed seed oil (183.20 mg KOH/g) than in wild seed oil (181.40 mg KOH/g). This suggests that the fatty acids in farmed seed oil are slightly shorter in chain length compared to those in wild seed oil. The refractive index, a measure of the oil's light-bending properties and a key indicator of its purity, was nearly identical in both farmed and wild seed oils (1.4570 and 1.4571, respectively). These values fall within the typical range for edible oils, indicating that both oils have similar purity and consistency. The unsaponifiable matter, which includes sterols, tocopherols, and other bioactive compounds, was also comparable between farmed (0.72%) and wild (0.74%) seed oils, highlighting the presence of valuable bioactive components that contribute to the oil's health benefits and stability.

Acidity, measured as the percentage of oleic acid, is a critical parameter for determining the oil's edibility and shelf life. Lower acidity levels are preferred for edible applications, as they indicate fewer free fatty acids, which can degrade and produce off-flavors. In this study, the acidity of wild seed oil (0.60%) was lower than that of farmed seed oil (0.81%), making wild oil more suitable for edible applications. These results suggest that wild *Moringa oleifera* oil may have a longer shelf life and better oxidative stability compared to farmed oil.

Tocopherol Content

Tocopherols, particularly α-tocopherol (vitamin E), play a crucial role in the antioxidant activity of vegetable oils. In this study, farmed *Moringa oleifera* seed oil exhibited higher levels of α-tocopherol (140.5 mg/kg) compared to wild seed oil (128.7 mg/kg). Tocopherols not only contribute to the nutritional value of the oil but also enhance its oxidative stability, making it more resistant to rancidity during storage and cooking [21]. The higher tocopherol content in farmed seed oil may be attributed to the controlled agricultural conditions under which the plants were grown, as environmental factors can influence the accumulation of tocopherols in plant tissues. Although wild seed oil had slightly lower tocopherol content, it still contained significant amounts of γ-tocopherol (60.10 mg/kg) and δ-tocopherol (59.45 mg/kg), both of which contribute to the overall antioxidant activity of the oil. The tocopherol content in both farmed and wild seed oils is comparable to other high-quality vegetable oils, such as sunflower and soybean oil, making *Moringa oleifera* oil a viable option for consumers seeking health-promoting oils with strong antioxidant properties [22].

Fatty Acid Composition

The fatty acid composition of *Moringa oleifera* seed oil is one of its most defining characteristics, particularly its high oleic acid content. In this study, wild seed oil had a higher oleic acid content (73.22%) compared to farmed seed oil (65.00%). This places wild *Moringa oleifera* oil in the category of high-oleic oils, which are known for their health benefits, particularly in

reducing the risk of cardiovascular diseases [23]. The high oleic acid content also makes the oil more stable during cooking, especially in high-temperature applications such as deep-frying, as oleic acid is less prone to oxidation compared to polyunsaturated fatty acids. In addition to oleic acid, the fatty acid profile of *Moringa oleifera* seed oil includes palmitic acid, stearic acid, and linoleic acid. Palmitic acid, a saturated fatty acid, was found in higher concentrations in farmed seed oil (12.31%) compared to wild seed oil (6.45%). While saturated fats have been linked to negative health effects when consumed in excess, the overall fatty acid composition of *Moringa oleifera* oil, with its high proportion of monounsaturated fats, still makes it a healthier option compared to oils rich in saturated fats. Linoleic acid, a polyunsaturated fatty acid, was also present in both farmed (16.00%) and wild (10.80%) seed oils. Linoleic acid is an essential fatty acid that the human body cannot synthesize, making it an important component of the diet. However, oils with high oleic acid content and moderate linoleic acid content, like *Moringa oleifera* oil, are preferred for cooking due to their balance of health benefits and oxidative stability [24]. The presence of stearic acid, a saturated fat that has been shown to have a neutral impact on blood cholesterol levels, further enhances the health profile of *Moringa oleifera* seed oil.

Antioxidant Activity

The antioxidant activity of *Moringa oleifera* seed oil was assessed through the total phenolic content, which is a measure of the oil's ability to neutralize free radicals and prevent oxidative damage. Farmed seed oil exhibited higher total phenolic content (160.00 µg/g) compared to wild seed oil (145.00 µg/g). Phenolic compounds are well-known for their antioxidant properties, and higher levels of these compounds are associated with increased protection against oxidative stress, which can lead to chronic diseases such as cancer and heart disease [25]. The higher phenolic content in farmed seed oil may be a result of controlled growing conditions, which can enhance the accumulation of bioactive compounds in plants. Despite the slightly lower antioxidant activity in wild seed oil, it still exhibited significant levels of phenolic compounds, making it a valuable source of antioxidants. The combination of tocopherols and phenolic compounds in *Moringa oleifera* oil contributes to its overall stability and health benefits, positioning it as a functional food ingredient with potential applications in both the food and pharmaceutical industries.

Commercial Implications

The results of this study suggest that *Moringa oleifera* seed oil, from both farmed and wild provenances, has significant potential for commercial production in Bangladesh. The higher oil yield and oleic acid content of wild seed oil make it an attractive option for the edible oil industry, particularly in the production of high-oleic oils, which are gaining popularity due to their health benefits and stability during cooking. The high tocopherol and phenolic content in farmed seed oil also positions it as a premium oil for both edible and cosmetic applications, where antioxidant properties are highly valued. The slight differences in nutritional composition, biochemical properties, and antioxidant activity between farmed and wild seed oils highlight the importance of provenance in determining the quality of *Moringa oleifera* oil. Further research into optimizing cultivation practices, particularly for wild varieties, could enhance oil yield and quality, making *Moringa oleifera* a sustainable and economically viable crop for Bangladesh. Given the global demand for functional foods and natural ingredients, *Moringa oleifera* oil has the potential to become a significant export product for the country, contributing to both economic development and public health.

In this study demonstrates that *Moringa oleifera* seed oil, from both farmed and wild sources, exhibits excellent nutritional and biochemical properties, making it a valuable resource for various industries. Wild *Moringa oleifera* seed oil, with its higher oleic acid content and lower acidity, is particularly suited for edible applications, while farmed seed oil, with its higher tocopherol and phenolic content, offers enhanced antioxidant activity for both food and cosmetic uses. The results highlight the potential for commercial production of *Moringa oleifera* oil in Bangladesh, paving the way for further research and development in this promising field.

CONCLUSION

This study demonstrated that *Moringa oleifera* seed oil from both farmed and wild sources

has excellent nutritional and biochemical properties, making it a valuable resource for edible and non-edible applications. The high oleic acid content and antioxidant activity highlight its potential for health benefits, commercial viability, and sustainability in Bangladesh.

Recommendations

Promote commercial cultivation of wild *Moringa oleifera* varieties for higher oil yield.

Further research on optimizing oil extraction techniques for enhanced quality.

Explore large-scale applications in the food, cosmetic, and pharmaceutical industries.

Acknowledgment

We would like to express our gratitude to the Department of Applied Nutrition and Food Technology, Faculty of Biological Science, Islamic University, Kushtia, Bangladesh, for providing the necessary facilities and support for conducting this study. Special thanks to the local farmers and community members in Kushtia for their cooperation in collecting farmed and wild *Moringa oleifera* seeds. We also appreciate the assistance of the laboratory team for their valuable contributions in the oil extraction and analysis process.

Funding: No funding sources

Conflict of interest: None declared

REFERENCES

1. Junior, A., Sanon, P. J., & Lordé, D. (2020). Phenotypic Diversity of Haitian Benzolive (Moringa oleifera Lam.). *Plantae Scientia*, *3*(1), 1-6.
2. Faisal, M. I., Iqbal, S., Basra, S. M. A., Afzal, I., Saddiq, M. S., Bakhtavar, M. A., ... & Habib-ur-Rahman, M. (2020). Moringa landraces of Pakistan are potential source of premium quality oil. *South African Journal of Botany*, *129*, 397-403.
3. Gharsallah, K., Rezig, L., Msaada, K., Chalh, A., & Soltani, T. (2021). Chemical composition and profile characterization of Moringa oleifera seed oil. *South African Journal of Botany*, *137*, 475-482.
4. Bazal, P., Gea, A., de la Fuente-Arrillaga, C., Barrio-López, M. T., Martinez-González, M. A., & Ruiz-Canela, M. (2019). Olive oil intake and risk of atrial fibrillation in the SUN cohort. *Nutrition, Metabolism and Cardiovascular Diseases*, *29*(5), 450-457.
5. Chowdhury, M. S., Rahman, M. M., Hossain, H., Ghosh, P., Islam, M. R., Lamichhane, B., ... & El Zowalaty, M. (2024). Subclinical Mastitis of Buffaloes in Asia: Prevalence, Pathogenesis, Risk Factors, Antimicro-bial resistance, and Current Treatment Strategies. *Journal of Animal Science and Technology*.
6. Rahman, S., & Masud-All-Kamal, M. Social Transformation in Bangladesh.
7. Iranloye, Y. M., Omololu, F. O., Olaniran, A. F., & Abioye, V. F. (2021). Assessment of potentials of Moringa oleifera seed oil in enhancing the frying quality of soybean oil. *Open Agriculture*, *6*(1), 771-778.
8. Barkas, F., Bathrellou, E., Nomikos, T., Panagiotakos, D., Liberopoulos, E., & Kontogianni, M. D. (2023). Plant sterols and plant stanols in cholesterol management and cardiovascular prevention. *Nutrients*, *15*(13), 2845.
9. Mashamaite, C. V., Albien, A. J., Mothapo, P. N., Pieterse, P. J., & Phiri, E. E. (2023). Local knowledge, perceptions, and uses of the potentially conflict-generating plant species, Moringa oleifera Lam.: a case study in Limpopo Province, South Africa. *Human Ecology*, *51*(5), 979-994.
10. Owon, M., Osman, M., Ibrahim, A., Salama, M. A., & Matthäus, B. (2021). Characterisation of different parts from Moringa oleifera regarding protein, lipid composition and extractable phenolic compounds. *OCL*, *28*, 45.
11. Özcan, M. M. (2020). Moringa spp: Composition and bioactive properties. *South African Journal of Botany*, *129*, 25-31.
12. Shampa, M. T. A., Shimu, N. J., Chowdhury, K. A., Islam, M. M., & Ahmed, M. K. (2023). A comprehensive review on sustainable coastal zone management in Bangladesh: Present status and the way forward. *Heliyon*.
13. Islam, M. A., Sheikh, A., Waterman, C., & Hosenuzzaman, M. D. (2020). Morphology, pod yield and nutritional quality of two cultivars of Moringa (Moringa oleifera) in Bangladesh. *Indian Journal of Science and Technology*, *13*(36), 3725-35.

14. Rahman, M. H., Rahman, S. S., & Akter, S. (2024). Enhancing Nutritional Security in Bangladesh: Innovations and Challenges. *Bangladesh Journal of Food and Nutrition*, *1*(1), 01-03.
15. Bassey, K., Mabowe, M., Mothibe, M., & Witika, B. A. (2022). Chemical characterization and nutritional markers of South African Moringa oleifera seed oils. *Molecules*, *27*(18), 5749.
16. Khan, S. (2020). Comparative analysis of the nutritional components of different parts of Moringa oleifera from Karachi, Pakistan. *Pakistan Journal of Science*, *72*(4).
17. Dzuvor, C. K., Pan, S., Amanze, C., Amuzu, P., Asakiya, C., & Kubi, F. (2022). Bioactive components from Moringa oleifera seeds: production, functionalities and applications–a critical review. *Critical Reviews in Biotechnology*, *42*(2), 271-293.
18. Silva, L. M. P., Inácio, M. R. C., Silva, G. G. C. D., Silva, J. M. D. S. E., Luz, J. R. D. D., Almeida, M. D. G., ... & Zucolotto, S. M. (2022). The first optimization process from cultivation to flavonoid-rich extract from Moringa oleifera Lam. leaves in Brazil. *Foods*, *11*(10), 1452.
19. Friday, O. A., & Eke, M. O. (2024). Inclusive diet of Balanites aegyptiaca Del defatted protein meal and protein concentrate on organ weight and diabetic conditioned Liver of Wister Albino rat. *Bangladesh Journal of Food and Nutrition*, *1*(1), 13-25.
20. Keller, A., O'Reilly, E. J., Malik, V., Buring, J. E., Andersen, I., Steffen, L., ... & Heitmann, B. L. (2020). Substitution of sugar-sweetened beverages for other beverages and the risk of developing coronary heart disease: results from the Harvard Pooling Project of Diet and Coronary Disease. *Preventive medicine*, *131*, 105970.
21. Rocchetti, G., Pagnossa, J. P., Blasi, F., Cossignani, L., Piccoli, R. H., Zengin, G., ... & Lucini, L. (2020). Phenolic profiling and in vitro bioactivity of Moringa oleifera leaves as affected by different extraction solvents. *Food Research International*, *127*, 108712.
22. Shahidi, F., Ramakrishnan, V. V., & Oh, W. Y. (2019). Bioavailability and metabolism of food bioactives and their health effects: A review. *Journal of Food Bioactives*, *8*.
23. Griffin, B. A., Mensink, R. P., & Lovegrove, J. A. (2021). Does variation in serum LDL-cholesterol response to dietary fatty acids help explain the controversy over fat quality and cardiovascular disease risk?. *Atherosclerosis*, *328*, 108-113.
24. Yanagisawa, R., He, C., Asai, A., Hellwig, M., Henle, T., & Toda, M. (2022). The impacts of cholesterol, oxysterols, and cholesterol lowering dietary compounds on the immune system. *International Journal of Molecular Sciences*, *23*(20), 12236.
25. Mensah, M. A. (2023). Polyphenols and Flavonoids Containing Food Spices. In *Analysis of Food Spices* (pp. 69-105). CRC Press.

Corresponding Author: Dr. Shammy Akter, PhD
Assistant Professor, Department of Applied Nutrition and Food Technology, Islamic University, Kushtia, Bangladesh
E-mail: shammyiu@yahoo.com