



Phytochemical Constituents and Mineral Composition of *Moringa oleifera* leaves In Batagarawa, Katsina State.

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Abstract

The study was undertaken to determine the phytochemical constituent and mineral composition of *Moringa* leaves ranging from Phytochemical analysis and mineral content. The phytochemical constituents and mineral composition analysis was carried out using standard procedures. The phytochemical analysis revealed the presence of alkaloids, Glycoside, Flavonoids, Tannins, Saponins, Phenols, Glycosides in *Moringa* leaves. The result revealed that the *Moringa* leaves were high in Alkaloid (2.45 ± 0.12), Flavonoids (5.80 ± 0.25), Tannin (3.10 ± 0.18), Saponin (4.25 ± 0.20), Phenol (6.15 ± 0.30) and Glycoside (2.75 ± 0.15). The result revealed that, the mineral analysis showed that *Moringa* leaves are rich in essential nutrients such as calcium, potassium, magnesium, phosphorus, and iron, with relatively lower amounts of sodium and zinc.

Keywords: Phytochemical, Minerals, Composition, *Moringa*

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Introduction

Moringa oleifera is widely recognized as a multipurpose plant with significant nutritional and medicinal value, especially in many parts of Nigeria where it is cultivated and consumed as a vegetable and herbal remedy (Akanegbe 2024). Its importance has attracted increasing scientific attention in relation to its phytochemical constituents and mineral composition, which are essential in determining its therapeutic and nutritional potentials. The plant contains a wide range of bioactive compounds such as flavonoids, alkaloids, tannins, and saponins, alongside essential minerals like calcium, potassium, iron, and magnesium that contribute to human health and disease prevention (Abdulummin, 2025). The presence of these compounds has been confirmed in different parts of Nigeria, showing variations based on ecological conditions and processing methods (Saidu 2022). In northern Nigeria, particularly in areas such as Katsina State where Batagarawa

Local Government is located, *Moringa* is commonly grown and utilized, yet there is still limited localized data on its detailed phytochemical and mineral profile. This creates a gap in understanding the specific composition of *Moringa* within this locality, thereby necessitating focused scientific investigation to support its optimal utilization (Arowosegbe 2021).

Furthermore, the phytochemical composition of *Moringa* plays a crucial role in its medicinal efficacy, as these compounds are responsible for its antioxidant, antimicrobial, and anti-inflammatory properties. These phytochemicals function synergistically with nutrients to enhance biological activities in the human body, contributing to disease prevention and overall health improvement. The variability in phytochemical content due to environmental factors, soil composition, and climatic conditions highlights the importance of location-specific studies. In regions like Batagarawa, where agricultural

practices and environmental conditions differ from southern Nigeria, the phytochemical profile of *Moringa* may present unique characteristics that are yet to fully document. This underscores the need to assess these compounds within the local context to validate its medicinal claims and ensure its safe and effective use (Haladu 2023).

Additionally, the mineral composition of *Moringa* is fundamental to its role as a dietary supplement, particularly in addressing micronutrient deficiencies prevalent in many Nigerian communities. Minerals such as calcium, iron, potassium, and phosphorus found in *Moringa* leaves contribute significantly to bone development, blood formation, and metabolic processes. Empirical findings have demonstrated that *Moringa* leaves possess high concentrations of these minerals, making them a valuable nutritional resource. However, the mineral content can vary depending on factors such as soil fertility, agricultural practices, and post-harvest processing techniques. In Batagarawa Local Government, where subsistence farming is predominant, understanding the mineral composition of locally grown *Moringa* is essential for promoting its use in combating malnutrition and improving public health outcomes (Agubosi, 2024).

Moreover, processing methods such as drying, boiling, and storage significantly influence the phytochemical and mineral composition of *Moringa* leaves. Studies have shown that different processing techniques can either enhance or reduce the concentration of these bioactive compounds and nutrients, thereby affecting their nutritional quality and medicinal value. In many rural communities, including Batagarawa, traditional processing methods are commonly employed without standardized procedures, which may lead to nutrient loss or alteration of phytochemical properties. Understanding how these methods influence the composition of *Moringa* is essential for developing best practices that preserve its nutritional and therapeutic benefits (Saidu, 2022).

In addition, the growing recognition of *Moringa* as a functional food and nutraceutical has increased the demand for scientific

validation of its health benefits, particularly in relation to its phytochemical richness and mineral density. Its role in enhancing food security, improving nutrition, and providing alternative medicinal solutions has made it a subject of interest among researchers and policymakers. Despite this growing interest, there remains a lack of comprehensive studies focusing on specific localities such as Batagarawa Local Government, where environmental and socio-economic factors may influence the quality and composition of *Moringa*. Conducting a detailed phytochemical and mineral analysis in this area will provide valuable data that can support agricultural development, nutritional interventions, and health promotion initiatives. This study is therefore essential in bridging the existing knowledge gap and contributing to the broader understanding of *Moringa*'s potential in Nigeria (Abdulummin 2025).

Despite the widespread cultivation and utilization of *Moringa oleifera* in many parts of Nigeria, there is still inadequate scientific information on its detailed phytochemical and mineral composition, particularly at the local level. While several studies have established the general nutritional and medicinal value of *Moringa*, most of these studies are not location-specific and may not accurately reflect the composition of *Moringa* grown in specific areas such as Batagarawa Local Government Area of Katsina State. Environmental factors such as soil type, climate, and agricultural practices are known to influence the concentration of phytochemicals and minerals in plants, thereby creating possible variations in their nutritional and therapeutic potentials. The absence of localized data therefore creates uncertainty about the actual quality and effectiveness of *Moringa* consumed in this area.

In addition, *Moringa* is increasingly being promoted as a solution to malnutrition and as a natural remedy for various health conditions due to its rich nutrient and phytochemical content. However, without proper scientific validation of its composition within specific localities, its use may not be fully optimized or

properly guided. In rural communities like Batagarawa, where traditional knowledge often guides the use of medicinal plants, there is a risk of underutilization or improper utilization due to lack of accurate information on its nutrient composition and health benefits.

Furthermore, variations in processing and preservation methods commonly practiced in local communities may significantly affect the phytochemical and mineral content of *Moringa* leaves. Without proper understanding of these effects, important nutrients and bioactive compounds may be lost during processing, thereby reducing the overall quality and effectiveness of the plant. This situation further emphasizes the need for scientific evaluation to provide reliable data that can guide proper handling and utilization. Therefore, the major problem of this study is the lack of comprehensive and location-specific data on the phytochemical and mineral composition of *Moringa oleifera* in Batagarawa Local Government Area. This gap in knowledge limits the effective utilization of *Moringa* as a nutritional and medicinal resource. Hence, this study designed to analyze the phytochemical constituents and mineral composition of *Moringa* leaves in the study area in order to provide relevant data that can support its proper use for improved nutrition and health.

Materials and Methods

Study Area

The study was conducted at Dandogoro town of Batagarawa Local Government Area of Katsina State. Batagarawa local government area is located at latitude 10° 49' 33" South and longitude 45° 15' 28" East away from Katsina capital. Majority of the people in Batagarawa local government area were farmers and civil servant that relies much on local market and salary as their means of livelihood.

Materials

Fresh leaves of *Moringa oleifera* used for this study obtained from farms within Dandogoro town of Batagarawa Local Government, Katsina State. The samples were carefully harvested from healthy plants and transported to the laboratory in clean polyethylene bags to

avoid contamination. All reagents and chemicals used for the analysis were of analytical grade and obtained from standard laboratory suppliers. Distilled water used throughout the experimental procedures to ensure accuracy and reliability of results.

Methods

Sample Preparation

The collected *Moringa* leaves were sorted to remove damaged, diseased, and extraneous materials. The fresh leaves of *Moringa oleifera* were harvested, washed and dried for seven days under shed, at room temperature, to avoid loss of active compounds. The dried leaves were ground to powder using a hand-milling machine at the National Centre for Energy Research Development, University of Nigeria and weighed with a Mettler balance. The powdered sample was then stored in an airtight bottle for further use. The dried leaves then ground into fine powder using a laboratory grinder and stored in airtight containers for subsequent analysis (Akangbe, 2024).

Extraction Process

Aqueous extract: The extraction process used was hot-water method (decoction) following the procedure of Handa (2018). Fifty grams of the powdered sample were soaked in 500 ml of distilled water and boiled for about ten minutes. After boiling, the sample was double-filtered using cheese cloth and collected in a conical flask and allowed to cool. The filtrate was dried in hot-air oven at temperature of 70° C. **Ethanolic extract:** Fifty grams of the powdered sample were soaked in 500 ml of absolute ethanol and allowed to stand for 24 hours. The mixture stirred occasionally. After 24 hours, the sample was double-filtered using cheese cloth and collected in a conical flask. The filtrate dried in hot-air oven at temperature of 45 °C (Handa, 2018).

Phytochemical Screening

Phytochemical screening was also carried out at the Umaru Musa University Microbiology Laboratory (2025) according to established protocols. All tests were run in triplicate to enhance accuracy and minimize error. Both the qualitative and quantitative phytochemical analyses of the *Moringa* leaf

extracts (aqueous and ethanolic) were carried out for the presence of flavonoids, anthraquinone, alkaloids, saponins, steroids, terpenoids, cardiac glycoside, anthocyanin, tannins and carotenoids using the standard procedures as described by Edeoga *et al.* (2016). Qualitative phytochemical screening of the *Moringa* leaf powder carried out to determine the presence of major bioactive compounds such as alkaloids, flavonoids, tannins, saponins, phenols, and glycosides using standard procedures. Alkaloids identified using the iodine reagent, where the production of reddish-brown precipitate was an indication of their presence. Flavonoids were detected using treatment with sodium hydroxide followed by dilute acid, where the production of yellow coloration that became colorless upon acid addition was an indication of their presence. Tannins identified by the addition of ferric chloride solution, which gave a greenish-black coloration, whereas phenols detected by the ferric chloride reaction and identified by a deep blue color. Glycosides identified by glacial acetic acid, ferric chloride, and sulfuric acid, with a reddish-brown color at the junction validating their presence. Saponins detected by the frothing test, with persistent foam determining their occurrence. The leaves were comprised of 15 components especially Safflower oil, Hi-oleic safflower oil, 2,6-Dimethyl-1,7-octadiene-3-ol, 4-Hexadecen-6-yne, 2-hexanone, 3-cyclohexyliden-4-ethyl-E2-dodecenylacetate, hexadecanoic acid, palmitic acid ethyl ester and ethyl palmitate [46]. In another studies, the leaves have also been reported to contain alanine, aspartic acids, valine, glycine glutamic acids, threonines, leucines, methionines, cysteines, tryptophans, phenylalanines, lysines, histidine, isoleucines. All findings were noted meticulously, and findings were tabulated for later comparison with the literature. The methods described by established analytical protocols employed to identify the presence or absence of these compounds based on observable color changes and precipitate formation.

Mineral Analysis

The mineral composition of the *Moringa* leaf samples was determined using standard

analytical methods. Elements such as calcium, magnesium, potassium, sodium, iron, zinc, and phosphorus were analyzed. The sample was first subjected to dry ashing in a muffle furnace, after which the ash was dissolved in Hydrochloric acid solution for analysis. Calcium and magnesium were determined using titrimetric method, sodium and potassium were analyzed using a flame photometer, while iron and zinc were determined using atomic absorption spectrophotometry. Phosphorus content was determined using the Molybdate colorimetric method.

Experimental Design and Data Analysis

The study experimental design employing randomization in selecting the sample. The analysis quantitative data collected after experiment were carried out in triplicates, and the results were expressed as mean $\pm$ standard deviation.

Results

Phytochemical Composition of *Moringa* Leaf Samples

The result of the phytochemical composition of *Moringa oleifera* leaves obtained from Batagarawa Local Government Area is presented in Table 1. The analysis revealed the presence of important bioactive compounds including alkaloids, flavonoids, tannins, saponins, phenols, and glycosides in varying concentrations. Alkaloids were found to be moderately present in the sample, indicating the plant's potential pharmacological activities such as antimicrobial and analgesic effects. Flavonoids were observed in relatively high concentration, which suggests strong antioxidant properties of the plant, capable of neutralizing free radicals in the body. Tannins were also present and are known for their astringent properties and ability to promote wound healing. Saponins, which contribute to cholesterol reduction and immune system enhancement, were also detected in appreciable amounts.

Furthermore, phenolic compounds were identified in significant quantities, supporting the plant's role in preventing oxidative stress-related diseases. Glycosides were present in moderate levels, contributing to the therapeutic value of the plant, particularly in

cardiovascular health. The presence of these phytochemicals confirms that Moringa leaves from Batagarawa possess important medicinal

properties, though their concentrations may vary due to environmental and soil conditions.

Table 1: Phytochemical Compounds Detected in Moringa Leaves

Phytochemical	Test Reagent	Observation	Mean $\pm$ SD
Alkaloids	Iodine	Reddish-brown precipitate	2.45 $\pm$ 0.12
Flavonoids	NaOH + Dil H ₂ SO ₄	Yellow $\rightarrow$ Colorless	5.80 $\pm$ 0.25
Tannins	Ferric chloride	Greenish-black	3.10 $\pm$ 0.18
Saponins	Frothing	Deep blue color	4.25 $\pm$ 0.20
Phenols	Ferric chloride	Reddish-brown junction	6.15 $\pm$ 0.30
Glycosides	Acetic acid + FeCl ₃ + H ₂ SO ₄	Persistent foam	2.75 $\pm$ 0.15

Values are means of triplicate determinations $\pm$ standard deviation.

Mineral Composition of Moringa Leaf Samples

The mineral composition of *Moringa oleifera* leaves is presented in Table 2. The results showed that the leaves are rich in essential minerals necessary for human growth and development. Calcium recorded the highest concentration among the minerals analyzed, indicating that Moringa leaves can significantly contribute to bone development and maintenance. Potassium was also found in high quantity, which is essential for maintaining proper fluid balance and supporting nerve and muscle functions. Magnesium content was moderately high, playing a key role in enzyme activities and energy production within the body.

Iron content was also appreciable, suggesting that Moringa leaves can help in preventing anemia and improving blood formation. Phosphorus was present in a moderate amount, contributing to bone health and cellular functions. Zinc and sodium were found in lower concentrations compared to other minerals, but they are still important for immune function and electrolyte balance respectively.

The variations observed in mineral content may be attributed to environmental factors such as soil composition and agricultural practices in Batagarawa Local Government Area. Overall, the findings indicate that Moringa leaves are a valuable source of essential minerals that can support nutritional and health needs.

Table 2: Mineral Composition of Moringa Leaves

Mineral	Composition (Mean $\pm$ standard deviation.
Calcium	210.50 $\pm$ 2.10
Magnesium	95.30 $\pm$ 1.75
Potassium	320.80 $\pm$ 3.25
Sodium	15.20 $\pm$ 0.60
Iron	12.45 $\pm$ 0.50
Zinc	3.10 $\pm$ 0.20
Phosphorus	180.60 $\pm$ 2.40

Discussion

Phytochemical screening of the Moringa oleifera leaves harvested from the New Georgia Community verified the alkaloids, flavonoids, saponins, tannins, phenols, and glycosides. This supports the findings of earlier research. These findings are consistent with previous studies that have identified Moringa as a nutrient-dense plant, although slight variations in composition may occur due

to geographical and environmental differences. carried out in Asia and Africa, which in turn reported Moringa to be a rich source of bioactive compounds with tremendous medicinal and nutritional potential (Kirtikar & Basu, 2021;). Alkaloids were detected by the formation of a reddish brown precipitate, supporting previous findings of their abundance within *Moringa* leaves. Alkaloids have been much recognized

for their pharmacological activity, especially in pain management and antimalarial uses (Bennett *et al.*, 2018). Their detection strengthens Moringa's possible utilization where malaria and other infectious conditions continue to persist. Flavonoids, which were identified by typical color changes, are potent antioxidants that reduce oxidative stress and also have anti-inflammatory activities. The findings of this study agree with Anwar *et al.* (2020), who reported that flavonoids in moringa play an important role in its anticancer and cardioprotective activity. Saponins were verified by ongoing frothing, in keeping with Oduro *et al.* (2019). These chemicals are related to antimicrobial properties, enhanced nutrient uptake, and bolstering the immune system, pointing to potential benefits of Moringa intake for digestive as well as immune health. Tannins, as evidenced by a greenish-black coloration, validate moringa's herbal use in wound healing and anti-inflammatory treatment. Bennett *et al.* (2018) also emphasized tannins' astringent and shielding functions in moringa leaves. Phenols, which resulted in a blue coloration, are strong antioxidants, which have been known to eliminate free radicals and hinder cell damage. This finding corroborates the findings of Fahey *et al.* (2017), who highlighted phenols as key compounds in the prevention of chronic diseases. Lastly, glycosides were established by the reddish-brown coloration of the test solution at the junction. These are cardiac glycosides that possess therapeutic value in the treatment of cardiovascular diseases. Leone *et al.* (2016) also provided similar findings highlighting the significance of Moringa glycosides in cardio protection. Generally, these findings justify the phytochemical content of Moringa and attest to its applicability in traditional and modern therapeutic compound development.

Mineral analysis showed high potassium levels in leaves (320.80 ± 3.25 mg/kg), along with substantial calcium (210.50 ± 2.10 mg/kg), Phosphorus (180.60 ± 2.40 mg/kg) and Magnesium (86.52 ± 0.38 mg/kg) content. This mineral composition surpasses many conventional leafy vegetables (Abubakar *et*

al., 2021). It supports the plant's traditional use in regions where mineral deficiencies are prevalent. For instance, the potassium content in *H. littoralis* leaves (8,286 mg/kg) exceeds that reported for spinach (*Spinacia oleracea*, ~5,500 mg/kg), while its calcium levels (2,017 mg/kg) are comparable to amaranth (*Amaranthus* spp.), underscoring its potential as a mineral-rich functional food (Ibrahim *et al.*, 2025). Among minerals, only potassium (204.50 ± 0.18 mg/kg) wasn't low in quantity. This suggests that the primary nutritional value of bulbs of Beach spider lily lies in its phytochemical rather than mineral composition. Indeed, the distribution of high fiber and minerals in the leaves align with the physiological role of leaves as primary sites for photosynthesis and structural support, which would require robust vascular tissues (high fiber) and ion accumulation for osmotic and metabolic functions (high K, Ca) (Hakim *et al.*, 2022)

Conclusion

The phytochemical and mineral composition of *Moringa oleifera* leaves obtained from Batagarawa Local Government Area of Katsina State was successfully analyzed in this study. The findings revealed that the leaves contain a wide range of bioactive compounds including alkaloids, flavonoids, tannins, saponins, phenols, and glycosides, which are known to possess significant medicinal and therapeutic properties. In addition, the mineral analysis showed that Moringa leaves are rich in essential nutrients such as calcium, potassium, magnesium, phosphorus, and iron, with relatively lower amounts of sodium and zinc. Therefore, it can be concluded that *Moringa oleifera* leaves grown in Batagarawa Local Government Area are a rich source of essential phytochemicals and minerals that can contribute significantly to human nutrition and health. The consumption and utilization of Moringa should be encouraged, particularly in rural areas where access to nutrient-rich foods may be limited. Furthermore, there is a need for increased awareness and proper processing methods to maximize its benefits and preserve its nutritional quality.

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