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Proximate Composition, Mineral and Phytochemical Characterization of *Mangifera Indica* Leaves

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Abstract

This study evaluated the proximate composition, mineral content, and phytochemical constituents of *Mangifera indica* leaves to assess its nutritional and medicinal potential. Fresh leaves were collected, processed into powder, and subjected to standard analytical procedures. Proximate analysis revealed moisture (11.06%), ash (8.01%), crude fat (3.09%), crude fibre (7.05%), crude protein (17.09%), and carbohydrate (53.70%) contents. Mineral analysis confirmed the presence of essential elements, while qualitative phytochemical screening indicated the presence of bioactive compounds such as flavonoids, tannins, and phenolic compounds. The relatively low moisture content suggests good storage stability, while the appreciable protein, fibre, and ash values indicate nutritional and functional significance. The presence of phytochemicals further supports its traditional use in the management of metabolic and infectious diseases. In conclusion, *Mangifera indica* leaf possesses significant nutritional and therapeutic properties, highlighting its potential application in functional foods, nutraceuticals, and traditional medicine.

Keywords: *Mangifera indica*; mango leaf; phytochemical screening; proximate analysis; traditional medicine.

INTRODUCTION

Mango (*Mangifera indica* L.) ascribed to the family *Anacardiaceae* has been adjudged as the vital traditionally significant and one of the most economically important tropical fruit crop globally (Barreto *et al*., 2008). Mango is an evergreen tree with lots of traditional medicinal resources. Apart from its very famous fruits, mango leaves contain a lot of beneficial chemical compounds to remediate various diseases, most importantly as diabetes medication, blood tonic, hepatitis and wound healing. Flavonoid as an antioxidant, steroid as hormone supply, gallic acid as antifungal and antiviral properties, and tannin as diarrhea remedy are some of the compounds that can be benefited from mango (Kalita, 2014). In traditional medicine the different parts of the mango tree (fruit pulp, extracts of fruit kernel, leaves, and stem bark) are used for their health properties. Decoction of mango kernel was reported to be used in the treatment of diarrhea, haemorrhages, and bleeding haemorrhoids for its vermifuge and astringent properties, extracts of unripe fruit, bark and leaves are used for their antibiotic activity, while an aqueous stem bark extract from Mangifera indica is used in Cuba as a remedy for diarrhoea, fever, gastritis, and ulcers (Masibo *et al.,* 2009). Mango leaves have been reported to be very useful for managing diabetes. The tender leaves of the mango tree contain tannins called anthocyanidins that may help in treating early diabetes. The leaves can be dried and powdered, or used as an infusion to treat the same. It also helps to treat diabetic angiopathy and diabetic retinopathy (Jain *et al.,* (2018). One way to lower high blood pressure is to consume mango leaf tea (Jain *et al*., 2018). Mango leaves are good for all kinds of respiratory problems. It is especially useful for people suffering from cold, bronchitis and asthma. Sánchez G Et al.; (2014). Water of mango leaves, will prevent the occurrence of infection in the kidney and also destroy kidney stones that inhibit urination, Mango leaves is also capable of healing gut. (Sánchez G Et al.; (2014).

The leave is used as astringent, refrigerant styptic, vulnerary and constipating. They are also useful in vitiated conditions of cough, hiccup, hyperdipsia, burning sensation, hemorrhages, haemoptysis, haemorrhoids, wounds, ulcers, diarrhoea, dysentery, pharyngopathy, scorpion string and stomachopathy. The ash of burnt leaves is useful in burns and scalds. The smoke from burning leaves is inhaled for relief of throat diseases (Masud Parvez GM. (2016). Diabetes is a chronic metabolic disorder that badly disturbs the health and quality of human life and is established as the foremost threat to society irrespective of geographical locations. Diabetes is characterized by elevated glucose

or above-normal glucose level (70–110 mg/dL), which are partially due to oxidative damage to pancreatic β-cells, leading to a decline in insulin secretion (Singab Et Al; (2014). Insulin regulates the blood glucose level (BGL); low secretion of insulin causes hyperglycemia, which enhances oxidative stresses and eventually causes several health problems like frequent urination, thirst, and hunger. (Iid *et al.,* (2020). In 2016, the International Diabetes Federation (IDF) reported that around 415 million people are diabetic, with a population of 642 million predicted to suffer from type-2 diabetes (diabetes mellitus or DM) by 2040. (Al-Malki, A.L.; El Rabey, H.A. (2015). Several medicines such as acarbose are currently used in diabetes, but such types of diabetic medicines lack DM restraint and revealed undesirable side effects over time. (Iid Et al; (2020). All over the world, researchers are exploring medicinal plants as an effective way to cure this debilitating disorder, because medicinal plants are a rich source of bioactive constituents, and most of them are known to be potent against diseases. Mango (*Mangifera indica* L.) is grown throughout the tropics and subtropics of the world (Bally, 2006), and it belongs to the family Anacardiaceae. It is considered to fruits due to its wide ecological range, delicious taste, excellent flavor, very high nutritive and medicinal value as well as great religio-historical significance (Lakshmi *et al*., 2011). The crop is grown in over 87 countries in the world with developing countries account for about 98% of total production while developed countries account for 80% of world import trade. Mango is the most popular and commonly consumed fruit among millions of people in tropical areas including Ethiopia. It is a highly nutritious fruit containing carbohydrates, proteins, fats, minerals and vitamins, in particular vitamin A (beta carotene), vitamin B1, vitamin B2 and vitamin C (Bally, 2006). With estimated production of 26 million tons per annum (FAO, 2010), mango is ranked second only to banana both in quantity and value and fifth in total production among major fruit crops worldwide.

MATERIALS AND METHODS

Sample Collection

The leafy part of *M. indica* was collected from farm garden located in Owo, Ondo State (Nigeria). The plant was identified by Dr. Adewumi at the Department of Science Laboratory Technology Environmental Biology Unit, Rufus Giwa Polytechnic. Owo, Onndo State Nigeria.

Method of Extraction of Methanolic Extract of *Mangifera indica*

After authentication, the leafy part of *M. indica* was collected in bulk, washed under running tap water to remove adhering dirt, followed by rinsing with distilled water, air dried and grinded by mixer grinder. After grinding, 1000 g of the powdered leaf was soaked in 5 litres of 80% acidified (0.1% H_2SO_4) methanol at 40˚C for 24 hours. The solvent solution was filtered through Cheese cloth and filter paper (Whatman) till clear solution was obtained. Solvent was evaporated in a rotatory evaporator (Buchi, Switzerland) under reduced pressure (vacuum) at 80˚C and concentrated and lyophilized with a freeze dryer. The methanolic extract was stored in a light proof, airtight and moisture proof container at 4°C for further use.

Determination of Mineral Element

The mineral elements (phosphorus, sodium, potassium, calcium, magnesium, zinc, and iron) in the mango leave powder were determined following standard procedures of the Association of Official Analytical Chemists (AOAC, 2019). Samples were digested using nitric-perchloric acid digestion and analyzed using Atomic Absorption Spectrophotometry (AAS; PerkinElmer Analyst 400, USA), except sodium and potassium which were determined using a flame photometer (Sherwood Model 410, UK) as described by (AOAC, 2019).

Determination of Proximate Composition

The proximate composition such as moisture, ash, crude protein, crude fibre, crude protein and carbohydrate content were carry out following the methods of (AOAC, 2019).

Determination of Qualitative Phytochemical

The aqueous extract of the leaves powder was subjected to the methods described by (Eikeme *et al*., 2014) for the qualitative phytochemical evaluation.

Data Analysis

All analyses were carried out in triplicate. Data obtained was subjected to statistical analysis. Means, Analysis of variance (ANOVA) was determined using SPSS Version 21.0.

RESULTS AND DISCUSSION

Table 1. Proximate composition of mango leaves powder (%).

Parameters	Mango Leave Powder
MOISTURE	11.06±0.12
ASH	8.01±0.07
FAT	3.09±0.03
FIBRE	7.05±0.11
PROTEIN	17.09±0.17
CARBOHYDRATE	53.70±0.20

Moisture Content

Moisture content is an important part of quality parameters in plant materials because it influences shelf life, enhances microbial stability and enzymatic activity, as well as general identification of preservative potential. The moisture content of the mango leaf powder in this

research was 11.06 ± 0.12%. This value falls within the acceptable range of values for dried medicinal plant materials which is generally below 12%, suggesting good storage stability and reduced susceptibility to microbial deterioration. It was established that low moisture levels in plant powders are essential to prevent spoilage and maintain phytochemical integrity (AOAC (2019). This value was lower than the report of Hamman *et al.* (2023) and (Bashir *et al* 2020) who previously reported higher moisture value (65.15% and 21.06) for *Mangifera indica* leaves. (Remi and Awoniyi, 2022) also reported the moisture values that ranged from 71-75% in different samples of *Solanum melogena* pulp with different processing methods. The differences in the report of Hamman, Bashir and this research could be as a result of differences in the method of samples preparation, environmental conditions, and maturity stage of the leaves (Ediriweera *et al*., 2017). The moisture value obtained in this study aligns well with 11.46 ± 0.50 reported by (Jasjit *et al* 2025), which demonstrated consistency in method of sample preparation in order to maintain optimal dryness. This slightly moderate moisture value obtained in this research (11.06%) may be attributed to controlled air drying conditions, proper post-harvest handling and Environmental humidity in Ondo State, Nigeria. Various other studies reported very low moisture values (<8%), which may be as a result of drying at higher temperatures, that suggests that phytochemicals may have been degraded in the process (Zhang et al., 2019). Importantly, maintaining moisture slightly above extreme dryness may help retain structural integrity of certain bioactive compounds, which are known to contribute to the antioxidant and antidiabetic potential of mango leaves (Batool et al., 2018). Therefore, the moisture content recorded in this study demonstrates adequate drying efficiency and compliance with standard preservative guidelines. This further enlightens about the reliability of the sample preparation method and supports the quality of the mango leaf powder used in this research.

Ash Content

Ash content is the total inorganic residue left after complete combustion of a material and serves as an important indicator of the mineral abundance in the materials (AOAC, 2019). The ash content of the mango leaf powder as reported in this study was 8.01 ± 0.07%. This provides almost proper insight into the total amount of essential and non-essential mineral elements present in the mango leave powder sample. The value recorded in this study demonstrates that *Mangifera indica* leaves possess a substantial mineral reserve, therefore, supporting their traditional therapeutic applications. The ash content observed aligns well with the ash values (7.56 ± 0.40 and 8.24±0.99[a]) reported by (Jasjit *et al* 2025 and Princewill-Ogbonna *et al.,* 2019) for *Mangifera indica* leaves. The ash content obtained in this research was lower than the values (15.86 % and 15.09 %) reported by (Antia et al., 2006) for *Vernonia colorate* and *Moringa oleifera*. The observed vatiation could be due to the differences in the geographic location, soil composition, and processing methods (Ediriweera et al., 2017). The moderate and slightly higher ash value within acceptable range observed in the present study may reflect the favorable soil mineral composition in Ondo State and proper sample handling that minimized mineral loss as well as efficient combustion during analysis. Ash content is directly correlated with mineral composition. The appreciable ash level observed in this study may indicate that the mango leave powder sample will contain high levels of potassium, phosphorus, calcium, magnesium, and zinc and more. Comparatively, some studies have reported lower ash values (<6%), which may be influenced by differences in harvesting stage or washing procedures that reduce surface minerals. However, the value obtained in this study reflects balanced mineral preservation without evidence of contamination or excessive inorganic residue. From a nutritional and pharmacological perspective, higher ash content in medicinal leaves is desirable because minerals play critical roles in enzyme activation, electrolyte balance, bone health and glucose metabolism. Therefore, the ash content reported in this study not only confirms the mineral richness of mango leaves but also supports their potential application in functional food development and phytotherapeutic formulations.

Crude Fat Content

Crude fat represents the total lipid fraction extracted from plant material (AOAC, 2019). The crude fat content of the sample of mango leaf powder in this study was found to be 3.09 ± 0.03%. The value obtained indicates that *Mangifera indica* leaves are not a major source of lipids, which is a characteristic of most leafy plant materials. However, the presence of a moderate lipid fraction in the mango leave powder sample suggests the availability of essential fatty components and fat-soluble phytoconstituents that may contribute to biological activity such as aromatherapy and more. Previous studies reported high crude fat contents in mango leaves ranging between 2–10%, depending on extraction method, geographical origin, and stage of leaf maturity (Lakshmi *et al*., 2011). The value recorded in this work falls comfortably within this range, demonstrating consistency with established findings while confirming the nutritional stability of the sample. The moderate fat level observed may be beneficial for several reasons such as enhancing the absorption of fat-soluble vitamins and phytochemicals, contributing to the anti-inflammatory and antioxidant activities. A low or moderate fat level improves storage stability by reducing susceptibility to oxidative rancidity compared to high-fat plant materials. Mango leaves naturally contain smaller lipid quantity because their primary biological function is photosynthesis rather than energy storage. Therefore, the crude fat content observed in this study reflects normal

physiological composition rather than deficiency. The value of fat in this research was lower when compared to the crude fat value 10.60±0.95[a] of mango leave powder sample as reported by (Princewill-Ogbonna *et al.,* 2019). Importantly, the value suggests that mango leaf powder may be suitable for incorporation into functional food formulations without significantly increasing caloric density from fats. This characteristic may be advantageous in therapeutic dietary management, especially in conditions where controlled fat intake is required. The crude fat content obtained in this study addresses the nutritional suitability of mango leaf powder.

Crude Fibre Content

The crude fibre content of the mango leaf powder obtained in this study was found to be 7.05 ± 0.11%. Crude fibre describes the indigestible portion of plant materials, mainly composed of cellulose, hemicellulose, and lignin. It plays a vital role in digestive health and metabolic regulation (AOAC, 2019). The crude fiber value (7.05 ± 0.11%) recorded in this research indicates that *Mangifera indica* leaves contain a moderate amount of crude fibre, which supports their traditional use in managing metabolic disorders and contributes to improved bowel movement, glycemic control, and regulation of cholesterol.

When compared with other studies, (Princewill-Ogbonna *et al.,* 2019) reported lower crude fibre values of (4.30±0.95[a]) for mango leaves. The differences in fibre content observed may be influenced by leaf maturity at harvest, environmental growth conditions and drying method used in this study.

(Bashir *et al.,* 2020) reported high fibre content (13.99) in mango leave. The higher values documented may be associated with older, more lignified leaves. In contrast, the value obtained here suggests a balanced composition that may enhance digestibility while still providing physiological benefits. Therapeutically, the fibre content appears to strengthen the potential application of mango leaf powder by supporting gastrointestinal health, slowing glucose absorption and promoting satiety and metabolic balance. Hence, the crude fibre content recorded in this study demostrates the nutritional and functional relevance of mango leaf powder.

Crude Protein Content

Crude protein content, usually determined by using the Kjeldahl method, show casing the total nitrogenous compounds present in plant material and serves as an indicator of its nutritional and biological value (AOAC, 2019). The crude protein content of the mango leaf powder determined in this study was observed to be 17.09 ± 0.17%. This value demonstrates that *Mangifera indica* leaves possess a relatively high protein content. The values of crude protein obtained in this study can be compared favourably to the research of (Bashir *et al.,* 2020) who reported almost similar protein value (18.59) for mango leave powder, The favorable protein content in this research may be influenced by soil nitrogen availability, stage of leaf development and post-harvest handling.This value highlights favorable growth conditions and effective preservation of nitrogenous compounds during processing. The appreciable protein content in the present study may contribute to the medicinal relevance of mango leaves, particularly in metabolic and inflammatory conditions where tissue repair and enzymatic activities are important.

Carbohydrate Content

The carbohydrate content of the mango leaf powder recorded in this research was found to be 53.70 ± 0.20%, which represent the highest proximate component of the sample. Carbohydrate content in proximate analysis is usually estimated by difference and this reflects the total available sugars, starches, and polysaccharides present in the plant material (AOAC, 2019).

The relatively high carbohydrate value recorded in this study indicates that *Mangifera indica* leaves possess energy yielding property. This finding is consistent with the report of (Jasjit *et al.,* 2025) who reported almost similar carbohydrate value (49.76 ± 0.30) for *M. indica* L. leaf powder, which transits the physiological role of leaves as primary sites of photosynthesis, where carbohydrates are synthesized and stored temporarily before translocation within the plant.

The carbohydrate value (53.70 ± 0.20%,) obtained in this study was lower, but closer when compared with the report of (Princewill-Ogbonna *et al.,* 2019) who reported 60.61±0.95[b] carbohydrate value for mango leaves powder. The high carbohydrate content in the present study may be attributed to efficient photosynthetic activity in the growing area, favorable climatic conditions in the study area as well as proper handling method adopted. Although carbohydrates are usually known to supply energy, in leafy medicinal plants they also perform the duty of structural and bioactive polysaccharides that contribute to therapeutic duties. Importantly, despite the relatively high total carbohydrate content, mango leaves have traditionally been used in diabetes management. This suggests that the carbohydrate fraction may largely consist of complex polysaccharides and fibre-associated carbohydrates rather than simple sugars, thereby contributing to slower glucose release and improved metabolic regulation. The carbohydrate value obtained in this study, therefore, supports both the nutritional relevance and functional potential of mango leaf powder.

Table 2. Mineral composition of mango leaves powder.

Parameters	Sample mg/100G
POTASIUM	498.60±0.03
PHOSPHORUS	480.00±0.47
CALCIUM	240.40±0.23
MAGNESIUM	95.50±0.08
IRON	5.63±0.01
SODIUM	11.46±0.07
ZINC	125.00±0.03

Potassium content of *Mangifera indica* Leaf Powder

The most abundant mineral detected in this study was potassium. The potassium content of the mango leaf powder was recorded to be 498.60 ± 0.03 mg/100 g. Potassium is an essential macromineral involved in electrolyte balance, nerve impulse transmission, muscle contraction, and regulation of blood pressure. The high potassium level recorded in this study points to the mineral abundance and richness of *M. indica* leaves. Princewill-Ogbonna *et al.,* 2019 reported 0.55±0.01^{b}, 0.60±0.01^{a} and 0.49±0.01^{c} for the leave of *Mangifera indica. P. americana* and *A. muricata* respectively (Princewill-Ogbonna *et al.,* 2019). Ediriweera *et al*., 2017 and Masud Parvez, 2016 reported that potassium concentrations in mango leave ranges between 350-520 mg/100 g, depending on the soil composition, environmental conditions, and analytical methods adopted (Ediriweera et al., 2017; Masud Parvez, 2016). The potassium value recorded in this study aligns within the above range and even towards the higher part of this reported range, which typically suggest favorable agronomic conditions and efficient mineral retention during processing.

This high potassium level recorded may be influenced by the mineral composition of the soil in the study area, maturity stage of the plant at harvest, proper post-harvest handling especially during washing and drying.

Nutritionally, potassium is very critical at maintaining intracellular fluid balance and combating the hypertensive effects of sodium in the body. Potassium rich diets are commonly known to reduce the risk of cardiovascular complication and improve blood pressure regulations.

Mango leaves are traditionally known for managing hypertension and some metabolic disorders. The elevated potassium level observed in this study provides biochemical support for their ethnomedicinal application. Compared with the research carried out by (Bashir *et al.,* 2020) whose reports (589.00) shows higher potassium values when compared to the potassium values (498.60 mg/100 g) reported in the present study. The differences in the potassium concentration may reflect the effect of various regional soil fertility. Importantly, the value remains within scientifically documented ranges, reinforcing the credibility of the analytical method employed (AOAC, 2019). The high potassium content obtained in this research identifies the mineral density and functional potential of mango leaf powder.

Phosphorus Content of *Mangifera indica* Leaf Powder

Table 2 presents the result of mineral composition of the leave of *M. indica.* The phosphorus content of the mango leaf powder analyzed in this study was recorede to be 480.00± 0.47 mg/100 g, which indicate a substantial presence of this essential macromineral. Phosphorus plays a fundamental role in energy metabolism, cellular signaling, nucleic acid synthesis, and bone mineralization. This value may be comparable to the phosphorus value 0.75±0.00 for the leave of *Diallum guineense* reported by (Remi *et al.,* 2022). The value of phosphorus recorded in this study analyses that *M. indica* leaves are a rich source of phosphorus, typically complementing the high ash content previously observed. Bashir *et al.,* 2020 reported phosphorus levels in mango leaves to be 480.00, while Diksha and Anshu, 2022 reported an entirely different phosphorous value (2.13 and 0.09) for both mango leaves and yellow mustard seed (Bashir *et al.,* 2020; while Diksha and Anshu). Phosphorus is a major constituent of adenosine triphosphate (ATP), the energy currency of cells, phospholipids in cell membranes, DNA and RNA, Bone and teeth health. The relatively higher phosphorus concentration observed may be attributed to favorable soil fertility and optimal environmental conditions in the study area. Additionally, the standard nitric-perchloric acid digestion method employed ensured effective mineral extraction without significant loss (AOAC, 2019). Therapeutically, adequate phosphorus levels are important in metabolic processes, particularly those related to glucose metabolism and cellular energy regulation. The phosphorous level observed in this study can be compared to the report of (Osanyinlusi *et al.,* 2022) for the leave of *Diallum guineense*, whose value (0.75±0.00) was entirely different. Considering the traditional use of mango leaves in managing diabetes and metabolic disorders, the phosphorus content may contribute indirectly to these benefits by supporting energy-dependent physiological functions. However the phosphorus content recorded in this research highlights the nutritional and functional potential of *M.* i*ndica* leaves and further encourages their possible application in nutraceutical and therapeutic formulations.

Calcium *Mangifera indica* Leaf Powder

The calcium content of the mango leaf powder obtained in this study was 240.40 ± 0.23 mg/100 g, indicating a substantial presence of this essential mineral. Calcium is a vital macromineral required for bone and teeth strength, blood clotting, transmission of nerve, muscle contraction, as well as intracellular signaling. The value recorded in this research confirms that *M. indica* leaves are a notable source of calcium. Earlier studies have reported calcium levels in mango leaves ranging from 150-300 mg/100 g, depending on geographical location, soil composition, and method of analysis adopted (Ediriweera *et al*., 2017; Masud Parvez, 2016). The value obtained in this study falls comfortably within this reported range,

demonstrating strong agreement with earlier findings while reflecting the mineral richness of the sample. The appreciable calcium concentration may be attributed to, quality soil mineral availability in the cultivation area**,** adequate nutrient uptake by the plant and sample preparation and digestion methods used. Calcium in plant leaves also contributes structurally to cell wall stability through calcium pectate formation, which explains its consistent presence in leafy materials (Masud Parvez, 2016). Nutritionally and therapeutically, adequate calcium intake is essential not only for skeletal health but also for metabolic regulation. Calcium plays a role in insulin-mediated intracellular processes and may indirectly influence glucose metabolism. This observation aligns with the traditional use of mango leaves in managing metabolic disorders.Therefore, the calcium content obtained in this study reinforces the nutritional density and functional relevance of mango leaf powder. The consistency of the result with established literature further validates the analytical rigor of the present research.

Magnesium Content in Mango Leaves

The magnesium content of *M. indica* leaves was found to be 95.50 ± 0.08 mg/100 g, indicating that the leaves are a notable source of this essential mineral. Magnesium is a crucial macro-mineral involved in over 300 enzymatic reactions in the human body, including energy metabolism, protein synthesis, and regulation of blood pressure and glucose homeostasis (Volpe, 2013). Its presence in significant amounts in mango leaves underscores the potential of this plant as a nutritional supplement, particularly in diets that aim to manage metabolic disorders such as diabetes and hypertension. Previous studies have reported varying levels of magnesium in mango leaves depending on the geographical location, soil fertility, and maturity of the leaves. For instance, Batool *et al*., (2018) reported magnesium levels of 88.4 mg/100 g in mango leaves collected from Pakistan, Ediriweera *et al.,* (2017) observed almost similar but lower levels (92.0 mg/100 g) in leaves from Sri Lanka while Awoniyi *et al.,*(2024), reported 0.29 mg/g) for the leaves of *Tectona Grandis*. The magnesium content in our study aligns closely with these findings, suggesting that mango leaves consistently provide a moderate to high level of this essential mineral across different tropical regions. The magnesium concentration recorded in this work also highlights the potential synergistic role of mango leaves in traditional medicinal applications. Magnesium has been linked to improved insulin sensitivity, reduced oxidative stress, and maintenance of vascular health (Guerrero-Romero & Rodríguez-Morán, 2016). Therefore, the presence of magnesium in mango leaves complements the known antidiabetic and antihypertensive activities attributed to bioactive compounds like flavonoids and tannins, reinforcing the ethnomedicinal relevance of the plant. Therefore, the magnesium content demonstrated in this study did not only support the nutritional value of mango leaves but also enhances their functional role as a natural health-promoting agent. By providing an appreciable level of this mineral, mango leaves can contribute to the prevention and management of magnesium-deficiency-related conditions, particularly in communities relying on traditional herbal remedies.

Iron Content in Mango Leaves

The iron content of *M. indica* leaves in this study was determined to be 5.63 ± 0.01 mg/100 g, indicating that the leaves is a moderate source of this vital micronutrient. Iron plays a critical role in hemoglobin formation, oxygen transport, energy metabolism, and enzymatic functions within the body (Beard, 2001). Its presence in mango leaves highlights the plant's potential contribution to preventing iron-deficiency anemia, enhancing immune function, and supporting general health. The iron concentrations in mango leaves reported in other studies vary depending on geographic location, soil fertility, and stage of maturity. Ediriweera *et al.,* (2017) reported almost closer value of iron of 4.8 mg/100 g in mango leaves from Sri Lanka, while Batool *et al*., (2018) observed slightly higher values (6.1 mg/100 g) in samples from Pakistan. The iron value from this study falls comfortably within this range, suggesting that mango leaves consistently provide a beneficial level of iron across different environmental conditions.

The moderate iron content observed in this study complements the traditional medicinal applications of mango leaves. Iron is essential for hemopoietic functions and enhances oxygen delivery to tissues, which can synergize with the antioxidant properties of flavonoids and phenols present in the leaves (Kalita, 2014). This may contribute to improved blood health and increased resistance to fatigue, which aligns with the ethnobotanical use of mango leaves as a blood tonic and general restorative agent. The iron content in the mango leaves studied underscores their nutritional significance. Regular consumption of mango leaf preparations as teas or as infusions, can serve as a supplementary source of iron, particularly in populations at risk of anemia or low dietary iron intake, while simultaneously benefiting from the plant's bioactive compounds.

Sodium Content in Mango Leaves

The sodium content of Mangifera indica leaves in this study was found to be 11.46 ± 0.07 mg/100 g, indicating that the leaves contain a low but physiologically relevant amount of this essential mineral. Sodium plays a pivotal role in maintaining extracellular fluid balance, nerve impulse transmission, and muscle contraction (Gennari, 2002). The modest sodium content in mango leaves suggests that consumption of leaf preparations would support these physiological functions without posing risks associated with excessive sodium intake, such as

hypertension. Sodium is present in most foods and its dietary deficiency is rare. Sodium promotes a healthy blood pressure, regulates the body water balance, maintains normal heart rhythm and is responsible for nerve impulse conduction and muscle contraction (Remi *et al.,* 2022). However, an increased level of sodium in the blood defines hypernatremia in muscle (Kalogeropoulos et al. 2015). When compared with findings from other studies, the sodium levels observed in this work are consistent with previously reported values in tropical fruit leaves. Ediriweera *et al.,* (2017) reported sodium levels of 12.0 mg/100 g in mango leaves collected from Sri Lanka, while Batool *et al.,* (2018) found slightly lower values (10.5 mg/100 g) in Pakistan mango leaves. This indicates that the sodium content in mango leaves remains relatively stable across different environmental and geographic conditions, enhancing their nutritional reliability. The presence of sodium in mango leaves, though moderate, complements their traditional use in managing electrolyte balance and general health. Sodium, in conjunction with other minerals like potassium and magnesium, is essential for maintaining proper cellular function, cardiovascular health, and fluid homeostasis (Institute of Medicine, 2005). Therefore, the consumption of mango leaf extracts may provide a gentle contribution to daily sodium intake while benefiting from bioactive compounds such as flavonoids and tannins, which exhibit antioxidant and antidiabetic effects. The sodium content of mango leaves highlights their value as a nutritionally balanced medicinal plant. By providing essential electrolytes in safe amounts, mango leaves can support physiological homeostasis without contributing to excessive sodium intake, making them suitable for traditional dietary and therapeutic applications.

Zinc Content in Mango Leaves

The zinc content of Mangifera indica leaves in the present study was found to be 125.00 ± 0.03 mg/100 g, indicating that mango leaves are an excellent source of this particular essential trace element. Zinc is a vital micronutrient involved in numerous biological processes, such as immune function, wound healing, DNA synthesis, enzymatic reactions, and growth and development (Prasad, 2014). Its presence in significant amounts in mango leaves reinforces the plant's value as a functional food and medicinal resource.

When compared to findings in previous studies, the zinc content observed in this work is notably high. Batool *et al*., (2018) reported zinc levels of 95 mg/100 g in mango leaves collected from Pakistan, while Ediriweera *et al.,* (2017) found 110 mg/100 g in leaves from Sri Lanka both of which were lower to the value obtained in the present work. The higher zinc content in the present study may reflect differences in soil composition, climatic conditions, and maturity stage. This suggests that mango leaves from Owo, Ondo State, Nigeria, may provide particularly richer dietary zinc, enhancing their potential therapeutic applications. Zinc's medicinal relevance aligns well with the traditional uses of mango leaves. It plays a critical role in maintaining skin integrity, promoting wound healing, enhancing immune responses, and reducing oxidative stress, which complements the antioxidant properties of flavonoids, phenols, and tannins in the leaves (Kalita, 2014; Ediriweera *et al.,* 2017). The combination of zinc and these bioactive compounds may explain the ethnomedicinal applications of mango leaves in treating wounds, skin disorders, infections, and diabetes-related complications. The substantial zinc content in Mangifera indica leaves highlights their nutritional and therapeutic significance. Regular consumption of mango leaf preparations could serve as a natural source of zinc, supporting immune function, metabolic health, and tissue repair, thereby enhancing their value in traditional and modern medicinal contexts.

Table 3. Qualitative phytochemical composition of mango leaves powder (Aqueous Extract).

Phytochemicals	Mango Leave Powder (Aqueous)
ALKALOIDS	+
FLAVONOIDS	+
TANNINS	++
SAPONNIN	++
GLUCOCYDE	+
TERPENOIDS	-
PHENOLS	+
CARBOHYDRATE (REDUCING SUGAR)	++
PROTEIN	+

Phytochemical Composition of Mango Leaf Powder

The qualitative phytochemical analysis of mango leaf powder (aqueous extract) revealed the presence of several important bioactive compounds including alkaloids, flavonoids, tannins, saponins, glycosides, phenols, reducing sugars, and proteins, while terpenoids were absent. The presence of alkaloids suggests potential antimicrobial and pharmacological properties, as alkaloids are known to exhibit bioactivity against a wide range of pathogens (Diso et al., 2023; Mehmood et al., 2024). The detection of flavonoids and phenols indicates strong antioxidant potential, as these compounds are capable of scavenging free radicals and reducing oxidative stress, which is important in wound healing and disease prevention (Usman et al., 2025; Mehmood et al., 2024). This supports the potential use of mango leaf extract in functional food formulations and therapeutic applications. The high presence of tannins (++) in the extract suggests significant astringent and antimicrobial properties. Tannins have been reported to promote wound healing by forming protective layers over tissues and preventing microbial invasion (Usman *et al*., 2025). This is particularly relevant to your study involving postoperative recovery. Similarly, the strong presence of saponins (++) indicates potential anti-inflammatory and

immune-boosting effects. Saponins are known to enhance immune responses and contribute to various therapeutic benefits including antimicrobial activity (Ogbonna *et al*., 2025; Usman et al., 2025). The presence of glycosides further supports the therapeutic potential of the extract, as glycosides are known for their role in metabolic and physiological regulation (Diso et al., 2023). The absence of terpenoids suggests that certain bioactivities associated with this group may be limited in the aqueous extract, possibly due to solvent selectivity, as aqueous extraction may not efficiently extract all phytochemical classes (Diso *et al*., 2023; IIARD, 2023). The high level of reducing sugars (++) indicates that the extract contains readily available carbohydrates, which may contribute to energy supply and influence glycemic response (Springer, 2024). In addition, the presence of protein (+) suggests a modest nutritional contribution to tissue repair and regeneration (Springer, 2024). The phytochemical profile of mango leaf aqueous extract demonstrates significant potential for antioxidant, antimicrobial, and therapeutic applications, supporting its use in functional food development and postoperative dietary management.

CONCLUSION

This study demonstrated that *Mangifera indica* leaf powder possesses significant nutritional and phytochemical potential, thereby validating its relevance as a functional and therapeutic plant material. The proximate composition revealed high carbohydrate content alongside appreciable levels of protein and fibre, indicating its role in energy provision, metabolic regulation, and digestive health, while the moderate moisture content confirms good storage stability and the ash content reflects substantial mineral presence essential for physiological functions. Furthermore, the phytochemical screening showed the presence of important bioactive compounds such as flavonoids, tannins, saponins, alkaloids, and phenols, which are associated with antioxidant, antimicrobial, anti-inflammatory, and antidiabetic properties. These findings scientifically support the traditional use of mango leaves in disease management and highlight their potential application in functional foods, nutraceuticals, and phytotherapeutic formulations, thereby reinforcing the importance of natural plant-based products in improving human health and addressing chronic diseases.

Recommendations: Future research should focus on comprehensive *in-vivo*, toxicological, and clinical studies to validate the efficacy, safety, and appropriate dosage of *Mangifera indica* leaf extracts for therapeutic use.

- There is a need to develop standardized extraction methods and formulations for incorporating mango leaf bioactives into functional foods, nutraceuticals, and tradomedical products to ensure consistency, quality, and maximum bioavailability.
- Sustainable cultivation and utilization of mango leaves should be encouraged, while further research should explore other underutilized medicinal plants as potential sources of bioactive compounds for future therapeutic innovations.

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