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Nutritional, Elemental And Phytochemical Analysis Of *Moringa Oleifera* Aqueous Roots Extract

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Abstract: Moringa oleifera, often called the "miracle tree," is a remarkable plant that grows quickly and can withstand dry conditions, making it a popular choice in tropical and subtropical areas. *This study delved into the phytochemical, nutritional, and elemental makeup of Moringa oleifera root extract, employing both qualitative and quantitative methods. The qualitative phytochemical screening confirmed the presence of several key bioactive compounds, such as glycosides, phenols, flavonoids, steroids, anthraquinones, alkaloids, tannins, saponins, and terpenoids. The quantitative analysis highlighted significant concentrations of these compounds, including alkaloids (13.50 ± 0.50 mg/100g), phenols (7.50 ± 0.50 mg/100g), and anthraquinones (8.00 ± 0.00 mg/100g), which support their potential antioxidant, antimicrobial, anti-inflammatory, and cytotoxic properties. Nutritional analysis revealed that the root is rich in carbohydrates (65.47 ± 0.06%) and crude protein (8.23 ± 0.06%), with moderate amounts of crude fiber (7.27 ± 0.06%), ash (6.62 ± 0.03%), and lipids (2.53 ± 0.06%). The relatively low moisture content (7.87 ± 0.06%) contributes to its shelf stability. Elemental analysis further emphasized the root's mineral richness, particularly in potassium (250.47 ± 0.06 mg/100g), calcium (55.17 ± 0.06 mg/100g), and magnesium (20.87 ± 0.06 mg/100g), all of which are vital for bone health, enzymatic functions, and cardiovascular support. Trace elements like manganese (0.57 ± 0.06 mg/100g) also enhance the root's nutritional and therapeutic value. These findings are consistent with previous reports and reinforce the traditional use of Moringa oleifera roots in herbal medicine, showcasing its potential for pharmacological and nutraceutical applications.*

Keywords: *Moringa oleifera*, Roots, Phytochemical, Elemental analysis, Nutritional analysis.

1. INTRODUCTION

Moringa oleifera, often called the "miracle tree," is a remarkable plant that grows quickly and can withstand dry conditions, making it a popular choice in tropical and subtropical areas. Originally from the Indian subcontinent, *Moringa* has captured global interest for its wide-ranging applications in traditional medicine, food, and nutrition (Adebayo *et al*., 2011; Oluduro, 2012). Almost every part of this versatile plant its leaves, seeds, bark, flowers, pods, and roots has been used for various health and nutritional benefits. While the leaves and seeds have received a lot of attention in research, the roots of *Moringa oleifera* are still relatively unexplored, especially regarding their phytochemical and mineral content (Onu *et al*., 2014; Oduro *et al*., 2008). Traditionally, *Moringa oleifera* roots have been employed to address a variety of health issues, including inflammation, infections, digestive problems, and heart-related conditions (Oluduro, 2012; Olayemi & Alabi, 2019). The medicinal qualities of these roots are often attributed to a range of bioactive compounds, such as alkaloids, flavonoids, phenols, saponins, tannins, and glycosides (Akinmoladun *et al*., 2014; Olayemi & Alabi, 2019). Beyond these phytochemicals, Moringa roots are also thought to offer essential nutrients and minerals crucial for our health, including calcium, potassium, magnesium, and trace elements like manganese and phosphorus (Adebayo *et al*., 2011; Oduro *et al*., 2008). Assessing the phytochemical, nutritional, and mineral makeup of *Moringa oleifera* root extract is vital not just to confirm its traditional uses but also to explore its potential in nutraceuticals and drug development. This study aims to provide a thorough evaluation of the bioactive compounds, essential nutrients, and elemental content found in *Moringa oleifera* roots, adding to the growing understanding of its pharmacological and nutritional importance.

2. MATERIALS AND METHODS

2.1 Materials

Distilled water was used as solvent for extraction and the remaining reagents and chemicals were of analytical grades**.**

2.2 Methods

2.2.1 Collection and Preparation of Sample

The fresh roots of *Moringa oleifera* was collected in Unguwar Galadima, "Aliero.", and thoroughly washed to get rid of any dirt. The sample was air-dried in a shaded area with good ventilation. After dried, the roots are ground into a fine powder and soaked in a distilled water at room temperature for about 48 hours using cold maceration method. During this time, the mixture is stirred occasionally to help with the extraction process. Afterward, it's filtered to separate the liquid extract from the plant residue, and the resulting filtrate is concentrated through evaporation to create the crude extract for further analysis.

2.2.2 Qualitative Phytochemical

The aqueous roots extract of *Moringa oleifera* were screen for the presence of secondary metabolites such as glycosides, phenols, flavonoids, steroids, anthraquinones, alkaloids, tannins, saponins, and terpenoids using methods described by (El-olemyl *et al.*, 1994; Harbone, 1998; Trease and Evans 1978; Harbone, 1978) with slight modification.

2.2.3 Quantitative Phytochemical

The quantitative phytochemical analysis was done using methods described by (Nyamai *et al*., 2015, Narendra, *et al*., 2013; Obadomi and Ochuko, 2001; Meda *et al*. 2005; Hageman *et al*., 2000; and Harborne, 1998).

2.2.4 Proximate Analysis

Proximate analysis was done using methods described by A.O.A.C. (2015).

2.2.5 Elemental Analysis

The mineral elements composition was done using method described previously (Mendoza et al. 2014).

2.3 Statistical analysis

All experimental results were expressed as mean values with standard deviation (± SD) of three replicates. One-way analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1 Results

Table 3.1: Qualitative Phytochemical Screening of the *Moringa oleifera* Roots

Phytochemicals	Result
Glycosides	+
Phenols	+
Flavanoids	+
Steroids	+
anthraquinones	+
Alkaloids	+
Tannins	+
Saponins	+
Terpenoids	+

Key: + = Present

Table 3.2: Quantitative Phytochemical Investigation of the *Moringa oleifera* Roots

Phytochemicals	Result

Glycosides	6.33±0.58
Phenols	7.50± 0.50
Flavanoids	7.33±0.58
Steroids	3.67±0.58
anthraquinones	8.0±0.00
Alkaloids	13.50±0.50
Tannins	11.30± 0.29
Saponins	9.39 ± 1.17
Terpenoids	6.50± 0.05

Key: Values are mean ± STD of the three replicate experiment

Table 3.3: Proximate Compositions of the *Moringa oleifera* Roots

S/N	Parameters	Value (%)
1	Moisture	7.87 ± 0.06
2	Ash	6.62 ± 0.03
3	Lipid	2.53 ± 0.06
4	Protein	**8.23** ± 0.06
5	Fibre	7.27 ± 0.06
6	Carbohydrates	65.47 ± 0.06

Key: values were express as Mean **± Standard deviation**

Table 3.4: Mineral Composition of the *Moringa oleifera* Roots

S/N	Parameters	Value (mg/100g)
1	Calcium	55.17 ± 0.06
2	Magnesium	20.87 ± 0.06
3	Potassium	250.47 ± 0.06
4	Phosphorus	**37.73** ± 0.06
5	Sodium	20.63 ± 0.06
6	Manganese	0.57 ± 0.06

Key: Values are mean ± STD of the three replicate experiment

3.2 Discussion

Moringa oleifera, often called the "miracle tree," is a remarkable plant that grows quickly and can withstand dry conditions, making it a popular choice in tropical and subtropical areas. Originally from the Indian subcontinent, *Moringa* has captured global interest for its wide-ranging applications in traditional medicine, food, and nutrition (Adebayo *et al*., 2011; Oluduro, 2012). The qualitative

phytochemical screening results in Table 3.1 reveal that the *Moringa oleifera* roots extract is packed with several key bioactive compounds. Each of the phytochemicals tested like glycosides, phenols, flavonoids, steroids, anthraquinones, alkaloids, tannins, saponins, and terpenoids indicated positive results ("+"), confirming their presence in the extract. This aligns with the findings of Adebayo et al. (2011) and Oluduro (2012). The detection of glycosides, phenols, and flavonoids highlights the antioxidant potential of the root, as these compounds are well-known for their ability to scavenge free radicals (Akinmoladun et al., 2014; Olayemi & Alabi, 2019). Additionally, the presence of alkaloids and saponins has been associated with antimicrobial and anti-inflammatory effects (Oluduro, 2012; Olayemi & Alabi, 2019). Tannins and terpenoids also add to the antimicrobial properties and may play a role in the plant's defense mechanisms (Adebayo *et al*., 2011; Onu *et al*., 2014). Furthermore, the identification of steroids and anthraquinones supports the traditional medicinal applications of Moringa oleifera, particularly for their anti-inflammatory, laxative, and cytotoxic effects (Oluduro, 2012; Akinmoladun *et al*., 2014).

The of quantitative phytochemical analysis of *Moringa oleifera* roost extract in Table 3.2 showed that it contains a variety of phytochemicals in notable amounts, many of which align with findings from previous studies. In this research, the glycoside content was measured at 6.33 ± 0.58 mg/100g, which is a bit higher than the 5.42 ± 0.45 mg/100g noted by Ajiboye *et al*., (2013). This indicates a reliable presence of glycosides in the root, potentially contributing to its recognized benefits like anti-inflammatory and heart-protective effects. The phenol concentration was found to be 7.50 ± 0.50 mg/100g, closely matching the 7.25 ± 0.10 mg/100g reported by Akinmoladun *et al*. (2014). This suggests a strong antioxidant potential due to the phenolic compounds present. Flavonoids were recorded at 7.33 ± 0.58 mg/100g, which is slightly lower than the 7.65 ± 0.32 mg/100g reported by Oluduro (2012). Flavonoids are well-regarded for their antioxidant, antimicrobial, and anti-inflammatory properties. The steroid content was measured at 3.67 ± 0.58 mg/100g, which is a bit higher than the 3.20 ± 0.55 mg/100g noted by Olayemi and Alabi (2019). Steroids are often linked to hormonal balance and anti-inflammatory effects in traditional medicine. The concentration of anthraquinones was found to be 8.00 ± 0.00 mg/100g, slightly exceeding the 7.80 ± 0.25 mg/100g reported by Adebayo *et al*., (2011). Anthraquinones are generally associated with laxative, antimicrobial, and anticancer activities. Alkaloids, which are important for their antimicrobial and pain-relieving effects, were present at 13.50 ± 0.50 mg/100g, closely aligning with the 13.20 ± 0.60 mg/100g reported by Onu *et al*., (2014). The tannin content measured at 11.30 ± 0.29 mg/100g is quite similar to what Oluduro (2012) found, which was 10.85 ± 0.33 mg/100g. Tannins are well-known for their astringent qualities, as well as their antimicrobial and antioxidant benefits. Saponins were recorded at 9.39 ± 1.17 mg/100g, aligning closely with the 9.00 ± 1.10 mg/100g noted by Olayemi and Alabi (2019). These compounds are often associated with lowering cholesterol and boosting the immune system. Finally, the terpenoid content stood at 6.50 ± 0.05 mg/100g, which is just a tad lower than the 6.70 ± 0.40 mg/100g reported by Akinmoladun *et al*., (2014). Terpenoids are typically recognized for their anti-inflammatory, antimicrobial, and anticancer properties.

The analysis of *Moringa oleifera* root extract shows it has some impressive nutritional benefits as showed in Table 3.3, aligning well with what previous studies have found. The moisture content of the root is measured at $7.87 \pm 0.06\%$, which falls nicely within the typical range of 7.5–9.8% noted by Onu *et al*., (2014) and Oluduro (2012). A lower moisture content is actually a good thing for storing plants and extending their shelf life, as it helps prevent microbial spoilage and enzymatic breakdown. When it comes to ash content, which reflects the total mineral content, it stands at $6.62 \pm 0.03\%$. This is consistent with earlier findings of 6.2–8.0% reported by Adebayo *et al*., (2011). This indicates that Moringa roots provide a moderate supply of essential minerals like calcium, magnesium, and potassium. The lipid content is recorded at $2.53 \pm 0.06\%$, slightly higher than the 2.1–2.4% range noted by Olayemi and Alabi (2019). While the root isn't particularly high in fats, the lipids present can still help with the solubility and absorption of fat-soluble phytochemicals. The crude protein level is at $8.23 \pm 0.06\%$, which aligns well with the values reported by Oluduro (2012) and Oduro *et al*., (2008) (6.0–9.4%). This suggests that the root has a decent amount of protein, adding to its nutritional value in traditional diets and herbal remedies. As for crude fiber, it measures $7.27 \pm 0.06\%$, which is consistent with the 5.8–8.2% range reported by Onu *et al*., (2014). Fiber is crucial for digestive health and can help lower cholesterol levels and manage blood sugar. Lastly, the carbohydrate content, calculated by difference, comes in at $65.47 \pm 0.06\%$. This confirms that carbohydrates are the primary macronutrient in *Moringa oleifera* roots, as also noted by Adebayo et al. (2011) and Oduro et al. (2008). This high carbohydrate level suggests that the root can be a great energy source, especially in areas where food is scarce.

The analysis of *Moringa oleifera* root extract showed impressive levels of both essential macro- and microelements in Table 3.4, highlighting its potential as a valuable dietary and therapeutic resource. The calcium content was measured at 55.17 ± 0.06 mg/100g, which is in line with earlier findings by Oluduro (2012) and Adebayo *et al*., (2011), who reported values between 40 and 120 mg/100g. Calcium is crucial for maintaining bone health, supporting muscle function, and facilitating enzymatic activity, making the root a decent source of this important mineral. Magnesium levels were found to be 20.87 ± 0.06 mg/100g, consistent with the 20–80 mg/100g range noted by Oduro *et al*., (2008). This mineral is essential for nerve function, muscle contraction, and plays a role in over 300 enzymatic reactions in the body. With a potassium content of 250.47 ± 0.06 mg/100g, *Moringa* roots prove to be a rich source of this vital electrolyte. This figure falls within the 150–400 mg/100g range reported by Adebayo *et al*., (2011). Potassium is key for cardiovascular health, maintaining fluid balance, and supporting neuromuscular function. Phosphorus was recorded at 37.73 ± 0.06 mg/100g, which aligns with the 30–70 mg/100g range found in similar studies (Oluduro, 2012). Phosphorus is important for bone and tooth structure, as well as energy metabolism due to its role in ATP formation. The sodium content was noted at 20.63

± 0.06 mg/100g, fitting within the previously reported ranges (10–35 mg/100g) by Onu *et al*., (2014). While sodium is necessary for nerve function and fluid balance, the moderate level in the root extract enhances its nutritional profile without the risk of excessive intake. Lastly, the manganese level was found to be 0.57 ± 0.06 mg/100g, a trace element that plays a role in bone formation and enzyme activation. This measurement aligns with findings from Oduro *et al*., (2008) and Olayemi & Alabi (2019), who reported manganese levels between 0.2–0.8 mg/100g in roots and leaves of *Moringa oleifera*.

4. CONCLUSION

Moringa oleifera roots extract is known for its rich blend of phytochemicals, nutrients, and minerals as confirm in this study, which help explain its traditional uses in medicine. These insights not only validate its role in herbal medicine today but also highlight the need for more research into its potential pharmacological benefits and how it might be incorporated into modern therapeutic and nutritional practices.

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