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# Proximate and Mineral Analyses of African Grapes *(Lannea microcarpa)* Roots for Nutritive and Therapeutic Application

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## Abstract

*The roots of African grapes (Lannea microcarpa) have long been utilised in traditional medicine for their perceived therapeutic properties. However, their comprehensive proximate and mineral analysis remains largely unexplored. Proximate composition and mineral content analysis of the roots were conducted. The sample was obtained from Katsayal, Katsina State, and analysed using standard procedures. The macro and micro metals were determined using Flame Photometer and Atomic Absorption Spectroscopy, respectively. The results revealed a moisture content of 28.0 ±2.0%, an ash content of 21.3±1.2%, and significant levels of crude fibre (29.0±0.50%), crude lipid (9.60±0.20%), crude protein (6.91±0.01%), and available carbohydrates (33.3±0.10%). The calorific value of the root was determined to be 245 ± 0.01 kcal/g. The micro-mineral analysis revealed the detection of Copper (8.60 ± 0.002 mg/kg), Magnesium (9.24 ± 0.004 mg/kg), Manganese (41.9 ± 0.001 mg/kg), Iron (405 ± 0.042 mg/kg), and Zinc (9.46 ± 0.001 mg/kg). The macro-minerals, namely Calcium (28400 mg/kg), Potassium (1530 mg/kg), and Sodium (45030 mg/kg), were found to be present in the sample. It is advisable to conduct additional research to examine the identified minerals' bioavailability, clarify the phytochemical profile, and investigate potential bioactive compounds.*

**Keywords**: African grape roots, *Lannea macrocarpa*, medicinal applications, mineral analysis, therapeutic.

## INTRODUCTION

*Lannea microcarpa,* commonly known as Wild Grape or African Grape, belongs to the family *Anacardiaceae*. In West Africa, it is known by various vernacular names, including "Faaru" (Hausa), "Mpékou" (Bambara), and "Sabga" (Mooré). It is a deciduous tree species, characterised by a compact, semi-spherical canopy, can reach heights of up to 16 meters and

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is native to several West African countries, including Benin, Cameroon, Côte d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, and Togo (Zizka et al., 2015; Arbonnier, 2019). The plant has a high level of adaptability, and it grows in both fertile and rocky soils; hence, it thrives more, particularly in the Sahel savanna region. *L. microcarpa* is abundant in Nigeria and distributed across the northern states, such as Sokoto, Kebbi, Zamfara, Kaduna, Katsina, Kano, and Jigawa (Yaradua & El-Ghani, 2014).

*L. microcarpa* have several benefits to local communities, particularly traditional benefits. As a results of this, it is often regarded as a multipurpose plant. The fresh leaves are utilised as vegetables, whilst the fruits and seeds are processed to yield many important goods, including edible oil, which is employed in animal feed, cosmetics, and biodiesel manufacturing (Bazongo et al., 2014; Nitiéma et al., 2019). Additionally, the fruit pulp can be processed into wine and jam and, when fermented, it is a good source of an alcoholic beverage (Yunus et al., 2013). Ethnopharmacologist have extensively reported traditional (medical) applications of various parts of *L. Macrocarpa,* including the roots, leaves, back and the fruit. For example, James et al. (2015) and Ouédraogo et al. (2017) outlined that, the leaves, bark, roots, and fruits are employed in treating many health ailments, citing mouth blisters, rheumatism, sore throats, dysentery, conjunctivitis, stomatitis, skin eruptions, and ulcers as common health conditions treated using *L. Macrocarpa*. Similarly, Bazongo et al. (2018) conducted a phytochemical screening of the plant and uncovered that the seed contain 21.14% protein and 64.90% oil.

While traditional uses and preliminary research on *L. microcarpa's* fruits and seeds were reported in the literature, but comprehensive research on the root's nutritional and mineral composition remains unexplored. Although some of the existing studies have focused on the plant's ethnomedicinal applications and seed composition, a huge gap exists in understanding the nutritional profile of its roots. This research aimed to conduct proximate and mineral analyses of the plant’s (*L. Macrocarpa*) roots. The findings are targeted at bridging the identified gap and unveil its potential new nutraceutical applications while validating traditional medicinal uses.

**Figure 1:** Lannea microcarpa plant (Source: Engl. & K. Krause., 1911)

## METHODOLOGY

*Sample collection*

Sample of the *L. microcarpa* roots were collected from Katsayal (town), Sandamu Local Government, Katsina State, Nigeria. The roots were cut from the plant using a sharp axe (to minimize damage). Sufficient sample was obtained, placed and packaged in a clean and dry polythene bag to preserve its integrity from sampling site, during transportation and until delivered to the laboratory for further analysis.

*Sample preparation*

The roots were washed thoroughly with tap water to remove any surface impurities such as soil debris and then rinsed with distilled water to eliminate any residual contaminants. The roots were cut into smaller pieces using a sharp knife before further processing. To protect the sample from environmental factors that could affect its composition, the roots were air dried, and ground into a fine powder using a mortar and pestle. The resulting powder was carefully transferred and stored in a clean, dry container, to protect contamination from moisture and other potential sources. Most importantly, the sample was authenticated at the Herbarium unit, Biology Department, Umaru Musa Yar'adua University Katsina.

*Proximate analysis*

A proximate sample analysis of the roots was conducted by adopting the methodology reported by Muhammad *et al.* (2018). For the mineral analysis, 1g of the sample was digested using 4 mL of perchloric acid ($HClO_4$, 60%) and concentrated sulphuric ($H_2SO_4$) acid (7:1) and 15 mL of concentrated nitric ($HNO_3$) acid. The solution was filtered in a 100 mL standard flask using Whatman filter paper and glass funnel, and the volume was adjusted to the mark (100 mL). The solution was analyzed for macro and micro minerals using Flame Atomic Absorption Spectroscopy (FAAS) and Flame Photometer respectively at the Umaru Musa Yar'adua University Central Research Laboratory.

## RESULTS AND DISCUSSION

The proximate analysis results as presented in Table 1 provide important understanding of the proximate composition of the *Lannea microcarpa,* specifically the roots, macro and micro mineral content. Additionally, the results provided key premises to potential implications for the roots nutritive and therapeutic applications.

**Table 1**: Proximate parameters value obtained in the roots of *Lannea macrocarpa*

| S/N | Parameter | Composition (%) |
|---|---|---|
| 1 | Moisture* | 28.00 ± 2.000 |
| 2 | Ash | 21.30 ± 1.160 |
| 3 | Crude fiber | 29.00 ± 0.500 |
| 4 | Crude lipid | 9.60 ± 0.200 |
| 5 | Crude protein | 6.91 ± 0.014 |
| 6 | Available carbohydrate | 33.30 ± 0.100 |
| 7 | Calorific value | 246.84 ± 0.010 |

* = *Percentage wet weight*

Generally, the root shows a relatively high moisture content (Table 1). The findings aligned with some and differed from previous studies on medicinal plant roots. For example, Liang et al. (2024) reported a similar moisture content observed comparable to *Codonopsis radix* roots. They argued that *Codonopsis radix* contains significant moisture content which affect its stability and preservation characteristics (Liang et al., 2024). This pointed out the need for proper drying and storage techniques to preserve the roots quality. Additionally, the results indicated roots potential as a source of essential minerals, with a high ash content of 21.3% (Table 1). The value observed is particularly noteworthy, as it exceeds values reported for many medicinal roots, corroborating it as a substantial mineral reserve (Maroyi, 2018).

The crude protein content (6.91 ± 0.014%) is relatively modest compared to the protein content found in *L. microcarpa* seeds (21.14%) (Maroyi, 2018). However, this protein level is consistent with typical root tissue compositions of other medicinal plants (Eyong et al., 2011; Wakawa et al., 2018; Agbo & Eze, 2024). The crude lipid content (9.60 ± 0.20%) is significant for root tissue, suggesting potential bioactive lipid compounds that may contribute to the plant's documented therapeutic properties (Maroyi, 2018).

The micro-minerals analysis revealed the presence of copper, magnesium, manganese, iron, and zinc in the following order of concentration magnitude: Fe>Mn>Zn>Mg>Cu (Table 2). The findings differ from many medicinal roots investigated, where magnesium is usually the major component in higher concentrations. While these minerals play essential roles in various physiological processes and are known to contribute to antioxidant defence, immune function, and metabolism, studies have shown that medicinal plant roots can accumulate significant amounts of essential minerals like calcium, magnesium, potassium, iron, zinc, and copper (Hédiji et al., 2015; Olaofe & Sanni, 1988). According to Hédiji et al. (2015), when tomato plants were exposed to cadmium stress, the roots showed increased calcium content at moderate cadmium levels, while zinc and copper contents increased in roots at higher cadmium exposure. The finding pointed out that plant roots can play a role in bioaccumulating minerals under stress conditions and hinted at their role as potential bioremediation agents. Generally, minerals in medicinal plants differ from plant to plant, part to part, but roots may have higher concentrations of certain minerals in many cases than shoots or fruits (Hédiji et al., 2015). The roots contain significant levels of calcium (28400 mg/kg), potassium (1526 mg/kg), and sodium (45033 mg/kg), as highlighted in Figure 1.

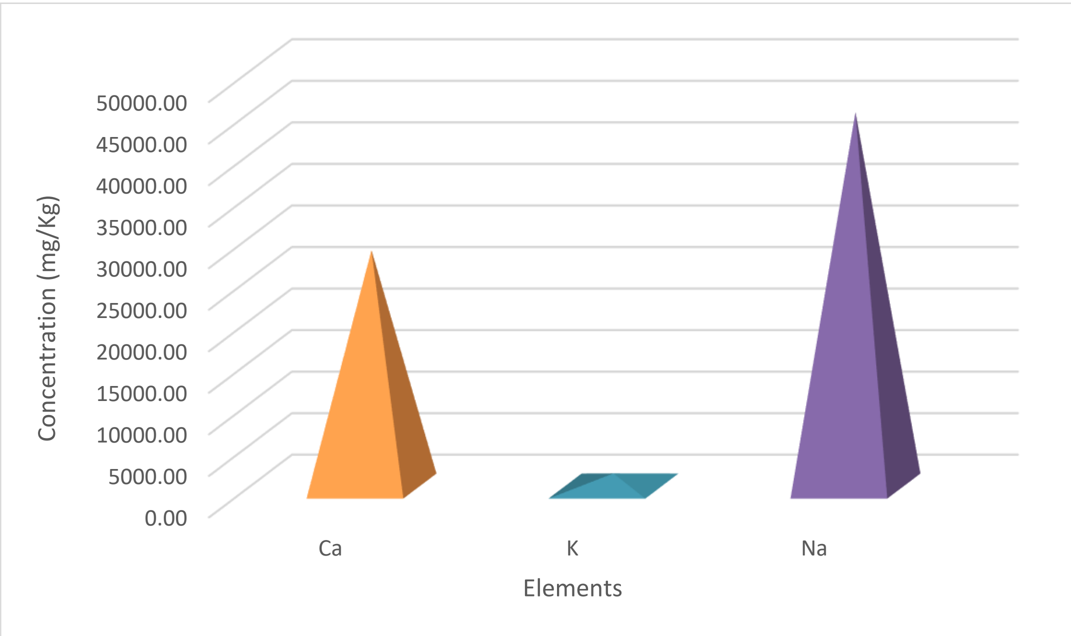


Fig. 1: Concentration of selected macro metals in the roots of *Lannea microcarpa*

The presence of these minerals in the root suggests its potential therapeutic applications in traditional medicine practices. For example, Calcium is useful in bone and teeth development, while potassium and sodium are good in maintaining a balanced fluid and nerve function in the body system. The levels of minerals depicted in Fig. 1 agreed with the finding of Radha et al. (2021), who investigated wild medicinal plants from the Himalayan region and observed varying levels of minerals like sodium, potassium, phosphorus, zinc, iron, copper, manganese, calcium, magnesium and sulfur.

As presented in Table 2, the amount of iron (~405mg/Kg) in the plant's roots may be attributed to its traditional uses in anaemia and related conditions treatment (Maroyi, 2018). The level of calcium content (28400 mg/kg) is particularly noteworthy, as it exceeds levels reported in many medicinal roots. The results further support the roots traditional use in bone-related ailments. Moreover, the level of sodium (45033 mg/kg) and potassium (1526 mg/kg) reported are high and unique compared to other medicinal roots. Accordingly, these maybe associated with the plant's traditional usage in hypertension and cardiovascular health conditions treatment (Maroyi, 2018).

**Table 2**: Concentration of some selected micro-metals in the *L. macrocarpa* roots.

| S/N | Element | Concentration (Mean ± SD) [mg/Kg] |
|---|---|---|
| 1 | Copper (Cu) | 8.600 ± 0.002 |
| 2 | Magnesium (Mg) | 9.240 ± 0.004 |
| 3 | Manganese (Mn) | 41.900 ± 0.001 |
| 4 | Iron (Fe) | 404.500 ± 0.042 |
| 5 | Zinc (Zn) | 9.460 ± 0.001 |

## CONCLUSION

This research conducted mineral and proximate analyses of the *Lannea microcarpa* to provide a critical and new perspective on its nutritional and therapeutic potential, with particular attention to the roots. The findings show that the roots have significant ash content, crude fibre, accessible carbohydrates, and essential minerals, such as Cu, Mg, Mn, Fe, and Zn. Although it may not substantially contribute to crude protein and lipids, the presence of a considerable amount of dietary fibre indicates potential advantages for gastrointestinal well-being. The presence of minerals and their respective applications in antioxidant defence, immune function, and metabolism corroborated the traditional medicinal uses of the root. Further research is recommended to investigate the bioavailability of minerals, phytochemical profile, and the bioactive compounds in the plant's root. Additionally, it will be important to investigate the biological functions of the root and conduct a clinical trial in order to identify the roots unique medicinal applications. This will enhance our comprehension of the mechanisms behind the root's effects and its synergistic interactions with other botanical compounds for evidence-based interventions development. This, in turn, would facilitate the integration of the plant's roots into the nutraceutical and pharmaceutical industries.

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