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Proximate and Mineral Analyses of African Grapes (*Lannea microcarpa*) Root for Nutritive and Therapeutic Applications

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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 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*; proximate analysis; mineral analysis; medicinal applications

INTRODUCTION

According to Zizka et al. (2015), *Lannea microcarpa* is a deciduous tree characterised by a compact, semi-spherical canopy reaching a maximum height of 16 metres. The tree species is native to the countries of Benin, Cameroon, Côte d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, and Togo. Nigeria exhibits a notable abundance of the aforementioned resources within its Northern states, namely Sokoto, Kebbi, Zamfara, Kaduna, Katsina, Kano, and Jigawa. The tree in question is widely recognised as a versatile species in West Africa, predominantly thriving in fertile and rocky soil, particularly within the Sahel savanna region. It is frequently gathered from its natural habitat to serve as a valuable resource for the local population, offering sustenance, medicinal properties, fibre, dye, handicraft materials, woodcarving materials, and fuel. The young leaves of *L. microcarpa* are consumed as leafy vegetables (Zizka, 2015; Nitiéma et al., 2019). Additionally, the seeds of *L. microcarpa* serve as significant sources of edible oil, which finds application in animal feeds, cosmetics, and biodiesel production (Yunus et al., 2013; Bazongo et al., 2014; Mustapha, 2014). The cultivation of this tree is conducted on a limited commercial basis and is observable within the vicinity of villages in Nigeria. According to Yunus et al. (2014), the fruit possesses desirable qualities for jam production, can be utilised in the production of wine, and its pulp can undergo fermentation to yield a highly potent alcoholic beverage. According to the findings of James et al. (2005), various parts of the plant, including its leaves, bark, roots, and fruits, have been traditionally employed for the treatment of a range of ailments such as mouth blisters, rheumatism, sore throats, dysentery, conjunctivitis, stomatitis, skin eruptions, and ulcers. According to various reports, the seed of this particular plant

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has been found to possess significant potential as a valuable source of protein (21.14%) and oil supplement (64.90%) when appropriately utilised (James et al., 2005; Yunus et al., 2013; Yaradua & El-Ghani, 2014). These reports have also provided detailed information regarding the proximate compositions of the seed and the physicochemical properties of its oil.

In recent years, interest has increased in the quest for new and sustainable sources of nutrients and medicinal chemicals. Botanical resources have been used for centuries in African traditional medicine to treat a wide range of health issues (Ouédraogo et al., 2017). One such plant, *Lannea microcarpa*, also called African grapes, has been acknowledged for its potential therapeutic benefits. For its numerous health advantages, African herbal medicine has long used *Lannea microcarpa's* root in particular. This research explores Lannea microcarpa's potential as a valuable source of nutraceutical and medicinal chemicals. Specifically, the research will investigate the proximate and mineral content of the roots. Proximate analysis will determine the macronutrient composition of the root, including levels of proteins, carbohydrates, and lipids. Additionally, essential elements like sodium, calcium, and potassium will be identified and quantified.

METHODOLOGY

The *Lannea microcarpa* root was harvested from Katsayal in the Sandamu Local Government of Katsina State. Careful measures were taken to obtain the sample, using a sharp axe to minimise damage. The root was then placed in a clean and dry polythene bag to preserve its integrity during transportation to the laboratory for further analysis. Upon arrival, the root was meticulously washed with tap water to remove any surface impurities and then rinsed with distilled water to eliminate residual contaminants. The root was expertly reduced into smaller sizes with a sharp knife to prepare for processing. The prepared root samples were then left to air dry, ensuring adequate ventilation and protection from environmental factors that could affect the composition. Upon complete dryness, the roots were meticulously ground into a fine powder using a mortar and pestle. The resulting powder was carefully transferred and stored in a clean, dry container, safeguarding it against moisture and other potential sources of contamination. To ensure accuracy and authenticity, the sample underwent authentication at the Herbarium unit, Biology Department, Umaru Musa Yar'adua University Katsina.

A proximate sample analysis was conducted following the methodology reported by Muhammad et al. (2018). The sample (1g) was digested using 4 mL of a mixture (7:1) of perchloric acid ($HClO_4$, 60%) and concentrated sulphuric acid and 15 mL of concentrated nitric (HNO_3) acid. The digestate was filtered, and the volume was adjusted to 100 mL in a standard flask. Analysis was carried out using Flame Atomic Absorption Spectroscopy (FAAS) for macro minerals, while a Flame Photometer was used to determine micro minerals.

RESULTS AND DISCUSSION

The results provide valuable insights into the proximate composition of the *Lannea microcarpa*, macro and micro mineral content, and potential implications for nutritive and therapeutic applications. In terms of proximate analysis, the root exhibited a relatively high moisture content (Table 1). The presence of moisture can affect the stability and shelf life of the root, highlighting the need for proper drying and storage techniques to preserve its quality. The ash content (21.3 ± 1.2) suggests a significant mineral composition in the root, indicating its potential as a source of essential minerals. The root sample demonstrated a considerable crude fibre content, indicating its potential as a dietary fibre source, crucial for promoting digestive health and regulating blood glucose levels. However, the relatively lower levels of crude protein (6.91 ± 0.014%) and crude lipids (9.60 ± 0.20%) suggest that the *Lannea microcarpa* root may not be a significant source of these macronutrients.

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

S/N	PARAMETER	COMPOSITION (%)
1	Moisture*	28.0 ± 2.0
2	Ash	21.3 ± 1.2
3	Crude fiber	29.0 ± 0.50
4	Crude lipid	9.60 ± 0.20
5	Crude protein	6.91 ± 0.01
6	Available carbohydrate	33.3 ± 0.10
7	Calorific value	247 ± 0.01

* = Percentage wet weight.

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). These minerals play essential roles in various physiological processes and are known to contribute to antioxidant defence, immune function, and metabolism. The presence of these minerals in the root suggests its potential therapeutic applications in traditional medicine practices. Similarly, the roots contain significant levels of calcium (28400 mg/kg), potassium (1526 mg/kg), and sodium (45033 mg/kg), as highlighted in Figure 1. Calcium is crucial for bone and teeth health, while potassium and sodium are vital in maintaining fluid balance and nerve function. These macro-minerals further support the root's potential contribution to overall health and well-being.

Table 2. Concentration of some selected micro-metals in the roots of *Lannea microcarpa.*

S/N	Element	Concentration (Mean ± SD) [mg/Kg]
1	Copper (Cu)	8.60 ± 0.002
2	Magnesium (Mg)	9.24 ± 0.004
3	Manganese (Mn)	41.9 ± 0.001
4	Iron (Fe)	405 ± 0.042
5	Zinc (Zn)	9.46 ± 0.001

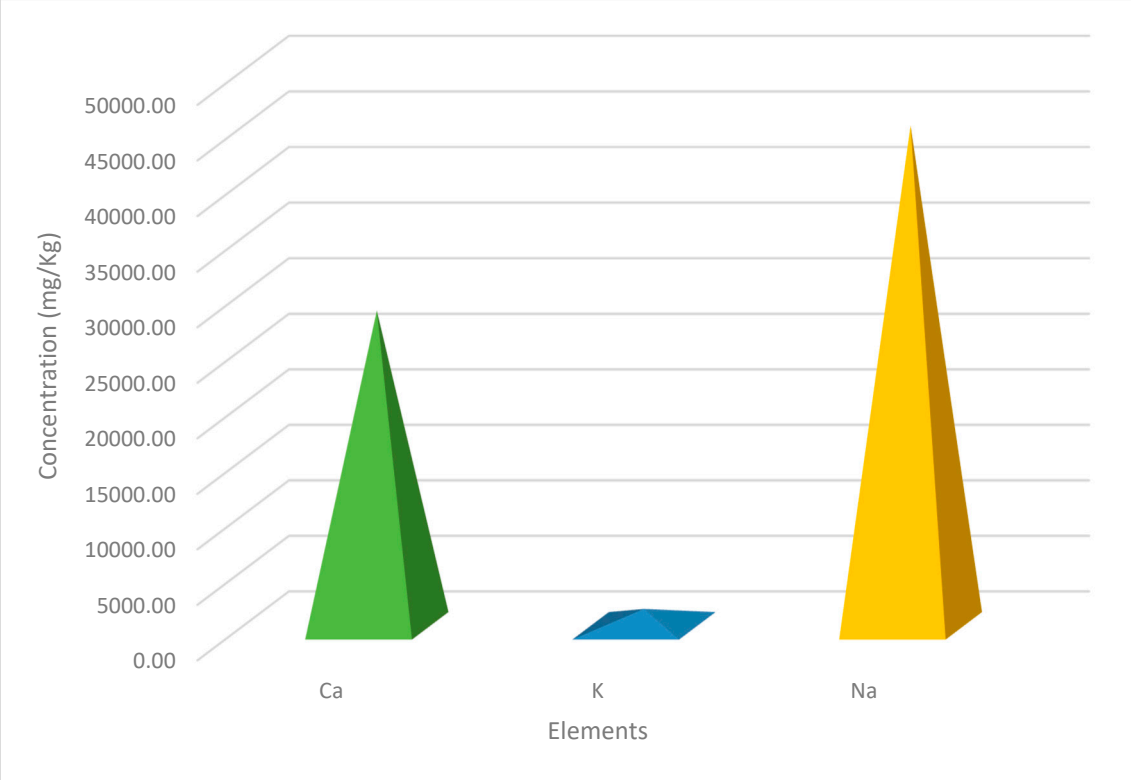

Figure 1. Concentration of selected macro metals in the roots of *Lannea microcarpa.*

CONCLUSION

The mineral and proximate analyses of the *Lannea microcarpa* root offer critical new perspectives on its nutritional and therapeutic potential. The root exhibits notable ash concentrations, crude fibre, accessible carbohydrates, and essential minerals, including copper, magnesium, manganese, iron, and zinc. Although it may not substantially contribute to crude protein and lipids, the presence of a considerable amount of dietary fibre in this substance indicates potential advantages for gastrointestinal well-being. The traditional medicinal uses of the root are underscored by the presence of various identified minerals and their respective roles in antioxidant defence, immune function, and metabolism. It is advisable to conduct additional research to investigate the bioavailability of minerals, the phytochemical profile, and the potential bioactive compounds in the root. Researching the biological functions of the root and carrying out clinical trials can also aid in identifying the unique medicinal uses of the root. Enhancing our comprehension of the mechanisms underlying the *Lannea microcarpa* root's effects and its potential synergistic interactions with other botanical compounds would significantly advance the development of evidence-based interventions. This, in turn, would facilitate the integration of *Lannea microcarpa* root into the nutraceutical and pharmaceutical industries.

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