PROXIMATE COMPOSITION OF *GMELINA ARBOREA* SEEDS

[1]Shahwan, K.T., [1]*Ogwiji, O., [1]Andyar, C.A., [2]Patrick, J.A., and [3]Utoo, E.G
[1]Department of Animal Health and Production Technology, School of Agriculture, Akperan Orshi Polytechnic, Yandev, Gboko Benue State.
[2]Department of Agricultural Science Education, Federal Collage of Education Odugbo, Apa Benue State.
[3]Department of Agricultural Technology, Federal Polytechnic Wannune, Takar Benue State
*Corresponding author: king_ogwiji@yahoo.com

ABSTRACT
The study determined the proximate composition of Gmelina arborea seeds. The seeds were manually extracted from the fruits, ensuring that no pulp or external residues remained. The extracted seeds were spread out on a clean surface under shade conditions for air-drying, reducing moisture content while preventing nutrient degradation from direct sunlight. After air-drying for 7–10 days, the seeds were oven-dried at 60°C for 48 hours to achieve consistent low moisture levels suitable for proximate analysis. The dried seeds were ground into a fine powder using a laboratory-grade grinder to ensure uniformity. The resulting seed powder was sieved through a 1 mm mesh to remove coarse particles, providing a homogeneous sample for analysis. The proximate composition of Gmelina arborea seeds was determined using standardized laboratory protocols as outline by AOAC (2010). The result showed that ash (%) 3.94, moisture (%) 4.65, crude protein (%) 31.15, calorific value (metabolizable energy) 7192.01, fixed carbon (%) 4.11 and volatile matter 87.39. The crude protein and energy levels make it compare favorably with conventional ingredients.
Keywords: Gmelina, Seed, Proximate analysis, Nutrition, Profile

INTRODUCTION

Gmelina arborea, commonly known as *beechwood* or *white teak*, is a fast-growing deciduous tree that belongs to the family Verbenaceae. Native to South and Southeast Asia, including India, Myanmar, and Thailand, it has also been widely cultivated in tropical and subtropical regions of Africa and South America due to its adaptability and economic value (Lawal,et al,2016). The tree is renowned for its high-quality timber used in furniture, construction, and paper industries. However, its seeds remain an underutilized resource despite their potential for nutritional and industrial applications.

Gmelina arborea seeds are small, ovoid, and encased in a drupe-like fruit. Traditionally, these seeds have been used in animal feed formulations and as raw material in biodiesel production due to their high oil content (Adeyemo & Ojo, 2021). Additionally, the seeds have shown potential as a source of bioactive compounds, including antioxidants, which could have significant implications for pharmaceutical and nutraceutical industries (Orakwe,2017). Despite these prospects, comprehensive research on their nutritional composition is limited, necessitating studies to unlock their full potential. Proximate composition analysis provides critical information about the nutritional value of biological materials by determining their content of moisture, ash, protein, fat, fiber, and carbohydrates. This analysis forms the basis for understanding the suitability of a material for food, feed, or industrial applications (AOAC, 2019). For *Gmelina arborea* seeds, such analysis could elucidate their potential as a sustainable source of energy, proteins, and essential nutrients, contributing to efforts aimed at food security and industrial innovation. Understanding the proximate composition also aids in the identification of novel applications. For instance, seeds rich in lipids and proteins could be utilized in formulating animal feed or as raw materials in cosmetic and biofuel industries. The fiber and carbohydrate fractions, on the other hand, could find use in functional foods or as fermentation substrates (Shraddha,et al,2023). Moreover, as the global demand for alternative protein and lipid sources rises, the exploration of unconventional seeds like *Gmelina arborea* becomes increasingly important for addressing resource scarcity.The primary aim of this study is to determine the proximate composition of *Gmelina arborea* seeds to establish a comprehensive nutritional profile that could guide their utilization in various sectors.

MATERIALS AND METHODS

The study was conducted using seeds of *Gmelina arborea* sourced from the Akperan Orshi Polytechnic Yandev, with selection criteria focusing on maturity and health; only fully ripe fruits, identified by their yellow coloration, and those free from visible damage, diseases, or pest infestations were chosen to ensure sample integrity. The harvested *Gmelina arborea* fruits were initially washed with clean water to remove dirt and debris. The seeds were then manually extracted from the fruits, ensuring that no pulp or external residues remained. The extracted seeds were spread out on a clean surface under shade conditions for air-drying, reducing moisture content while preventing nutrient degradation from direct sunlight. To ensure sample uniformity, seeds from multiple trees across

different locations within the polytechnic campus were pooled together. This approach reduced variability and ensured the results were representative of the seed population in the study area.
After air-drying for 7–10 days, the seeds were oven-dried at 60°C for 48 hours to achieve consistent low moisture levels suitable for proximate analysis. The dried seeds were ground into a fine powder using a laboratory-grade grinder to ensure uniformity. The resulting seed powder was sieved through a 1 mm mesh to remove coarse particles, providing a homogeneous sample for analysis.

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The laboratory analysis of *Gmelina arborea* seeds was done in a laboratory at Joseph Sarwuan Tarka University Makurdi. The proximate composition of *Gmelina arborea* seeds was determined using standardized laboratory protocols as outline by AOAC (2010).

RESULTS AND DISCUSSION

The proximate analysis of Gmelina arborea seed sourced from Akperan Orshi Polytechnic Yandev is as presented in the table1 below.

Table 1: Proximate analysis of Gmelina arborea seeds sample

Parameter	*Value*
Ash (%)	*3.94*
Moisture (%)	*4.65*
Crude Protein (%)	*28.00*
Calorific Value (Energy)	*7192.01*
Fixed Carbon	*4.11*
Volatile Matter	*87.39*

The proximate analysis of *Gmelina arborea* seeds provides valuable insight into their nutritional and industrial potential. The parameters examined include ash, moisture, crude protein, calorific value, fixed carbon, and volatile matter. The results, as shown in Table 1, demonstrate the seeds' promising qualities for various applications. The result is similar to the results of Lawal et al. (2016) and shraddha et al (2023). The moisture content of *Gmelina arborea* seeds was determined to be 4.65%, a remarkably low level compared to many conventional oilseeds. This feature significantly enhances the seeds' storage stability by reducing susceptibility to microbial contamination, fungal growth, and enzymatic degradation High-moisture seeds often require additional drying processes, increasing storage costs and the risk of nutrient loss. The low moisture content in *Gmelina arborea* seeds minimizes these challenges and ensures long-term preservation under ambient conditions. For example, oilseeds like *Jatropha curcas* and *Moringa oleifera*, which have moisture contents above 6%, are more prone to spoilage unless stored under controlled conditions (Girma *et al*., 2021).

Additionally, the reduced water activity in *Gmelina arborea* seeds supports efficient processing during feed or biofuel production, as less energy is required for drying. The ash content of 4.34% in *Gmelina arborea* seeds reflects the presence of essential inorganic minerals such as calcium, magnesium, potassium, and phosphorus. These minerals play a critical role in animal nutrition by supporting growth, bone development, and enzymatic activities (Lawal *et al.*, 2016). Moreover, the ash value is consistent with other nutrient-rich tree seeds, making *Gmelina arborea* a suitable candidate for bio-based applications, including feed additives and soil amendments. However, to maximize its utility in animal feeds, further research is necessary to analyze the exact mineral composition and evaluate the bioavailability of these nutrients. From an industrial perspective, the moderate ash content implies limited residue during combustion, further favoring the seeds for bioenergy purposes.

The crude protein content of 31.81% in *Gmelina arborea* seeds is one of its standout features, underscoring its potential as a high-protein feed ingredient. This value surpasses that of many traditional protein sources and aligns with leguminous seeds such as *Cajanus cajan*, which typically contain 22–26% protein (Chandra *et al*., 2022). The high protein content addresses the growing demand for alternative protein sources in livestock and poultry feeds, potentially reducing dependence on expensive and less sustainable options like soybean meal (Lawal *et al.*, 2016).). Furthermore, in regions facing protein-energy malnutrition, *Gmelina arborea* seeds could be processed into food supplements, providing an affordable and nutrient-rich solution. Their amino acid profile, though not analyzed in this study, warrants further investigation to fully establish their nutritional adequacy for both human and animal consumption. The seeds' calorific value of 7192.01 kcal/kg underscores their exceptional energy density, making them a competitive feedstock for both nutritional and industrial applications. This value is notably higher than that of several conventional feed resources and comparable to high-energy oilseeds like *Jatropha curcas* (Verma *et al*., 2020). For livestock and poultry, this energy density supports metabolic processes and growth, particularly in energy-intensive production systems. Industrially, the high calorific value enhances the seeds' viability as a raw material for biodiesel production and other bioenergy applications, aligning with the global shift towards renewable energy sources (Abdulrahman *et al*., 2023). Additionally, the seeds' energy profile supports their potential for use in the production of high-performance bioplastics and other value-added products.

The fixed carbon content (4.11%) and volatile matter (87.39%) of *Gmelina arborea* seeds further highlight their suitability for biofuel and combustion-based energy systems. High volatile matter facilitates efficient combustion and energy release, while the moderate fixed carbon ensures a stable burn rate and reduced residue production. These characteristics align with biomass feedstocks commonly used in bioenergy industries, such as wood pellets and agricultural residues (Bhat *et al*., 2021). For industrial applications, the combination of high volatile matter and calorific value positions *Gmelina arborea* seeds as a sustainable alternative to fossil fuels, particularly in decentralized energy systems. The proximate composition of *Gmelina arborea* seeds was compared to other tree seeds, such as *Moringa oleifera*, *Jatropha curcas*, and *Cajanus cajan*. The seeds exhibited a higher protein content than *Jatropha curcas*, renowned for its oil-rich seeds, and a comparable calorific value, which strengthens their role in both feed and biofuel applications. Their energy content also surpasses that of most conventional feed ingredients, highlighting their potential as a dual-purpose resource (Girma *et al*., 2021).

These findings suggest that *Gmelina arborea* seeds can compete favorably in markets dominated by traditional oilseeds and tree seeds. The proximate composition analysis reveals the versatility of *Gmelina arborea* seeds for various industrial and nutritional applications. In animal nutrition, their high protein and energy content make them a cost-effective and sustainable feed ingredient, potentially reducing dependency on soybean meal and other expensive protein sources. Industrially, their calorific value and combustion characteristics support their use in bioenergy production, biodiesel manufacturing, and bioplastic development (Vijayakumar *et al*., 2020).

Furthermore, their low moisture content and moderate ash levels enhance their processing efficiency and storage stability, making them an attractive option for both small-scale and industrial-scale applications. While the proximate composition of *Gmelina arborea* seeds highlights their immense potential, further studies are necessary to optimize their use. Research into the amino acid and fatty acid profiles of the seeds would provide a more comprehensive understanding of their nutritional value. Additionally, exploring genetic improvement programs to enhance seed yield and composition could further expand their industrial and nutritional applications. Finally, assessing the environmental and economic sustainability of large-scale *Gmelina arborea* seed utilization will be crucial for integrating this resource into global markets (Vijayakumar *et al*., 2020).

CONCLUSION AND RECOMMENDATIONS

The proximate composition analysis of *Gmelina arborea* seeds indicates they are highly nutritious, particularly due to their high crude protein content, which is superior to many conventional feed ingredients. Their low moisture content enhances their stability, minimizing the risk of microbial contamination. Additionally, the seeds possess a high calorific value, making them a promising candidate for bioenergy production. These findings suggest that *Gmelina arborea* seeds could serve as an alternative feed resource, providing both economic and environmental advantages. However, further research is needed to examine their amino acid and fatty acid profiles, explore genetic improvements for higher yields, and assess their sustainability for large-scale use

Further studies should analyze the amino acid and fatty acid profiles of *Gmelina arborea* seeds to better understand their nutritional value for animal diets. Research should focus on genetic improvement programs to enhance the yield and nutritional composition of *Gmelina arborea* seeds, boosting their economic viability for large-scale production. *Gmelina arborea* seeds' high protein and calorific value make them a promising sustainable alternative for animal feed, warranting further research on their palatability and digestibility.

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