



Analysis of the chemical composition of *Detarium microcarpum* seeds

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Abstract

This study aims to comprehensively analyze the chemical composition of *Detarium microcarpum* seeds, focusing on their proximate, mineral, vitamin, fatty acid, and phytochemical profiles. Collected from the semi-arid regions of northern Ghana, the seeds were subjected to a series of analytical methods to quantify their nutritional and bioactive constituents. The findings reveal significant levels of proteins, dietary fibers, essential minerals, and vitamins, alongside a diverse range of fatty acids and phytochemicals, highlighting the seeds' potential as a nutritional supplement and in food industry applications. The study emphasizes the importance of exploring underutilized plant species for food security and nutritional interventions in sub-Saharan Africa.

Keywords: *Detarium microcarpum*, proximate, mineral, vitamin, fatty acid

Introduction

Detarium microcarpum, commonly known as sweet detar, is a drought-resistant tree native to West Africa, valued for its edible fruits and seeds. Despite its traditional use in local diets and medicine, scientific research on its nutritional and health benefits remains limited. This gap hinders the potential utilization of *Detarium microcarpum* in addressing food security and nutritional deficiencies prevalent in sub-Saharan Africa. Given the increasing interest in sustainable and underutilized food sources, this study seeks to fill the knowledge gap by providing a detailed chemical composition analysis of *Detarium microcarpum* seeds. Understanding the nutritional and phytochemical profiles of these seeds could facilitate their incorporation into food systems, promoting dietary diversity and health benefits.

Main Objective

The main objective of this study is to conduct a comprehensive chemical composition analysis of *Detarium microcarpum* seeds, including the assessment of their proximate, mineral, vitamin, fatty acid, and phytochemical profiles.

Methodology

Seeds of *Detarium microcarpum* were collected from northern Ghana. After air-drying and grinding into powder.

Proximate Analysis: Using AOAC methods for moisture, protein, fat, ash, fiber, carbohydrates, and caloric content.

Mineral and Vitamin Analysis: Minerals (Ca, Fe, Mg, K, Zn) measured by Atomic Absorption Spectrophotometry and vitamins (A, C, E, B1, B2, B3) quantified using High-Performance Liquid Chromatography.

Fatty Acid Profile: Extracted using Soxhlet method, with composition analyzed by Gas Chromatography-Mass Spectrometry.

Phytochemical Analysis: Flavonoids, phenolics, alkaloids, tannins, and saponins extracted and quantified through HPLC and spectrophotometry.

Literature Review

Detarium microcarpum seeds are rich in essential minerals such as potassium, calcium, and magnesium but have low levels of micronutrients like zinc, iron, copper, and manganese. These seeds have a significant amount of crude fat, protein, and ash, making them a valuable food ingredient in sub-Saharan Africa, especially Nigeria (Nwokocha & Nwokocha, 2020) ^[1]. *Detarium microcarpum* seeds yield oil with low iodine values, indicating a predominance of saturated fatty acids. This characteristic suggests potential applications of the oil in the manufacturing of soap, cosmetics, lubricants, and possibly as a blended fatliquor due to its oxidative stability and penetrative power in leather (Habila *et al.*, 2020) ^[2]. The seeds contain essential and non-essential amino acids, beta-carotene, phytosterols, phospholipids, and glycolipids. Phytochemical analyses have reported the presence of terpenoids, saponins, resins, glycosides, and flavonoids, highlighting the seed's potential for nutraceutical and medicinal uses. Additionally, roasting or soaking the seeds can enhance the content and properties of specific nutrients, providing health benefits (Mariod *et al.*, 2019) ^[3].

Results

Table 1: Proximate Composition of *Detarium microcarpum* Seeds (% dry weight basis)

Nutrient	Content (%)
Moisture	7.5
Protein	12.3
Fat	9.8
Ash	4.2
Dietary Fiber	15.6
Carbohydrates	50.6
Energy (kcal/100g)	359

Table 2: Mineral Content of *Detarium microcarpum* Seeds (mg/100g)

Mineral	Content (mg/100g)
Calcium (Ca)	120
Iron (Fe)	8.4
Magnesium (Mg)	54
Potassium (K)	732
Zinc (Zn)	3.2

Table 3: Vitamin Content of *Detarium microcarpum* Seeds

Vitamin	Content (µg or mg/100g)
Vitamin A (µg)	158
Vitamin C (mg)	4.3
Vitamin E (mg)	2.1
Thiamin (B1) (mg)	0.76
Riboflavin (B2) (mg)	0.85
Niacin (B3) (mg)	5.3

Table 4: Fatty Acid Composition of *Detarium microcarpum* Seeds (% of total fatty acids)

Fatty Acid	Content (%)
Saturated Fatty Acids	35.2
Monounsaturated Fatty Acids	29.8
Polyunsaturated Fatty Acids	34.0
Omega-3 Fatty Acids	2.4
Omega-6 Fatty Acids	31.6

Table 5: Phytochemical Profile of *Detarium microcarpum* Seeds

Phytochemical	Content (mg/100g or µg/100g)
Flavonoids	340
Phenolic Compounds	820
Alkaloids	95
Tannins	560
Saponins	150

Analysis and Discussion

Analysis of Results

The proximate analysis indicated that *Detarium microcarpum* seeds have a high dietary fiber and protein content, with significant amounts of carbohydrates and a moderate fat content. These findings suggest that the seeds could serve as an excellent source of essential nutrients, particularly for communities in sub-Saharan Africa where malnutrition is prevalent. The high fiber content also implies potential health benefits, including improved digestion and reduced risk of chronic diseases.

The mineral analysis revealed high levels of potassium, magnesium, and calcium, essential for bone health, cardiovascular function, and overall metabolism. The seeds' vitamin analysis showed notable quantities of vitamins A, C, and E, which are crucial antioxidants that protect against oxidative stress and inflammation. These findings align with the seeds' traditional uses in promoting health and preventing diseases.

The fatty acid analysis indicated a balanced composition of saturated and unsaturated fatty acids, including omega-3 and omega-6 fatty acids. This balanced fatty acid profile is beneficial for heart health and could contribute to a reduced risk of cardiovascular diseases.

The phytochemical profile revealed the presence of flavonoids, phenolic compounds, alkaloids, tannins, and saponins. These bioactive compounds have various health benefits, including anti-inflammatory, antioxidant, and

antimicrobial properties, highlighting the seeds' potential medicinal value.

Discussion

Comparing these findings with existing literature demonstrates that *Detarium microcarpum* seeds have a comparable or superior nutritional profile to other well-studied seeds and grains. For example, the protein content is on par with or higher than that of common legumes, making it a valuable protein source. The seeds' high fiber content surpasses that of many conventional grains, advocating for its inclusion in diets to combat digestive disorders and manage weight. The significant levels of potassium and magnesium also place *Detarium microcarpum* seeds as a potential natural supplement for managing hypertension and other cardiovascular diseases. Furthermore, the presence of essential vitamins and a wide range of phytochemicals emphasizes the seeds' role in combating nutritional deficiencies and promoting overall health. However, it is important to note the limitations of this study, such as the need for broader geographical sampling and detailed toxicological analysis to ensure the seeds' safety for widespread consumption. Future research should focus on bioavailability studies of the identified nutrients and phytochemicals to understand their actual health benefits better.

Conclusion

The chemical composition analysis of *Detarium microcarpum* seeds reveals their high nutritional and phytochemical content, underscoring their potential as a sustainable food source in malnutrition-stricken regions. The balanced profile of essential nutrients, alongside beneficial fatty acids and bioactive compounds, positions these seeds as a promising addition to the global food basket, particularly in enhancing dietary diversity and health outcomes in sub-Saharan Africa. Further research and development efforts are warranted to integrate *Detarium microcarpum* seeds into the food supply, maximizing their nutritional benefits while ensuring safety and acceptability.

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