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Comparative Study on the Phytochemicals, Proximates, Vitamins and Mineral Elements Compositions of Unfermented and Fermented Seeds of *Parkia biglobosa*

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Abstract
This study was undertaken to compare the phytochemical, proximate, vitamin and mineral elements compositions of unfermented and fermented seeds of *Parkia biglobosa* (African locust bean). The results revealed that the unfermented seeds had higher amounts of alkaloids, tannins and Phytate, compared to the fermented seeds with higher amounts of flavonoids and saponins. The proximate composition showed that the unfermented seeds contained higher amounts of dry matter, crude fibre and carbohydrate, compared to the fermented seeds having higher amounts of moisture, crude protein and lipids, while there was no significant difference in their amount of ash. The fermented seeds contained higher concentrations of retinol, ascorbic acid, thiamine riboflavin and niacin, compared to the unfermented seeds having a higher concentration of only tocopherol. The results of the mineral elements composition for the unfermented and fermented seeds showed that there was no significant difference in the concentrations of potassium, calcium, magnesium, phosphorus, iron, zinc, manganese and copper, while the unfermented seeds had significantly higher amount of sodium than the fermented seeds. These investigations revealed that the fermented seed of P. biglobosa is more nutritionally rich than the unfermented seeds. The fermented seeds are also more suitable for consumption by hypertensive patients.

Keywords: Fermented, Minerals, *Parkia biglobosa*, Phytochemicals, Proximate, Unfermented, Vitamins

Introduction
Legumes are plant seeds such as beans, peas and peanuts. They are edible plants which are used as staple food around the globe. Legumes are highly nutritious being rich in protein, amino acids, dietary fibre, vitamins and fatty acids [1,2]. Despite the high nutritional values of legumes, certain legumes are still underutilized in South Eastern Nigeria. One of such legume is *Parkia biglobosa*, commonly known as the African Locust Bean. *Parkia biglobosa* is a perennial leguminous tree belonging to the family, Leguminosae and sub family, Mimosideae [3]. Its vernacular names include; Ogiri in Igbo, Irugba in Yoruba and Dorowa in Hausa [4]. The seed is usually extracted from the yellow pulp. The seed can be roasted for the production of Soudan Coffee. The seed is eaten as meal when cooked and are used as condiments to enhance the flavor of foods when fermented [5]. The plant parts such as the leaves, stem bark, pulp and seed are used to relief diarrhea, dysentery and in the prevention of cardiovascular diseases [6]. In Ghana, the leaves, stem bark, raw fruit and fermented seed are used for the treatment of malaria and stomachache [7]. In Nigeria, the leaves roots and stem bark are used for the treatment of hypertension, stomachache, ulcer, fever and stroke [8,9]. *Parkia biglobosa* is a wild legume and wild legumes have been reported as rich sources of protein, amino acids, essentially fatty acids, fibre and vitamins [10]. The phytochemical, proximate and mineral elements compositions of both the seeds, fruit pulp and leaves have been reported [11,12]. Fermented foods have been found to be more nutritious than their unfermented counterparts [13]. Hence, the aim of the present study is to compare the phytochemicals, proximate, vitamins and mineral elements composition of unfermented and fermented seeds of P*arkia biglobosa.*

Materials and Methods
Sample Collection and Preparation
Matured locust bean pods were gotten from Gwagwa local market, Abuja. The fruit yellow pulp was separated from the seed by scraping it off with the aid of a knife. Dehulling of the seed was done using a mortar and pestle. The dehulled seeds were grounded into powder using a blender. Fine grounded powder of the seeds was obtained by sieving with 1 mm aperture and the sample stored for laboratory analysis. The powdered seeds were

divided into two portions. One portion was fermented for four days before determining the chemical compositions, while the chemical compositions of the other portion were determined without fermentation.

Determination of Plant Chemicals

Alkaloids and saponins were determined according to the method of Harbone [14]. Tannins was determined as described by Kirk and Sawyer [15]. Flavonoids was determined as described by Bohma and Kocipal, while phytate was determined by the method described by Ajayi [16,17]. Vitamins were determined by the method of the Association of vitamin chemist as described by Kirk and Saywer except for thiamine, riboflavin and niacin which were determined according to the method described by Okwu and Ndu [18,19]. The mineral elements composition was determined by the methods described by the Association of Official Analytical Chemists [20]. The proximate composition was determined by the method of James [21].

Statistical Analysis

Data in Tables were mean ± standard deviation (SD) of triplicate determinations.

Results and Discussion

Table 1: Phytochemical composition of unfermented and fermented *Parkia biglobosa* seeds

Phytochemicals	Concentration mg/100 Unfermented	Concentration mg/100g Fermented
Alkaloids	0.13±0.01	0.11±0.01
Flavonoids	0.29 ±0.03	2.57±0.15
Saponins	0.35±0.01	1.23±0.03
Tannins	0.16±0.02	0.09±0.01
Phytate	0.12±0.01	0.05±0.02

Values are mean ± SD of triplicate determinations

Table 2: Proximate compositions of unfermented and fermented *Parkia biglobosa* seeds

Proximates	Composition (%) Unfermented	Composition (%) Fermented
Moisture content	6.20±0.13	8.40±0.10
Dry matter	93.80±0.13	91.60±0.10
Ash content	7.20±0.04	7.10±0.03
Crude protein	31.07±0.27	37.21±0.51
Crude fibre	13.22±0.39	9.15±0.75
Lipid content	23.22±0.39	26.10±0.05
Carbohydrate	20.70±0.80	18.25±0.15

Values are mean ± SD of triplicate determinations

Table 3: Vitamin compositions of unfermented and fermented *Parkia biglobosa* seeds

Vitamins	Composition mg/100g Unfermented	Composition mg/100g Fermented
Retinol	158.07 ±1.71	161.10±1.15
Ascorbic acid	13.20±0.04	15.30±0.05
Tocopherol	118.20±0.02	116.71±0.02
Thiamine	0.04±0.01	0.07±0.03
Riboflavin	0.02 ± 0.01	0.04±0.02
Niacin	0.12 ± 0.01	0.31±0.01

Values are mean ± SD of triplicate determinations

Table 4: Mineral Element compositions of unfermented and fermented *Parkia biglobosa* seeds

Minerals	Composition mg/100g Unfermented	Composition mg/100g Fermented
Sodium	168.08±2.10	144.03±1.90
Potassium	138.3±0.50	138.10±0.60
Calcium	551.62±0.15	551.70±0.17
Magnesium	68.53±1.10	68.05±0.90
Phosphorus	58.44±0.15	57.90±0.01
Iron	9.66±0.02	9.71±0.02
Zinc	7.22±0.01	7.18±0.03
Manganese	0.78±0.01	0.77±0.01
Copper	1.77±0.01	1.80±0.02

Values are mean ± SD of triplicate determinations

The phytochemical constituents of unfermented and fermented seeds of *Parkia biglobosa* are shown in Table 1. The unfermented seeds had higher concentrations of alkaloids, tannins and phytates, while the fermented seeds contained higher amounts of flavonoids and saponins compared to the unfermented seeds. The medicinal properties of plants are related to the phytochemicals present in it [22]. Alkaloids are low molecular weight nitrogen containing compounds with pharmacological properties such as analgesic, anticancer, anti-hyperglycermic, antiarrhythmic, antibacterial, sitmulating and psychotropic properties [23]. Saponins have anti-inflammatory, anti-cancer, haemolytic and hypoglycemic properties [24]. Saponins also precipitate cholesterol and help prevent hypercholesterolemia, which is implicated in cardiovascular diseases [25]. Flavonoids are polyphenolic compounds with antioxidant properties. As antioxidants, they protect the body against diseases caused by free radicals. Flavonoids also possess anti-inflamatory, anticancer, antimicrobial, immune stimulatory, vasolidating and antiallergic properties [26]. Tannins have been used for immediate relief of sore throat and diarrhea. Tannins heal burns, stop bleeding and protect the kidney [27]. Phytate helps prevent kidney stone formation, protect against diabetes, cancer, atherosclerosis and coronary heart disease. However, it prevents the absorption of some minerals in the body [28]. Fermentation decreased the concentration of phytate, an antinutrient. It also increased the flavor and taste of *Parkia biglobosa* seeds due to increase in the concentration of flavonoids and decrease in the concentration of tannins. The proximate compositions of the unfermented and fermented seeds of *Parkia biglobosa* are displayed in Table 2. Dry matter, crude fibre and carbohydrate were higher in the unfermented seeds, while moisture, crude protein and lipid contents were higher in the fermented seeds compared to the unfermented seeds. There is no significant difference in the ash content of both the unfermented and fermented seeds. Proteins help in body development, formation of hormones and enzymes, and in the maintenance of fluid balance [29]. Lipids provide energy and protect the body from mechanical injury, while fibre helps prevent constipation, bowel problems and colon cancer [30]. An increase in the lipid content of the seed upon fermentation, means an increase in the palatability of fermented *Parkia biglobosa*. Carbohydrates supply energy to the brain, muscle and blood. The ash content is a measure of the number of mineral elements in the seed, while moisture is a measure of the shelf life of the seed. The vitamin compositions of the unfermented and fermented seeds, shown in Table 3, indicated that the fermented seeds had higher amounts of retinol, ascorbic acid, thiamine, riboflavin and niacin, while the unfermented seeds had higher amount of tocopherol, compared to the fermented seeds. Ascorbic acid is essential for growth and development, prevention of night blindness, as well as strengthening the immune system [31]. Tocopherol and ascorbic acid are good antioxidants which protect the cell membrane from damage/oxidative stress emanating from free rad-

icals [32]. Riboflavin play an important role in eye health, while niacin helps lower cholesterol, ease arthritis and boost brain function [33]. The mineral element compositions of the unfermented and fermented seeds of *Parkia biglobosa* are shown in Table 4. The mineral elements present include sodium, potassium, calcium, magnesium, phosphorus, iron, zinc, manganese and copper. From the results, there is no significant difference in the mineral elements composition of both the unfermented and fermented seeds, except for sodium, whose concentration is higher in the unfermented seeds, compared to the fermented seeds. Calcium is required for the formation of teeth and bone and blood clothing. Sodium and potassium are essential nutrients needed for maintenance of plasma volume, acid- base balance and normal cell functions [34]. A decrease in the amount of sodium in the seed upon fermentation would mean a decrease in blood pressure, thereby making fermented *Parkia biglobosa* seeds suitable for consumption by hypertensive patients. Magnesium helps in maintaining bone health, prevention of osteoporosis and atherosclerosis. Iron is essential for haemoglobin formation while zinc is vital for protein synthesis, immunity and sexual functions [35]. Phosphorus is important for normal cell growth and repair, bone growth and kidney function. Copper is essential for maintenance of healthy bone and in iron absorption, while manganese helps in the metabolism of amino acids and carbohydrates. It also plays a role in bone formation and blood clothing. Fermented foods improve digestion and digestibility of foods, lower serum cholesterol, protect against infection, enhance the immune system and bioavailability of nutrients, as well as have antihypertensive and anticarcinogenic activities [36].

Conclusion

From the results obtained in this study, fermented *Parkia biglobosa* seeds have better nutritional value, owing to its higher amounts of proteins, lipids, vitamins, as well as lower amounts of phytate and sodium, compared to the unfermented seeds. This investigation therefore suggests the consumption of the fermented seeds more than the unfermented ones especially by hypertensive patients.

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