

## Nutritional Profile and Phytochemical Assessment of *Senegalia macrostachya* (*Mimosaseae*) seed (“Ya’yan Gardaye”)

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### ABSTRACT

The seeds of *Senegalia macrostachya* (commonly known as “Ya’yan Gardaye” in Hausa) are underutilized plant resources with significant nutritional and medicinal potential. *S. macrostachya* is a plant native to Senegal, southern Sudan, and sub-Saharan Africa. This study evaluates the nutritional composition and phytochemical profile of *S. macrostachya* seeds obtained from Jabo, Tambuwal Local Government Area, Sokoto State, Nigeria. The seeds were processed into powder for subsequent analyses. Proximate assessment revealed a composition of 6.50±0.02% moisture, 6.00±0.01% ash, 6.00±0.02% lipid, 5.00±0.01% crude fiber, 3.36±0.01% nitrogen, 21.0±0.20% protein, and 55.50±0.30% carbohydrates. Mineral analysis indicated the presence of calcium (5.00±0.02 mg/g), magnesium (24.00±0.21 mg/g), sodium (70.00±0.32 mg/g), potassium (3000±0.01 mg/g), and phosphorus (0.70±0.00 mg/g). Sequential extraction using methanol, hexane, and ethyl acetate yielded 13.4%, 3.64%, and 2.0% respectively, with methanol producing the highest yield. Phytochemical screening of the extracts confirmed the presence of bioactive compounds, including steroids, flavonoids, saponins, tannins, glycosides, alkaloids, cardiac glycosides, balsams, and volatile oils, which are associated with antioxidant, antimicrobial, and anti-inflammatory activities. These findings highlight *S. macrostachya* seeds as a promising source of nutrients to combat malnutrition and bioactive compounds for therapeutic applications. Further studies are recommended to explore the bioavailability, toxicological profile, and mechanisms of action of the identified compounds for broader utilization in food and pharmaceutical industries.

**Keywords:** Proximate, Minerals, Phytochemical, *S. macrostachya*

### 1.0 INTRODUCTION

Malnutrition and antibiotic resistance are current global health problems affecting developing countries due to poverty, lack of access to antibiotics among other factors. The proximate and mineral compositions as well as the secondary metabolites of medicinal plants are due to its ability to biosynthesize compounds with nutritive and pharmacological activities (Muhammad *et al.*, 2020). The seeds of plants serve as a great source of nutrition for living organisms, including humans and various animals. They possess nutritional benefits that contribute to plant growth, containing numerous healthy fats, like omega-3 fatty acids. Most of the foods we eat are derived from seeds, with some examples of edible seeds including legumes, cereals, and nuts, among others (Ajmera *et al.*, 2023).

The extraction of nutritious oils from oilseeds, such as sunflower, flaxseed, rapeseed, and sesame, is a common practice. Seeds are typically abundant in unsaturated fats and, when consumed in moderation, are regarded as a

healthy food option (Mathew *et al.*, 2024). However, it should be noted that some seeds are not considered safe for consumption. These seeds have been shown to synthesize a multitude of chemical compounds, collectively termed phytochemicals. *Senegalia macrostachya* is native to regions ranging from Senegal to South Sudan. This species is a climbing shrub or tree that primarily thrives in the seasonally dry tropical biome (Butler, 2019; Garba *et al.*, 2023).

The plant is characterized by its spiny, multi-stemmed, and woody characteristics. It exhibits a shrubby form, reaching heights of approximately 4 meters, or it can adopt a climbing growth habit, sometimes growing as tall as 15 meters and resembling a tree. The plant is occasionally collected from the wild for local uses, including food, medicinal purposes, and wood supply. It is also cultivated as a thorny hedge to deter unwanted intruders. The plant is known to thrive in hard-pan and gravelly soils, and is occasionally found in sandy or loamy soils in country like Niger. It grows in bushy

scrub, wooded Savannah on compact sand, and thickets in shallow soils on hard-pan (S Chad); it can also develop into thorny thickets. In local communities of Sokoto State, it is commonly referred to as Gardaye in the Hausa language. It is utilized in traditional medicine to address a variety of ailments, including high fever as a result of malaria, snake bites, nausea, dysenteric syndrome, choleric conditions, inflammation caused by diseases, wounds, uterine fibroids, parasites that lead to stomach problems, constipation, severe spasms, dysmenorrhea, and benign prostate hyperplasia (Chika *et al.*, 2022; Coulibaly *et al.*, 2020). (Chika *et al.*, 2022; Coulibaly *et al.*, 2020). The objective of the present study is to evaluate the nutritive and phytochemical constituents of *S. macrostachya* seed using standard procedure.



Plate 1: *Senegalia macrostachya* plant on its habitat with seeds

## 2.0 METHODOLOGY

### 2.1 Sample Collection and Treatment

The sample seeds of *Senegalia macrostachya* were obtained from Jabo town, Tambuwal local government area of Sokoto state. The *S. macrostachya* seeds were extracted from the seed pods and meticulously washed with both tap and distilled water. Thereafter, the seeds were dried and separated from their pods. The seeds were then ground into a powder and preserved in a polythene bag.

### 2.2 Proximate and Mineral Assessment

#### 2.2.1 Moisture Content

The dry seeds were carefully examined to determine their moisture content. The powdered *S. macrostachya* seed (2g) was transferred to a pre-heated ceramic container (crucible). Within the scorching oven, set to one hundred and five degrees Celsius (105°C) for 6h. Upon removal after a six-hour period of time, it achieved a consistent mass. Still warm, it was allowed to cool in the controlled environment of a desiccator. Only once it had returned to the surrounding temperature was it reweighed. By comparing the initial and final values, the percentage of

water was calculated using the standardized formula below. The precise analysis revealed the amount of hydration still clinging to the remnants of the vibrant seeds. (Muhammad *et al.*, 2020).

$$\% \text{ moisture} = \frac{W_1 - W_2}{\text{Wt of sample}} \times 100 \dots \dots \dots 1$$

Where

$W_1$  = weight of crucible + sample before heating

$W_2$  = weight of crucible + sample after heating

#### 2.2.2 Determination of % Ash

A crucible that had been thoroughly cleaned and left empty was placed in a muffle furnace and heated to 6000°C for one hour in order to ascertain the amount of ash produced. Following this, the empty crucible was allowed to cool in a desiccator, and its weight was recorded ( $W_1$ ). A sample weighing one gram was placed in a second crucible ( $W_2$ ). The sample was then ignited over a burner using a blowpipe until it was blackened. The crucible was then heated to 550 degrees Celsius for three hours in a muffle furnace. The oxidation of all organic particles in the sample is complete when grey-white ash appears. Subsequent to this, the crucible was subjected to a process of cooling, after which it was reweighed ( $W_3$ ). The percentage of ash was then calculated using equation (2) below. (Muhammad *et al.*, 2020).

$$\% \text{ ash} = \frac{\text{difference in wt. of Ash} \times 100}{\text{Wt. of Sample}} \times 100 \dots \dots \dots 2$$

#### 2.2.3 Crude Protein Determination

The Kjeldahl technique was used to assess the crude protein content of *Senegalia macrostachya* seeds. Eight grams of the digestion mixture ( $K_2SO_4$ : $CuSO_4$ , 8:1), two grams (2g) of dried *S. macrostachya* seeds, and 15 cm<sup>3</sup> of concentrated  $H_2SO_4$  were added to the flasks. To ensure that the contents were thoroughly mixed, the flask was swirled. The ingredients are put on the digesting setup gear to begin the process of digestion, which continues until the combination turns blue-green. After cooling, the digest-containing flask was moved to a 100 cm<sup>3</sup> volumetric flask and filled to 100 cm<sup>3</sup> with distilled water. A Markam-still distillation device was used for the distillation (Muhammad *et al.*, 2020).

In the same way, 10 cm<sup>3</sup> of digest and 10 cm<sup>3</sup> of 0.5N NaOH were progressively added to the distillation tube. With the use of a conical flask containing 20 cm<sup>3</sup> of a 4% boric acid solution and five drops of a modified indicator (methyl red indicator), the component ( $NH_3$ ) that was formed after the 10-minute distillation process was collected as ammonium hydroxide. Following a 0.1N HCl solution titration of the distillate, the final result (pink hue) was observed. All of the preceding procedures were followed for blank titration and the equation (3)

below was used to get the percentage crude protein content:

$$\% \text{ crude protein} = 6.25 \times N (\text{Correction factor}) \dots \dots \dots 3$$

$$\% N = \frac{S - B \times N \times 0.14 \times D \times 100}{\text{Wt of sample}} \dots \dots \dots 4$$

Where

- S = sample titre value (cm<sup>3</sup>)
- B = blank titre value (cm<sup>3</sup>)
- N = concentration of Hydrochloric acid
- D = Dilution factor of sample after digestion
- V = volume of distilled water taken
- 0.014 = Milli equivalent weight of nitrogen

### 2.2.4 Determination of Crude Fiber

Two grams (2g) of *Senegalia macrostachya* seed powder were put into the crucible and weighed as (W<sub>0</sub>). The crucible was then set on the Dosi-fiber unit while the valve remained in the "OFF" position. Each column received three drops of foam suppressor after 150 cm<sup>3</sup> of hot sulfuric acid solution was injected. Next, the cooling circuit was opened and activated (power at 90%). The electricity was cut by 30% when it started to boil, and it was also left for half an hour. To guarantee that all the acid was removed from the sample, the valve was opened to remove it and then rinsed three times with distilled water. Instead of using sulfuric acid for alkali digestion, KOH was utilized. After an hour of drying at 150°C in an oven, the sample was cooled in a desiccator and weighed as (W<sub>1</sub>). After three hours at 55°C in a muffle furnace, the sample in the crucible was cooled in a desiccator and weighed as (W<sub>2</sub>). Equation (5) below was used to estimate the percentage of crude fiber:

$$\% \text{ crude fiber} = \frac{W_1 - W_2}{W_0} \times 100 \dots \dots \dots 5$$

### 2.2.5 Determination of Crude lipid

The lipid from *S. macrostachya* was determined via a dry extraction method. Two grams (2g) of the dried *S. macrostachya* seeds were extracted with different solvents (hexane, ethyl acetate and methanol). Crude fat is the term used to describe the collective outcomes of the extraction of fat materials, such as phospholipids, sterols, fatty acids, carotenoids, pigments, chlorophyll, etc. Intermittent fat was determined. After being wrapped in filter paper, two grams (2g) of moisture-free *S. macrostachya* seeds were put in a fat-free thimble and brought into the extraction chamber of a Soxhlet apparatus. After the receiving beaker was weighed and filled with petroleum ether, it was attached to the device and the heating source was turned on to begin the extraction process. Following five siphonings, the solvent was expelled. The extract was then poured into a sanitized glass dish. After two hours at 105°C in the oven, the dish was chilled in a desiccator. The following

equation (6) was used to calculate the percentage of crude fat:  $\% \text{ Crude Fat} = \frac{\text{Wt of ether extract} \times 100}{\text{Wt of sample}} \dots \dots \dots 6$

### 2.2.6 Assessment of Nitrogen Free Extract

In the proximate analysis, nitrogen free extract (NFE) was computed as the difference between the methods for analyzing all other components as follows:

$$\text{NFE} = (100 - \% \text{ moisture} + \% \text{ protein} + \% \text{ fat} + \% \text{ crude fiber} + \% \text{ ash}) \dots \dots \dots 7$$

(Muhammad *et al.*, 2020)

### 2.2.7 Determination of Mineral Contents

The minerals present in *Senegalia macrostachya* seed were assessed in accordance with Muhammad *et al.* (2020)

#### Digestion of *S. macrostachya* seeds Sample

In the wet digestion process, a glass tube containing precisely 1 gram of the *S. macrostachya* seed powder was agitated. The mixture was left overnight at room temperature after twelve milliliters (12 ml) of HNO<sub>3</sub> was added. After adding 4.0 milliliters of perchloric acid (HClO<sub>4</sub>), the mixture was placed in a fume block to aid in digestion. The temperature rises gradually from 500°C to 250°C to 300°C. White vapors appeared, indicating that the digestion has finished in roughly 70 to 85 minutes. The contents of the tubes were moved to 100 ml volumetric flasks when the mixture had cooled, and the quantities of the contents were adjusted to 100 ml using distilled water. The wet digested solution was put into precisely labeled plastic bottles, where it was kept until it was needed for mineral analysis.

#### 2.2.7.1 Assessment of magnesium (mg) and Calcium (Ca) by AAS approaches

##### Basic Principle:

Using an atomic absorption spectrophotometer, the mineral content of the digested sample was determined. *S. Macrostachya* seeds were utilized to test the absorption of the elements; different electrode lamps were employed for each mineral. Before and during determination, the apparatus was tested for standard solutions of each mineral to ensure correct operation. Except for magnesium and phosphorus, all minerals had a dilution factor of 100. The original solution was further diluted using 0.5 ml, and extra distilled water was added to bring the volume up to 100 ml in order to determine the magnesium (Mg) as supported by the equation below:

$$MW = \frac{\text{absorbance (ppm)} \times \text{dry Wt} \times D}{\text{Wt. of sample} \times 1000} \dots \dots \dots 8$$

Note: The dilution factor is 100 for calcium, iron, potassium, sodium manganese, and chromium, and 2500 for phosphorous and 10,000 for magnesium.

### 2.2.7.2 Flame Photometry Assessment of Potassium and Sodium

The sample was analyzed for sodium (Na) and potassium (K) using the flame photometry method. Na and K were determined using the same wet digested sample solution used in AAS. For both Na and K, standard solutions of 20, 40, 60, 80, and 100 milliequivalent/L were employed. The same process used in AAS is used to calculate the total mineral intake.

### 2.2.7.3 Spectrophotometry Analysis of phosphorus

Phosphorous in the *S. macrostachya* seeds were assessed using method describe by Muhammad *et al.* (2020).

### 2.3 Extraction of Plant material

One kilogram (1kg) of dried plant material was extracted using organic solvents with an increased polarity (starting with n-Hexane followed by ethyl acetate and finally methanol). The solvent was then removed at 45°C with the aid of a rotary evaporator. The extract yield was computed using the equation (9) below:

$$\% \text{ Yield} = \frac{\text{weight of extract}}{\text{weight of plant material}} \times 100 \dots \dots \dots 9$$

### 2.4 Preliminary Phytochemical Screening

The phytochemical constituent was assessed using standard methods for phytochemical screening with little modification, as reported by Balamurugan *et al.* (2019) and Muhammad *et al* (2022):

#### 2.4.1 Determination Alkaloids

**Detection of alkaloids via Mayer's Approaches:** Four (4) drops from Mayer's solution were added to two centimeters of *S. macrostachya* extracts. Alkaloids were present as an orange precipitate was obtained.

**Wagner's Test:** Two centiliters of crude extracts in a test tube were combined with few drops of Wagner's solution, the presence of alkaloids was revealed by the production of a dark brown precipitate.

**Dragendorff's Test:** Four (4) drops of Dragendorff's solutions were applied to the *S. macrostachya* extracts (2 cm<sup>3</sup>), formation of a reddish-brown precipitate confirmed the presence of alkaloids.

#### 2.4.2 Keller Kiliani Test for Cardiac Glycosides

Two centimeters (2 cm<sup>3</sup>) of acetic acid were mixed with four (4) drops of 5% FeCl<sub>3</sub> solution, 50 mg of *S. macrostachya* extracts were dissolved, then the solution was transferred into to a test-tube, followed by 2 cm<sup>3</sup> H<sub>2</sub>SO<sub>4</sub>. Formation of brown-ring at the interface indicated that cardiac glycoside was present.

### 2.4.3 Determination of Anthraquinones (Borntrager's Test)

Two centimeters (2 cm<sup>3</sup>) of 10% NH<sub>4</sub>OH was added in to 2 cm<sup>3</sup> of extracts. A rose-pink color obtained which indicated anthraquinones present.

### 2.4.4 Ferric Chloride Test for Flavonoids

A test tube holding five centimeters of crude extracts was filled with two (2 cm<sup>3</sup>) of 5% FeCl<sub>3</sub> solution. Green precipitates formed. This indicated that Flavonoids are present presence.

### 2.4.5 Salkowski Test for Steroids/Terpenes

After dissolving the 0.5 g of crude extracts in 5 cm<sup>3</sup> of chloroform, 2 cm<sup>3</sup> of concentrated sulfuric acid was added to the mixture. Red precipitation formed which reveals the presence of steroids.

**Liebermann-Buchards' Test:** Concentrated sulfuric acid (2 cm<sup>3</sup>) and 5 cm<sup>3</sup> of acetic acid anhydride were added to small amounts of the *S. macroatachya* seed extracts, which have been diluted with chloroform (2 cm<sup>3</sup>). Steroid presence was manifest as the creation of green coloration obtained.

### 2.4.6 Frothing Test for Saponins

Five (5 cm<sup>3</sup>) distilled water was vigorously shaken with 2 cm<sup>3</sup> of *S. macrostachya* seed extracts and allowed 15 minutes to stand. Formation foam for a long period of time indicated saponin in the sample.

### 2.4.7 Ferric Chloride Test for Tannins

A small amount of crude (2 cm<sup>3</sup>) was combined with 5 cm<sup>3</sup> of distilled water. Two drops of 5% FeCl<sub>3</sub> were added. After mixing, boil for five (5) minutes. Tanning agents were detected by the formation of a greenish precipitate.

## 3.0 RESULTS

**Table 1: Proximate Analysis of *Senegalia macrostachya* Seeds**

Proximate	Concentration (%)
Moisture content	6.50 ± 0.02
Ash content	6.00 ± 0.01
Crude Lipid	6.00 ± 0.02
CrudeFibre	5.00 ± 0.01
Nitrogen Free Extract	3.36 ± 0.01
Crude Protein	21.0 ± 0.20
CHO	55.50 ± 0.30

**Table 2: Minerals Analysis of *Senegalia macrostachya* seed**

Mineral Elements	Concentration in DW (mg/100g)
Calcium (Ca)	5.00 ± 0.02
Magnesium (Mg)	24.00 ± 0.21
Sodium (Na)	70.00 ± 0.32
Potassium (K)	300 ± 0.50
Phosphorous	0.70 ± 0.00

**Table 3: Results of Extraction *Senegalia macrostachya* seeds**

Extracts	Yield in %		Color
	Yield in gram	Yield in %	
Hexane	27	3.64	Greenish-yellow
Ethyl acetate	15	2.0	Green
methanol	99	13.41	Brown

**Table 4: Phytochemical Screening of *Senegalia macrostachya* Seed Extracts**

Phytochemicals	Extracts		
	Hexane	Ethyl acetate	Ethanol
Tannins	+	+++	++
Flavonoids	+	+++	+
Saponins	+	++	++
Glycosides	+	++	+
Steroids	+	+++	++
Alkaloids	+	+++	++
Cardiac glycoside	++	+++	+
Saponin glycoside	+	++	++
Balsams	++	+++	+++
Anthraquinones	ND	ND	ND
Volatile oil	+	+++	++

**Key:** Trace Amount = +, Moderate Amount = ++, Large Amount = +++, Not Detected (ND)

#### 4.0 DISCUSSION

The results for proximate analysis of *Senegalia macrostachya* seeds as presented in Table 1 show a moisture content of 6.5%, which is slightly lower than 7.17% for *Rothmannia longiflora* seed (Muhammad *et al.*, 2020) and 7.9 for *Moringa oleifera* seed (Ahmed *et al.*, 2023). The result was found to be higher than that of *Tamarindus indica* seed at 6.0% (Shlini *et al.*, 2020), and 4.25% for melon seed (Obasi *et al.*, 2012). The low moisture content of seeds significantly enhances their shelf life. The result for the ash content was found to be 6.0%. This is slightly lower than that of *Rothmannia longiflora* seeds (8.67) as reported by Muhammad *et al.* (2020) and 11.65 for *Moringa oleifera* seeds (Ahmed *et al.*, 2023), but it was found to be higher than that of *Sphenostylis* seeds (5.78%) as reported by Chinedu and Nwinyi, (2019) respectively. High ash content is directly proportional to the high concentration of minerals present in the seed which catalyze metabolic reactions as well as improve its growth and development (Muhammad *et al.*, 2020). The results of crude fiber from

*S. macrostachya* seed were found to be 5.0±0.20%. This is higher than that of *Brebra* seeds (2.41±0.12%) as *Dioclea reflexa* (2.00±0.2%), *Voadzeia subterranean* (2.68±0.02%) and *Sphenostylis stenocapa* (3.85±0.02%), *Strychnos innocus* Del (3.33±0.62%) as reported by Andualem and Gessesse, (2020); Akinyede *et al.* (2019); Chinedu and Nwinyi, (2019) and Abdulmumin, *et al.* (2017). It has been observed that taking adequate fiber (dietary fiber) can reduce cholesterol (Muhammad *et al.*, 2020). Hence, *S. macrostachya* seeds can serve to reduce diabetes and cancer. The protein contents (crude protein) from *S. macrostachya* seed were obtained to be 21.0%, which, in comparison, was found to be higher than that of tiger nut (4.33%), *Gardenia Sokotensis* seed (6.86%), *Rothmania longiflora* seeds (4.60%) as reported by Adel, *et al.* (2015), Abdulmumin *et al.* (2017) and Muhammad *et al.* (2020). Therefore, *S. macrostachya* seeds could serve as sources of proteins in producing animal and human foods due to their high and appreciable protein content. The carbohydrate content (CHO) of *Senegalia macrostachya* seeds was found to be 55.50 ± 0.30, which is slightly lower than that of *Rothmania longiflora* seeds (59.51±1.02%) reported by Muhammad *et al.* (2020), *Pearsea americana* seeds (67.68±0.31%) reported by Talabi, *et al.* (2016). The value of *S. macrostachya* seeds, however, was much higher compared to *Punica gratun* seeds (39.54±0.06%), *Teramarindus indica* seeds (50.72%) (Shlini and Murthy, 2020) and were also found to be less low than that of *Strychnos innocus* Del (56.31±0.52%) as reported by Abdulmumin *et al.* (2017). These values from *S. macrostachya* seeds show that the seeds have a high energy content due to high carbohydrates. Hence, Muhammad *et al.* (2020) pointed out that any seed which produces about 17% yield of oil is said to be considered seed oil plants. *Senegalia macrostachya* seeds can also be seen or considered as seed oil plants (seeds that produce adequate oil) and also have the potential to be used industrially.

If properly utilized, the seeds' increased crude lipid content could make them a useful source of edible vegetable oil to complement more traditional sources. In addition to facilitating intestinal absorption and the transfer of soluble vitamins A, D, E, and K, lipids give the body its maximal energy, which is roughly twice that of protein and carbohydrates. It was discovered that the nitrogen (%N) from *Senegalia macrostachya* seeds was 3.36.

Table 2 shows the mineral composition of the *Senegalia macrostachya* seeds. The constituent elements were sodium, potassium, magnesium, calcium, and phosphorous. Potassium concentration of the *S. macrostachya* seeds was 3000mg/100g, which was higher than (180±6.298mg/100g), *Rothmannia*

*longiflora* seeds (Muhammad *et al.*, 2020), and for *Moringa oleifera* seeds (559.0±14mg/100g) as reported by Ahmed *et al.* (2023), also was found to be high that of *Strychnos innocus* (383.33±12.47mg/100g) as shown by Abdulmumin *et al.*(2017) likewise *Annona diversifolia kanel* (356.4mg/100g) as reported by Marroquin-Andrade *et al.* (2011). A vital nutrient, potassium is crucial for the production of proteins and amino acids. Potassium is essential to the body's physiological processes and aids in preserving the proper water balance (Muhammad *et al.*, 2020). The sodium (Na) concentration from the *S. macrostachya* seeds was 70.0 mg/100g. These results were found to be higher than that reported by Muhammad *et al.* (2020); 10.75±0.41 mg/100g for the seeds *Rothmannia longiflora* seeds, *Moringa oleifera* seeds (21.50±1.5 mg/100g) reported by Ahmed *et al.* (2023). Sodium is essential for blood pressure regulation as well as the healthy operation of muscles and neurons. Adults in good health should consume less than 2000 mg of salt per day, while those with high blood pressure should consume no more than 1500 mg per day (WHO, 2023). Because of this, the plant seed is thought to have a modest salt content and may be used as a supplement. The phosphorous in the *S. macrostachya* seeds were 0.70mg/100g in comparison is found to be similar to that obtained from Seeds *Rothmania longiflora* (0.651±0.002mg/100g) as reported by Muhammad *et al.* (2020). In addition, the results were lower than that of *Strychnos innocus* (2.10±0.00mg/100g) reported by Abdulmumin *et al.* (2017), and also for the seeds of melon (5.77±0.007mg/100g) as pointed by Jacob *et al.* (2015). Phosphorous is a component of adenosine triphosphate (ATP), teeth, and bones. Because of its critical function in energy transfer in both plants and living things, phosphorous is a macronutrient that is necessary for plants and one of the three nutrients that are often provided to the soil during fertilizer application (Muhammad *et al.*, 2020). The concentration calcium in *S. macrostachya* seed were 5.0mg/100g which were comparable with 5.21±1.18mg/100g for *Rothmania longiflora* seeds (Muhammad *et al.*, 2020). *S. macrostachya* seed calcium contents was highly lower than that of Bambara groundnut (30.5±1.6mg/100g) as reported by Yao *et al.* (2019). As a component of bones, calcium aids in proper body contraction, blood coagulation, and nerve transmission. Since calcium is necessary for the prevention and management of disease, it may also have a therapeutic effect on plants (Muhammad *et al.*, 2020). The magnesium content was found to be 24.0mg/100g which is high than 4.22±1.33mg/100g for *Rothmania longiflora* seed (Muhammad *et al.*, 2020), also that of *Annona diversifolia* seeds (4.5%mg/100g), and is comparable to

that of melon seeds reported by Jacob *et al.* (2015) (20.45±0.00mg/100g). Magnesium helps control blood pressure and reduces the risk of stroke, cardiac arrest, and unexpected heart attacks. Similar to calcium, magnesium plays a crucial role in the structural development of bones. Table 3 shows the extract yield of *Senegalia macrostachya* seeds with methanol have the high yield. The hexane extract was found to be oily and golden yellow (9g, 3.64%), methanol brown (33g, 13.41%) and ethyl acetate (5g, 2.0%). The extraction was achieved using sequential extraction via maceration with hexane ethyl acetate and methanol in increasing polarity. This shows that the seed have high amount of polar compounds. The phytochemical screening of *Senegalia macrostachya* seeds extracts (Hexane, ethyl acetate and methanol) shown the following phytochemicals viz; Tannins, flavonoids, saponins, glycosides, steroid, alkaloids, cardiac glycosides, saponin glycosides balsams and volatile oil. Flavonoids, tannins, steroids, alkaloids, cardiac glycoside and volatile oil are found in large amount in ethyl acetate extracts than the other extracts. Balsams are much present in methanol and ethyl acetate than that of hexane extract, while anthraquinones were not detected. As presented in Table 4 above. This indicated that the *Senegalia macrostachya* seeds have vast Secondary metabolite. These secondary metabolites are of pharmacological importance, as suggested by literature plants that are rich in tannins exhibit some activity such as anti-diarrhea, antioxidant and anti-inflammatory activity (Khalid *et al.*, 2019). Saponins, phenols and flavonoids are known to possess antimicrobial properties; as antifungal, antispasmodic, antibacterial, anti-allergenic as well as anti-inflammatory (Khalid *et al.*, 2019). Likewise, Alkaloids have been reported to aid in anti-diuretic activity of medicinal plants (Khalid *et al.*, 2019).

## 5.0 CONCLUSION

From the research results obtained, *Senegalia macrostachya* seeds was seen to be an excellent source for minerals; calcium, sodium, potassium, magnesium also could be seen as source for proteins, carbohydrate, Fibre and lipids the indicated that it is a good source/ nutritional supplement. As the *S. macrostachya* seed shown low ash content as well as % fibre make the plant seeds (*Senegalia macrostachya* seed) was suitable in the formulation of feedstuff for human and animals and also suitable in alternative bio-energy generation. The phytochemical presence in the *S. macrostachya* seeds indicated that the seeds have pharmacological application.

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## REFERENCES

- Abdulmumin, U., Umar, K.J., Muhammad, M.U & Abubakar, L. (2017). Nutritional and anti-nutritional composition of monkey orange (*Strychnos innocua Del*) fruit seeds grown in Zuru, Nigeria. *African Journal of Food Science and Technology*. 056-062, doi:<http://dx.doi.org/10.14303/ajftrt.2017.017>.
- Adel, A.A.M., Awad, A.M., Mohammed, H.H & Iryna, S. (2015) Chemical composition, phytochemical Properties and fatty acid profile of Tiger nut (*Cyperus esculentus* L) seed oil as affected by different preparation methods. *International Food Research Journal* 22(5):1931-1938. <https://www.researchgate.net/publication/282741300>
- Ahmed, M., Marrez, D.A., Abdelmoeen, N.M., Ebtesam Abdelmoneem Mahmoud, E.A., Ali, M.A.S, Decsi, K. & Tóth, Z. (2023). Proximate analysis of *Moringa oleifera* leaves and the antimicrobial activities of successive leaf ethanolic and aqueous extracts compared with green chemically synthesized Ag-NPs and crude aqueous extract against some pathogens. *International journal of molecular science*. 24(4):3529. <https://doi.org/10.3390/ijms24043529>
- Ajmera, R., Bassham., J & Campbell, J. (2023). The 6 best plant sources of Omega-3 fatty acids retrieved from <https://www.healthline.com/nutrition/7-plant-sources-of-omega-3s>
- Akinyede, A. I., Amoo, I. A., & Eleyinmi, A. F. (2019). Chemical and functional properties of full fat and defatted *Dioclea reflexa* seed flours. *Journal of Food, Agriculture and Environment*, 3(2), 112-115
- Andualem, B., & Gessesse, A. (2020). Proximate composition, mineral content, and antinutritional factors of *Brebra* (*Milletia ferruginea*) seed flour as well as physicochemical characterization of its seed oil. *Springer Plus*, 3(1):298 DOI:10.1186/2193-1801-3-298
- Balamurugan, S., Fatima, S. & Velurajan., A. (2019). A guide to phytochemical analysis. *International Journal of Advance Research and Innovative Ideas in Education* 5 (1): 236-245. [www.ijariie.com](http://www.ijariie.com)
- Bulter, R.A (2019). World rain forests. Available on <https://worldrainforests.com/04-rainforest-canopy.html>

- Chika, A., Bello, S.O., Yunusa, A., Yahaya, A.B., & Sadiq, A. (2022). Ethnobotanical survey of medicinal plants used as remedies for benign prostatic hyperplasia in Sokoto North western Nigeria. *National Journal of Physiology, Pharmacy and Pharmacology*.12(4):511-518.

doi: 10.5455/njppp.2022.12.01043202203032022

- Chinedu, S. N., & Nwinyi, C. O. (2019). Proximate analysis of *Sphenostylis stenocarpa* and *Voandzeia subterranea* consumed in South Eastern Nigeria. *Journal of Food and Agriculture*, 7(3), 45-52. DOI:10.5897/JABSD11.012

- Coulibaly, A.C., Esther, W.L.M., Kabre, B., Traore, T.K., Achatde, C., Boly, G.L., Nebie, M.T., Ouedraogo, N., Kiendrebeogo, M., & Sawadogo, R.W. (2020). Phytochemical screening, anti-inflammatory and Analgesic activities of Root barks from *Acacia macrostachya* Reichenb. Ex DC. (Fabaceae). *Annual Research and Review in Biology* 35(7):76-83 DOI: 10.9734/arrb/2020/v35i730249

- Garba, U., Faruk, U.Z., Uba, A., Nasir, I & Yusuf, A.J. (2023). Phytochemical and antibacterial studies of *Acacia macrostachya* leaves . A Paper Presented at ISCEST X Annual International and 4th Virtual conference 29th November 2023

- Jacob A.G Etong D.I & Tijjani, A. (2015). Proximate, Mineral and Antinutritional Composition of Melon (*Citrus lanatus*) Seeds. *British Journal of Research*. BJR 2(5):142-151

- Khalid, A., Ahmed, Z., & Khan, M. (2019). Pharmacological importance of secondary metabolites: Tannins and their bioactivities. *Journal of Natural Remedies*, 28(1), 45-55. <https://doi.org/10.1007/978-3-030-58975-2>

- Mathew, R., Kumar, P., & Singh, A. (2024). Safety and consumption of seeds: Nutritional benefits and potential risks. *Journal of Food Safety and Nutrition*, 12(1), 45-52.

- Muhammad., M.U., Faruq, U.Z., Sani, N.A., Baki, A.S & Garba, U. (2020). Nutritional and Phytochemical Composition of *Rothmannia longiflora* Seed. *Sumerianz Journal of Agriculture and Veterinary*, 3 (6): 66-73. <https://www.sumerianz.com>

- Muhammad, M.U., Gayari, M.S., Idris, B., Garba, U. & Bello, I. (2022) Evaluation of Phytochemical Composition and Antibacterial Activity of *Indigofera hirsuta* Linn. *Arid Zone Journal of Basic and Applied Research*. 1(5):192-203 doi.org/10.55639/607.1322

- Obasi, N.A., Ukadelonu, J., Eze, E., Akubugwo, E.I., & Okorie, U.C. (2019). Proximate composition, extraction, characterization and comparative assessment of coconut (*Cocos nucifera*) and melon (*Colocynthis citrullus*) seeds and seed oils. *Pakistan*



DOI: <https://doi.org/10.57233/ijsgs.v11i1.800>

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*Journal of Biological Sciences* 15(1), 1-9.  
DOI:10.3923/pjbs.2012.1.9

Shlini, P., & Murthy, K. R. S. (2020). Proximate composition, antinutritional factors, and protein fractions of *Tamarindus indica* seeds as influenced by processing treatments. *International Journal of Food and Nutritional Sciences*, 4(4), 123-130.

Talabi J.Y, Osukoya O.A, Ajayi O.O & Adegoke G.O. (2016). Nutritional and Antinutrition Composition of Processed Avocado (*Persea Americana* Mill) Seeds. Pelagia Research Library. *Asian Journal of Plant Science and Research* 6(2):6-12

Yao, D. N., Kouassi, K.N., Erba, D., Seazzina, F., Pellegrini, N & Casiraghi, M.C. (2019). Nutritive Evaluation of the Bambara Groundnut Ci12 Landrace [*Vigna subterranean* (L.) Verdc (Fabacea)] Produced in Cote d'ivoire. *International Journal of Molecular Science*.16(9):21428-21441  
doi:10.3390/ijms160921428

WHO (2023) world Health organization; Sodium reduction, <https://www.who.int/news-room/fact-sheets/detail/salt-reduction>