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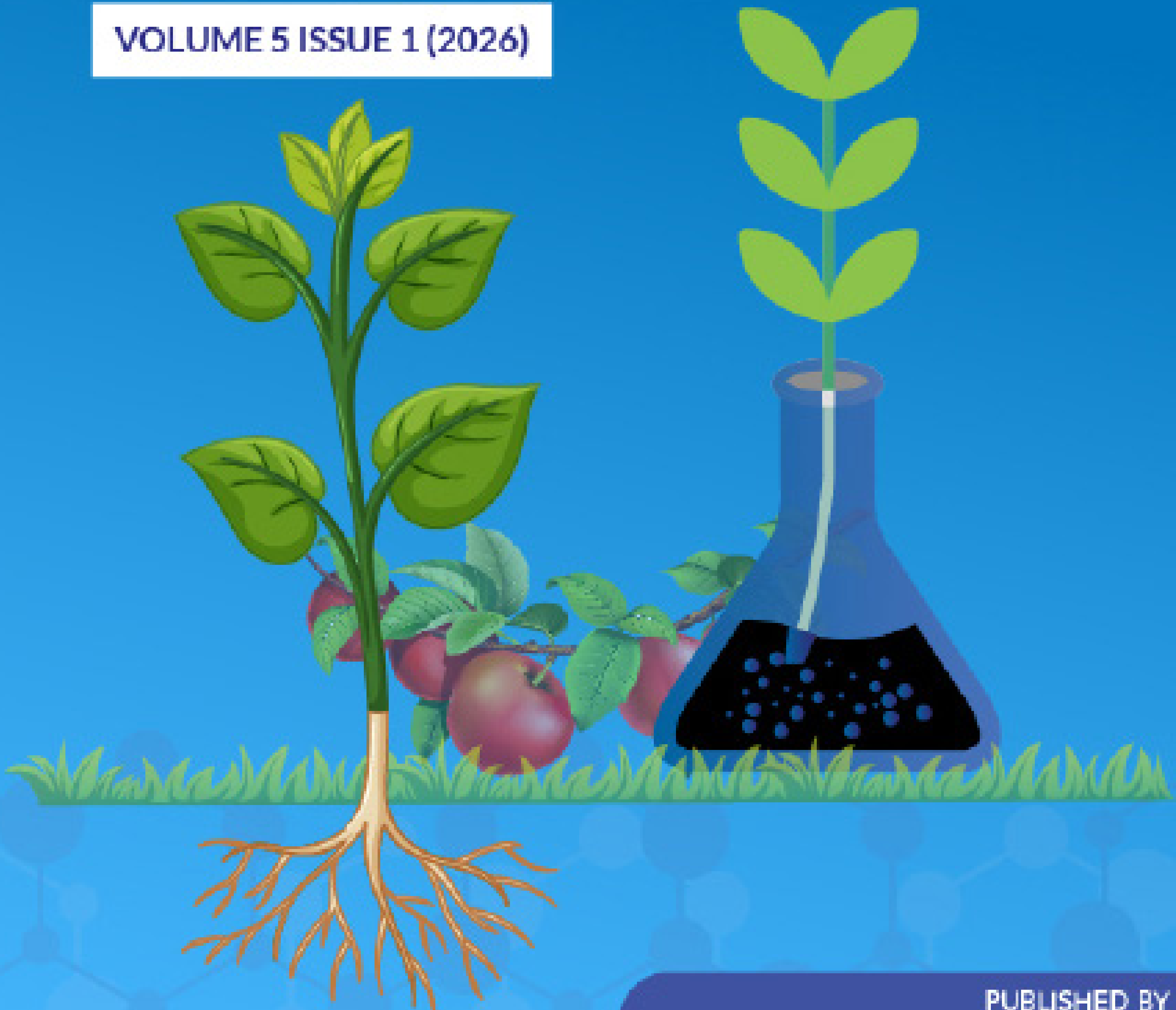

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Nutritional Profile of Hibiscus sabdariffa (Roselle) and Ceiba pentandra (Kapok) Leaves

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ABSTRACT

Plants are valuable sources of nutrients and bioactive compounds with therapeutic importance. Hibiscus sabdariffa (Roselle) and Ceiba pentandra (Kapok) are widely used in traditional medicine for the management of various ailments, yet scientific information on their nutritional and antioxidant properties remains limited and inconsistent. This gap necessitates a systematic evaluation of their proximate composition, mineral and vitamin contents, and antioxidant activity. This study aimed to provide a comprehensive nutritional assessment of Roselle and Kapok leaves. Leaf samples were washed, processed, and analyzed using standard AOAC methods. Proximate analysis revealed relatively low moisture, fat, fiber, and protein contents, but high carbohydrate levels (70.09% in Roselle; 78.70% in Kapok). Calcium was the most abundant mineral (5675.29 mg/kg in Roselle; 553.96 mg/kg in Kapok), followed by magnesium (22.52–27.35 mg/kg), zinc, iron, and potassium, while phosphorus was undetectable. Vitamins A, C, and E were present in modest amounts (0.02 - 0.34 mg/100 g). Antioxidant activity of ethanolic and n-hexane extracts ranged from 0.34 - 1.55 mg AAE/100 g, indicating measurable free-radical scavenging potential. Overall, the study demonstrates that Roselle and Kapok leaves are carbohydrate and calcium-rich vegetables with antioxidant activity, supporting their potential use as affordable dietary supplements, functional food ingredients, and natural nutraceutical sources.

INTRODUCTION

Plants are rich sources of bioactive compounds associated with the prevention and management of chronic health conditions such as hypertension, cardiovascular disease, inflammation, and cancer. For centuries, the flowers, leaves, and fruits of diverse plants have been used in traditional medicine worldwide, with consumers often linking their consumption to health benefits beyond basic nutrition (Formagio *et al.*, 2017). Beyond their nutritional role, plants have served as the cornerstone of traditional medical systems such as Ayurveda and Unani, which continue to provide novel therapeutic agents. A significant proportion of populations in developing countries rely on medicinal plants for primary health care due to their affordability, availability, and relatively minimal side effects (Ali *et al.*, 2005). Consequently, modern research increasingly focuses on validating the therapeutic potential of these traditional remedies.

Hibiscus sabdariffa (Roselle) is an annual plant widely used in traditional medicine. Extracts from its calyces and leaves exhibit multiple pharmacological activities, including anti-obesity (Alarcon-Aguilar *et al.*, 2007), antihypertensive (Herrera-Arellano *et al.*, 2007), anticancer, and antibacterial effects (Olvera-García *et al.*, 2008). Although the calyces are most extensively studied, the leaves are also consumed as vegetables yet remain underutilized in scientific research. Almost every plant part is potentially useful in herbal formulations (Sulaiman *et al.*, 2014), but safety concerns exist since some secondary metabolites may exert toxic effects (Ekor, 2014). Therefore, toxicological and phytochemical assessments of both calyces and leaves are critical. Factors such as cultivar type, growth stage, and environmental conditions influence the phytochemical profile and biological activity (Koleva *et al.*, 2003; Khare *et al.*, 2012).

Ceiba pentandra (Kapok) is a tree that belongs to the Malvaceae family with significant ethnobotanical relevance. Locally called Araba (Yoruba), Akpu-ogwu (Igbo), and Rimi (Hausa), it has been traditionally employed in African, Indian, and Asian medicine (Chaiarrekij *et al.*, 2012; Mojica *et al.*, 2002). Different plant parts are used for managing fever, headache, diarrhoea, dermatological conditions, hypertension, heart problems, and even trypanosomiasis (Friday *et al.*, 2011; Osuntokun *et al.*, 2017; Fatim *et al.*, 2019). Its leaves, in particular, are consumed as vegetables and soups, contributing both to nutrition and medicinal value (Olajide, 2021). Despite widespread use, comprehensive scientific studies on the nutritional and phytochemical properties of Kapok leaves remain limited.

Both Roselle and Kapok represent underutilized leafy plants in Nigeria and other tropical regions, where they serve as food and medicine. While their ethnobotanical uses are well-documented, there is limited scientific data on the full nutritional composition of their leaves (Mahadevan *et al.*, 2009; Edeoga *et al.*, 2005). Therefore, the aim of this work was to evaluate the Nutritional profile of Hibiscus sabdariffa (Roselle) and Ceiba pentandra (Kapok) Leaves.

MATERIALS AND METHODS

Sourcing of Raw Materials and Sample Preparation

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The leaves of the Roselle and Kapok plants were procured from Modern Market, Makurdi Benue State. The leaves were taken to the laboratory of Biological Science Department, Rev. Fr. Moses Orshio Adasu University (formerly Benue State University) Makurdi, Benue state where it was identified as Hibiscus sabdariffa and Ceiba pentandra. All reagents and solvents used in this study were analytical grade.

The fresh leaf samples were washed with clean water and air-dried for two weeks at an average temperature of 25ºC and humidity of 86%. The dried samples were crushed using mortar and pestle and preserved in air tight Ziploc bags, labelled and stored for further analysis.

Analyses

Determination of proximate compositions.

The method of AOAC (2012) was used to determine the Moisture, Ash, Fat, Crude fiber, Protein content of the plant sample. All measurements were replicated three times.

Mineral analysis

Calcium, Phosphorus, Potassium, Magnesium, Iron and Zinc were determined according to the method of Omoboyowa *et al.* (2015) with slight modifications. The ground plant samples were sieved with a 2 mm rubber sieve and 2 g of each of the plant samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a muffle furnace. The resultant ash was dissolved in 5 ml of HNO_3/HCl/H_2O (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5 mL of deionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100 mL volumetric flask by filtration through a Whatman No 42 filter paper and the volume was made to the mark with deionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. All measurements were done in triplicate.

Determination of vitamins content.

Vitamins are necessary part of the human diet. Vitamins A, C and E were determined using the method described by Omoboyowa *et al.* (2015) with slight modifications. All measurements were done in triplicate.

i. Vitamin A: One gram (1 g) of the sample was weighed and macerated with 20 mL of petroleum ether. It was evaporated to dryness and 0.2 mL of chloroform acetic anhydride was added and 2 mL of TCA chloroform were added and the absorbance measured at 620 nm. Then concentration of vitamin A was extrapolated from the standard curve.

ii. Vitamin C (Ascorbic Acid)

Vitamin C content of the samples was evaluated by pouring 20 mL of 0.4% oxalic acid into each of the samples (1 g each). The mixture was filtered and indophenol reagent was reacted with the filtrate in the ratio of 9 to 1 (filtrate: indophenol). Vitamin C standard (ascorbic acid) was prepared using the same procedure for the samples. The final concentration of 1 mg/mL was made for both standard and samples. Serial dilution of the concentration was later done giving concentration levels 1, 0.8, 0.6, 0.4 and 0.2 mg/mL. The absorbance of the resulting sample solution and standard was read at 760 nm. Vitamin C content in milligram ascorbic acid/100 g DW of the each of the samples was extrapolated from the standard curve.

iii. Vitamin E.

One gram (1 g) of the sample was weighed and macerated with 20 mL of ethanol. One milliliter (1 mL) of 0.2% ferric chloride in ethanol was added, then 1 mL of 0.5% α, α-dipyridyl was also added, it was diluted to 5 mL with distilled water and absorbance was measured at 520 nm. Then concentration of Vitamin E was extrapolated from the standard curve.

Determination of Antioxidant Activity

The Antioxidant Activity of the Roselle and Kapok leaves were determined using FRAP assay and CUPRAC assay. All measurements were done in triplicate.

i. Ferric Reducing Antioxidant Power (FRAP) assay

The reducing power of the extracts was determined by the method described by Bhatti *et al.* (2015) with slight modifications. 0.5 mL of the extract was mixed with phosphate buffer (2.5 mL, 0.2 M, pH 6.6) and potassium ferricyanide [$K_3Fe(CN)_6$] (2.5 mL, 1%). The mixture was incubated at 50˚C for 20 min and then 2.5 mL of trichloroacetic acid (10%) was added to the mixture, which was centrifuged at 3000 rpm for 10 min. The upper layer of solution (2.5 mL) was mixed with distilled water (2.5 mL) and (0.5 mL) of 0.1% $FeCl_3$ and then the absorbance was measured at 700 nm using a spectrophotometer. Ascorbic acid was used as a standard.

ii. Cupric reducing antioxidant capacity (CUPRAC) assay

0.25 mL of $CuCl_2$ (0.01 M), 0.25 mL of neocuproine ethanol solution ($7.5x10^{-3}$ M) and 0.25 ml of CH_3COONH_4 (1 M) buffer solution were mixed in a test tube, and then 0.5 mL of the peel extract was added. The total volume was then made up to 2 mL with distilled water and mixed. The tubes were closed and left at room temperature. Absorbance at 450 nm was measured against blank reagent (water) after waiting 30 min (Apak *et al.*, 2004; Masek 2019). The Cupric ions (Cu^{2+}) reducing power was calculated as:

$\Delta A = A_{30} - A_0$,

Where; A_0 - absorbance of the reagent test, A_{30} - absorbance after 30 min of reaction.

Statistical Analysis

All measurements were replicated three times. Statistical analyses were conducted using SPSS program version 27 for windows. Significant differences among samples were analysed by using ANOVA, Duncan-post hoc test at a level of $p < 0.05$.

RESULTS AND DISCUSSIONS

Proximate Composition of Roselle and Kapok Leaves

Proximate composition serves as an indicator of the macromolecular composition of edible plant parts and is utilized for nutritional labelling and assessing the potential of raw materials for food production (Olika *et al*., 2020)

The proximate composition of Hibiscus sabdariffa (Roselle) leaves is presented in Table 1. The moisture content was found to be 7.37%, which is lower than the 12.50% documented by Edo *et al.* (2023). Such variation may reflect differences in environmental conditions (temperature, rainfall, humidity) or post-harvest handling, as moisture is highly influenced by growing and drying conditions. Lower moisture content in this study suggests better storage stability, since high moisture favors microbial growth and rapid spoilage (Zambrano *et al*., 2019). The ash content was 7.83%, slightly above the 6.20% reported by Edo *et al.* (2023). Ash reflects the total mineral composition (Tsado *et al*., 2015); hence, the higher value could indicate better mineral accumulation in the leaves. Such differences are often attributed to soil fertility, cultivar type, or analytical procedures. The crude fiber content was 2.47%, considerably higher than the 0.87% recorded by Balarabe *et al.* (2019). Fiber content in leafy vegetables is influenced by maturity stage and varietal characteristics (Perveen *et al*., 2025). The relatively higher value here suggests that Roselle leaves could make a stronger contribution to dietary fiber intake than previously reported. The crude fat content was 9.03%. Although Roselle is not a rich fat source, this moderate level may contribute essential fatty acids and aid in the absorption of fat-soluble vitamins. Variations in fat content across studies are commonly linked to genetic differences among cultivars and solvent extraction techniques used during analysis (Kaseke *et al*., 2020). The crude protein content was 5.36%, which is very similar to the 5.37% observed by Balarabe *et al.* (2019). This consistency across studies confirms Roselle leaves as a modest source of plant protein. Finally, the carbohydrate content was 70.09%, which aligns closely with the 73.27% and 73.61% reported by Nur *et al.* (2024) and Oluwatayo *et al.* (2024) respectively. Carbohydrate levels in leafy vegetables may vary slightly depending on the balance of other proximate components (moisture, protein, fat) (Abiona *et al*., 2021). The high carbohydrate proportion highlights Roselle leaves as an energy contributor in diets.

The proximate composition of Kapok leaves is also shown in Table 1. The moisture content was found to be 9.25%, which is higher than the 7.32% recorded by Osuntokun *et al.* (2017). Moisture variations are often linked to environmental factors such as humidity and drying methods. The slightly higher value obtained in this study may indicate differences in post-harvest handling or varietal moisture retention capacity (Zambrano *et al*., 2019). The ash content was 7.12%, compared with 8.72% reported by Osuntokun *et al.* (2017). Since ash reflects the total mineral concentration, the lower value may be due to differences in soil mineral composition, fertilizer application, or ecological conditions during cultivation. The crude fiber content was 0.55%, which is substantially lower than the 17.60% documented by Olajide (2021). Such a large discrepancy could be attributed to varietal differences, leaf maturity at harvest, or analytical techniques. Fiber levels in leafy vegetables are known to vary widely with growth stage, and younger leaves generally contain less structural fiber than mature ones (Perveen *et al*., 2025). The crude fat content was 1.72%, closely matching the 1.59% reported by Olajide (2021). This consistency suggests that fat content in Kapok leaves may be relatively stable across different growing conditions and methodologies. The crude protein content was 9.76%, comparable to the 9.42% reported by Olajide (2021). This similarity indicates that Kapok leaves are a reliable source of plant protein, with minimal variation across studies. The carbohydrate content was 78.70%, which is notably higher than the 57.20% reported by Olajide (2021). Carbohydrate levels are calculated by difference, and variations in other proximate components (especially fiber and ash) may account for this discrepancy. The higher carbohydrate value obtained in the present study suggests that Kapok leaves could provide greater energy contribution than previously reported (Abiona *et al*., 2021).

The result shows that the leaves of Roselle are rich in dietary fiber as compared to Kapok, which assist in the digestive system by aiding bowel wellbeing and lowering the risk of colon cancer. Fiber's presence in the human diet is crucial for digestion; it regulates glucose and cholesterol levels in the bloodstream, acts as a prebiotic, stimulates and enhances intestinal contractions, and facilitates waste evacuation (DeVries *et al*., 2001). Fats and oils are essential raw materials and functional ingredients for various food products such as confectionery, bakery, ice creams, emulsions, sauces, shortenings, margarine, and other specially modified products (Rios *et al*., 2014). Sufficient dietary protein consumption is essential for sustaining good health during normal growth and aging (Carbone *et al*, 2019). Study shows that both Roselle and Kapok have shown to be good sources of carbohydrate which is essential for normal bodily functions.

Mineral Composition of Roselle and Kapok Leaves

Table 1: Proximate Composition of Roselle and Kapok Leaves

Nutrient (%)	AS	VA
Moisture	$7.37^a \pm 0.07$	$9.25^b \pm 1.59$
Ash	$7.83^b \pm 0.09$	$7.12^a \pm 0.38$
Fiber	$2.47^b \pm 0.97$	$0.55^a \pm 0.41$
Fat	$9.03^b \pm 0.51$	$1.72^a \pm 0.88$
Protein	$5.36^a \pm 0.72$	$9.76^b \pm 1.52$
Carbohydrate	70.09a±1.26	$78.70^b \pm 2.05$

Values within the same rows with the same superscript are not significantly different at p< 0.05

KEY: AS= Roselle, VA = Kapok

Minerals are vital for numerous physiological functions, ranging from nerve transmission to bone development and enzymatic regulation. The mineral composition of Roselle leaves is presented in Table 2, with calcium (Ca) and magnesium (Mg) being the most abundant. In this study, Ca was 5675.29 mg/kg, while Mg was 27.35 mg/kg. These values are considerably lower than those reported by Jung *et al.* (2013), who found Ca at 10,707.58 mg/kg, and by Balarabe *et al.* (2019), who documented Mg at 13,500 mg/kg. Such differences may be attributed to soil mineral composition, environmental growing conditions, or differences in sample preparation and analytical techniques. The trace minerals detected in Roselle leaves included Zn (1.75 mg/kg), Fe (13.16 mg/kg), and K (11.65 mg/kg). These values are also much lower than those recorded in earlier studies. For instance, Jung *et al.* (2013) reported Zn (32.62 mg/kg) and Fe (163.43 mg/kg), while Nagihan (2018) reported K (856 mg/kg). The markedly reduced levels observed in the present study could reflect varietal differences, differences in soil fertility, or the possibility of nutrient depletion in the cultivation environment.

The mineral profile of Kapok leaves as shown in Table 2, shows Mg (22.52 mg/kg) and Ca (553.96 mg/kg) being the most abundant. Compared with Shahin *et al.* (2016), who reported Ca (17.70 mg/kg) and Mg (4.81 mg/kg), the present study revealed substantially higher values for both minerals. These differences could stem from variations in soil fertility, plant maturity at harvest, or analytical methods used across studies. For the trace minerals, the Kapok leaves contained Zn (1.49 mg/kg), Fe (10.31 mg/kg), and K (18.37 mg/kg). Shahin *et al.* (2016) reported Zn (2.70 mg/kg), Fe (0.15 mg/kg), and K (15.36 mg/kg). While the Fe concentration in the present study was markedly higher, Zn was lower, and K showed close similarity to literature values. The observed variability may reflect environmental factors such as soil micronutrient levels, genetic differences between plant accessions, or post-harvest handling.

Overall, the findings suggest that while Roselle leaves are a source of important minerals, their concentrations vary widely across studies, highlighting the strong influence of environmental and methodological factors. When compared with the recommended daily intake (RDI) for minerals, the values of all elements in Kapok leaves fell below the dietary requirement for all age groups. However, the calcium concentration in Roselle leaves (5675.29 mg/kg) was sufficient to meet the RDI, highlighting Roselle as a more nutritionally significant mineral source compared to Kapok.

Table 2: Mineral Analysis of Roselle and Kapok Leaves

MINERALS (mg/kg)	AMPLE	
	AS	VA
P	BD	BD
Zn	$1.75^{b}\pm0.01$	$1.49^{a}\pm0.01$
Ca	$5675.29^{b}\pm0.01$	$553.96^{a}\pm0.02$
Fe	$13.16^{b}\pm0.02$	$10.31^{a}\pm0.01$
K	$11.65^{a}\pm0.01$	$18.37^{b}\pm0.02$
Mg	$27.35^{b}\pm0.01$	$22.52^{a}\pm0.01$

Values within the same rows with the same superscript are not significantly different at p< 0.05

KEY: AS= Roselle, VA = Kapok

Vitamin Composition of Roselle and Kapok Leaves

Vitamins are nutrients that the body needs to stay healthy and function properly. Vitamins help the body to grow the way it should. Vitamins are rich in antioxidants which protect the cells from the effects of free radicals, there are also essential for maintaining healthy vision, skin, and boosting immune system (Awuchi *et al.*, 2020). In Roselle leaves, vitamin A was found to be 0.13 mg/100 g, which falls slightly below but within the lower limit of the range (0.16–1.23 mg/100 g) documented by Salami *et al.* (2021). This suggests that the vitamin A content of Roselle can vary considerably depending on plant variety, maturity at harvest, and soil nutrient availability. The vitamin C content obtained in this study was 0.20 mg/100 g, which is markedly lower than the range (1.93–4.49 mg/100 g) reported in the literature (Salami *et al.*, 2021). Such differences may be attributed to methodological variations in extraction and quantification, as well as environmental factors such as sunlight exposure, rainfall, and soil composition, all of which strongly influence ascorbic acid accumulation in leafy vegetables. For vitamin E, our study recorded a value of 0.13 mg/100 g, which is substantially lower than the reported range of 35.11–37.30 mg/100 g (Salami *et al.*, 2021). This wide discrepancy may be due to differences in analytical sensitivity, possible varietal differences between Roselle accessions, and the physiological age of leaves analysed. Vitamin E is known to fluctuate with plant maturity and environmental stress conditions (Munné-Bosch, 2005), this may explain the relatively low concentration found in this study.

In Kapok leaves, vitamin A was determined to be 0.24 mg/100 g, which aligns closely with the 0.23 mg/100 g value reported by Enechi *et al.* (2013). This consistency suggests that vitamin A levels in Kapok are relatively stable across different studies, likely influenced more by genetic factors than by environmental variation. The vitamin C content in this study was 0.02 mg/100 g, which is substantially lower than the 0.97–1.19 mg/100 g range documented by Olajide & Baiyeri (2021). Such discrepancies may be attributed to differences in sample preparation (fresh vs. dried leaves), extraction methods, or degradation of ascorbic acid during handling and storage, as vitamin C is highly sensitive to light, temperature, and oxidative conditions. For vitamin E, Kapok leaves recorded 0.34 mg/100 g, whereas much higher values have been reported in the literature: 2.99 mg/100 g (Enechi *et al.*, 2013) and 18 mg/100 g (Friday *et al.*, 2011). The significant variation may reflect differences in analytical methodology, varietal differences in Kapok accessions studied, as well as environmental influences such as soil fertility and climatic stress, both of which affect tocopherol synthesis.

Taken together, while the values obtained for vitamin A are consistent with literature trends, those of vitamin C and vitamin E are considerably lower, highlighting the strong influence of environmental, varietal, and methodological factors on vitamin content determination in Roselle and Kapok leaves.

Antioxidant composition of Roselle and Kapok Leaves

Table 3: Vitamins Composition of Roselle and Kapok leaves

Vitamins (mg/100 g)	Sample	
	AS	VA
Retinol	0.13^a±0.04	0.24^b±0.00
Ascorbic acid	0.20^b±0.00	0.02^a±0.00
Tocopherol	0.13^a±0.00	0.34^b±0.00

Values within the same rows with the same superscript are not significantly different at $p< 0.05$

KEY: AS= Roselle, VA = Kapok

Antioxidant analysis was carried out on the extracts of Roselle and Kapok leaves. Ethanol and N-Hexane were the solvents used. FRAP and CUPRAC assay were used on the extracts with results shown in Table 4.

Ferric Reducing Antioxidant Power (FRAP)

The ferric reducing antioxidant power (FRAP) is a method that can be used to determine the antioxidant capacities in extracts, in this case the Roselle and Kapok leaves. It is based on the ability of antioxidants to reduce ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}). This then forms a blue complex. A higher absorbance readout shows that the extract has a good ferric reducing power. The presence of reducing agents such as antioxidants in extracts allows the reduction of ferric iron to ferrous iron (Zhong *et al*., 2015).

From our tables, the Ethanolic extract of Kapok showed the highest concentration with 1.55 mg/100g followed by the ethanolic of Roselle with values 1.40 mg/100 g. N-Hexane extracts of Kapok and Roselle leaves have values 0.57 mg/100g and 0.34 mg/100 g. these values are less than the values gotten for the ethanolic extract. This outcome is consistent with that reported by Subhaswaraj *et al.* (2017) which shows ethanolic extract showed strongest antioxidant activities. According to research on the total antioxidant activity of the ethanolic leaf extract from H. sabdariffa and C. caudatus, as concentration rises, so does absorbance, which corresponds to a rise in total antioxidant activity (Subhaswaraj *et al*., 2017).

Cupric Reducing Antioxidant Capacity (CUPRAC)

The Cupric Reducing Antioxidant Capacity (CUPRAC) method measures the antioxidant capacity of a sample by evaluating its ability to reduce Cu (II) ions to Cu(I) ions in the presence of Neocuproine. The antioxidants in the sample react with the copper (II)-neocuproine reagent, subsequently reducing the copper (II) ions to copper (I) ions. This reduction forms a copper(I)-neocuproine complex, which is subsequently measured spectrophotometrically. Increased absorbance correlates with elevated antioxidant capacity (Apak *et al*., 2005). The Roselle and Kapok samples extracted with ethanol exhibited higher results compared to the N-hexane extracts. The ethanolic extract of Roselle had the highest concentration at 0.63 mg/100 g, followed by the ethanolic extract of Kapok at 0.48 mg/100 g. The N-Hexane extracts of Roselle and Kapok exhibit values of 0.35 mg/100 g and 0.34 mg/100 g, respectively. Apak *et al*. (2006) reported CUPRAC values of total antioxidant capacity ranging between 0.1 and 1.6 mmol TR/g of different herbal tea infusions like Anagallis arvensis 1.63 mmol TR/g, Camellia sinensis 1.07 mmol TR/g, Tribulus terrestris 0.08 mmol TR/g.

The variation in the concentration at which a specific solvent extracts a compound may be attributed to its polarity. Ethanol is a polar protic solvent that is capable of solubilizing a broad spectrum of antioxidant phytochemicals, including phenolic acids, flavonoids, anthocyanins, tannins, and some moderately nonpolar compounds. These classes of compounds especially polyphenols are widely documented as the main contributors to the antioxidant activity of plant materials. In contrast, N-hexane is a nonpolar solvent, which primarily extracts lipophilic compounds such as chlorophylls, carotenoids, and certain lipids (Lee *et al*., 2024). The solvent–compound polarity match explains the higher yield of bioactive antioxidant molecules in ethanol extracts as compared to n-hexane extracts as seen in tables 4. Higher antioxidant activity in ethanolic extracts suggests that Roselle and Kapok leaves may be valuable dietary sources of compounds capable of neutralizing reactive oxygen species (ROS) and reducing oxidative stress in the body. Oxidative stress is linked to the pathogenesis of chronic diseases such as cardiovascular

Table 4: Antioxidants Analysis of Roselle and Kapok Leaves

SAMPLE	FRAP (mg AAE/100 g)	CUPRAC (mg AAE/100 g)
NHV	0.57^b±0.00	0.34^a±0.30
NHA	0.34^a±0.00	0.35^a±0.08
EV	1.55^d±0.05	0.48^a±0.05
EA	1.40^c±0.09	0.63^a±0.04

Values within the same column with the same superscript are not significantly different at $p< 0.05$

KEY: NHV= N-Hexane extract of Kapok, NHA= N-Hexane extract of Roselle, EV=Ethanolic extract of Kapok, EA=Ethanolic extract of Roselle disorders, type 2 diabetes, neurodegenerative diseases (e.g., Alzheimer's and Parkinson's), and certain cancers (Lobo *et al.*, 2010).

CONCLUSION

This study examined the nutritional profile of Hibiscus sabdariffa and Ceiba pentandra. The proximate analysis which is a method for assessing nutritional composition, showed that the crude protein, crude carbohydrates, crude fat, moisture content, and ash content were present in significant quantities except in the Crude fibre and Fat for Kapok. The result for minerals showed that Calcium was abundant in both leaves while Iron, Potassium and Magnesium were in appreciable quantities. The Zinc content was low and Phosphorus was undetected. When nutrients fall below the Recommended Dietary Allowance (RDA) or are undetectable, they can be supplemented by other foods abundant in those nutrients. Vitamins A, C and E was found present in both leaves. The antioxidant assays conducted in this work (FRAP and CUPRAC) demonstrated that both Roselle and Kapok leaves, when extracted with ethanol and N-hexane, exhibited antioxidant activity, with ethanolic extracts yielding the greatest levels. This effect may be attributed to ethanol's polarity, allowing for the extraction of a diverse array of compounds. The results have shown that Hibiscus sabdariffa and Ceiba pentandra leaves are rich in carbohydrates, calcium, and antioxidants, meaning they can be used as a dietary source to improve nutrition and protect the body from harmful free radicals, fight malnutrition, boost mineral intake (especially calcium and iron), and serve as natural sources of antioxidants in food or herbal medicine. All of the above findings highlight the nutritional significance of Roselle and Kapok leaves and support their application in functional food, pharmaceutical development and use in local diets. Further studies should be done on other areas like bioavailability studies, anti-nutrient analysis and on other parts of the Roselle and Kapok plant.

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