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Comparative Proximate Composition of Leaves and Stems of *Artocarpus heterophyllus*, *Artocarpus altilis*, and *Artocarpus camansi*

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Abstract: This study compared the proximate and mineral compositions of *Artocarpus heterophyllus, Artocarpus altilis, and Artocarpus camansi*. Fresh leaf and stem samples were collected from Aguluezechukwu, Anambra State, Nigeria, and authenticated by a plant taxonomist. Proximate analyses were conducted using standard AOAC (2016) methods for moisture, crude protein, ash, crude fibre, fat, carbohydrate, and dry matter determination. Mineral composition was assessed using Atomic Absorption Spectrophotometry following acid digestion. Data obtained were analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test at 5% significance level. Results revealed no significant differences ($p>0.05$) in most proximate parameters among the three species, although variations in mean values were observed. *Artocarpus altilis* exhibited comparatively higher fibre, carbohydrate, and ash contents, while *A. camansi* showed slightly higher moisture and fat contents in some parameters. Mineral analysis indicated that leaves generally contained higher concentrations of calcium, phosphorus, potassium, and sodium, whereas stems showed relatively higher magnesium levels. In conclusion, while these *Artocarpus* species share similar proximate profiles, their distinct mineral distributions highlight their specific nutritional value, suggesting they are viable resources for dietary supplementation and therapeutic applications in Nigeria.

Keywords: *Artocarpus* species, proximate composition, biomass utilization

INTRODUCTION

The proximate and mineral architecture of *Artocarpus heterophyllus*, *Artocarpus altilis*, and *Artocarpus camansi* underscores their dual value as vital nutritional resources and functional therapeutic substrates. Evaluating these specific parameters in a continuous narrative reveals how moisture, macronutrients, and key elemental minerals are distributed throughout their leaves and stems (Jagtap & Bapat, 2010). The physiological framework of these vegetative organs relies heavily on the balance between fluid retention and solid organic mass. The moisture content within the fresh leaves regulates cellular turgor and metabolic pathways, yet it varies inversely with the total dry matter composition. When analyzing these parameters, the dry matter composition represents the concentrated accumulation of structural and nutritional components after all water has been eliminated. This reciprocal relationship between moisture retention and dry matter deposition is highly sensitive to environmental factors and species-specific variations, directly impacting how vegetative biomass yields stable powders or concentrated extracts during baseline processing (Fatoki *et al.*, 2024).

Within this accumulated dry matter framework, carbohydrate composition serves as the primary energy reserve and structural scaffolding, manifesting as complex polysaccharides in the fiber of the stems and digestible sugars within the leaves. This rich carbohydrate baseline works alongside the crude protein composition of the tissues. The protein composition provides essential amino acids necessary for cellular repair and enzyme synthesis, making the leaves an intriguing option for dietary or forage considerations (Sikarwar *et al.*, 2014). Conversely, the crude fat composition remains relatively low across these vegetative structures, existing primarily as functional lipophilic components, lipid membranes, and specialized essential oils within the tissue matrix (Ante *et al.*, 2016). Finally, the overall organic breakdown is completed by the total ash composition, which is a direct measurement of the total residual, non-combustible inorganic material left behind after high-temperature thermal degradation (Fatoki *et al.*, 2024).

This total ash composition is further broken down into a diverse mineral composition, featuring a complex array of macro-elements essential for both plant physiology and consumer nutrition (Jagtap & Bapat, 2010). Among these, the calcium composition stands out as a dominant component, playing an essential role in structural cell wall synthesis and maintaining membrane integrity within both leaves and stems. This element works in tandem with the phosphorus composition; together, calcium composition and phosphorus composition maintain a metabolic equilibrium critical for cellular energy transfer and nucleic acid synthesis within the plant's active growth zones. Furthermore, the potassium composition acts as the primary osmotic regulator within the intracellular fluid, driving stomatal movements in the leaves and managing enzyme activation throughout the vascular tissues. This is supported by the magnesium composition, which functions as the central metallic core of the chlorophyll molecule in green leaves, directly driving photosynthetic capacity and carbohydrate synthesis. Ultimately, this integrated network of moisture, macronutrients, and elemental minerals establishes the foundational baseline that governs the successful pharmacological, dietary, and industrial applications of these three *Artocarpus* species (Akhil *et al.*, 2014; Sikarwar *et al.*, 2014).

Processing methods alter these values significantly; the effect of boiling and fermentation on the nutrient profile of breadnut seed flours demonstrates that targeted processing enhances nutrient availability and reduces antinutritional factors (Amadi *et al.*, 2019). These properties support their use in food systems and traditional medicine. Translating this complex biochemistry into curriculum-based biology achievement requires fostering student motivation and self-esteem (Ezeanyagu *et al.*, 2023), while directly addressing deep-seated alternative conceptions of scientific phenomena (Okafor, 2019). Furthermore, overcoming difficulties with analytical and mathematical calculations in related sciences (Ugonwa, 2015) demands globally competitive, digitally literate science teachers (Nneka & Okafor, 2013). Implementing innovative pedagogical frameworks, including technological gamification, effectively stimulates student interest and clarifies dense scientific data (Enem *et al.*, 2025).

When studying the processing parameters of plant materials, models such as the production and determination of the drying parameters of Solanum esculentum powder offer standard methodological frameworks for conserving heat sensitive phytochemicals during dehydration. Despite their widespread ethnomedicinal and dietary use in Nigeria, a detailed comparative baseline of the nutritional and mineral values of *Artocarpus heterophyllus*, *Artocarpus altilis,* and *Artocarpus camansi* leaves and stems remains poorly documented. Investigating these specific vegetative organs is essential to determine their exact nutrient distributions and validate their traditional roles in human nutrition and animal feed. Furthermore, identifying resource-efficient, local alternatives for dietary supplementation and pharmaceutical raw materials is critical. This study addresses these gaps by evaluating their proximate and mineral profiles, establishing scientific proof of their potential as accessible, high-value functional foods and therapeutic agents.

2. Method

2.1 Source of Materials.

The test samples, (the leaves and stem of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*) were obtained from Aguluezechukwu, in Aguata Local Government Area of Anambra State, Nigeria. The town is known for agriculture and a strong community-driven development approach. It was founded by an individual from Uga who hunted an elephant in the forest ("Agụ"). The town, led by traditional ruler Igwe F.E. Ebelendu, faces erosion issues but is actively growing, developing infrastructure like roads, schools, and the Nkwo market. Chemicals and facilities used in the practical were obtained from the laboratory of Food and Nutrition Department and Plant Science and Biotechnology Laboratory, University of Nigeria Nsukka, Nigeria.

2.2 Identification of Materials

All plant materials for this study were identified by Prof. C. A. Ezeabara, a Plant Taxonomist in Botany Department, Nnamdi Azikiwe University, Awka and given herbarium numbers as NAUH - 264[A] for *Artocarpus heterophyllus,* NAUH – 077[B] for *Artocarpus altilis and* NAUH - 265[A] for *Artocarpus camansi*,

2.3 Nutritional Analysis (Proximate Composition)

The proximate and mineral compositions of the plant samples were determined using standard analytical procedures described by AOAC (2016), Anakhu *et al*. (2023), and Uddin *et al*. (2016). Moisture content was determined using the oven-drying method. A known weight of the sample was placed in a pre-weighed crucible and dried in an oven at 105°C until a constant weight was obtained. The loss in weight after drying represented the moisture content, which was expressed as a percentage of the original sample weight.

Protein content was determined using the Kjeldahl method. The sample was digested with concentrated sulfuric acid in the presence of a selenium catalyst to convert organic nitrogen into ammonium sulfate. The digest was subsequently neutralized, distilled, and titrated to determine the nitrogen content. The percentage nitrogen obtained was multiplied by a conversion factor of 6.25 to estimate the crude protein content. Ash content was determined by incinerating a known weight of the sample in a muffle furnace at 550°C until all organic matter was completely removed, leaving only inorganic mineral residues. The weight of the residue was expressed as a percentage of the initial sample weight.

Crude fibre determination involved sequential digestion of the sample with dilute sulfuric acid and sodium hydroxide under reflux conditions. The residue obtained after filtration was dried, weighed, and then ashed in a muffle furnace. The difference in weight before and after ashing was used to calculate the crude fibre content. Crude fat was determined using the Soxhlet extraction method with petroleum ether as the extraction solvent. A known quantity of the sample was extracted continuously until all fat-soluble components were removed. The solvent was evaporated, and the extracted fat was dried to constant weight and expressed as a percentage of the sample weight.

Carbohydrate content was determined by difference. This was achieved by subtracting the combined percentages of moisture, crude protein, fat, crude fibre, and ash from 100. The resulting value represented the carbohydrate content of the sample. Mineral analysis was carried out to determine the concentrations of calcium, phosphorus, potassium, magnesium, and sodium. The samples were digested using freshly prepared aqua regia, a mixture of nitric acid and hydrochloric acid, under controlled heating conditions until complete dissolution was achieved. The digested samples were filtered, diluted with deionized water, and analyzed using an Atomic Absorption Spectrophotometer (Buck Scientific 210VGP). This technique enabled accurate quantification of the mineral elements present in the samples.

2.4 Data Analysis

Data collected was analysed using Analysis of Variance (ANOVA) and test of significance was processed using Duncan’s Multiple Range Test (Duncan, 1955) and Student’s ‘t’ test at 5% level of probability.

3. Result

3.1 Comparative Moisture Content of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the moisture Content of the three plant species showed that no significant differences exist between the leaf and stem moisture content among the plant species. ($p>0.05$). Although, *A. camansi* showed the highest leaf and stem moisture content of 62.26±7.56 and 59.53±0.64 as presented in Table 1.

3.2 Comparative Fat Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the fat Content of the three plant species showed that no significant differences exist between the leaf and stem fat content among the plant species. ($p>0.05$). Even so, *A. camansi* showed the highest leaf and stem fat content of 2.48±0.51 and 0.79±0.25 as presented in Table 2.

3.3 Comparative Ash Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the ash Content of the three plant species showed that no significant differences exist between the leaf and stem ash content among the plant species. ($p>0.05$). However, *A. altilis* showed the highest leaf and stem ash content of 13.55±0.33 and 9.97±0.45 as presented in Table 3.

Table 1: ***Comparative Percentage Moisture Content of A. heterophyllus, A. altilis and A.camansi***

Moisture Content (%)	*A. heterophyllus*	*A. altilis*	*A. camansi*	P-value
Leaf	57.34±0.99[a]	55.26±1.64[a]	62.26±7.56[a]	0.23
Stem	58.55±1.48[a]	58.62±0.92[a]	59.53±0.64[a]	0.50

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

Table 2: ***Comparative Percentage Fat Composition of A. heterophyllus, A. altilis and A. camansi***

Fat Content (%)	*A. heterophyllus*	*A. altilis*	*A. camansi*	P-value
Leaf	2.39±0.53[a]	2.25±0.21[a]	2.46±0.51[a]	0.83
Stem	0.74±0.06[a]	0.79±0.23[a]	0.79±0.25[a]	0.94

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

Table 3: *Comparative Percentage Ash Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

Ash Content (%)	***A.heterophyllus***	***A. altilis***	***A. camansi***	**P-value**
Leaf	12.77±0.30 [a]	13.55±0.33 [a]	13.30±0.51 [a]	0.12
Stem	9.18±0.47 [a]	9.97±0.45 [a]	9.78±0.67 [a]	0.26

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05
Results are in Mean ± Standard Deviation

3.4 Comparative Percentage Fibre Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the fibre Content of the three plant species showed that significant differences exist between the leaf fibre content of *A. heterophyllus* and *A. camansi* but no significant differences between the stem fibre content among the plant species. (p>0.05). However, *A. altilis* showed the highest leaf and stem fibre content of 5.59±0.31 and 26.65±1.15 as presented in Table 4.

3.5 Comparative Carbohydrate Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the carbohydrate content of the three plant species showed that significant differences exist between the leaf carbohydrate content of *A. heterophyllus* to *A. camansi and A. altilis* but no significant differences between the stem carbohydrate content among the plant species. (p>0.05). Meanwhile, *A. altilis* showed the highest leaf and stem carbohydrate content of 22.99±1.40 and 4.13±0.30 as presented in Table 5.

3.6 Comparative Protein Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the protein Content of the three plant species showed that no significant differences exist between the leaf and stem protein content among the plant species. (p>0.05). Although, *A. camansi* showed the highest leaf and stem protein content of 2.48±0.51 and 0.79±0.25 as presented in Table 6.

Table 4: ***Comparative Percentage fibre Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Fibre Content (%)	***A.heterophyllus***	***A. altilis***	***A. camansi***	**P-value**
Leaf	4.77±0.50 [a]	5.59±0.31 [ab]	5.50±0.33 [b]	0.08
Stem	25.12±0.52 [a]	26.65±1.15 [a]	25.05±1.44 [a]	0.22

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05

Results are in Mean ± Standard Deviation

Table 5: ***Comparative Percentage Carbohydrate Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Carbohydrate (%)	***A.heterophyllus***	***A. altilis***	***A. camansi***	**P-value**
Leaf	18.40±0.77 [a]	22.99±1.40 [b]	21.45±0.49 [b]	0.00
Stem	3.71±0.24 [a]	4.13±0.30 [a]	3.92±0.26 [a]	0.25

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05

Results are in Mean ± Standard Deviation

Table 6: ***Comparative Percentage Protein Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Protein Content (%)	***A. heterophyllus***	***A. altilis***	***A. camansi***	**P-value**
Leaf	4.56±0.40 [a]	4.15±0.12 [a]	4.72±0.62 [a]	0.32
Stem	3.28±0.18 [a]	3.98±0.70 [a]	4.24±0.14 [a]	0.50

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

3.7 Comparative Dry Matter Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the dry matter Content of the three plant species showed that no significant differences exist between the leaf and stem dry matter content among the plant species. ($p<0.05$). Though *A. altilis* gave higher percentage leaf dry matter content of 44.74±1.63 while *A. heterophyllus* gave higher percentage stem dry matter content of 41.45±1.48 as presented in Table 7.

Table 7: ***Comparative Percentage Dry matter Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Dry Matter (%)	*A.heterophyllus*	*A. altilis*	*A. camansi*	P-value
Leaf	42.66±0.99 [a]	44.74±1.63 [a]	37.74±7.58 [a]	0.32
Stem	41.45±1.48 [a]	41.38±0.92 [a]	40.47±0.64 [a]	0.50

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05

Results are in Mean ± Standard Deviation

3.8 Mineral Composition of the Parts of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

3.8.1 Mineral Composition of the Leaf and Stem of *A. heterophyllus*

Result of the mineral compositions of leaf and stem of *A. heterophyllu*s revealed that leaf extract gave higher composition of calcium (180.93±05.15 mg/g), phosphorous (62.48±0.56mg/g), potassium (39.88±0.22mg/g) and sodium (54.17±0.60mg/g) while the stem extract gave higher percentage of magnesium (27.81±0.26 mg/g) as presented in Table 8.

3.8.2 Mineral Composition of the Leaf and Stem of *A. altilis*

Result of the mineral compositions of leaf and stem of *A. altilis* revealed that leaf extract gave higher composition of calcium (185.75±4.29 mg/g), phosphorous (62.99±0.78mg/g), potassium (41.28±0.86mg/g) and sodium (50.59±5.22mg/g) while the stem extract gave higher percentage of magnesium (27.39±2.47mg/g) as presented in Table 9.

3.8.3 Mineral Composition of the Leaf and Stem of *A. camansi*

Result of the mineral compositions of leaf and stem of *A. camansi* revealed that leaf extract gave higher composition of calcium (185.75±4.29 mg/g), phosphorous (62.99±0.78mg/g), potassium (41.28±0.86mg/g) and sodium (50.59±5.22mg/g) while the stem extract gave higher percentage of magnesium (27.39±2.47mg/g) as presented in Table 10.

Table 8: ***Mineral Composition of Leaf and Stem of A. heterophyllus***

Plant parts	Calcium (mg/g)	Phosphorus (mg/g)	Potassium (mg/g)	Magnesium (mg/g)	Sodium (mg/g)
Leaf	180.93±05.15	62.48±0.56	39.88±0.22	26.08±0.17	54.17±0.60
Stem	86.18±3.37	42.95±0.07	36.31±0.61	27.81±0.26	44.01±0.22

Results are in Mean ± Standard Deviation

Table 9: ***Mineral Composition of Leaf and Stem of A. altilis***

Plant parts	Calcium (mg/g)	Phosphorus (mg/g)	Potassium (mg/g)	Magnesium (mg/g)	Sodium (mg/g)
Leaf	185.19±4.42	63.22±0.69	38.90±1.16	23.93±0.94	41.82±1.57
Stem	86.95±0.38	43.33±0.70	35.67±1.25	23.47±1.91	27.13±2.07

Results are in Mean ± Standard Deviation

Table 10: ***Mineral Composition of Leaf and Stem of A. camansi***

Plant parts	Calcium (mg/g)	Phosphorus (mg/g)	Potassium (mg/g)	Magnesium (mg/g)	Sodium (mg/g)
Leaf	185.75±4.29	62.99±0.78	41.28±0.86	23.99±3.12	50.59±5.22
Stem	86.20±1.96	43.36±0.74	34.38±0.32	27.39±2.47	26.76±1.63

Results are in Mean ± Standard Deviation

3.8.4 Comparative Calcium Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the calcium composition of the three Plant showed no significant differences in the leaf and stem calcium content among the three plant species. ($p>0.05$). However, *A. altilis* gave higher percentage leaf calcium content of 185.75±4.29 while *A. camansi* gave higher percentage stem calcium content of 86.95±0.38 as presented in Table 11.

3.8.5 Comparative Phosphorus Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the phosphorus composition of the three Plant Species showed no significant differences in the leaf and stem phosphorus content among the three plant species. ($p>0.05$). Although *A. camansi* gave higher percentage leaf phosphorus content of 63.22±0.69 while *A. altilis* gave higher percentage stem phosphorus content of 43.36±0.74 as presented in Table 12.

3.8.6 Comparative Potassium Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the potassium composition of the three Plant Species showed significant differences in the leaf potassium content of the three plant species with .*A. altilis* having higher composition of 41.28±0.86. While in the stem potassium composition of the three plant species, no significant differences exist between *A. heterophyllus* and *A. altilis* and between *A. altilis* and *A. camansi,* though *A. heterophyllus* showed significant differences with *A, camansi* as presented in Table 13.

Table 11: ***Comparative Calcium Composition of A. heterophyllus, A. altilis and A. camansi***

Calcium Composition (mg/g)	*A.heterophilus*	*A. altilis*	*A. camansi*	P-value
Leaf	180.93±05.15[a]	185.75±4.29 [a]	185.19±4.42 [a]	0.43
Stem	86.18±3.37 [a]	86.20±1.96 [a]	86.95±0.38 [a]	0.90

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

Table 12: ***Comparative Phosphorus Composition of A. heterophyllus, A. altilis and A. camansi***

Phosphorus Composition (mg/g)	*Artocarpus heterophyllus*	*Artocarpus altilis*	*Artocarpus camansi*	P-value
Leaf	62.48±0.56 [a]	62.99±0.78 [a]	63.22±0.69 [a]	0.44
Stem	42.95±0.07 [a]	43.36±0.74 [a]	43.33±0.70 [a]	0.66

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

Table 13: ***Comparative Potassium Composition of A. heterophyllus, A. altilis and A. camansi***

Potassium Composition (mg/g)	*Artocarpus heterophyllus*	*Artocarpus altilis*	*Artocarpus camansi*	P-value
Leaf	39.88±0.22 [a]	41.28±0.86 [ab]	38.90±1.16 [b]	0.04
Stem	36.31±0.61 [a]	34.38±0.32 [ab]	35.67±1.25 [b]	0.07

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05. Results are in Mean ± Standard Deviation

3.8.7 Comparative Magnesium Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative magnesium composition of the three plant species showed no significant differences in the leaf magnesium content among the three species. However, *A. heterophyllus* gave higher leaf magnesium content of 26.08±0.17 while *A. camansi* gave the lower leaf magnesium content of 23.93±0.94. Also, significant differences exist in the stem magnesium content of *A. heterophyllus* (27.81±0.26) when compared to other species with 27.39±2.47 for *A. altilis* and 23.47±1.91 for *A. camansi* respectively ($p>0.05$) as presented in Table 14.

3.8.8 Comparative Sodium Composition of *Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi*

The comparative result on the sodium composition of the three Plant Species showed significant differences in both the leaf and stem sodium content of the three plant species. *A. heterophyllus* gave higher leaf sodium content of 54.17±0.60 while *A. camansi* gave lower leaf sodium content of 41.82±1.57 and also *A. heterophyllus* also gave a higher stem sodium content of 44.01±0.22 while *A. altilis* gave lower stem sodium content of 26.76±1.63 (p>0.05) Table 15.

Table 14: ***Comparative Magnesium Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Magnesium Composition (mg/g)	***Artocarpus heterophyllus***	***Artocarpus altilis***	***Artocarpus camansi***	**P-value**
Leaf	26.08±0.17 [a]	23.99±3.12 [a]	23.93±0.94 [a]	0.35
Stem	27.81±0.26 [a]	27.39±2.47 [b]	23.47±1.91 [b]	0.05

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05
Results are in Mean ± Standard Deviation

Table 15: ***Comparative Sodium Composition of Artocarpus heterophyllus, Artocarpus altilis and Artocarpus camansi***

Sodium Composition (mg/g)	***Artocarpus heterophyllus***	***Artocarpus altilis***	***Artocarpus camansi***	**P-value**
Leaf	54.17±0.60 [a]	50.59±5.22 [a]	41.82±1.57 [b]	0.01
Stem	44.01±0.22 [a]	26.76±1.63 [b]	27.13±2.07 [b]	0.00

For each parameter, columns sharing similar superscripts are not significantly different at P<0.05
Results are in Mean ± Standard Deviation

Discussion

The comparative proximate analysis of *Artocarpus heterophyllus, Artocarpus altilis,* and *Artocarpus camansi* revealed both similarities and subtle variations in their biochemical composition, which can be interpreted in relation to existing literature. The moisture content showed no significant differences among the species (p>0.05), although *A. camansi* recorded the highest leaf and stem values. This finding agreed with the report of Sikarwar *et al*. (2014), who noted that *Artocarpus* species generally possess high internal water content due to their succulent parenchymatous tissues.

Fat content was generally low and statistically non-significant across species ($p>0.05$), although *A. camansi* showed slightly higher values. In a related study, Jagtap and Bapat (2010) reported that *Artocarpus* leaves typically contain low lipid fractions compared to seeds, supporting the current observation. Similarly, Daud et al. (2020) emphasized that lipid content in *A. heterophyllus* leaves is minimal, reinforcing the consistency of this result across the genus. Ash content revealed no significant differences ($p>0.05$), with *A. altilis* showing marginally higher values. This finding agreed with Rao *et al*. (2013), who reported relatively high mineral residue in *A. altilis* leaves due to its rich phytochemical accumulation. In contrast, Periyanayagam and Karthikeyan (2013) observed moderate ash levels in *A. heterophyllus*, suggesting slight interspecific variation in mineral accumulation. Carbohydrate content differed significantly in leaves ($p<0.05$), with *A. altilis* again recording the highest value. This agreed with Omar *et al*. (2011), who associated higher carbohydrate accumulation in *Artocarpus* leaves with metabolic activity and photosynthetic efficiency. In contrast, Jagtap and Bapat (2010) suggested that carbohydrate distribution varies widely among species depending on environmental adaptation.

Protein content showed no significant differences ($p>0.05$), although *A. camansi* recorded slightly higher values. This finding agreed with Amadi *et al.* (2019), who reported moderate protein levels in *Artocarpus* vegetative tissues after processing. Similarly, Fatoki *et al.* (2024) noted that protein variation in breadnut leaves is generally minimal across plant parts. Dry matter content showed no significant differences, although *A. altilis* recorded slightly higher leaf values. This finding is consistent with Sikarwar *et al.* (2014), who reported that *A. altilis* exhibits higher biomass accumulation compared to related species. Mineral analysis revealed species-specific trends. Calcium, phosphorus, potassium, magnesium, and sodium varied significantly in some cases, with *A. altilis* and *A. heterophyllus* often showing higher accumulation. This agreed with Rao *et al.* (2013), who reported strong mineral enrichment in *A. altilis* leaves. In contrast, Plavcova *et al.* (2024) emphasized that mineral distribution in woody plants is strongly tissue-dependent, explaining the observed variation between leaves and stems.

Conclusion

The comparative proximate evaluation of the leaves and stems of *Artocarpus heterophyllus*, *Artocarpus altilis*, and *Artocarpus camansi* demonstrates revealed no significant differences in most proximate parameters, including moisture, fat, protein, ash, and dry matter content, indicating a broadly similar biochemical composition across the species. However, variations observed in fibre, carbohydrate, and selected mineral contents suggest species-specific advantages in industrial applications. *Artocarpus camansi*, on the other hand, showed relatively higher values in certain nutritional components such as fat and protein, while *Artocarpus heterophyllus* demonstrated balanced mineral distribution across plant parts.

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