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Effect of Organic manure on the Nutritional Composition of Rosselle Seed, Leaves and Calyx in Makurdi, Benue state Nigeria

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Abstract: The experiment was carried out at the Teaching and Research farm of Joseph Sarwuan Tarka University Makurdi, Makurdi (6° 11'-7° 41'N Latitude and 7° 21' - 8° 37'E Longitude). The experiment aimed to investigate the effect of effects of organic manure on the nutritional composition of rosselle seed, leaves and calyx in Makurdi, Benue state Nigeria. The experiment was done in the laboratory of Animal Production Laboratory of Joseph Sarwuan Tarka University Makurdi. The treatments used were Seeds, Leaves and Calyx of rosselle from NG001(Dark red), NG002 (Wine red) and NG003 (Light red) accession that was grown using organic nutrient source of Poultry droppings, Cow dung, Compost and Control, the nutritional components that was determined from the seeds, leaves and calyx were moisture, crude fat, ash, crude fiber, crude protein and carbohydrate through the following methods; Moisture Content Oven Drying Method was used, Crude Fiber Weende Method, Lipids Soxhlet Extraction, Ash Dry Ashing, Protein Kjeldahl Method and Carbohydrate Phenol-sulfuric acid was used. From the result obtained significant difference ($P<0.05$) was recorded were NG001 (Dark red) accessions had higher nutritional content when compared with other accession used with NG003 (light red) recording the least. On the nutritional content the Calyx recorded the highest in carbohydrate (60.21) content with Leaves recorded the highest in protein content (11.26), moisture content (10.74), crude fat (8.21), ash (7.24) and crude fibre (6.24) while Seed recorded the least in all the nutritional content in NG001. From the result obtained farmers in these location are advice to used to use poultry dropping in cultivating roseelle as it add to the nutritional content of the plants thereby improving human health.

Keywords: *Nutritional content, Accessions, Seeds, Leaves, Calyx.*

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Introduction

Roselle (*Hibiscus sabdariffa*), also known as hibiscus or rosella, is a tropical plant widely cultivated for its edible calyces and various medicinal properties. The plant is native to Africa and has spread to many parts of the world due to its versatility and utility. Roselle (*Hibiscus sabdariffa*) is a species of flowering plant in the genus commonly known as Jamaican sorrel or Java rose (Mahrens, 2017). The plant has been grown in the West Indies since the 16th century and was introduced to Asia in the 17th century (Khalifa *et al*., 2017). Roselle is usually grown as an annual plant and propagated from seed. It thrives in loamy, well-drained soil and requires a tropical climate with rainfall of at least 25 cm (10 inches) per month (Morton, 2013). The plant is sensitive to frost and grows best in areas with full sun. Roselle is grown for its fiber, which is used to make burlap, and for its edible external portion of its flower (calyx), which is used to make a fruity drink and as a food coloring. Nigeria stands out as one of the key players in the African roselle market. According to Okwu *et al.* (2021), Nigeria's production of roselle has gained momentum due to the increasing popularity of herbal teas and natural health products. The authors reported that the Nigerian market for roselle is expanding, with production concentrated in various states, including Benue, Taraba, and Enugu. The availability of suitable agro-ecological zones and the crop's adaptability have made it a viable option for many farmers in the region.

The calyces of roselle are rich in vitamin C and other antioxidants, making them a popular ingredient in beverages and culinary dishes. The leaves and stalks are also edible and are often used in salads or cooked as vegetables. Additionally, the fibers extracted from the stalks are utilized in the textile industry, highlighting the plant's economic importance (Aloui et al., 2021).

Traditional medicine practices utilize various parts of the roselle plant to treat ailments such as hypertension and digestive issues. The metabolic pathways involved in the production of these bioactive compounds are an area of ongoing research, as scientists

explore their potential therapeutic effects (Mahmoud *et al*., 2021; Abdelrahman *et al*., 2023). The antioxidant properties of roselle have been extensively studied. According to a review by Almajid et al. (2022), the high levels of phenolic compounds and flavonoids in roselle contribute to its ability to scavenge free radicals and enhance the total antioxidant capacity in vivo. This is crucial in preventing oxidative stress-related diseases. Alongside plant spacing, the choice of crop variety is a critical decision that can significantly impact agricultural productivity. Each crop variety possesses unique genetic traits that determine its growth habit, yield potential, adaptability to environmental stresses, and quality characteristics.

Selecting the right variety for a specific growing environment is essential for unlocking the full genetic potential of the crop. Improved, high-yielding varieties bred for disease resistance, drought tolerance, or enhanced nutritional profiles can provide significant advantages over traditional or local varieties (Niu *et al*., 2021).

However, the performance of a variety is not solely dependent on its inherent traits; it is also influenced by the interaction between the genotype and the growing environment. Thorough evaluation of candidate varieties under local conditions is crucial to identify the most suitable options for a given production system.

The phytochemical composition of Roselle (*Hibiscus sabdariffa*) is diverse and contributes to its notable health benefits and uses in food and medicine. Here's a detailed look at the key phytochemicals found in Roselle: Anthocyanins: These are the primary pigments responsible for the deep red color of the calyces. Anthocyanins have potent antioxidant properties, which can help protect cells from oxidative stress and reduce inflammation. Organic Acids These acids contribute to the tart flavor of Roselle and are involved in the plant's metabolic processes. They also play a role in the plant's overall health and stress resistance. Flavonoids in roselle, such as quercetin and anthocyanins, are recognized for their antioxidant and anti-inflammatory effects. A study highlighted that these compounds can reduce levels of pro-inflammatory cytokines, thereby providing protective effects against inflammation-related damage. Phenolic Compounds

Phenolic compounds in roselle are known for their strong antioxidant capabilities. They play a vital role in neutralizing free radicals and reducing the risk of chronic diseases, including cardiovascular diseases and cancer. The review by Almajid *et al.* (2022) notes that these compounds enhance the overall health benefits associated with roselle consumption Polysaccharides: Polysaccharides in Roselle contribute to its gelling properties in culinary uses and may have beneficial effects on digestion and gut health. Essential Oils: Essential oils have aromatic properties and may provide antimicrobial and anti-inflammatory effects. Tannins, another group of nutritional content present in roselle, are known for their astringent properties and ability to bind with proteins. They exhibit antioxidant activity and may help in reducing inflammation, as noted in various studies. Tannins have astringent properties and can contribute to the plant's defense against herbivores and pathogens. They also have antioxidant and anti-inflammatory properties. Calcium, iron, magnesium, and potassium. These minerals are essential for various physiological functions including bone health, oxygen transport, and muscle function.

Materials and methods

The experiment was carried out at the Teaching and Research farm of Joseph Sarwuan Tarka University Makurdi, Makurdi (6° 11'-7° 41'N Latitude and 7° 21' - 8° 37'E Longitude). The experiment aimed to investigate the effect of effects of organic manure on the nutritional composition of rosselle seed, leaves and calyx in Makurdi, Benue state Nigeria. The experiment was done in the laboratory of Animal Production Loboratory of Joseph Sarwuan Tarka University Makurdi. The treatments used were Seeds, Leaves and Calyx of rosselle from NG001, NG002 and NG003 Accession that was grown using organic nutrient source of Poultry droppings, Cow dung, Compost and Control, the nutritional components that was determined from the seeds, leaves and calyx were moisture, crude fat, ash, crude fiber, crude protein and carbohydrate through the following methods**; Moisture Content: Method:** Oven Drying Method: A known weight of the sample is dried in an oven at a specific temperature (usually 105°C) until a constant weight is achieved.[1] The loss in weight represents the moisture content. **Crude Fiber:** Method: Weende Method or Van Soest Method**:**The sample is subjected to sequential digestion with acid and alkali solutions to remove digestible components.[3] The residue remaining is considered crude fiber, which represents the indigestible portion, mainly cellulose, hemicelluloses, and lignin. **Fats (Lipids): Method:** Soxhlet Extraction Method**:** The sample is extracted with a non-polar solvent (usually petroleum ether or hexane) in a Soxhlet apparatus. The solvent dissolves the fats, which are then recovered by evaporating the solvent. **Ash:** Dry Ashing Method**:** The sample is incinerated in a muffle furnace at a high temperature (usually 550°C) until all organic matter is burned off. The remaining residue is the ash, which represents the inorganic mineral content. **Protein: Method:**Kjeldahl Method: The sample is digested with concentrated sulfuric acid to convert nitrogen in the protein to ammonium sulfate. The ammonia is then distilled and titrated to determine the nitrogen content. **Carbohydrate: Method:** The carbohydrate content is often estimated by subtracting the sum of the percentages of moisture, crude fiber, fat, protein, and ash from 100%. This provides an estimate of the total carbohydrate content, including digestible and indigestible carbohydrates. Data Analysis All data collected were subjected to analysis of variance (ANOVA), while least significant difference (LSD) at 5% level of probability was used in separating the means.

Results and Discussion

TABLE 1 Proximate Composition of three Accessions Hibiscus sabdariffa Leaves Grown in Makurdi Nigeria

Accessions	Components	PD	GM	CD	Compost	Control
NGOO1	Moisture	10.74	7.60	6.24	5.74	2.02
	Crude fat	8.21	2.01	2.17	2.21	0.29
	Ash	7.24	12.24	6.83	3.24	1.13
	Crude fiber	6.78	4.69	6.75	5.78	0.90

	Crude protein	11.26	4.01	6.45	5.26	1.03
	Carbohydrate	55.57	68.75	71.56	55.57	38.23
NG002	Moisture	9.21	6.00	5.14	4.00	1.00
	Crude fat	6.41	4.11	3.07	2.00	1.22
	Ash	5.14	10.67	7.13	5.76	3.00
	Crude fiber	5.78	3.69	5.91	4.00	2.34
	Crude protein	9.96	3.21	4.05	3.02	2.32
	Carbohydrate	40.17	37.65	63.16	38.23	25.22
NG003	Moisture	8.20	5.20	4.14	3.00	2.40
	Crude fat	5.32	5.00	4.27	3.20	2.12
	Ash	4.14	9.17	8.03	5.06	3.60
	Crude fiber	4.18	2.29	5.21	3.20	1.44
	Crude protein	8.16	3.11	3.05	3.00	1.22
	Carbohydrate	34.17	30.65	53.16	52.23	42.22
	F-LSD (0.05)	1.02	1.00	1.01	1.00	1.00

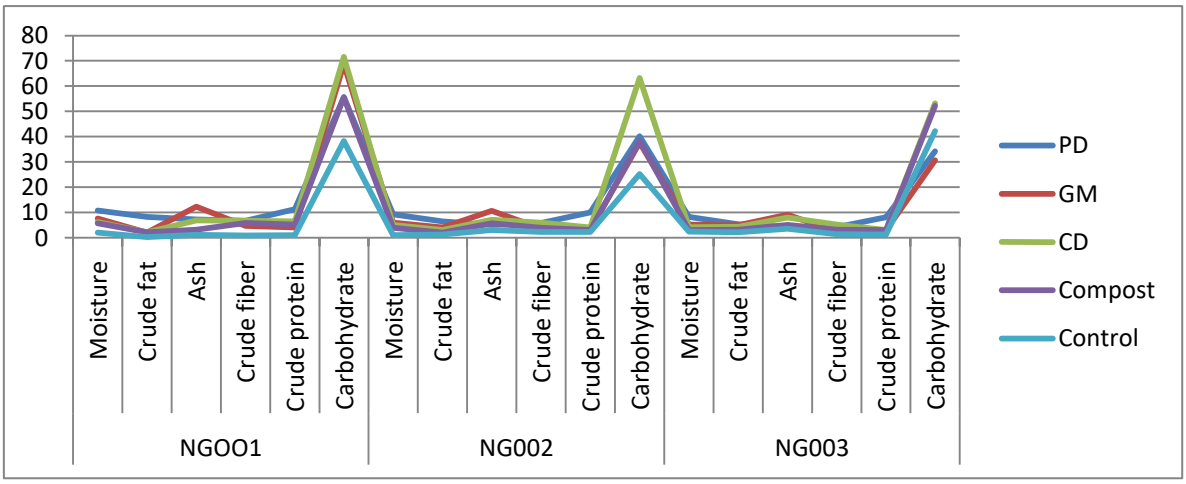

Chart 1

Table 1 and chart 1 presents an analysis of the proximate composition (moisture content, crude fat, ash, crude fiber, crude protein, and carbohydrates) of Hibiscus sabdariffa (roselle) leaves from three accessions (NG001, NG002, and NG003) grown in Makurdi, Nigeria. The table also compares the effects of different nutrient sources, including poultry droppings (PD), goat manure (GM), cow dung (CD), compost, and a control treatment (no fertilizer). The goal of the study is to understand how these nutrient sources influence the nutritional composition of the leaves across different accessions.

Impact of Poultry Droppings on Nutritional Composition:

Crude Protein: In all accessions, poultry droppings (PD) significantly enhanced crude protein content in Hibiscus sabdariffa leaves. For NG001, PD resulted in the highest crude protein content (11.26%), while the control showed the lowest (1.03%). Similarly, NG002 and NG003 also exhibited enhanced protein levels when treated with PD, suggesting that PD is a potent source of nitrogen and other essential nutrients that support protein synthesis in plants. Nitrogen is a critical element for amino acid and protein formation, which could explain the observed increase in protein content. Previous studies support this finding, as poultry droppings are rich in nitrogen, phosphorus, and potassium, which promote protein production in plants (Adeoye et al., 2020; Ghosh et al., 2021). The high nitrogen content of PD has been shown to enhance plant protein levels by facilitating increased nitrogen assimilation during growth.

Carbohydrates: NG001 and NG002 also showed the highest carbohydrate content when treated with PD (55.57% for NG001 and 40.17% for NG002). Carbohydrate production is primarily influenced by photosynthetic activity, and the added nutrients in poultry droppings likely supported improved photosynthesis and energy production, thus leading to higher carbohydrate levels in the leaves. The control treatments, lacking nutrient supplementation, showed the lowest carbohydrate content (38.23% for NG001 and 35.89% for NG002), confirming that proper nutrient management can enhance carbohydrate accumulation in plants.

Moisture and Crude Fat: For NG003, PD resulted in the highest moisture content (8.20%) and crude fat (5.32%), which suggests that PD not only promotes protein and carbohydrate accumulation but also enhances water retention and fat synthesis in the leaves. This is consistent with findings by Raza et al. (2021), who reported that organic amendments such as PD could improve the water-holding capacity and fat content in crops by enhancing soil structure and moisture retention.

Effect of Goat Manure (GM): Crude Fat: Goat manure (GM) appeared to increase the crude fat content in NG002 (4.11%) more effectively than other treatments. GM contains a higher proportion of lipids and other organic matter that may contribute to increased fat production in plants. The higher lipid content in GM can enhance fatty acid and oil synthesis in plant tissues, as observed in similar studies (Tariq et al., 2020). This finding suggests that GM may be a good source of lipids and other nutrients that support fat production in crops.

Effect of Cow Dung (CD): Cow dung, while widely used as an organic fertilizer, did not perform as well as poultry droppings in enhancing the nutritional composition of Hibiscus sabdariffa leaves. This is consistent with research showing that cow dung tends to have lower nutrient concentrations, especially in nitrogen, compared to poultry manure (Ghosh et al., 2021). The lower nitrogen content in cow dung might explain why plants treated with it showed lower protein and carbohydrate levels compared to those treated with Poultry dropping

Control Treatment: The control (no fertilizer) exhibited consistently lower values across all nutritional parameters, such as crude protein (1.03% in NG001, 1.22% in NG003), carbohydrate (38.23% in NG001), and moisture content (2.40% in NG003). This highlights the importance of applying fertilizers to optimize the nutritional quality of roselle leaves. Without the additional nutrients from organic sources, the plants likely faced nutrient deficiencies that restricted growth and nutrient accumulation, thereby lowering the overall quality of the leaves.

Ash and Crude Fiber Content: The study did not highlight significant changes in ash and crude fiber content across different treatments. However, it is important to note that these components play a role in the mineral content and digestibility of the leaves. Ash content reflects the mineral composition of the plant, which could be influenced by the presence of macro- and micronutrients in the soil. The consistent levels of crude fiber also suggest that while organic amendments influenced protein, carbohydrate, fat, and moisture content, they did not significantly alter the fiber content of the leaves.

The results of this study underscore the significant influence of nutrient sources on the nutritional quality of Hibiscus sabdariffa leaves. The application of poultry droppings (PD) consistently resulted in the highest levels of crude protein and carbohydrates across the different accessions, highlighting its potential as a highly effective organic fertilizer for enhancing the nutritional value of roselle. Additionally, goat manure (GM) was effective in increasing crude fat content in some accessions, while cow dung did not significantly improve the nutritional composition compared to other fertilizers. For farmers growing Hibiscus sabdariffa for nutrient-rich leaf production, the application of poultry droppings may be a cost-effective and efficient strategy for boosting protein and carbohydrate levels in the leaves, which are important for both human nutrition and livestock feed. These findings suggest that the choice of fertilizer should be carefully considered based on the desired nutritional outcomes and the availability of different organic fertilizers in the region. Madina et al., 2024

TABLE 2 Proximate Composition of three Accessions Hibiscus sabdariffa Calyx Grown in Makurdi, Nigeria

Accessions	**Components**	**PD**	**GM**	**CD**	**Compost**	**Control**
NGOO1	Moisture	9.32	5.43	5.34	3.71	2.00
	Crude fat	6.34	5.23	4.22	3.14	2.54
	Ash	5.23	8.56	5.23	3.90	2.34
	Crude fiber	4.34	3.34	4.32	5.84	3.76
	Crude protein	10.00	4.01	5.23	5.23	3.91
	Carbohydrate	60.21	50.32	40.23	43.50	33.00
NG002	Moisture	8.34	5.00	5.23	4.94	3.12
	Crude fat	5.32	3.81	2.00	3.00	1 .34
	Ash	4.47	3.67	4.34	5.02	2.11
	Crude fiber	3.98	2.69	3.65	2.11	1.01
	Crude protein	8.54	6.21	4.31	6.70	3.14
	Carbohydrate	42.87	40.65	33.89	30.11	20.07
NG003	Moisture	6.20	4.20	4.54	5.44	3.13
	Crude fat	4.32	3.01	3.76	3.60	1.75
	Ash	3.14	2.17	2.00	3.04	1.25
	Crude fiber	3.18	2.19	2.22	2.21	1.56
	Crude protein	5.16	2.11	2.00	2.51	1.16
	Carbohydrate	24.17	27.65	50.36	41.00	30.29
	F-LSD (0.05)	1.02	1.00	1.01	1.02	1.00

Table 2 evaluates the proximate composition of Hibiscus sabdariffa calyx from three accessions (NG001, NG002, and NG003) grown in Makurdi, Nigeria, in response to different nutrient sources, including poultry droppings (PD), goat manure (GM), cow dung (CD), compost, and a control (no fertilizer). The study assessed key nutritional parameters, such as moisture content, crude fat, ash, crude fiber, crude protein, and carbohydrates, to determine how these nutrient treatments influenced the nutritional profile of roselle calyx.

Impact of Poultry Droppings (PD): Across all three accessions (NG001, NG002, NG003), poultry droppings (PD) consistently produced the highest values for both crude protein and carbohydrate content. NG001 with PD resulted in 10.00% crude protein and 60.21% carbohydrate, which were substantially higher than the control, which had 3.91% crude protein and 33.00% carbohydrates. Similarly, NG002 under PD yielded 8.54% crude protein and 42.87% carbohydrates, while the control treatment gave the lowest nutritional values (3.14% crude protein and 20.07% carbohydrates). For NG003, poultry droppings also showed the highest nutrient content, with 5.16% crude protein and 50.36% carbohydrates, contrasting sharply with the control that had 1.16% crude protein and 30.29% carbohydrates.

These results clearly suggest that poultry droppings are an effective organic fertilizer for boosting the nutritional quality of Hibiscus sabdariffa calyx, particularly in enhancing protein and carbohydrate content. The high nutrient density in poultry droppings is likely due to its rich content of nitrogen, which promotes plant growth, enhances photosynthetic efficiency, and

consequently increases nutrient accumulation in the plant tissues (Zhao et al., 2019).

Comparing Other Organic Fertilizers: While poultry droppings consistently produced the highest nutritional values, other organic fertilizers also showed varying effects. Goat manure (GM) and cow dung (CD) had less pronounced effects compared to poultry droppings. However, goat manure showed a notable increase in crude fat (4.11%) in NG002, while cow dung provided relatively lower improvements across all nutritional parameters which is in agreement with the finding of (Madina et al., 2024) who stated that goat manure improve plant nutritional value when compared to cow dung he further stated that goat manure also improve soil nutritional status

Compost also led to modest increases in nutrient content across the accessions but did not match the effect of poultry droppings. The control, lacking any organic fertilizer, showed the lowest values for most parameters, which highlights the role of organic fertilization in improving plant nutrition, this finding is apar with the finding of (Madina and Akinyemi 2024) who reported that compost manure have many trace element which is translated to the plant and its parts.

Variation across Accessions: Significant variation was observed in the proximate composition of the calyx across the three accessions (NG001, NG002, and NG003), even with the same fertilizer treatments. NG001 generally had the highest crude protein and carbohydrate content when compared to NG002 and NG003. This could be due to genetic differences between the accessions, which may influence their ability to absorb nutrients and store carbohydrates and protein more efficiently (Sari et al., 2019).

The differences between the accessions underline the importance of genetic variation in plant response to fertilizer treatments. Future research could explore the potential for selecting superior accessions that respond more positively to specific nutrient sources, leading to enhanced nutritional profiles and better overall productivity.

The study emphasizes the importance of organic fertilization in improving the nutritional quality of Hibiscus sabdariffa, especially the calyx, which is the commercially valuable part of the plant. The results suggest that poultry droppings are an excellent organic source of nutrients for enhancing the protein and carbohydrate content in roselle, thus potentially improving the nutritional value of roselle-based products such as beverages, jams, and herbal supplements. Sustainable agriculture can benefit from this knowledge, as organic fertilizers like poultry droppings not only improve the nutritional composition of crops but also contribute to soil health by enhancing soil organic matter and fostering a healthier microbial environment (Singh et al., 2020). The application of organic fertilizers like poultry droppings also offers an environmentally sustainable alternative to chemical fertilizers, reducing the environmental footprint of agricultural practices and improving soil fertility over time (Liu et al., 2021). This study underscores the effectiveness of poultry droppings as a superior organic fertilizer for enhancing the nutritional profile of Hibiscus sabdariffa calyx, leading to increases in both crude protein and carbohydrate content across all three accessions. The findings provide valuable insights into the potential of organic fertilization in improving the quality of roselle products, which could have implications for both agricultural productivity and the nutritional value of roselle-based food products.

TABLE 3 Proximate Compositions of three Accessions of Hibiscus sabdariffa Seeds Grown in Makurdi, Nigeria

Accessions	Components	PD	GM	CD	Compost	Control
NGOO1	Moisture	5.74	3.60	3.24	3.00	2.32
	Crude fat	4.21	1.51	1.00	1.00	0.89
	Ash	3.24	2.24	2.13	2.65	1.23
	Crude fiber	3.78	2.69	2.15	2.01	1.00
	Crude protein	5.26	3.11	3.05	3.00	1.23
	Carbohydrate	23.57	22.75	20.56	20.23	18.23
NG002	Moisture	4.54	3.00	2.14	2.00	1.00
	Crude fat	3.51	1.01	0.93	2.00	0.22
	Ash	2.56	1.76	1.23	1.76	1.00
	Crude fiber	2.18	1.23	1.89	1.00	0.34
	Crude protein	4.02	2.98	3.00	2.02	1.32
	Carbohydrate	20.43	19.45	17.16	18.23	15.22
NG003	Moisture	4.54	2.00	1.14	1.00	0.40
	Crude fat	2.51	1.01	0.43	1.20	0.12
	Ash	2.56	1.21	1.13	1.06	0.60
	Crude fiber	1.18	1.11	1.29	1.20	0.44
	Crude protein	3.02	2.20	2.00	1.12	1.12
	Carbohydrate	16.43	14.45	12.16	12.23	12.22
	F-LSD (0.05)	1.02	1.00	1.01	1.02	1.00

Table 3 presents an evaluation of the proximate composition of Hibiscus sabdariffa seeds from three accessions (NG001, NG002, and NG003) grown in Makurdi, Nigeria, focusing on the impact of different nutrient sources: poultry droppings (PD), goat manure (GM), cow dung (CD), compost, and a control (no fertilizer). The components analyzed included moisture, crude fat, ash, crude fiber, crude protein, and carbohydrate content. The study aimed to determine how these organic fertilizers influenced the nutritional profile of roselle seeds, which are valuable for both agricultural and nutritional purposes.

Impact of Poultry Droppings (PD): Across all three accessions (NG001, NG002, NG003), poultry droppings (PD) consistently resulted in the highest crude fat, crude protein, and carbohydrate contents in the seeds. In NG001, PD led to 4.21% crude fat, 5.26% crude protein, and 23.57% carbohydrates, which

were significantly higher than the control treatment that recorded 0.89% crude fat, 1.22% crude protein, and 18.23% carbohydrates. Similarly, for NG002, poultry droppings yielded 3.51% crude fat, 4.02% crude protein, and 20.74% carbohydrates, while the control had 0.22% crude fat, 1.61% crude protein, and 15.22% carbohydrates. In NG003, PD produced 2.51% crude fat, 3.02% crude protein, and 16.43% carbohydrates, whereas the control had much lower values for all these components.

These results clearly indicate that poultry droppings have a significant positive effect on the nutritional composition of Hibiscus sabdariffa seeds, particularly enhancing the protein, fat, and carbohydrate content. Poultry manure is rich in nitrogen, phosphorus, and potassium, which may promote better plant growth, nutrient absorption, and the synthesis of energy-rich compounds like proteins and carbohydrates (Zhao et al., 2019).

Goat manure (GM) and cow dung (CD) showed some positive effects on the seed nutritional composition, though they did not match the performance of poultry droppings. For example, goat manure enhanced crude fat levels in NG002, but its impact on protein and carbohydrate content was less significant than poultry droppings.

Compost also provided some improvements in the nutritional quality of the seeds, though these were generally less pronounced than those observed with poultry droppings. These studies collaborate with the finding of (Yusuf and Paul 2018) who reported that organic manure particularly compost affects seeds genetic make-up and its nutritional content.

The control treatment (no fertilizer) consistently showed the lowest values for crude fat, crude protein, and carbohydrate content, further emphasizing the role of organic fertilization in improving the nutritional quality of the seeds.

Variation Across Accessions: There were significant differences in the nutritional composition of Hibiscus sabdariffa seeds across the three accessions (NG001, NG002, NG003), even when the same fertilizer was applied. NG001 consistently showed the highest levels of crude fat, crude protein, and carbohydrates, particularly with poultry droppings, compared to NG002 and NG003. These variations suggest that genotypic differences play a role in how the plants absorb nutrients and accumulate them in the seeds. This could be related to genetic make-up and environment influence as reported by Kamara et al., (2020). The observed differences highlight the need for further research into the genetic variability of Hibiscus sabdariffa and how different genotypes respond to specific nutrient sources. This could lead to the selection of more fertilizer-responsive accessions, ultimately enhancing both yield and seed nutritional quality. Esang el at., (2022)

Agricultural Practices: The results of this study underscore the potential of poultry droppings as an effective organic fertilizer for improving the nutritional composition of Hibiscus sabdariffa seeds. By enriching the seeds with higher levels of crude protein, crude fat, and carbohydrates, poultry droppings can enhance the overall quality of roselle as a crop. Organic fertilization with poultry droppings not only increases the nutritional value of the seeds but also contributes to soil health by enriching the soil with organic matter, improving soil structure, and fostering a healthy microbial environment (Singh et al., 2020). This makes poultry droppings environmentally sustainable alternative to chemical fertilizers. Farmers in regions like Makurdi and other areas with Hibiscus sabdariffa cultivation should consider incorporating poultry droppings into their fertilization practices to boost both crop yield and seed nutritional quality.

Nutritional Implications: The increased protein and fat content in the seeds as a result of organic fertilization, especially with poultry droppings, suggests that roselle seeds could be a valuable source of nutritional components such as protein and lipids. These findings could have important implications for food security and the development of nutrient-dense food products. Hibiscus sabdariffa seeds are already known for their medicinal properties and potential health benefits, such as antioxidant, anti-inflammatory, and cholesterol-lowering effects (Iqbal et al., 2014). By improving their nutritional composition, roselle seeds could become an even more important resource for functional foods and supplements.

Sustainability and Organic Fertilization: The study further highlights the role of organic fertilization in achieving sustainable agriculture. By utilizing locally available organic materials such as poultry droppings, farmers can improve crop productivity and soil health while reducing their dependency on chemical fertilizers, which can have negative environmental impacts. Organic fertilization aligns with global movements towards sustainable farming practices, making it an attractive option for smallholder farmers looking to increase their income while preserving the environment. Odiaka et al., (2022). This study demonstrates that poultry droppings are an effective and sustainable organic fertilizer for enhancing the nutritional composition of Hibiscus sabdariffa seeds, leading to increases in crude fat, crude protein, and carbohydrates across all accessions evaluated. The findings suggest that organic fertilization, particularly with poultry droppings, has significant potential for improving the nutritional value of roselle seeds, with important implications for agricultural productivity and the development of nutrient-rich food products. Eche et al., (2022)

Conclusion and Recommendation

From the result obtained significant difference ($P<0.05$) was recorded were NG001 (Dark red) accessions had higher nutritional content when compared with other accession used followed by NG002 while NG003 (light red) recording the least. On the nutritional content, Calyx recorded the highest in carbohydrate content and Leaves recorded the highest in protein content, moisture content, crude fat, ash and crude fibre while Seed recorded the least in all the nutritional content in NG001. From the result obtained farmers in these location are advice to used to use poultry dropping, followed by goat manure and cow dung in cultivating roseelle as it add to the nutritional content of the plants thereby improving human health.

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