

Comparative Analysis on the Proximate and Mineral Compositions of *Musa Paradisiaca* Peels, Stems and Leaves

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Abstract: This study was carried out to do a comparative analysis on proximate and mineral compositions of *Musa paradisiaca* peels, stems and leaves. Proximate result showed that moisture, crude protein, ether extract, ash, crude fibre and energy in *Musa paradisiaca* peel were; 13.40 %, 6.33 %, 1.71 %, 10.76 %, 14.61 % and 2910.7 kcal/kg while those for *Musa paradisiaca* leaves; moisture (15.09 %), crude protein (5.02 %), ether extract (0.81 %), ash (8.45 %), crude fibre (16.30 %), energy (2510.8 kcal/kg) and *Musa paradisiaca* stems; moisture (18.05 %), crude protein (3.63 %), ether extract (1.45 %), ash (7.55 %), crude fiber (16.91 %) and energy (2110.7 kcal/kg). Crude protein, ether extract, ash, and energy values were higher in *Musa paradisiaca* peel, intermediate in *Musa paradisiaca* leaves and lower in *Musa paradisiaca* stems ($p < 0.05$) except for crude fibre composition which was highest in *Musa paradisiaca* leaves compared to *Musa paradisiaca* peels and *Musa paradisiaca* stems. Calcium, phosphorus and potassium values varied from 395.7 - 556.7 mg/100g, 188.3 - 310.2 mg/100g and 404.1 - 838.91 mg/100g respectively. Magnesium (86.73 - 140.3 mg/100g), zinc (30.90 - 97.94 mg/100g), manganese (8.42 - 18.56 mg/100g) and copper (6.06 - 10.22 mg/100g). Result showed that *Musa paradisiaca* peels contains high levels of minerals compared to *Musa paradisiaca* stems and leaves. It was concluded that *Musa paradisiaca* peels can serve as a good source of energy when used to replace some conventional energy feedstuffs. Its utilization may further help to reduce the cost of production and boost livestock farming.

Keywords: Feedstuffs, proximate, peels, minerals, *Musa paradisiaca*.

INTRODUCTION

The expansion of the livestock industry depends on the availability of good quality feed in sufficient quantities and at prices affordable to both producers and consumers (Odunsi, A., 2003). Recently, there has been a continuous increase in prices of feed ingredients, especially the conventional feedstuffs. This necessitated the search for non-conventional feedstuffs or agro-industrial by-products to reduce the cost of production and boost livestock production (Farinu, G. *et al.*, 2008). Among the potential agro-industrial by-products are banana (*Musa paradisiaca*) peels, leaves, and stems.

Banana (*Musa paradisiaca*) belongs to the Musaceae family which grows predominantly in the continents of Asia, South America, and the tropical African sub-continent (Nayar, N.M., 2010). Banana peels are by-products of the banana processing industry, which are normally dumped in landfills, rivers, or unregulated grounds and most times cause pollution to the environment (Omole, A.J. *et al.*, 2008). Recent research has shown that waste from banana (peels, leaves, and stems) is rich in non-toxic and rich nutrients, vitamins, and minerals such as iron, zinc, potassium, phosphorus, calcium, magnesium, amongst others in significant quantities (Stein, A.J., 2010). For instance, (Oyeyemi, S. *et al.*, 2019) reported that *Musa paradisiaca* leaves have a moisture content (15.58%), ash (6.51%), crude fiber (14.05%), crude fat (3.28%), and crude

protein (24.16%), while those of their peels; moisture (13.68%), ash (10.50%), crude fiber (10.78%), and crude protein (20.38%). The same author reported that dried *Musa paradisiaca* leaves contain sodium (235.6 mg/100g), calcium (110.2 mg/100g), iron (9.47 mg/100g), magnesium (18.40 mg/100g), copper (0.39 mg/100g), and manganese (2.45 mg/100g). (Jones, A.D. & Ejeta, G.A., 2016) stated that *Musa paradisiaca* leaves and peels are rich in water and fat-soluble vitamins which are essential for growth and health. Their main role is to facilitate and regulate body processes. However, their chemical composition is influenced by variety, geographical location, age of the plant, amongst others (John, A.O., 2024b; John, A.O., 2024c).

In view of the abundant potentials in *Musa paradisiaca* leaves, stems and peels, these byproducts still underutilized. Therefore, this study was designed to do a comparative analysis on the proximate and mineral compositions of *Musa paradisiaca* peels, stems and leaves.

MATERIALS AND METHODS

Experimental Location

The experiment was carried out at Vet Etcetera Concepts Integrated Farms Chikuku, Tsoho, along Gwagwalada road, Kwali Local Government, Kuje Abuja located between latitude 8°53'47"N and longitude 7°14' 24"E north and east of Abuja and south of Abaji area councils.

Collection of Samples and Processing

Fresh samples of *Musa paradisiaca* stems and leaves were harvested from Vet Acretra Farms in Old Chikuku, Kuje Abuja. Plant identification was carried out by a certified taxonomist at the International Institute of Tropical Agriculture, Kubwa Abuja. *Musa paradisiaca* peels were gotten by manually removing the peels from the inner freshly portion with kitchen knife from a mature *Musa paradisiaca* fruit, thereafter, samples were air dried under a shade for 14 days until a constant weight was achieved before it was grounded into powder using a hammer mill and stored in a labeled polythene bag before it was transferred to the laboratory for further analysis.

Proximate analysis of samples

Proximate analysis of dried *Musa paradisiaca* peels, stem and leaf powder was carried out using table top automated near-infra-red feed analyzer (DS-2008H, Netherlands). 100 g of each sample was passed through the sample chamber and the kit was adjusted at a frequency range of 120 - 150 Hz, optimum temperature (70°C) and a precision time of 60 seconds.

Mineral Analysis of Samples

Analysis of minerals was carried out using Bucks Atomic Absorption Spectrophotometer (Model 255 ATS, Netherlands). To ensure accuracy in results, machine was operated according to the specified manufacturers' recommendations.

STATISTICAL ANALYSIS

All the experiments were conducted in triplicates. Analysis of variance (ANOVA) was performed and significant differences in mean values were evaluated by Duncan ($P < 0.05$) using SPSS version 25.0 (SPSS, Chicago, Illinois, USA).

RESULTS AND DISCUSSION

Proximate composition of *Musa paradisiaca* peels, leaf and stem is presented in Table 1. Values for moisture content varied from 13.40 - 18.05 %, crude protein (3.63 - 6.33 %), Ether extract (0.81 - 1.71 %), ash (7.55 - 10.76 %), crude fiber (14.61 - 16.91 %) and energy (2110.7 - 2910.7 kcal/kg). Moisture content, crude protein, ether extract, ash and energy values were higher in *Musa paradisiaca* peels, intermediate in *Musa paradisiaca* leaves and lower in *Musa paradisiaca* stem ($p < 0.05$). Conversely, crude fibre content was higher in *Musa paradisiaca* stem relative to the other samples. Crude protein and ash content recorded in this study was higher than 5.30 % and 8.80 % reported by (Hassan, P. & Peh, K.K., 2018;

Romelle, F. *et al.*, 2016). Ash and crude protein values reported for *Musa paradisiaca* stem in this experiment was higher than 4.10 % and 3.30 % reported by (Morais, R. *et al.*, 2017; Mydhili, M. *et al.*, 2022). However, energy content of *Musa paradisiaca* peels and stem aligns with the reports of (Ramu, R. *et al.*, 2017; Ho, L.H. *et al.*, 2017). The disparity in results can be attributed to variety, geographical locations and age of plants (Ojediran, T.K. *et al.*, 2024b). Outcome of these study indicates that *Musa paradisiaca* peel can be used as a good source of energy and minerals for animals. *Musa paradisiaca* peels, leaves and stems are low in protein therefore they cannot be used as protein supplement for livestock's (Singh Sharma *et al.*, 2022). The high moisture content was within the range 15.0 - 21.00 % reported by (Shittu, M.D. & Alagbe, J.O., 2020; Alagbe, J.O., 2020). The variation in moisture content between the samples could be linked to changes in climatic condition (Alagbe, J.O., 2020). Crude protein values recorded in this study is in agreement with reports of (Okareh, O.T. *et al.*, 2015; Barnabas, O.O. & Anthony, J.A., 2019). High crude fibre recorded for *M. paradisiaca* leaves suggests that it can function in the removal of wastes in the body (Ishida, H. *et al.*, 2000). According to (Ishida, H. *et al.*, 2000), high dietary crude fibre can lower serum cholesterol and increase digestion in the gastro intestinal tract of animals (Singh Sharma *et al.*, 2022).

Mineral composition of *Musa paradisiaca* peels, leaf and stems is presented in Table 2. Calcium, phosphorus and potassium values ranged from 395.7 - 556.7 mg/100g, 188.3 - 310.2 mg/100g and 404.1 - 838.91 mg/100g respectively. Magnesium (86.73 - 140.3 mg/100g), zinc (30.90 - 97.94 mg/100g), manganese (8.42 - 18.56 mg/100g) and copper (6.06 - 10.22 mg/100g). Results obtained indicates that calcium, phosphorus, potassium, manganese, zinc, magnesium, iron and copper concentrations were highest in *Musa paradisiaca* peels, intermediate in *Musa paradisiaca* leaves and lowest in *Musa paradisiaca* stems ($p < 0.05$). The result obtained for *Musa paradisiaca* peels in this study was higher than those reported by (Tsado, A.N. *et al.*, 2021), calcium (17.85 mg/100g), copper (1.35 mg/100g), manganese (10.38 mg/100g), magnesium (49.32 mg/100g), potassium (38.22 mg/100g), potassium (22.64 mg/100g) and iron (5.06 mg/100g). Result on *Musa paradisiaca* leaves and stems aligns with the reports of (Adeolu, A.T. & Enesi, D.O., 2013). Variation in mineral composition obtained in this study could be due to differences in geographical locations or

variety (Alagbe, J.O. *et al.*, 2021; Agubosi, O.C.P. *et al.*, 2021). Calcium is a vital part of body fluids and bone formation in synergy with phosphorus (Ojediran, T.K. *et al.*, 2024a). Manganese plays an important role in energy production and in supporting the immune system (Fennell, C.W. *et al.*, 2010). Magnesium is an activator in enzyme systems which maintains electrical potential in nerves (Fennell, C.W. *et al.*, 2010). Sodium and potassium influence osmotic pressure and contribute to normal pH equilibrium (Hussain, J. *et al.*, 2013). Zinc forms metalloproteinase and

enzyme complexes which cannot be dissociated without loss of activity (Muhammad, A. *et al.*, 2011).

CONCLUSION

It was concluded that *Musa paradisiaca* peels, leaves and stems are rich in various nutrients that can be used in feeding animals. Though there are variations in their nutrient components, however, utilization of these plants will help to reduce the pressure on conventional feedstuffs and will further help to reduce the cost of production.

Table 1: Proximate composition of *Musa paradisiaca* peels, leaves and stems

Variables (%)	Peels	Leaves	Stem
Moisture	13.40±0.55 ^c	15.09±0.09 ^b	18.05±0.18 ^a
Crude protein	6.33±0.20 ^a	5.02±0.18 ^b	3.63±0.10 ^c
Ether extract	1.71±0.03 ^a	0.81±0.03 ^b	1.45±0.01 ^a
Ash	10.76±0.61 ^a	8.45±0.50 ^b	7.55±0.35 ^b
Crude fiber	14.61±0.07 ^b	16.30±0.20 ^a	16.91±0.22 ^a
Energy (Kcal/kg)	2910.7±12.8 ^a	2510.8±10.2 ^b	2110.7±9.97 ^c

Values followed by different letters were significantly different ($p < 0.05$); outcomes

represent the mean ± standard deviation of the analysis carried out in triplicate.

Table 2: Mineral composition of *Musa paradisiaca* peels, leaf and stem

Variables (mg/100g)	Peels	Leaves	Stem
Calcium	556.7±2.77 ^a	411.3±1.56 ^b	395.7±1.10 ^c
Phosphorus	310.2±0.09 ^a	200.5±0.16 ^b	188.3±0.13 ^c
Potassium	838.91±5.61 ^a	561.7±4.04 ^b	404.1±3.50 ^c
Magnesium	140.3±0.71 ^a	100.1±0.11 ^b	86.73±0.06 ^c
Zinc	97.94±0.04 ^a	54.12±0.15 ^b	30.90±0.20 ^c
Manganese	18.56±0.006 ^a	10.40±0.002 ^b	8.42±0.001 ^c
Iron	9.55±0.66 ^a	5.40±0.52 ^b	4.99±0.21 ^c
Copper	10.22±3.83 ^a	7.86±2.91 ^b	6.06±2.88 ^b

Values followed by different letters were significantly different ($p < 0.05$); outcomes represent the mean ± standard deviation of the analysis carried out in triplicate.

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