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PHYTOCHEMICAL, NUTRITIONAL PROFILE AND INVITRO ANTIOXIDANT POTENTIAL OF MUSA PARADISIACA FRUIT AND PEEL.

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Abstract

Plantain (*Musa paradisiaca*) is an important food crop, while its peel is commonly discarded despite its potential to contain useful nutrients and bioactive compounds. This study compared the phytochemical profile, proximate composition, vitamin and mineral contents, and *in vitro* antioxidant activity of plantain fruit and peel. Phytochemical constituents were profiled using gas chromatography-based analysis, while proximate composition, vitamins, minerals and antioxidant activities were determined using the methods described in the underlying research project. The reported proximate results showed higher moisture (10.518%), fat (17.098%) and protein (11.20%) in the peel than in the fruit (8.342%, 7.715% and 10.15%, respectively), whereas the fruit had higher ash (8.515%), fibre (8.870%) and carbohydrate (56.408%) than the peel (7.428%, 3.858% and 49.898%). The peel showed greater DPPH scavenging activity across the tested concentrations, increasing from 93.097% at 10 mg/mL to 94.829% at 80 mg/mL, compared with 82.058–85.781% for the fruit. At 100–300 mg/mL, ABTS scavenging activity was also higher in the peel (67.019–71.247%) than in the fruit (55.180–59.408%). In contrast, ferric-reducing antioxidant power was higher in the fruit at the tested concentrations. Overall, the findings indicate that the peel contains measurable nutrients and exhibits promising *in vitro* radical-scavenging activity, while the fruit remains a substantial source of carbohydrate and showed stronger ferric-reducing activity. The results showed that the fruit and peels

of *Musa paradisiaca* contained different phytochemicals, minerals, vitamins and antioxidant which are vital for human health and survival. The peels showed more potential than the edibles in the sense that it contained more phytochemicals, minerals, vitamins except in the antioxidants where the edibles contained more ferric reducing antioxidant power than the peels. *Musa paradisiaca* edible and peels are rich sources of macronutrients, dietary fiber and minerals, making them suitable for utilization in both human and animal nutrition.

Keywords: *Musa paradisiaca*; plantain peel; proximate composition; phytochemicals; antioxidant activity; DPPH; ABTS

1. Introduction

Plantain (*Musa* spp.) is an important tropical staple that contributes dietary energy and other nutrients to populations across Africa and other tropical regions. The edible fruit is consumed in a variety of forms, while the peel is often treated as waste. The disposal of fruit peels creates an opportunity to explore their potential use as sources of nutrients and plant-derived compounds, provided their composition, safety and processing characteristics are adequately established.

Plant foods contain primary metabolites, including carbohydrates, proteins, lipids and fibre, as well as secondary metabolites that may contribute to biological activities. Antioxidant assays conducted in vitro provide preliminary information about the ability of extracts or samples to scavenge selected radicals or reduce oxidants under specified experimental conditions. However, in vitro activity alone does not establish a clinical benefit or demonstrate efficacy in humans.

Comparing the fruit and peel of *M. paradisiaca* can help clarify whether the peel has compositional features that may justify further food-science or waste-valorisation research. The present study therefore evaluated and compared the phytochemical profile, proximate composition, vitamin and mineral contents, and in vitro antioxidant activities of plantain fruit and peel.

2. Materials and Methods

2.1 Sample collection and preparation

Plantain fruit and peel samples was purchased from Nibo market Awka, Anambra state.

. The edibles and peels of *Musa paradisiaca* was procured from nibo market. It was washed, peeled and was chopped into pieces and allowed to dry for two weeks under room temperature. After drying, it was grinded into powder by corona manual grinding machine.

2.2 Phytochemical profiling

The original project reports gas chromatography-based profiling (GC-FID/GC-MS terminology is used in different sections) of the edible portion and peel. Detected compounds and their reported

percentage composition were tabulated in the project appendix. Before journal submission, the analytical platform, extraction solvent and procedure, instrument model, column, carrier gas, temperature programme, identification library/standards, and whether reported percentages represent peak-area percentages must be confirmed from the laboratory method and instrument output.

2.3 Proximate composition, vitamins and minerals

Moisture, ash, crude fat, crude fibre, crude protein and carbohydrate were determined using the procedures described in the project. Vitamin analysis covered selected fat-soluble and water-soluble vitamins. Elemental analysis was reported for iron, zinc, copper, manganese, calcium, potassium, magnesium and selenium. The original appendix reports proximate results as mean $\pm$ SEM, vitamin values in mg/100 g and mineral values in ppm. The exact standard methods, sample basis (fresh weight or dry weight), replicate number, and units should be verified and stated consistently in the final manuscript.

2.4 In vitro antioxidant assays

The project reports DPPH and ABTS radical-scavenging assays, hydrogen peroxide scavenging, hydroxyl-radical scavenging, total antioxidant capacity (TAC), and ferric-reducing antioxidant power (FRAP). Results are presented below using the values transcribed from the project appendix. Reference standards are identified in the source as BHT for DPPH and gallic acid for several other assays (the source spells this inconsistently as “galic acid”). Assay-specific protocols, calculation equations, blank corrections, incubation conditions, wavelengths, and standard-curve procedures should be checked against the original laboratory records before submission.

2.5 Statistical analysis

The source tables label results as mean $\pm$ SEM but report SEM as 0.00 throughout. The number of independent replicates and statistical tests are not sufficiently clear from the extracted results. These details must be confirmed and corrected from the original data before publication; no inferential statistical significance is claimed in this draft.

3. Results

3.1 Proximate composition

The peel contained higher moisture, fat and protein than the edible pulp, whereas the pulp contained higher ash, fibre and carbohydrate (Table 1). The reported carbohydrate content was the largest proximate fraction in both sample types.

Parameter	Fruit	Peel
Moisture (%)	8.342 $\pm$ 0.00	10.518 $\pm$ 0.00
Ash (%)	8.515 $\pm$ 0.00	7.428 $\pm$ 0.00
Fat (%)	7.715 $\pm$ 0.00	17.098 $\pm$ 0.00
Fibre (%)	8.870 $\pm$ 0.00	3.858 $\pm$ 0.00
Protein (%)	10.15 $\pm$ 0.00	11.20 $\pm$ 0.00

Carbohydrate (%)	56.408 ± 0.00	49.898 ± 0.00
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Interpretation: The peel had higher reported moisture, fat and protein, whereas the edible pulp had higher ash, fibre and carbohydrate. These findings provide a useful comparison of the two sample fractions.

However, the manuscript must state the sample basis (for example, dry weight or fresh weight), confirm how carbohydrate was calculated, and clarify whether the fibre measurement represents crude fibre or total dietary fibre.

3.2 Vitamin composition

The source reported differences in vitamin distribution between the two sample portions. The pulp had higher alpha-tocopherol, cholecalciferol, phylloquinone, niacin, ascorbic acid, cobalamin and pyridoxine. The peel had higher gamma-tocopherol, retinol, riboflavin and thiamin, and the source reported beta-tocopherol, menaquinone and biotin only in the peel, while ergocalciferol was reported only in the pulp (Table 2)

Vitamin	Pulp (mg/100 g)	Peel (mg/100 g)
Beta-tocopherol	Not detected/reported	0.232 ± 0.00
Alpha-tocopherol	5.063 ± 0.00	0.150 ± 0.00
Gamma-tocopherol	0.169 ± 0.00	0.270 ± 0.00
Ergocalciferol	0.777 ± 0.00	Not detected/reported
Cholecalciferol	96.220 ± 0.00	0.966 ± 0.00
Menaquinone	Not detected/reported	1.141 ± 0.00
Phylloquinone	2.426 ± 0.00	1.343 ± 0.00
Retinol	0.155 ± 0.00	0.952 ± 0.00
Riboflavin	0.243 ± 0.00	0.721 ± 0.00
Niacin	0.324 ± 0.00	0.197 ± 0.00
Thiamin	1.232 ± 0.00	1.708 ± 0.00
Ascorbic acid	22.443 ± 0.00	6.677 ± 0.00
Cobalamin	0.932 ± 0.00	0.543 ± 0.00
Pyridoxine	1.234 ± 0.00	Not detected/reported
Biotin	Not detected/reported	0.197 ± 0.00

Table 2

The edible pulp had a higher reported ascorbic acid concentration: 22.443 mg/100 g, compared with 6.677 mg/100 g in the peel.

The peel had a higher reported thiamine concentration: 1.708 mg/100 g, compared with 1.232 mg/100 g in the pulp.

Riboflavin was reported as 0.243 mg/100 g in the pulp and 0.721 mg/100 g in the peel.

The reported vitamin results also include tocopherols, vitamin D forms, vitamin K forms, retinol, niacin, cobalamin, pyridoxine and biotin.

3.3 Mineral composition

The source reported higher iron, zinc, copper and selenium in the pulp, while manganese, calcium, potassium and magnesium were higher in the peel (Table 3). The reported unit is ppm; the sample basis and method-specific detection limits should be stated in the final paper.

Mineral	Pulp (ppm)	Peel (ppm)
Iron	1.905 ± 0.00	1.049 ± 0.00
Zinc	0.910 ± 0.00	0.477 ± 0.00
Copper	0.587 ± 0.00	0.361 ± 0.00
Manganese	0.258 ± 0.00	0.306 ± 0.00
Calcium	8.478 ± 0.00	9.267 ± 0.00
Potassium	7.893 ± 0.00	9.064 ± 0.00
Magnesium	6.989 ± 0.00	7.267 ± 0.00
Selenium	0.545 ± 0.00	0.267 ± 0.00

Table 3. Mineral values as reported in the project appendix. The original table heading calls this “heavy metal analysis.

3.4 In vitro antioxidant activity

In the DPPH assay, the peel showed higher reported scavenging activity than the pulp at all tested concentrations. Peel activity ranged from 93.097% to 94.829%, while pulp activity ranged from 81.463% to 85.781%. The reported BHT reference value was 98.501% (Table 4).

Concentration	Pulp (% scavenging)	Peel (% scavenging)	Reference
10 mg/ml	82.058 ± 0.00	93.097 ± 0.00	BHT: 98.501 ± 0.00
20 mg/mL	81.463 ± 0.00	93.589 ± 0.00	BHT: 98.501 ± 0.00
40 mg/mL	85.781 ± 0.00	93.899 ± 0.00	BHT: 98.501 ± 0.00
80 mg/mL	85.057 ± 0.00	94.829 ± 0.00	BHT: 98.501 ± 0.00

Table 4. DPPH radical-scavenging activity transcribed from the project appendix.

In the ABTS assay, peel values exceeded pulp values at all three reported concentrations, although both were below the gallic-acid reference. Peel scavenging activity ranged from 67.019% to 71.247%, compared with 55.180% to 59.408% for the pulp (Table 5).

Concentration	Pulp (%)	Peel (%)	Gallic acid reference (%)
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100 mg/mL	55.180 ± 0.00	67.019 ± 0.00	74.207 ± 0.00
200 mg/mL	57.505 ± 0.00	68.288 ± 0.00	78.858 ± 0.00
300 mg/mL	59.408 ± 0.00	71.247 ± 0.00	82.030 ± 0.00

Table 5. ABTS radical-scavenging activity transcribed from the project appendix.

For hydrogen peroxide scavenging, the peel values were higher than the pulp values at 5, 10 and 50 mg/mL, but lower at 100 mg/mL. The values reported for pulp/peel were 55.180/67.019%, 57.505/68.288%, 59.408/71.247% and 61.311/66.596%, respectively. The hydroxyl-radical table also reported higher peel values at 10 and 20 mg/mL, with smaller differences at 40 and 80 mg/mL. For total antioxidant capacity, the peel had higher values than the pulp across 10–80 mg/mL. In the FRAP assay, the pulp showed higher values than the peel at 10, 20, 40 and 80 mg/mL; at 40 mg/mL, pulp and peel values were 88.652% and 77.196%, respectively, while the gallic-acid reference was 76.950%. At 80 mg/mL, pulp and peel values were 90.071% and 79.614%, respectively, and the reference was 93.617%.

3.5 Phytochemical profiling

Gas chromatography-based profiling in the project appendix listed different compounds in the pulp and peel. The pulp list included compounds such as levomenthol, α -terpineol, carveol, D-carvone, fatty-acid-related compounds and methyl esters. The peel list included compounds such as squalene, 9-octadecenoic acid (Z)-glycerol ester and 13-octadecenal (Z), among others. These identifications should be treated as tentative until confirmed against chromatograms, mass-spectral/library match criteria, authentic standards where available, and contamination/blank checks

4. Discussion

The results suggest that plantain pulp and peel differ in their nutritional composition. The pulp had higher reported carbohydrate and fibre, consistent with its role as an energy-yielding food portion. The peel showed higher reported moisture, fat and protein in this dataset. Because high moisture can affect stability and microbial susceptibility, any practical use of peel would require suitable processing, drying and storage validation. The apparent differences should be interpreted cautiously until the sample basis, analytical procedures and replicate statistics are confirmed.

The vitamin and mineral results indicate that some measured components were higher in the peel and others in the pulp. The peel showed higher reported calcium, potassium and magnesium, while the pulp showed higher iron, zinc, copper and selenium. These comparisons are descriptive only: mineral concentration does not by itself establish bioavailability or dietary adequacy. Some reported vitamin values, particularly the very high cholecalciferol value, warrant checking against calibration records, units and the assay's specificity before publication.

The peel displayed higher DPPH and ABTS scavenging activity than the pulp at the concentrations reported. Peel values were also higher in the total antioxidant capacity table, while pulp values were higher in the FRAP assay. The different rankings across assays are not necessarily contradictory because the assays measure different reaction mechanisms and may respond differently to sample

constituents. The findings should therefore be described as in vitro chemical activity rather than evidence of a therapeutic effect. Further work should use validated protocols, concentration-response analysis, appropriate positive and negative controls, independent replicates and statistical comparisons.

5. Conclusion

This study revealed that the edibles and peels of *Musa paradisiaca* contained substantial to high levels of potassium, iron, calcium (essential for strong bone and teeth), magnesium, manganese and so on. *Musa paradisiaca* edible and peels are rich sources of macronutrients, dietary fiber and minerals, making them suitable for utilization in both human and animal nutrition. They contain a broad spectrum of bioactive compounds, potentially useful as anti-inflammatory, antioxidants, antimicrobial agents, and anticancer antitumorigenic agents in various therapeutic preparations. They exhibited high in vitro antioxidant capacity which help to combat oxidative stress and cell damage. Results from this study confirmed that plantain peels and edibles are good sources of nutrients, minerals, vitamins and antioxidants. They could be nutritionally studied and properly processed as good sources of nutrients. The presence of antioxidants also shows its potential to serve as scavengers and also reduces or mitigate oxidative stress and a medicinally vital material in humans.

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