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Bio-nutrients profile of ensiled *Musa paradisiaca l* peels with *Centrosema pubescens* leaves for ruminants

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***Target Audience:** Ruminant Livestock farmers, Animal Production graduates and Lecturers*

Abstract

Bio-nutrient profile of ensiled ripe Musa paradisiaca (MP) peels with different levels of Centrosema pubescens (CP) leaves was studied. C. pubescens leaves were chopped to 3-5cm, wilted and ensiled with MP peels at different proportions (%) to have five experimental treatments in a Completely Randomized Design: T1:100 MP peel; T2:75% MP+25% CP; T3:50% MP + 50% CP; T4:25% MP + 75% CP; and T5:100% CP. Buckets (4litres) were used as laboratory silos. The treatments were packed, compressed, compacted to expel air and sealed with black polythene bag materials and kept for 28 days. Physical characteristics, proximate composition, fibre fractions and anti-nutritional factors were examined. The result showed a pleasant odour in all the treatment groups with colour range from deep brown in T1, greenish brown in T2, T3, T4 and deep green in T5. The texture was firm in all the treatment combinations, while the pH ranges from 4.83-5.14. There was an absence of mould infestation in all the treatments. There were significant (P<0.05) differences in dry matter, crude protein, ether extract, crude fibre, ash, and nitrogen free extract. Furthermore, the fibre fraction showed significant (P<0.05) difference in neutral detergent fibre, acid detergent fibre. Acid detergent lignin, hemicellulose, and cellulose, while the tannin, saponin, and phytate differed significantly (P<0.05). We conclude that ensilage of M. paradisiaca peels with C. pubescens can sustain ruminant production especially during the dry season due to their nutritive content.

***Key words:** Bio-nutrients; Centrosema; Plantain peels; Ruminants; Silage.*

Description of Problem

The unavailability of easily digestible forage during the dry season as well as high cost of feed for ruminants and horses remains one of the greatest challenges to livestock production in Nigeria (1). There are variations in bio-nutrient content of forage, especially for the dry season when the forage is fibrous, sometimes lignified and lacks many essential bio-nutrients such as protein, energy, minerals and vitamins needed for increased rumen microbial fermentation and production of volatile fatty acids needed for energy metabolism in ruminants (2). This has led to search for ways to provide adequate feedstuff with needed macro and micro nutrients, including the use of crop residues (3), saw dust and poultry litter (4) agro-industrial by-products AIBPs (5) and silage, a type of fodder made from green foliage crops which have been preserved by fermentation to the point of acidification (6). The fermentation and storage process is called ensilage, ensiling or

silaging.

Centrosema pubescens, or butterfly pea, is a legume cultivated in tropical areas as a forage for livestock. It is a source of protein, calcium and potassium for ruminant animal as forage (7) while *Musa paradisiaca* L. or plantain is predominantly a tropical plant that constitute a staple food crop in Central and West Africa (8). Plantain peels are however, usually discarded as waste. This study was therefore conducted to determine the nutrient profile of ensiled *Centrosema pubescens* and ripe plantain peels for ruminant nutrition.

Materials and Methods

Location of study

The study was carried out in the University of Port Harcourt Teaching and Research Farm Choba Campus of the University of Port Harcourt, Choba, Rivers State, Nigeria. The Farm is situated on latitude 4.9069° N and longitude 6.9170° E of the equator with an average of about 2000mm of rain per annum, with temperature range of 25°C-28°C and a very high humidity (above 80%) (9).

Experimental Design and collection of samples

The experiment was a Completely Randomized Design. Musa paradisiaca (MP) peels were sourced from Alakahia, Rivers state and chopped into 3cm to 5cm. *Centrosema pubescens* were collected from the university environment and ensiled with MP peels into five treatment groups as shown below:

Treatment 1	100% MP
Treatment 2	75% MP+25% CP
Treatment 3	50% MP + 50% CP
Treatment 4	25% MP + 75% CP
Treatment 5	100% CP

There were three replicates per treatment, these were packed in plastic buckets, compressed and compacted into silos, sealed with black polythene bags and opened on the 28th day.

Analytical procedure

Physical characteristics such as temperature, colour, aroma and pH were determined immediately the custard buckets were opened using the Physical rating scale on Table 1. The colour was determined by comparing the colour of the silage samples to a colour chart. Aroma was perceived and the pH was determined using digital pH meter. The texture was assessed by pressing with fingers, wetness was assessed by pressing the silage with hands.

Samples of the silages were chemically analysed according to the official method of analysis described by Association of Official Analytical Chemist (10). Crude protein content was determined using kjeldahl's method of nitrogen determination. Ether extract was also determined using solvent extraction. Crude fibre was determined using the Weende's method and NFE using the formula = (100- %M+%CP+%EE+% CF+ %ash) (10). Anti-nutritional factors and fibre fractions were determined according to (10).

Statistical analysis

The data were subjected to one-way analysis of variance (ANOVA). The significant differences among samples of the silage were analysed using Duncan test (11).

Results

Physical characteristics of ripe Musa paradisiaca peels ensiled with *Centrosema pubescens*.

Table 2 shows the physical characteristics of ripe MP peels ensiled with *C. pubescens*. The result showed a pleasant odour in all the treatments. Thus, the colour ranges from brown in T1, greenish brown in T_2, T_3 and T_4, and deep green in T_5,

respectively. The texture was firm in all the treatment combinations, while the pH ranges from 4.83-5.14 in T_2 and T_4 respectively. Furthermore, the physical characteristics also recorded an absence of mould growth in all the treatments.

Table 1: Physical properties rating scale

Characteristics	Rating scale		
	Good quality (1)	Intermediate quality (2)	Poor quality (3)
Colour	Deep green	greenish brown	brown
Odour	Pleasant	Fairly pleasant	Slightly pungent
Texture	Firm	Slightly firm but softer	moist
Mould	No mould	Slightly mouldy	Heavily mouldy
pH	4.2 -5.2	Over 5.2	Nil

Source: (33)

Table 2: Physical characteristics of ripe *Musa paradisiaca* peels ensiled with *Centrosema pubescens*

Parameters	T_1	T_2	T_3	T_4	T_5
Odour	1	1	1	1	1
Colour	3	2	2	2	1
Texture	1	1	1	1	1
pH	5.11	4.83	5.12	5.14	4.93
Mould growth	1	1	1	1	1

Proximate composition of ripe Musa paradisiaca peels ensiled with *Centrosema pubescens*.

The proximate composition of ripe MP peels ensiled with *C. pubescens* is shown in Table 3 Dry matter, crude protein, crude fibre, ether extract, ash, and nitrogen free extract differed significantly ($P<0.05$) for all treatments.

The highest dry matter (80.69%), crude protein (23.73%), ether extract (4.05%), crude fibre (17.65%), and ash (8.74%) were recorded in treatment 5 followed by those in Treatment 4 for crude protein, ether extract, crude fibre and ash. However, NFE values were similar ($P>0.05$) in Treatment 1, 2, and 5.

Table 3: Proximate composition of ripe *Musa paradisiaca* peels ensiled with *Centrosema pubescens*

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM
Dry matter	36.91^{e}	48.35^{d}	60.08^{b}	58.54^{c}	80.69^{a}	0.03
Crude protein	2.22^{e}	9.72^{d}	14.83^{c}	20.22^{b}	23.73^{a}	0.05
Ether extract	1.24^{e}	1.98^{d}	3.02^{c}	3.27^{b}	4.05^{a}	0.01
Crude fibre	3.87^{e}	7.05^{d}	11.55^{c}	16.80^{b}	17.65^{a}	0.02
Ash	2.53^{e}	3.11^{d}	5.79^{c}	7.93^{b}	8.94^{a}	0.02
NFE	27.04^{a}	26.51^{a}	24.87^{b}	10.31^{c}	26.81^{a}	0.22

^{abc} Means in the same column with different superscripts are significantly ($P<0.05$) different.
NFE= Nitrogen free extract

Anti-nutritional constituents of ripe M. paradisiaca peels ensiled with *C. pubescens*.

Table 4 shows the anti-nutritional factors in the different treatments. The result showed that there were significantly differences (P<0.05) in tannin, saponin, and phytate, for all the treatments, while oxalate did not differ significantly (P>0.05) for all the treatments.

Thus, values for tannin (0.006%), saponin (0.24%), and phytate (0.02%) were significantly highest in treatment 5 when compared to others.

Table 4: Anti-nutritional factors of ripe *Musa paradisiaca* peels ensiled with *Centrosema pubescens*

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Tannin	0.001^{d}	0.001^{d}	0.002^{c}	0.003^{b}	0.006^{a}	0.00
Saponin	0.11^{d}	0.11^{d}	0.18^{c}	0.19^{b}	0.24^{a}	0.01
Phytate	0.01^{b}	0.01^{b}	0.01^{b}	0.01^{b}	0.02^{a}	0.01
Oxalate	0.01	0.01	0.01	0.01	0.01	0.01

^{abc} Means in the same column with different superscripts are significantly (P<0.05) different

Fibre fraction analysis of ripe Musa paradisiaca peels ensiled with *Centrosema pubescens*

The fibre fraction analysis is shown in Table 5. The result showed that there were significant differences (P<0.05) in the neutral detergent fibre, acid detergent fibre, acid detergent lignin, hemicelluloses, and cellulose in all the treatments. Thus, treatment 5 recorded the highest value of NDF (49.03%), ADF (25.52%), ADL (7.02%), Hemicellulose (23.46%), and cellulose (18.55%), respectively.

Table 5: Fibre fraction analysis of ripe *Musa paradisiaca* peels ensiled with *Centrosema pubescens*

Parameters (%)	T_1	T_2	T_3	T_4	T_5	SEM
NDF	32.77^{e}	36.12^{d}	43.07^{c}	46.29^{b}	49.03^{a}	0.02
ADF	18.10^{e}	19.74^{d}	21.02^{c}	24.10^{b}	25.57^{a}	0.02
ADL	1.36^{e}	2.77^{d}	4.54^{c}	5.85^{b}	7.02^{a}	0.02
Hemicellulose	14.67^{e}	16.38^{d}	22.05^{c}	22.19^{b}	23.46^{a}	0.01
Cellulose	16.73^{d}	16.97^{c}	16.48^{e}	18.24^{b}	18.55^{a}	0.01

^{abc} Means in the same column with different superscripts are significantly (P<0.05) different.
NDF= Neutral Detergent Fibre, ADF= Acid Detergent Fibre, ADL= Acid Detergent Lignin

Discussion

The pleasant odour of the ensiled materials corroborates with the report of (12) that well fermented silage should exhibit a pleasant smell which indicates well-prepared silage. Silage with rancid butter or putrid smell often depicts poor fermentation dominated by *Clostridia spp*. *Clostridia spp* is commonly related with the formation of a foul odour, due primarily to butyric acid, one of its principal fermentation products (13).

It was also observed that the texture of the silages were all dry and firm, agreeing with (14) who reported that a good quality silage should have a dry and firm texture due to the production of lactic acid and acetic acid.

The colour of silages was close to the original colour of the legume, which was an indication of good quality silage that was

well preserved according to (15). The brownish colour recorded for 100 % of ripe *M. paradisiaca* peel silage (T1) in this study was due to the colour of the peels and not that due to deterioration of the silage (16).

Furthermore, silage that has been properly fermented will have a lower pH than the original forage. The pH of the silage in this study fell within the range of 4.50-5.50 reported and classified as good silage by (17). As the ensiling period increased, it is also expected that the pH continued to reduce which helped to keep the quality of the silage (18).

The range of mould-free silage in this study was a clear indication that the silages were well preserved. This is in line with the findings of (19) when *Pennisetum*, *Panicum* and *Centrosema* silages were made

The dry matter content of feeds gives an indication of its quality and richness in nutrient (20). Thus, the high dry matter content among the treated silage indicated that ensiling *Centrosema pubescens* with ripe M. paradisiaca peels could help in addressing the poor quality feed in ruminants. The crude protein of the ripe M. paradisiaca peels ensiled with *Centrosema pubescens* in T_2, T_3, T_4 and T_5 showed that they can serve as feed for ruminants because their crude protein contents are above the recommended 7% crude protein requirement for ruminants which will provide ammonia required by rumen microorganisms to support optimum microbial activity (21). Furthermore, the ensiled ripe *M. paradisiaca* peels with *Centrosema pubescens* had crude fibre contents of 3.81 – 17.65% which was higher than the 2.53% reported by (22). High fibre content in diets have been reported to result in increased removal of potential mutagens, steroids and xenobotics by binding or absorbing to dietary fibre components and thereby aids digestion, hence these wastes will have health promoting benefits for livestock (23). The ether extract of the *Musa paradisiaca* peels and *C. Pubescens* silages was very low and may need to be fortified to become a good source of fat-soluble vitamins (23). The ash contents reported for the silages in this study were lower than the ash content of 17.96% reported by (24). This shows that ripe M. paradisiaca peels could only improve the mineral constituents of the feed by fortifying it with *Centrosema pubescens*.

Thus, the comparable higher values of NFE in T1, T2, and T5 shows that ripe M. paradisiaca peels will supply reasonable amount of energy when fed to small ruminants because inadequate energy will depress reproductive performance of extensively and intensively managed goat and sheep (25).

Feedstuff containing tannin and saponin has been shown to be defaunating agent and capable of reducing methane production (26; 27). Thus, the saponin content of all the treatments fell within the 3% safe range reported by (28) making it ideal for utilization in livestock nutrition.

The tannin level in this study is below 6.00 % reported by (29) to have adverse effects on small ruminants, and it could be an added advantage as a natural additive in the diet of ruminants, since forage or feeds containing tannin have potential of forming complexes with protein as bypass protein in the rumen by diminishing rumen protein digestibility, thus improving on the availability of protein to ruminants at the lower gut (30).

Fibre fractions that contribute to the nutritional value of the feed are the NDF and ADL (31). The ensiled ripe plantain peel with *Centrosema pubescens* in all the treatments have values of NDF below 60% which opines that they could be vital in improving the nutritive quality of the silage (32).This agreed with the reports of (31) who

indicated that ripeness results to higher NDF and ADL fractions.

Conclusion and Applications

From the results of this experiment, we conclude that:

1. Ripe *M. paradisiaca* peels ensiled with *C. pubescens* (T_3 – T_5) had crude protein contents above the 7 – 10 % recommended for sheep and goat production.
2. T4 and T5 had crude fibre content above the 12% crude fibre recommended for ruminants.
3. The anti-nutritive values were well below tolerable levels for ruminants and so they are safe for ruminant feeding.
4. Based on results obtained in this study, treatments 3, 4 and 5 are recommended for ruminant feeding especially during the dry season when forages are lignified and of low nutritive quality.

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