# SUPPLEMENTAL EFFECTS OF GRADED LEVELS OF CASSAVA FOLIAGE ON THE UTILIZATION OF GROUNDNUT HAULMS BY SHEEP [1]

# EFECTO DE LA SUPLEMENTACIÓN CON NIVELES CRECIENTES DE FOLLAJE DE YUCA EN LA UTILIZACIÓN DE TALLOS DE CACAHUATE POR OVEJAS

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## SUMMARY

The use of cassava foliage in Nigeria as a low cost supplemental nitrogen to crop residues generally characterized by low nutrient levels allows increased microbial protein synthesis in the rumen of ruminant animals. The effects of the supplementation of groundnut haulms (GH) with graded levels of cassava foliage (CFL) at 0, 10, 20 and 30% on the performance of the West African dwarf (WAD) breed of sheep with average body weight of 13.20 ± 0.34kg were evaluated in a complete randomized design in a 90 day experiment. Data were obtained on feed intake, weight gain, digestibility and haematological parameters. Results showed that CFL supplementation of GH had a positive effect ($P<0.05$) on dry matter (DM) intake and weight gain of sheep. Sheep supplemented with 20% CFL showed better DM intake (455.74g/day), weight gain (45.24g/day) and feed conversion ratio (9.96). Digestibility values for dry matter and crude protein increased ($P<0.05$) with an increase with the inclusion levels of CFL in the diets but similar values observed in 20 and 30% CFL supplemental diets. Higher ($P<0.05$) values were observed in packed cell volume, haemoglobin concentration and red blood cell counts of sheep supplemented with graded levels of CFL. It was concluded that the supplementation of groundnut haulms with cassava foliage offered sheep a better plane of nutrition, thereby supporting higher growth rates with sheep supplemented with 20% CFL inclusion levels having the best feed intake, digestibility and weight gain.

**Keywords:** Sheep; cassava foliage; groundnut haulms; performance; haematology

## RESUMEN

El uso de follaje de yuca en Nigeria como suplemento de nitrógeno de bajo costo a subproductos agrícolas que en general se caracterizan por sus bajos niveles de nutrientes permite una mejor síntesis de proteína microbiana en el rumen de los rumiantes. Los efectos de la suplementación de tallos de maní (GH) con niveles graduales de follaje de yuca (CFL) (0, 10, 20 y 30%) en el rendimiento de la raza de ovejas enana de África Occidental (WAD) con peso promedio de 13.20 ± 0.34kg fueron evaluados en un diseño completamente al azar en un experimento de 90 días. Se obtuvieron datos sobre el consumo de alimento, ganancia de peso, la digestibilidad y parámetros hematológicos. Los resultados mostraron que la administración de suplementos de GH con CFL tuvo un efecto positivo ($P <0.05$) en el consumo de materia seca (MS) y el aumento de peso de las ovejas. Ovejas suplementado con 20% CFL mostraron un mejor consumo de MS (455.74g / día), aumento de peso (45.24g / día) e índice de conversión (9.96). Los valores de digestibilidad de la materia seca y proteína se incrementaron ($P <0.05$) con el nivel de inclusión de CFL en las dietas pero se observaron valores similares a 20 y 30% CFL. Se observaron ($P <0.05$) valores mayores de hematocrito, concentración de hemoglobina y glóbulos rojos de ovejas suplementadas CFL. Se concluyó que la administración de suplementos de tallos de maní con follaje de yuca ofreció ovejas un mejor plano de la nutrición, con tasas de crecimiento más altas en ovejas suplementadas con 20% CFL dónde se presenta la mejor ganancia de peso, ingesta de alimento y digestibilidad.

**Palabras clave:** ovejas; yuca follaje; tallos de maní; de rendimiento; hematología

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## INTRODUCTION

The production of sheep in Nigeria is a growing enterprise among smallholder livestock farmers, widely adopted in the rural, urban and semi urban areas, kept in small numbers and managed on whatever feed resources are available at village level. These animals are exposed to numerous constraints, characterized by poor housing and poor nutrition, high incidence of diseases, poor breeding methods, among others (Sanusi et al., 2010). The direct competition with man and industries for feed resources as well as the inadequacy of year round feed availability, mainly because of the seasonal fluctuation leading to wide fluctuations in the quantity and quality of forage available to animals has being a major limiting factor in sheep production (Bamigboye et al., 2013).

Moreover, over the years, attempts have been made to alleviate the problem of feed shortage in ruminant production systems through the use of crop residues as alternative and strategic cheap source of feed for ruminants (Elginaid et al., 1997). Though, the utilization of most of these crop residues is often limited by low nutrient levels and low digestibility, there is the need for the introduction of low-cost supplementary nitrogen in the diets of ruminants to stimulate rumen microbes to obtain maximal rate of digestion of carbohydrate diet as well as high microbial protein synthesis (Madsen and Hvelplund, 1988).

Groundnut haulms are the major residue obtained after groundnut harvesting and have been used as excellent feed with palatable quality especially when harvested as soon as it reaches full seed production (Ayantunde et al., 2007). Cassava foliage on the other hand, has been found to be readily available and excellent feed for ruminants, serving as a good source of supplemental nitrogen in ruminant diets (Oni et al., 2011; Fasae et al., 2011). This study therefore investigates into the effect of supplementation of groundnut haulms with graded levels of cassava foliage in improving smallholder sheep production.

## MATERIALS AND METHODS

### Experimental animals and management

The experiment was carried out at the Directorate of University farms, Federal University of Agriculture, Abeokuta, Ogun state, Nigeria. Sixteen (16) West African dwarf (WAD) sheep aged 9 to 12months and average body weight of 13.20±0.35kg was purchased from smallholder farmers in Abeokuta, Ogun-State, Nigeria. They were quarantined for 30days, treated against endo and ecto parasites, tagged and housed in individual pens. Bags of groundnut haulms (GH) were purchased from a nearby market within the study area and the cassava foliage (CFL) sourced from harvested cassava plants in farms within the University campus, chopped to about 4-5cm and sundried for 5 days before feeding to the animals. The animals were randomly allotted to 4 dietary treatments namely: 0, 10, 20 and 30% CFL inclusion in groundnut haulms based diets, for treatments 1 to 4, respectively. Feeding was carried out twice every day at 0800 and 1300hours, respectively with constant supply of fresh water.

### Data collection

The feed offered and feed refusal was taken to get the feed intake which was recorded throughout the 90 day experimental period. Weight changes were observed on each animal, using a spring balance on weekly basis. Animals were transferred into individual metabolic cages for the digestibility trial at the last 14days of the experiment, involving 7 days of adaptation to the cages and 7 days faecal collection. At the termination of the digestibility experiment, blood was obtained from the jugular vein of all the animals into sample bottles containing ethylene diamine tetraacetic acid. Red blood cell and white blood cell counts were determined using a haemocytometer. The packed cell volume was estimated by the microhaematocrit method and the haemoglobin concentration by the cyanmethaemoglobin method (Jain, 1986).

### Chemical Analysis

Feed and faecal samples collected were dried in oven to a constant weight and bulked, then analyzed for proximate analysis (AOAC, 1990) while the fibre fractions (neutral detergent fibre, acid detergent fibre, acid detergent lignin) were analyzed using the methods of Van Soest et al., (1991). Hydrocyanic acid was determined through the procedures described by Bradbury et al., (1999).

### Statistical Analysis

Data obtained were subjected to one way analysis of variance in a completely randomized design using the statistical package (SAS, 1999). Significant means was compared using the Duncan multiple range test (Duncan, 1955).

## RESULTS

The chemical composition of the experimental diets fed to sheep is shown in Table 1. The dry matter content are relatively high and is similar ($P>0.05$) across the treatments. The crude protein content of the diets increased with an increase in the inclusion of the cassava foliage (CFL) in the diets and ranged from 107.3 in 0%CFL to 139.7g/Kg DM in 30% CFL diets. Hydrocyanic acid also increased with an increase in CFL inclusion in the diets. The non-linear increment of HCN in diets with graded levels of CFL could be attributed to the process of sun-drying of the leaves before inclusion in the diets. Sun-drying has been found to be more effective in reducing HCN than other processing methods (Phuc et al., 1996).

The performance of sheep fed groundnut haulms supplemented with varying levels of cassava foliage is shown in Table 2. The DM intake observed across the dietary treatments differed (P<0.05) without any definite pattern. Nevertheless, the CFL supplementation at different graded levels improved (P<0.05) the total DM intake across treatments. The weight gain (g/day) of 27.74 to 45.24 g/day obtained across dietary treatments differed (P<0.05) with highest weight gain observed in sheep fed GH supplemented with 20% CFL, and least value observed in sheep fed sole GH. The best feed conversion ratio of 9.96 was observed in animals on 20% CFL supplementation, though not different (P<0.05) from other CFL supplemented treatments while sheep fed sole GH had the worst FCR (11.19).

Results on the nutrient digestibility of the experimental diets (Table 3) revealed that dry matter and crude protein increased with CFL supplementation in the diets. DM digestibility ranged from 53.09% (0%CFL) to 67.54% (30% CFL) and did not differ (P>0.05) across the CFL supplemented treatments. Crude protein digestibility (CPD) increased with the inclusion of CFL in GH diets and were similar (P>0.05) and better in 20% and 30% CFL diets compared to the other treatments. The CPD value ranges between 54.04% (0% CFL) to 64.26% (30% CFL).

The mean values for blood indices of WAD sheep fed groundnut haulms supplemented with graded levels of cassava foliage are shown in Table 4. The packed cell volume and haemoglobin levels in this experiment differed (P<0.05) among treatment groups. The higher (P<0.05) red blood cells values were observed in sheep on CFL supplementation. The white blood cell counts were similar among the treatment groups.

Table 1: Chemical composition (g/kgDM) of the experimental diets

| Composition | 0% CFL | 10% CFL | 20% CFL | 30% CFL | CFL |
|---|---|---|---|---|---|
| Dry matter | 953.8 | 955.0 | 958.8 | 960.0 | 952.1 |
| Crude protein | 107.3 | 111.7 | 135.8 | 139.7 | 181.7 |
| Neutral detergent fibre | 406.6 | 447.9 | 508.0 | 561.4 | 582.2 |
| Acid detergent fibre | 267.7 | 352.1 | 379.9 | 401.7 | 429.8 |
| Acid detergent lignin | 40.10 | 43.20 | 49.01 | 54.70 | 68.10 |
| Ether extract | 105.1 | 138.3 | 105.0 | 102.5 | 152.2 |
| Ash | 132.5 | 106.3 | 107.3 | 112.5 | 59.00 |
| Hydrocyanic acid (Mg/kg) | 0.00 | 20.20 | 23.30 | 34.90 | 92.10 |

CFL: cassava foliage

Table 2: Performance indices of sheep fed groundnut haulms supplemented with varying levels of cassava foliage

| Parameters | 0% CFL | 10% CFL | 20% CFL | 30% CFL | SEM |
|---|---|---|---|---|---|
| Total DM intake (g/day) | 307.53$^{c}$ | 367.93$^{b}$ | 455.74$^{a}$ | 385.63$^{ab}$ | 45.79 |
| Initial weight (kg) | 13.17 | 12.90 | 13.50 | 13.33 | 0.35 |
| Final weight (kg) | 15.50 | 15.90 | 17.30 | 16.57 | 0.57 |
| Weight gain (kg) | 2.33$^{c}$ | 3.00$^{b}$ | 3.80$^{a}$ | 3.23$^{b}$ | 0.16 |
| Daily weight gain (g/day) | 27.74$^{c}$ | 35.71$^{b}$ | 45.24$^{a}$ | 38.45$^{b}$ | 2.91 |
| Weight gain (g/kgW$^{0.75}$/day) | 12.09$^{c}$ | 14.61$^{b}$ | 17.44$^{a}$ | 15.44$^{a}$ | 0.54 |
| Feed conversion ratio | 11.00$^{b}$ | 10.30$^{b}$ | 9.96$^{b}$ | 10.02$^{b}$ | 0.29 |

$^{a,b,c}$ *means with different superscript on the same row are significantly different (P<0.05).*
CFL: cassava foliage.

Table 3: Nutrient digestibility (g/kgDM) of groundnut haulms supplemented with varying levels of cassava foliage in West African dwarf sheep.

| Parameters | 0% CFL | 10% CFL | 20% CFL | 30% CFL | SEM |
|---|---|---|---|---|---|
| Dry matter | 530.9$^{b}$ | 661.0$^{a}$ | 676.1$^{a}$ | 675.4$^{a}$ | 17.5 |
| Crude protein | 540.4$^{b}$ | 553.6$^{b}$ | 633.6$^{a}$ | 642.6$^{a}$ | 11.7 |
| Neutral detergent fibre | 483.6$^{c}$ | 538.9$^{bc}$ | 596.8$^{ab}$ | 616.4$^{a}$ | 12.3 |
| Acid detergent fibre | 490.1$^{b}$ | 549.3$^{ab}$ | 587.1$^{a}$ | 591.2$^{a}$ | 11.0 |
| Acid detergent lignin | 453.2$^{b}$ | 473.3$^{ab}$ | 501.1$^{a}$ | 512.2$^{a}$ | 10.3 |
| Ether extract | 662.6 | 654.4 | 686.6 | 697.1 | 16.2 |
| Ash | 562.8 | 526.8 | 529.2 | 540.7 | 11.9 |

$^{a,b,c}$ *means with different superscript on the same row are significantly different (P<0.05).*
CFL: cassava foliage.

Table 4: Mean values for blood indices in West African dwarf sheep fed groundnut haulms supplemented with graded levels of cassava foliage

| Parameters | 0% CFL | 10% CFL | 20% CFL | 30% CFL | SEM |
|---|---|---|---|---|---|
| Packed cell volume (%) | 25.00$^{b}$ | 27.50$^{a}$ | 30.00$^{a}$ | 28.50$^{a}$ | 1.05 |
| Haemoglobin (%) | 9.70$^{b}$ | 8.80$^{ab}$ | 10.05$^{a}$ | 9.45$^{a}$ | 0.36 |
| Red blood cell (x10$^{6}$/l) | 6.95$^{b}$ | 7.90$^{ab}$ | 8.85$^{a}$ | 8.65$^{a}$ | 0.32 |
| White blood cell (x10$^{6}$/dl) | 7.10 | 6.70 | 7.75 | 7.75 | 0.28 |
| Neutrophil (%) | 31.50 | 31.00 | 29.00 | 29.00 | 1.22 |
| Lymphocyte (%) | 62.50 | 64.50 | 63.50 | 63.50 | 1.36 |
| Eosinophil (%) | 0.00 | 0.00 | 0.50 | 0.00 | 0.10 |
| Basophil (%) | 0.50 | 0.50 | 0.00 | 0.00 | 0.10 |
| Monophil (%) | 1.50 | 0.00 | 1.00 | 1.00 | 0.11 |

$^{a,b,c}$ *means with different superscript on the same row are significantly different (P<0.05).*
CFL: cassava foliage.

**DISCUSSION**

The values for the chemical composition of cassava foliage were within range values reported by Alli-ballogun (1995) and Oni et al. (2011), confirming its potential as a source of supplemental nitrogen to crop residues characterized by low nutrient levels in assisting the rumen microbes, therefore it would generate a higher level of ammonia in the rumen and promote an efficient digestion process (Orskov, 1995). The chemical composition of groundnut haulms in this study was not comparable with earlier reports (Ayoade *et al.,* 1983, Bawa *et al.,* 2008) when used as feed for various livestock species which could be attributed to the variety groundnut haulms used and processing methods.

The crude protein content of the diets were generally higher than 8%, below which, Norton (2003) observed that feeds will not provide the required levels of ammonia for optimum rumen microbial activity is suggestive of the fact that these diets could be of high nutritional quality. Also, the NDF level of diets in this study was lower than the safe upper limit of 60% (Meissner *et al.* 1991) for guaranteed forage intake by sheep. This implies that the fibre fractions of the diet would enhance rumination in the fore-stomach of the animals. Excess NDF reduces the rate of fermentation and reduces feed intake, but too little fibre leads to rapid rumen fermentation and potential acidosis.

The improvement observed in the total DM intake across treatments influenced by CFL supplementation at different graded levels corroborates earlier findings of increasing level of cassava foliage supplementation in improving the total DM and nitrogen intake in goats and cattle fed a basal diet of grass as the supplement to ammoniated rice straw and rice straw with para grass, respectively (Ho Quang Do et al., 2002; Sath et al, 2012).

The low DM intake observed in sheep fed sole GH could be as a result of the low crude protein content of the GH compared to the CFL supplemented treatments as low protein content diets have been found to depress animal intake (Ifut, 1988). Therefore, the observed significant effect of CFL supplementation on total DM intake maybe attributed to the higher crude protein intake from CFL in sheep fed the supplemental treatments, compared to the control. However, the slight decrease in total DM intake observed in sheep supplemented with 30% CFL compared to animals fed 20%CFL corroborates the reports of Myrelles et al. (1977) that reported similar result in which animal responses to utilization of high proportion of cassava foliage as protein roughage supplement to sugarcane-based diet was positive but low thereby contributing to poor animal performance. Nevertheless, the high content of cyanide in the diets of sheep fed 30% CFL may also be an additional factor, though; the values of HCN in this study did not exceed the tolerance level of 4.0mg/kg BW for sheep (Kuma, 1992). The cyanoglycosides that give rise to HCN give a bitter taste to the leaves and in other studies this has been reported to depress DM intakes when higher levels are given to livestock (Lee and Hutagulung, 1972; Sudaresan, et al., 1987). The highest feed intake observed in sheep fed 20%CFL diet may be attributed to optimal level of CFL inclusion in the diet which could have promoted by-pass protein and maintain low anti-nutritional factor present in the diet. Mpairwe et al, (2003) also observed that providing supplements with adequate crude protein to ruminants has promoted dry matter intake, rumen degradation and nutrient flow to small intestine and culminated in higher animal performance.

The observed weight gain (g/day) of 27.74 to 45.24 g/day obtained across dietary treatments falls within 39.2 to 69.3 g/day reported by Alli-ballogun (1995) in sheep fed cassava foliage and groundnut haulms with a basal diet of Gamba grass. Higher feed intake and better efficiency of feed utilization may account for the higher weight gain observed in sheep fed GH supplemented with CFL in this study. The best feed conversion ratio observed in animals on 20% CFL supplementation, though not different ($P<0.05$) from other CFL supplemented treatments indicates the efficient utilization of CFL supplementation of groundnut haulms. This supports the increasing number of reports demonstrating the important role played by the cassava plant as a source of protein as well as roughage supplement for ruminant animals (Oni *et al.,* 2011; Fasae *et al*., 2011; Sath et *al.*, 2012) The high digestibility values obtained for the nutrients in CFL supplemented diets suggest high utilization of the feed by the animals which corroborates the findings of Ahamefule *et al*., (2010) in bucks of West African Dwarf goats fed cassava leaf and maize offal based diets. The digestibility of dry matter and crude protein that increased with CFL supplementation in the diets agrees with the findings of Ososanya, (2012) that observed increased in digestibility of these nutrients as *Cynodon nlemfuensis* hay was replaced with groundnut haulms in diets of rams. The crude protein digestibility are comparable to that obtained by Fadel Elseed *et al.*, (2012) and Fasae *et al.* (2012) in sheep fed groundnut haulms and cassava forage diets, respectively.

The packed cell volume (PCV) and haemoglobin levels in this experiment though differed among treatment groups were within normal ranges previously reported for sheep (Baiden *et al.*, 2007; Bawala *et al.*, 2007), suggesting that the quality of the test feeds was good enough to maintain the good health of the rams. The higher ($P<0.05$) values observed in PCV and haemoglobin (Hb) concentration of sheep supplemented with graded levels of CFL indicates the quality of these diets to be properly utilized by the sheep for the formation of Hb concentration and compensatory accelerated production of PCV. This observation is further attested to by the higher values observed for red blood cell (RBC) in the CFL supplemented treatments. The low ($P<0.05$) PCV and RBC values observed in sheep fed sole GH could however be associated to the low crude protein content in the diet. The higher ($P<0.05$) RBC values, as observed for sheep on CFL supplementation in this study, could be attributed to a higher plane of nutrition. Rekwot *et al.* (1987) observed that White Fulani cattle that were fed a high protein diet had significantly higher RBC values than those on low protein diet, which supports the variations in the crude protein content of experimental diets in this study. The white blood cell counts were also within the normal range (5 to 11 $x10^6$/dl) reported by Scott *et al.* (2006) for sheep. This is an indication of the ability of the experimental sheep to fight against the presence of foreign body in the circulating system. The similar WBC count and WBC differential counts obtained implies that the ability of the rams to respond to and eliminate infection was not compromised with the inclusion of CFL in the diet up to the 30% level. This can serve as a feedstuff during period of forage scarcity or unavailability of conventional feeds in small holder sheep production systems.

## CONCLUSION

The supplementation of groundnut haulms with cassava foliage offered sheep a better plane of nutrition, thereby supporting higher growth rates. However, the supplementation of groundnut haulms at 20% inclusion levels of cassava foliage improves feed intake, digestibility, and weight gain in sheep.

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