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Effect of Combined Levels of *Panicum maximum* and *Gliricidia sepium* on Nutrient Digestibilities and Utilization by West African Dwarf Goats Fed Cassava Offal Based Concentrate

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Abstract: West African Dwarf (WAD) does were used to investigate the effect of combined levels of mixed forages on the utilization of cassava offal based diets. Thirty goats weighing between 5.82 and 5.92 kg and with ages from 4-7 months were assigned to 5 dietary treatments in a completely randomized design experiment with 6 animals per treatment. Animals were housed in individual pens and offered the experimental diet daily for 98 days. The 5 dietary treatments were: G 0: 100% *Panicum maximum* + concentrate; G 25: 75% *P. maximum* + 25% *Gliricidia sepium* + concentrate; $_{G50}$: 50% *P. maximum* + 50% *G. sepium* + concentrate; G 75: 25% *P. maximum* + 75% *G. sepium* + concentrate and G 100: 100% *G. sepium* + concentrate. Feed intake, growth rate, digestibility and nitrogen balance were monitored. The highest daily total DMI (547.65 g DM day^{-1}) was recorded in G0 and the values were significantly ($p<0.05$) different among treatment means. DM, CP NDF, ADF and ADL intake (g kg$^{0.75}$day 1) were ($p<0.05$) significantly different among treatment means. Animals fed G 75 and G 100 had the highest weight gains. The apparent digestibilities of DM, CP, NDF and ADL were generally high in all treatment groups but were highest in G 100. Nitrogen balance was highest for G 100, but the percentage of N retained w as highest for G 50. Results indicated that feeding *G. sepium* together with *P. maximum*, supplemented with cassava offal based concentrate could lead to improved weight gain, feed efficiency, digestibility and nitrogen utilization in WAD goats.

Key words: *Panicum maximum*, *Gliricidia sepium*, Cassava offal, digestibility, utilization

INTRODUCTION

Small ruminant livestock are important component of farming systems. They contribute milk, meat, fibre and skin that are significant to the productivity and sustenance of many farming systems. Adequate nutrition is however, required to enhance productivity of these animals. Goats can utilize grasses for tissue development. However, the quality and quantity of the grasses fluctuate with seasons and stages of maturity. Also, most of the feed resources used for supplementation by stockholders in developing countries are highly fibrous. Crop residues, various byproducts and processing waste materials have nutritive values that vary greatly from sometimes high energy feed to highly liquid materials which are nearly indigestible. These fibrous feeds are characterized by nutrient digestibilities below 50% and crude protein contents below the critical 7% (Taiwo, 1995). Where concentrate supplement is provided to enhance productivity and improve overall animal efficiency, demand for protein sources such as oil seed cake is highly competitive for other uses such as monogastric feedstuff and human food. The high cost of importing such protein sources has also limited their widespread use (Richard, 2001).

Alternative, less expensive and locally available sources of protein are needed to curtail the ever-rising cost of production, especially during the dry season. The search for less expensive and locally available sources of protein has placed attention on multipurpose tree legumes such as *Gliricidia sepium*, which is a leguminous, perennial browse plant that is available year round and has a crude protein content of 29.3% (Ajayi *et al*., 2005). *Gliricidia* foliage could act as food supplement or substitute, for example to complement cassava offal during the dry season. Cassava cultivation has increased especially now due to the current presidential initiative on cassava production. Cassava offal is the waste from Fufu processing. It has a high starch content (70-78%) which could act as a source of energy for goats (Nwokoro *et al*.,

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2005). The evolution of various cassava by-products which are not directly useful to man can be channeled towards the production of animals and their products, thereby reducing the over-dependence on cassava roots. Guinea grass (*Panicum maximum*) is highly relished by goats and may be fed to stimulate ruminal micro-organisms.

In general, this study was aimed at evaluating the performance of goats fed a basal diet of cassava offal with different levels and combinations of *P. maximum* and *G. sepium*. The specific objectives of the study were to determine the optimum inclusion levels of the various components for optimum production, feed intake, weight gain and nitrogen utilization in goats fed with *G. sepium* and/or *P. maximum* as a supplement to a basal diet of cassava offal.

MATERIALS AND METHODS

The study was conducted at the goat unit of Olabisi Onabanjo University, Yewa Campus, Ayetoro, Ogun State, Nigeria. Ayetoro is located at latitude 7°15'N and longitude 3°3'E in a deciduous derived savannah zone of Ogun State. The climate is sub-humid tropic with annual rainfall of 963.3 mm in 74 days and temperature varies between 29 and 34°C.

Thirty growing West African Dwarf does aged 5-7 months and with an average live weight of 5.86 kg were used for this experiment. They were obtained from donor farms located some 15 km northwest of the experimental site. Two weeks before the commencement of the experiment, animals were dewormed with Levamisole (Kepro, B.V Holland, 1 mL per 20 kg body weight) to control endoparasites and dipped in Diasuntol solution (Alfasan International, B.V Holland) at the rate of 1 mL per litre of water against ectoparasites. Long acting Oxitetraciclina 200 LA (Invesa, Spain; 1 mL per 10 kg body weight) were also administered. The animals were randomly allocated on a live weight basis to 5 groups of 6 does each. The 5 groups were then moved into previously sanitized individual pens and offered the experimental diets daily for 98 days (including the first 14 days for adaptation and subsequent 84 days for measurement).

The dietary treatments were:

- 100% *Panicum maximum* and 0% *Gliricidia sepium* (G 0).
- 75% *Panicum maximum* and 25% *Gliricidia sepium* (G 25).
- 50% *Panicum maximum* and 50% *Gliricidia sepium* (G 50).
- 50% *Panicum maximum* and 75% *Gliricidia sepium* (G 75).
- 0% *Panicum maximum* and 100% *Gliricidia sepium* (G 100).

Combined levels of *P. maximum* and *G. sepium* were supplemented with a cassava offal based concentrate. The *G. sepium* foliage was harvested on the university premises and allowed to wilt overnight prior to feeding. *P. maximum* leaves were harvested daily, chopped to about 5 cm and fed to the animals fresh. All animals were fed twice daily (forages at 3%body weight by 08.00 h and concentrate by 16.00 h at 2% BW) and fresh water was available at all times.

Cassava offal used for the study was collected from 4 Fufu processing centers in Ayetoro, Ogun State and dried to a moisture content level of about 12% before being used to compound a concentrate ration containing 16% CP and 2.62 Kcal kg^{-1} ME. The concentrate included 40% cassava offal, 15% cassava peels, 15% GNC, 25% PKC 4% Bone Meal, 0.5% mineral premix and 0.5% salt. The animals were weighted once weekly and the level of feeding adjusted depending on liveweight changes. Daily voluntary intake was estimated by difference of the feed offered and residue collected. Digestion and Nitrogen balance trial was conducted after 72 days of feeding. During the metabolism trial, the goats were housed in individual metabolism cages (90 cm × 75 cm × 90 cm) made of welded wire mesh fitted with removable feeders and arranged for quantitative collection of faeces and urine separately. The trial lasted for 12 days with a 5 day adaptation period to accustom the goats to cages prior to a 7 day collection and measurement period. Total faecal output and urine were collected in the mornings before feeding and watering. The faeces were weighed fresh and 10% aliquots of each day's collection for each animal were taken, dried at 60°C for 48 h in a forced draught air oven and bulked. A sub sample from each animal was dried in a similar oven at 100-105°C for 48 h for DM determination. Another sub sample was thoroughly mixed and milled to pass through a 0.60 mm sieve and stored in sealed polythene bags until analysed. The urine was collected in a plastic tray placed under each cage; 10 mL of 10% concentrated H_2 50_4 was added to the tray daily to prevent volatilization of NH_3 from the urine. The total output of urine per animal was measured and 10% aliquots were saved in stoppered numbered plastic bottles and stored at -5°C. Feed and faecal samples were analysed for their proximate composition while urine sample was analysed for Nitrogen (AOAC, 1995). The various fibre components were determined according to Georing and Van Soest (1970).

The data obtained from these analyses were used to calculate the digestibility, nutrient intake and Nitrogen balance by the growing West African Dwarf goods. Data were subjected to analysis of variance for complete randomized design using SAS (2002).

RESULTS AND DISCUSSION

The chemical compositions of the experimental diets are presented in Table 1. The crude proteins of forage (7.09 and 18.61%) were lower than those reported by Gbankoto (1982) and Ajayi *et al*. (2005), but the cell wall fractions were proportionately greater. The ether extract content of the concentrate was higher (13.61%), but the ash contents of the forages were relatively low (2.29 and 3.61%) suggesting a high fibre content. The-low nutrient content may be attributed to the stage of maturity of the forage at the time of harvest, since fibre content of forage increases as the forage matures and lignification increases (Olubajo and Aken Ova, 1985; Cleake and Bull, 1986). Nutrient composition also may be affected by factors such as type and level of fertilizer applied and variety of forage (Ademosun, 1973). Tannin and cyanide were higher in the concentrate because of the presence of cassava offal and peels. Phytate was found in both forages and the concentrate. The values for phytate and oxalate obtained in the study fell within the ranges reported by Onwuka (1996).

The performance characteristics of WAD goats fed the experimental diets are shown in Table 2. Growth performance of WAD goats was lowest when *P. maximum* only was fed with the concentrate (G_0). Animals on G0 had the lowest ($p<0.05$) final live weight and live weight gain (8.44 kg and 31.27 g day^{-1}, respectively) and the poorest feed efficiency (0.06). Animals fed G100 had the highest final live weight (9.40 kg), which was not significantly ($p>0.05$) different from the value (9.16 kg) obtained for animals fed G75. This might be because G100 provided the best balance of nutrients for growth as well as the superior nutritive value of *G. sepium* (Odeyinka and Ademosun, 1995).

Animals on *P. maximum* and *G. sepium* based diets (G75 and G100) had higher values of weight gain (40.40 g day^{-1} and (42.26 g day^{-1}, respectively) which were not significantly ($p>0.05$) different. Goats fed G0 and G25 had lower but similar ($p>0.05$) daily live weight gains. This lower growth may have been due to the antinutritional factors found in the feed materials; their effects range from decreasing the nutritive value of feed materials to depressing growth directly. However, ruminants could tolerate these levels of antinutritional factors. Reduced growth could also have been due to reduced nutrient content of the grass as compared to the legume foliage.

Table 1: Chemical composition (% of DM of *Panicum maximum*, *Gliricidia sepium* and concentrate diets fed to West African Dwarf goats

Composition	*P. maximum*	*G. sepium*	Concentrate
Dry matter	75.15	53.02	82.66
Organic matter	46.16	47.52	40.36
Crude protein	7.09	18.61	14.50
Crude fibre	31.26	21.21	18.51
Ether extract	3.20	2.51	3.61
Ash	2.29	10.15	12.98
NFE	56.16	47.52	50.40
NDF	71.88	45.24	27.11
ADF	37.25	47.30	47.30
ADL	8.11	3.27	3.27
Antinutritional factors (mg/100g)			
Oxalates		1.25	1.160
Phytate	98.45	101.22	113.510
Cyanide		0.148	0.339
Tannin		2.65	3.060
Saponin		0.10	0.110

The reduced DMI in G75 and G100 might be due to the low level of grass consumed. No significant ($p>0.05$) difference occurred in concentrate intake but animals fed G100 consumed the greatest amount of concentrate which might be due to the reduced intake of forage. The crude protein intake was significantly ($p<0.05$) different among treatment means, being highest in animals fed G100, which had *G. sepium* as the sole forage. The intake of cell wall fractions (ADF, ADL, NDF and CF) was highest in animals fed G0 and decreased among treatments as *P. maximum* intake decreased and *G. sepium* intake increased ($p<0.05$).

The digestibilities of proximate nutrients are shown in Table 3. Significant ($p<0.05$) differences were obtained for the digestibility percentages of all the proximate nutrients. The high digestibility values obtained for most nutrients (except for crude protein) suggests that the diets were highly degraded in the rumen. The high digestibilities of cell wall fractions demonstrate the ability of ruminant animals to process structural carbohydrates and obtain nutritional benefit from them.

Crude protein digestibility was significantly ($p<0.05$) different among treatment means and was highest in G100 (76.75%), which had the highest intake of *G. sepium*. This suggests that protein digestibility increased with increasing supplementation of *G. sepium* which had a greater content of nitrogen and good utilization (Ifut, 1992). High digestibility values recorded in goats fed G100 suggest that the cell wall and cell contents of *Gliricidia* were utilized more efficiently than that of *P. maximum*, making its nutrients more available.

The nitrogen utilization by goats in this study, is shown in Table 4. Significant ($p<0.05$) differences occurred in nitrogen intake and utilization among treatments. Although, there was no definite trend in nitrogen intake of goats as the level of supplementation with Gliricidia increased, G100 (3.86 g day^{-1}) had the

Table 2: Performance characteristics of West African Dwarf goats fed *Panicum maximum*, *Gliricidia sepium* and concentrate diets

	G0	G25	G50	G75	G100	SEM
Intake (g/DM/day)						
P. maximum	469.22^{a}	359.10^{b}	223.16^{d}	102.87^{d}	0.00^{e}	29.64
G. sepium	0.00^{e}	69.11^{d}	157.64^{e}	217.74^{d}	327.36^{a}	11.05
Concentrate	78.43	71.75	88.28	84.03	92.76	7.38
Total	547.65^{a}	499.96^{b}	469.07^{c}	402.98^{d}	417.95^{d}	20.61
Nutrient intakes (g kg$^{-0.75}$day^{-1})						
Dry matter	127^{a}	113^{b}	104^{c}	89.7^{d}	91.1^{d}	5.82
Crude protein	10.2^{d}	10.9^{c}	12.9^{b}	13.3^{b}	16.19^{a}	0.57
CF	37.0^{a}	31.4^{b}	26.5^{c}	20.7^{d}	18.9^{d}	2.75
NFE	56.9^{a}	51.0^{b}	47.3^{c}	40.8^{d}	45.9^{c}	1.85
NDF	82.2^{a}	69.2^{b}	56.7^{c}	43.1^{d}	37.7^{e}	5.27
ADF	48.6^{a}	44.9^{b}	44.2^{b}	40.0^{c}	43.2^{b}	1.76
ADL	9.32^{a}	7.56^{b}	5.80^{c}	4.02^{d}	2.99^{e}	1.08
Initial live wt (kg)	5.82	5.92	5.87	5.83	5.85	0.19
Final live wt (kg)	8.44^{c}	8.75^{b}	9.05^{ab}	9.16^{ab}	9.40^{a}	0.28
Wt gain (g day^{-1})	31.27^{c}	33.69^{c}	37.89^{b}	40.40^{a}	42.26^{a}	2.47
Metabolic wt	4.36^{b}	4.46^{b}	4.51^{ab}	4.52^{ab}	4.59^{a}	0.10
Feed efficiency	0.06^{d}	0.07^{c}	0.08^{b}	0.10^{a}	0.11$_{a}$	0.006

Values in the same row with different superscripts differ ($p<0.05$)

Table 3: Apparent digestibilities (%) of West African Dwarf goats fed *Panicum maximum Gliricidia sepium* and concentrate diet

Apparent digestibility (%)	G0	G25	G50	G75	G100	SEM
Dry matter	64.30^{a}	54.77^{b}	47.96^{c}	52.88^{b}	66.65^{a}	2.86
Crude protein	44.30^{c}	43.42^{c}	49.36^{b}	52.51^{b}	76.75^{a}	3.23
NDF	77.43^{a}	77.14^{a}	77.65^{a}	67.18^{c}	74.89^{b}	1.06
ADF	60.17^{d}	64.75^{b}	62.94^{bc}	62.44^{c}	77.47^{a}	2.08
ADL	84.90^{a}	80.68^{b}	80.73^{b}	74.16^{c}	71.58^{a}	0.61
CF	82.17^{a}	81.50^{a}	72.02^{c}	64.26^{d}	76.60^{b}	1.52
Ether extract	79.97^{b}	78.80^{c}	77.75^{d}	74.08e	87.21^{a}	1.03
Ash	67.84^{a}	65.60^{b}	53.69^{e}	59.22^{d}	62.05^{c}	1.53

Values in the same row with different superscripts differ ($p<0.05$)

Table 4: Nitrogen utilization of WAD goats fed *Panicum maximum Gliricidia sepium* and concentrate diets

Nitrogen utilization (g/day)	G0	G25	G50	G75	G100	SEM
Nitrogen intake	3.56^{b}	3.26^{b}	3.12^{bc}	3.31^{c}	3.86^{a}	0.24
Nitrogen excretion						
Faecal	2.36^{a}	1.98^{b}	1.60^{ab}	1.60^{ab}	1.80^{b}	0.24
Urinary	0.27	0.59	0.31	0.81	0.61	0.06
Total	2.63	2.57	1.91	2.47	2.41	0.22
Nitrogen Balance	0.93^{bc}	0.69^{c}	1.21^{ab}	0.84^{c}	1.45^{a}	0.30
Nitrogen retained (%)	26.12^{b}	21.17^{b}	38.78^{a}	25.38^{b}	37.56^{b}	8.13

Values in the same row with different superscripts differ ($p<0.05$)

highest nitrogen intake. The percentage nitrogen retention pattern differed from the observed pattern in crude protein digestibility. Increased nitrogen retention percentage might be ascribed to higher protein digestibility, which led to higher utilization of nitrogen from microbial protein.

Nitrogen balance and retention values were greatest in animals fed G50 and G75, which supports the notion that nitrogen retention increased with protein supplementation (Mupangwa *et al*., 2000). The positive nitrogen balance observed in all treatment groups suggests that all the nitrogen absorbed was well tolerated and utilized by the animals.

CONCLUSION AND RECOMMENDATIONS

The effect of combined levels of mixed forages supplemented with a cassava offal based concentrate in WAD goats was investigated. Data from the study showed that all 5 diets were acceptable to the animals and also supported reasonable weight gains, satisfying the nutritional needs of young WAD goats. Animals fed G100 performed better with respect to weight gain than those fed diets containing different levels of *P. maximum* and *G. sepium*. Cassava offal can effectively be put to use by supplementing it with grass or legume. All grass-legume mixtures can enhance productivity during the dry seasons since they are high in protein and minerals and perennial in nature, coupled with high herbage yield. This implies that they can be harvested at any time of the year and fed to increase the efficiency of utilization of basal diets for livestock which in the tropics generally comprises low nitrogen pastures and poor quality grass.

A 50:50 grass: legume mix appeared the most beneficial in terms of all the aspects considered. Although, animals fed G50 had lower ($p<0.05$) weight gains than animals fed G100, G50 can effectively support the growth of animals in the dry season. An important

finding in this study, was the presence of antinutritonal factors in feed materials. Therefore, more research should be conducted to find out the effect of treatment or processing on feedstuffs containing antinutritonal factors.

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