DIGESTIBILITY AND GROWTH IN WEST AFRICAN DWARF SHEEP FED GLIRICIDIA-BASED MULTINUTRIENT BLOCK SUPPLEMENTS

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ABSTRACT

Sixty West African Dwarf (WAD) rams aged between 7 - 10 months and mean body weight of 12.6kg were used to study the influence of Gliricidia - based multinutrient blocks (MNBs) as supplement to Panicum maximum and cassava peel feed for 12 weeks using experimental research design. Gliricidia + Poultry manure (GPMNB), Gliricidia + Urea + Poultry manure (GUPMNB) and Gliricidia + Urea (GUMNB) and Panicum - cassava peel (control) were analyzed for proximate composition, mineral content, gross energy and anti-nutritional factors. The coefficient digestibility of DM, CP, CF, EE, NFE of the rams in the control ratio were consistently lower than those fed the MNBs supplemented ratio. The body length gains of rams fed with MNBs were significantly higher than those rams fed with the control diet. It was concluded that Gliricidia - based multinutrient block supplements could be fed with Panicum - cassava peels to improve feed intake, nutrient digestibility and nitrogen utilization leading to a better performance of sheep.

Keywords: *Panicum - cassava peels, Gliricidia-based multinutrient blocks, utilization, performance, conversion ratio.*

INTRODUCTION

Small ruminants suffer from scarcity in feed supply and pasture quality in the humid region of West Africa, especially during the dry season when the natural vegetation is of poor nutritive value (Akinfala and Tewe, 2002; Aye, 2007). There has been a search for and interest in the use of unconventional and less expensive feed ingredients to mitigate this scarcity (Odeyinka, Hector and Orskov 2003). Low Nitrogen (N) forages and cassava peel-based diets supplemented with urea show increased feed intake and protein digestibility in ruminants but use of browse plants and other feed sources alone or as supplement have proved satisfactory. Browse plants with high nutritive values have been successfully fed to small ruminants in alley farming systems (Ngwa and Tawah, 2002; Fasae and Alokan, 2006).

Gliricidia sepium is a suitable feed for ruminant which it can consume in large quantities without deleterious effects on animal performance (Oladokun, Aina and Oguntona, 2003; Bawala, Akinsoyinu and Folorunso, 2006). Multinutrient blocks are lick blocks containing urea, molasses, vitamins, minerals and other nutrients (Hendratno, Nolan and Leng, 1991). Multinutrient blocks represent a vast reservoir of cheap nutrients, particularly for ruminants (Hendratno, Tjiptosumirat and Sofian, 1989). Multinutrient feed block has been advocated as a panacea for protein and energy deficiencies in ruminants especially during the extended dry season (Onwuka, 1999). It has been demonstrated to improve dry matter intake and live weight gain in lambs on a basal diet of wheat straw (Hendratno et al., 1991). The objective of this study therefore, was to evaluate the effects of Poultry manure and Urea as sources of nutrients in a multinutrient block used to supplement Panicum- Cassava peel diet.

MATERIALS AND METHODS

Experimental Site, Animals and Management: The study was conducted in the Small Ruminants Section of the Teaching and Research Farm, University of Ado-Ekiti, Nigeria. Sixty West African Dwarf (WAD) sheep aged 7-10months with a mean body weight of 12.6 kg (range 9.3 - 14.5 kg) were purchased from the open market at Otun-Ekiti. On arrival, the sheep were given antistress and prophylactic treatments consisting of intramuscular injection of Oxytetracycline (LA:1ml/10kgBW) and a coccidiostat. They were dewormed with Baminth 11^{R} wormer (12.5g/kgBW) and bathed with Asuntol^{R} powder solution (3g/litre) to eliminate ectoparasites. They were also given Tissue Culture Rinderpest Vaccine

(TCRV) against Peste de Petit Ruminant (PPR) about a week after arrival. The animals were quarantined for a period of 4 weeks and subsequent housed individually in open-sided, well-ventilated pens. The sheep were allowed fourteen days adaptation period during which they were fed with multinutrient blocks, as well as Panicum maximum and cassava peels. The animals had free access to fresh water daily.

Experimental diet (multi-nutrient blocks) preparation

Gliricidia - molasses - urea blocks, Gliricidia - molasses - poultry manure blocks and Gliricidia - molasses - urea - poultry manure blocks were made as follows: Cement was mixed(W/W) with water at the ratio of 1:2 , Gliricidia residue, molasses, urea/poultry manure, Sodium chloride (NaCl) were added in that order and the cement mixture added last. The mixture was poured into a cellophane-lined plastic mould measuring 14cm x 10cm x 5cm. The blocks formed were put on table tops, sun-dried and packed into jute bags. Guinea grass (Panicum maximum) was harvested at the pre-anthesis stage at a height of about 20cm. The harvested grass was chopped into small bits (about 2 - 3cm) allowed to wilt for 2 - 3 days (for each cutting), baled into jute bags and kept in a well-ventilated room. The total collection lasted about 12 weeks. Cassava peels were collected fresh from a gari processing factory in Ado-Ekiti and sun dried for 5 days after which it was packed into jute bags and kept in well-ventilated room. The ingredient composition of the Gliricidia - based multinutrient blocks are as presented on table 1.

Table 1: Ingredient composition (%) of the experimental multinutrient blocks

Ingredients	Treatment		
	GPMNB	GUPMNB	GUMNB
Molasses	40	40	40
Urea	-	5	10
Poultry manure	10	5	-
NaCl	5	5	5
Cement	15	15	15
Gliricidia residue	30	30	30
Total	100	100	100

GPMNB= Gliricidia - Poultry manure multinutrient blocks

GUPMNB = Gliricidia - Urea - Poultry manure multinutrient blocks

GUMNB = Gliricidia - Urea multinutrient blocks

Source: Field experiment, 2009

Feeding of Animals: Feeding which lasted for 12 weeks was preceded by 2 weeks of acclimatization. The animals were weighed before the commencement of the feeding. They were divided into four groups of fifteen animals balanced for body weight (BW) and randomly allocated to dietary treatments. The experimental diets were fed in two installments per day at 0800h and 1600h respectively. The multinutrient blocks were fed to a basal diet of Panicum maximum plus cassava peels based on daily feed allowance of 5.0% of BW and fresh water was supplied regularly in the pens.

Digestibility and Nitrogen balance trials: The animals were transferred into wooden metabolic cages fitted with facilities for separate collection of feaces and urine. The quantity of feed offered, feed refusal, feaces and urine were determined for 7 days, after 14 days of adjustment to the cages. Ten percent of the feaces and urine collected daily over the 7- day period were bulked. Nitrogen loss from urine and bacteria growth infestation were prevented by introducing $20cm^3$ of 10% Tetraoxosulphate (vi) acid (H_2SO_4) into a well-labelled urine collection bottle and stored in a refrigerator. The ten percent feaces taken were weighed and used for moisture determination. The remaining feaces were oven dried at 70^oC for 36 hours, milled and stored in air tight bottles.

Data collection and Statistical Analysis: The daily feed provided and the left over of the previous day's feed were weighed to determine the total feed intake of each animal and on daily basis. Samples of experimental diets were collected during the experiment for dry matter (DM) determination and proximate analysis. The samples were weighed and dried in an oven at 105^oC to constant weight. The dried samples were weighed and ground to pass through a 2mm sieve. The milled samples were subjected to proximate analysis as described by AOAC (1995). The animals' weights were taken once a week before the morning feed was offered. Linear body measurements including body length, height at withers and heart girth were also recorded once a week.

The milled experimental diets and feacal samples were analyzed for dry matter (DM) Crude protein (CP) Crude fibre (CF) Ether extract (EE) and Nitrogen free extract (NFE) according to AOAC (1995). Gross energy of feeds was determined with adiabatic bomb calorimeter. Mineral analysis was by wet digestion of samples in Trioxonitrate (v) acid (HNO_3) and Calcium (Ca) and Phosphorus(P) determined with atomic absorption spectrophotometer. The Nitrogen content of the urine was determined by the Kjeldahl method according to AOAC (1990) procedure. Analyses of extractable condensed tannins were carried out by the method described in Markkar and Goodchild (1996). Data generated from parameters investigated were subjected to Analysis of Variance (ANOVA) using the General Linear Modelling Procedure (SAS 1988). Significant differences between treatment means were separated using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

The proximate composition, energy, mineral and antinutrients contents of Gliricidia - based multinutrient blocks are shown on Tables 2, 3 and 4. Gliricidia - Poultry manure multinutrient Blocks (GPMNB) with the highest dry matter has the least crude protein, crude fibre and gross energy. Gliricidia - urea multinutrient blocks (GUMNB) has the highest crude protein and gross energy while Gliricidia - urea - Poultry manure multinutrient blocks (GUPMNB) had least dry matter but the best crude fibre and ether extract. The nitrogen free extractive value was highest in GPMNB and least value was in GUMNB. Sodium (Na), Calcium (Ca), Potassium (K), Magnessuim (Mg), Zinc (Zn) and Iron (Fe) were the most abundant minerals in the multinutrient blocks while Cu was the least abundant. GPMNB contained the highest amount of Sodium (Na), Phorsphorous (P), Potassium (K), Sulphur (S) and Copper (Cu) while Calcium (Ca), Iron (Fe) and Zinc (Zn) were highest in GUPMNB and Mg and Mn in GUMNB. The tannins ranged from 0.44g100g-1DM in GPMNB to 1.54g100g-1DM in GUPMN while phytin varied from 9.06mg100g-1DM in GUMNB to 22.24mg100g-1DM in GPMNB. The Phytin-P ranged from 2.55mg100g-1DM in GUMNB to 6.26mg100g-1DM in GPMNB and oxalate content varied from 7.56mg100g-1DM in GPMNB to 8.73mg100g-1DM in GUMNB. Weight gain, feed consumption and feed efficiency and body measurements as affected by the diets are shown on Tables 5, 6 and 7. The mean weight gain (WG), heart girth gain (HGG), Height at wither gain (HWG), Body length gain (BLG) and feed conversion ratio (FCR) were significantly influenced by the dietary treatments. The weight gain of sheep fed GPMNB, GUPMNB and GUMNB were significantly higher than those fed with the control diet but GUMNB produced the highest weight gain.

Sheep fed control diet had the least feed conversion ratio while sheep fed supplemental GUMNB had highest feed conversion ratio followed by GPMNB and GUPMNB. The body length gain of sheep fed GUMNB, GPMNB and GUPMNB were significantly higher than those fed the control diet . A similar trend was observed for heart girth gain (HGG) and height at wither gain which were significantly higher in sheep fed diets supplemented with Gliricidia - based multinutrient blocks. The dry matter intake (DM1) were higher in sheep fed diets supplemented with Gliricidia - based multinutrient blocks. The values ranged from 1528.00+5.3g day-1 in GUPMNB to 1584.67+2.9gday-1 in GPMNB which differed significantly from the value of 1102.00+9.6gday-1 in the control diets. The metabolic DM1 also followed the same trend as the dry matter intake being consistently high with supplementation of the multinutrient blocks. GUMNB, GUPMNB and GUPMNB supplementation diets produced daily average weight gain of 57.1+0.0, 47.6+1.6 and 28.6+0.8g respectively which were significantly superior to the 9.5±4.9g in the control treatment.

The nitrogen metabolism data shown on table 8 indicate that variations in digested nitrogen (g day-1) were significant. The sheep on GUMNB digested significantly higher values of Nitrogen per day than those on GUPMNB and GPMNB which were significantly superior to those on the control diets. The treatment effects on nitrogen balance (NB) were significant. Nitrogen-Balance values for sheep on treatments GUMNB, GUPMNB and GPMNB were significantly higher than the mean values for sheep on control suggesting that the higher Nitrogen-intake significantly improved Nitrogen-Balance.The Nitrogen-Rretention (NR) in treatments GUMNB, GUPMNB and GPMNB were 59.83+2.7, 44.51+4.8 and 33.33+2.3g day,-1 respectively which were significantly higher than in the control treatment. Nitrogen-Retention for diets with high protein levels tends to be higher compared to low protein level diets. The coefficients of digestibility of dry matter, crude protein, crude fibre, ether-extract, ash and nitrogen free extracts of the animals fed on the control diets were consistently lower than those fed the Gliricidia-based multinutrient blocks supplemented rations. A similar result was obtained on percent digestible crude protein, crude fibre, ether extract, ash and NFE.

The proximate compositions, energy, mineral and anti-nutritional constituents of the multinutrient blocks revealed their potentials as sources of feed for ruminants. The dry matter content of the blocks was quite high and appears adequate, especially they are to serve as supplements to other conventional feeding stuffs with urea and poultry manure known for ammonia release. The nitrogen free extractives reflect the energy content of the blocks and these are in relation to the molasses content. Thus, multinutrient blocks will supply reasonable levels of available energy and nitrogen when fed to animals.

The crude protein content of GPMNB, GUMNB and GUMNB compared favourably with and even surpassed those reported for urea-molasses blocks (Mata and Cambellas, 1992; Onwuka, 1999).The study also shows that the Gliricidia-based multinutrient blocks contained some valuable mineral elements- K, Na, Ca, Mg, P and Zn at levels considered particularly high when compared with most other foods (Leng, Preston, Sansoucy and George-Kunju, 1991), while Fe which is commonly deficient in many diets is fairly abundant. The anti-nutrients content were very low compared with most other foods (Agbede and Aletor, 2004; Agbede, 2006; Aye 2007).

This study demonstrates that sheep fed Gliricidia - based multinutrient blocks performed better than those fed control diet of Panicum + cassava peels only. This suggests that the multinutrient blocks have the tendency of improving rumen fermentation which provides a better balance of nutrients to the animals for absorption (Habib et al., 1991), and so can be used as a farm package to increase growth rates of sheep under confinement sheep management. Previous studies have shown that multinutrient blocks improved heart girths, height at wither and body length of sheep dependent on low quality forages as their main diet (Habib et al., 1991; Hendratno et al., 1991; Hadjipamayiotou et al., 1993b). Increase in biometric measurements brings about progressive increase in feed intake as well as effective utilization of the multinutrient blocks. This finding confirms the experiences in other countries where multinutrient blocks manufactured from urea and/or poultry manure and agro-industrial by-products are used as supplements for improving the productivity of sheep (Sancoucy et al., 1988; Leng et al., 1991; Hadjipanayioutou et al., 1993a). Therefore urea and or poultry manure or urea + poultry manure combination of 10% in block packages further confirmed that urea used at this level will not have adverse effect on the block utilization by animals (Habib et al., 1991).

CONCLUDING REMARK

Multinutrient blocks are potential sources of readily available energy and nitrogen which would fill the gap in feed availability to ruminants during the extended annual dry season months of November through April. The ease of preparation and maintenance make the block technologies easy for adoption by small-scale farmers at rural level. Rations supplements with multinutrient blocks offered a balance of essential nutrients, which is the major determinant of dry matter intake and growth rate and so would overcome dry season weight losses and rather poor performance in sheep fed cut and carry fodder.

Table 2: Proximate composition (g Kg-1) and Gross energy (MJ Kg^{-1}) of the experimental Multinutrient blocks

Treatments	DM	CP	CF	EE	Ash	NFE	Gross Energy
GPMNB	785.6+0.01	179.0+1.20	70.3+0.01	81.9+0.01	333.1+0.04	484.5+0.57	11.67
GUPMNB	711.8+0.01	261.2+0.61	121.0+0.03	91.1+0.15	284.9+0.05	324.0+0.98	14.56
GUMNB	765.6+0.02	344.2+1.19	77.4+0.04	65.1+0.01	266.0+0.04	247.2+1.16	15.48
CV	5.06	85.15	30.65	15.61	11.74	34.41	14.30

CV= Coefficient of Variation

Source: Field experiment, 2009

Table 3: Mineral constituents of the experimental multinutrient blocks (mg kg^{-1})

Treatments	Na	P	K	Ca	Mg	S	Zn	Fe	Cu	Mn
GPMNB	873.50	162.50	923.20	766.60	166.70	141.67	258.30	158.30	0.08	50.00
GUPMNB	771.40	71.40	831.00	892.90	142.90	131.55	414.30	264.30	ND	57.00
GUMNB	642.10	89.40	663.50	757.10	192.90	121.43	171.40	257.10	ND	57.00
CV	15.71	44.77	16.34	9.41	14.93	7.69	43.74	26.14	96.00	11.00

ND = Not Detected

Source: Field experiment, 2009

Table 4: Antinutrients in the experimental multinutrient blocks

Treatments	Tannin ($g100g^{-1}$)	Phytin - P ($mg100g^{-1}$)	Phytate ($mg100g^{-1}$)	Oxalate ($mg100g^{-1}$)
GPMNB	0.44	6.26	22.24	7.56
GUPMNB	1.54	3.94	14.00	7.83
GUMNB	0.63	2.55	9.06	8.73
CV	67.58	44.10	44.10	7.62

Source: Field experiment, 2009

Table 5: Performance of sheep fed basal diet supplemented with Gliricidia - based multinutrient blocks

Parameters	Treatments			
	GPMNB	GUPMNB	GUMNB	CONTROL
DM1 (g day^{-1})	$1584.67+2.9^{a}$	$1528.00+5.3^{a}$	$1573.33+2.1^{a}$	$1102.0+9.6^{b}$
DM1 (g $day^{-0.75}$)	$250.64+3.4^{a}$	$244.38+3.4^{a}$	$249.81+2.6^{a}$	$191.17+1.3^{b}$
Weight gain (kg)	$1.9+0.2^{a}$	$1.4+0.4^{b}$	$2.0+0.9^{a}$	$0.7+0.2^{c}$
W0.75 gain (kg)	$0.9+0.3^{a}$	$0.6+0.4^{b}$	$0.9+0.4^{a}$	$0.4+0.2^{c}$
Feed Conversion Ratio	$21.3+1.2^{a}$	$26.6+0.4^{b}$	$20.6+0.1^{a}$	$50.6+0.2^{c}$

a, b, c, values with differing superscripts in the same row differ significantly (P<0.05)

Source: Field experiment, 2009

Table 6: Morphostructural differentiation of Sheep fed experimental multinutrient blocks (cm)

Treatments	Parameters		
	Heart girth gain	Height at Wither gain	Body Length gain
GPMNB	16.0+0.9[c]	20.4+1.0[b]	20.3+2.0[a]
GUPMNB	18.0+0.3[b]	23.0+0.3[a]	15.7+3.5[b]
GUMNB	22.3+0.3[a]	21.7+0.6[b]	25.0+0.7[a]
Control	8.7+0.6[d]	6.3+0.7[c]	9.6+1.2[c]

a, b, c, d values with differing superscripts in the same row differ significantly (P<0.05)

Source: Field experiment, 2009

Table 7: Live weight change of Sheep fed basal diet supplemented with Gliricidia - based multinutrient blocks

Parameters	Treatments			
	GUPMNB	GPMNB	GUMNB	Control
Initial Live Weight (kg)	11.9+2.4	12.0+2.7	12.0+0.8	11.8+1.2
Final Live Weight (kg)	12.1+2.4	12.3+0.2	12.4+0.8	11.9+1.2
Mean Live Wt gain (kg)	0.2+0.0[b]	0.3+0.1[a]	0.4+0.0[a]	0.1+0.1[c]
Average Daily Wt gain (g)	28.6+0.0[c]	47.6+1.6[b]	57.1+0.0[a]	9.5+4.9[d]
Metabolic Daily Wt gain (g0.75)	12.4+0.0[b]	18.1+1.4[a]	20.8+0.0[a]	5.4+2.9[c]

a, b, c, d values with differing superscripts in the same row differ significantly (P<0.05)

Source: Field experiment, 2009

Table 8: Nitrogen Utilization by Sheep fed experimental multinutrient blocks (g day-1)

Parameters	Treatments			
	GUPMNB	GPMNB	GUMNB	Control
Nitrogen Intake	5.30+0.5[b]	6.28+0.6[a]	8.92+0.5[a]	4.25+0.3[c]
Faecal - N	2.98+0.2	2.78+0.3	2.88+0.2	2.71+0.1
Digested - N	2.32+0.2[b]	3.50+0.2[b]	6.04+0.1[a]	1.51+0.2[c]
Urinary - N	0.56+0.1[c]	0.70+0.1[a]	0.64+0.1[b]	0.40+0.0[d]
N - Retention	33.33+2.3[c]	44.51+4.8[b]	59.83+2.7[a]	26.18+3.6[d]

a, b, c, d values with differing superscripts in the same row differ significantly (P<0.05)
Source: Field experiment, 2009

Table 9: Nutrient digestibility coefficient of Sheep fed basal diet supplemented with Gliricidia - based multinutrient blocks

Nutrients	Treatments			
	GPMNB	GUPMNB	GUMNB	Control
Dry matter	85.94+1.6[a]	86.79+1.3[a]	85.24+2.0[a]	68.66+2.6[b]
Crude protein	80.74+3.0[b]	85.41+1.9[a]	85.34+1.6[a]	64.54+0.5[c]
Crude fibre	93.06+2.4[a]	93.80+0.5[a]	92.13+1.1[a]	76.45+5.6[b]
Ether extract	76.33+4.4[a]	75.09+3.2[a]	71.79+4.4[b]	61.68+2.9[c]
Nitrogen free extracts	93.64+0.5[a]	92.85+15[a]	91.70+0.9[a]	71.98+1.9[b]

a, b, c, d values with differing superscripts in the same row differ significantly (P<0.05)
Source: Field experiment, 2009

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