COMPARATIVE STUDY ON THE USE OF FOUR PROTEIN SUPPLEMENTS BY WEST AFRICAN DWARF (WAD) SHEEP.

A. A. TAIWO[a]., E.A. ADEBOWALE[1], A.O. AKINSOYINU[2] AND J.F.D. GREENHALGH[3]

1. Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan, Nigeria

2. Department of Animal Science, University of Ibadan, Nigeria

3. School of Agriculture, University of Aberdeen, 581 Kings Street Aberdeen, U.K.

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ABSTRACT

Feedblocks, poultry manure diet, gliricidia: leucaena mixture (1:1 W/W) and maize offal diet were compared as sources of protein supplements for WAD sheep fed a basal diet of elephant grass hay (Pennisetum purpureum), through a 12-week performance and digestibility study. Dry matter and organic matter intakes (DMI, OMI) of the sheep were higher (P0.05) on the gliricidia: leucaena supplement than on the other diets. DMI on poultry manure and maize offal diets were not significant (P0.05). Organic matter intake (OMI) of the animals followed the same trend as DMI. Sheep fed legume supplements excelled in intakes of crude protein (CP), acid detergent fibre (ADF) and digestibilities of dry matter (DM), organic matter (OM) and neutral detergent fibre (NDF) ($P > 0.05$). Intakes of CP and ADF by sheep on the other supplements were not significantly different ($P > 0.05$). Sheep fed on feedblock supplement consumed the least amount (P0.05) of NDF. Variations were observed in DM,OM, and NDF digestibilities by sheep on maize offal, poultry manure and legumes supplements. Crude protein digestibility in the legumes and feedblocks supplements was higher (P0.05) than with the other two supplements. All the sheep used gained weights but those on maize offa' diet recorded higher (P0.05) weight gain (86.57g) than those on browse leaves (59.40g), feedblocks (47.80g) and poultry manure (40.44g). Rumen pH was lower ($P < 0.05$) on the gliricidia: leucaena supplement than on other diets. Total VFA recorded for sheep on maize offal diet and legumes supplements was higher ($P < 0.05$) than for the other two supplements. Blood urea nitrogen of the supplements were not significantly different ($P > 0.05$)

Key word: Protein utilization, Feedblocks, Gliricidia, leucaena, Poultry manure, WAD sheep.

INTRODUCTION

Adequate nutrition is one of the ways to enhance the productivity of West African dwarf (WAD) sheep. This will increase the animal protein available for human growth and development. Sheep can utilize grasses for tissue development. However, the quality of the grasses fluctuates with seasons and stages of maturity. This does not allow for enhanced performance and predictable output of animal products.

Forages with crude protein levels below 7% cannot sustain liveweight in animals (Milford and Minson, 1966). This necessitates supplementation with proteinous feeds. The feeding value of different protein supplements would depend not only on its crude protein contents but also on the proportions of rumen degradable protein (RDP) and rumen by-pass protein that can be utilized for microbial synthesis in the rumen and tissue growth, respectively.

Thus the purpose of this study was to evaluate the relative usefulness of four protein supplements: feedblocks, gliricidia/leucaena mixture, poultry manure and maize offal based diets as sources of supplementary protein for WAD sheep fed a basal diet of elephant grass.

MATERIALS AND METHODS

Experimental Treatments:

The four protein supplements-maize offal based diet, poultry manure based diet,

a Corresponding Author

gliricidia: leucaena leaves and feedblocks formed the experimental treatments. They were fed as supplements to elephant grass hay (Pennisetum purpureum). The compositions of poultry manure and maize offal are shown on Table 1. Feedblocks contained the following ingredients: Molasses 42.86%, Wheat offal 28.57%, Cement 14.29%, Urea 9.52%, Salt 3.81% and Salt lick 0.95%.

Feedblocks were prepared according to the procedure outlined by Sansoucy (1986). Poultry manure was collected from laying birds housed in battery cages on a private commercial farm. The wet manure was sun-dried for one week. It was milled before mixing with other ingredients to form poultry manure diet. The leaves of gliricidia and leucaena were wilted for 24 hours before feeding to the sheep in a ratio of 1:1 (W/W).

TABLE 1: DIET COMPOSITION FOR POULTRY MANURE AND MAIZE OFFAL DIETS

Ingredient	Poultry manure diets (%)	Maize offal diet (%)
Poultry manure	50.0	-
Maize offals	27.5	44.5
Brewers dried grain	13.0	30.0
Palm Kernel Cake	5.5	19.0
Groundnut Cake	2.0	4.5
Bone meal	1.5	1.5
Salt	0.5	0.5
Total	100.0	100.0

Animals and their Management.

The experimental unit consisted of 16 West African dwarf (WAD) rams weighing between 12-14kg. They were obtained from the Sheep Unit of the Institute of Agricultural Research and Training Ibadan. The sheep were dewormed with Systamex and disinfected with Asuntol solution before the experiment commenced. The animals were housed individually in pens provided with separate troughs for elephant grass hay, protein supplements and water. The animals had free access to salt lick except those on feedblocks supplement that already contained salt lick.

The diets were offered once daily at 08.00 hour. Feed refusals were collected and weighed the following morning before offering fresh feed. This was used to estimate feed intakes. The grass hay was calculated and offered to provide maintenance ration for the sheep (Kearl, 1982). The supplements were then given to boost growth rate.

Experimental Design and Feeding Trials.

A completely randomized design was used. The 16 sheep were randomly assigned to the four treatments at the rate of four replicates per treatment. There were two feeding trials. These were the growth study and metabolism trial. The growth study was for a 10week period. It was preceded by a 2-week preliminary period. The animals were weighed at the beginning of the experiment and weekly thereafter. This was to assess liveweight changes. At the third week, blood samples were obtained via the jugular veins of the sheep 3 hour post feeding. This was used to assess the influence of the treatments on urea level in the plasma. Rumen liquor was collected from the sheep 4 hours after feeding using the stomach tube.

The metabolism trial was conducted with 2 male sheep per treatment in metabolism cages with facilities for separate collection of faeces and urine. There was a 14 day adjustment period and 7 days of collection. Each of the feeds was offered in separate feed troughs. The animals were weighed at the beginning and at the end of the collection period. Faecal sample of each animal was weighed and representative samples taken for daily dry matter determination. These were bulked for chemical analyses.

Data and Sample Analyses

Data were analysed by the analysis of variance (Steel and Torrie, 1980). Least significant difference (LSD) was used to separate differences between significance means.

The proximate composition of the feed and faecal samples was determined by standard

TABLE 2: CHEMICAL COMPOSITION OF BASAL GRASS AND SUPPLEMENTS (g/100 DM BASIS) FED TO WAD SHEEP

Sample Description	Dry matter	Organic matter	Ash	Crude Protein	ADF	NDF	Cu (ppm)
Elephant grass	89.25	81.88	18.12	6.53	40.30	56.13	15
Gliricidia sepium leaves	89.41	87.09	12.91	24.80	31.30	50.54	16
Leucaena Leucocephala (Leaves)	89.58	88.35	11.66	25.34	20.23	45.47	18
Maize offal diet	91.92	77.57	22.43	14.84	27.53	49.50	20
Caged layer poultry manure	93.43	50.71	49.29	16.01	33.92	37.71	45
Poultry manure diet	92.84	68.72	31.28	18.45	29.59	36.84	42
Feedblocks	85.00	63.30	36.70	39.01	6.27	12.58	-

ADF = Acid detergent fibre; NDF = Neutral detergent fibre - = Not determined.

TABLE 3: TOTAL DRY MATTER INTAKE AND PROPORTION OF GRASS AND SUPPLEMENTS CONSUMED (DM BASIS) BY WAD SHEEP FED GRASS HAY WITH PROTEIN SUPPLEMENTS

Intake	SUPPLEMENTS			
	Maize offal diet	Poultry manure diet	Gliricidia: leucaena	Feedblocks
Total DM intake				
(g/day)	633.0	596.2	704.6	464.4
(g/day/kgw $^{0.75}$) +	87.3^b	82.6^b	99.1^a	57.7^c
Grass intake (%)	40.1	51.1	45.3	63.0
Supplements intake (%)	59.9	48.9	54.7	36.9

(a,b,c) Means within a row with different superscripts differ ($P < 0.05$).

methods (A.O.A.C., 1980). Samples were ground through a 1mm sieve in laboratory mill prior to chemical analysis. Acid and neutral detergent fibre determinations were carried out by the methods of Goering and van Soest, (1970). Total volatile fatty acid in ruminal fluid was assessed by distillation involving titration with 0.01N NaOH. The pH of the ruminal liquor was measured with a pH meter.

RESULT AND DISCUSSION

Chemical Composition

The chemical Composition of basal grass hay and supplements is shown in Table 2. They all had high dry matter (DM) contents ranging from 85% in feedblocks to 93% in poultry manure. The elephant grass, browse leaves, poultry manure and feedblocks were sun-cured prior to use which could account for the high DM recorded. Poultry manure and feedblocks had relatively low organic matter contents of 50.71% and 63.30%, respectively. The values reflected the high ash contents in the samples. Feedblocks contained the highest concentration of crude protein (CP) (about 39%) while elephant grass had the least (6.53%). The high CP in the feedblocks was as a result of the urea (about 9.5%) it contained. The low CP content of the grass justified the need for its supplementation with proteinous feeds. Feedblocks had the least fibre contents; 6.3% ADF and 12.6% NDF. This should be expected as most of its ingredients were devoid of fibres. The grass hay contained high fibres; 40.5% ADF and 56.1% NDF.

Dry Matter Intake (DMI)

Table 3 shows the total feed intake and the proportions of grass and supplements consumed. Animals on browse leaves supplement had significantly ($P<0.05$) higher feed intake (99.1g/day/kgw$^{0.75}$) than animals on other supplements. Animals on feedblocks consumed the least (57.7g/day/KgW$^{0.75}$) amount. Differences observed in feed intake for sheep on supplements of maize offal diet and poultry manure diet were not significant ($P>0.05$). The higher feed intake with the browse supplement could be due to the stimulatory effect associated with supplementation of green feed such as leucaena (Moran et al., 1983).

This could be ascribed to the increase in the rate of passage of digesta, balances of dietary nutrients (N,P and Ca) and levels of rumen metabolites (Moran *et al.*, 1983). The low feed intake with feedblocks' supplement could be due to the high level of salt (3.8%) it contained. The high level of salt was purposely included to prevent copious consumption of feedblocks that could result into urea and molasses toxicities (Sancousy, 1986). The total DM intake on supplement of poultry manure diet (82.6g/day/KgW$^{0.75}$) is lower than 107.8g/day/KgW$^{0.75}$ obtained by Adegbola *et al.*, (1990) who fed a basal diet of cassava peels supplemented with diet containing 45% dried poultry waste. Grass intake as a proportion of total intake was highest on the feedblocks supplement (63%) and least on the maize offal diet (40%). The animals on browse leaves supplement were able to adjust their intakes of gliricidia and leucaena to a ratio of about 1:1 when offered in equal amounts in separate feed troughs.

Nutrients Intake

Organic matter intake (OMI) followed the same trend as DM intake. Sheep on browse supplement had significantly ($P<0.05$) higher OMI (87.4g/day/KgW$^{0.75}$) than those on other supplements (Table 4). Crude protein intake (CPI) was higher ($P<0.05$) in sheep fed on gliricidia: Leucaena supplement than with the other supplements. There were no differences ($P>0.05$) in the CPI of sheep on the other supplements. Sheep fed on supplements of browse leaves, maize offal and poultry manure diets consumed similar amounts ($P>0.05$) of ADF. These were higher ($P<0.05$) than the intake recorded on feedblocks supplement. Neutral detergent fibre intake on browse leaves supplement was higher ($P<0.05$) (53.1g/day/KgW$^{0.75}$) than on feedblocks and poultry manure diet supplements. Differences recorded in the NDF intakes on supplements of browse leaves and maize offal diets were not significant ($P>0.05$). The supplements provided the bulk of the CPI (over 70%) in all the treatments.

TABLE 4: NUTRIENTS INTAKE (g/kgW $^{0.75}$) OF WAD SHEEP FED GRASS HAY* WITH PROTEIN SUPPLEMENTS

	SUPPLEMENTS			
Nutrients	Maize offal diet	Poultry manure diet	Gliricidia: leucaena leaves	Feedblocks
Organic matter	72.45^{b}	65.97^{b}	87.42^{a}	48.46^{c}
Crude protein	10.5^{b}	9.79^{b}	16.0^{a}	11.97^{b}
Acid detergent fibre	29.16^{a}	30.64^{a}	33.18^{a}	17.91^{b}
Nuetral detergent fibre	47.65^{ab}	40.8^{b}	53.1^{a}	25.9^{c}

*Grass hay = (*Pennisetum purpureum*)   a,b,c, Means with different superscripts in a row differ significantly ($P < 0.05$).

TABLE 5: PERFORMANCE OF WAD SHEEP FED GRASS HAY+ WITH PROTEIN SUPPLEMENTS

	SUPPLEMENTS			
	Maize offal diet	Poultry manure diet	Gliricidia: leucaena leaves	Feedblocks Digestibility
Dry matter	62.5^{a}	60.2^{a}	65.2^{a}	43.7b
Organic matter	65.9^{a}	62.3^{a}	67.6^{a}	46.2b
Crude protein	41.9^{b}	47.2^{b}	62.7^{a}	57.7a
ADF	51.1^{ab}	57.6^{a}	52.0^{a}	43.0^{b}
NDF	65.0^{a}	61.1^{a}	64.8^{a}	43.6^{b}
Mean initial liveweight (kg)	12.56	11.88	14.33	14.35
Mean final liveweight (kg)	18.62	14.72	18.47	17.69
Mean liveweight (kg)	15.59	13.3	16.4	16.0
Liveweight changes (g/day)	86.57^{a}	40.44^{c}	59.20^{b}	47.80^{c}

a,b = Means with different superscripts differ(P).
+Grass hay = (*Pennisetum purpureum*)
ADF = Acid detergent fibre
NDF = Neutral detergent fibre.

Digestibility of Nutrients

Sheep fed on supplements of browse leaves, maize offal and poultry manure diets digested dry matter (DM) and organic matter (OM) to the same ($P > 0.05$) extent (Table 5). These were higher ($P < 0.05$) than the corresponding values for feedblocks supplement. The low digestibility of DM and OM on feedblocks supplement could have been due to its interferring high ash content. Crude protein digestibility (CPD) by sheep offered supplements of browse leaves and feedblocks was similar ($P > 0.05$). These were higher than the CPD of sheep on supplements of maize offal and poultry manure diets. There were no difference ($P > 0.05$) in the digestibility of ADF and NDF of sheep fed on supplements of browse leaves, maize offal and poultry manure diets. Neutral detergent fibre was better digested ($P < 0.05$) in these supplements than on feedblocks supplement. Supplements of feedblocks and maize offal diet had comparable ($P > 0.05$) ADF digestibilities. The nutrient digestibility values on feedblocks supplement in this study compared favourable with those obtained in a study with buffalo calves fed wheat straw supplemented with 500g wheat bran plus oil extracted rice bran and ad libitum urea molasses blocks (Tiwari *et al.*, 1990). they obtained values of 47.8% (DM), 50.5% (OM), 56.0% (CP), 40.7% (ADF) and 50.5% (NDF).

Liveweight Changes

Sheep fed on all the supplements gained weight. Supplement of maize offal diet resulted in significantly higher ($P < 0.05$) liveweight gain (86.7g/day) of sheep than other supplements (Table 5). Liveweight gain on browse leaves supplement was higher ($P < 0.05$) than the remaining two supplements. The difference observed in the liveweight changes of sheep on the poultry manure based diet and feedblocks supplements were not significant ($P > 0.05$). The liveweight gain (47.8g/day) recorded on feedblocks supplement is appreciable when compared with weight change of 68g/day in oxen fed wheat straw supplemented with feedblocks (Preston, 1986). The relatively high liveweight gain of sheep on supplement of maize offal diet could be due to the ability of the supplement to provide necessary nutrients (especially fermentable N) in ensuring optimal microbial biomass, together with possible by-pass protein from the supplement which would enhance the production of body tissues. It has been reported (Orskov, 1982; Kellaway and Leiboholz, 1983; Leng, 1990) that adequate nutrients in feeds, taken in by ruminants for the rumen microbes plus some rumen by-pass protein would stimulate optimal productive functions in ruminant livestock.

Rumen and Blood Metabolites

Sheep on supplements of maize offal and poultry manure diets had the highest rumen pH of 6.8. Supplementation with feedblocks slightly ($P > 0.05$) depressed the pH to 6.7 (Table 5). There was a further fall ($P < 0.05$) in pH to 6.5 with browse leaves' supplement. The differences in pH values could be caused by variations in the secretions of saliva which arise from differences in the time required for chewing and rumination (Orskov and Ryle, 1990). This is influenced by the physical structure and the chemical composition of the feed. The pH in turn can affect the type of micro-organisms inhabiting the rumen and hence the rumen fermentation pattern. This may be drastically changed only when the rumen pH falls below 6.0 (mould and Orskov, 1984).

Supplements of browse leaves and poultry manure diet produced comparable ($P > 0.05$) levels of total volatile fatty acid (TVFA) (80.3 and 84.0 milliequl/litre, respectively) (Table 5). These were higher ($P < 0.05$) than the values obtained for supplements of maize offal diet (54.5 milliequi/litre) and feedblocks (56.5 milliequi/litre). The type of carbohydrate substrate fed influences TVFA production. Feeds containing high proportion of soluble sugars generally give rise to high TVFA in the rumen, due to their rapid rate of fermentation (Orskov and Oltjen, 1967).

Studies by Ram and Kunju (1986) showed that increasing the amount of concentrate feed from 270 to 450g/day in buffalo calves fed *ad libitum* rice straw and urea molasses mineral block, resulted in significant ($P<0.01$) increase in TVFA produced. However the composition of the TVFA is more important in determining the quality of a feed. Higher proportion of propionic acid in TVFA is more desirable (Orskov and Ryle, 1990). This reduces the available hydrogen and hence methane production, which is a loss of dietary energy to the animals.

The blood urea nitrogen (BUN) was highest on supplement of poultry manure diet (35.8mg/100ml) and least on feedblocks supplement (25.78mg/100ml) (Table 5). However differences in the BUN on all the supplements were not significant ($P>0.05$). The high BUN on supplement of poultry manure diet could be due to its high uric acid content (Flegal *et al*, 1972). This could be converted to urea via hydrolysis to ammonia.

CONCLUSION

It is apparent that on the average, feedblocks supplementation to sheep promoted the least desirable effects of the parameters examined. Feeds nutrients intakes, and digestibility were lowest on it except for its crude protein digestibility. Liveweight was low compared to supplements of maize offal diet and browse leaves. Nevertheless, it has a place in ruminant livestock production. The readily available urea and molasses and the convenience of carrying feedblocks could make it a useful supplement to grazing ruminants in Nigeria. This is important during the dry season when pasture is sparse and poor. It will reduce the characteristics weight loss (especially in cattle) associated with this period. Poultry manure diet promoted good nutrients' intakes and digestibilities. However, weight gain was low. The high Cu content of the diet suggested a caution as feed for sheep. However, in this era of looking inwards for unconventional feed resources, the level of incorporation into a diet can be curtailed to 20 and 40% (Kanyongo *et al.* 1992). Supplement of gliricidia and leucaena leaves produced desirable nutrients' intake and digestibility. Liveweight gain by sheep on this diet can be further improved by reducing the degradation of protein in the rumen. This will make available by-pass protein in the lower gut for tissue synthesis.

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