

Performance and Digestibility of West African Dwarf Sheep fed varying forage and concentrate ratios

Yusuf, A. O., Bawala, O. T., Sowande, O. S. and Adegbenjo, F. D.

Department of Animal Production and Health, University of Agriculture, Abeokuta, Ogun State

*Corresponding author: zee_mine@yahoo.com, kemibawala@yahoo.com.

Target Audience: Extension agents, Nutritionist, farmers

Abstract

This study was conducted to determine performance and nutrient digestibility of twenty four West African Dwarf Sheep aged between 10 and 12 months fed varying levels of forage and concentrate. Animals were allotted to three treatment groups in a completely randomized design at 75% concentrate and 25% grass, 50% grass and 50% concentrate and 25% concentrate and 75% grass designated as treatment 1, 2 and 3, respectively. Daily nutrient intake, apparent digestibility, average daily gain, and protein efficiency were measured. Data were analyzed by one-way analysis of variance. The protein efficiency, average daily gain and daily nutrient intakes were significantly ($P < 0.05$) influenced by the treatments. Apparent digestibility of nutrients by the sheep were also significantly ($P < 0.05$) different across the treatments except for the NFE and NDF which were not significantly ($P > 0.05$) influenced by the treatments. Diet 3 (75% forage and 25% concentrates) which supported superior sheep performance in most of the economical traits considered was thereby recommended.

Keywords: Sheep, forage, concentrate, performance and digestibility.

Description of problem

Sheep are very flexible with the type of feedstuffs they feed on. It has been found that they can survive on pasture herbage such as grasses, legumes and herbs as well as concentrates (1). High producing sheep cannot meet their high level of nutritional requirement; even with the best quality forage feed. Hence adequate nutrition is one of the ways to enhance the productivity of West African Dwarf (WAD) sheep (2). The natural food of herbaceous domestic animals is pasture,

and for a large part of the year this forms all or most of the diet (3). The composition of the dry matter pasture grass is very variable. The fibre content is broadly related inversely to the crude protein content (3). In small ruminants, forages usually furnish the maintenance and concentrate supplements furnish the production of meat or milk (4). Consequently, high production requirement can be satisfied by concentrate supplies because it is the best way of adjusting energy, protein, mineral

and vitamin supplies both quantitatively and qualitatively.

Forages are typically the least expensive feed resources available for nutrition of ruminants. However, depending on quality and availability, forage alone may not be sufficient. Grazing alone is insufficient for satisfactory weight gain. Thus, concentrate feedstuff are fed in many cases when the requirements of animals are high and quality of forage is inadequate (5).

However, it was observed that the quality of grasses fluctuates with seasons and stages of maturity and thus forages with crude protein levels below 7% cannot sustain live weight in animals(1). This necessitates supplementation of forage with concentrate feeds in this study as a means of improving the performance and digestibility of sheep especially during the dry season when the quantity and quality of grass are poor.

Materials and Method

Experimental site

The experiment was carried out at the Small Ruminant Unit of the Teaching and Research Farm, University of Agriculture, Abeokuta, Ogun State. The site is located in the rain forest vegetation zone of South-Western Nigeria on Latitude 7° 13' 49.46'' N, longitude 3° 26' 11.98''E and altitude 76m above the sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature and relative humidity of 34.7°C and 83%, respectively.

Experimental animals and management

Twenty four West African Dwarf sheep (twelve rams, twelve ewes) between the ages of 10 and 12 months were used for the experiment. The animals were given prophylactic treatment at the onset of the quarantine period. They were quarantined for four weeks during which antibiotics and dewormer Oxybiotic LA (long acting) and Albendazole were administered.

After the quarantine, animals were randomly grouped into three, balanced for body weight. Each group was allotted to each experimental diet in a 100-day experimental period. Identical housing, health care and sanitary measures were provided throughout the period.

Experimental animals and design

The animals were fed guinea grass s (*Panicum maximum*) which was fed after 24 hours of wilting (to reduce the moisture content) along with a concentrate diet. One of the three groups of animals was randomly assigned to one of the diets (diets 1, 2 and 3) in which guinea grass was replaced with concentrates at 25, 50 and 75% respectively in a completely randomized design. The animals were fed and offered water *ad libitum*. The dietary treatments are given below.

Experimental diets

The gross composition of the concentrate diets contains 19.8 % GNC, 78.2 % wheat offal, 1.0 % Bone meal and 1.0 % Mineral / Vitamin.

Diet 1 25G:75C Basal diet:Concentrate

Diet 2 50G:50C Basal diet:Concentrate

Diet 3 75G:25C Basal diet:Concentrate

Data collection

Dry matter intake and Body weight changes

The animals were weighed at the commencement of the experiment as a measure of their initial body weight and thereafter on weekly basis throughout the period of the experiment. The total feed intake was measured by subtracting the feed refusal from the amount of feed offered.

Two weeks to the end of the experiment, faecal outputs of three representative animals per treatment were collected. The faecal samples were weighed, dried in an oven at 75°C (to avoid protein loss), milled, bulked and stored in air tight polythene bags until when required for analysis. Nutrient intake (DM, CP, Ash, CF, EE and NFE) were determined.

Nutrient digestibility was calculated by the formula:

$$\frac{\text{Nutrient intake} - \text{Nutrient in faeces}}{\text{Nutrient intake}} \times 100$$

Chemical analysis

The milled samples the of concentrate diet, *Panicum maximum* and faecal samples were analyzed for their proximate components and fibre fractions (ADF, NDF and ADL) using the procedure outlined by (6).

Statistical analysis

All data generated were subjected to One-way Analysis of Variance (ANOVA) in a completely randomized design and the significant means were

separated using new Duncan Multiple range test as in SPSS software package (7).

Results and Discussion

The result of the proximate composition (g/100DM) of *Panicum maximum* and concentrate diet fed to the WAD sheep is as shown in Table 1. The results of proximate analysis of *Panicum maximum* differed slightly from that obtained in an earlier experiment where 25.7% dry matter (DM), with 7.8% crude protein (CP), 33.4% crude fibre (CF), 12.2% ash, 1.4% ether extract (EE) and 45% nitrogen free extract (NFE) as percentage of dry matter was observed (8). The neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) represent the CF. The *Panicum maximum* is higher in ash content, NDF, ADF and ADL but lower in CP than the concentrate. The CP content of the concentrate is higher than the dietary level (14% CP) for growing sheep (3).

Table 2 showed the results of the daily feed intake (g/day) of the WAD sheep. Varied forage: concentrate ratios significantly (P<0.05) influenced DM and nutrient intakes. The daily DM intake was highest for animals on treatment 3 (1046.26), followed by treatment 2 (977.48) and the least in treatment 1 (913.28). The CP intake was highest in those fed 25% grass and 75% concentrate, treatment 1, (167.89), while least value (121.08) was obtained for those fed with highest grass composition, treatment 3. Ash intake was highest in treatment 3 (109.55g/day), followed by

those on treatment 2 (89.36) and the least in treatment 1 (84.55).

Table 1: Proximate composition (g/100DM) of *Panicum maximum* and concentrate diet fed to WAD sheep

Composition	<i>Panicum maximum</i>	Concentrate
Dry matter	71.29	85.06
Crude protein	7.20	22.57
Ash	11.25	8.51
Ether Extract	3.07	6.08
NFE	25.18	44.68
Neutral Detergent Fiber	73.39	56.6
Acid Detergent Fiber	36.95	7.2
Acid Detergent Lignin	8.71	2.8

Those animals fed 25 % grass and 75 % concentrate, treatment 1, and those on 50% grass and concentrate combination had similar ($P>0.05$) ash value which were statistically ($P<0.05$) lower than the value obtained for sheep in treatment 3. Animals on treatment 1 had the highest EE and NFE intake, followed by those on treatment 2 and those on treatment 3 respectively. For NDF, ADF and ADL, animals on treatment 3 had highest values ($P<0.05$) of intake followed by those on Treatment 2 and lastly Treatment 1, respectively.

The result showed that feeding WAD sheep with varying combinations of *Panicum maximum* and concentrate significantly ($P<0.05$) influenced DM intake in sheep. Sheep that received highest grass concentration (75% grass), diet 3 had highest average daily gain of 65g. This is similar to the observation that diets high in cereal reduce feed intake, nutrient absorption and depress animal performance (9). Highest crude protein intake of sheep in treatment 1

could be due to highest substitution of grass with more proteinous concentrate. Similarly, highest ash intake of animal fed diet 3 corresponds with the higher ash content of grass (*Panicum maximum*), which could serve as a source of the minerals essential for optimal performance. Also, despite the lowest dietary crude protein content with attendant lowest protein intake of sheep in treatment 3, the animals had the highest daily weight gain and protein efficiency, suggesting the adequacy of nutrition of the diet. The high NDF and ADF intake in treatment 3 was as a result of the higher content of NDF and ADF in grass which formed 75% of the diet.

The summary of weight gain is represented in Table 3. The experimental treatments had no significant ($P>0.05$) effect on final weight and metabolic weight. Highest ($P<0.05$) daily gain (g/day) (65.0) was recorded for sheep on treatment 3, followed by those on treatments 2 (47.5) and treatment 1 (32.5), respectively.

Table 2: Daily nutrient intake of WAD sheep fed varying levels of *Panicum maximum* and concentrates

Parameters	T₁	T₂	T₃	SEM
Intake (g/day)	25%G +75%C	50%G +50%C	75%G +25%C	
Dry matter	913.28 ^c	977.48 ^b	1046.26 ^a	6.47
Crude protein	167.89 ^a	143.92 ^b	121.08 ^c	1.43
ASH	84.55 ^b	89.36 ^b	109.55 ^a	6.70
EE	48.02 ^a	44.41 ^b	41.08 ^c	0.39
NFE	359.40 ^a	339.44 ^{ab}	333.40 ^b	11.41
NDF	559.84 ^c	637.05 ^b	717.86 ^a	3.46
ADF	140.02 ^c	218.85 ^b	298.14 ^a	0.47
DL	40.32 ^c	56.87 ^b	73.54 ^a	0.18

^{a,b,c} Means on the same row with the same superscripts are not significantly different (P>0.05).

There was significant difference (P<0.05) between treatments for average daily gain and protein efficiency. The highest daily gain and protein efficiency showed by animals in treatment 3, having 65.0g/day, despite the lowest protein intake suggest the adequacy of the ration (11). These results are in contrast with the experimental findings that when two groups of female lambs were fed roughages and concentrates with different combinations (25:75 and 75:25) from the age of two weeks to one year, maximum

weight gain was observed in group fed 75% concentrate. This might be attributed to the high crude protein content in the concentrate diet used in the present study compared to their high energy rich diet. It was also found higher growth rate in group fed energy-rich concentrate diet than grazing alone and supplementation of grazing by concentrate feeding was more economical than feeding pure concentrate (12).

Table 3: Weight gain of WAD sheep fed varying levels of forage and concentrates

Parameters	T ₁ 25%G +75%C	T ₂ 50%G +50%C	T ₃ 75%G +25%C	SEM
Initial weight (kg)	11.75	8.25	10.50	0.34
Final weight (kg)	15.00	13.00	17.00	0.76
Met weight (KgBW ^{0.75})	6.99	5.88	7.11	0.19
Average daily gain (g/day)	32.50 ^{bc}	47.50 ^b	65.0 ^a	3.06
Protein efficiency	0.19 ^c	0.33 ^b	0.54 ^a	0.18

^{a,b,c} Means on the same row with the same superscripts are not significantly different (P>0.05) Met = Metabolic

Results of apparent nutrient digestibility (%) of WAD sheep fed the experimental diets were presented in Table 4. The varying levels of forage: concentrate influenced (p<0.05) the DM, CP, ASH, EE, ADF and ADL digestibilities. The results showed that DM and EE digestibilities were highest in treatment I (86.36%) followed by treatment 2 (86.13%) and the least value of 83.8% was recorded in treatment 3. Highest CP

digestibility was recorded in treatment I, closely followed by treatment 2 and the least was treatment 3. No significant difference (P>0.05) was observed for NFE and NDF. For ADF and ADL, treatment 3 had highest value when compared to treatments 2 and 1. Treatment 2 ranked first, followed by treatment 3 and then treatment 1 for Ash digestibility.

Table 4: Apparent nutrient digestibility (%) of WAD sheep fed varying levels of forage and concentrates

Parameters	T ₁ 25%G +75%C	T ₂ 50%G +50%C	T ₃ 75%G +25%C	SEM
Dry matter	86.36 ^a	86.13 ^b	83.89 ^c	0.45
Crude protein	83.89 ^a	79.88 ^{ab}	76.37 ^c	0.72
Ash	74.32 ^b	84.06 ^a	75.65 ^{ab}	1.42
Ethe Extract	91.90 ^a	86.87 ^b	77.17 ^c	0.58
Nitrogen Free Extract	86.42	83.47	85.69	0.48
Neutral Detergent Fiber	89.95	89.11	89.59	0.36
Acid Detergent Fiber	83.28 ^c	87.12 ^b	91.82 ^a	0.58
Acid Detergent Lignin	74.08 ^b	59.29 ^c	86.74 ^a	0.98

^{a,b,c} Means on the same row with the same superscripts are not significantly different (P>0.05).

The dry matter digestibility ranged from 83.89% to 86.36% which deviated slightly from those values obtained for sheep and goat fed forage supplemented with concentrate were between 78 and 79% and between 78 and 80% for lambs and kids, respectively (10). The highest apparent nutrient digestibility of crude protein in Treatment 1 showed that the dietary protein is highly utilized by the animals than those on treatments 2 and 3. This could be due to the highest inclusion of proteinous concentrate in the diet. The ADF and ADL apparent nutrient digestibility were highest in treatment 3 which could have resulted from the high fibre content of *Panicum maximum* which formed 75% of the diet. This also showed that *Panicum maximum* is highly digested by sheep.

Conclusion and Application

It was concluded that ruminants would prefer diets containing more forages to concentrate diets in order to support rumen microbial activities while inducing higher absorption and utilization and a higher animal performance.

References

1. Njike, M.C. (1997). Utilization of by – products as Animal Feeds. *Nigeria Journal of Animal Production* 4:8 – 84.
2. Charray, J., Humvert, J.M. and Lerif, J. (1992). Manual of Sheep production in the tropics. CAB – International Wallingford U.K. pp 187.
3. McDonald, P., Edwards, R.A. and Green – Haigh J.F.D. (1995). *Animal Nutrition*. 5th edition Longman, Singapore Publisher Limited.
4. Giger – Reverdin, S. and Sauvant, D. (1991). Evaluation and utilization of concentrates in goats. EAAP Publication No. 46, 172.
5. Mahajan, J.M., Chauhan, D.S. and Tomor, V.P.S. (1976). Effect of supplementary feeding to grazing on growth and wool production in sheep. *Indiom Journal of Animal Research* 10:2
6. A.O.A.C., 2000. Official methods of analysis. Association of Official Analytical Chemists (17th ed). Arlington. VA.
7. Statistical Package for Social Scientists, SPSS Base 16. User's Guide, (c) 2006. SPSS Inc. 23 South Wacker Drive. 11th Floor, Chicago, IL 60606 -6412.
8. Gohl, B. (1981). Effect of dietary forage: Concentrate ratio on growth performance and carcass characteristics of growing Baladi kids. *Small Ruminant Research*. 39:41-46.
9. Owens, F.N., Secrist, D.J. Hill, W.J. and Gill, D.R. (1998). Acidosis in cattle: a review. *J. Anim. Sci.* 76: 275 – 285.
10. Adeneye, J.A. and Sumon, E.M. (1994). Growth of male WAD sheep fed cassava waste or dried sorghum brewers grain as supplements to tropical grass or legume forage. *Small Rum. Res.* 13:242-249.

11. Gabrovska, L. and Ganovski, K. H. (1986). Effect of feeding various types of rations on the growth of lambs. *Vet. Med. Nauki*, 23(1): 58-64.
12. Schiere, J. B., M. M. Ibrahm and H. Van Keulen, 2000. The role of livestock for sustainability in mixed farming: criteria and scenario studies under varying resource allocation. *Agri., Ecosyst. Environ.*, 90(2): 139-153.