The Feeding Value of Five Different Hays As Fed to Sheep

W. L. BRINCKMAN¹
Shika Research Station
Ahmadu Bello University
Zaria

SUMMARY

In a feeding trial, five different roughages were compared viz: *Chloris gayana*, *Andropogon gayanus*, *Stylosanthes guyanensis*, *S. humilis* and *Arachis hypogaea*. The sheep were supplemented with half a kg of a high-energy and high-protein concentrate daily. Gains were rather poor, especially on the grass hays. Intake and gain on *A. hypogaea* were highest. The prices of the concentrates were too high for economical fattening. Local sheep compared well with crossbreds under these conditions.

INTRODUCTION

THE system of sheep production in Northern Nigeria, used by the local Hausa people, has little input and hence little outputs. During the wet season, the animals are kept inside the compound, which consists usually of a few mud buildings, surrounded by a mud wall. Apart from kitchen refuse, fresh grass is cut daily or sometimes bought on the market. The grass comprises usually annual and perennial species (*Eragrostis*, *Digitaria*, *Pennisetum* and *Andropogon*).

In the dry season, as soon as the crops are harvested, the animals are let loose and roam around, eating crop residues (cotton, guinea corn, millet or maize), standing hay, legumes and shrubs. Although they are certainly not fat during this part of the year, they thrive remark-

ably well, often considerably better than do cattle.

The sheep used in this part of the country is the Yankasa breed. It is an intermediate breed between the long-legged Fulani sheep and the small West African Dwarf sheep. These sheep grow slowly and because of the high mortality, the annual take-off is usually low. To improve output, a system has to be found to make sheep production more intensive and profitable. One of the first steps is to improve the dry season performance, by feeding concentrates and good quality hay.

EXPERIMENTAL METHODS

Forty 8-month old rams, made up of 20 local Yankasa's and 20 crosses between local and imported breeds were placed in pens, 4 locals or 4 crosses in each pen.

The rams weighed between 20 and 38 kg at the start of the experiment. The pens were in the open and partly sheltered against the sun. The trial started in November, 1972 and continued for 60 days.

Shika Livestock Research Station is situated in the Northern Guinea Savanna

¹ Research Fellow, Institute for Agricultural Research, Shika Livestock Research Station, P. O. Box 116, Zaria, Nigeria.

Zone with an annual rainfall of 1092 mm, falling from April to October.

Five different hays were fed to the animals viz: *Chloris gayana*, (Rhodes gras, *Andropogon gayana* (Gamba grass), *Stylosanthes guyanensis* (= *S. gracilis*, Stylo), *Stylosanthes humilis* (Townsville

Stylo) and *Arachis hypogaea* (groundnut haulms). The hays were harvested in late October and baled, except for the groundnut haulms, which were stacked in the field while the nuts were drying. After the nuts were removed, it was fed directly from the heaps. Each type of hay was fed to a group of locals and a group of crossbreds.

TABLE 1

Proximate Analysis of the Feed Stuffs

Components	<i>Chloris gayana</i>	<i>Andropogon gayanus</i>	<i>Stylosanthes guyanensis</i>	<i>Stylosanthes humilis</i>	<i>Arachis hypogaea</i>
Dry Matter, %	95.7	95.8	95.8	95.2	94.3
Crude protein, %	2.8	3.0	9.6	8.4	11.0
Crude fibre, %	36.6	37.2	33.5	34.5	27.9
Ether extract, %	1.2	1.1	1.5	2.1	1.7
N-free extract, %	54.3	52.8	48.2	49.7	45.9
Digestible energy ^a	2240	2218	2363	2394	2310
Dry matter digestibility ^b	40.7	35.7	51.2	51.9	48.8

a DE in kcal/kg dry matter, derived from formula. (Harris *et al.*, 1972)

b In vitro dry matter digestibility in percentage

Feeding took place in the morning, after the hay residues of the previous day were weighed. The hay ration was calculated to be 25% in excess of the previous day's intake. This was to allow an equal amount of selection on all the hays. Concentrate fed was a mixture of 50% groundnut cake and 50% guineacorn. This was fed at a constant level of 450 g/day. This was a level on which reasonable gains were expected and not as high as to eliminate the hay differences.

Water and a complete mineral mixture were supplied *ad libitum*. Weekly samples of feeds and residues were oven-dried and stored. At the end of the trial, proximate analyses were carried out on the pooled samples of each hay, using the official methods of AOAC (1970). The animals were weighed every two weeks before feeding. After the trial period, some of the animals were sold at the rate of 47 kobo

per kg liveweight. The prices of the hays were 1½ kobo per kg, while the concentrate price at the time of the trial was 10 kobo/kg.

Some local rams were used for digestibility study, where only the hays were fed. Two rams stayed on each ration to which they were accustomed. A preliminary feeding period of 7 days was used to determine the amount to be fed (intake + 25%). Hay on offer, residues and faeces were collected, measured daily for 7 days and dried. Apparent dry matter digestibility was calculated.

In vitro digestibility studies were carried out on the forages, using the two-stage method described by Tilley and Terry (1963). For the energy estimation, a formula given by Harris, Kearl and Fonnebeck (1972) was used, which computes TDN from the proximate analysis. Digestible energy (DE) content of the forage

was calculated from the relationship $\text{kg TDN} = 4.4 \text{ Meal DE (NRC 1968)}$. Another formula was used (Harris *et al* 1972) to calculate the DE values of the concentrate.

Expected daily gain was calculated by using a formula given by Garret, Meyer and Lofgreen (1959):

$\text{DE} = 138 W^{0.75} (1_g + 5.3 \text{ g})$ where W is body weight and g is daily gain in kg.

RESULTS

The daily liveweight gains are given in table 2. The analysis of variance on these

TABLE 2

Intake, Gains, Expected Gains and Costs per Kg Gain

		Hay intake g/day	Hay intake g/W _{kg} ^{0.75}	Total intake g/W _{kg} ^{0.75}	Observed daily gain (g)	Expected daily gain	Obs/Exp day	Feed cost kobo/ gain	Feed cost kobo/kg gain	Concen- trate con- sumed/gain
<i>Chloris gayana</i> Local		451	36	70	66	90	0.7	5.4	812	6.8
(Rhodes grass) Crossbred		536	41	75	59	104	0.6	5.6	104	7.7
<i>Andropogon</i>										
<i>gayanus</i> Local		460	36	79	64	86	0.7	5.4	84	7.1
(Gamba grass) Crossbred		596	47	81	83	123	0.7	5.7	69	5.5
<i>Stylosanthes</i>										
<i>guyanensis</i> Local		662	54	89	100	161	0.6	5.9	59	4.5
(Stylo) Crossbred		598	41	72	125	96	1.3	5.7	46	3.6
<i>Stylosanthes</i>										
<i>humilis</i> Local		728	58	92	108	170	0.6	6.0	56	4.2
(Townsville stylo) Crossbred		772	55	86	144	146	1.0	6.0	42	3.2
<i>Arachis</i>										
<i>hypogaea</i> Local		1282	92	123	163	257	0.6	7.1	44	2.8
(Groundnut haulms) Crossbred		1491	106	137	172	301	0.6 80.7	7.5	44	2.6

c Expected gain from DE estimation using the formula of (Harris *et al* 1972)

weight gains indicated that there was no significant difference ($P > 0.05$) between the breeds, neither was there a breed X hay interaction. A t-test on the five hay groups showed that the two grass hays were not significantly different, as were the two Stylo hays ($P > 0.05$) table 3.

Table 3 also shows the weight changes during the digestibility study, only on the groundnut haulms and on Townsville Stylo were the animals able to make some gain.

Because of the group feeding, statistical analysis on the intake figures was not possible. Intakes are given in table 2 in gram per day and in gram per day per kg metabolic weight. Observed weight gains are compared with expected weight gains. The ratio between these two indicates if the expected gain and thus the estimated energy content of the feedstuffs was in agreement with the resulting gain. Feed costs per day and per kg gain are given in this same table, while the last

TABLE 3

Weight Changes in G/day for Feeding Trial and Digestibility Study

Component	Feeding trial	Digestibility study
<i>Chloris gayana</i>	+ 62 ^a	— 81
<i>Andropogon gayanus</i>	+ 74 ^a	—162
<i>Stylosanthes guyanensis</i>	+112 ^b	— 65
<i>Stylosanthes humilis</i>	+126 ^b	+ 65
<i>Arachis hypogaea</i>	+167 ^c	+ 65

Figures with different superscripts are significantly different ($P > 0.05$)

column gives the ratio between concentrate consumed and weight gain.

In table 4, the intakes of the different hays are repeated for the feeding trials,

TABLE 4

Trial Roughage intake: (g. DM/kg. Metabolic Weight) for Feeding and digestibility Study Compared with Literature and in Vitro and in Vivo D.M.D. Compared with in vivo D.M.D.

Hay types	Feeding trial	Digestibility study	In vivo D.M.D.	In vitro D.M.D.	In vivo D.M.D. Literature
<i>Andropogon gayanus</i>	41.5	35.5 49.5 ^e	15.0	35.7	48.8 ^e , 44.9 ^f
<i>Chloris gayana</i>	38.5	36.3 44.0 ^g , 46.8 ^a	32.7	40.7	45.5 ^g
<i>Stylosanthes guyanensis</i>	44.9	49.3 38.6 ⁱ , 60 ^d , m, 97.1 ⁱ , 73.6 ^g	34.9	51.2	56.5 ^h , 46.1 ⁱ , 68.6 ^g
<i>S. humilis</i>	56.5	49.8 36.1 ⁱ , 77.6 ^g , 54 ^d , m, 61.5 ^l	42.2	51.9	44.9 ⁱ , 57.6 ^g
<i>Arachis hypogaea</i>	99.0	83.9 68 ^d , m, 71 ^k , 80 ⁿ , 123.3 ^l	59.8	48.8	59.6 ^k , 56.1 ^f , 63.0

d	Supplemented	i	Newman, (1968)
e	Haggar, (1970)	k	Combellas <i>et al</i> , (1972)
f	Miller <i>et al</i> , (1964)	l	Brinckman unpublished
g	Brinckman in Anon., (1974)	m	Shiawoya and De Leeuw, (1971)
h	Ademosun, (1970)	n	Velasquez and Jimenes, (1972)

while the intakes for the digestibility study are added, they are compared with figures from the literature.

Also the *in vivo* and *in vitro* dry matter digestibility figures are given in table 4, compared with literature figures for *in vivo* DMD

DISCUSSION

Comparing the intakes during the feeding trial with those during the digestibility

study, it was clear that the supplementation increased roughage intake. Intakes of the two grasses were low, compared with results from other studies, (Haggar 1970, Brinckman unpublished). This might be caused by the low digestibility of our grasses. The intakes of the two *Stylo* species were also low compared with other trials at Shika, (Shiawoya and De Leeuw, 1971, Brinckman in Anon. 1974 and Brinckman unpublished), but Australian figures (Newman 1968) were

even lower in intake as well as in digestibility.

The *in vivo* dry matter digestibility figures were rather low, especially for *Andropogon gayanus* and *Stylosanthes guyanensis*, however they compared well with the weight changes of the animals during the digestibility study. The reason for this is probably that the preliminary feeding period between the feeding trial and the digestibility study was too short to accustom the animals from the excess of nitrogen during the feeding trial to the more or less nitrogen-deficient roughages. The bacterial flora apparently needs more time for this change of diet. For this reason, the more realistic *in vitro* digestibility figures were used for calculating the digestible energy content.

Consumption of the groundnut haulms was higher than expected from the *in vitro* digestibility figures. Crampton, Doenfer and Lloyd (1960) gave 80 g/kg metabolic weight as the Standard Forage Intake using forages which were 70% digestible. Blaxter, Wainman and Wilson (1961) related intake with digested energy, and stated that it is the digestibility of a forage and not the palatability, which determines the intake. In tropical forages however with such a big variation in quality, palatability might be another factor determining the voluntary intake.

The ratio of observed to expected daily gain (avg. 0.7) indicates that either applying the formula of Harris *et al* (1972) overestimates the feeding value of the roughages, or the efficiency of those animals is less than that of temperate sheep.

Feed conversion (kg concentrate/kg gain) was rather poor on the grass hays, compared with results of cattle feeding trials on grass hay. Results at Shika Research Station (Anonymous 1972, 1974, indicated that on high concentrate/low roughage rations, this conversion was between

5 and 6, while on low concentrate/high roughage rations, a ratio of 2.2 was realized. In both cases, the average daily gain was about 1 kg. The costings show, that fattening of sheep is only profitable on a high quality roughage. This is in agreement with Playne and Haydock (1972) who stated that cattle digest feeds with less than 55 % dry matter digestibility better than sheep. Prices of the concentrates were high in comparison with the meat price.

A total protein intake of 139 g/head/day on the ration lowest in protein, was sufficient for fattening of rams (NRC 1968).

The fact that the crossbred animals did not perform better than the locals, shows that at this level of feeding, the use of exotic breeds for crossbreeding is questionable. More research is needed to find optimum growth rates, before initiating expensive crossbreeding programmes.

ACKNOWLEDGEMENTS

The author wishes to thank the Director of the Institute for Agricultural Research, Ahmadu Bello University, Zaria for permission to publish. Thanks are due to the staff of the Grassland and Biochemistry Sections of Shika Livestock Research Station for carrying out the trial and processing of samples. The helpful advice of Mr. P. N. de Leeuw is also gratefully acknowledged.

REFERENCES

- A.O.A.C. (1970). Official Methods of Analysis (9th ed.) Association of Official Analytical Chemists, Washington, D.C.
- ADEMOSUN, A.A. (1970). Nutritive evaluation of Nigerian forages. II. The effect of stage of maturity on the nutritive value of *Stylosanthes gracilis*. *Nigerian agric. J.* 7, 164-173.

- ANONYMOUS, (1972). Annual report for the years, 1971, 1972, 1973, 1974. Shika Agricultural Research Station, Institute for Agricultural Research. Mimeogr. Rep.
- BLAXTER, K.L., F.W. WAINMAN and R.S. WILSON, (1961). The regulation of food intake by sheep. *Anim. Prod.*, 3, 51-61.
- COMBELLAS, J., A. CENTENO, B. MAZZANI y J. COMBELLA, (1972). Aprovechamiento de la parte aérea del mani. 2. Hemiclisis, consumo y digestibilidad *in vivo*. *Agronomía Tropical* 22, 281-285.
- GARRET, W.N., I.H. MEYER & G.P. LOFGREEN, (1959). The comparative energy requirements of sheep and cattle for maintenance and gain. *J. Anim. Sci.* 18, 528-547.
- GRAMPTON, E.W., DONEFER E., and L.E. LLOYD, (1960). A nutritive value index for forages. *J. Anim. Sci.* 19: 538-544.
- HAGGAR, R.J. (1970). The intake and digestibility of low quality *Andropogon gayanus* hay, supplemented with various nitrogenous feeds, as recorded by sheep. *Nigerian agric. J.* 7, 70-75.
- HARRIS, LE., L.L.C. KEARL, and P.V. FONNESBECK, (1972). Use of regression equations in predicting availability of energy and protein. *J. Anim. Sci.* 35, 658-680.
- MILLER, T.B., A. BLAIR RAIN and R.J. THORPE, (1964). The nutritive value and agronomic aspects of some fodders in Northern Nigeria. III Hays and dried crop residues *J. Brit. grassl. Soc.* 19: 77-80.
- NEWMAN, D.M.R. (1968). A comparison of the nutritive value of *Stylosanthes humilis*, *Stylosanthes guyanensis* and introduced grasses in Northern Australia. *Austr. J. Exp. Agric. Anim. Husb.* 8, 172-176.
- N.R.C. (1968). Nutrient Requirements of Sheep. National Academy of Science, Washington, D.C.
- PLAYNE, M.J. (1972). A comparison of spear grass (*Heteropogon contortis*) dominant pastures and Urochloa grass (*Urochloa mosambicensis*). *Austr. J. Exp. Agric. Anim. Husb.* 12, 378-383.
- PLAYNE, M.J. and HAYDOCK, (1972). Nutritive value of Townsville Stylo (*Stylosanthes humilis*) and of spear grass (*Heteropogon contortis*) — dominant pastures fed to sheep. I. The effect of plant maturity. *Austr. J. Exp. Agric. Anim. Husb.* 12, 365-372.
- RATTRAY, P.V., W.N. GARRET, N. NINMAN, GARCIA, I. and CASTILLO, J. (1973). A system for expressing the net energy requirements and net energy content of feeds for young sheep. *J. Anim. Sci.* 36, 115-122.
- SHIAWOYA, E.L. and P.N. DE LEEUW, (1971). Feeding sheep for mutton, some preliminary, feeding trials. *Samaru Agric. Newsletter*, 13 120-122.
- TILLEY, J.M.A. and TERRY, R.A. (1963). A two-stage technique for the *in vitro* digestion of forage crops. *J. Brit. Grass. Soc.* 18: 104-111.
- VELASQUEZ, J.A. y E.G. JIMENEZ, (1972). El valor nutritivo de la paja de mani (*Arachis hipogaea*). *Agronomía Tropical* 22: 287-290.