FEED INTAKE AND NUTRIENT UTILIZATION BY THREE BREEDS OF CATTLE

U.J. IKHATUA +AND F.O. OLUBAJO
Department of Animal Science, University of Ibadan, Ibadan — NIGERIA

SUMMARY

Two feeding and digestibility trials were carried out to investigate the effects of groundnut cake (GNC) supplementation on feed intake, DM digestibility, nutrient utilization and liveweight gain of three breeds of cattle fed on all-roughage rations (hay and fresh grass) of *Cynodon nlemfuensis* var *robustus*.

The results showed a decrease in mean DM intake of the basal ration by approximately 13.14%; 1.9% and 6.4% and an increase in total dry matter intake (basal + GNC supplement) of approximately 0.42%), 11.56% and 11.04% for the indigenous, crosses and exotic animals respectively.

The results also showed non-significent increases in the apparent digestibilities of the nutrients.

Both the total Digestible Nutrients (TDN) kg/$W^{0.75}_{kg}$) and Metabolizable Energy (ME) Kcal/$W^{0.75}_{kg}$ intake by the three breeds of cattle were increased with supplementation and mean daily liveweight increased by 18.92%, 13.15% and 16.27% respectively.

+Present address: *Department of Animal Husbandry and Biochemistry, National Animal Production Research Institute, P.M.B. 1096, Shika, — Zaria, — NIGERIA.*

INTRODUCTION:

Several reports in the literature have clearly shown the beneficial effects of nitrogen supplementation as regards nutrient consumption and availability of roughages by animals.

Elliot (1967 a,b) found that sheep and cattle increased their intake of total Digestible Nutrients (TDN) and Digestible Energy (DE) when more concentrate was fed with low quality hay. Elliot, Reed and Topps (1964) and Winchester and Harvey (1966) found that responses in terms of weight gain to increased intake of Digestible Energy were lower when cattle were on low — protein diets than when they received adequate protein.

Egan (1965) attributed the increase in the feed intake of roughage that occurred when protein supplements were given to sheep offered low-protein roughage to an improvement on the protein status of the animals. Similar observations have been reported by knox and Ward (1961). Campling (1965) reported a gradual decrease in the voluntary intake of hay from 10.50kg with hay alone to 10.3, 8.5 and 7.4kg with increasing concentrate with non-lactating cows receiving 0, 2.5; 5.0 and 7.5kg concentrate.

Murdoch (1964) found a small but non-significant effect on hay intake by cattle with addition of concentrate, while he observed a constant increase in straw intake with increasing quantities of concentrate offered to the cows. Working on the effect of adding concetrates to the diets of cows receiving an all-roughage *ad libitum* diet, Campling (1965) and Campling and Murdoch (1966) observed that adding as much as 6.0kg of concentrate daily to such all-roughage diet caused a small increase in the intake of barley straw. They also observed that increasing the amount of concentrate to between 6 and 8kg daily, reduced hay intake by between 0.2 and 0.4kg dry matter per kg concentrate dry matter offered. That the rate of decline in hay intake tended to be greatest with hays of the highest digestibility has been reported by Murdoch (1967).

The use of concentrate feedingstuffs to supplement low quality forages especially during the dry season to enhance better performance of animals is assuming higher dimension. Good responses to supplementation by growing animals have been reported by Zemmelink and De-Leeuw (1973).

These experiments were therefore designed to investigate if supplementation of *Cynodon nlemfuensis* var *robustus* with groundnut cake (GNC) might lead to higher intake and increases in the average daily liveweights of the experimental steers.

MATERIALS AND METHODS

The rations consisted of Giant star grass (*C. nlemfuensis* var *robustus)* hay and fresh grass and grass and groundnut cake. Both were fed at rates to supply 7.1% Digestible crude protein (DCP) as recommended by NRC (1970) for steers of similar liveweights.

Twelve animals made up of four steers each from three breeds of cattle namely the White Fulani (zebu) cattle, the German Brown and crosses between German Brown and N'Dama cattle were used in this study. The weights of the steers ranged from 189.5 — 205.60kg (mean 197.55 ± 8.05kg) White Fulani; 161 — 207.5kg (mean 184.3 ± 23.2kg) crossbred and 195.75 — 221.5kg (mean 208.63 ± 9.10kg) German Brown respectively.

Two feeding trials were carried out during the experimental period; one each, using either grasshay or fresh grass supplemented with groundnut cake for each breed of cattle.

Each of the feeding trials lasted between fifty-nine and sixty-three days. Feeding of the experimental animals was twice daily 0800 and 1600 hours. The groundnut cake supplement was however offered once daily at 0800 hours. The amount of the supplement offered, was determined by finding the ratios of the supplement to basal diet consumed by the experimental steers of each breed of cattle from the previous day intake.

The last 12 days of each trial were used for digestibility trials in which total collection of faeces and urine were made and the rations supplied sampled.

All chemical analysis were made by the A.O.A.C. (1975) method.

RESULTS

Results of the chemical compositions of the grasshay, fresh grass and groundnut cake supplement are shown in Table 1.

Utilization of nutrients from all-roughage rations did not indicate any significant differences among the breeds of steers (Table 2). Results of DM digestibility indicated significant differents ($P > 0.01$) among breeds with the addition of GNC to the roughage rations Table 3). The White Fulani and the German Brown steers digested he rations better than the crossbred. The mean digestion coefficients were 71.79 ± 0.90%; 69.11 ± 0.55% and 62.94 ± 0.9% for the WF, GB and crossbred animals respectively.

In Table 4 are shown the values for the digestibility of the supplementary concentrate. Differences among breeds in their ability to digest the supplementary ration were however not statistically significant.

Significant differences ($P > 0.05$) among breeds and between treatments were obtained in the digestibility of organic matter of the basal — supplement mixtures. Means of 73.32 ± 0.56%; 69.32 ± 0.55% and 65.06 ± 0.90% were recorded for the three breeds as for DM digestibility. Coefficient of apparent digestibility values of Organic Matter in the groundnut cake supplement were slightly higher (Table 4) than the DM values. Unlike the DM, the GB steers digested the OM content (76.08 ± 1.23% better than either the WF (75.20 ± 1.64%) or the crossbred (73.43 + 1.96%). Breed differences were however not significant.

The mean coefficients of apparent digestibility of crude protein for the basal ration plus the supplement were fairly high. The lowest value was recorded for the WF steers (76.40 ± 0.96%) while the values were very similar for the crossbred and German Brown steers. There were no significant differences among the breeds

TABLE I

Chemical Composition of Giant Star Grass *Cynodon nlemfuensis* var *r us* and Groundnut Cake Supplement g/100gDM

Constituents		Grass Hay	Fresh Grass	Groundnut Cake (GNC)
Dry Matter		85.90	25.70	89.40
Organic Matter		90.20	89.30	93.60
Crude Protein		9.30	10.60	49.20
Crude Fibre		31.60	30.50	5.40
Ether Extractives		1.20	1.20	9.70
Nitrogen-Free-Extractives		48.70	47.00	29.30
Ash		9.20	10.70	6.40
Energy Kcal/g		4.90	4.70	4.50
	MEAN	77.64 ± 1.34[c]	74.73 ± 2.12[c]	76.26 ± 1.31[c]
Nitrogen — Free Extractives	H	67.09 ± 0.24	71.23 ± 1.89	78.44 ± 1.68
	G	81.36 ± 1.38	74.55 ± 2.52	82.13 ± 1.04
	MEAN	74.23 ± 1.14[c]	72.89 ± 1.66	80.28 ± 1.04[c]
Energy	H	86.04 ± 2.51	80.01 ± 2.57	84.38 ± 1.56
	G	88.92 ± 2.19	84.35 ± 2.58	85.89 ± 1.52
	MEAN	87.49 ± 1.66[c]	82.18 ± 2.17[c]	85.13 ± 1.08[c]

* = Mean values from 12 determinations for 4 steers.
H = Hay Supplemented with GNC
G = Fresh grass supplemented with GNC
Figures in the same row followed by the same letter are not statistically different.

and between the treatments.

There were no significant breed differences in the digestibility of the GNC supplement. However, similar trends in the digestibility of the supplementary crude protein were obtained as in the total ration (basal + supplement) which varied between 78.96 ± 0.67% and 84.61 ± 1.03% for the indigenous and exotic breeds respectively. The ether extractives of the ration mixtures were digested to approximately the same extent by the experimental animals irrespective of breed. The crossbred had a slightly higher but non significant value of (80.01 ± 1.14%) than either the GB (79.33 ± 0.59%) or the WF (79.05 ± 0.98%). Treatment differences were also not significant. Apparent digestion coefficient values for the supplementary feeds were higher but not significantly different from those of the basal — supplementary feed mixtures. The digestibility varied between 80.54 ± 1.01% and 84.68 ± 2.11% respectively. Similar trends as for the OM digestibility were observed with the digestibility of the

The crude protein content of the fresh grass is approximately 12.3% higher than the corresponding content in the hay. Similarly, the total ash is higher in the fresh grass than in the hay by a mean value of about 14.0% whereas the hay ration is generally higher in its percentage contents of crude fibre and Nitrogen — free extractives than the fresh grass by mean percentage values of approximately

3.5% and 3.5% respectively. The differences observed may be due to handling during the process of hay making and time of harvest of the different batches of hay used.

The results of the mean apparent digestibilities of the roughage — (hay and fresh grass), the roughage with the GNC and of the Groundnut Cake alone are shown in Tables 2,3 and 4 respectively.

TABLE 2
Mean Coefficients of Apparent Digestibility of all — Roughage Rations (Hay and Fresh Grass) Fed to Three Breeds of Steers

Component		*White-Fulani*	*German Brown × N'Dama*	*German Brown*
Dry Matter	H	62.92 ± 2.16	59.20 ± 1.20	61.60 ± 0.55
	G	73.63 ± 0.58	62.32 ± 1.13	65.74 ± 1.66
	MEAN	69.40 ± 1.03[a]	60.76 ± 0.86[a]	63.67 ± 0.96[a]
Organic Matter	H	62.95 ± 2.04	62.08 ± 1.08	64.40 ± 0.50
	G	73.50 ± 0.62	65.61 ± 1.05	66.09 ± 1.68
	MEAN	69.65 ± 0.99[a]	63.73 ± 0.77[a]	65.25 ± 0.85[a]
Crude Protein	H	64.10 ± 1.81	70.07 ± 0.81	72.76 ± 0.81
	G	72.13 ± 1.33	76.43 ± 0.87	73.17 ± 0.91
	MEAN	68.12 ± 1.38[a]	73.14 ± 0.86[a]	72.98 ± 0.21[a]
Ether Extract	H	69.07 ± 1.15	72.19 ± 0.94	66.50 ± 1.41
	G	74.67 ± 2.17	70.43 ± 0.87	71.30 ± 1.43
	MEAN	71.96 ± 0.96[a]	71.31 ± 0.77[a]	69.0 ± 1.09[a]
Crude — Fibre	H	71.14 ± 0.93	64.41 ± 0.94	62.50 ± 0.66
	G	76.38 ± 0.62	63.32 ± 1.15	64.56 ± 1.60
	MEAN	73.45 ± 0.74[a]	63.87 ± 1.14[a]	63.53 ± 0.87[a]
Nitrogen-Free-Extractives	H	57.76 ± 1.85	57.95 ± 0.92	62.88 ± 0.52
	G	71.26 ± 2.12	68.29 ± 1.88	69.26 ± 1.88
	MEAN	66.79 ± 1.32[a]	62.87 ± 1.35[a]	66.07 ± 0.95[a]
Energy	H	80.23 ± 0.74	78.87 ± 0.55	76.20 ± 0.40
	G	86.70 ± 0.49	71.01 ± 0.61	76.42 ± 1.22
	MEAN	84.32 ± 0.59[a]	74.94 ± 1.17	76.32 ± 0.12[a]

H = Grass hay; G = Fresh grass.
Figures in the same row followed by the same letter are not statistically different.

TABLE 3

*Coefficients of Apparent Digestibility (%) of Giant Star Grass *(C. nlemfuensis var robustus)* Hay and Fresh Grass Plus Groundnut Cake

Nutrient		*White-Fulani*	*German Brown X N'Dama*	*German Brown*
Dry Matter	H+S	68.72 ± 0.92	61.42 ± 1.17	67.32 ± 0.53
	G+S	74.87 ± 0.60	64.45 ± 1.26	71.03 ± 0.60
	MEAN	71.79 ± 0.90[a]	62.94 ± 0.90[b]	69.11 ± 0.55[a]
Organic Matter	H+S	69.62 ± 0.91	62.67 ± 0.98	67.64 ± 0.44
	G+S	77.02 ± 0.55	67.45 ± 1.18	71.62 ± 0.60
	MEAN	73.32 ± 0.56[a]	65.06 ± 0.90[b]	69.63 ± 0.55[a]
Crude Protein	H+S	77.36 ± 1.22	79.59 ± 1.08	77.63 ± 0.36
	G+S	75.44 ± 0.73	77.37 ± 0.65	79.43 ± 0.39
	MEAN	76.40 ± 0.96[a]	78.47 ± 0.66[a]	78.53 ± 0.32[a]
Ether Extract	H+S	79.59 ± 0.96	77.26 ± 1.75	77.78 ± 0.56
	G+S	78.51 ± 0.66	82.23 ± 1.01	80.88 ± 0.84
	MEAN	79.05 ± 0.98[a]	80.01 ± 1.14[a]	79.33 ± 0.59[a]
Crude Fibre	H+S	73.96 ± 0.96	68.11 ± 0.88	65.30 ± 0.98
	G+S	78.54 ± 0.51	68.89 ± 1.39	65.86 ± 0.97
	MEAN	76.26 ± 0.89[a]	68.50 ± 0.81[b]	65.43 ± 0.67[b]
Nitrogen-Free Extractives	H+S	66.27 ± 1.01	59.46 ± 1.18	68.76 ± 0.61
	G+S	75.77 ± 0.57	70.11 ± 1.30	72.16 ± 0.71
	MEAN	71.02 ± 1.14[a]	67.28 ± 1.02[a]	70.44 ± 0.58[a]
Energy	H+S	82.14 ± 0.55	79.26 ± 0.64	79.23 ± 0.54
	G+S	89.62 ± 0.69	78.27 ± 1.09	81.28 ± 0.46
	MEAN	85.88 ± 0.56[a]	78.76 ± 0.54[a]	80.26 ± 0.41[a]

* = Mean values from 12 determinations for 4 steers.
H+S = Hay plus GNC supplement.
Figures in the same row followed by the same letter are not statistically different.

TABLE 4

*Coefficients of Apparent Digestibility (%) of Groundnut Cake Supplement

Nutrient		*White Fulani*	*German Brown X N'Dama*	*German Brown*
Dry Matter	H	77.05 ± 2.01	68.59 ± 2.76	72.14 ± 1.62
	G	77.59 ± 3.78	73.86 ± 2.65	74.43 ± 2.09
	MEAN	77.32 ± 0.27[c]	71.25 ± 2.70[c]	73.29 ± 1.15[c]
Organic Matter	H	71.14 ± 1.03	69.43 ± 2.85	74.35 ± 1.88
	G	79.25 ± 1.14	77.42 ± 1.36	77.81 ± 1.98
	MEAN	75.20 ± 1.64[c]	73.43 ± 1.96[c]	76.08 ± 1.23[c]
Crude Protein	H	78.29 ± 1.22	88.05 ± 2.33	86.11 ± 1.27
	G	79.62 ± 1.85	78.55 ± 2.97	83.11 ± 1.57
	MEAN	78.96 ± 0.67[c]	83.31 ± 2.01[c]	84.61 ± 1.03[c]
Ether — Extractives	H	81.55 ± 1.33	79.74 ± 2.95	82.57 ± 0.47
	G	79.53 ± 1.94	87.26 ± 0.84	86.79 ± 1.43
	MEAN	80.54 ± 1.01[c]	83,50 ± 1.74[c]	84.68 ± 2.11[c]
Crude Fibre	H	79.02 ± 1.75	74.13 ± 2.37	73.19 ± 1.27
	G	76.25 ± 2.36	75.32 ± 2.25	79.32 ± 2.43

crude fibre content of the all-roughage and groundnut cake supplement mixtures. The mean apparent digestibility coefficients of 76.26 ± 0.89%; 68.56 ± 0.81% and 65.43 ± 0.67% for the WF, crossbred and GB steers respectively were significantly different ($P < 0.05$). The values for the supplementary ration showed no significant differences. The values were 77.64 ± 1.34% (WF), 76.26 ± 1.31% (GB) and 74.73 ± 2.12% (GB × N'D) steers respectively.

The mean apparent coefficients of NFE digestibility of the basal ration plus the supplement and of the supplementary groundnut cake alone were quite high and followed similar patterns as those of DM digestibility. There were however no significant differences among the breeds as well as between treatments either when the total rations or the supplement alone were considered. Value obtained for the basal plus the supplement rations were 71.02 ± 1.14%; 70.44 ± 0.58% and 67.28 + 1.02% for the WF, GB and crossbred steers respectively. While for the GNC supplement were 80.28 ± 1.04%, 74.23 ± 1.14%, and 72.89 + 1.66% for the GB; WF and crossbred steers.

There were no statistical differences in the digestibility of energy among breeds either with the basal rations plus the supplement or with the supplement alone. The values obtained were high for either type of ration; and ranged from 78.76 ± 0.54% to 85.88 ± 0.56% and from 82.18 ± 2.17% to 87.49 ± 1.66% for the total ration (basal + supplement) and the GNC supplement respectively.

In Tables 5 and 6 are shown the mean DM intake (kg/day) and N-intake (g/day) and the regression equations relating the DM intake (Y) (kg/day) and the N-intake (X) (g/day). The values in Table 5 indicate that more of both DM and N were consumed from the fresh grass supplemented ration than from the corresponding hay supplemented ration. The mean Dry Matter intake was about the same for both the WF and GB breeds with either breed consuming approximately

TABLE 5

Mean DM Intake (kg/day) and N-intake (g/day) of Steers Fed Grass Hay and Fresh Grass of C.nlemfuensis var Robustus Supplemented with Groundnut Cake

Breeds	*White-Fulani*		*G. Brown X N'Dama*		*German Brown*	
Treatments	*DM-Intake kg/DAY*	*N-Intake g/day*	*DM-Intake kg/day*	*N-Intake g/day*	*DM-Intake kg/day*	*N-Intake g/day*
H + S	3.82 + 0.07	90.44 + 4.63	3.84 + 0.18	99.16 + 3.69	4.43 + 0.05	122.77 + 2.80
G + S	5.62 + 0.11	128.58 + 4.23	4.64 + 0.10	108.11 + 4.95	5.00 + 0.11	127.51 + 4.17
MEAN	4.72 + 0.20	109.51 + 5.02	4.24 + 0.11	103.64 + 3.16	4.71 + 0.09	125.51 + 2.51

H + S = Hay plus supplement, G + S = Fresh grass plus supplement.

TABLE 6

Regression Equations Describing the Relationships Between DM Intake (Y), (kg/Day) and Nitrogen Intake (X) (g/Day) of Steers Maintained on Grass Hay and Fresh Grass of (C. nlemfuensis var robustus) Supplemented with Groundnut Cake

Breeds	*Regression Equations*	*Correlation Coefficient*	*Standard Error*
White Fulani	$Y = 0.03 \times + 1.07$	0.85**	0.20
German Brown X N'dama	$Y = 0.02 \times + 2.01$	0.64*	0.11
German Brown	$Y = 0.02 \times + 2.00$	0.63*	0.09

* = ($P < 0.05$) ** = ($P < 0.01$)

10% more than the crossbred animals. However, the GB steers consumed about 14.6% more N than the WF and the latter approximately 5.7% more than the crossbred animals. The results also indicate that DM intake was positively correlated with N-intake and correlation coefficients of 0.85; 0.64 and 0.63 recorded for the indigenous; the crossbred and the German Brown cattle were each statistically significant ($P < 0.05$).

Whilst the total DM and N-intake from the all-roughage plus the supplement rations increased in all the breeds of cattle, the values being 4.72 ± 0.20; 4.24 ± 0.11 and 4.71 ± 0.99kg DM/day and 109.51 ± 5.02; 103.64 ± 3.16 and 125.51 ± 2.51gN/day for the WF; crossbred and German Brown steers respectively, the DM intake from the all-roughage alone in the all-roughage plus the supplement rations decreased by 13.14%; 1.87% and 6.44% in these animals respectively.

Results of the average daily liveweight gains of the experimental animals showed that all the steers increased their daily gain with supplementation of the all-roughage diets with groundnut cake. The increases in the daily liveweight gain over the values obtained with the all-roughage rations were 18.92%, 13.15% and 16.27% for the indigenous, crossbred and exotic cattle breeds respectively.

The mean daily liveweight increase of 426g on both hay and fresh-grass — GNC supplemented rations by the GB × N'Dama steers is approximately 4.7% higher than the mean daily liveweight of 407g of the WF steers but approximately 0.5% above that of the German Brown steers of 424g.

Table 7 shows the Total Digestible Nutrients (TDN) and Metabolizable Energy (ME) intake expressed as kg/Wkg$^{0.75}$ and Kcal/Wkg$^{0.75}$ respectively from both the supplemented rations and the supplement alone.

TABLE 7

Total Digestible Nutrients (TDN) kg/Wkg$^{0.75}$ and Metabolizable Energy (ME) MCAL/Wkg$^{0.75}$ Intake of Gaint Star Grass (C. nlemfuensis var robustus) Hay and Fresh Grass Plus Groundnut Cake Supplement and Supplement Fed to Experimental Cattle

Nutrients		*White Fulani*		*German Brown X N'dama*		*German Brown*	
		A	**B**	**A**	**B**	**A**	**B**
Total Digestible Nutrients TDN kg/W$^{0.75}$	H + S	0.054	0.074	0.042	0.084	0.052	0.086
	G + S	0.074	0.083	0.058	0.080	0.061	0.094
	MEAN	0.064 ± 0.01	0.079 ± 0.005	0.050 ± 0.008	0.082 ± 0.002	0.057 ± 0.004	0.09 ± 0.004
Metabolizable Energy ME KCAL/Wkg$^{0.75}$	H + S	195.13	267.54	151.85	303.40	188.03	310.93
	G + S	267.54	300.08	211.70	289.24	220.54	339.85
	MEAN	231.34 ± 36.21	283.81 ± 16.22	181.78 ± 29.93	296.47 ± 7.23	204.29 ± 16.26	325.39 ± 14.26

A = Basal ration + Supplement
B = GNC supplement alone
H + S = Grass hay + groundnut cake supplement.
G + S = Fresh grass plus groundnut cake supplement.

The TDN values were converted to the ME by using Jaqusch and Coop's (1971) conversion formula.

With the all-roughage plus the GNC supplement, the highest TDN values of 0.064 ± 0.01kg/Wkg$^{0.75}$ and 231.34 ± 36.21 Kcal. ME/Wkg$^{0.75}$ were recorded with the indigenous steers. Higher values were recorded with the exotic steers than with the Crossbred steers in both the TDN and ME intake. The values were 0.058 ± 0.004 and 0.050 ± O.008kg/Wkg$^{0.75}$ and 204.29 ± 16.26 and 181.78 + 29.93Kcal/ Wkg$^{0.75}$ for these animals respectively. There were no significant differences among the breeds either in terms of TDN or ME intake.

The values for TDN and ME intake from the supplement alone showed the highest values with the exotic animals. Similar values were recorded for the crossbred and the indigenous steers respectively. There were also no significant differences among the breeds in their intake from the supplement alone.

DISCUSSION

The chemical compositions of the hay and fresh grass fed in the present study are very similar to those of the hay and fresh grass rations fed in an earlier study (Ikhatua, Olubajo; Adeleye and Oyenuga (1978).

The results of this study showed that supplementation of all-hay or fresh grass ration with high protein concentrate (GNC) led to higher but non-significant intake and digestibility of both DM and nutrients by the experimental animals.

The improvement in the digestibility of the DM as well as the nutrients could be attributed to the higher intake of both DM and nutrients brought about by more intake of these components from the supplement. The observed increase in nutrient digestibility by the experimental animals on supplementation is in agreement with reports of Robinson and Forbes (1970), Andrews and Qrskov (1970) who reported increased digestibility with increasing intake of crude protein. It is also in accord with reports of Musangi, Holmes and Jones (1965) that concentrate supplements improved the overall digestibility of the diet by as much as 2—3 digestibility units.

The increased but non-significant digestibility of most nutrients with supplementation is also in accordance with the observation of Elliot and Loosli (1959) that the digestibilities of feed components were not signficantly affected by the proportions of concentrate supplementation to the rough-age in the rations.

The recorded increase in the total DM and N-intake from the all-roughage supplemented rations agrees with similar findings by Egan (1965) who attributed such increase that occurred when protein supplements were given to sheep offered low protein roughage to an improvement on the protein status of the animals. This is also in accordance with the observations of Knox and Ward (1961).

The decline in the DM intake of either hay or fresh grass from the all-roughage supplemented rations is in agreement with the reports of Campling (1965) and Murdoch (1967). They reported a gradual decrease in hay intake alone in hay-concentrate supplemented rations.

The increased intake of Total Digestible Nutrients (TDN) and Metabolizable Energy (ME) with the addition of GNC supplement to the all-roughage rations agrees with what nas been reported elsewhere in the literature. Elliot, (1967a, b) reported increasd intake of Total Digestible Nutrients (TDN) and Digestible Energy (DE) with sheep and cattle fed concentrate with adequate protein along with poor quality hay. The increases in the average daily liveweight gain with supplementation of the all-roughage rations are also in line with the findings reported with cattle by Winchester and Harvay (1966).

In conclusion, therefore, since there was no improvement on the intake of grass — either in the hay or fresh form, but on the total intake of DM with supplementation, which means in effect that less of the roughage was consumed at the expense of the concentrate, and considering the cost of protein concentrate (GNC) in relation to the extra liveweight increases above the gain with the all-roughage rations, there may be the need to supplement the local forage with a source of cheap energy along with the high protein concentrate.

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