

INFLUENCE OF CONCENTRATE SUPPLEMENTATION WITH BROWSE PLANT (*GLIRICIDIA SEPIUM*) ON NUTRIENT UTILIZATION AND GROWTH OF THE WEST AFRICAN DWARF (*FOUTA DJALLON*) KIDS

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SUMMARY

TWELVE West African dwarf (*Fouta Djallon*) kids, 4 to 6 months of age and weighing between 5.96 and 7.24kg, were used in the study of three dietary treatments involving a basal diet of browse plant (*gliricidia Sepium*) supplemented with concentrate feed at 25 and 50% levels of dry matter intake to appetite. The diets were fed for a period of three months in order to estimate nutrient intake and utilization, protein and energy requirements including growth performances of the kids.

Kids maintained on *gliricidia sepium* alone (G100C0) needed significantly ($P/0.05$) more dry matter (DM) consumption to appetite (294.66 ± 14.941 g/day) than kids maintained on either 75% *gliricidia sepium* plus 25% concentrate (G75 C25) or 50% *gliricidia sepium* plus 50% concentrate (GC)₅₀ (236.26 ± 0.385 kg) than either kids on treatments G100C0 or (GC)₅₀ (6.84 ± 0.214 and 6.92 ± 0.313 kg respectively). DM intake as a percentage of liveweight was about $3.60 \pm 0.237\%$.

The kids were in positive nitrogen balance and the nitrogen retention value ranged from 31.36 ± 1.633 to $50.22 \pm 0.994\%$. Metabolic faecal nitrogen (MFN) and endogenous urinary nitrogen (ENU) were 0.232 ± 0.005 g/100g DM intake and 0.070 g/day $W_{kg}^{0.734}$ respectively. The biological value (BV) of the diets ranged from 56.79 to 75.62%. The digestible crude protein (DCP) requirement for maintenance was 0.853 ± 0.133 g/day $W_{kg}^{0.734}$ while the DCP requirement for liveweight gain was 0.030 ± 0.001 g/day/ $W_{kg}^{0.734}$ per g of liveweight gain. The digestible energy (DE) and metabolizable (ME) energy requirements for maintenance were 124.42 ± 3.274 kcal/day/ $W_{kg}^{0.734}$ and 100.78 ± 4.588 kcal/day/ $W_{kg}^{0.734}$ respectively.

Results showed that the utilization of the browse plant (*gliricidia sepium*) by the kids was best when fed at 75% browse plus 25% concentrate.

INTRODUCTION

Gliricidia sepium is a perennial

leguminous browse plant which originated from South America. It is widely established in many tropical countries; it is fast growing and is able to thrive on low fertile soils (Whyte, Nilsson, Leissner and Trumble, 1959). The importance of browse plants as sources of protein and energy to ruminants particularly during the dry season of the year has been extensively discussed (Wilson, 1969; Mcleod, 1973; National Academy of Science, 1979; Rose-Innes, 1964; Short and Reagor, 1970; Singh, Punj, Kochar and Bhatia, 1972; Oh, Jones and Longhurst, 1968; Gartner and Hurwood, 1976 and Short, Blair and Epps Jr., 1973). However, browse plants alone cannot constitute a complete feed when fed alone; they should be given adequate attention in the feeding management of goats (Sidahoned, Morris, Koong and Radosevich, 1981b). Information available in the literature with regards to the utilization of *Gliricidia Sepium* by West African dwarf kids is very scanty.

This experiment was therefore designed to study the effects of supplementation of concentrate feed to basal browse plant diet (*Gliricidia Sepium*) on nutrient intake and utilization, protein and energy requirement and growth performances of West African dwarf (*Fouta Djallon*) kids.

MATERIALS AND METHODS

Twelve West African dwarf (*Fouta Djallon*) kids between 4 to 6 months of

age, weighing between 5.96 to 7.24 kg were fed on three dietary treatments in order to study the dry matter intake, nutrient utilization and growth performance of the kids.

The experimental diets comprised basal browse plant (*gliricidia sepium*) supplemented with concentrate feed at 25% and 50% of dry matter intake (browse plant) to appetite. The concentrate feed comprised 55% cassava flour, 36% dried brewer's grain, 5% non-dehydrated molasses, 2.5% urea, 1% common salt and 0.5% vitamin/mineral mixture.

Four kids (two males and two females) were randomly assigned to each of three dietary treatments. Kids on treatment (i) were fed the basal browse plant (*Gliricidia sepium*) alone and was designated as treatment $G_{100}C_0$. Kids on treatment (ii) were fed 75% browse plant plus 25% concentrate feeds and was designated as treatment $G_{75}C_{25}$. Kids on treatment (iii) were fed 50% browse plant plus 50% concentrate feeds and was designated as treatment $(GC)_{50}$.

The mean of dry matter intake of the browse plant, *gliricidia sepium*, to appetite by kids on treatment $G_{100}C_0$ was used to estimate the various levels of concentrate feed supplementation for kids on treatments $G_{75}C_{25}$ and $(GC)_{50}$. The kids were fed their respective diets for three months during which feed intake were measured. The kids were fed once a day at 8.00 hours and were weighed once a week before the morning feed. The kids had free access to fresh water supply and salt lick. At the end of three months on the diets, the kids were transferred to individual metabolism cages to study the digestibility and utilization of these experimental diets.

COLLECTION OF FAECES AND URINE

Total faeces voided were collected from each of the kids during the 7-day collection period, before the morning feed. The total faeces collected were weighed and dried in a

forced draught oven at 80°C for 24 hours. The daily samples were bulked for each kid at the end of the collection period and reweighed. The faeces were then milled and stored in air-tight bottles at room temperature until required for chemical analysis.

The urine output by each kid during the collection period was collected every morning in collection bottles which had been previously wetted with 3 ml of 10% mercuric chloride solution to preserve the urine. The daily output of urine was recorded while 10% of this volume were retained and stored in deep freeze at -5°C. At the end of the collection period, the daily samples were then bulked for each kid and stored at -5°C until required for chemical analysis.

ANALYTICAL PROCEDURE

The concentrate feed, browse plant faeces and urine were analysed for proximate principles by the procedure of AOAC (1970).

The metabolic faecal nitrogen content of the milled faecal samples were determined according to the methods of Van Soest and Wine (1967) as modified by Mason (1969) and from regression equation (Titus, 1927; Mitchell and Bert, 1954).

The energy content of the samples of feed, faeces and browse plant and urine were determined using a ballistic Bomb calorimeter (A. Gallenkamp, London).

RESULTS

The summary of dry matter (DM) consumption by the West African dwarf kids is shown in Table 1. The mean daily DM intakes were significantly ($P/0.01$) different from one another. Kids maintained on the basal browse plant treatment without concentrate ($G_{100}C_0$) consumed significantly ($P/0.05$) more DM per day than those on 75% browse plus 25% concentrate ($G_{75}C_{25}$) and 50% browse plus 50% concentrate ($(GC)_{50}$). When the mean DM consumptions were expressed on metabolic size ($\text{g/dayW}_{\text{kg}}^{0.734}$) these were again significantly ($P<0.01$) different from one another. The DM intake as a percentage of

TABLE 1

Dry matter (DM) consumption by West African Dwarf (*Fouta Djallon*) maintained on three dietary treatments.

	T R E A T M E N T		
	G 100Co	G75 C25	(GC) 50
Mean liveweight (kg)	6.910 ± 0.241	7.34 ± 0.408	7.09 ± 0.362
Mean liveweight ($W_{kg}^{0.734}$)	4.132 ± 0.105	4.317 ± 0.176	4.208 ± 0.157
Dry matter (DM) Consumption from <i>gliricidia sepium</i> g/day	294.66 ± 14.941	178.96 ± 14.312	199.17 ± 4.741
Dry matter (DM) consumption from concentrate g/day	—	57.30 ± 0.00	144.60 ± 0.00
Total Dry matter intake g/day	294.66 ± 14.94	236.26 ± 14.312 ^b	233.77 ± 4.741 ^b
Total Dry matter consumption as % of mean liveweight	4.269 ± 0.230	3.23 ± 0.266	3.31 ± 0.171
Total Dry matter consumption/ $W_{kg}^{0.734}$	74.33 ± 3.594 ^a	54.81 ± 3.970 ^b	55.64 ± 2.267 ^b
Dry matter consumption/100kg liveweight	2095.72 ± 106.754	1610.13 ± 116.625	1634.51 ± 66.60

Mean values with same superscript in a row are not significant ($P > 0.05$) — No concentrate feed was offered.

liveweight across all the treatment groups was about $3.60 \pm 0.334\%$.

The summary of nutrient intake and digestibility by the kids are presented in Table 2. Dry matter, organic matter, crude protein, crude fibre, ether extract and gross energy consumptions per day were significantly ($P < 0.05$) highest for kids maintained on treatment $G_{100}C_0$ and which was significantly ($P > 0.05$) higher than the figure for kids on treatment $G_{75}C_{25}$.

The mean crude protein (CP) consumption per day decreased with increasing level of concentrate supplement in the diet while crude fibre (CF) and cellulose intake increased with increasing levels of browse plant in the diet.

There were no significant ($P > 0.05$) differences, between the dry matter (DM), Organic matter (OM) gross energy (GE) and CP digestibilities of the three diets. However, the OM digestibility coefficients increased with increasing level of concentrate supplementation. The CF digestibility coefficient

increased with increasing level of browse in the diet, whereas the digestibilities of ether extract (EE) and nitrogen free extract (NFE) were highest at the maximum level of concentrate supplementation in the diets.

The summary of nitrogen (N) intake and utilization by the West African dwarf kids are shown in Table 3. The mean dietary N consumption by kids on treatment $G_{100}C_0$ was slightly higher than the consumption figures for kids on treatments $G_{75}C_{25}$ and $(GC)_{50}$, but the differences were not significant ($P > 0.05$).

The mean faecal N output (g/day) were significantly ($P < 0.05$) greater for kids on treatment $G_{100}C_0$ than for those on treatments $G_{75}C_{25}$ and $(GC)_{50}$. Thus higher faecal-N output by kids on treatment $G_{100}C_0$ reflected a higher N-intake by these kids.

Kids on treatment $G_{100}C_0$ excreted significantly ($P < 0.05$) more nitrogen in the urine than kids maintained on treatment

TABLE 2

Nutrient intake and digestibility for West African Dwarf (*Fouta Djallon*) kids maintained on three dietary treatments.

	TREATMENT		
	G100Co	G75 C25	(GC) 50
Dry matter (DM) intake g/day	294.66 ± 14.941	178.96 ± 14.312	119.17 ± 4.741
Dry matter digestibility %	61.73 ± 2.535	59.79 ± 3.266	65.11 ± 4.741
Organic matter (OM) intake g/day	253.97 ± 12.88 ^a	207.05 ± 12.416 ^b	208.15 ± 4.087 ^b
Organic matter digestibility %	57.49 ± 7.784	62.34 ± 3.184	67.56 ± 1.135
Crude Protein (CP) intake g/day	57.00 ± 2.910 ^a	48.05 ± 2.80 ^b	43.72 ± 0.921 ^b
Crude Protein digestibility %	59.61 ± 1.981	62.12 ± 1.718	60.91 ± 0.608
Crude Fibre (CF) intake g/day	81.89 ± 4.151 ^a	58.71 ± 3.957 ^b	51.12 ± 1.314 ^c
Crude Fibre digestibility %	71.00 ± 1.766 ^a	69.26 ± 2.677 ^a	62.15 ± 1.129 ^b
Ether Extract (EE) intake g/day	24.05 ± 1.218 ^a	17.11 ± 1.146 ^b	15.60 ± 0.377 ^b
Ether Extract digestibility %	50.00 ± 8.881 ^b	49.70 ± 5.305 ^b	69.45 ± 1.936 ^a
Nitrogen Free Extract (NFE) intake g/day	91.05 ± 4.816 ^b	83.16 ± 4.482 ^c	98 ± 1.470 ^a
Nitrogen Free Extract digestibility %	74.83 ± 5.933 ^b	84.89 ± 0.891 ^a	78.43 ± 2.883 ^a
Hemicellulose intake g/day	47.68 ± 2.338 ^a	39.70 ± 2.259 ^b	40.82 ± 0.754 ^b
Hemicellulose digestibility %	63.24 ± 6.182 ^b	60.17 ± 6.654 ^b	73.05 ± 2.919 ^a
Cellulose intake g/day	54.78 ± 2.776 ^a	35.06 ± 2.641 ^b	25.75 ± 0.882 ^c
Cellulose digestibility %	69.36 ± 3.259 ^a	56.80 ± 5.708 ^b	66.14 ± 3.828 ^a
Gross energy (GE) intake kcal/day	1370.06 ± 42.860	1286.41 ± 91.560	1266.15 ± 30.000
Gross energy digestibility %	50.03 ± 4.330	47.46 ± 2.600	53.40 ± 0.770

Mean values with same superscript in a row are not significant ($P > 0.05$)

G100Co = *Gliciridia sepium* Ad-Lib.

G75 (25 = 75% *Gliciridia sepium* plus 25% concentrate

(GC) 50 = 50% *Gliciridia sepium* plus 50% concentrate.

G₇₅C₂₅ and (GC)₅₀. All kids were in positive nitrogen balance and nitrogen retention values ranged from 31.36 ± 1.633 to 5.22 ± 0.994%.

Comparison of metabolic faecal nitrogen (MFN) values obtained from regression equation (Titus, 1927; Mitchell and Bert, 1954) and by chemical method of neutral detergent technique (Van Soest and Wines, 1967) as modified by Mason (1969) using "t" test showed significant ($P > 0.05$) differences. The mean of the two sets of values were used for subsequent calculations and were 0.237 ± 0.006, 0.239 ± 0.002 and 0.221 ± 0.001 g/100 g DM consumed for kids maintained on treatments G₁₀₀Co, G₇₅C₂₅ and (GC)₅₀ respectively.

$$Y_{G_{100}Co} = 0.060 + 0.378 X_r = 82^{**}, SE = 0.029$$

$$Y_{G_{75}C_{25}} = 0.107 + 0.278 X_r = 83^{**}; SE = 0.017$$

$$Y_{(GC)50} = 0.041 + 0.179 X_r = 87^{**}, SE = 0.002$$

The regression of urinary-N (Y) on absorbed-N (X) both expressed in g/day/W_{kg}^{0.734} showed a highly significant ($P < 0.01$) degree of correlation. The relationships were described by:

The values of 0.060, 0.107 and 0.041 (g/day/W_{kg}^{0.734}) were the endogenous urinary nitrogen (EUN) obtained for kids on treatments G₁₀₀Co, G₇₅C₂₅ and (GC)₅₀ respectively. These EUN values represent the urinary-N excreted at zero-N absorption.

The biological values (BV) of the rations were estimated by regression method and by Thomas-Mitchell (1924) formula (a) Regression of N-balance (g/day/W_{kg}^{0.734}), Y) on absorbed N (g/day/W_{kg}^{0.734}), X.

The relationships were described by

TABLE 3

Nitrogen metabolism for West African dwarf kids maintained on *Gliricidia sepium ad-lib.* (G 100Co), 75% *Gliricidia sepium* plus 25% concentrate (G75 C25), 50% *Gliricidia sepium* plus 50% concentrate (GC) 50.

	T R E A T M E N T		
	G100Co	G75 C25	(GC) 50
Mean liveweight (kg)	6.91 ± 0.241	7.34 ± 0.408	7.09 ± 0.362
Mean liveweight (W _{kg} ^{0.734})	4.13 ± 0.105	4.32 ± 0.178	4.21 ± 0.159
N-Metabolism (g/day)			
N-intake	9.21 ± 0.465	7.69 ± 0.448	7.0 ± 0.147
Faecal -N	3.69 ± 0.352	2.60 ± 0.233	2.40 ± 0.086
Urinary-N	2.57 ± 0.109	2.06 ± 0.322	1.09 ± 0.050
Absorbed-N	6.14 ± 0.196	5.75 ± 0.261	5.11 ± 0.093
N-balance	2.86 ± 0.136	3.12 ± 0.301	3.51 ± 0.128
N-Retention (%)	31.36 ± 1.633	40.61 ± 3.386	50.22 ± 0.994
N-intake (g/day/W _{kg} ^{0.734})	2.21 ± 0.094	1.78 ± 0.127	1.66 ± 0.069
Absorbed N (g/day/W _{kg} ^{0.734})	1.49 ± 0.060 ^a	1.33 ± 0.074 ^b	1.22 ± 0.042 ^b
Urinary-N "	0.62 ± 0.32	0.48 ± 0.073	0.26 ± 0.016
N-balance (g/day/W _{kg} ^{0.734})	0.69 ± 0.042	0.72 ± 0.084	0.84 ± 0.038
Faecal-N (g/100g DM consumed)	1.25 ± 0.071	1.06 ± 0.058	1.03 ± 0.018
Metabolic Faecal-N (HFN) (g/100 DH consumed)	0.241 ± 0.004	0.240 ± 0.003	0.221 ± 0.006
Metabolic Faecal-N (HFN) (g/day)	0.711 ± 0.37	0.565 ± 0.039	0.515 ± 0.010

Means with same superscripts in a row are not significant (P 0.05).

$$Y_{G100Co} = 0.115 + 0.5439 X r = 89^{**}; SE = 0.069$$

$$Y_{G75C25} = 0.062 + 0.5897 X r = 81^{**}; SE = 0.017$$

$$Y_{(GC)50} = 0.036 + 0.7165 X r = 90^{**}; SE = 0.048$$

A highly significant (P<0.01) degree of correlation were obtained between the variates. The gradient of the lines relating N-balance (g/day/W_{kg}^{0.734}) to absorbed-N (g/day/W_{kg}^{0.734}) represented the BV and which were 54.39, 58.97 and 71.66% for kids maintained on treatments G_{100Co}, G_{75C25} and (GC)₅₀ respectively.

Application of "t" test showed no significant (P > 0.05) differences between the two sets of BV and their means of 56.79, 62.49 and 75.62% for kids on treatment G_{100Co}, G_{75C25} and (GC)₅₀ respectively were used in subsequent calculations.

Digestible crude protein (DCP) requirement for maintenance were calculated by three methods (Table 4) based on regression equations and by factorial method (ARC, 1965).

The DCP requirements for maintenance

obtained from the three methods described above were not significantly (P 0.05) different from one another. The three set of values were then pooled and their means were 1.124 ± 0.228, 0.876 ± 0.286 and 0.560 ± 0.110 g/day/W_{kg}^{0.734} for kids on treatments G_{100Co}, G_{75C25} and (GC)₅₀ respectively.

The DCP intake g/day/W_{kg}^{0.734} (Y) were correlated with live-weight gain g/day, (X) (Table 5). The coefficients of "X" which represent the DCP requirement per g of liveweight gain were 0.018 g/day/W_{kg}^{0.734} for kids maintained on treatment G_{100Co}, weighing 6.91 ± 0.24/kg and gaining 27 ± 0.007 g/day with a corresponding DCP intake of 8.22 ± 0.379 g/day/W_{kg}^{0.734}. Kids maintained on treatment G_{75C25}, weighing 7.34 ± 0.120kg and gaining 37.00 ± 6.00 g/day required 0.045 g

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TABLE 4

Mean digestible crude protein (DC) requirement for maintenance from three methods for West African Dwarf (*Fouta Djallon*) kids maintained on *Gliricidia sepium ad-lib*. (C100Co), 75% *Gliricidia sepium* and 25% concentrate (G75 C25) and on 50% *Gliricidia sepium* and 50% concentrate (GC)50

Treatment	Regression of NB (y) on AN (x) g/day/ $W_{kg}^{0.734}$	Regression of NB (y) or NI (x) g/day/ $W_{kg}^{0.734}$	Factorial method (ARC) g/day/ $W_{kg}^{0.734}$	Mean DCP requirement for maintenance g/day/ $W_{kg}^{0.734}$
G 100 Co	1.319	0.574	1.478	1.124 ± 0.228
G 75 C25	0.657	0.408	1.562	0.876 ± 0.286
(GC) 50	0.314	0.780	0.587	0.560 ± 0.110

TABLE 5

Relationship between DCP intake (g/day/ $W_{kg}^{0.734}$) (y) and change in liveweight (g/day) (x) with estimate of g DCP/day/ $W_{kg}^{0.734}$ requirements for West African Dwarf (*Fouta Djallon*) kids maintained on (*Gliricidia sepium ad-lib* (G100 Co), on 75% (*Gliricidia sepium* and 25% concentrate (G75 C25), and on 50% *Gliricidia sepium* and 50% concentrate (GC) 50.

Treatment	Average initial Live-weight	average final Liveweight	liveweight change(x) g/day	DCP intake (y) g/day/ $W_{kg}^{0.734}$	Regression Equation	Correlation Coefficient	SE	DCP requirement for gain g/day/ $W_{kg}^{0.734}$
G 100 Co	6.84 ± 0.218	6.98 ± 0.275	27.00 ± 7.00	8.22 ± 0.377	y=6.728+0.018x	0.36 ^{na}	0.004	0.018
G75 C25	7.22 ± 0.385	7.46 ± 0.431	37.00 ± 6.00	6.92 ± 0.440	y=4.905 ± 0.058x	0.93 ^{xx}	0.002	0.053
(GC)50	6.92 ± 0.343	7.26 ± 0.384	49.00 ± 12.00	6.33 ± 0.242	y=5.526 ± 0.01yx	0.94 ^{xx}	0.0014	0.017

DCP/day/ $W_{kg}^{0.734}$ per g of live weight gain or the equivalence of 7.00 ± 0.444g DCP intake/day/ $W_{kg}^{0.734}$. The $W_{kg}^{0.734}$ kids on treatment (GC)₅₀ weighing 7.09 + 0.170kg and were gaining at the rate of 49.00 ± 12.00 g/day required 0.016g DCP/day/ $W_{kg}^{0.734}$ per g of liveweight gain or the equivalence of 6.33 ± 0.207 g DCKP intake day/ $W_{kg}^{0.734}$. The regression of (Y) digestible energy (DE) intake (kcal/day/ $W_{kg}^{0.734}$) on (X) liveweight gain (kg/day) were estimated as:

The correlation coefficients (r) were significant (P<0.01). The DE intake at Zero liveweight change gave the DE (Kcal/day/ $W_{kg}^{0.734}$ requirement for maintenance. The constant terms 126.57 ± 0.009, 116.65 ± 0.079 and 130.03 ± 0.014 were values of DE required for maintenance by the kids maintained on treatments G₁₀₀Co, G₇₅C₂₅ and (GC)₅₀ respectively giving an overall mean of 124.42 + 3.274 kcal/day/ $W_{kg}^{0.734}$.

The relationship between (Y)

$$Y_{G100Co} = 126.57 \pm 1.432 \quad X \quad r = 83^{**}; \quad SE = 0.009$$

$$Y_{G100Co} = 116.65 \pm 706.58 \quad X \quad r = 82^{**}; \quad SE = 0.079$$

$$Y_{(GC)50} = 130.03 \pm 635.34 \quad X \quad r = 99^{**}; \quad SE = 0.014$$

metabolizable energy (ME) intake (kcal/day/W_{kg}^{0.734}) and (X) liveweight gain (kg/day) were estimated as:

$$Y_{G100Co} = 102.521 \pm 1160.02X \quad r = 83^{**}; \text{SE} = 0.009$$

$$Y_{G75C25} = 94.49 \pm 572.29X \quad r = 82^{**}; \text{SE} = 0.079$$

$$Y_{(GC)50} = 105.31 \pm 514.94X \quad r = 99^{**}; \text{SE} = 0.014$$

The correlation coefficients (r) were significant ($P < 0.01$). The constant terms $102.521 \pm 0.00\%$, 94.49 ± 0.079 and 105.31 ± 0.014 were the ME required for maintenance by kids on treatments G₁₀₀Co, G₇₅C₂₅ and (GC)₅₀ respectively. This gave an overall estimate of 100.78 ± 4.588 kcal/day/W_{kg}^{0.734} for maintenance.

The summary of 2-weekly liveweight of the West African dwarf kids is shown in Table 6. The dietary treatments did not affect the mean live weight of the kids significantly ($P > 0.05$) up to the 5th week, but on 7th, 9th and 11th week of the experimental period, kids on treatment G₇₅ C₂₅ were significantly ($P < 0.05$) heavier than kids on treatment G₁₀₀ Co. Kids on treatment G₇₅ C₂₅ were slightly heavier than those on treatment (GC)₅₀, but the difference was not significant ($P > 0.05$) there was no significant

At the end of the experiment (13th week), treatment G₇₅ C₂₅ were slightly heavier than kids on treatments G₁₀₀ Co and (GC) 50.

DISCUSSION

The overall mean digestible crude protein DCP for maintenance was 0.85 ± 0.282 g/day/W_{kg}^{0.734} which was in close agreement with the values of 0.76 to 0.88 g/day/W_{kg}^{0.734} for sheep reported by Webster and Wilson (1966) to 0.82 g/day/W_{kg}^{0.734} for adult Jamnapari goats obtained by Majumdar (1960a). However, the value of DCP requirement for maintenance obtained from this study was lower than the figures of 1.43 and 1.96 g/day/W_{kg}^{0.734} reported by Mba, Akinsoyinu and Olubajo (1974) for growing West African dwarf goats.

TABLE 6

2 — Weekly liveweight (kg) for West African Dwarf (Fouta Djallon) kids maintained on three dietary treatment.

Treatment	LIVE WEIGHT						
	Beginning	Week 3	Week 5	Week 7	Week 9	Week 11	Week 13
G 100Co	6.20 ± 0.23	5.67 ± 0.08	5.49 ± 0.078	5.32 ± 0.5 ^b	5.48 ± 0.12 ^b	6.00 ± 0.21 ^b	6.84 ± 0.21
G75 C25	6.63 ± 0.04	5.96 ± 0.18	6.02 ± 0.38	6.36 ± 0.41 ^a	6.66 ± 0.46 ^a	6.91 ± 0.39 ^a	7.22 ± 0.39
(GC) 50	6.22 ± 0.14	5.74 ± 0.22	5.79 ± 0.39	6.03 ± 0.44 ^a	6.28 ± 0.35 ^b	6.34 ± 0.35 ^{ab}	6.92 ± 0.32

G 100 Co: 100% *Gliciridia sepium* without supplementation

G 75 C25: 75% *Gliciridia sepium* supplemented with 25% concentrate

(GC) 50: 50 *Gliciridia sepium* supplemented with 50% concentrate

Means with some superscripts in a column are not significant ($P > 0.05$).

to 0.053 ± 0.002 with pooled mean value of 0.030 ± 0.010 . Kids maintained on treatment G₇₅C₂₅ had slightly higher DCP requirement for live weight gain which could be related to the faster rate in which these kids were growing.

The energy requirements for maintenance ranged from 116.65 to 130.03 DE kcal/day/W_{kg}^{0.734} and 94.49 to 105.31 ME kcal/day/W_{kg}^{0.734}. The DE requirements were similar to a range of 125.21 to 132.42 kcal DE/day/W_{kg}^{0.734} obtained by Awah (1981) for 52-week old West African dwarf kids, but lower than 140 kcal DE/day/W_{kg}^{0.75} recommended by NRC (1968). The ME requirements for maintenance obtained from the present work was comparable to 90.35 kcal/day/W_{kg}^{0.75} reported by Devendra (1967a) for Jamnapari goats, 92.92 kcal/day/W_{kg}^{0.734} obtained by Akinsoyinu (1974) for West African dwarf goats and 91.99 kcal/day/W_{kg}^{0.75} reported by Adu (1975) for West African dwarf sheep.

The growth of the West African dwarf kids was very slow. The kids generally lost weight soon after they were placed on the experimental diets, but they later on began to gain weight gradually to the end of the experimental period. The initial loss in weight treatments. Initially kids maintained on treatment G₇₅C₂₅ grew at about the same rate with those on treatment (GC)₅₀ but were significantly ($P/0.05$) faster than those on treatment G₁₀₀Co. However, at the end of the experiment all kids had about the same live weight due to compensatory rate at which kids on treatment G₁₀₀Co were growing.

In conclusion, the results indicated that kids maintained on treatment G₇₅C₂₅ were in each case utilizing the diet better than those on either (GC)₅₀ or G₁₀₀Co.

Kids maintained on the basal browse plant *gliricidia sepium* alone (G₁₀₀Co) consumed significantly ($P/0.05$) more dry matter (DM) per day than in other

groups. The range of DM consumption values of 233.77 ± 4.741 to 294.66 ± 14.941 g/day obtained from this study was lower than the figure 466.0 ± 101.83 g DM obtained by Carew (1981) for West African dwarf goats fed *gliricidia sepium ad lib*. The lower value reported in this paper might be due to age difference, since older animals would consume more DM per day than younger animals.

The mean DM consumption per unit metabolic size (g/day/W_{kg}^{0.734}) were high and ranged from 54.82 ± 3.97 to 71.33 ± 3.590 . These values were in close agreement with the figure of 51.06g/day/W_{kg}^{0.734} reported by Robinson and Forbes (1970) for 7-month weaned lambs, but higher than the DM intake values of 39.43 ± 1.980 to 46.67 ± 1.806 g/day/W_{kg}^{0.734} reported by Awah (1981) for 24-week old West African dwarf kids.

The DM consumption as a percentage of liveweight ranged from 3.31 ± 0.171 to $4.27 \pm 0.230\%$ giving a pooled mean value of $3.60 \pm 0.237\%$. This figure is higher than the value of $2.55 \pm 0.089\%$ reported by Awah (1981) for West African dwarf kids maintained on different levels of milk feed. The difference between these two observations might be attributed to the nature of diet fed to the kids, since solid feeds were used in this study.

Nutrients consumption per day were generally high for kids maintained on treatment G₁₀₀Co, followed by kids on treatment G₇₅C₂₅.

Kids on treatment G₇₅C₂₅ had the lowest DM digestibility coefficients (about 60%), yet they performed best in live weight gains. Kids on treatment G₁₀₀Co had slightly higher DM digestibility (about 62%), yet they were the least in live weight performances, while kids on treatment (GC)₅₀ which had the highest DM digestibility coefficient (65%) were intermediate in their liveweight performance. This observation is rather difficult to explain, but it is important to stress that kids fed the 75% *gliricidia sepium* plus

25% concentrate performed best in live weight gains despite the fact that these kids had the lowest DM digestibility coefficient.

Organic matter (OM) digestibility (mean = $62.46 \pm 2.374\%$) increased with increasing level of concentrate inclusion in the diets. This could be explained from the availability of OM from a concentrate feed than from a browse plant. On the other hand the Crude fibre (CF) digestibility coefficients increased from the range of 62.15 ± 1.129 to $71.00 \pm 1.766\%$ with increasing level of basal browse plant in the diet. These values were higher than the figure of 48.2 to 58.6% reported by Adeleye and Ikhatua (1971) for West African forest sheep fed different concentrate and grass ratios, but the figure, $79.03 \pm 4.53\%$ reported by Olubajo (1977) for West African dwarf sheep fed *panicum maximum* was higher.

The mean metabolic faecal nitrogen (MFN) were 2.32, 2.37 and 2.20 g/kg DM intake for kids maintained on treatments G₁₀₀ Co, G₇₅ C₂₅ and (GC)₅₀ respectively, with overall mean of 2.30 g/kg DM intake. These values were lower than the figure of 4.3 g/kg DM intake reported by Akinsoyinu (1974) for West African dwarf goats or the value of 4.1g/kg DM intake by Majumdar (1960a) for Jamnapari goats. However, the MFN value obtained in the present work is comparable with the figures of 2.4g/kg DM consumed for sheep reported by Ellis, Garner, Muhrer and Pfander, (1956), and with the values of 2.04 and 2.09 g/kg DM consumed reported by Black, Pearce and Tribe (1973) for growing lambs. Factors such as level of feed intake, digestibility of the ration, CF level in the diet and size of an animal have been known to influence MFN excretion, which might explain the wide range of MFN values reported by various workers.

The mean endogenous urinary nitrogen (EUN) (g/day/W_{kg}^{0.734}) were 0.060, 0.107 and 0.041 for kids maintained on treat-

ments G₁₀₀Co, G₇₅ C₂₅ and (GC)₅₀. These values were lower than the figures of 0.237 g/day/W_{kg}^{0.734} obtained by Itoh, Haryn, Tano and Iwasaki (1979) for Japanese goats and 0.121 g/day/W_{kg}^{0.734} for small East African goats reported by Reynolds (1981). The overall mean EUN of 0.07 g/day/W_{kg}^{0.734} obtained from this study was slightly higher than the figure of 0.04 g/day/W_{kg}^{0.734} reported by Akinsoyinu (1974) for West African dwarf goats, and by Singh and Mahadevan (1970) for adult rams. However, the mean EUN value from this work was in close agreement with the figure of 0.08 reported by Sotola (1930), 0.12 and 0.09 g/day/W_{kg}^{0.734} accepted by the Agricultural Research Council (1965). Meanwhile, EUN values may not be constant under all conditions, but blood urea levels have been shown to influence EUN excretion (Mugerwa and Conrad 1971).

The biological value (BV) of the diets ranged from 56.8 to 75.6%. The BV of the experimental diets increased with increasing level of concentrate. However, the mean BV of 64.97 ± 5.575 was lower than either 85% reported by Stobo and Ray (1973) or 70% recommended by ARC (1965) for ruminants.

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