Studies on Comparative Utilization of Urea and Groundnut Cake Rations by Young Growing West African Dwarf Goats

II. EFFECT ON CARCASS QUALITY AND CHEMICAL COMPOSITION OF THE ORGANS AND MUSCLES

By

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SUMMARY

TWELVE West African Dwarf castrated goats, 6-8 months old, ranging in live-weight from 7 to 15 kg, were maintained on cassava flour-based rations with two sources of nitrogen from urea and groundnut cake. Each nitrogen source was fed to the goats at three levels of crude protein viz., 10, 17 and 24%. These rations constituted the concentrate fraction as supplements to *Cynodon nlemfuensis*. Six of the goats were slaughtered at the end of about three months on the dietary treatments, and the other six animals three months later; the overall experiment lasted for six months.

It was found that the dressing-out percentage (51.2%) on the groundnut cake — based supplement was not significantly higher than that of animals on the urea ration (50.0%). The two sources of nitrogen had no effect on the major cuts, such as the thigh, loin, shoulders and also the protein contents of the organs and muscles.

INTRODUCTION

FROM previous work (Mba, Akinsoyinu and Olubajo, 1974), it was observed that the live weight gains of castrated goats kept on urea-based ration as supplements to Giant Star grass (*Cynodon nlemfuensis*) was better than those fed on groundnut cake — based diets as the supplement, although the differences in live-weight gain were not significant. The N-balance studies with these goats tended to show better utilization of the urea-N than the groundnut cake-N, although the differences were not significant. The optimal N-balance was obtained at a 17 % protein level for the two sources of N.

The carcass and nutritive qualities of these live-weight gains need to be estimated because the gains might be due to accumulation of fats, tissue protein or even water (Maynard and Loosli, 1969). However a lot of information has accumulated on the techniques for the physical and chemical evaluation of carcass composition especially of the adult and young growing sheep (Mitchell Kammlade and Hamilton, 1926; Hammond, 1932; Palsson, 1939; Hankins 1947; Preston and Gee, 1957; Kirton and Barton, 1958; Garrett, Meyer and Lofgreen, 1959; Kirton, Ulyatt and Birton, 1959; Kirton, Barton and Rae, 1962), which may be applicable to goats. In addition it has been shown that dressing percentage (Barton and Kirton, 1958a; Kirton and Barton, 1962), sample joints or cuts (Palsson, 1939; Kirton, 1957; Barton and Kirton, 1958a; Kirton and Barton, 1962), liver protein (Allison, 1964), Kidney plus pelvic fat (Weniger, 1966) may be used with accuracy to obtain an estimate of carcass composition, thereby reducing the cost and labour requirements of investigation.

As part of a general study on the comparative utilization of urea and groundnut cake rations by young growing goats, the present experiment was planned to investigate the nature of the tissue laid down and

therefore the carcass quality, the effect on chemical composition of the organs and muscles maintained on the two sources of nitrogen fed at three levels. The parameters determined were dressing out percentage, weight of kidneys plus pelvic fat, chemical composition of the kidneys, liver and muscle of the leg plus loin cuts, and weights of the joints.

MATERIALS AND METHODS

Animals and their management

Twelve West African Dwarf castrated male goats, 6-8 months old, ranging in live-weight from 7 to 15 kg were used in the experiment. Clean fresh water and proprietary salt licks were provided *ad. lib.*

Diets and plan of the experiment

Two sources of nitrogen, urea and groundnut cake were used at three levels of crude protein (N x 6.25) : 10, 17 and 24 % in cassava flour based media. These rations constituted the concentrate supplements to Giant Star grass. Details of the composition and chemical analysis of the rations, and Giant Star grass were reported earlier (Mba *at. al.*, 1974).

Twelve goats were randomized into two groups of six animals. Each group was further randomized into three sub-groups of two animals and fed one of three levels of protein in a 3 x 3 Latin square design. One goat from each group of two was slaughtered at the end of the third month. The remainder were slaughtered at the end of the experimental period of six months.

Slaughter technique

The goats were starved for 12 hours and weighed just prior to slaughter. The animals were bled by cutting the throat and then slaughtered by severing the head at its articulation with the atlas. The dressed carcasses were weighed and immediately stored in a chilling chamber for 24 hours. Dressing percentage is given by the weight of the chilled carcass divided by the live weight before slaughter, the ratio is multiplied by 100. A chilled carcass is defined as the weight of the goat after removal of the head, skin, contents of the thoracic, abdominal and pelvic cavities (including the diaphragm and kidneys) and the limbs distal to the carpal and tarsal joints, and after storing in a chilling chamber for 24 hours. The gut was weighed before and after clearing. The heart, liver without the gall bladder, the mesenteric fat, the skin, the kidneys with the pelvic fat, and the limbs distal to the carpal and tarsal, were also weighed.

Jointing of the carcass

There is no special procedure for jointing of goat carcasses but the procedure of Palsson (1939) for lamb was followed with slight modification.

The frozen carcass was divided down the spinal column using a meat band saw. Each half was weighed. (Statistical analysis showed that the apparent variation in the weight of the left and right sides of the carcasses was not significant). The left half was divided into the following cuts. The *Leg* (thigh) was severed at the attachment of the femur to the acetabulum. The *loin* consisted of the lumbar region plus a pair of ribs and the *ends* (spare ribs plus belly) of six abdominal ribs. The *shoulder*, consisted of the scapula, humerus, radius ulna and carpals and the *sets* which made up of the breast and neck (Figure 1). Each of the cuts was weighed and the weight was doubled in each case before being expressed as a percentage of the chilled carcass. The leg plus loin cuts were then separated into muscles and bone with ligament to obtain the meat to bone ratio. The liver, kidneys and meat from the loin plus leg, were cut into pieces.

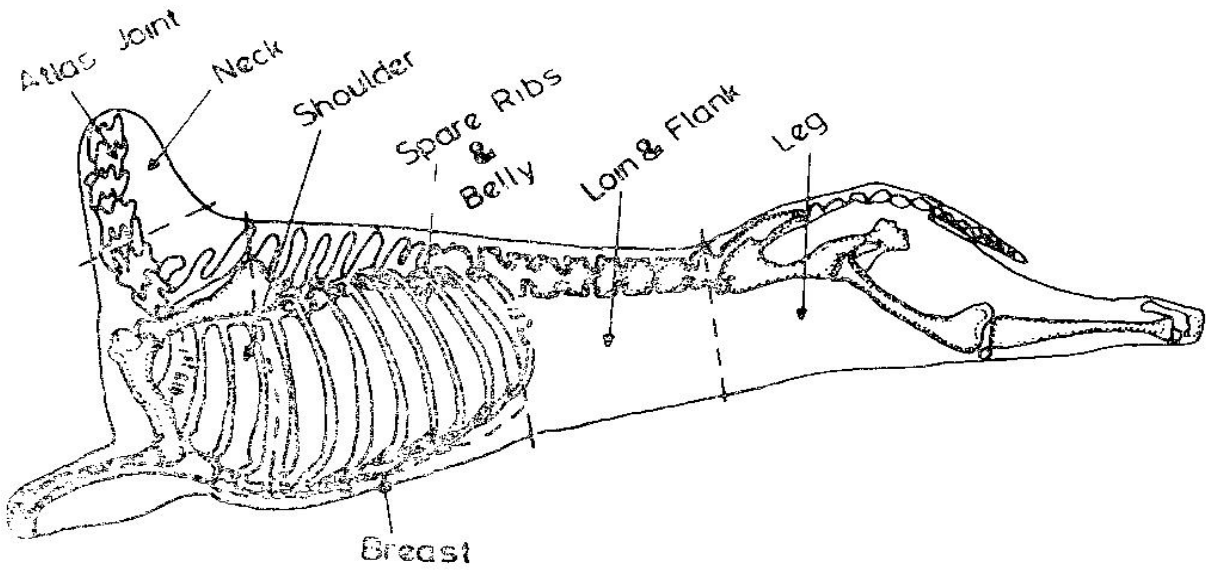

Fig. 1 Joint cuts of the carcass

homogenised separately, and stored at -5°C until they were required for analysis. 2.0 g of the freshly homogenised samples was weighed, frozen with liquid nitrogen and then freeze dried to constant weight for dry matter determination. The freeze-dried samples were crushed in each case and also stored at -5°C until required for analysis.

Analytical Procedures

2.0 g of the freshly-homogenised liver, kidney and meat specimens was taken in each case, for nitrogen determination using the semi micro-kjeldahl's procedure with mercury catalyst complex as outlined in AOAC (1970) method. About 2.0 g (accurately weighed) of the freeze-dried and crushed samples were weighed for fat determination by means of soxhlet apparatus using petroleum ether.

RESULTS

A Statistical analysis of the results showed that there were no treatment effects in the first and second slaughter of the goats. The results were therefore pooled for all goats in the same treatment.

Dressing-out percentage

The dressing-out percentages are shown in Table 1. The values for animals fed on the groundnut cake-based ration were 51.17 $\pm$ 0.69 while a corresponding value 50.01 $\pm$ 0.52 for the animals fed urea based ration.

The Cuts

The leg and loin cuts for animals fed the groundnut cake ration gave mean values of 34.24 $\pm$ 4.58 and 16.19 $\pm$ 2.12 respectively, when expressed as percentages of the carcass. Similar mean values for animals maintained on urea-based ration were 32.93 $\pm$ 5.99 and 15.39 $\pm$ 1.41 %.

The bone to lean meat ratio for the leg plus loin cuts combined (table 4) were constant (0.25) for all treatments irrespective of the source of nitrogen. The total fat (g/100 g DM) of the leg plus loin meat, was 8.0 g for animals on groundnut cake-based ration and 7.7g for those on urea-based diet. The corresponding estimate for the crude protein were 85.4 and 86.5 g/100 g DM respectively.

TABLE 1

Effect of Groundnut Cake and Urea Concentrates on Dressing-out percentage with a Display of Mean Slaughter weights and Chilling percent on Young West African Dwarf Goats

Characteristics	*Treatments*			
	Grass plus groundnut-cake concentrate		*Grass plus urea concentrate*	
	Means	*±SE*	*Means*	*±SE*
Live-weight at slaughter kg	14.43	0.34	16.90	0.90
Empty live-weight[a], kg	13.01	0.30	14.74	0.83
Warm Carcass weight, kg	7.41	0.95	8.47	0.16
Cold Carcass weight, kg	7.08	0.54	7.94	0·47
Chilling percent	4.39	0.16	5.02	0.17
Weight of each) Right kg	2.57	0.53	2.87	0.54
half of carcass) Left kg.	2.54	0.53	2.86	0.59
Dressing-out percentage	51.17	0.69	50.01	0.52

a) Empty live-weight = Live — weight at slaughter minus the gut content
± SE = Standard error

TABLE 2

Comparative Utilization of Urea and Groundnut Cake rations by Goats showing the effect on weights of cuts as percentages of chilled Carcass weight

Characteristics	*Treatments*			
	Grass plus gro ndnut cake concentrate		*Grass plus Urea concentrate*	
	Means	*±SE*	*Means*	*±SE*
Leg: Weight (g)	2357.8	197.5	2612.5	199.3
Percentage	34.24	1.52	32.93	2.00
Loin: Weight (g)	1142.0	146.0	1227.7	93.3
Percentage	16.15	0.70	15.39	0.46
Sets: Weight (g)	840.0	75·6	934.7	75.3
Percentage	12.20	0.73	11.71	0.45
Ends: Weight (g)	779.0	180.5	986.7	111.3
Percentage	10.96	0.87	12.29	1.01
Shoulder: Weight (g)	2317.3	184.9	2665.7	139.2
Percentage	33.65	1.08	33.73	1.18

±*SE* = Standard Error

Goats fed the groundnut cake ration had 12.20 ± 2.19 % of the carcass as the *sets*, while the bucks on the urea-based ration had 11.71 ± 1.34 % as the sets cuts. The corresponding values for the ends were 10.96 ± 2.36 and 12.29 ± 3.03 % (Table 2) respectively.

The kidneys plus pelvic fats and the organs.

The results obtained for the kidneys plus the pelvic fats as percentages of the empty live-weight were about 1.0 % for both sources of nitrogen treatment (Table 3). The values for the liver, pluck,

TABLE 3

Comparative Utilization of Urea and Groundnut Cake by Goats showing the effect on parts as percentages of Empty live-weight[a])

Characteristics	*Treatments*			
	Grass plus groundnut cake concentrate		*Grass plus Urea concentrate*	
	Means	*±SE*	*Means*	*±SE*
Liver: Weight (g)	253.2	16.71	277.97	20.48
Percentage	1.96	0.12	1.89	0.11
Kidneys and pelvic fats: Weight (g)	134.40	17.41	149.22	14.13
Percentage	1.01	0.08	1.00	0.08
Pluck: Weight (g)	673.8	76.0	725.67	73.00
Percentage	5.16	0.41	4.63	0.28
Feet: Weight (g)	585.17	36.11	645.0	42.31
Percentage	4.51	0.15	4.16	0.15
Head: Weight (g)	1250.00	103.31	1234.00	215.26
Percentage	9.48	0.39	8.94	0.18
Gut Empty: Weight (g)	1713.17	154.89	1874.83	191.64
Percentage	13.20	0.67	11.98	0.74
Intestinal fats: Weight (g)	379.37	85.92	352.50	60.54
Percentage	2.86	0.57	2.39	0.37

a) Empty live-weight = Live-weight at slaughter minus the gut content.
±SE = Standard error.

TABLE 4

Influence of feeding Groundnut Cake and Urea Concentrate on Organs and Muscles of Goats showing result of physical and Chemical Analysis

Characteristics	*Treatments*			
	Grass plus groundnut cake concentrate		*Grass plus Urea concentrate*	
	Means	*±SE*	*Means*	*±SE*
KIDNEY				
Dry Matter (%)	37.46	2.26	37.91	2.40
Crude Protein (g/100 g DM)	81.83	0.73	82.36	0.44
Fats (g/100gDM)	7.47	0.21	7.42	0.23
LIVER				
Dry Matter (%)	22.37	0.76	22.06	0.23
Crude Protein (g/100 g DM)	80.78	0.59	81.68	1.58
Fats (g/100 g DM)	12.02	0.21	11.78	0.19
LEG PLUS LOIN				
Total Weight (g)	3225.0	261.5	3655.0	302.7
Total lean meat (g)	2568.3	207.3	2923·3	222.4
Total bone (g)	640.0	52.1	731.7	70.7
Bone to Lean ratio	0.249	0.002	0.251	0.001
Dry matter of meat (%)	28.47	0.91	28.12	0.76
Crude protein of meat (g/100 g DM)	85.37	0.25	86.47	0.36
Fats (g/100 g DM)	8.04	0.01	7.74	0.03

± *SE* = Standard error

feet, head, and gut empty did not show any significant trends due to treatment.

The chemical composition (fats and protein) of the liver and the kidney (Table 4) indicated that the crude protein of the kidneys (82.36 g/100 g DM) of the goats fed urea was highly comparable to 81.83 g/100 g DM for goats fed groundnut cake. Similar values for the liver were 81.68 and 80.78 (g/100 g DM) respectively. Similar estimates of fat content of 7.42 and 7.47 (g/100 g DM) for the kidney, and estimates 11.78 and 12.02 (g/100gDM) for the fat content of the liver of animals were recorded for goats fed urea and groundnut cake diets respectively.

DISCUSSION

The dressing-out percentage values of 51.17 $\pm$ 0.69 and 50.01 $\pm$ 0.52 obtained for animals on groundnut cake-based ration and urea-based ration respectively, suggest that the utilization of the two dietary sources of N for deposition of fats was similar. This is evident from the observation of Mason (1951), Barton and Kirton (1958a,b) and Kirton and Barton (1962) which showed the dressing-out percentage as a function of the fat content of the carcass. The two dressing-out percentages (51.17 and 50.01) obtained in the present study are very close to 51.4 % for Anglo-Nubian goats (Gatan, 1941) and fall within the range of 48 to 52 % for Angora wethers (Miller, Jones and Burt, 1943). The data therefore indicated that the urea ration had not reduced the carcass qualities of these animals.

Sample joints have been investigated as suitable index for estimating the composition of the total carcass (Hankins, 1947; Field, Kemp and Varney, 1963; Preston and Gee, 1957; Kirton and Barton, 1962). The combination of the two joints, the one relatively late developing (the leg) and the other relatively early developing (the loin) offer greater opportunity of success in estimating the bone, muscle, and fat of the carcass (McMeekan, 1941; Barton and Kirton, 1961).

The constant ratio (0.25) for bone to lean meat appear to indicate a uniform proportion for the deposition of bone and meat in all the experimental animals irrespective of dietary sources of nitrogen. Comparative values of the crude protein and fat contents (g/100gDM) of the meat from the leg plus loin also indicated a proportional deposition of protein and fats.

This observation is further supported by the results of the kidneys plus pelvic fats as a percentage of the empty body weight. A value of about 1.0 % was obtained for all animals irrespective of dietary treatment. Weniger (1966) reported a high degree of correlation between the weights of kidney plus pelvic fats and total fat in a carcass. That the variation in the weights of kidney plus pelvic fats as a percentage of empty body weight, was not significant, suggested that the live-weight gain of the experimental animals could not have been due to excessive accumulation of fats. Even the data on the intestinal fats (Table 3) did not potray a relatively higher deposition of fats by animals fed on the urea ration.

The protein and fat contents of the livers in Table 4 were not affected by the treatment effects. The weight of the liver and its content of nitrogen per unit weight reflect the degree of utilization of dietary nitrogen (Addis, Poo and Lewis, 1936; McMeekan, 1940). The total liver proteins per unit weight of liver increase with N-intake (Allison, 1964). It therefore seems justifiable to infer that the degree of utilization of the nitrogen from urea was as good as that of the nitrogen from the groundnut cake, since the mean differences

between the liver proteins for the animals on the two sources of N, were not significant ($P>0.05$).

The results obtained on the cuts as percentages of the carcass, pluck, feet, head, gut empty as percentages of the empty live-weight, did not show any fall in value as a result of feeding the urea based concentrate to the animals in these studies.

The results obtained from the carcass evaluation and chemical composition of organs and muscles seemed to indicate that the utilization of urea-based rations by goats, did not result either in excessive deposition of fats or a reduction of carcass quality. The degree of utilization of nitrogen from urea followed the same pattern as that of nitrogen from groundnut cake as indicated by the results of the chemical composition of the organs.

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