PREDICTION OF CARCASE COMPOSITION IN THE INDIGENOUS MALAWI GOAT

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Summary

The growth of Indigenous male castrate Malawi goats, reared under traditional management, was measured by fortnightly weighings. Daily gains of 102g/day were recorded upto 12 weeks of age. From 12-126 weeks this declined to 40g/day, giving an overall mean of 68g/day. Kids, in groups of five, were slaughtered at birth and at intervals of 5kg between 5 and 25kg. Carcases were stored at -20^{0}C before dissection into lean, fat and bone. The data generated from the dissections were used to develop allometric growth curves for each joint and for each tissue, using multiple regression analysis. These data, in turn, were used to evaluate each of the joints as a possible sample joint for prediction purposes in subsequent work. The following year further goats were slaughtered and subject to the same dissections. The initial equations were used to predict full carcase composition and these predictions were then verified using actual dissection data. Subsequent work involved the removal of 200ml of milk from does in the morning before being allowed to suckle their kids. This had no statistically significant effect on the growth rate of their kids.

Introduction

Malawi has a malnutrition problem, especially in children and particularly in the immediate post-weaning period. A recent estimate produced the data in Table 1.

Though deficiencies of both energy and protein occur, protein deficiency is a particular problem and animal protein makes up only 9% of that which is available, and goats are estimated to provide 20% of the meat consumed (FAO, 1985).

Estimates of the numbers of goats in Malawi vary between 1.0 million (Zerfas, 1990) and 1.6 million (Malawi Government, 1988). The goats are of the small East African type with a mature weight of 30-35 kg. Most are owned by small-scale, subsistence farmers with 30% of households owning an average of 6 does (Zerfas and Stotz, 1987), however, Chimwaza (1982) estimated that 64% of Malawian householders owned some goats. Goats are traditionally grazed over indigenous pastures and crop residues during the dry season (May to November) but are often confined, usually by tether, during the wet, growing season. At night they are housed.

Improved husbandry and breeding programmes can only be developed and implemented when adequate data on the performance and potential of populations have been collected. The initial trial was undertaken to provide base line data, in order to allow comparisons to be drawn when alternative management strategies are adopted. Subsequent work was designed to determine whether the indigenous goat, under traditional management, is capable of producing a useable amount of milk daily whilst still satisfactorily rearing her kid/s. Such milk would make a significant contribution to the diet of weanling children within the families of the goat owners.

Materials and Methods

The goat herd was established by the purchase of 41 goats in July 1989. twenty more were added in January 1990. Animals were housed in a concrete-floored building (khola) constructed of blue-gum poles under a galvanised roof. Walls were made of 1.8 metre high chain-link fencing. Individual pens were aproximately 4m x 4m and each housed 10-14 does and their kids. Animals were housed at dusk and were turned out to graze at about 8am.

Feeding was based upon the grazing of indigenous pasture and bush grazing, with the predominant species being *Hypparhaenia spp*. During the dry season animals also had access to areas previously occupied by maize. Where required by treatment, supplementation with maize bran (madeya) was practiced. Madeya is a by-product of the preparation of maize for human consumption and is generally available widely and cheaply. Where supplementation was used it was at the rate of one double handful (250±10g) per doe per day. The proximate analysis of madeya is given in Table 2.

Meat Production

Kids were weighed at birth and at fortnightly intervals thereafter. In 1989-1990 castrate male kids, in groups of five, were slaughtered at birth and at intervals of 5kg. between 5kg and 25kg. Following slaughter, carcases were split down the backbone, weighed, packed into individual polythene bags and stored at -20^{0}C to await dissection.

Dissections were carried out during March 1990. Right-hand sides were thawed, cut into primal joints and dissected according to standard procedures (MLC,1972). Data generated were used to derive allometric growth curves and to evaluate each primal joint as a possible sample joint for use in future (1991-1992) work.

In 1992, six goats weighing 15kg. and four weighing 20kg. were slaughtered and subject to the same dissection procedure. Equations developed from the 1989-1990 data were used to predict full carcase composition and these predictions were then verified using actual dissection data.

In 1991 a trial was estalished to quantify the effect of milking does, after being housed overnight, and before being released to rejoin their kids for the day's grazing. Kids were weighed at fourtnightly intervals so as to ascertain the effect that milk removal would have on their growth.

Results and Discussion

Mean daily gain of kids born in 1990 up to 12 weeks of age was 102 g/day but this dropped to only 40g/day over the period 12-26 weeks giving an overall mean of 68g. This performance was in excess of that expected, since Zerfas and Stotz (1987) quote daily gains from birth to 12 months of 42g/day and Karua (1988) gives 47g/day to 150 days. Reynolds (1979) gives liveweight gains to 24 weeks of 10.4kg for singles and 7.2kg for twins and these figures equate to daily gains of 61.7 g and 43.0g/day respectively.

Dressing percentage (killing out percentage) was remarkedly consistent across the whole range of liveweights, varying only between 48.7% at 10kg and 51.1% at 20kg. As was expected, the proportion of lean in the carcase remained fairly constant as liveweight and carcase weight increased, ranging from 68.3% at 5kg liveweight to 73.0% at 25kg. Differences in the proportion of fat in the carcases increased, from 3.87% at 5kg to 11.6% at 25kg,were mirrored by a commensurate decrease in bone. The data generated by these dissections were used to develop allometric growth curves for each joint and for each tissue using multivariate regression analysis, co-efficients derived from these data were 0.676, 1.110 and 2.260 for bone, lean and fat respectively. Even at the heaviest slaughterweight, 25kg, a lack of fat in the carcases, excluding perirenal fat, was evident. Within joints (Tables 3-7 showing means $\pm$ standard errors) the greatest amount of fat was found in the Breast and this was reflected in the allometric growth co-efficient for this joint (0.84). Co-efficients for the other joints are shown in Table 8. The low proportion of fat in the carcase, even at 25kg, which led to the allometric growth co-efficient for fat of 2.26, is interesting. It suggests either that the Malawi goat is a very late-maturing genotype or, more probably, that the level of nutrition available to the kids was insufficient to allow partition of dietary energy to fat deposition. It would be interesting to examine the performance of such animals on *ad libitum*. feeding, but given the nature of goat production in Malawi, and the limited commercial market for carcases, it is unlikely that an improved feeding regime would prove economic.

In 1991-1992 growth rates were lower and more in line with previous studies (Table 9). The kids from does supplemented with madeya were consistently heavier than those from unsupplemented animals and those from unmilked does heavier than those from milked does but none of these differences was statistically significant.

After examination of the 1989-1990 equations, regressing joint values on whole carcase composition, and taking into account the ease of accurate joint removal, it was decided to examine the Best End of Neck (BEN) and Hindleg (HL) joints as predictor sample joints using data from the goats slaughtered in 1992. The prediction equations are given in Table 10 and the comparisons generated by these equations are given in Table 11 There were no statistically significant differences between predicted and actual values. Correlation co-efficients derived from the same data are given in Table 12. It can be seen that both joints were satisfactory predictors of whole carcase composition, but in the light of the ease and in the smaller element of error attached to the removal of the Hindleg and the fact that the joints in price per kilogramme are of the same financial value, it was concluded that this would prove the more useful in practice.

Conclusions

It is concluded that:

1 The growth rate of kids may be in excess of 100g/day during early lactation but overall growth rates of 50-60g are to be expected.

2. The composition and proportions of the joints of male Malawi goats slaughtered at weights between 5-25kg are similar to those reported elsewhere.

3. Both the Best End of Neck and the Hindleg joints may be used as predictor joints for full carcase composition. The Hindleg, because of the ease of removal and the little financial difference between the two joints, was the sample joint of choice.

4. The removal of 200ml of milk from the doe in the morning does not statistically affect the growth rate of the kid.

5. The 200ml of milk available would provide 10.5g of high quality animal protein, 13.5g

fat and 260mg of calcium per day. Such an amount would go a long way towards improving the nutrition of the under-fives children in Malawi.

Before attempting to validate this trial and to extend the work to answer further questions it was decided to repeat the work for a further year. The system of husbandry adopted for this trial was deliberately kept simple, nedessitating little alteration to traditional methods and requiring no cash expenditure. It should therefore be possible for the system to be adopted by 'village level' farmers. Given the similarities between goats and husbandry systems in Malawi and those in her neighbouring countries it is expected that any 'blue-print' to emerge from this work would be applicable over a wide region.

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TABLE 1 ESTIMATES OF CHILD (< 5 YEARS) MALNUTRITION IN VARIOUS REGIONS OF MALAWI.

DISTRICT	PERCENTAGE
Lilongwe Rural	36
Rumphi	38
Mzimba	55
Mulange	55
Zomba	55
Ntchisi	70

TABLE 2. PROXIMATE ANALYSIS OF MAIZE BRAN (MADEYA).

Dry Matter %	91.0
Crude Protein %	10.1
Ether Extract %	8.8
Crude Fibre %	7.0
Ash %	6.2
Nitrogen Free Extract %	59.0
Est. Metabolisable Energy (MJ/kg)	14.0

TABLE 3 COMPOSITION OF JOINTS: 1989 - 90 SLAUGHTERWEIGHT 5KG.

	LEAN(g)	FAT (g)	BONE(g)
Shoulder	139.5 ± 31	4.4 ± 4	94.1 ± 11
Foreleg	129.7 ± 28	4.7 ± 6	84.0 ± 21
B E Neck	39.0 ± 12	0.3 ± 0.6	40.4 ± 11
Loin	59.1 ± 13	4.5 ± 3	46.6 ± 12
Breast	86.9 ± 15	3.5 ± 2	20.3 ± 7
Hindle	282.3 ± 26	11.0 ± 9	129.6 ± 25
TOTAL	1156.0 ± 154	28.4 ± 16	414.9 ± 69

TABLE 4 COMPOSITION OF JOINTS 1989-90: SLAUGHTERWEIGHT 10KG

	LEAN(g)	FAT (g)	BONE(g)
Shoulder	231.5 ± 52	27.8 ± 17	155.4 ± 22
Foreleg	253.5 ± 36	50.7 ± 45	201.7 ± 35
B E Neck	66.2 ± 22	4.5 ± 6	69.8 ± 14
Loin	125.4 ± 32	8.0 ± 8	75.2 ± 11
Breast	91.5 ± 15	13.6 ± 13	30.4 ± 6
Hindleg	552.5 ± 68	26.6 ± 22	228.8 ± 30
TOTAL	1320.6 ± 173	131.1 ± 110	761.2 ± 52

TABLE 5 COMPOSITION OF JOINTS: 1989-90 SLAUGHTERWEIGHT 10KG

	LEAN(g)	FAT(g)	BONE(g)
Shoulder	326.5 ± 103	28.9 ± 7	174.7 ± 16
Foreleg	350.3 ± 53	38.9 ± 28	245.2 ± 20
B E Neck	101.5 ± 34	3.8 ± 2	72.4 ± 14
Loin	195.6 ± 34	6.8 ± 6	107.6 ± 36
Breast	124.9 ± 37	5.2 ± 3	39.6 ± 6
Hindleg	793.7 ± 92	42.3 ± 23	263.2 ± 41
TOTAL	1892.0 ± 241	125.9 ± 55	902.7 ± 94

TABLE 6 COMPOSITION OF JOINTS: 1989 - 90 SLAUGHTERWEIGHT 20KG

	LEAN(g)	FAT(g)	BONE(g)
Shoulder	528.4 ± 69	31.0 ± 17	259.1 ± 72
Foreleg	578.5 ± 96	32.3 ± 20	346.0 ± 60
B E Neck	163.8 ± 44	8.7 ± 1	114.2 ± 26
Loin	345.0 ± 107	9.8 ± 2	115.7 ± 38
Breast	197.2 ± 20	11.2 ± 1	69.1 ± 34
Hindleg	1208.0 ± 85	53.3 ± 27	441.9 ± 63
TOTAL	3021.0 ± 54	146.2 ± 41	1346.0 ± 20.9

TABLE 7 COMPOSITION OF JOINTS 1989 - 90: SLAUGHTERWEIGHT 25KG

	LEAN(g)	FAT (g)	BONE (g)
Shoulder	722.2 ± 56	24.5 ± 12	413.0 ± 63
Foreleg	695.2 ± 50	35.5 ± 8	370.9 ± 47
B E Neck	171.7 ± 9	14.1 ± 1	164.9 ± 25
Loin	329.9 ± 17	10.8 ± 4	149.8 ± 33
Breast	197.3 ± 46	23.9 ± 6	71.5 ± 16
Hindleg	1286.7 ± 88	38.5 ± 20	528.1 ± 59
TOTAL	3402.0 ± 148	147.3 ± 36	1698.1 ± 131

TABLE 8 ALLOMETRIC GROWTH CO-EFFICIENTS FOR JOINTS AND TISSUE

JOINTS	CO-EFFICIENT
Breast	0.84
Shoulder	1.00
Best End Neck	0.99
Loin	1.02
Foreleg	1.06
Hindleg	1.01
TISSUES	
Bone	0.676
Lean	1.110
Fat	2.260

TABLE 9 WEIGHTS (KG) OF KIDS BORN IN YEAR 1991-92 BY AGE AND TREATMENT GROUP

	TREATMENT			
	NON MILKED		MILKED	
AGE (WKS)	NON SUPPLEMENT	SUPPLEMENT	NON SUPPLEMENT	SUPPLEMENT
Birth	1.88 ± 0.125	1.88 ± 0.08	1.78 ± 0.07	2.00 ± 0.11
4	3.00 ± 0.102	3.14 ± 0.09	3.06 ± 0.03	3.18 ± 0.24
8	3.42 ± 0.46	3.60 ± 0.19	3.17 ± 0.11	3.59 ± 0.20
12	4.17 ± 0.36	4.50 ± 0.79	3.96 ± 0.18	4.32 ± 0.29
16	4.83 ± 0.22	5.19 ± 0.65	4.55 ± 0.27	5.05 ± 0.29
20	5.58 ± 0.46	5.88 ± 0.59	5.25 ± 0.37	5.73 ± 0.36
24	6.25 ± 0.76	6.56 ± 0.58	5.88 ± 0.52	6.39 ± 0.42
28	7.25 ± 0.87	7.63 ± 0.55	6.75 ± 0.66	7.33 ± 0.60
52	14.00 ± 1.73	13.67 ± 3.76	13.25 ± 1.03	15.67 ± 0.88

TABLE 10 REGRESSION EQUATIONS USED IN PREDICTING CARCASE COMPOSITION OF 1992 GOATS FROM 1989 - 90 SAMPLE - JOINT DATA

PREDICTOR JOINT	TISSUE	EQUATION
BEN	LEAN	14.7- 0.17 BEN W + 2.03 BEN L + 0.497 SWT
BEN	FAT	-103 - 1.58 BEN W + 14.4 BEN F + 0.255 SWT
BEN	BONE	72.6 - 0.712 BEN W + 3.98 BEN B + 0.195 SWT
HL	LEAN	-82.4 + 0.279 HL W + 1.30 HL L + 0.201 SWT
HL	FAT	92.7 - 0.835 HL W + 0.54 HL F + 0.445 SWT
HL	BONE	85.1 - 0.22HL W + 1.82 HL B + 0.165 SWT

WHERE:
BEN W/HL W = Weight of sample joint
BEN F/HL F = Fat in sample joint
BEN L/HL L = Lean in sample joint
BEN B/HL B = Bone in joint
SWT = Sideweight

TABLE 11 PREDICTED AND ACTUAL CARCASE COMPOSITION (g)

	LEAN	FAT	BONE
Actual	2061.1	503.5	895.9
BEN Prediction	2014.2	514.2	944.0
HL Prediction	1981.9	530.6	894.2

TABLE 12 CORRELATION CO-EFFICIENTS BETWEEN PREDICTED AND ACTUAL CARCASE COMPOSITION : 1992 SLAUGHTERING

	LEAN	FAT	BONE
BEN	0.993	0.972	0.941
HL	0.997	0.989	0.968