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Level of feed intake on performance of two goat genotypes

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Abstract

There is a paucity of literature characterizing response to varying levels of feed intake in goats. A controlled experiment was designed at Prairie View A&M University (PVAMU) with purebred goats, to measure feed intake, and its subsequent effects on growth of different goat genotypes when raised intensively. Two goat populations, the Spanish (SP) and the Tennessee Stiff-legged (TS) were fed three levels: 100% or *ad libitum*, 85% and 70% of *ad libitum*, of the same ration containing 180 g CP/kg and 65% ME. Daily feed intake, bi-weekly growth weights, orts and faeces were collected until yearling age. Feed intake, in intermediate sized SP (67.7 kg), was equal to that of small sized TS (66.7 kg), at 13 months. Feed efficiency calculated for SP and TS breeds, respectively, from weaning to six months was 0.122 *vs.* 0.167 kg and from 9 to 13 months was 0.088 *vs.* 0.104 kg), and differed significantly from each other. This implies that the TS breed was more efficient in converting feed into weight gain compared to the SP breed. Knowledge of the interaction between feed intake, genotype and subsequently, body composition changes will help characterize growth curves in goats.

Keywords: Spanish, Tennessee Stiff-legged, goats, feed intake, efficiency
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Introduction

Feed intake in ruminants is difficult to measure, particularly when animals are free grazing. It is, however, one of the most, if not the most important factor in allowing meat animals to express their genetic potential. Studies have been conducted with cattle (Woldehawariat *et al.*,1990*;* Patterson *et al.*, 2003). Intake studies conducted with goats are limited and are usually of shorter duration. Sahlu *et al.* (1999) concluded that the level of feed intake can have a more prolonged effect on mohair growth than body weight change. The small-bodied Assamese goat (8 kg at 9-10 months) in India is very prolific. The goat was crossbred to the medium sized Beetal breed to increase growth and meat yield. Saikia *et al.* (1995) measured feed intake in the crossbred goat to determine energy required for optimum growth, and reported that a diet containing 120 g CP/kg, 70% ME and 3 MJ DE/kg DM was most suitable. On the other hand, Smith (2000) and Dzakuma *et al.* (2002) have conducted intake studies over longer periods of time, from weaning to yearling ages. Such measures of intake are needed, for different goat genotypes, in order for growth to be fully expressed and studied. There is a dearth of literature characterizing response to varying levels of feed intake in goats. Thus, a controlled experiment with purebred goats raised intensively was conducted. The objective of this paper is to present results on feed intake and measures of feed efficiency and their interactions with genotype. Effects of feed intake on growth of these goats have been presented by Blackburn *et al.* (2001) and Risch *et al.* (2001).

Materials and Methods

In 1997/98, the International Goat Research Centre at Prairie View A&M University established a project to perform growth curve analyses on different goat genotypes under varying nutritional regimens. Twenty four goats of each breed, comprised of equal sexes, were penned in individual crates and fed varying levels (100% or *ad libitum*, 85% and 70% of the previous week's *ad libitum* averages for both males and females) of an 180 g CP/kg and 65% ME diet. Amount of feed given was weighed daily and orts, faeces and urine were collected and weighed. Bi-weekly weights were taken on all goats until they were slaughtered at approximately six and 13 months of ages. Two breeds of goats, the Spanish (SP) representing an

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intermediate breed and the Tennessee Stiff-legged (TS) representing a small mature size breed were used in characterizing growth curves. (Mature sizes, as measured on three- to four-year old PVAMU female goat population, were: SP = 47.5 and TS = 36.8 kg).

Weaning weight was adjusted to a constant age by multiplying average daily gain (ADG) from birth to weaning by the standard length of time in days,

i.e., Adjusted weaning weight = Birth weight + 70 (Average daily gain from birth to weaning). Average daily gain, post weaning, was calculated as the difference in weight between the final and initial weights divided by the interval in days from the dates the initial and final weights were taken,

i.e., ADG = Weight gain / interval in days.

Feed efficiency (FE) was calculated as the difference in weight between the final and initial weights divided by the amount of feed consumed between the dates the initial and final weights were taken,

i.e., FE = Weight gain / Feed consumed.

These variables (ADG post weaning and FE) were calculated between weaning and six months and then between nine and 13 months of age in the 1997/98 population. These periods corresponded to where data were collected on these goats. Analyses of all variables used in this paper were performed using the GLM procedure in SAS (1999), with dietary level, breed, and sex as main effects. Interaction effects tested were, breed *x* dietary level, and sex *x* dietary level, and breed *x* sex *x* dietary level. Only results from the main effects and two-way interactions will be presented in this paper.

Results and Discussion

For the main effects of dietary level, weights from weaning (wn, 70 days) to six months (176 days) and from nine months (219 days) to 13 months (395 days) correspond to where data were collected (Table 1). Consistent differences existed at all three dietary levels for the two breeds of goats as measured at biweekly intervals. Cumulative amount of feed eaten, from weaning to 176 d of age, differed ($P < 0.001$) between goats maintained at the 70%, 85% and 100% levels (41.7, 48.1 and 62.9 kg), respectively. Differences also existed in the cumulative intake from 219 to 395 days of age. Intake for goats maintained at the 70% levels differed ($P < 0.001$) from those at the 85% and 100% levels (61.0 *vs.* 68.9 and 71.7 kg), respectively. These differences may have been caused as a result of restricting the amount of feed given, however, they provide meaningful interpretation of results.

Table 1 Feed intake least squares means (kg): Main effects of dietary level, breed and sex

Days	85	99	114	128	141	155	176	Cum 6 Mo intake	Avg[1] daily intake	Cum 13 Mo intake	Avg[2] daily intake
Dietary level											
70%	2.10	4.24	5.15	6.43	7.64	6.61	9.56	41.73[a]	0.39[a]	60.99[a]	0.35[a]
85%	2.43	5.20	6.34	7.89	9.00	7.06	10.17	48.10[b]	0.44[b]	68.89[bc]	0.39[bc]
100%	3.41	6.64	7.81	9.67	11.54	9.03	14.76	62.86[c]	0.61[c]	71.69[c]	0.41[c]
Breed											
SP	2.54	5.48	6.67	8.14	9.28	7.64	11.51	51.52	0.49	67.72	0.38
TS	2.76	5.24	6.20	7.86	9.51	7.49	11.49	50.54	0.47	66.65	0.38
Sex											
F	2.60	5.47	6.43	8.21	9.27	7.48	11.62	51.08	0.49	63.69[a]	0.36[a]
M	2.69	5.25	6.43	7.78	9.52	7.65	11.38	50.71	0.48	70.69[b]	0.40[b]

[a,b,c]Column means with different superscripts differ significantly at $P < 0.05$

[1]Average daily intake at 6 months; [2]Average daily intake at 13 months

No statistically significant differences were observed for main effects of breed in feed intake amounts between the SP and the TS breeds throughout the duration of the study (Table 1). Cumulative amounts of

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feed intake for the SP and the TS breeds, respectively, from weaning to six months of age were (51.5 and 50.5 kg) and from 6-13 months of age were (67.7 and 66.7 kg). The smaller TS breed ate just about the same amount of feed as the intermediate SP breed. Differences ($P < 0.001$) in cumulative intake amounts were observed for female and male goats (63.7 and 70.7 kg), respectively, at 395 days, but not at 176 days.

For the interaction effects of dietary level x breed, comparisons were made between SP and TS at 70, 85 and 100% levels. The following results, in kg, were obtained for, respectively, comparing the SP at 70% to the TS at 70% level of the ration, at the following days: 85 (12.0 *vs.* 8.7); 99 (13.3 *vs.* 10.3); 114 (13.4 *vs.* 9.5); 128 (14.7 *vs.* 11.9); 141 (16.4 *vs.* 13.3); 155 (17.0 *vs.* 14.1) and 176 (18.5 *vs.* 16.0). From day 85 through day 176 or six months of age, the SP breed maintained at the 70% dietary level was significantly heavier ($P < 0.05$) than the TS breed maintained at the same level. Thereafter there were no differences in weight gain of the two breeds compared at the same dietary level. This may be because the SP and TS breeds were virtually eating the same amount of feed as shown in Table 1. No differences ($P > 0.05$) were observed in cumulative feed intake from 219 days to 395 days for the SP and the TS breeds, respectively, at 70% level (61.1 *vs.* 60.9 kg) nor at 85% level (69.2 *vs.* 68.6 kg) and at 100% level (72.9 *vs.* 70.5 kg). This implies the same amount of feed intake for SP and TS breeds within nutritional levels of the ration.

Least square means for feed efficiency (FE) and average daily gain (ADG) are shown in Table 2. Feed efficiency as indicated by the main effects of breed for SP and TS breeds, respectively, $FE_{\text{wn-6 mo}}$ (0.122 *vs.* 0.167) and $FE_{\text{9-13 mo}}$ (0.088 *vs.* 0.104) were different ($P < 0.01$) from each other. Similarly, $ADG_{\text{wn-6mo}}$ (0.058 *vs.* 0.083) differed ($P < 0.01$) but not $ADG_{\text{9-13 mo}}$ (0.034 *vs.* 0.038). This would imply that during $FE_{\text{wn-6 mo}}$, the TS breed was more efficient in growth, gaining 0.167 kg weight/kg of feed consumed compared to a gain of 0.122 kg weight/kg feed consumed for the SP breed. Breed differences in the efficiency of body weight gain over a fixed age or weight intervals have been clearly shown in beef cattle (Smith *et al.*, 1976; Cundiff *et al.*, 1981).

Table 2 Main effects on least squares means for feed efficiency (FE_i) and average daily gain (ADG_i)

	$FE_{\text{wn-6 mo}}$	$FE_{\text{9-13 mo}}$	$ADG_{\text{wn-6 mo}}$ kg	$ADG_{\text{9-13 mo}}$ kg
Dietary level				
70%	0.153	0.119[a]	0.060[a]	0.042
85%	0.132	0.071[b]	0.061[a]	0.028
100%	0.148	0.097[a]	0.092[b]	0.039
Breed				
SP	0.122[a]	0.088	0.058[a]	0.034
TS	0.167[b]	0.104	0.083[b]	0.038
Sex				
F	0.142	0.095	0.071	0.034
M	0.146	0.096	0.071	0.038

[a,b]Column means with different superscripts differ significantly at $P < 0.05$

Statistically significant differences were observed in birth (3.2 *vs.* 2.5 kg) and in weaning weights (12.8 *vs.* 10.1 kg), respectively, for SP and TS goats. Prior experiences with these breeds formed the basis for classifying the SP as an intermediate sized breed and the TS as a small sized breed, *a priori*. Despite the size differences, when the "P" values obtained from analyses of growth weights of these two breeds were examined, they indicated that the differences in weights started to diminish from 85 days through to 141 days. On approaching 176 days, no statistically significant differences in growth weights were observed between the SP and TS breed (19.1 *vs.* 18.6 kg), respectively. Neither were there statistically significant differences in growth weights, for the SP and the TS breeds, from 219 days through to 395 days when the project was terminated. Such a result implies TS is growing more efficiently than SP, confirmed by feed efficiency and average daily gain calculated on these goats in Table 2. Blackburn *et al.* (2001) from fitting the Brody (1945) growth function to these data also reported the same maturing rates (0.00268) for the SP and the TS breeds.

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Conclusions

Feed efficiency showed how much weight was gained from consuming one kilogram of feed for Spanish (0.122 kg) and Tennessee Stiff-legged (0.167 kg) breeds. Statistically significant weight differences existed between the intermediate size SP and the small size TS breed to a point when dietary level x breed interactions were examined. However, the smaller TS breed was more efficient in converting feed into kilograms of weight gain and eventually grew at the same rate as the intermediate SP breed. The average daily gain indicated that the TS gained faster than the SP (0.083 *vs*. 058 kg at six months). Intake at six months (50.5 *vs*. 51.5 kg) and 13 months (66.7 *vs.* 67.7 kg), respectively, for TS and SP was similar. Knowledge of the interaction between feed intake and genotype will help the characterization of growth curves.

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