Effect of Breed-Type and Feeding Regimen on Goat Carcass Traits[1]

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ABSTRACT: Meat-type (Boer × Spanish and Spanish) goats from two feeding regimens (feedlot and range) were slaughtered and live and carcass weights were obtained. At 24 h after death, various yield and quality measurements were collected. One side from each carcass was fabricated into major wholesale cuts for dissection into major carcass components. Feedlot goats had heavier ($P < .05$) live and carcass weights and carcasses that yielded more ($P < .05$) dissectible fat and lean and less ($P < .05$) bone, as a percentage of carcass weight, than did the carcasses of range goats. In the feedlot environment, Boer × Spanish goats had greater ($P < .05$) live weights, carcass weights, actual and adjusted fat thicknesses, carcass conformation scores, and leg circumference scores than did Spanish goats of similar age. The only breed-type differences that were significant after adjusting for live weight using analysis of covariance were that Boer × Spanish goats in the feedlot treatment had greater ($P < .05$) actual and adjusted fat thickness and carcass conformation than Spanish goats on the feedlot treatment. The Boer × Spanish goat carcass trait advantage could mainly be attributed to their larger size and enhanced capacity for growth.

Key Words: Goat Feeding, Goats, Goat Breeds, Goat Meat

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Introduction

A rising interest and demand for goat meat in Texas and the United States has resulted from increased ethnic diversity. In the last decade, immigration into the United States has averaged 61,150 persons each month; many of these immigrants are goat meat consumers (Pinkerton et al., 1994). The USDA slaughter numbers reflect the growing demand for goat meat. Approximately 60,000 meat goats were slaughtered at USDA-inspected plants in 1981; in 1990, approximately 200,000 goats were slaughtered in USDA-inspected plants (NASS, 1991).

Goat production in Texas and the United States historically has been a low-labor enterprise with little emphasis on animal productivity and management practices. The majority of the meat-type goats in the U.S. are Spanish goats. The term “Spanish” is used to describe common, meat-type goats and to distinguish them from dairy- and fiber-type goats; technically, “Spanish” is not a breed (Shelton, 1978).

The Boer breed was developed in South Africa for the purpose of meat production. This breed is known for its large frame size, muscularity, and characteristic white body and brown or red-colored head (Van Niekerk and Casey, 1988). Boer goats were imported into the United States in April 1993. According to a simulation study reported by Blackburn (1995), Boer goats should produce more saleable weight per doe than Spanish goats when forage conditions are not limited; however, under less than optimal conditions, they are not more productive.

The effect of breed-type and diet on goat carcass characteristics has been investigated in only a limited number of studies. The objectives of this study were to determine the effects of breed-type and feeding regimen on carcass characteristics of meat-type goats.

Materials and Methods

This study included Boer × Spanish and Spanish kids obtained from the Texas Agricultural Experiment Station at San Angelo. All animals were intact males from the spring 1994 kidding season. The Boer × Spanish and Spanish kids were a subset of those used in a breed comparison trial (Waldron et al., 1996). The kids in this study were chosen to be representative of each of the sires. Boer × Spanish (n = 24) and Spanish (n = 24) kids were assigned randomly to either a feedlot (n = 12 for each breed-type) or a range (n = 12 for each breed-

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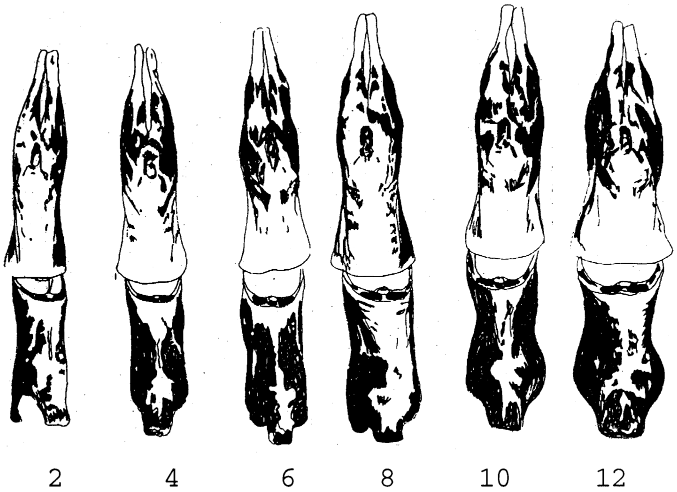

Figure 1. Conformation score scale.

type) treatment for a 130-d postweaning growth period starting when the average age of kids was 124 d. Kids assigned to the feedlot treatment were fed an 80% concentrate, either a 12.5 or 15% CP, diet for ad libitum consumption. Range kids were turned out on rangeland consisting of multiple species of native grasses and forbs; no supplemental feed was given, and rainfall was atypically low.

Kids were slaughtered at the Rosenthal Meat Science and Technology Center on the Texas A&M University campus at an average age of 254 d. Live weights and hot carcass weights were collected. Carcasses were chilled at 2°C, and, at approximately 24 h postmortem, the following measurements were taken: longissimus muscle area at the 12th rib; actual and adjusted (visually adjusted for variations in fat thickness over the leg, loin, rack, and shoulder) 12th rib fat thickness; body wall thickness (5.1 cm from the ventral edge of the longissimus dorsi); leg circumference (across the stifle area of the leg, encompassing both legs); and carcass length (measured from the point of the hock to the point of the shoulder). Scores for marbling, flank streaking, maturity, color, and buckiness (a measure of carcass masculinity based on a 5-point scale where 1 = no buckiness and 5 = extremely bucky) also were assigned to each carcass by Texas Agricultural Experiment Station personnel.

Because no official grading standards exist that are designed specifically for U.S. goat carcasses, number scores and general descriptions were assigned for carcass conformation based on muscle shape and thickness of the leg, loin, rack, and shoulder. A scale was developed by selecting carcasses representative of eight conformation types given even-numbered scores of 0 to 14. Animals falling between the categories were assigned odd-numbered scores, resulting in a 15-point scale: 1 = very thin and angular and 15 = very thick and bulging. Figure 1 illustrates animals representative of conformation scores 2, 4, 6, 8, 10, and 12.

One side from each carcass was dissected into knife-separable components of subcutaneous fat, intermuscular fat, internal fat, lean, and bone to determine physical composition. Analysis followed a 2 × 2 factorial arrangement with breed-type (Boer × Spanish and Spanish) and feeding regimen (feedlot and range) as the main effects. All data were analyzed with PROC GLM (SAS, 1991). Analyses were conducted with a model that included breed-type (Boer × Spanish and Spanish) and feeding regimen (feedlot and range) as main effects and the two-way interaction between them. Least squares means were estimated, and mean separation was performed using pairwise *t*-tests ($\alpha = .05$). A second model was used for carcass yield traits, which also included live weight as a covariate in order to compare carcass traits adjusted for differences in live weight.

Results and Discussion

Mean live weights, carcass weights, and carcass measurements for meat-type goats are reported in Table 1. In the feedlot, Boer × Spanish goats possessed heavier ($P < .05$) live and carcass weights, greater ($P < .05$) actual and adjusted fat thicknesses, higher ($P < .05$) carcass conformation scores, and larger ($P < .05$) leg circumferences than did Spanish goats. There were no significant differences observed between the Boer × Spanish range goats and the Spanish range goats.

Diet had a significant effect on live and carcass weights and carcass measurements. Feedlot goats possessed heavier ($P < .05$) live and carcass weights, larger ($P < .05$) longissimus muscle areas, greater ($P < .05$) actual and adjusted fat thicknesses, and greater ($P < .05$) body wall thicknesses, carcass conformation scores, carcass lengths, leg circumferences, skeletal maturity scores, marbling scores, flank streaking scores, and buckiness scores. Lean maturity scores were not different ($P > .05$) between feedlot and range goats. There was a significant interaction between breed and feeding regimen only for actual and adjusted fat thickness. Feedlot Boer × Spanish goat carcasses possessed greater ($P < .05$) actual and adjusted fat thicknesses than did feedlot Spanish goat carcasses, whereas there was no significant difference between Boer × Spanish range goat carcasses and Spanish range goat carcasses (Table 1). Additionally, feedlot goat carcasses had higher ($P < .05$) actual and adjusted fat thicknesses than did range goat carcasses. The results from the analyses that included live weight as a covariate indicate that the significant differences among traits shown in Table 1 are largely a function of live weight differences. The only breed-type differences that were significant after adjusting for live weight were that Boer × Spanish goat carcasses in the feedlot treatment had greater actual and adjusted fat thicknesses and carcass conformation scores than Spanish goat carcasses in the feedlot treatment (data not shown). These results suggest that the choice of the basis of comparison of carcasses from Boer × Spanish and Spanish goats affects the evaluation. Data shown in Table 1 are relevant for comparisons at a mean age of 254 d. The analysis that included live weight as a covariate is relevant for comparisons at a common live weight of 36 kg for feedlot goats and 19 kg for range goats.

Mean percentages of carcass components within breed-type and feeding regimen are reported in Table 2. Feedlot Boer × Spanish and Spanish goat carcasses had a higher ($P <. 05$) percentage of lean from the side than did range Spanish goat carcasses; however, feedlot Spanish goat carcasses were not different ($P > .05$) from range Boer × Spanish goat carcasses for lean percentage. Feedlot goat carcasses possessed higher ($P < .05$) fat percentages and lower ($P < .05$) bone percentages than range goat carcasses. This trend was generally observed for most major wholesale cuts. When live weight was added to the model for analysis of the composition traits of Table 2, the results were not substantially different from those shown in Table 1. The breed-type × feeding regimen interaction was not a significant source of variation ($P > .05$) for percentage of lean or bone for the side or any of the cuts. The interaction was a significant source of variation ($P < .05$) for percentage of fat for the shoulder and rack and tended toward significance ($P < .10$) for the side and sirloin. Although there were no significant differences between the breed-types within a feeding regimen, it can be observed in Table 2 that Boer × Spanish least squares means were higher than those for Spanish goats on the feedlot treatment and lower than those for Spanish goats on the range treatment. The actual and adjusted fat thickness (Table 1) traits also showed a significant interaction; the Boer × Spanish goats were fatter on the feedlot treatment, and little or no difference was evident between the breed-types on the range treatment.

Diet has been found to affect carcass characteristics in other species. Tatum et al. (1989) reported that lambs fed in a feedlot produced fatter carcasses than lambs fed limited or no grain. Several studies have verified this for beef cattle as well (Bowling et al., 1977; Burson et al., 1980; Schroeder et al., 1980). The results from the present study with goats agree with the results from these studies with other species, in that they indicate that a feedlot diet did result in fatter carcasses.

Implications

Feeding goats results in heavier live and carcass weights and more heavily muscled, fatter carcasses. Crossbreeding using Boer influence results in heavier live and carcass weights, higher conformation scores, and larger leg circumferences when goats are compared

Table 1. Least squares means of carcass yield and quality measurements for meat-type goats within breed-type and feeding regimen

	Boer × Spanish		Spanish		
Item	Feedlot	Range	Feedlot	Range	SEM
Live wt, kg	38.17[e]	20.51[g]	33.52[f]	18.42[g]	1.21
Hot carcass wt, kg	21.72[e]	10.00[g]	19.24[f]	8.75[g]	.60
Longissimus muscle area, cm^2	12.51[e]	6.25[f]	11.51[e]	5.28[f]	.39
Actual fat thickness, cm	.12[e]	.03[g]	.07[e]	.03[g]	.01
Adjusted fat thickness, cm	.16[e]	.04[g]	.11[f]	.04[g]	.01
Body wall thickness, cm	1.32[e]	.62[f]	1.40[e]	.53[f]	.08
Carcass conformation score[a]	11.42[e]	3.25[g]	8.33[f]	1.83[g]	.65
Carcass length, cm	106.94[e]	92.13[f]	104.88[e]	90.49[f]	1.13
Leg circumference, cm	54.87[e]	44.03[g]	52.61[f]	42.60[g]	.63
Lean maturity score[b]	1.42[e]	1.37[e]	1.45[e]	1.42[e]	.04
Skeletal maturity score[b]	1.70[e]	1.42[f]	1.67[e]	1.47[f]	.06
Marbling score[c]	3.35[e]	1.70[f]	3.06[e]	1.80[f]	.20
Flank streaking score[c]	3.62[e]	2.01[f]	3.40[e]	1.78[f]	.16
Buckiness score[d]	4.42[e]	1.58[f]	4.00[e]	1.33[f]	.26

[a]Means based on a 15-point descriptive scale (1.0 = very angular, narrow, and thin; 15.0 = extremely thick and bulging).

[b]Means based on USDA (1992) skeletal and lean maturity scores for lamb where 1.00 = A^{00} and 2.00 = B^{00}.

[c]Means based on USDA (1992) marbling and flank streaking scores where 1.0 = Practically $Devoid^{00}$, 3.0 = $Slight^{00}$, and 5.0 = $Modest^{00}$).

[d]Means based on a 5-point scale (1.0 = no buckiness; 5.0 = extremely bucky).

[e,f,g]Within a row, means lacking a common superscript letter differ ($P < .05$).

Table 2. Least squares means of carcass components for meat-type goats within breed-type and feeding regimen

	Boer × Spanish		Spanish		
Cut and component	Feedlot	Range	Feedlot	Range	SEM
Side[a]					
Lean, %	57.79[b]	55.78[bc]	57.61[b]	55.28[c]	.65
Bone, %	26.50[c]	36.89[b]	27.58[c]	36.48[b]	.82
Fat, %	15.71[b]	7.34[c]	13.40[b]	8.24[c]	.81
Shoulder					
Lean, %	61.43[bc]	59.59[c]	63.30[b]	60.85[bc]	1.13
Bone, %	21.57[c]	31.93[b]	22.17[c]	29.42[b]	1.43
Fat, %	16.88[b]	8.16[c]	14.40[b]	9.45[c]	.89
Rack					
Lean, %	54.16[bc]	50.96[d]	56.16[b]	52.19[cd]	1.04
Bone, %	29.43[c]	43.97[b]	30.61[c]	40.38[b]	1.25
Fat, %	16.41[b]	5.07[c]	13.24[b]	7.43[c]	1.21
Shortloin					
Lean, %	56.54[b]	50.49[c]	52.83[bc]	50.34[c]	1.83
Bone, %	24.40[c]	42.68[b]	25.27[c]	39.47[b]	2.20
Fat, %	19.06[b]	6.83[c]	21.89[b]	10.19[c]	1.87
Sirloin					
Lean, %	57.17	54.36	56.41	54.18	1.48
Bone, %	21.02[c]	35.90[b]	25.34[c]	34.41[b]	1.90
Fat, %	21.81[b]	9.74[c]	18.25[b]	11.41[c]	1.43
Leg					
Lean, %	62.23[b]	59.56[c]	62.52[b]	59.05[c]	.59
Bone, %	29.54[c]	35.47[b]	31.01[c]	35.90[b]	.57
Fat, %	8.23[b]	4.97[d]	6.74[c]	5.05[d]	.51

[a]Side includes major wholesale cuts plus neck, shank, breast, plate, and flank.
[b,c,d]Within a row, means lacking a common superscript letter differ ($P < .05$).

at the same age. Boer × Spanish and Spanish goats differed only for conformation scores and actual and adjusted fat thicknesses in the feedlot treatment, when carcass traits were adjusted to a common live weight. Thus, the advantage of the Boer × Spanish kids is primarily in the greater live weight at a given age. There is a need for standardized grades to facilitate marketing of the various sizes and types of goats currently being produced. Because much of the goat meat consumed today is by ethnic groups with different preferences in terms of age, weight, and quality, future research should focus on market development and determining the demand for various types and sizes of goats.

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