Live and Carcass Traits and Cut Yields From Crossbred and Purebred Boer Wether Kid Goats

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Abstract—**Increased global demands for animal protein include increasing meat from more goats and more meat per goat. The objective was to evaluate relative influences of hybrid vigor (heterosis) and heritability by comparing live traits, carcass traits, and cut yields from purebred and crossbred Boer goats from the same herd. Wether kid goats (50, 75, 88, and 100% Boer; remainder Spanish; n = 10, 25, 24, 9, respectively) from a commercial producer were transported to university abattoirs. Live weights, linear body measurements, and conformation after overnight fasting were determined before humane sacrifice. Carcasses were evaluated after 22 h 4°C chilling for conformation, muscling, fat score, kidney fat, and flank color before cutting right sides into primal cuts. Shoulders, forelegs, hindlegs, and backs were manually deboned to obtain boneless yields. Results showed 50% Boer goats had heavier live slaughter weights; larger heart girth, chest width, and chest depth; and higher dressing percentages (P<0.05) than 100% Boer goats, which had the lowest (P<0.05) carcass fat score and hind leg circumference. Foreleg and back cuts were heavier and boneless foreleg yield, rib cuts, total carcass cuts, and boneless yields were lower (P<0.05) in 100% Boer goat carcasses. Simple correlations were 0.56 between live and carcass subjective conformation scores, 0.61 between dressing percentage and hindleg circumference, 0.52 between dressing percentage and boneless cut yield, and 0.64 between boneless hindleg and boneless cut yield. Conclusions are that additional data is needed to estimate goat meat yields from live or carcass traits.**

Keywords— **meat goats, live traits, carcass yields.**

I. INTRODUCTION

Goat production for meat remains a predominantly small-scale subsistence enterprise [1]. Goats are adaptable to harsh environments and have sustainable grazing and browsing behaviors, but sustainable productivity also depends upon profitability, and producer satisfaction. Genetic and environmental factors both influence meat goat performance. Hybrid vigor (heterosis) is higher in reproductive and growth traits while heritability is higher in carcass and meat characteristics [2]. Purebred goats would be expected to have more desirable carcasses and meat yields than crossbred goats so this study compared live meat goat traits at slaughter, carcass traits, and meat yields of crossbred and purebred Boer wether kid goats.

II. MATERIALS AND METHODS

Eight to 10 month old wether kid goats from a commercial meat goat producer were transported to university abattoirs in two successive years. Goats in the first year were 50, 75, and 88% Boer breeding with remainder Spanish breeding fed pasture and supplemental grain before transport 800 km to the LSU AgCenter Meat Laboratory and in the second year were 75, 88, and 100% Boer breeding with remainder Spanish breeding fed hay and supplemental pellets before transport 328 km to the Angelo State University. Numbers for the two years were 10 50%, 25 75%, 24 88%, and 9 100%.

After transport, goats were penned overnight with water before measurement of live weight; chine, loin, rump lengths; withers and hip heights; heart girth and barrel circumferences; chest width and depth; shoulder width; and visual appraisal of live conformation score. Slaughter was by approved humane methods in the inspected abattoirs as designated by the Institutional Animal Care and Use Committees at the two universities. Carcasses were chilled overnight at 2 to 4°C before evaluation of visual carcass conformation score, fat score, kidney and pelvic fat, and flank lean color [3] and measurement of hind leg circumference in the center and at the tail, barrel and chest body circumference, and aitch bone to first rib length.

Carcasses were split into sides for fabrication of right sides into neck, fore leg, shoulder, rib, back, and rear leg primal cuts with modification of the food service cutting style [3] so the hind leg and sirloin were not separated. Shoulders, fore legs, rear legs, and backs were manually deboned for commercial primal and boneless lean yields, calculated as percentage of cold side weight. Dressing percentage was calculated as hot carcass weight percentage of live slaughter weight. Data was analyzed by Proc GLM and Proc Corr procedures [4] using P=0.05 for significance of Least Square Means and simple correlation coefficients among variables with model of year and breed.

III. RESULTS

Year was a factor (P<0.05) for most live, carcass, and cut variables. Live slaughter weight was 25.6 kg in year 1 and 19.3 kg in year 2 (P<0.05). This was likely due to the higher energy supplement in the first year compared with the second year. Year was used as a covariate and breed as the independent variable in re-analysis of the data for statistically valid comparisons of all of the breed compositions.

The live and carcass conformation scores; chine, loin, and rump lengths; withers and hip heights; barrel circumferences; shoulder widths; kidney and pelvic fat estimations, flank color, and circumferences in center of hind leg, barrel, and chest were not different with breed composition. The least squares means of live and carcass traits that were different (P<0.05) with breed composition are in Table 1.

The percentages of cold side weight for carcass kidney and pelvic fat, fore legs, fore trotters, fore shanks, shoulders, necks, boneless shoulders, rear legs, rear trotters, rear shanks, boneless rear legs, and *Longissimus dorsi* and *Psoas major* muscles were not different with breed. The primal cut percentage least square means of fore legs with the trotters removed, boneless fore legs, trimmed ribs, and back that were different (P<0.05) are in Table 2. The table also gives the least square means for primal cut yields and boneless lean yields that varied (P<0.05) with percentage of Boer breed composition.

Live goat measurements were correlated (P<0.05) one another except for loin length with shoulder width and live conformation and rump length with loin length, withers height, and live conformation. Live visual conformation was correlated (P<0.001) with carcass conformation (r = 0.56). Dressing percentage was correlated (P<0.05) with live weight (r = 0.62). Lean flank color was not correlated with any live or carcass measurement. All other carcass characteristics were correlated (P<0.05) with live and one another (r = 0.29 to 0.94). Correlations of primal cuts with one another were variable.

Table 1. Live and carcass trait differences of Boer crossbred and purebred wether kid goats.

	% Boer breeding, remainder Spanish				
Variable	50	75	88	100	s.d.
Live slaughter weight, kg	24.4a	23.2ab	23.2ab	19.6b	4.1
Heart girth, cm	67.0a	64.9ab	64.4ab	60.8b	4.4
Chest width, cm	59.8a	42.6a	43.0a	36.3b	12.8
Chest depth, cm	43.3a	35.2a	35.5a	20.3b	11.9
Dressing percentage	62.4a	58.6a	59.1a	52.7b	6.0
Carcass fat score, 0 to 3	1.6a	1.3ab	1.2ab	0.8b	0.7
Leg circumference at tail, cm	46.6a	46.5a	46.3ab	42.7b	3.8
Carcass length, cm	64.2a	61.3ab	61.6ab	58.1b	4.4

Least square means in the same row with different letters are different (P<0.05).

Table 2. Primal cut and yield percentage differences of Boer crossbred and purebred wether kid goats.

	% Boer breeding, remainder Spanish				
Variable, % of cold side weight	50	75	88	100	s.d.
Fore leg, trotters removed	18.3b	18.9ab	18.3b	19.8a	1.3
Boneless fore leg	10.1a	9.7ab	9.8a	8.6b	1.1
Ribs, trimmed	9.9a	8.2ab	8.3a	6.3b	2.1
Back	14.3b	15.1b	15.1b	17.4a	1.8
Primal cut yield	86.0a	84.3ab	84.3ab	79.6b	3.9
Boneless lean yield	39.7a	37.9ab	38.9ab	36.5b	2.7

Least square means in the same row with different letters are different (P<0.05).

Correlations of primal cut and boneless yield percentages with selected live and carcass traits are in Table 3. Primal cut yield was correlated (P<0.0001) with boneless lean yield (r = 0.57). The four measurements of leg and body circumferences were correlated (P<0.0001) with primal cut yield and boneless lean yield at r = 0.45 to 0.61. Live and carcass conformation scores were negatively correlated with yields and fat score was lowly correlated (r = 0.27) with the primal cut and boneless lean yields.

Table 3. Simple correlations of primal cut and boneless yield percentages with selected live and carcass traits.

	Primal cut yield	Boneless yield
Live weight	0.56	0.46
Chine length	0.50	0.41
Hip height	0.54	0.39
Heart girth	0.51	0.45
Barrel circumference	0.41	0.41
Live conformation	-0.43	-0.31
Dressing percentage	0.66	0.52
Carcass conformation	-0.31	-0.18
Leg circumference at tail	0.50	0.46
Body circumference at ribs	0.61	0.48
Carcass length	0.52	0.46

All correlations higher than 0.45 have probabilities <0.0002.

Table 4. Simple correlations of primal cut and boneless yield percentages with selected meat cuts.

	Primal cut yield	Boneless yield
Fore shank	0.51	0.08
Fore leg	0.16	-0.10
Boneless fore leg	0.44	0.52
Shoulder	-0.14	-0.12
Boneless shoulder	0.11	0.56
Ribs, trimmed	0.81	0.54
Rear shank	0.43	0.14
Rear leg	0.47	0.41
Boneless rear leg	0.51	0.64
Back	-0.71	-0.29
Boneless back muscles	-0.48	0.05

All correlations higher than 0.45 have probabilities <0.0002.

IV. DISCUSSION

The body weight for all goats was less than that reported for 50% Boer cross goats [5] and 75% Boer goats [6] fed concentrates, but about the same weight for 5 month 50% Boer 50% Spanish wether kid goats fed on hay and grain [7].

It was expected that there would be differences in height and length measurements of the wether kid goats with breed composition because there were differences in live weight. Heterosis of 16.4 to 22.4% had also been reported for weight gain and size [1]. However, live weight was lower (P<0.05) only with the 100% Boer purebred goats. One factor may have been that the superior purebred and 7/8 (88%) Boer crossbred goats in the herd had previously been sold as sire bucks. Another factor is that heritability of growth traits is higher than heterosis and both Spanish crossbred dams and Boer sires had been selected for growth and size traits. It has been anecdotally observed by meat goat producers, but not reported in the scientific literature, that 50% and 75% breed composition of meat goats increases growth and meat deposition compared with 88% and purebred goats.

The only linear body measurements showing differences (P<0.05) with breed composition were heart girth, chest width, and chest depth. These results were unexpected since heart girth is measured around the chest and barrel circumference around the body middle. The goats had been fasted for 30 hours before slaughter so the barrel circumference should have been unaffected by digestive system fill. The chest width and depth differences might indicate slight differences in maturing patterns with the different goat breed compositions as growth in kid goats proceeds from anterior to posterior. However, it would be anticipated that chine, loin, and rump length differences would have been observed if this were a primary cause of the differences in chest measurements.

Contrary to expectations, the visually assessed live and carcass conformation scores (2^{87} and 1^{19}, respectively) were not different with the different weights, heart girth body sizes, and chest widths and depths between the purebred and crossbred kid goats. The lack of differences might indicate the uniformity of the entire farm goat herd for the two years of study or the relatively high standard deviations (±39) among the groups of goats.

The dressing percentages were much higher than the 48 to 50% expected for wether kid goats [7]. The fat scores, leg circumferences at the tail, and carcass lengths were lowest (P<0.05) for purebred Boer kid goats compared with the 50% crossbred Boer kid goats. The heterosis for width, shape, and internal fatness was reported to be 4.3-8.6% [2], which would only partially explain the differences observed in the present study. The increased size of the crossbred goats would correspond with some of the differences in carcass traits, but would not explain that the carcass conformation scores and the other carcass circumference measurements were not different.

There were only a few differences in primal cut percentages with breed composition. The fore leg and boneless fore leg differences between the purebred and crossbred wethers can be explained by increased bone amounts in the fore leg with higher percentages of Boer breeding that resulted in correspondingly lower boneless fore leg percentages. The increased live heart girth and chest measurements were reflected as higher proportions of ribs, but lower proportions of back primal cuts, with increased Boer percentage.

Heavier goats would be expected to yield more primal cuts and heavier muscled goats would be expected to yield higher proportions of lean meat. High correlations of live weight with the primal cut and lean meat yields were observed in this study. The differences in magnitude and significance of the correlations between live goat measurements and primal cut and boneless lean yields cannot be fully explained by differences in growth patterns, heritability, or heterosis among the goat breed compositions. The variability in measuring accuracy of the live goat linear measurements would contribute to inconsistencies in correlations on the relatively small numbers of goats in this study.

It was unexpected to have negative correlations between live and carcass conformation scores and the primal cut and lean yields because conformation scores were developed to estimate the relative proportions of muscling to fat and bone [3]. This may be an artifact of the study or an indication that it is difficult to accurately evaluate the visual differences in goat and carcass body characteristics. The trimmed ribs were highly correlated with primal cut yields while the boneless rear leg had the highest correlation with lean meat yield of the boneless meat cuts. These correlations would correspond with the high correlation of the live goat heart girth with primal cut yields. Rear leg composition is highly related to carcass composition in other meat species. The highly negative correlation of the back with the primal cut yields and low correlation of boneless back muscles with primal cut yields and boneless yields emphasizes that the *Longissimus dorsi* muscle size often used in estimations of lean yields in beef, pork, and lamb carcasses is of much less value for goat carcasses.

V. CONCLUSIONS

The 50% and 75% breed compositions provided higher primal cut and lean yields, which would match the higher live weights and dressing percentages. Uniform goat herds will have minimal variation in traits with breed type. Increased numbers of kid goats of each breed composition would provide additional insight into the results of this study.

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