

CARCASS QUALITY TRAITS AMONG CROSSES OF ANGUS, SANTA GERTRUDIS AND GELBIEH BEEF CATTLE

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Summary

A total of 333 calves were evaluated for carcass quality traits including: dressing percentage (DP), yield grade (YG), marbling score (MS), fat thickness (FT) and percent body fat (PF). Mating types included straightbred Angus (A) and Santa Gertrudis (S), the reciprocal crosses of these two breeds and Gelbvieh (G) × Angus. The year of birth, slaughter group and dam breed were found to have greatly influenced DP. Mating types had no effect on DP. For YG, sire breed, sire within sire breed and slaughter group were important. Crossbreds of A × S had the highest YG followed by A purebreds. Crossbreds of G × A had the lowest YG. Sire breed, dam breed and the slaughter group has significantly affected the MS. Sire breed, sire nested within sire breed and slaughter group were found to have greatly influenced the FT. Sires and dams of A produced the greatest FT while sires of G produced the lowest. Slaughter group 2 (slaughtered at 433 days of age) had a greater FT than group 1 (slaughtered at 393 days of age). For PF, sire breed, sire within sire breed, dam breed and slaughter group had significant effects. A purebreds had the largest PF while S purebreds and G × A crosses had the least.

(Key Words : Beef Cattle, Angus, Santa Gertrudis, Gelbvieh, Heterosis, Marbling Scores, Yield Grade, Fat Thickness)

Introduction

Commercial cattlemen have become dependent on crossbreeding systems for efficient and profitable beef cattle production in the USA. (Gotti and Benyshek, 1988). Crossbreeding provides the quickest improvement in beef traits of economic importance through heterosis of breed differences. Carcass attributes, including composition and palatability of meat from different breeds or breed crosses, are important in determining the potential value of alternative germ plasm resources for profitable beef production. It had been reported that growthier types tend to have leaner carcass at comparable weights (Koch et al., 1982).

This paper discusses the meat quality characteristics of calves from a partial diallel mating scheme utilizing straightbred Angus and

straightbred Santa Gertrudis and then crosses plus Gelbvieh × Angus crosses.

Materials and Methods

Angus (A), Santa Gertrudis (S) and Gelbvieh (G) sires were mated to Angus and Santa Gertrudis dams to produce five mating types, A × A, S × S, S × A, A × S and G × A. Cattle were grouped together and then randomly allotted to two slaughter groups each year of study. Age weight, mating type and sex were considered in the stratified randomization procedures. Number of calves and sires are shown in table 1. The data were obtained from the University of Georgia Experiment Station on calves born from 1977 through 1980. The station is located in the Piedmont area of Georgia. The average rainfall for the area is 128 cm with a mean temperature of 16.3°C (Gotti et al., 1985; Gotti and Benyshek, 1988).

Cow herds were maintained on pastures of Fescue in winter and Bermuda grass in summer and, when required cows were supplemented with grazing (winter animals), hay and corn. The calves were born between January and March of each

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year of the study. Bull calves were castrated soon after birth. The weaned calves were randomly allotted to feeding pens by sex.

After an adjustment period the calves were fed a free choice high energy concentrate diet consisting of steamed rolled corn (65.5%), soybean oil meal (8%), liquid molasses (0.5%), cottonseed hulls (10%), peanut hulls (10%), trace mineral salt (0.5%), defluorinated phosphate (0.5%) and limestone (0.5%).

Cattle were slaughtered at approximately 393 and 433 days of age for slaughter group 1 and 2, respectively. The cattle were slaughtered at a commercial packing plant.

Data collected

Hot-carcass weight, quality grade, fat thickness over the 12th rib eye area, yield grades, estimates of kidney, pelvic and heart fat and marbling scores were taken according to USDA standards after approximately 48 hours chilling at 2 to 3°C. Percent body fat was estimated by the formula described by Kraybill et al. (1952). The specific gravity was measured from the 9th, 10th and 11th rib weight in air and water. Yield grades were computed using the formula given by Romans and Ziegler (1977). The traits examined in this study included the dressing percentage (DP), yield grade (YG), marbling score (MS), fat thickness (FT) and percent body fat (PF).

Data analysis

Data were analyzed using computational procedures of the statistical analysis system (Barr et al., 1979). Several statistical models were used in this study, which included calf year, sire breed, sire nested within breed of sire, dam breed, slaughter group, the interaction of sire breed \times dam breed and a covariate for age at slaughter. The deviation of age from the average age of the slaughter group was used in this analysis. In addition to age at slaughter used as a covariate other models were alternately included as covariates: FT, PF, MS and carcass weight nested within the slaughter group. The component of sires nested within sire breed was used as the error term to test for sire breed effect. The interaction of sire breed \times dam breed was kept in the model to examine the effect of heterosis, which was found significant for some of the traits evaluated. The interaction of calf year

\times slaughter group and calf year \times dam breed were found significant for most of the traits but their biological significance was not clear. Other two-way interactions were non-significant and, therefore removed from the models. The three-way interaction of sire breed \times dam breed \times slaughter group was found to be non-significant and therefore removed from subsequent models.

Results and Discussion

The effects of calf year, sire breed, sire within sire breed, dam breed, slaughter group and interaction of sire breed \times dam breed on various carcass traits of economic importance are discussed below for all the five mating types. The mating plan is given at table 1.

TABLE 1. CARCASSES EVALUATED

Breed of sire	Breed of dam		
	Angus	Santa Gertrudis	Total
Angus (26 ^a)	96 (49)*	44 (24)	140 (73)
Santa Gertrudis (23)	84 (50)	46 (23)	130 (73)
Gelbvieh (14)	63 (37)	— —	63 (37)
Total	243 (136)	90 (47)	333 (183)

* Number of hindquarters evaluated.

* Number of sires used.

Dressing Percentages

Least square means and standard error estimates, are given in table 2. DP was found to have been greatly affected by the year of calf in all the models. Other factors which contributed to variation of DP were slaughter group and age as a covariate within slaughter group. Obviously, slaughter group two had on the average a highest DP as compared to the first group. When carcass weight was put in the model as another covariate, in addition to age at slaughter within slaughter group, the effect of dam breed was found to be highly significant. Carcass weight used as a

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covariate was source of double adjustment for DP, since it is part of DP. Therefore, the effect of dam breed represents true genetic effect for this trait. Dams of A breed produced progeny which on average had higher DP. Many research

workers have reported DP of various meat animals including cattle. Long and Gregory (1975) estimated heterosis for carcass characters from A and Hereford crosses and observed results similar to those presented here.

TABLE 2. ESTIMATES OF HETEROSIS AND LEAST SQUARE MEANS AND STANDARD ERROR FOR BREED OF SIRE, BREED OF DAM, CALF YEAR, SLAUGHTER GROUP AND BREED OF SIRE X BREED OF DAM

Mating or effect ¹	Dressing percent	Yield grade	Marbling score	Fat thickness (cm)	Percent body fat
AA	63.0 ± .002 ^a	3.6 ± .1 ^a	19.1 ± .5 ^a	1.8 ± .08 ^a	30.6 ± .3 ^a
AS	63.0 ± .003 ^a	3.8 ± .1 ^a	15.3 ± .6 ^b	1.8 ± .10 ^a	28.0 ± .4 ^b
SA	63.0 ± .002 ^a	3.4 ± .1 ^b	15.1 ± .5 ^b	1.5 ± .08 ^b	28.6 ± .4 ^b
SS	63.0 ± .003 ^a	3.3 ± .2 ^b	12.3 ± .7 ^c	1.3 ± .10 ^b	27.0 ± .5 ^c
GA	63.0 ± .002 ^a	2.6 ± .1 ^c	15.8 ± .7 ^b	1.0 ± .08 ^c	27.0 ± .4 ^c
A Sires	63.0 ± .002 ^a	3.7 ± .1 ^a	17.3 ± .3 ^a	1.8 ± .05 ^a	29.0 ± .2 ^a
S Sires	62.0 ± .002 ^b	3.3 ± .1 ^b	13.6 ± .3 ^b	1.5 ± .05 ^b	27.6 ± .2 ^b
G Sires	62.0 ± .003 ^b	2.6 ± .1 ^c	15.5 ± .5 ^b	1.1 ± .05 ^c	26.5 ± .3 ^c
A Dams	63.0 ± .001 ^a	3.2 ± .1 ^a	16.7 ± .2 ^a	1.5 ± .03 ^a	28.8 ± .2 ^a
S Dams	62.0 ± .002 ^b	3.3 ± .1 ^b	13.2 ± .4 ^b	1.5 ± .05 ^a	27.2 ± .3 ^b
77 Calf yr	63.0 ± .002 ^a	3.1 ± .1 ^a	15.2 ± .3 ^a	1.3 ± .05 ^a	27.6 ± .2 ^a
78 Calf yr	64.0 ± .002 ^b	3.0 ± .1 ^b	14.8 ± .4 ^a	1.3 ± .05 ^a	27.1 ± .3 ^a
79 Calf yr	64.0 ± .002 ^b	3.4 ± .1 ^b	16.8 ± .4 ^b	1.5 ± .05 ^b	29.0 ± .3 ^b
80 Calf yr	61.0 ± .003 ^c	3.9 ± .1 ^c	15.2 ± .4 ^a	1.9 ± .05 ^c	30.1 ± .3 ^c
SG I ³	62.0 ± .002 ^a	3.2 ± .1 ^a	14.6 ± .3 ^a	1.3 ± .03 ^a	28.3 ± .3 ^a
SG II	63.0 ± .002 ^b	3.5 ± .1 ^b	16.5 ± .3 ^b	1.7 ± .05 ^b	28.8 ± .2 ^a
Heterosis ²	0	0.2 (5.9%)	-0.5 (3%)	0.05 (8.3%)	0

¹ A = Angus, S = Santa Gertrudis, G = Gelbvieh, Sires/breed listed first.

² Heterosis = 1/2 [(SA + AS) - (AA + SS)].

³ SG I (slaughter group I) = 393 d, SG II = 433 d.

^{a,b,c} Values with different superscripts are different (p < .05).

Yield Grade (or Actual Yield)

Least square means and standard error estimates are presented in tabel 2 for YG. Sire breed, sire within sire breed, and slaughter group, were found to be significant. Crossbreds from A x S had the highest numerical YG, followed by purebred A, although the effects of heterosis was not significant. Among the crossbreds, G x A had the lowest numerical YG compared to other groups indicating their advantages in leanness. Purebred S were the next lowest group in YG.

Baker et al. (1984) reported that Hereford

and A ranked high for conformation score and final grade while Holstein and Jersey ranked low in these traits. These findings are similar to the present study. Other scientists have reported similar results: Long and Gregory 1975, Swartzel et al. 1984, Young 1978, Clayton et al. 1979 and Gotti 1982.

Marbling

Least square means and standard error estimates are given in table 2 for MS. Marbling is one of the important factors in determining the

quality grade of beef. MS were significantly affected by the sire breed, dam breed and slaughter group. Heterosis was non-significant. PF as a covariate was highly significant in this analysis; MS and PF have linear relationship with each other. In these analysis, purebred A progeny were the highest, purebred S the lowest and the crossbreds intermediate in average MS. The G crossbreds had less fat but equivalent MS when compared to the other crosses. Calf year, sire within sire breed, and age at slaughter seemed to have no effect on this traits. Baker et al. (1984) analyzed carcass data from bulls of five breeds; A, Brahman, Hereford, Holstein and Jersey and their reciprocal crosses, and reported heterosis estimates for many traits including MS. They used the proportion of estimated respective breed-type mature size at slaughter as a covariate and observed that Hereford and A ranked higher for MS than Holsteins and Jerseys. In our study A were found to have more marbling than all the other breeding groups.

Drewry et al. (1979) reported results similar to the current study. They found that steers from A sires had greater rib eye area, and rib fat depth, USDA carcass grades and MS. Significant dam breed effects were also observed in these traits. Adams et al. (1977) reported that steers sired by British breeds (A, Hereford and Lincoln Red) had higher MS as compared to French breeds, namely, Limousin, Maine Anjou and Charolais. Swortzel et al. (1984) analyzed the carcass data from steers sired by A, Charolais and Holstein bulls bred to A cows and reported result similar to those found in the present study. Similarly, Young (1978) observed that steer sired by A bulls had the most fat cover and poorest YG, but had the highest MS and quality scores.

Fat Thickness

Least square means and standard error estimates for FT are given in table 2. This is another trait of economic importance for beef producers. It is measured to determine the YG of slaughtered cattle. FT was found to have been influenced by the sire breed, sire nested within sire breed and slaughter group. A sires and dam produced the greatest FT and G sires produced the lowest. Slaughter group 2 had greater FT than group 1.

Baker et al. (1984) analyzed carcass data from

bulls of five breeds and their reciprocal crosses. They reported heterosis estimates for FT to be negative. In the present study it was observed that the progeny of purebred A and A \times S crossbreds had greater FT as compared to the other groups. The crossbred progeny of G \times A measured the lowest FT. When FT was used as another covariate, in addition to age at slaughter within slaughter group, the effect of sire within sire breed was no longer an important source of variation. However, with MS as a covariate instead of PF, the significance of sire nested within breed of sire was regained. Using carcass weight nested within slaughter group had a similar effect, as found in the original model, except that calf year was found to be significant. This could be attributed to environmental variation. Difference in these models suggest that covariates such as MS, PF or carcass weight are unlikely to result in comparable fat thickness in the carcass from widely divergent genetic types.

Adams et al. (1977) compared carcass traits of steers from Hereford dams sired by Hereford, A, Lincoln Red, Brown Swiss, Simmental, Limousin, Maine Anjou or Charolais bulls. They observed that British breeds had greater FT than other breeds. Similar results were also reported by Long and Gregory (1975), Swortzel et al. (1984) and Hedrick et al. (1975). All these results are similar to this study.

Percent Body Fat

Least square means and standard error estimates for PF are given in table 2. Sire breed, sire within sire breed, dam breed, slaughter group, age at slaughter within slaughter group, FT and MS has significant effects on PF when the later three effects were included as covariates in the model. Heterosis or interaction between sire breed \times dam breed was found to be non-significant. Purebred A cattle were found to have the largest amount of body fat while purebred Santa Gertrudis and G \times A crossbreds had the least.

Other scientists have also worked on these important traits and have reported results similar to this study. Dhuyvetter et al. (1985) compared carcass traits of Charolais and Limousin as terminal cross sire breeds. They observed that Charolais crosses had slightly less internal and external fat. Dean et al. (1976) observed that both fat thickness and kidney, heart and pelvic fat

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per 100 kg of carcass tended to decrease with increasing levels of Holstein breeding.

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