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# CHARACTERIZATION OF DIFFERENT BIOLOGICAL TYPES OF STEERS (CYCLE IV): RETAIL PRODUCT YIELDS [1]

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## Summary

Retail product (RP) yields of 888 steers were obtained from mating Hereford (H) and Angus (A) dams to H or A (HA), Charolais (Ch), Gelbvieh (Gb), Pinzgauer (Pz), Shorthorn (Sh), Galloway (Gw), Longhorn (Lh), Nellore (Ne), Piedmontese (Pm), and Salers (Sa) sires. The yields were measured at two trim levels (.30 and .00 in.). Data were evaluated at constant age (426 d), carcass weight (714 lb), and marbling (Small$^{00}$) endpoints. At a constant age of 426 d, RP% was greater in carcasses from steers sired by Continental European breeds (Gb, Ch, Sa, Pz; 63.3 to 65.5 % at .00 in. trim) than steers sired by British breeds (Sh, HA; 60.1 to 61.0%). Carcasses from Pm-sired steers had the highest RP% (69.7%) at the age-constant endpoint. Although carcasses were heavier (P<.05) for Ch-sired than for Pm-sired steers, lean growth rate measured by RP trimmed to .30 in. fat at 426 d, was similar for Ch- and Pm-sired steers. Lean growth rate was slowest for Lh-sired steers. Differences in RP% among sire breeds were minor at the Small$^{00}$ marbling endpoint. The ranking of sire breeds for weight of RP at a constant age of 426 d was: Ch, Pm, Gb, Sa, Ne, Pz, HA, Sh, Gw, and Lh. These sire-breed differences in RP yields allow for selection and crossing of breeds to optimize these traits. Of the breeds evaluated, Pm-sired steers produced the most muscular, trimmest, and highest cutability carcasses, and HA and Sh-sired steers produced the fattest, lowest cutability carcasses. Lh-sired steers had the slowest lean growth rate. Differences in RP% and(or) weight among sire breeds should be balanced with meat quality and other important production traits.

(Key Words: Breeds, Carcasses, Retail Product.)

## Introduction

Breed differences in production traits are essential genetic resources for improving beef production efficiency and carcass RP yields, because no breed excels in all traits important to beef production. Diverse breeds are necessary to exploit heterosis and complementarity through crossbreeding and to match genetic potential with feed resources, environments, and market demands. Considerable variation in percentage and weights of retail product and fat trim was detected among 16 sire breeds characterized in the first three cycles of the GermPlasm Evaluation (GPE) research project at the Roman L. Hruska U.S. Meat Animal Research Center. The objective of Cycle IV research, which includes six new breeds and five breeds repeated from earlier cycles of GPE research, was to characterize a new sample of cattle breeds representing diverse biological

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types for carcass yields of RP, fat trim, and bone that affect quantity and value of production.

## Experimental Procedures

Cycle IV of the GermPlasm Evaluation program began in 1985. Hereford and Angus dams were mated by AI to 30 Angus, 32 Hereford (both born 1982 to 1984), 29 Longhorn (Lh), 24 Piedmontese (Pm), 31 Charolais (Ch), 29 Salers (Sa), 31 Galloway (Gw), 22 Nellore (Ne), and 26 Shorthorn (Sh) bulls to produce progeny in five calf crops. Only data from Hereford × Angus and Angus × Hereford (HA) matings and not purebreds are presented to avoid confounding sire-breed effects with heterosis effects. After a 45-day AI period, one or two bulls each of Hereford, Angus, Ch, Gelbvieh (Gb), and Pinzgauer (Pz) breeds were used each year by natural service in single-sire breeding pastures. Data from cleanup (CU) sires were reported separately from AI sire data because of differences in selection intensity for those sires.

Calves were born from mid-March to late May and creep fed whole oats from mid July or early August until weaning in October at about 170 days of age. Following a postweaning adjustment of 25 to 40 days, steers were fed separately by sire breed in replicated pens for about 200 days. A growing diet containing 66% corn silage, 22% corn, and 12% supplement (dry matter basis) was fed until steers weighed about 706 lb. Then a finishing diet containing 25% corn silage, 70% corn, and 5% supplement was fed to slaughter. Steers were slaughtered serially each year, in three or four groups spanning 56 to 84 days. USDA yield and quality grade data were obtained by USDA-ARS personnel.

The right side of each carcass was fabricated into subprimal cuts trimmed to .30 in, lean trim (20% fat), fat trim, and bone. Retail product was the sum of subprimal cuts plus lean trim. Subprimal cuts then were trimmed free (.00 in.) of surface fat, and all components were reweighed.

Data were analyzed by least squares, mixed model procedures. In addition, linear regressions of traits on days fed provided a method of adjusting the age constant sire breed means to alternative endpoints. The regressions were used for estimating values that would have been obtained if all animals in a sire breed had been fed fewer or more days until the breed group average reached a given endpoint with regard to age, carcass weight, fat thickness, fat trim percentage, or marbling.

## Results and Discussion

When data were adjusted to 426 days of age, AI Ch-sired steers produced the heaviest carcasses, whereas Lh-sired steers produced the lightest carcasses (Table 1). Carcasses produced by Gw-sired steers were lighter than all breeds except Lh. Carcasses from AI Ch- and Pm-sired steers produced greater weights of RP than most other sire breeds at both trim levels. Carcasses from Lh-sired steers produced the lowest weight of RP at both trim levels, followed by Gw- and CU HA-sired steers. AI HA- and Sh-sired steers produced similar weights of RP. Carcasses from Pm-sired steers produced the lowest weight of fat trim at both trim levels, whereas Sh- and AI HA-sired steers produced the most fat trim (Table 1). AI Ch-sired steers yielded the greatest weight of bone, whereas Lh-sired steers yielded the lowest weight of bone followed by Gw-sired steers. Differences in weights of carcass components, of course, were associated with sire-breed differences in carcass weights.

When RP, fat trim, and bone were expressed as percentages of carcass weights, Pm-sired steers showed greater advantages over other breeds in percentages of RP and fat trim than in weights of these components. Their RP% was 4.2 to 5.8% greater at .00 in. trim than the Ch- and Gb-sired groups. AI Ch-, CU Ch-, Sa-, and CU Gb-sired steers were intermediate in RP% (64.2 to 65.5% at .00 in. trim), whereas AI HA-, CU HA- and Sh-sired steers had the lowest RP% (60.1 to 61.0% at .00 in. trim). These differences in RP% among sire-breed groups largely were due to differences in percentages of fat trim, but also to differences in muscle to bone ratio rather than to differences in percentages of bone. For example, the difference between AI HA- and Pm-sired steers in percentage of fat trim (.00 in.) was 26.4 versus 16.9%, respectively, whereas no difference occurred in percentage of bone (13.4 versus 13.4%). The range in percentage of bone among all sire-breed groups was from 13.4 to 14.5%.

When data were adjusted to a constant carcass weight of 714 lb, Pm-sired steers still produced the highest RP% and lowest percentage of fat trim. Shorthorn-, CU HA-, AI HA-, and Lh-sired steers produced carcasses with the lowest RP%. Longhorn-sired steers produced carcasses with a higher percentage of fat trim than all sire breeds except CU HA-, AI HA-, and Sh-sired steers. Carcasses from Pm-sired steers produced the lowest percentage of fat trim of all sire breed groups. In fact, Pm-sired steers produced less fat at .00 in. trim than AI HA-, CU HA-, Sh-, Gw- and Lh-sired steers when trimmed to only .30 in. The percentage of bone still ranged only from 13.0 to 15.0% among sire breed groups when data were adjusted to a constant weight of 714 lb. These differences among sire breeds at 714 lb endpoint reflect maximum variation in RP, fat trim, and bone percentages relative to age or marbling endpoints.

At a constant marbling endpoint ($Small^{00}$), CU Ch- and Ne-sired steers produced the heaviest carcasses, whereas Sh-, Lh and CU HA-sired steers produced the lightest. Carcasses from Pm-sired steers still had the highest RP%, whereas AI HA and Ne-sired steers had lower RP% than all sire breeds except for CU Ch-sired steers. Percentages of fat trim among AI HA-, CU HA, Lh-, and Sa-sired steers were not different (P<.05) at $Small^{00}$ marbling. However, Sh-sired steers produced carcasses with a lower percentage of fat trim than AI HA- and CU Ch-sired steers at $Small^{00}$ marbling. Percentage of fat trim was highest for Ne-sired steers at $Small^{00}$ marbling. Percentages of bone changed only slightly when the data were adjusted to different endpoints.

On the average, RP% was reduced 5.6% by trimming all fat (.00 in.) compared to leaving .30 in. of fat on subprimal cuts. Trim level had little impact on sire breed differences in RP%, although relatively less fat was trimmed from Pm- and more from Sh- and HA-sired steers by trimming to .00 in. compared to trimming to .30 in.

**Table 1. Sire Breed Least Squares Means for Product Yields at Two Fat Trim Levels Adjusted to 426 Days of Age**

| | | | Sire Breed[a] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trait | Trim Level | Mean | AI HA | CU HA | AI Ch | CU Ch | CU Gb | CU Pz | Sh | Gw | Lh | Ne | Pm | Sa | LSD[b] |
| Cold carcass wt, lb[c] | | 686 | 718 | 679 | 751 | 720 | 709 | 690 | 716 | 645 | 600 | 711 | 695 | 717 | 22.5 |
| Product wt, lb | | | | | | | | | | | | | | | |
| Total retail product | .30 in. | 468 | 473 | 452 | 524 | 503 | 498 | 473 | 468 | 444 | 411 | 487 | 515 | 498 | 16.3 |
| | .00 in. | 430 | 431 | 412 | 484 | 464 | 461 | 436 | 427 | 407 | 378 | 447 | 483 | 459 | 15.4 |
| Fat trim | .30 in. | 132 | 157 | 142 | 127 | 124 | 119 | 128 | 156 | 122 | 114 | 137 | 96 | 127 | 12.3 |
| | .00 in. | 162 | 191 | 174 | 157 | 154 | 148 | 157 | 188 | 151 | 139 | 169 | 120 | 157 | 13.7 |
| Bone | .30 in. | 86 | 88 | 85 | 100 | 93 | 91 | 89 | 92 | 80 | 75 | 87 | 85 | 92 | 3.1 |
| | .00 in. | 94 | 96 | 93 | 109 | 101 | 99 | 97 | 100 | 87 | 83 | 95 | 93 | 100 | 3.5 |
| Product, %[d] | | | | | | | | | | | | | | | |
| Total retail product | .30 in. | 68.5 | 66.1 | 66.8 | 70.0 | 70.2 | 70.6 | 68.8 | 65.7 | 69.0 | 68.7 | 68.7 | 74.3 | 69.6 | 1.3 |
| | .00 in. | 62.9 | 60.2 | 61.0 | 64.8 | 64.9 | 65.5 | 63.4 | 60.1 | 63.3 | 63.3 | 63.2 | 69.7 | 64.2 | 1.4 |
| Fat trim | .30 in. | 18.9 | 21.4 | 20.6 | 16.6 | 16.8 | 16.4 | 18.2 | 21.4 | 18.6 | 18.7 | 18.9 | 13.5 | 17.5 | 1.5 |
| | .00 in. | 23.3 | 26.4 | 25.3 | 20.7 | 20.0 | 20.4 | 22.5 | 25.9 | 23.1 | 22.9 | 23.4 | 16.9 | 21.7 | 1.6 |
| Bone | .30 in. | 12.6 | 12.3 | 12.6 | 13.4 | 13.0 | 13.0 | 13.0 | 12.9 | 12.5 | 12.6 | 12.3 | 12.2 | 12.9 | .4 |
| | .00 in. | 13.8 | 13.4 | 13.7 | 14.5 | 14.2 | 14.1 | 14.1 | 14.1 | 13.6 | 13.8 | 13.5 | 13.4 | 14.0 | .4 |

[a]The Hereford and Angus sires were considered new (born 1982-84) relative to the original Hereford and Angus sires (born 1963-70) used in Cycles I to III of the GermPlasm Evaluation project. Cleanup (CU) sires also represented "new" sires, but did not have as much selection intensity as the AI sires, and thus results from their progeny were reported separately. HA = Hereford × Angus and Angus × Hereford crosses, Ch = Charolais, Gb = Gelbvieh, Pz = Pinzgauer, Sh = Shorthorn, Gw = Galloway, Lh = Longhorn, Ne = Nellore, Pm = Piedmontese, Sa = Salers.
[b]LSD is the least difference between means of breeds required for significance (P<.05).
[c]Calculated as the sum of all dissected parts from each side (x 2 to give carcass weight) to avoid confounding percentage yield differences with differences in side shrink caused by various lengths of time before sides were cut.
[d]Expressed as a percentage of carcass weight.

**Table 2. Sire Breed Least Squares Means for Percentages of Product at Two Fat Trim Levels Adjusted to a Common Carcass Weight or Marbling Endpoint**

| | | Sire Breed[a] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Endpoint | Trim Level | AI HA | CU HA | AI Ch | CU Ch | CU Gb | CU Pz | Sh | Gw | Lh | Ne | Pm | Sa | LSD[b] |
| Carcass wt, 714 lb | | | | | | | | | | | | | | |
| Total retail product, % | .30 in. | 67.0 | 66.6 | 71.7 | 71.1 | 71.3 | 68.9 | 66.4 | 67.8 | 66.0 | 69.3 | 74.6 | 70.3 | 1.3 |
| | .00 in. | 61.2 | 60.8 | 66.5 | 65.8 | 66.1 | 63.5 | 60.8 | 62.1 | 60.5 | 63.8 | 70.0 | 65.0 | 1.4 |
| Fat trim, % | .30 in. | 20.3 | 20.9 | 14.8 | 15.8 | 15.7 | 18.1 | 20.3 | 20.1 | 22.1 | 18.2 | 13.3 | 16.7 | 1.5 |
| | .00 in. | 25.1 | 25.6 | 18.8 | 20.0 | 19.7 | 22.4 | 24.8 | 24.6 | 26.4 | 22.6 | 16.7 | 20.8 | 1.7 |
| Bone | .30 in. | 12.5 | 12.6 | 13.8 | 13.2 | 13.2 | 13.0 | 13.1 | 12.1 | 11.9 | 12.5 | 12.3 | 13.1 | .4 |
| | .00 in. | 13.6 | 13.7 | 15.0 | 14.4 | 14.3 | 14.1 | 14.3 | 13.3 | 13.0 | 13.6 | 13.5 | 14.3 | .4 |
| Marbling, small[00] | | | | | | | | | | | | | | |
| Carcass weight, lb | | 617 | 547 | 716 | 760 | 705 | 597 | 544 | 596 | 564 | 749 | 708 | 714 | 24.3 |
| Total retail product, % | .30 in. | 68.7 | 70.2 | 70.9 | 69.2 | 70.7 | 71.3 | 69.9 | 70.3 | 69.8 | 67.8 | 73.9 | 69.7 | 1.3 |
| | .00 in. | 62.8 | 64.4 | 65.7 | 63.9 | 65.6 | 65.9 | 64.3 | 64.7 | 64.4 | 62.2 | 69.3 | 64.3 | 1.5 |
| Fat trim, % | .30 in. | 17.9 | 15.7 | 15.7 | 17.9 | 16.3 | 15.2 | 15.1 | 16.9 | 17.3 | 20.2 | 13.8 | 17.4 | 1.6 |
| | .00 in. | 22.6 | 20.4 | 19.7 | 22.1 | 20.3 | 19.4 | 19.6 | 21.3 | 21.5 | 24.7 | 17.2 | 21.6 | 1.7 |
| Bone | .30 in. | 12.9 | 13.6 | 13.6 | 12.7 | 13.0 | 13.6 | 14.1 | 12.8 | 12.9 | 12.1 | 12.1 | 12.9 | .4 |
| | .00 in. | 14.1 | 14.7 | 14.8 | 13.9 | 14.2 | 14.8 | 15.3 | 14.0 | 14.1 | 13.2 | 13.3 | 14.1 | .4 |

[a]The Hereford and Angus sires were considered new (born 1982-84) relative to the original Hereford and Angus sires (born 1963-70) used in Cycles I to III of the GermPlasm Evaluation project. Cleanup (CU) sires also represented "new" sires, but did not have as much selection intensity as the AI sires, and thus results from their progeny were reported separately. HA = Hereford × Angus and Angus × Hereford crosses, Ch = Charolais, Gb = Gelbvieh, Pz = Pinzgauer, Sh = Shorthorn, Gw = Galloway, Lh = Longhorn, Ne = Nellore, Pm = Piedmontese, Sa = Salers.

[b]LSD is the least difference between means of breeds required for significance (P<.05).