CARCASS AND MEAT CHARACTERISTICS OF TULI, BORAN, BRAHMAN, BELGIAN BLUE, PIEDMONTESE, HEREFORD, AND ANGUS BREED CROSSES IN THE CATTLE GERMPLASM EVALUATION PROGRAM

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SUMMARY

Preliminary results are presented for live weight at slaughter and carcass and meat characteristics of steers in the first of three calf crops to be produced in Cycle V of the Germplasm Evaluation (GPE) Program at the Roman L. Hruska U. S. Meat Animal Research Center (MARC). Progeny of Hereford, Angus and Belgian Blue sires were heavier (441 days) than those of Brahman, Piedmontese, Boran, or Tuli sires ($P<.05$). Mean weight of retail product was greater for progeny of Belgian Blue sires than for Piedmontese sires, which was greater than for Hereford, Angus or Brahman sires, which was greater than for Tuli and Boran sires ($P<.05$). Progeny of Piedmontese and Belgian Blue sires exceeded those of all other sire breeds in percentage of retail product ($P<.05$). Marbling score was higher in progeny of Angus, Tuli, Hereford and Boran sires than in progeny of Piedmontese sires, which was higher than in progeny of Brahman and Belgian Blue sires ($P<.05$). Shear force and sensory panel evaluations indicated that longissimus muscle steaks from progeny of Belgian Blue, Piedmontese, Angus, Hereford, and Tuli sires were significantly more tender than those from progeny of Boran or Brahman sires.

INTRODUCTION

Breed differences in bioeconomic traits are an important genetic resource for improving efficiency of beef production. Diverse breeds are necessary to exploit heterosis and complementarity through crossbreeding and in new composite breeds to match genetic potential with market requirements and diverse feed resources and climates. Beef producers are under increasing pressure to reduce fat while maintaining tenderness and palatability of products. No single breed excels in all traits of importance to beef production. *Bos indicus* X *Bos taurus* (e.g., Brahman, Sahiwal and Nellore sired F_1 cows out of Hereford or Angus dams) crosses were exceptionally productive and efficient cows (Cundiff et al., 1986; Green et al., 1991), especially in subtropical environments (Olson et al., 1991). However, the advantages of *Bos indicus* crosses were tempered by older age at puberty (Cundiff et al., 1986), and reduced meat tenderness as the proportion of *Bos indicus* increased (Cundiff et al., 1986; Crouse et al., 1989). This report presents preliminary results from Cycle V of the GPE Program at MARC to characterize some heavy muscled continental European breeds and some tropically adapted breeds as well as some British breeds for carcass and meat characteristics of importance in beef production.

MATERIALS AND METHODS

The GPE program has been conducted in five cycles. Table 1 shows the mating plan for each cycle. In Cycle V, as in previous cycles of the program, the base cows included Angus (about 500) and Hereford (about 350) cows calving at 4 years of age or older. In addition, about 550 composite MARC III (1/4 Angus, 1/4 Hereford, 1/4 Pinzgauer and 1/4 Red Poll) cows calving at 4 years of age or older were included. The cows were mated to produce topcrosses by the following sire breeds.

Hereford and Angus. Semen from polled and horned Hereford and from Angus sires was used to produce F_1 cross progeny. Hereford-Angus reciprocal crosses have been produced throughout

Table 1. Sire breeds Used in Germplasm Evaluation Program at MARC

Cycle I (1970-72)	Cycle II (1973-74)	Cycle III (1975-76)	Cycle IV (1986-90)	Cycle V (1992-94)
Hereford	Hereford	Hereford	Hereford	Hereford
Angus	Angus	Angus	Angus	Angus
Jersey	Red Poll	Brahman	Longhorn	Tuli
S. Devon	Braunvieh	Sahiwal	Salers	Boran
Limousin	Gelbvieh	Pinzgauer	Galloway	Belgian Blue
Simmental	Maine Anjou	Tarentaise	Nellore	Brahman
Charolais	Chianina		Shorthorn	Piedmontese
			Piedmontese	
			Charolais	
			Gelbvieh	
			Pinzgauer	

the GPE program to facilitate pooling of data and comparison of breeds in different cycles. More than 30 sires of each breed, some of which were included in Cycle IV (born from 1982-1984) and others born since 1988, are being used in Cycle V.

Tuli. The Tuli, a Sanga type of cattle, was developed in a research program initiated in the 1940's using foundation cattle considered to be the most productive type selected from indigenous Tswana cattle in Zimbabwe. Australian scientists at CSIRO, Tropical Agricultural Research Station, Rockhampton, Queensland, and a consortium of private breeders in Australia imported frozen Tuli embryos from Zimbabwe into Australia in 1990. Semen from nine Tuli bulls was imported from Australia for use in the GPE Program.

Boran. Borans are a pure zebu breed (*Bos indicus*) that evolved in southern Ethiopia and are believed to have been developed for milk and meat production under stressful conditions of the dry tropics. They were imported into Australia from Zambia. Semen from eight Boran bulls was imported from Australia for the GPE Program.

Brahman. Semen from a current broad sample of at least 30 Brahman (Grey and Red) bulls is being used to produce F_1 progeny. In addition, semen is being used from sires sampled in Cycle III of the GPE program (bulls produced in the early 1970's) to facilitate pooling of data over cycles and estimate genetic trends.

Belgian Blue. Muscular hyperplasia (double muscling) has been favored for at least 40 years by Belgian Blue breeders in Belgium. Semen from 26 bulls is being used in the GPE Program.

Piedmontese. Piedmontese originated in the Piedmont region of northern Italy. Seventeen Piedmontese sires included in cycle IV were repeated to produce one calf crop (1992) in Cycle V.

Calves were born in the spring of 1992. Male calves were castrated within 24 hr of birth. Calves were creep fed whole oats from mid July until weaning in early October. Following a postweaning adjustment period of about 30 days, steers were penned and fed separately by sire breed for an average of 230 d. The growing diet contained about 2.7 Mcal ME/kg and 12.9% crude protein and the finishing diet fed from about 320 kg to slaughter contained about 3.04 Mcal ME/kg and 10.9% crude protein. Representative samples of steers were slaughtered serially in 3 slaughter groups spaced 28 days apart. The steers were slaughtered in a commercial facility, and hot carcass weights were obtained and used to estimate dressing percent (100 X carcass weight/final live weight). After a 24-hr chill, USDA yield grade (fat thickness, longissimus area, estimated % kidney fat) and quality grade (marbling, maturity) data were obtained. The

right side of each carcass was transferred to the meat laboratory at MARC and fabricated into closely trimmed (8 mm fat thickness) and totally trimmed (0 mm fat thickness) boneless, retail product (steaks, roasts, and lean trim with 20% chemical fat), fat trim and bone. Retail product, fat trim, and bone from the right side was doubled to estimate retail product yield from the carcass. Warner-Bratzler shear force and sensory panel evaluations of tenderness, juiciness and flavor were determined for cooked rib steaks from each carcass following AMSA (1978) procedures. Data were analyzed by least squares procedures (Harvey, 1977) using a model that included fixed effects for sire breed, dam breed, age of dam (5, 6-8, 9, > 10 yr), sire breed X dam breed, and covariates for age at weaning (mean = 180 d) and days fed postweaning (mean = 261 d).

RESULTS

Breed of sire means averaged over Angus, Hereford and MARC III dams for final live weight at slaughter and some carcass and meat characteristics adjusted to 441 days of age are provided in Tables 2 and 3. These results are preliminary, including only the first of three calf crops to be produced in Cycle V. Nevertheless, mean squares for effects of sire breed were significant ($P<.05$) for all traits reported, except sensory panel flavor.

Progeny of Hereford, Angus, and Belgian Blue sires were heavier (441 days) than those of Brahman, Piedmontese, Boran, or Tuli sires ($P<.05$). Mean weight of retail product was greater for progeny of Belgian Blue sires than for Piedmontese sires, which was greater than for Hereford, Angus or Brahman sires, which was greater than for Tuli and Boran sires ($P<.05$). Although live weights of Piedmontese were significantly lighter than those of Angus or Hereford sires, retail product weight was greater because of their higher dressing percentage and higher percentage retail product ($P<.05$). Mean percentage fat trim was less in progeny of Belgian Blue and Piedmontese sires than in progeny of Brahman sires which was less than that in progeny of Angus, Hereford, Boran or Tuli sires ($P<.05$). Percentage bone was less in progeny of Boran and Tuli sires than in progeny of Belgian Blue sires ($P<.05$), and more intermediate for progeny of Piedmontese, Angus, Hereford and Brahman sires.

Mean marbling score was higher in progeny of Angus than in progeny of all sire breeds except Tuli; marbling was greater in progeny of Tuli, Hereford and Boran sires than in progeny of Piedmontese sires which was higher than in progeny of Brahman and Belgian Blue sires ($P<.05$). Progeny of Angus, Tuli and Hereford sires graded USDA Choice quality with a higher frequency than those of Piedmontese, Brahman or Belgian Blue sires ($P<.05$). Shear force and sensory panel estimates of tenderness of longissimus muscle steaks were significantly more favorable for progeny of Belgian Blue, Piedmontese, Angus, Hereford, and Tuli sires than for progeny of Boran or Brahman sires. Sensory panel estimates for juiciness were lower for progeny of Brahman sires than for progeny of other sire breeds.

DISCUSSION

Preliminary results indicate that Belgian Blue and Piedmontese are excellent candidates for use as terminal sire breeds because their progeny have a high yield of retail product and longissimus steaks that are relatively tender. Additional data are needed to characterize reproduction and calving traits of backcross and F_2 progeny to assess their potential for use in rotational crossing systems or in composite populations.

Preliminary results indicate that the Tuli breed which evolved in the tropics, produce crossbred progeny with carcass and meat characteristics more similar to those by British *Bos taurus* breeds (i.e., Hereford and Angus) than to progeny sired by *Bos indicus* breeds (i.e., Brahman or Boran). Cooperative research efforts are in progress to evaluate reproduction and maternal performance of F_1 cows by Tuli, Boran and Brahman sires at subtropical locations in the U.S. (i.e., Florida, Georgia, Texas, New Mexico and Oklahoma) as well as at MARC representing a temperate climate.

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Table 2. Final Weight and Carcass Characteristics of Steers in the First of Three Calf Crops in Cycle V of the Germ Plasm Evaluation Program

Breed group	No.	Final wt., kg	Dress. pct., %	Fat thick-ness, mm	Longiss-imus area, cm^2	Retail prod. 0 mm trim, kg	Retail prod. 0 mm trim, %	Fat 0 mm trim, %	Bone 0 mm trim, %
Hereford-X	9	580.8	60.1	10.4	72.9	204.1	61.5	23.8	13.4
Angus-X	10	558.8	60.1	12.3	73.1	201.6	63.4	22.2	13.2
Brahman-X	27	527.9	60.5	8.7	70.7	197.6	64.6	20.6	13.6
Boran-X	30	505.8	60.0	11.0	72.7	177.4	62.3	24.1	12.5
Tuli-X	47	501.8	60.8	11.1	69.9	178.2	61.9	24.2	12.7
Piedmontese-X	35	524.6	61.4	5.2	82.1	215.1	71.1	14.5	13.2
Belgian Blue-X	28	558.2	61.8	5.5	83.3	227.8	69.2	15.7	13.9
Mean LSD.05		28.5	1.4	2.5	4.4	11.6	2.4	2.7	.6

Table 3. Beef Quality Characteristics of Steers in the First of Three Calf Crops in Cycle V of the Germplasm Evaluation Program

Breed group	No.	Marbling score[a]	Longissi-mus fat content, %	USDA Choice, %	WB shear, kg	Sensory panel[b] Tender-ness	Flavor	Juici-ness
Hereford-X	9	525	4.4	70.8	5.9	5.0	4.7	5.1
Angus-X	10	567	4.6	90.6	5.7	5.0	4.6	5.2
Brahman-X	27	466	3.2	23.4	8.1	4.1	4.4	4.8
Boran-X	30	519	3.8	54.7	7.3	4.6	4.4	5.2
Tuli-X	47	548	4.7	80.5	5.9	5.0	4.6	5.3
Piedmontese-X	35	477	3.5	35.5	5.8	5.0	4.6	5.1
Belgian Blue-X	28	460	3.0	21.3	5.8	5.1	4.6	5.1
Mean LSD.05		42	.7	31.7	1.1	.6	.3	.3

[a]Slight = 400 to 499, small = 500 to 599, etc.

[b]Scored: 1 = extremely tough, bland or dry through 8 = extremely tender, intense or juicy.