THE EFFECT OF ANGUS, PIEDMONTESE AND BRAHMAN SIRES ON MEAT QUALITY OF PROGENY

H. Hearnshaw[1], P. F. Arthur[2], B. Gogel[3], J. M. Thompson[4], and P. J. Williamson[1]

[1]NSW Agriculture, Agricultural Research and Advisory Station, Grafton, NSW 2460
[2]NSW Agriculture, Agricultural Research Centre, Trangie, NSW 2823
[3]NSW Agriculture, Agricultural Research Institute, Wollongbar, NSW 2480
[4]Beef and Cattle Meat Quality CRC, University of New England, Armidale, NSW 2351

SUMMARY

Sixty one Angus, Piedmontese (P) and Brahman (B)-sired steer progeny from Hereford, B and crossbred cows, were evaluated for growth, carcass, meat yield and quality. Steers were slaughtered at 31 months of age with carcasses averaging 325 kg. Carcasses were electrically stimulated with low voltage, boned and primal cuts weighed. Samples from *M. longissimus* (loin) were evaluated in the laboratory for tenderness and other meat quality traits (samples not aged); and by consumers for overall eating quality (samples aged 14 days). Growth, live and carcass weight and fatness were affected by heterosis, resulting in an interaction between sire and dam breeds. Crosses between *Bos indicus* and *Bos taurus*, expressing greatest heterosis, had fastest growth and heaviest carcasses. Sire breed differences were generally not significant for laboratory meat quality traits. However consumers scored B-sired steaks lowest eating quality. P-sired carcasses had greatest muscling, total weight of primal cuts and % saleable meat yield. Sire breed was mostly not significant for % of individual primal cuts; however strong and consistent trends favoured P-sired carcasses for these yields.

Keywords: Piedmontese, Brahman, Angus, meat quality, yield

INTRODUCTION

Crossbreeding is currently being used in the beef industry to improve animal productivity and to increase the ability of slaughter animals to meet the specifications of different markets. In Australia's harsh tropical and subtropical environments, *Bos indicus* infused cattle are widely used. However, many lucrative markets have excluded these cattle because of concerns about poor and inconsistent meat quality. Arthur (1995) concluded that connective tissue affected meat toughness, especially in older cattle, but this effect was less in doubled-muscled animals such as Piedmontese (P) and Belgian Blue because their muscle had lower collagen content with a lower proportion of stable non-reducible cross-links. Current studies in USA have shown that P- and Belgian Blue-cross *Bos taurus* have high yields, little marbling and tender meat (Cundiff *et al.* 1996). Since the likely meat quality and yield of these sire breeds crossed with *Bos indicus* was unknown, a breeding program was undertaken by NSW Agriculture at Grafton. This paper presents information on growth, carcass, yield and meat quality of 31 month old steers from the second cohort of progeny. Previous results from yearling cattle have been presented by Hearnshaw *et al* (1997, 1998b, 1998c).

MATERIALS AND METHODS

The 61 steers used in this study were part of a large 3-year breeding program based at Grafton. Steers were bred from 28 Angus (A), Brahman (B) or P sires and mature cows with varying levels of B and

Hereford (H) genes. Dams grazed subtropical pastures on properties at Grafton and Ballina NSW, and for ease of analysis, dams were classified into three genotype groups: 0 %B, ≤50 %B, and >50 %B. After weaning at about 8 months of age, steer progeny were transported to a commercial property near Ebor on the Northern Tablelands of NSW. After 6 months with no weight gain due to drought conditions, steers were moved to temperate pastures on Glen Innes Research Station where they grazed for a further 18 months. Steers were then transported 380 kms from Glen Innes to Stockyard Meats, Grantham, Qld, where they were slaughtered on the one day.

Steers were weighed every two months from birth to 31 months of age, but for this paper, only growth rates from birth to slaughter or weaning to slaughter, were analysed. All carcasses were electrically stimulated (ES) using extra low voltage immediately after stunning. Carcasses were boned, and weights of 11 primal cuts (flank steak, topside, eyeround, outside, knuckle, rump, striploin, tenderloin, cuberoll, blade and brisket) were recorded as part of the processing operation. Before analysis, weights of primals were expressed as % of cold-side-weight. Complete data were only available for 7 of the primal cuts (excluding flank, eyeround, blade and brisket) so their total weight was also analysed to give an estimate of saleable meat yield. Samples of *M. longissimus et lumborum* (loin) were collected from all carcasses and frozen within 24 hours for laboratory analyses. For this paper, results from 40 of the 61 unaged loin samples were analysed for a suite of objective meat quality measurements including pH, Hunter meat colour 'L', 'a' and 'b', Instron compression, peak force, sarcomere length, and cooking loss (Hearnshaw, *et al.* 1998a). Additional loin samples from the same carcasses were aged for 14 days, then were scored by consumers for overall eating quality (1-100; 100=best), (Gee *et al.* 1998).

The data were analysed using fixed linear models in ASREML (Gilmour *et al.* 1996). Initial models for all traits included sire breed (s), %B in the dam (d), herd of origin (hd) and 1st order interactions. Reduced models, containing significant terms ($P<0.05$), were used to estimate least square means and standard errors for all traits. Significant interactions that did not account for a major proportion of ther variance, will not be discussed in this paper. For appropriate traits, the covariates carcass weight and fatness were used separately, and for meat quality traits, pH was also included as a covariate.

RESULTS AND DISCUSSION

Analyses of preslaughter weight, growth rate, carcass weight and fatness resulted in significant interactions between s x d. This indicated that heterosis was important for the expression of these traits. Except for fatness, trends were similar and to illustrate this, Table 1 shows the interaction between s x d for carcass weight. Carcasses from all crosses by P sires were leaner than those from A or B sires, even though trends varied across dambreed. These trends were similar to those reported for yearlings by Hearnshaw *et al* (1997). Visual marbling was low and similar for all three sire breeds.

Sire breed effects for laboratory meat quality traits were generally not significantly different for loin samples (Table 1). This contrasts with our previous results (Hearnshaw *et al.* 1998b) where loin and eyeround steaks from P-sired yearlings were more tender than those from either A or B-sired yearlings; and P-sired loin steaks from 28month old steers were more tender than those from B–sired carcasses. Results from the USDA germ plasm evaluation (Cundiff *et al.* 1996), show that both shear

force and sensory panel estimates of tenderness were similar and better for P and A-sired loins, compared with those from B-sired loins when crosses to British dams. In this study, B-sired loins had greatest cooking loss, indicating drier meat, and sarcomere lengths were shortest for P-sired loins. Differences in results reported here compared with those already published, may be due to the use of older, fewer carcasses or the use of effective ES on all carcasses in this study, compared with other studies where chilling, electrical stimulation and ageing treatments were included.

Table 1. The significance of sirebreed, and its interaction with dambreed for carcass weight, for meat yield and quality traits of loin steaks, (standard error, (s.e.)).

Trait	Sire breed			Av. s.e.
	Angus	Piedmontese	Brahman (B)	
Number of carcasses	17(10)#	24(13)	20(17)	
Hot carcass weight (kg)	343.4	306.5	320.8	6.74*
0%B in dam	276	300	323	11.92
50%B in dam	343	306	321	
>50%B in dam	343	308	281	
Carcass P8 fatness (mm)	13.2	7.4	10.6	1.41*
Objective meat quality				
Instron compression (kg)	2.03	2.01	1.98	0.078
Peak force (kg)=ϕ	4.59	4.76	4.92	0.200
pH	5.56	5.49	5.49	0.035
Cooking loss (%)	19.6	20.5	22.0	0.58*
Sarcomere length (μm)	1.73	1.64	1.75	0.024*
Consumer eating quality				
Score (1-100, 100 = best)	61.3	61.7	48.4	2.62*
Meat yield				
Eye muscle area (cm sq) =	67.5	75.5	67.3	1.65*
Total of 7 primal wts (kg) =	36.3	37.9	36.3	0.41*
% 7 primal wts	23.4	24.8	23.9	0.29*
% flank	0.52	0.50	0.46	0.018
% topside	5.58	6.03	5.74	0.281
% eyeround	1.61	1.75	1.58	0.043
% outside	3.82	3.80	4.23	0.218
% knuckle	3.42	3.70	3.44	0.053
% rump	3.74	3.82	3.84	0.069
% striploin	3.59	3.96	3.85	0.102
% tenderloin	1.34	1.48	1.42	0.032
% cuberoll	1.91	2.19	1.82	0.061*
% blade	5.27	5.86	5.50	0.119
% brisket	2.63	2.94	2.94	0.162

#, numbers with meat quality data in parentheses.
* indicates significant ($P<0.05$) sire breed differences.
=ϕ, significant covariates of carcass weight (=) and pH (ϕ).

When consumers tasted loin steaks that had been aged for 14 days, they found B-sired steaks were lowest in eating quality (Table 1). These steaks were from steers with 50-100 % Brahman content. Previous research has shown that post-slaughter factors can have a major effect on eating quality, and that carcasses with greater than 50 % B, may need ageing for up to 28 days plus ES (high voltage) or tenderstretching to consistently produce tender steaks (Hearnshaw *et al.* 1998b, 1998c).

Eye muscle area, the total weight of seven primal cuts, and their % of the cold-side-weight all indicate that P-sired carcasses have best muscling and meat yield. Sire breed was not generally significant for analyses of individual primal weights as a % of side weight. However, for 10 of 11 primal cuts, P-sired carcasses ranked first or equal first for yield of cut. These data support other reports (Cundiff *et al.* 1996; Hearnshaw *et al.* 1997) indicating that P-sired carcasses have significant advantages in yield of saleable meat.

These data indicated that Piedmontese sired progeny from *Bos indicus* and *Bos taurus* dams produced heavy lean carcasses with little marbling, high saleable meat yields and acceptable meat quality. Brahman sired carcasses were least acceptable for eating quality, but based on results from other studies, this decrease may be minimised by post-slaughter treatments such as ES (high voltage) and ageing for up to 28 days post-mortem.

ACKNOWLEDGMENTS

The authors thank J&R Rees; Phil Stephenson, Bernie Makings, Bill Lee, and Peter Kamphorst (NSW Agriculture); the Piedmontese society; Paul Reynolds, Andrew Blakely and Keryn Zirkler (UNE Armidale); Stockyard Meats Grantham and MSA for consumer analyses and financial assistance.

REFERENCES

Arthur, P.F. (1995) *Aust. J. Agric. Res.* **46:** 1493

Cundiff, L.V., Gregory, K.E., Wheeler, T.L., Shackelford, S.D., Koohmaraie, M. Freetly, H.C., and Lunstra, D.D. (1996) Germ Plasm Evaluation Program, Progress Report No. 15, ARS USDA, Clay Centre, Nebraska

Gee, A., Coffey, D., Porter, M. and Polkinghorne, R. (1998). Design and protocol for steak grilling trials. Meat Standards Australia, Sydney

Gilmour, A.R., Thompson, R., Cullis, B.R. and Welham, S.J. (1996) ASREML. Biometric Bulletin: NSW Agriculture, Australia

Hearnshaw, H., Arthur, P.F., Shorthose, W.R., Sinclair, A.J., Johnston, D. and Stephenson, P.D. (1998a) *Aust. J. Agric. Res.* **49:** 1009

Hearnshaw, H., Arthur, P.F., Stephenson, P.D., Dibley, K., Ferguson, D. and Thompson, J.M. (1997) *Proc. Assoc. Advmt. Anim. Breed.Genet.* **12:**575

Hearnshaw, H., Arthur, P.F., Stephenson, P.D., Dibley, K., Ferguson, D., Thompson, J.M., O'Hallaran, J., Morris, S. and Woodhead, A. (1998b) *Proc. 6th Wld. Cong. Genet. App. Livest. Prod.* 25: 165

Hearnshaw, H., Gursansky, B.G., Gogel, B., Thompson, J.M., Fell, L.R., Stephenson, P.D., Arthur, P.F., Egan, A.F., Hoffman, W.D. and Perry, D. (1998c). Proc. 44th ICoMST, Spain, B112