Searching for Tender Brahman Sires

C.C. Chase, Jr.[1], A.C. Hammond[2], T.A. Olson[3], R.L. West[3] and D.D. Johnson[3]

[1]USDA, ARS, Subtropical Agricultural Research Station, Brooksville, Florida, [2]Pacific West Area, Albany, California, and the [3]University of Florida, Gainesville

Introduction

Consistent carcass quality and adequate meat tenderness are among the most significant problems facing the beef cattle industry and are of particular concern to producers of Brahman-influenced cattle. Improving the quality/ consistency of beef has been identified as the number one priority for improving competitiveness of beef (NCA, 1994). The National Consumer Retail Beef Study indicated that consumers identified tenderness as more important than flavor or juiciness in relation to palatability and(or) satisfaction received from eating beef. Results from the National Beef Quality Audit indicated that one out of every four steaks is less than desirable in tenderness. Also, it was estimated that one tough beef carcass could affect as many as 542 consumers.

Previous studies have indicated that, in general, *Bos indicus* breeds consistently have lower marbling scores than British breeds, and less desirable shear force (a mechanical measure of meat tenderness) and sensory panel tenderness scores than *Bos taurus* breeds (Marshall, 1994). As the proportion of *Bos indicus* breeding increased, shear force increased and marbling and sensory tenderness scores decreased (Crouse et al., 1989; Huffman et al., 1990; Marshall, 1994; West et al., 1995). While carcasses from 1/4, 3/8, and perhaps 1/2 Brahman cattle can be acceptable, more information is needed to clearly identify both tender and tough Brahman sires and to determine if certain lines within the Brahman breed may be more tender than others (NCA, 1994; West et al., 1995). Therefore, we initiated a study to progeny test Brahman sires to determine the relationship between variation in tenderness and the relationship of this variation to potential genetic markers that could be obtained from a blood test. If markers can be located that are closely related to increased tenderness, selection for tender-ness in the Brahman breed will become much faster, simpler, and cheaper. In this report, only the preliminary results of feedlot performance and carcass data are discussed.

Materials and Methods

In 1994, we began a five-year progeny test of Brahman sires at the Subtropical Agricultural Research Station (STARS) in Brooksville, Florida to determine the relationship between variation in tender-ness and variation in potential genetic markers that could be obtained from a blood test. Each year five registered Brahman bulls that were loaned by producers or from the STARS herd were used in natural breeding single-sire breeding herds on approximately 30 Brahman cows per breeding herd. One bull each year was also used a second year to tie data between years. Thus, over a five-year period 21 different bulls could be evaluated. The breeding season began approximately March 20 each year and lasted for 105 days. Bull calves were castrated shortly after birth and all calves were weaned in late September. All but the very lightest of the steer and heifer calves at weaning were placed on feed. After about two weeks on a preconditioning diet, calves were placed in feedlot pens blocked by sex and weight, implanted (Synovex H for heifers and Synovex S for steers), and fed a corn based-diet (gradually adjusted to a final diet of 72.5% corn, 15% cottonseed hulls and/or ground hay, 7.5% supplement with monensin, vitamin A, microminerals, and MGA for heifers only, and 5% molasses). Blood was obtained from each sire, dam and calf and white blood cells stored for later DNA extraction. Calves were slaughtered by pen when average backfat for

the pen reached .4 in as determined by ultrasound. Carcasses were graded for USDA quality and yield factors after which a strip loin was removed, cut into 1.0 in steaks, vacuum-packaged, aged for 7, 14, or 21 days, and then frozen until analyzed by Warner-Bratzler (a mechanical method of testing tenderness) shear and sensory panel (day 14). Preliminary data analyses were conducted for each year by analysis of variance using the MIXED procedure of SAS (1996) that included the fixed effects of sire and sex, and random effect of penblock.

Results and Discussion

To date, feedlot performance and carcass data have been collected from the calves born in the first three years of the study, the calves from the fourth year are currently in the feedlot, and the fifth calf crop will be weaned in September 1999. A summary of the feedlot performance and carcass data for Brahman steer and heifer progeny from sires 1 to 5 used in year 1 of the study are shown in Table 1. There was no effect of sire on initial body weight, but sire effects were observed for final body weight ($P < .01$) and average daily gain (ADG; $P < .01$). Sire affected hot carcass weight ($P < .001$), dressing percentage ($P < .001$), fat thickness over the ribeye ($P < .01$), and ribeye area ($P < .01$), but there was not a significant effect of sire on USDA yield grade. Sire 4 ranked the highest and sire 2 the lowest for final body weight, ADG, hot carcass weight, and ribeye area. Sire effects were highly significant for marbling score ($P < .001$) and USDA quality grade ($P < .001$). Sire 1 ranked the highest for marbling score and USDA quality grade; carcasses from sire 1 were graded 21.4% Choice, 64.3% Select, and 14.3% Standard. Sire effects were not significant for tenderness score evaluated by sensory panel (day 14) or Warner-Bratzler shear on days 7, 14, and 21. Sire 1 that was ranked highest for marbling score (a desirable trait) was also ranked highest for Warner-Bratzler shear (an undesirable trait).

A summary of the feedlot performance and carcass data for Brahman steer and heifer calves from sires 3 and 6 to 9 used in year 2 of the study are shown in Table 2. There was no effect of sire on initial body weight, but sire effects were observed for final body weight ($P < .01$) and ADG ($P < .01$). Sire affected hot carcass weight ($P < .01$), dressing percentage ($P < .05$), fat thickness over the ribeye ($P < .001$) and USDA yield grade ($P < .05$), but the effect of sire was not significant for ribeye area. Sire 8 ranked the highest and sire 7 the lowest for final body weight, ADG, and hot carcass weight. Sire effects were not significant for marbling score or USDA quality grade. Carcasses from sire 6 all graded either Choice or Select. There was no significant effect of sire on tenderness score evaluated by sensory panel (day 14), however, sire affected Warner-Bratzler shear on day 7 ($P < .05$) and 14 ($P < .05$). Sire 3 ranked the lowest for Warner-Bratzler shear on all days which is consistent with him also being ranked the highest for taste panel tenderness score. Sire 3 was also used in year 1 of the study where he also was ranked the lowest (most tender) for Warner-Bratzler shear (Table 1).

Feedlot performance and carcass data for purebred Brahman steers and heifers from sires 7 and 10 to 14 used in year 3 of the study are summarized in Tables 3 and 4. There was no effect of sire on initial body weight, final body weight, ADG, hot carcass weight or dressing percentage. Sire affected fat thickness over the ribeye ($P < .001$), ribeye area ($P < .001$), and USDA yield grade ($P < .001$). For ribeye area, sire 13 was ranked the highest and sire 14 the lowest (Table 4). Sire effects were significant for marbling score ($P < .001$) and USDA quality grade ($P < .001$). Sires 12 and 13 were ranked among the highest for marbling score and USDA quality grade and the majority of their calves carcasses graded Choice and Select. There was no effect of sire on tenderness score evaluated by sensory panel (day 14) or Warner-Bratzler shear on days 7, 14, and 21.

When the study is completed, a final statistical analyses will be conducted that will include data from all years of the study. It will be possible to compare the Warner-Bratzler shear and tenderness values of all the sires used in the study at that time through the use as "ties" of the bulls that were used in consecutive years. Additionally, it is important to evaluate the variation in Warner-Bratzler shear force among progeny from a sire. For example, in year 2 for progeny from sire 3 that ranked the lowest for Warner-Bratzler shear (Table 2), the range in Warner-Bratzler shear for day 7 was 7.5 to 21.2 lb, for day 14 was 7.5 to 18.7 lb, and day 21 was 4.8 to 14.6 lb. Likewise in year 1 for progeny from sire 1 that ranked relatively high for Warner-Bratzler shear (Table 1), the range for Warner-Bratzler shear for day 7 was 14.1 to 24.9 lb, for day 14 was 12.4 to 26.5 lb, and day 21 was 10.8 to 21.2 lb. Perhaps there were substantial influences of the dams of these calves on their tenderness values. It should be possible to evaluate differences in tenderness among the dams that produce multiple progeny to some extent.

In summary, feedlot and performance data from Brahman steer and heifer calves from 14 Brahman sires have been collected during 3 years of a 5 year study. Preliminary analyses revealed significant sire effects on feedlot performance and USDA quality grade. Three sires were ranked the highest for marbling score and USDA quality grade (sires 1, 12, and 13). Sire effects on Warner-Bratzler shear were only significant in year 2 of the study. Sire 3 was ranked the lowest for Warner-Bratzler shear on days 7, 14, and 21 after slaughter and these values averaged 12.8, 11.8, and 10.3 lb, respectively. Sire 3 was ranked the best for tenderness score as evaluated by a sensory taste panel. In year 1 of the study in which he was also used, sire 3 was also ranked the lowest for Warner-Bratzler shear and the highest for tenderness score but sire effects for Warner-Bratzler shear and tenderness score were not significant that year.

Feedlot performance and carcass data are being collected for 2 more years to progeny test additional sires that will complete this 5 year project. Additionally, cooperators are beginning the DNA-based genetic marker evaluation part of this study. Specific genetic markers that have previously been identified as potential markers for marbling and tenderness traits are being emphasized. Results from the genetic markers will then be directly compared to the carcass and tenderness data and should lead to an evaluation of the feasibility of using those markers for marker-assisted selection.

Finally, this project will be incorporated into the Carcass Merit Project that was recently begun by the National Cattleman's Beef Association (NCBA). The Carcass Merit Project includes the participation of 16 breed associations and involves the evaluation of 10 sires per breed and 50 progeny per sire. Carcass data, tenderness data including Warner-Bratzler shear and sensory panel evaluation, and evaluation of genetic markers developed by Texas A&M University and NCBA will be determined. We are working with the American Brahman Breeders Association (ABBA) and will include some of the sires from years 4 and 5 of our current project in the evaluation and also will breed the STARS Brahman cow herd for two additional years (years 6 and 7) of progeny testing to further participate in the NCBA project. In addition to further progeny testing and genetic marker evaluation, the NCBA project will determine carcass and tenderness EPD's for the Brahman and other breed associations.

References

Crouse, J.D., L.V. Cundiff, R.M. Koch, M. Koohmaraie, and S.C. Seideman. 1989. Comparisons of Bos indicus and Bos taurus inheritance for carcass beef characteristics and meat palatability. J. Anim. Sci. 67:2661-2668.

Huffman, R.D., S.E. Williams, D.D. Hargrove, D.D. Johnson, and T.T. Marshall. 1990. Effects of percentage Brahman and Angus breeding, age-season of feeding and slaughter end point on feedlot performance and carcass characteristics. J. Anim. Sci. 68:2243-2252.

Marshall, D.M. 1994. Breed differences and genetic parameters for body composition traits in beef cattle. J. Anim. Sci. 72:2745-2755.

NCA. 1994. National Beef Tenderness Conference Executive Summary, 16 pp. April 22-23, 1994, Denver, CO., National Cattleman's Association, Englewood, CO.

SAS. 1996. SAS/STAT Software: Changes and Enhancements through Release 6.11, 1104 pp. SAS Inst. Inc., Cary, NC.

West, R.L., M.A. Elzo, and D.L. Wakeman. 1995. Effects of breed composition on carcass and meat traits, p. 150-166. Proceedings, 44th Annual Florida Beef Cattle Short Course, 166 pp., Gainesville, FL

Table 1. Effects of sire on feedlot performance and carcass characteristics of purebred Brahman steers and heifers, Year 1.

	Sire				
Trait	1	2	3	4	5
n =	14	16	14	19	15
Initial body wt., lb	474 ± 27.5	467 ± 27.3	484 ± 27.4	476 ± 27.2	476 ± 27.3
Final body wt,** lb	1004 ± 32.7	975 ± 31.6	1029 ± 32.2	1073 ± 31.0	1031 ± 31.9
Days on feed[a]	200	202	213	209	206
ADG,** lb/day	2.6 ± .11	2.5 ± .10	2.6 ± .10	2.9 ± .09	2.7 ± .10
Hot carcass wt.,*** lb	645 ± 19.6	623 ± 18.6	646 ± 19.3	696 ± 18.1	655 ± 18.9
Dressing percentage***	67.2 ± .61	65.4 ± .57	65.0 ± .59	67.2 ± .54	65.7 ± .58
Fat over the ribeye,** in	.57 ± .036	.42 ± .033	.42 ± .036	.53 ± .031	.48 ± .034
Ribeye area,** in^2	11.8 ± .25	10.8 ± .24	11.6 ± .26	12.1 ± .22	11.8 ± .24
USDA yield grade	3.24 ± .164	3.11 ± .151	2.83 ± .161	3.27 ± .142	3.11 ± .155
Marbling score[b]***	367 ± 11.4	281 ± 10.7	289 ± 11.5	314 ± 9.8	322 ± 10.9
USDA quality grade[c]***	551 ± 9.7	496 ± 9.0	501 ± 9.6	517 ± 8.4	520 ± 9.2
Choice[a], %	21.4	0	7.1	0	6.7
Select[a], %	64.3	37.5	50.0	57.9	73.3
Standard[a], %	14.3	62.5	42.9	42.1	20.0
Tenderness score[d]	4.1 ± .21	4.2 ± .19	4.6 ± .21	4.3 ± .18	4.4 ± .20
Warner-Bratzler, lb					
Day 7	18.9 ± .94	16.5 ± .87	15.6 ± .93	16.9 ± .81	16.9 ± .89
Day 14	17.0 ± 1.23	15.6 ± 1.16	14.3 ± 1.20	15.4 ± 1.12	15.2 ± 1.18
Day 21	14.8 ± .81	14.1 ± .75	14.1 ± .80	14.6 ± .70	14.1 ± .77

*P<.05; **P<.01; ***P<.001

[a]Means not analyzed statistically.
[b]Traces = 200 to 299; slight = 300 to 399; small = 400 to 499.
[c]Standard = 400 to 499; Select = 500 to 599; Choice = 600 to 699.
[d]Day 14, scored on an 8-point scale (4 = slightly tough; 5 = slightly tender; 6 = moderately tender).

Table 2. Effects of sire on feedlot performance and carcass characteristics of purebred Brahman steers and heifers, Year 2.

	Sire				
Trait	3	6	7	8	9
n =	17	12	17	22	21
Initial body wt., lb	467 ± 18.8	459 ± 19.4	457 ± 18.9	465 ± 18.6	478 ± 18.7
Final body wt,** lb	1018 ± 27.1	1012 ± 30.1	960 ± 27.4	1046 ± 25.9	1022 ±26.3
Days on feed[a]	205	201	206	210	205
ADG,** lb/day	2.7 ± .09	2.7 ± .10	2.4 ± .09	2.8 ± .08	2.6 ± .08
Hot carcass wt.,*** lb	637 ± 17.1	642 ± 18.9	599 ± 17.0	655 ± 16.0	647 ± 16.3
Dressing percentage*	64.1 ± .41	65.9 ± .48	65.0 ± .41	64.8 ± .37	65.4 ± .38
Fat over the ribeye,*** in	.45 ± .048	.73 ± .057	.34 ± .048	.53 ± .043	.51 ± .044
Ribeye area, in^2	11.1 ± .25	10.7 ± .30	10.5 ± .25	10.9 ± .22	11.0 ± .23
USDA yield grade*	3.15 ± .174	3.72 ± .200	2.94 ± .174	3.38 ± .159	3.41 ± .163
Marbling score[b]	308 ± 10.9	339 ± 12.9	322 ± 10.9	305 ± 9.7	310 ± 10.0
USDA quality grade[c]	511 ± 8.5	538 ± 10.2	529 ± 8.5	512 ± 7.5	513 ± 7.7
Choice[a], %	0	16.7	5.9	9.1	0
Select[a], %	64.7	83.3	70.6	54.5	57.1
Standard[a], %	35.3	0	23.5	36.4	42.9
Tenderness score[d]	5.2 ± .15	4.9 ± .18	5.0 ± .15	5.0 ± .13	5.1 ± .14
Warner-Bratzler, lb					
Day 7*	12.8 ± .77	14.2 ± .92	14.4 ± .76	14.1 ± .67	15.9 ± .69
Day 14*	11.8 ± .80	15.1 ± .92	13.2 ± .80	13.0 ± .74	13.8 ± .75
Day 21	10.3 ± .70	12.2 ± .83	12.0 ± .69	12.3 ± .61	12.8 ± .63

*P<.05; **P<.01; ***P<.001

[a]Means not analyzed statistically.
[b]Traces = 200 to 299; slight = 300 to 399; small = 400 to 499.
[c]Standard = 400 to 499; Select = 500 to 599; Choice = 600 to 699.
[d]Day 14, scored on an 8-point scale (4 = slightly tough; 5 = slightly tender; 6 = moderately tender).

Table 3. Effects of sire on feedlot performance and carcass characteristics of purebred Brahman steers and heifers (Sires 7, 10, 11), Year 3.

	Sire		
Trait	7	10	11
n =	18	19	7
Initial body wt., lb	475 ± 25.1	481 ± 25.0	477 ± 26.44
Final body wt., lb	999 ± 45.5	980 ± 44.7	982 ± 49.0
Days on feed[a]	202	195	191
ADG, lb/day	2.5 ± .11	2.4 ± .10	2.5 ± .14
Hot carcass wt., lb	582 ± 20.5	589 ± 20.2	597 ± 24.7
Dressing percentage	63.1 ± .39	63.2 ± .38	63.6 ± .62
Fat over the ribeye,*** in.	.39 ± .038	.43 ± .036	.57 ± .060
Ribeye area,*** in^2	10.9 ± .22	10.7 ± .21	10.8 ± .33
USDA yield grade***	2.61 ± .119	2.86 ± .115	3.34 ± .181
Marbling score[b]***	315 ± 14.9	315 ± 14.4	316 ± 23.1
USDA quality grade[c]***	522 ± 10.3	518 ± 10.0	519 ± 16.1
Choice[a], %	0	5.3	0
Select[a], %	72.2	63.1	71.4
Standard[a], %	27.8	31.6	28.6
Tenderness score[d]	5.0 ± .14	5.2 ± .14	5.4 ± .23
Warner-Bratzler, lb			
Day 7	15.2 ± .98	14.1 ± .95	15.1 ± 1.47
Day 14	12.6 ± .86	12.8 ± .86	11.9 ± 1.23
Day 21	12.7 ± .82	11.7 ± .80	12.1 ± 1.22

*P<.05; **P<.01; ***P<.001

[a]Means not analyzed statistically.
[b]Traces = 200 to 299; slight = 300 to 399; small = 400 to 499.
[c]Standard = 400 to 499; Select = 500 to 599; Choice = 600 to 699.
[d]Day 14, scored on an 8-point scale (4 = slightly tough; 5 = slightly tender; 6 = moderately tender).

Table 4. Effects of sire on feedlot performance and carcass characteristics of purebred Brahman steers and heifers (Sires 12, 13, 14), Year 3.

	Sire		
Trait	12	13	14
n =	17	16	22
Initial body wt., lb	468 ± 25.1	468 ± 25.2	478 ± 24.9
Final body wt., lb	978 ± 46.3	1008 ± 45.1	977 ± 44.5
Days on feed[a]	194	185	202
ADG, lb/day	2.6 ± .12	2.7 ± .11	2.4 ± .10
Hot carcass wt., lb	596 ± 20.5	599 ± 21.0	586 ± 19.9
Dressing percentage	62.6 ± .40	62.1 ± .43	62.6 ± .36
Fat over the ribeye,*** in.	.65 ± .039	.56 ± .041	.53 ± .034
Ribeye area,*** in^2	10.7 ± .22	11.6 ± .23	10.2 ± .20
USDA yield grade***	3.35 ± .120	3.08 ± .128	3.16 ± .109
Marbling score[b]***	347 ± 15.1	400 ± 16.1	324 ± 13.6
USDA quality grade[c]***	550 ± 10.5	578 ± 11.2	527 ± 9.4
Choice[a], %	11.8	43.8	13.6
Select[a], %	82.3	50.0	63.6
Standard[a], %	5.9	6.2	22.8
Tenderness score[d]	5.2 ± .15	5.2 ± .16	5.0 ± .13
Warner-Bratzler, lb			
Day 7	13.9 ± .99	14.5 ± 1.05	14.7 ± .91
Day 14	13.7 ± .86	14.0 ± .91	13.2 ± .81
Day 21	12.2 ± .83	12.5 ± .88	13.9 ± .76

*P<.05; **P<.01; ***P<.001

[a]Means not analyzed statistically.
[b]Traces = 200 to 299; slight = 300 to 399; small = 400 to 499.
[c]Standard = 400 to 499; Select = 500 to 599; Choice = 600 to 699.
[d]Day 14, scored on an 8-point scale (4 = slightly tough; 5 = slightly tender; 6 = moderately tender).

NOTES:

NOTES: