EFFECTS OF PERCENTAGE BRAHMAN AND ANGUS BREEDING, AGE-SEASON OF FEEDING AND SLAUGHTER END POINT ON MEAT PALATABILITY AND MUSCLE CHARACTERISTICS

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ABSTRACT

Steers (n = 125) of known percentage Angus (A) and Brahman (B) breeding (A = 31, 3/4A:1/4B = 32, 1/2A:1/2B = 31, 1/4A:3/4B = 31) were slaughtered after being fed as calves during the cool period of the year or fed as yearlings during the warm period of the year. Steers were slaughtered at equivalent outside fat thickness as monitored visually and with real-time ultrasound. Warner-Bratzler shear (WBS) force increased and sensory panel tenderness decreased as percentage Brahman increased. Loin muscle characteristics indicated that differences in tenderness between breed groups were not attributed to cold shortening effects or differences in amount or integrity of connective tissue. Fragmentation values suggested that breed group tenderness differences probably resulted from differences in the muscle fiber component. A 10-d postmortem aging study revealed a differential breed group response to postmortem aging, suggesting that breed groups differed in amount and/or activity of naturally occurring proteolytic enzymes in muscle tissue. (Key Words: Beef, Brahman, Palatability, Composition.)


Introduction

Numerous researchers have reported production and reproduction advantages from crossing Brahman with British cattle to produce animals that are adapted to the semitropical environment of the Gulf Coast region of the U.S. Most beef cattle produced in that region have some percentage of Brahman breeding. Traditionally, Brahman and Brahman crossbred cattle have been discriminated against by the feeding and packing industries. Some of this discrimination has been attributed to lower meat quality, especially tenderness, for carcasses with heavy Brahman influence. Several researchers (Ramsey et al., 1963; Luckett et al., 1975; Thompson and Barlow, 1981; Koch et al., 1982; Peacock et al., 1982) have reported higher Warner-Bratzler shear force values and lower sensory panel tenderness scores for steaks from carcasses of higher percentage Brahman breeding. These comparisons were not made equitably because cattle with different growth potentials were slaughtered at constant age, constant days on feed or constant weight, and no attempt has been made to compare palatability traits at similar stages of subcutaneous fat deposition. Many of the differences reported between Brahman and British cattle have been confounded by differences in the physiological stage of growth at which the cattle were slaughtered. The objective of this study was to compare palatability and muscle characteristics of steaks from steers of various percentages of Brahman and Angus breeding when slaughtered at similar stages of subcutaneous fat deposition.

1980
Materials and Methods

A total of 125 steers of known percentage Angus (A) and Brahman (B) breeding (A = 31, 3/4A:1/4B = 32, 1/2A:1/2B = 31, 1/4A:3/4B = 31) were purchased at weaning from different herds in Florida in 1985 and 1986 and transported to the Beef Research Unit, Gainesville. Each year, half of the steers in each breed group were assigned randomly to be fed a high-concentrate diet as calves during the cool period of the year (November to May), and the other half were assigned to a winter stocker program followed by high-concentrate feeding during the warm period of the year (June to October). A detailed description of feeding regimen, feedlot performance and carcass characteristics was given by Huffman et al. (1990). Prior to placement on feed, one-half of each breed group was assigned to be slaughtered at either 1.0 or 1.5 cm subcutaneous fat opposite the longissimus muscle at the 12th/13th rib interface. Fatness was estimated both visually, by three trained evaluators, and with real-time ultrasound measurements. Steers were slaughtered at the University of Florida Meats Laboratory according to standard slaughter procedures. After slaughter and carcass evaluation, carcasses were categorized into four fatness end points (<.9, 1.0 to 1.15, 1.27 to 1.40 or ≥ 1.5 cm), based on adjusted subcutaneous fat evaluations at the 12th/13th rib interface.

Carcasses were chilled at 0 to 2°C for 24 h, ribbed, and graded for USDA quality and yield factors. These data were discussed in detail by Huffman et al. (1990). Four 2.54-cm-thick steaks were removed from the short loin of the non-electrically stimulated side of each carcass. The first and third steaks from the rib end were used for sensory panel evaluation, the second steak was used for Warner-Bratzler shear force determination and the fourth steak was utilized for chemical analysis. Steaks were removed from the carcasses at 24 h postmortem, vacuum-packaged in oxygen barrier bags\(^5\), aged for 5 d postmortem at 0 to 2°C and frozen at -18°C until laboratory determinations could be performed. Loin steaks for Warner-Bratzler shear (WBS) and sensory analyses were thawed 18 h at 2 to 4°C, then broiled on Farberware open-hearth broilers\(^6\) to an internal temperature of 70°C (AMSA, 1978). Internal temperatures were monitored using copper-constantan thermocouples attached to a potentiometer\(^7\). Steaks used for WBS determination were cooled to 21°C; eight cores (1.27-cm diameter) were removed parallel to fiber orientation and sheared on a Warner-Bratzler shearing device.

Cooked loin steaks for sensory evaluation were cut into 1.27-cm\(^2\) samples and served warm to an 8- to 10-member trained sensory panel (AMSA, 1978). Steak samples were evaluated for flavor (8 = extremely intense to 1 = extremely bland), juiciness (8 = extremely juicy to 1 = extremely dry), tenderness (8 = extremely tender to 1 = extremely tough), amount of detectable connective tissue (8 = none to 1 = abundant), and off-flavor (6 = none detected to 1 = extreme off-flavor).

The steak for sarcomere length, fragmentation index and chemical analyses was trimmed of all subcutaneous fat and epimysial connective tissue and cut while frozen into 7-mm cubes without being allowed to thaw. Sarcomere length was determined by homogenizing a 5-g sample in 25 ml of cold .25 M sucrose solution. A drop of the homogenate was placed on a microscope slide for helium-neon laser\(^7\) diffraction through individual myofibrils. Fifteen diffraction patterns were measured, and the equation of Cross et al. (1981) was used to convert these measurements to sarcomere length in micrometers.

Fragmentation index was performed with modifications according to the procedure outlined by Davis et al. (1980). A 10-g sample of meat was homogenized in 50 ml of cold homogenizing solution (.25 M sucrose, .02 M KCl) at full speed for 45 s using a homogenizer\(^8\). This homogenate was filtered through a 250-μm mesh screen. After a 40-min drying period, the screen was weighed and the fragmentation index was calculated according to Davis et al. (1980).

Frozen cubes from the steak assigned for chemical analyses were powdered in a Waring blender in a −40°C freezer with liquid nitrogen. The powdered sample was used for moisture determination by oven-drying and lipid determination by ether extraction (AOAC, 1983).

\(^{5}\)Cryovac\(^\text{\textregistered}\) B 620, Duncan, SC.
\(^{6}\)Model 455N, Youkers, NY.
\(^{7}\)Speedomax\(^\text{\textregistered}\), 165, Leeds and Northrup, North Wales, PA.
\(^{8}\)Model 155, Spectra Physics, Inc., Mt. View, CA.
\(^{\text{\textregistered}}\)Virtis 23, The Virtis Co., Gardiner, NY.
TABLE 1. WARNER-BRATZLER SHEAR FORCE AND SENSORY PANEL EVALUATIONS

<table>
<thead>
<tr>
<th>Effect</th>
<th>No.</th>
<th>WBS, kg</th>
<th>Tenderness&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Flavor&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Juiciness&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Connective tissue&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Off-flavor&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed group</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>31</td>
<td>4.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.9</td>
<td>5.9&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.3</td>
<td>5.8</td>
</tr>
<tr>
<td>3/4A: 1/4B</td>
<td>32</td>
<td>4.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.9&lt;sup&gt;de&lt;/sup&gt;</td>
<td>5.7</td>
<td>5.9&lt;sup&gt;d&lt;/sup&gt;</td>
<td>6.1</td>
<td>5.8</td>
</tr>
<tr>
<td>1/2A: 1/2B</td>
<td>31</td>
<td>4.2&lt;sup&gt;de&lt;/sup&gt;</td>
<td>5.6&lt;sup&gt;e&lt;/sup&gt;</td>
<td>6.0</td>
<td>5.5&lt;sup&gt;e&lt;/sup&gt;</td>
<td>6.1</td>
<td>5.8</td>
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<tr>
<td>1/4A: 3/4B</td>
<td>31</td>
<td>5.2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5.5&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5.7</td>
<td>5.6&lt;sup&gt;e&lt;/sup&gt;</td>
<td>6.1</td>
<td>5.7</td>
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<tr>
<td>Age-season</td>
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<tr>
<td>Calves-cool</td>
<td>63</td>
<td>4.6</td>
<td>6.1&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.8</td>
<td>5.6</td>
<td>6.4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.8</td>
</tr>
<tr>
<td>Yearlings-warm</td>
<td>62</td>
<td>4.3</td>
<td>5.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.8</td>
<td>5.8</td>
<td>5.9&lt;sup&gt;e&lt;/sup&gt;</td>
<td>5.8</td>
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<tr>
<td>Slaughter end point, cm</td>
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<td>&lt;.9</td>
<td>20</td>
<td>4.4</td>
<td>5.7</td>
<td>5.7</td>
<td>5.8</td>
<td>6.2</td>
<td>5.7</td>
</tr>
<tr>
<td>1.0–1.15</td>
<td>42</td>
<td>4.6</td>
<td>5.7</td>
<td>5.8</td>
<td>5.7</td>
<td>6.1</td>
<td>5.8</td>
</tr>
<tr>
<td>1.27–1.40</td>
<td>31</td>
<td>4.5</td>
<td>5.8</td>
<td>5.7</td>
<td>5.6</td>
<td>6.3</td>
<td>5.8</td>
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<tr>
<td>≥1.5</td>
<td>32</td>
<td>4.2</td>
<td>5.9</td>
<td>6.1</td>
<td>5.8</td>
<td>6.1</td>
<td>5.9</td>
</tr>
<tr>
<td>RMSE&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
<td>1.59</td>
<td>92</td>
<td>.59</td>
<td>.68</td>
<td>.70</td>
<td>.32</td>
</tr>
</tbody>
</table>

<sup>a</sup> = Extremely tender, intense and juicy to 1 = extremely dry, bland and tough.<br>
<sup>b</sup> = None detected to 1 = abundant.<br>
<sup>c</sup> = None detected to 1 = extreme off-flavor.<br>
<sup>d</sup> = Means in the same column within main effect with different superscripts differ (P < .05).<br>
<sup>f</sup> = Standard errors for means can be calculated as RMSE/√N, where RMSE = root mean square error and n = number of steers for that main effect.

The powdered sample also was used to determine total and percentage heat-soluble intramuscular collagen. By the procedure of Hill (1966), 3 to 5 g of powdered tissue, in triplicate, was used to extract the soluble and insoluble fractions of collagen. Hydroxyproline in the fractions was determined by the spectrophotometric method of Bergman and Loxley (1963) and converted to total collagen by multiplying by a factor of 7.25.

Data were analyzed by least squares with a fixed model of breed group, age-season of feeding, fat thickness, diet and year and all first-order interactions in the preliminary analysis. The effects of diet and interactions involving diet were not significant (P > .05) for palatability or muscle characteristics and were removed from the final model. No significant two-way interactions were noted for sensory traits, shear force values or muscle characteristics. Chi-square analyses (Steel and Torrie, 1980) were utilized to test distribution differences between breed groups for loin steak tenderness unacceptability (unacceptable = WBS > 5.5 kg or mean sensory panel tenderness score < 5.0).

To investigate the influence of endogenous enzymes on tenderness, a postmortem aging study was conducted on the last group of yearlings fed during the warm season (year 2, n = 32). Three additional steaks were removed 24 h postmortem from the loin of each carcass and assigned to one of three aging periods (1, 5 and 10 d) at 0 to 2°C. Samples were frozen at −18°C after their respective aging periods until Warner-Bratzler shear force determinations were completed. Additional analysis of these data was conducted, and significant effects for breed, postmortem aging and linear breed × linear aging interactions were found.

Results and Discussion

Sensory panel evaluation of loin steaks (Table 1) revealed lower (P < .05) tenderness scores for 1/2 and 3/4B carcasses compared with steaks from Angus carcasses slaughtered at comparable outside fat thickness, but tenderness of loin steaks from 1/4B carcasses were not different (P > .05) from those from Angus. Warner-Bratzler shear force values substantiated that tenderness values for loin steaks from Angus and 1/4B carcasses were not different, but loin steaks from 3/4B carcasses had higher Warner-Bratzler shear force values than did loin steaks from Angus and 1/4B carcasses. Average shear value for the 3/4B was 5.2 kg, indicating that a sizable portion of the 3/4B carcasses would produce steaks that would be of unacceptable or undesirable tenderness by
some consumers. Chi-square analysis showed a difference ($P = .04$) in distribution of percentage of steaks that would be considered unacceptable (>5.5 kg) as indicated by WBS values for the breed groups as follows: $A = 13.8; 1/4B = 15.6; 1/2B = 22.6; 3/4B = 41.9$.

Breed group, age-season of feeding and slaughter end point did not significantly influence sensory panel flavor or off-flavor scores (Table 1). Loin steaks from Angus and 1/4B carcasses were juicier ($P < .05$) than loin steaks from 1/2B or 3/4B carcasses. No breed group effects were noted for detectable connective tissue.

Numerous researchers have reported that loin steaks of Bos indicus and Bos indicus-crossbred cattle had higher shear force values and lower sensory panel tenderness scores than those of Bos taurus cattle (Ramsey et al., 1963; Carroll et al., 1964; Luckett et al., 1975; Thompson and Barlow, 1981; Koch et al., 1982; Norman, 1982; Peacock et al., 1982; Bidner et al., 1986; Crouse et al., 1989). In all the studies reported above, except Carroll et al. (1964), Luckett et al. (1975) and Crouse et al. (1989) shear or tenderness were significantly different only in cattle of 1/2 or greater Bos indicus breeding compared with Bos taurus cattle. In contrast to the current study, Carroll et al. (1964), Luckett et al. (1975) and Crouse et al. (1989) reported that palatability differed between steaks and roasts from 1/4 Bos indicus and cattle with no Bos indicus breeding. Findings from the present study indicate that tenderness differences do exist between steaks from 1/2 and higher percentage Brahman cattle versus steaks from 1/4 or less percentage Brahman cattle when slaughtered at compositionally equivalent slaughter end points. Chi-square analysis showed no difference ($P = .5$) in the distribution of the percentage of loin steaks rated as unacceptable in tenderness by sensory evaluation; however, numerical differences did exist ($A = 13.8, 1/4B = 15.6, 1/2B = 25.6, 3/4B = 25.8$). The underlying cause-effect relationship has not been developed.

Koch et al. (1982), Norman (1982) and Stanley et al. (1983) reported no breed-type effects on sensory panel juiciness or flavor scores. Carroll et al. (1964) found that juiciness scores were lower for steaks from 1/4 Brahman × 3/4 Hereford compared with steaks from straight Herefords. Ramsey et al. (1963) also reported lower juiciness and flavor scores for loin steaks and rib roasts from zebu versus British or dairy cattle, but they found no juiciness or flavor differences in steaks from the round.

Loin steaks from calves fed in the cool season were rated by sensory panel members as more tender and having less detectable connective tissue than loin steaks from yearlings fed in the warm season (Table 1). These results suggest that differences in sensory panel tenderness may have resulted from less collagen being solubilized during cooking. Results consistent with these were reported by Lopes (1986) and Drouillard (1986) for sensory panel tenderness scores due to age-season of feeding. However, they reported significantly higher shear force values for steers fed during the warm season. Other palatability traits were not affected by age and season of feeding.

Slaughter fatness end points (<0.9, 1.0 to 1.15, 1.27 to 1.40 or ≥1.5 cm) evaluated in this study did not significantly affect shear force value, sensory panel tenderness, juiciness or detectable connective tissue. The sensory panel flavor scores tended to increase and off-flavor to decrease as slaughter fatness increased (Table 1).

Table 2 depicts least squares means for loin muscle characteristics by breed group, age-season of feeding and slaughter end point. Loin muscle from Angus and 1/4B had more fat within the muscle (marbling or intramuscular fat) than did muscle tissue from 1/2B and 3/4B. Huffman et al. (1990) noted that all four breed groups were slaughtered at very similar 12th rib adjusted fat thickness, even though 1/2B and 3/4B carcasses had significantly lower marbling scores than did the Angus and 1/4B carcasses. The higher degree of marbling present in the loin muscle of Angus and 1/4B compared with loin muscle of the 1/2B or 3/4B carcasses could be partially responsible for the higher sensory panel tenderness and juiciness scores and the lower Warner-Bratzler shear force values. Calves fed in the cool season had more fat in the loin muscle than did yearlings fed in the warm season. Although both calves and yearlings were fed to the same 12th rib adjusted fat thicknesses, the calves fed in the cool season spent more total days in the feedlot on high-concentrate feedstuffs than did yearlings fed in warm season (Huffman et al., 1990). This difference in time on feed also might explain the difference in intramuscular fat deposition. The greater amount of fat in the
TABLE 2. MEANS FOR LOIN MUSCLE CHARACTERISTICS BY BREED GROUP.
AGE-SEASON AND SLAUGHTER END POINT

<table>
<thead>
<tr>
<th>Effect</th>
<th>No.</th>
<th>Fat, %</th>
<th>Moisture, %</th>
<th>Sarcomere length, μm</th>
<th>Fragmentation index</th>
<th>Total collagen, mg/g</th>
<th>Soluble collagen, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breed group</strong></td>
<td></td>
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<tr>
<td>A</td>
<td>31</td>
<td>4.4b</td>
<td>73.9</td>
<td>1.72</td>
<td>321.1b</td>
<td>3.19</td>
<td>20.1</td>
</tr>
<tr>
<td>3/4A: 1/4B</td>
<td>32</td>
<td>4.2b</td>
<td>73.8</td>
<td>1.74</td>
<td>376.9bc</td>
<td>3.29</td>
<td>21.8</td>
</tr>
<tr>
<td>1/2A: 1/2B</td>
<td>31</td>
<td>3.6c</td>
<td>74.6</td>
<td>1.74</td>
<td>412.1c</td>
<td>3.54</td>
<td>19.8</td>
</tr>
<tr>
<td>1/4A: 3/4B</td>
<td>31</td>
<td>3.1c</td>
<td>74.6</td>
<td>1.73</td>
<td>414.8c</td>
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<td>21.4</td>
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<td><strong>Age-season</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Calves-cool</td>
<td>63</td>
<td>4.4b</td>
<td>74.4</td>
<td>1.76b</td>
<td>408.2</td>
<td>3.62b</td>
<td>23.9b</td>
</tr>
<tr>
<td>Yearlings-warm</td>
<td>62</td>
<td>3.6c</td>
<td>74.1</td>
<td>1.70c</td>
<td>354.3</td>
<td>3.08c</td>
<td>17.6c</td>
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<td>Slaughter end point, cm</td>
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<td>&lt; .9</td>
<td>20</td>
<td>3.0b</td>
<td>75.6b</td>
<td>1.74</td>
<td>396.6</td>
<td>3.52</td>
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<td>1.0–1.15</td>
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<td>3.8c</td>
<td>74.3c</td>
<td>1.72</td>
<td>367.0</td>
<td>3.35</td>
<td>21.0</td>
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<td>1.27–1.40</td>
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<td>4.0d</td>
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<td>353.4</td>
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<td>20.0</td>
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<tr>
<td>≥ 1.5</td>
<td>31</td>
<td>4.2d</td>
<td>73.1d</td>
<td>1.77</td>
<td>408.0</td>
<td>3.25</td>
<td>20.0</td>
</tr>
<tr>
<td>RMSE</td>
<td>1.2</td>
<td>2.0</td>
<td>.12</td>
<td>138.3</td>
<td>.83</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

*100 = Extremely fragmentable; 600 = extremely unfragmentable.

b,c,d Means in the same column within main effect with different superscript differ (P < .05).

Standard errors for means can be calculated as RMSE/√N, where RMSE = root mean square error and n = number of steers for that main effect.

Loin muscle of the steers fed as calves versus the yearlings might partially explain higher sensory panel tenderness scores for the steers fed as calves. Also, as slaughter fatness end point increased, there was a corresponding increase in fat deposition within the loin muscle; this relationship did not appear to influence palatability traits.

Percentage intramuscular moisture, which normally would be inversely related to intramuscular fat, was not significantly affected by breed group or age-season of feeding. Data in Table 2 indicate that as slaughter fatness end point increased, percentage intramuscular moisture decreased; this illustrates the inverse relationship of intramuscular fat to moisture.

Sarcomere length, a measure of cold-induced muscle shortening, was not significantly affected by breed group or slaughter end point. This result would be anticipated due to the similarity in adjusted fat thickness among breed groups. Loin muscle from calves fed in the cool season had longer sarcomere lengths than yearlings fed in the warm season. Because both slaughter groups were killed at comparable outside fatness, producing similar chilling rates, this age-season effect on sarcomere length was somewhat unexpected.

Fragmentation index identifies differences in muscle fiber integrity and has been shown to be related closely to sensory panel tenderness and Warner-Bratzler shear force values (Davis et al., 1980). Presumably, fragmentation index is related to postmortem tissue degradation and structural weakening. Breed group effects on fragmentation index followed very closely the breed group effects on Warner-Bratzler shear values and sensory panel tenderness. As the percentage of Brahman breeding increased, fragmentation index tended to increase (Table 2). Age-season of feeding and slaughter fatness end point did not significantly affect fragmentation index in this study.

Total collagen, a measure of total amount of connective tissue within the loin muscle, and percentage soluble collagen, a measure of the amount of connective tissue solubilized at cooking temperatures, were not affected by breed group or slaughter fatness end point (Table 2). Norman (1982) also reported no difference in total intramuscular collagen between Bos indicus and Bos taurus breeds for longissimus dorsi, semimembranosus, psoas major or triceps brachii. He did, however, report a trend for higher mean collagen thermostability in zebu breeds versus non-zebu breeds and related these lower solubility characteristics to textural differences in the muscle. Loin muscle from calves fed in the cool seasons had more total collagen than did loin muscle from yearlings fed in the warm season. The loin muscle from the calves was higher (P < .05) in percentage heat-soluble collagen, indicating that a greater portion of the connective tissue would be broken down.
during cooking; this would explain a greater perceived tenderness in the calves by the sensory panel.

Data from the loin muscle indicate that breed group tenderness differences were not attributed to cold shortening effects or to differences in amount or integrity of the connective tissue component of muscle tissue. Fragmentation data suggest that tenderness differences due to breed group probably would rest in the muscle fiber component of muscle tissue, which in turn could be influenced greatly by endogenous enzymes during normal postmortem aging.

Mean values for shear force by breed group and aging period are presented in Figure 1. These data indicate that loin steaks from Angus and 1/4B carcasses showed a greater response to 10-d postmortem aging than did loin steaks from 1/2B and 3/4B carcasses. Loin steaks from the Angus and 1/4B decreased in shear values by 37 and 27%, respectively, during the 10-d postmortem aging period, and the steaks from the 1/2B and 3/4B decreased in shear value by only 9.4 and 16.7%, respectively. This differential response to postmortem aging suggests that the muscle from carcasses with 1/4 or zero Brahman breeding had more naturally occurring tenderizing enzymes present or that the enzymes present were more active in degrading the muscle tissue during the 10-d aging period. These results are critical for the industry, because cuts typically are aged 7 to 11 d before being offered for sale to the public. If meat from carcasses with 1/2 or more Brahman breeding responded to postmortem aging in a way similar to Angus and 1/4B carcasses, then perhaps tenderness of meat from higher percentage Brahman carcasses would present less of a problem to consumers. This relationship needs further study to identify the enzymes involved and their mode of action to further explain and reduce tenderness variation.

Implications

This study suggests that steaks from steers with 1/2 or higher percentage Brahman breeding are less tender than steaks from 1/4 or lower percentage Brahman, even when slaughtered at comparable levels of outside fatness. Percentage Brahman breeding did not affect flavor, juiciness or incidence of off-flavor. Muscle characteristics suggest that the underlying cause would be in the muscle fiber component and not in the connective tissue portion of the muscle. Postmortem aging studies found a differential response to aging; steaks from 1/4 or zero Brahman improved in
tenderness more than steaks from 1/2 or more Brahman. Mechanisms causing this differential response to aging need further study.

Literature Cited


