Pre-harvest cattle management practices enhance beef tenderness

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Summary

Beef producers have worked diligently during the last several years to identify primary consumer demand drivers and become more responsive to consumer needs by improving the quality, safety and convenience of beef products. A recent checkoff-funded review paper identified several pre-harvest factors that can influence the eating quality of beef and be managed to enhance the quality of the end product.

Background

The key elements of effective pre-harvest beef tenderness management systems (i.e., process control points) include: 1) control of breed/genetic inputs; 2) use of feeding systems that enhance product quality; 3) judicious application of growth enhancement technologies; and 5) adherence to best management practices to avoid quality and tenderness problems associated with the effects of morbidity, pre-harvest stress, administration of animal health products and hormonal status of the animal.

Managing genetic inputs

The high degree of genetic diversity in U.S. beef production systems, while advantageous from a production standpoint, represents an important source of variation in beef tenderness. The carcass quality and beef tenderness characteristics of eight of the most widely utilized beef cattle breeds in modern production systems are compared in Table 1. While all of the Bos taurus breeds listed in the table (and several others not listed) merit consideration for use in consumer-driven breeding systems, producers whose goals are focused specifically on production of high-quality, tender beef should emphasize use of breeds with lower mean shear force values and higher mean marbling scores.

Crossbreeding systems that result in feeder cattle with 50 percent to 75 percent British and 25 percent to 50 percent Continental breed influence are recommended for balancing the growth performance and carcass yield advantages of Continental breeds with the maternal performance and beef quality advantages of British breeds.

An effective strategy for enhancing tenderness through the selective use of breeds is to moderate the percentage of Bos indicus breeding in market steers and heifers. Research suggests that limiting Bos indicus inheritance to three-eights (37.5%) or less is effective for reducing the incidence of tenderness problems. Heritability estimates from a number of studies suggest that tenderness is moderately heritable (h² = 0.24 to 0.53) in Bos taurus and Bos taurus/Bos indicus crossed cattle populations but less heritable (h² = 0.14 to 0.17) in pure strains of Brahman cattle. The time and expense associated with changing tenderness via traditional selection methods have been major impediments to genetic improvement of beef tenderness.

Feeding systems

Cattle feeding systems in the United States are designed specifically to produce grain-fed beef, which is demanded by most mainstream markets (both domestic and export). Grain-fed cattle produce carcasses with brighter-colored, finer-textured lean, whiter fat and more marbling – all of which enhance acceptability of fresh beef in retail. In addition, most comparisons of forage-fed and grain-fed beef suggest that grain feeding improves tenderness and flavor. Research conducted to characterize the relationship between time-on-feed (the number of days cattle are fed a high-concentrate finishing diet) and beef palatability attributes has shown that most improvements in tenderness and flavor occur during the early portion of the finishing period (before 112 days on feed), and that finishing periods longer than approximately 100 days seem to provide little additional improvement in either tenderness or flavor. Correspondingly, to minimize the incidence of toughness problems stemming from advanced maturity, grain-finished cattle should be harvested at young ages – preferably less than 24 months of age.

Comparison of carcass quality and beef tenderness characteristics for eight of the most widely used cattle breeds in U.S. production systems

<table>
<thead>
<tr>
<th>Breed</th>
<th>Age-constant mean a</th>
<th>Marbling score</th>
<th>% Choice &amp; higher</th>
<th>Shear force, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>Bos taurus/British</td>
<td>SM88</td>
<td>88</td>
<td>4.0</td>
</tr>
<tr>
<td>Hereford</td>
<td>Bos taurus/British</td>
<td>SM68</td>
<td>65</td>
<td>4.1</td>
</tr>
<tr>
<td>Red Angus</td>
<td>Bos taurus/British</td>
<td>SM58</td>
<td>50</td>
<td>4.1</td>
</tr>
<tr>
<td>Charolais</td>
<td>Bos taurus/Continental</td>
<td>SM17</td>
<td>62</td>
<td>4.3</td>
</tr>
<tr>
<td>Galloway</td>
<td>Bos taurus/Continental</td>
<td>SM10</td>
<td>58</td>
<td>4.5</td>
</tr>
<tr>
<td>Limousin</td>
<td>Bos taurus/Continental</td>
<td>SM14</td>
<td>57</td>
<td>4.3</td>
</tr>
<tr>
<td>Simmental</td>
<td>Bos taurus/Continental</td>
<td>SM27</td>
<td>66</td>
<td>4.3</td>
</tr>
<tr>
<td>Brahman</td>
<td>Bos indicus/Zebu</td>
<td>SL73</td>
<td>30</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Use of growth enhancement technologies

Growth promoting implants administered to growing and finishing cattle, significantly increase net returns by increasing both rate and efficiency of weight gain through enhanced accretion (protein accumulation). These implants improve daily gain by approximately 6 percent in suckling calves, 12 percent to 16 percent in stocker cattle and 15 percent to 25 percent in feedlot cattle. Some estimates indicate that the cumulative effects of growth promoting implants used in each successive phase of production (suckling, stocker and feedlot) can increase live weight by approximately 125 pounds and add more than $90 to the value of each animal. Careful use of finishing implants is essential for effective tenderness assurance, and aggressive implant programs should be avoided to circumvent toughness problems.

The feed additive melengestrol acetate (MGA) can be included in the diets of heifers to suppress estrus and improve growth performance. However, the increased physical activity and stress associated with behavioral estrus in heifers following MGA withdrawal can result in an abnormally high incidence of dark cutting carcasses. Heifers should not be removed from MGA-supplemented diets for periods longer than 24 hours prior to harvest. In the United States, MGA has no withdrawal requirement and may be fed until the time of shipment for subsequent harvest.

Optaflexx™ (the trade name for ractopamine hydrochloride) is a beta-adrenergic agonist that is mixed into cattle finishing diets and provided to feedlot steers and heifers during the final 28 to 42 days before harvest to improve feed efficiency an increase carcass yields of lean beef.

Health management and tenderness

Tenderness management demands effective health programs at all points in the beef chain. Administration of animal health products via intramuscular (IM) injection can cause development of a lesion near the site of the injection, which influences tenderness of the surrounding muscle tissue. Strict adherence to Beef Quality Assurance (BQA) guidelines for use of animal health products is advocated to avoid tenderness problems associated with IM injection. Timely application of routine management practices, such as castration of male calves, also can reduce variation in beef tenderness.

Avoiding pre-slaughter stress

Pre-harvest conditions that cause any form of physical or psychological stress among cattle can result in muscle glycogen depletion and increase the incidence of dark cutting beef. Final muscle pH within a range of 5.4 to 5.7 is considered normal for beef. Beef carcasses with slightly higher-than-normal final muscle pH values, ranging from 5.8 to 6.2, exhibit a lean color that is only slightly dark; however, a number of studies have shown that muscle pH values within this range are associated with a comparatively high frequency of meat toughness. Adoption of management practices that reduce handling and environmental stress and preferential selection of cattle with calm temperaments are essential elements of effective beef quality management systems.

Delivering a quality eating experience is critical to the continued success of the beef industry and its efforts to build consumer demand for beef products. Beef consumers associate eating satisfaction with product value and many are willing to pay premium prices for beef with the level of tenderness or flavor characteristics they prefer.

The complete version of this review document is available for purchase from The Beef Checkoff Customer Service Department by calling 800-368-3138. Reference item No. 12811.
Key Points

• Beef consumers associate eating satisfaction with product value and many are willing to pay premium prices for beef with the level of tenderness or flavor characteristics they prefer.

• The key elements of effective pre-harvest beef tenderness management systems include: breed/genetic inputs, feeding systems, judicious use of growth enhancement technologies and best management practices.

• The high degree of genetic diversity in U.S. beef production systems, while advantageous from a production standpoint, represents an important source of variation in beef tenderness.

• Research conducted to characterize the relationship between time-on-feed and beef palatability attributes has shown that most improvements in tenderness and flavor occur during the early portion of the finishing periods.

• Careful use of finishing implants is essential for effective tenderness assurance, and very aggressive implant programs should be avoided to circumvent toughness programs.

• Adoption of management practices that reduce handling and environmental stress and preferential selection of cattle with calm temperaments are essential elements of effective beef quality management systems.