Cattle Stress and Handling Factors that Impact Beef Quality
AMI
October 2013
National Beef Quality Audit
NBQA Phase 1: Face-To-Face Interviews
Retailers 30 Interviews
### Retail Most Important Attributes

<table>
<thead>
<tr>
<th>Rank</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>93</td>
<td>Food safety</td>
</tr>
<tr>
<td>70</td>
<td>Eating satisfaction</td>
</tr>
<tr>
<td>24</td>
<td>How and where the cattle were raised</td>
</tr>
<tr>
<td>23</td>
<td>Visual characteristics</td>
</tr>
<tr>
<td>11</td>
<td>Weight and size</td>
</tr>
<tr>
<td>11</td>
<td>Lean, fat, and bone</td>
</tr>
<tr>
<td>8</td>
<td>Cattle genetics</td>
</tr>
</tbody>
</table>
## Retailer Definitions Of The Specified Quality Categories

<table>
<thead>
<tr>
<th>Food safety</th>
<th>Eating satisfaction</th>
<th>How &amp; where the cattle were raised</th>
<th>Visual char.</th>
<th>Weight &amp; size</th>
<th>Lean, fat, &amp; bone</th>
<th>Cattle genetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced in effective food safety environ. (40.0%)</td>
<td>Flavor (70.0%)</td>
<td>Origin of product (60.0%)</td>
<td>Amount of marbling (100.0%)</td>
<td>Uniformity in cuts (63.3%)</td>
<td>Lean to fat ratio (83.3%)</td>
<td>Primarily black hide (50.0%)</td>
</tr>
<tr>
<td>Require application of HACCP (33.3%)</td>
<td>Tenderness (66.7%)</td>
<td>Animal well-being (50.0%)</td>
<td>Correct product color (86.7%)</td>
<td>Correct ribeye size (30.0%)</td>
<td>Cut to spec (23.3%)</td>
<td>Genetic potential for marbling (23.3%)</td>
</tr>
<tr>
<td>USDA inspected &amp; verified (26.7%)</td>
<td>Consistency (40.0%)</td>
<td>Feed ingred. (30.0%)</td>
<td>Trim level (40.0%)</td>
<td>Carcass weights (23.3%)</td>
<td>Quality grade (20.0%)</td>
<td>Not Bos indicus (13.3%)</td>
</tr>
<tr>
<td>Traceability (26.7%)</td>
<td>Customer satisfaction (36.7%)</td>
<td>Never received antibiotics (20.0%)</td>
<td>Correct muscle size (23.3%)</td>
<td>Cut weights (20.0%)</td>
<td>Adequate fat cover (10.0%)</td>
<td>EPDs (13.3%)</td>
</tr>
<tr>
<td>No detectable E. coli O157:H7 (26.7%)</td>
<td>Juiciness (23.3%)</td>
<td>Maintain mgmt. records (16.7%)</td>
<td>No defects (16.7%)</td>
<td>Box weight (16.7%)</td>
<td>Adequate muscling (10.0%)</td>
<td>Palatability traits (10.0%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Never received a hormonal implant (16.7%)</td>
<td></td>
<td></td>
<td>Boneless (10.0%)</td>
<td>Consistency (10.0%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Primary British (10.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Sustainability</strong></td>
<td><strong>Animal Well-being</strong></td>
<td><strong>Traceability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmentally friendly (36.7%)</td>
<td>Animals are healthy and provided adequate nutrition (36.7%)</td>
<td>Ability to trace an outbreak or a recall back to a point of origin quickly (36.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making the best decisions in order to maintain the family business (10.0%)</td>
<td>Humane treatment and handling (30.0%)</td>
<td>The product can be backed up (16.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply and Demand – making sure there is enough supply to meet demand (10.0%)</td>
<td>Temple Grandin designed facilities and practices (13.3%)</td>
<td>COOL (16.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have an organized sustainability program (10.0%)</td>
<td>Follow animal welfare standards set by USDA and our company (10.0%)</td>
<td>Birth to Box story (16.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase from suppliers with sustainability program in place (10.0%)</td>
<td>Suppliers educate us about the programs they use (6.7%)</td>
<td>Ability to know every step of the process and where the product has been and has gone (6.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not important to us right now (6.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Phase 2
Inplant Audits

Packer
<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargill Meat Solutions</td>
<td>Dodge City, KS</td>
</tr>
<tr>
<td>Cargill Meat Solutions</td>
<td>Schuyler, NE</td>
</tr>
<tr>
<td>Creekstone Farms Premium Beef</td>
<td>Arkansas City, KS</td>
</tr>
<tr>
<td>JBS Swift &amp; Company</td>
<td>Cactus, TX</td>
</tr>
<tr>
<td>JBS Swift &amp; Company</td>
<td>Greeley, CO</td>
</tr>
<tr>
<td>National Beef Packing Company</td>
<td>Brawley, CA</td>
</tr>
<tr>
<td>Tyson Fresh Meats</td>
<td>Amarillo, TX</td>
</tr>
<tr>
<td>Tyson Fresh Meats</td>
<td>Lexington, NE</td>
</tr>
</tbody>
</table>
Carcasses With NO Bruises

<table>
<thead>
<tr>
<th>Year</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBQA-1991</td>
<td>61</td>
</tr>
<tr>
<td>NBQA-1995</td>
<td>52</td>
</tr>
<tr>
<td>NBQA-2000</td>
<td>53</td>
</tr>
<tr>
<td>NBQA-2005</td>
<td>65</td>
</tr>
<tr>
<td>NBQA-2011</td>
<td>77</td>
</tr>
</tbody>
</table>
NBQA-2011 Carcass Bruise Location

Percentage

<table>
<thead>
<tr>
<th>Location</th>
<th>NBQA-2005</th>
<th>NBQA-2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loin</td>
<td>14.0</td>
<td>13.8</td>
</tr>
<tr>
<td>Chuck</td>
<td>11.7a</td>
<td>3.8b</td>
</tr>
<tr>
<td>Rib</td>
<td>7.8a</td>
<td>5.9b</td>
</tr>
<tr>
<td>Round</td>
<td>15.5a</td>
<td>8.8b</td>
</tr>
</tbody>
</table>
NBQA-2011: Instrument Grading

- \( n = 2.4 \times 10^6 \)
- Data collected from November 2010 to November 2011 every other month for one week (about 20 days worth of data overall per month)
- Multiple plants (\( n = 17 \)) from multiple companies (\( n = 4 \))
Percentage Distribution of Dark Cutters - 2011

0.77% Dark Cutter

Month

Carcasses Grading Choice by Month: Instrument Assessment

%  58.3  64.9  64.7  62.4  61.7  58.8  57.7

Nov 10  Jan 11  Mar 11  May 11  Jul 11  Sep 11  Nov 11
# Dark Cutter By Gender

Percentage distribution of beef carcasses stratified by dark cutter carcasses and gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Dark Cutter</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steer</td>
<td>0.45%</td>
<td>57.78%</td>
</tr>
<tr>
<td>Heifer</td>
<td>0.33%</td>
<td>37.43%</td>
</tr>
<tr>
<td>Dairy Steer</td>
<td>0.07%</td>
<td>3.77%</td>
</tr>
<tr>
<td>Dairy Heifer</td>
<td>0.001%</td>
<td>0.17%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.85%</strong></td>
<td><strong>99.15%</strong></td>
</tr>
</tbody>
</table>
National Market Cow and Bull Beef Quality Audit-2007:
A Survey of Producer Related Defects

Strategy Summit
Travel Distance on a Truck

Dairy Cattle Traveled Shorter Distances

- All Cattle: 409, 473, 227.1
- Beef: 450.9
- Dairy: 60.2
- Mixed: 22, 60, 25, 22

Mean, Minimum, Maximum Distances
Load Sorting Information

73% of Beef Loads WERE NOT Separated by Gender

% Sorted by Gender
Dairy Cows had a greater incidence of lameness
Cause of Blood Splash

- Improper stunning
- Too long of an interval between stunning and sticking
- Double stunning
- Stress and temperament can also be a factor
Callused Eye
What is Quality?

A quality defect is anything that impacts the value of beef or impairs consumer confidence.
Meat Quality
Glucose Metabolism

Principles of Meat Science
Aberle et al. Textbook


Figure 4.9  Cyclic nature of the pathways that provide energy for muscle contraction and heat production is summarized in this diagram. Courtesy of W. H. Freeman and Company.
Glucose Metabolism Postmortem


Principles of Meat Science Aberle et al. Textbook
Hormonal Control

Pituitary Gland

ACTH - Stimulation of corticoid release
Adrenocorticotropic hormone

Adrenal Gland
Corticoid - synthesis of carbohydrates, maintenance of cell response

Epinephrine and Norepinephrine - Influence blood flow and heart rate, breakdown glycogen and lipid

Thyroid Gland

- stimulation of oxidative metabolism, increases metabolic rate

Adapted from Principles of Meat Science, Aberle et al. Textbook
• Short-term pre-harvest stress, accompanied by elevated blood epinephrine concentrations, reduces beef tenderness without affecting final muscle pH (normal pH = 5.4 to 5.5) or lean color. Possibly to heat shock protein formation.

• Longer-term, sustained stress depletes muscle glycogen reserves, resulting in high-pH (>5.8), dark-cutting beef.
Chemistry Of Meat Protein

- Myosin is generally considered the singly most important because:
  - amino acid composition gives highly-charged, polar molecule
  - present in large quantity in lean muscle

Chemistry Of Water

Water

- present in greatest quantity in most products
- important to eating quality and economics
- remember: water is both a meat component and a non-meat (added) ingredient

Bound by proteins

In order to understand water in meat systems it is necessary to understand

- water : protein interactions
- water : water interactions

Water is a unique compound with a unique structure

\[
\begin{array}{c}
\text{H}_2\text{O} \\
\text{H}^+ \\
\text{O} \\
\text{H}^+ \\
\text{H}_2\text{O}
\end{array}
\]

Water attracts Water
“Free” water is loosely held and very dependent upon capillary space between and within proteins.

Stress reactions to the slaughter procedure influence ante- and post-mortem muscle metabolism and, consequently, the rate and extent of glycogen breakdown and pH decline, color and drip loss.

Effects are principally due to variations in ATPase activity and muscle glycogen reserves.

Behavioral, physiological and metabolic responses to aversive situations depend on genetic background and prior experience of the animals.
Handling and Stressors

The Stressors of Marketing

- From farm to slaughter animals are subjected to:
  - Removal from their home environment
  - Loading and unloading from vehicles
  - Transport and holding in unfamiliar surroundings

- In addition to:
  - Noise
  - Strange odors
  - Deprivation of food and water
  - Vibration and changes in velocity
  - Temperature Extremes
  - Confinement
## Persistent Pinking in Ground Beef and Stress and Elevated pH

### Photo 1: Color of Cooked Ground Beef Patties as Affected by the Initial Chemical State of Myoglobin of Uncooked Patties.

<table>
<thead>
<tr>
<th></th>
<th>DMb</th>
<th>OMb</th>
<th>MMb</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raw</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Cooked</strong></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
</tbody>
</table>

*Picture courtesy of the Kansas State University Meat Science Program.*
Persistent Pink
Beef that has some degree of red remaining after cooking can be associated with the presence of undenatured pigments or the formation of certain denatured globin hemochromes.

Persistent pink from undenatured pigments is promoted by a high pH level, pigments in the reduced state that are more heat stable, and in muscles containing high levels of pigmentation.

IN ADDITION TO HIGH PH (6.6), EXTREME DC beef rounds had higher than normal myoglobin concentration and lower than normal oxidation-reduction potential and reducing ability.
pH Decline of Dark Cutting

![Graph showing pH decline over hours postmortem for different stress conditions.](image-url)
pH Decline and intital Glycogen

Dark cutting beef and ways to reduce the problem Graham Gardner, and Dave Pethick. - Meat Science
The Cause of Dark Cutting

Glycogen storage - feeding level
Glycogen loss - pre-slaughter stress
The Cause of Dark Cutting

Glycogen storage - feeding level
Glycogen loss - pre-slaughter stress
Glycogen Pasture vs Feedlot


Dark cutting beef and ways to reduce the problem
Graham Gardner, and Dave Pethick. J - Meat Science
Stress and Heat Transfer

Importance of access water

Thermal Heat Signature

Normal beef (non DFD)
Mean dorsal temp 30.07°C

Dark-Firm-Dry (DFD) beef (Can. B4)
Mean dorsal temp 33.00°C
This study evaluated A total of 272,936 cattle in 2,082 pens were evaluated and 4,460 dark cutters (1.6%) were found. Factors contributing to the incidence of DCB included

Carrying of cattle overnight at the slaughter plant, carrying of cattle overnight at the slaughter plant significantly increased the percent of dark cutters from 1.0 to 2.7%.

Gender mixing of cattle
Feedlot mixing of cattle
This study evaluated a total of 272,936 cattle in 2,082 pens were evaluated and 4,460 dark cutters (1.6%) were found. Factors contributing to the incidence of DCB included fluctuating weather conditions, such as excessive heat and extreme cold. The highest percentage (1.9%) of dark cutters occurred when temperature ranges exceeded 10 to 15 degrees Celsius.

In turn, supplements that increase blood glucose levels (i.e., an electrolyte solution) should be added to feed or water during stressful climatic periods to help reduce DCB.
Incidence of Dark Cutting

Jones and Tong (1987) reported that:
(a) The frequency of dark-cutting beef increased as transportation distance from the farm to the slaughter plant changed (from less than 60 miles to more than 180 miles).
(b) Mixed loads of cattle had a significantly higher frequency of dark-cutting beef than unmixed loads.
(c) The frequency of dark-cutting beef differed widely among packing plants—from a low of 0.26% to a high of 1.79%.
Gender Frequency of DC

Effects Of Gender On The Incidence of Dark Cutters

- Steers
- Heifers
- Spayed Heifer

Means bearing different superscript letters differ (P < .05).

Scanga et al. (1997)

Factors Contributing to the Incidence of Dark Cutting Beef
J. A. Scanga, K. E. Belk2, J. D. Tatum, T. Grandin, and G. C. Smith
## Implant Strategy Frequency of DC

<table>
<thead>
<tr>
<th>Implantation Strategy&lt;sup&gt;c&lt;/sup&gt;</th>
<th>No. of pens</th>
<th>LS Mean ± SE of % DC&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Pens &gt; 6% DC %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination&lt;sup&gt;e&lt;/sup&gt;/Combination&lt;sup&gt;f&lt;/sup&gt;</td>
<td>165</td>
<td>.86&lt;sup&gt;y&lt;/sup&gt; ± .003</td>
<td>7.88</td>
</tr>
<tr>
<td>Estrogen/Estrogen</td>
<td>553</td>
<td>.08&lt;sup&gt;z&lt;/sup&gt; ± .009</td>
<td>0</td>
</tr>
<tr>
<td>Estrogen/Combination</td>
<td>61</td>
<td>.19&lt;sup&gt;z&lt;/sup&gt; ± .008</td>
<td>1.64</td>
</tr>
<tr>
<td><strong>Heifers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double Androgen/Androgen</td>
<td>6</td>
<td>.67&lt;sup&gt;yz&lt;/sup&gt; ± .096</td>
<td>0</td>
</tr>
<tr>
<td>Androgen/Double Androgen</td>
<td>11</td>
<td>.26&lt;sup&gt;z&lt;/sup&gt; ± .052</td>
<td>0</td>
</tr>
<tr>
<td>Androgen/Androgen</td>
<td>129</td>
<td>.54&lt;sup&gt;yz&lt;/sup&gt; ± .001</td>
<td>3.1</td>
</tr>
<tr>
<td>Androgen/Combination</td>
<td>10</td>
<td>.54&lt;sup&gt;z&lt;/sup&gt; ± .084</td>
<td>--</td>
</tr>
<tr>
<td>Androgen/Estrogen</td>
<td>46</td>
<td>1.66&lt;sup&gt;y&lt;/sup&gt; ± .033</td>
<td>0</td>
</tr>
<tr>
<td>Estrogen/Estrogen</td>
<td>12</td>
<td>.92&lt;sup&gt;yz&lt;/sup&gt; ± .134</td>
<td>8.33</td>
</tr>
</tbody>
</table>

<sup>a</sup> Standard error of the least squares means.

<sup>b</sup> Pens with a greater than 6% incidence of dark cutters were considered epidemics and termed "Blowout" pens.

**Factors Contributing to the Incidence of Dark Cutting Beef**

J. A. Scanga, K. E. Belk, J. D. Tatum, T. Grandin, and G. C. Smith


76:2040-2047
Managing Dark Cutters

Factors Contributing to the Incidence of Dark Cutting Beef

J. A. Scanga, K. E. Belk2, J. D. Tatum, T. Grandin, and G. C. Smith
Table 1. Effects of feed withdrawal prior to marketing on steer weights and feed intakes.

<table>
<thead>
<tr>
<th>Feed withdrawal time, h</th>
<th>Difference</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>24</td>
<td>Numeric</td>
</tr>
<tr>
<td>Cattle, no</td>
<td>563</td>
<td>%</td>
</tr>
<tr>
<td>Pens, no</td>
<td>3</td>
<td>P &lt;</td>
</tr>
</tbody>
</table>

Dark cutting carcasses

<table>
<thead>
<tr>
<th></th>
<th>All types, %</th>
<th>Full dark, %</th>
<th>Blood splash, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.68</td>
<td>.35</td>
<td>1.61</td>
</tr>
<tr>
<td></td>
<td>1.75</td>
<td>1.04</td>
<td>2.26</td>
</tr>
<tr>
<td></td>
<td>.07</td>
<td>.69</td>
<td>.65</td>
</tr>
<tr>
<td></td>
<td>4.17</td>
<td>197.14</td>
<td>40.37</td>
</tr>
<tr>
<td></td>
<td>.84</td>
<td>.11</td>
<td>.52</td>
</tr>
</tbody>
</table>

Impact of Withholding Feed on Performance and Carcass Measurements of Feedlot Steers
• Crossbred heifer (n = 72) and steer (n = 72)
• assigned randomly to four treatment groups: A) Control, 0% added dietary Mg, B) 0.25% added dietary Mg, C) 0.50% added dietary Mg, and D) 0.75% added dietary Mg. Supplemental Mg was provided in the form of magnesium oxide (MgO) for the final 14 days of the finishing period. The basal diet contained 0.2% Mg.
• On the day before each harvest date, animals comprising each block (steers and heifers from all four treatment groups) were commingled in a large pen to induce a stress response associated with agonistic behavior.
• No evidence to support the premise that Mg supplementation of cattle lessens the effects of pre-harvest stress on beef quality characteristics.

• Heifers and steers exhibited distinctly different stress responses. Heifers were more excitable than steers during pre-harvest handling and exhibited a short-term (acute) stress response that resulted in increased meat toughness without a concomitant increase in muscle pH.

• Steers, on the other hand, exhibited greater physical activity (sustained stress) during the mixing period and, therefore, produced carcasses with lower muscle glycogen concentrations and higher 48-hour muscle pH values compared with heifers. Steers also produced tougher strip steaks than did heifers.
Additionally, stress-induced increases in muscle pH significantly reduced early postmortem tenderization, thereby influencing aging requirements for beef strip loins.
Electrolytes – Sodium is the major determinant of extracellular and total body water, whereas potassium is the primary determinant of intracellular fluid volume (Tasker, 1980). Both these cations are lost during antemortem stress.


Table 1. Nutritional therapy effects on hot carcass yield and grade in beef cattle and swine

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Nutritional therapy</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>1,130</td>
<td>990</td>
<td>—</td>
</tr>
<tr>
<td>USDA Prime, %</td>
<td>1.4</td>
<td>4.4</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>USDA Choice, %</td>
<td>56.0</td>
<td>67.0</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>USDA DFD, %</td>
<td>1.84</td>
<td>1.07</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Yield, %</td>
<td>61.38</td>
<td>62.03</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Swine b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>41</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td>Hot carcass wt/farm wt, %</td>
<td>72.9</td>
<td>73.7</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*a*Market-weight beef cattle held overnight and offered 2 kg of Nutri-Charge per animal for 24 h before slaughter (from Schoefen et al.)

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Electrolyte Supplements

Dark cutting beef and ways to reduce the problem
Graham Gardner, and Dave Pethick
/1234/20085/FSS03-Gardner-
Dark_cutting.pdf?sequence=1
### Nutritional Additives

**Trace Minerals**

**Carbs**

**Magnesium**

---

**Pethick et al. (1999) The regulation of glycogen level in the muscle of ruminants by nutrition**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Species/diet</th>
<th>Consumed on farm(^a)</th>
<th>Time lairage</th>
<th>Consumed in lairage</th>
<th>Offered in lairage(^b)</th>
<th>Extent of glycogen increase (SM)(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucotrans</td>
<td>Cattle/feedlot</td>
<td>yes</td>
<td>40</td>
<td>yes</td>
<td>yes</td>
<td>+</td>
</tr>
<tr>
<td>Nutricharge 1</td>
<td>Cattle/feedlot</td>
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<td>20</td>
<td>no</td>
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<td>none</td>
</tr>
<tr>
<td>Nutricharge 2a</td>
<td>Cattle/feedlot</td>
<td>yes</td>
<td>40</td>
<td>yes</td>
<td>yes</td>
<td>+++</td>
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<tr>
<td>Nutricharge 2b</td>
<td>Cattle/feedlot</td>
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<td>no</td>
<td>yes</td>
<td>none</td>
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<tr>
<td>Nutricharge 3a</td>
<td>Cattle/feedlot</td>
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<td>1</td>
<td>no</td>
<td>no</td>
<td>+</td>
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<tr>
<td>Nutricharge 3b</td>
<td>Cattle/feedlot</td>
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<tr>
<td>Nutricharge 4a</td>
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<td>yes</td>
<td>20</td>
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<td>no</td>
<td>+</td>
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<tr>
<td>Nutricharge 4b</td>
<td>Lambs/feedlot</td>
<td>yes</td>
<td>20</td>
<td>no</td>
<td>no</td>
<td>none</td>
</tr>
</tbody>
</table>

\(^a\) consumed 1kg/hd of Nutricharge pellets; \(^b\) offered 2 kg/hd of Nutricharge pellets

\(^b\) significant effect P<0.1
Electrolytes

Bovine BlueLite® helps reduce dark cutters and maximize profits

Summary
- Improve beef quality and grade
- Preserve weight gain and Hot Carcass Weight (HCW)
- Reduce dark cutters through maintaining energy balance
- Replenish electrolyte balance
- Improve consumer acceptance

Bovine BlueLite Pellets Pre-Harvest Protocol
For cattle fed 3x/day
Add 0.33 lbs per head, per feeding to the mixing load starting no less than two days prior to shipping. Do not hold cattle off feed or water and make sure cattle are fed to a slick bunk to ensure consumption. Feeding product during each load ensures intake by all cattle.

For cattle fed 2x/day
Add 0.5 lbs per head, per feeding to the mixing load starting no less than two days prior to shipping. Do not hold cattle off feed or water and make sure cattle are fed to a slick bunk to ensure consumption. Feeding product during each load ensures intake by all cattle.

Questions?
We're always available to answer any questions you may have.
Email info@techmixglobal.com or call (877) 466-6455.
Electrolytes

GUARANTEED ANALYSIS
Calcium (Ca), min.............0.05%
Calcium (Ca), max.............0.55%
Phosphorus (P), min...........0.30%
Salt (NaCl), min..............8.00%
Salt (NaCl), max.............9.60%
Potassium (K), min...........8.25%
Magnesium (Mg), min........0.14%
Vitamin A, min..............1,000,000 IU/lb
Vitamin D3, min............200,000 IU/lb
Vitamin E, min.............1,000 IU/lb

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TechMix, LLC • 740 Bowman St • PO Box 221 • Stewart, MN 55385 • 877.466.6455 • TechMixGlobal.com
Factors contributing to the incidence of DCB included:
- Carrying of cattle overnight at the slaughter plant
- Breed type
- Poor nutrition
- Slaughter plant
- Gender
- Gender mixing of cattle
- Feedlot mixing of cattle
- Fluctuating weather conditions, such as excessive heat and extreme cold
- Transportation

Usually a combination of factors.
Grandin (1992a) made the following observations regarding bruising of slaughter cattle at packing plants:

(a) If there is a sudden occurrence of bruises, look for recent changes in personnel and/or for broken equipment.
(b) Back bruises almost always are caused by gate, truck deck or personnel problems.
(c) Loin bruises result from horns on cattle, narrow entryways, protrusions into alleyways or rough handling.
(d) Shoulder bruises are caused by horns on cattle, protrusions into alleyways or rough handling.
(e) Cattle can still be bruised after stunning and prior to bleeding. Bruising can occur until the blood pressure is zero.
If there is a Blood Pressure then Bruising can Happen

Old Bruises have a yellow mucous fluid in them

Relatively New Bruises do not

Can not determine the timing of bruises within 24 hours

Bruises take up to 30 days to heal
Meischke et al. (1974) noticed that carcasses were more bruised on the left side than on the right side; further investigation revealed that the left side was the side cattle fell on after stunning when released from the knocking box.

Meischke and Horder (1976) studied bruises on cattle in six abattoirs in Australia and determined that differences in carcass bruises were related to the way in which each carcass was ejected from the knocking box.
Bruising and Transportation

Trucking Tips to Reduce Bruising

• More than 50% of bruising is due to rough, careless handling
• 2/3 of bruising occurs while loading/unloading
• Cows bruise easier than steers

Overcrowding and Improper Trailer Positioning
Transportation checklist

Loading, transporting and unloading cattle can be stressful — for both you and the cattle. Without proper handling practices, the transportation process can negatively affect meat quality, namely causing bruising and dark cutters. Here’s a checklist of proper handling to help you preserve meat quality.

Pre-trip inspection

- Driver physically and mentally ready
- Truck and trailer appropriately prepared for summer or winter travel
- Trailer in good operating order
- Bedding provided if required
- Trailer properly decked and set to receive the load
- Trailer properly cleaned to prevent dumping of manure on road

Inspection of facilities

- Chute/ramp in good condition and able to withstand weight and pressure of animals to be loaded
- Chute/ramp width accommodates animals to be loaded
- Check for and fix protruding sharp objects, broken gates, fences, latches, etc.
- Check for and fix traction problems that could affect both you and the animals, such as ice or mud

Line-up and docking

- Back into the chute slowly
- Align properly with chute, leaving no gaps or holes between chute and trailer

Loading

- All actions should be slow and quiet
- Lead animal may hesitate because of glaring light, shadows or dark entry; steep, slippery, or unsteady chute or ramp; and unfamiliar noise. Anticipate and address these items during your pre-trip inspection of facilities.

- Segregated animals should be loaded last and put in the back compartment of the trailer
- Don’t slam a gate closed to stop an animal that is trying to go through it
- Don’t drop your tailgate on animals when loading
- Use prods judiciously. If an animal is already moving or has no room to move, prodding devices should not be used, as they can contribute to bruising.
- Keep in mind the AMI guideline for electric prods use: “The use of [electric prods] are discouraged. However, when they are used and required to move cattle, do not use [electric prods] on the genital or anal areas or in front of the shoulders.”

When loaded

- Verify that space requirements are met
- Load density may change depending on weather, type, physical condition and distance to destination

Before you actually hit the road

- Secure the load
- Check the animals
- Check the tailgate
- Know the axle weight restrictions in all states that you will travel
- Complete required paperwork

On the road

- Ease away from the chute
- Start, stop and turn slowly
- Check your load every few hours
Temperament and Tenderness

Tenderness has been shown to be influenced by temperament as Warner-Bratzler shear force measures were greater in steers with an excitable temperament when compared to calmer cattle (Voisinet et al., 1997a).

Yearling-fed steers classified as Excitable before shipment to the feedlot produced steaks with higher WB shear forces (P < 0.05). (King et al., 2006)
Prodding and Quality

Effect of acute pre-slaughter stress (no prodder vs. electric prodder, 6–8 prods, 15 min pre-slaughter) on plasma lactate and meat quality measures (Warner et al., 2007)

<table>
<thead>
<tr>
<th>Trait</th>
<th>No electric prodder</th>
<th>Electric prodder</th>
<th>Significance</th>
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</thead>
<tbody>
<tr>
<td>Plasma lactate at slaughter (mmol/L)</td>
<td>4.29</td>
<td>7.12</td>
<td>$P &lt; 0.05$</td>
</tr>
<tr>
<td>pH 1 h</td>
<td>6.33</td>
<td>6.29</td>
<td>ns</td>
</tr>
<tr>
<td>Temperature 1 h</td>
<td>37.7</td>
<td>37.7</td>
<td>ns</td>
</tr>
<tr>
<td>pHu</td>
<td>5.46</td>
<td>5.38</td>
<td>ns</td>
</tr>
<tr>
<td>Purge% (21 day)</td>
<td>3.5</td>
<td>5.4</td>
<td>$P &lt; 0.05$</td>
</tr>
<tr>
<td>Shear force (2 day) (N)</td>
<td>91.1</td>
<td>89.2</td>
<td>ns</td>
</tr>
<tr>
<td>Shear force (21 day) (N)</td>
<td>47.0</td>
<td>51.0</td>
<td>ns</td>
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<tr>
<td>MSA CMQ4 consumer score*</td>
<td>59.6</td>
<td>55.6</td>
<td>$P &lt; 0.05$</td>
</tr>
</tbody>
</table>

* CMQ4 score (1–100) is a consumer weighted score based on assessments of tenderness, juiciness, flavour and overall liking.

Thank you to the following for providing material for this presentation

http://www.grandin.com/
www.animalhandling.org/

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