Customer Satisfaction and National Tenderness Survey

Jason M Scheffler
Department of Animal Sciences
Palatability

• Perceived eating satisfaction influenced by:
  - Flavor 43.4% of variation in overall palatability
  - Juiciness 7.4%
  - Tenderness 49.4%

• Meta analysis of 11 studies covering 1,500 beef samples and 1,800 customers

Flavor

• Highly complex
  ▪ Degradation of lipids by heat
    • Grass fed

  ▪ Non-enzymatic browning or Maillard reaction
    • Amino acid + Reducing sugar + Dry heat

  ▪ Interaction of lipids and Maillard products
Flavor

• Highly variable acceptability by customer

• Unacceptable flavor more likely to cause steak to be rated unacceptable than tenderness or juiciness (O’Quinn 2018)

• Flavor chemistry is a growing field
Juiciness

- Marbling
- Endpoint Degree of Doneness
- Perception that marbling provides “insurance”
Impact of marbling on juiciness

Interaction of marbling and degree of doneness

Objective Juiciness

Prime | Top Choice | Low Choice | Select | Standard

140°F | 160°F | 170°F

Lucherk et al 2016
How important is marbling?

Sensory Experience (panel rating above 7.5)

- Traces: 15%
- Slight: 29%
- Small: 62%
- Moderate: 82%
- Modest: 88%
- Slightly abundant: 99%
- Moderately abundant: 98%

Emerson et al. 2011
Importance of beef tenderness

Tenderness had linear relationship with WBSF

Value of tenderness

Tasting vs No Tasting Respondents' S/Kg Willingness-to-Pay Estimates

PEAR = post extraction algal residue
M.D. Johnson et al, 2016
J Anim Sci. 94:3072-3083
Value of tenderness

• Consumers willing to pay $1.23/lb more for steaks after blind taste test (Lusk et al 2001)

• For every 1 lb increase in WBSF, willingness to pay decreased $0.24/lb (Feuz et al 2004)
  ▪ Auction system
    • Increasing # panelists increased bid by $0.29/lb
  ▪ Tenderness was associated with improved juiciness, flavor and overall acceptability

Journal of Agricultural and Resource Economics Vol. 29, No. 3 (December 2004), pp. 501-516
Certified tender

- WBSF <9.7 lbs (4.4 kg)
- Program started in 2014
- Cargill, sold at Harris Teeter in NC
- Success?

https://www.ams.usda.gov/sites/default/files/media/LPSP_Laboratory_Proficiency_Testing_for_Shear_Force%5B1%5D.pdf
Palatability in the UF multibreed herd

- WBSF and tenderness inversely related

- Variation ↑ as Brahman % ↑

Elzo et al 2012.
Meat Science
90(1):87-92
Where tenderness means dollars

• 91 USDA certified beef programs discriminate against carcasses with humps >2”

• Steaks from carcasses with hump height measurements of 7.60 cm (3”) or greater had lower panel tenderness ratings and higher WBS values (P < .05) than steaks from carcasses with hump heights less than 6.35 cm (2.5”).


Exceptions

• G5          Swift Chef’s Exclusive EU (JBS)
• G-33        Where Food Comes From Certified Beef Program
• G 38        FM Meat Products Beef
• G 131       Switzerland Export Certified Beef
• G NR        Nolan Ryan's Tender Aged Beef
National Beef Tenderness Survey

• Cross-sectional assessment of retail and food service
• Benchmark tenderness to track progress

• The 2017 study was conducted in 2015
Warner-Bratzler shear force values of retail and food service steaks

- Bottom round
- Top round
- Top Sirloin
- Porterhouse
- T-bone
- Top loin-bone-in
- Top loin
- Rib eye, bone-in
- Rib eye, boneless
- Top blade

Foodservice
Retail

WBSF (lbs)

Meat and Muscle Biology 1:138-148
Warner-Bratzler shear force values of retail steaks

- Bottom round: ↓ 27%
- Top round: ↓ 26%
- Top Sirloin: ↓ 23%
- Porterhouse: ↓ 26%
- T-bone: ↓ 26%
- Top loin-bone-in: ↓ 26%
- Top loin: ↓ 26%
- Rib eye, bone-in: ↓ 26%
- Rib eye, boneless: ↓ 26%
- Top blade: ↓ 26%

1998 - 2017

WBSF (lbs)

Meat and Muscle Biology 1:138-148
Percentage of steaks meeting tenderness thresholds

Percentage distribution

- **Top Blade**
  - 2015: 100%
  - 2011: 90%
  - 2005: 80%

- **Ribeye, boneless**
  - 2015: 90%
  - 2011: 80%
  - 2005: 70%

- **Top Loin**
  - 2015: 100%
  - 2011: 90%
  - 2005: 80%

- **Top Round**
  - 2015: 90%
  - 2011: 80%
  - 2005: 70%

- **Bottom Round**
  - 2015: 80%
  - 2011: 70%
  - 2005: 60%
National Beef Tenderness Survey

• Slow but steady progress

• Need to reduce variation
  ▪ Sorting seems to have pushed less tender product to food service
What influences tenderness?

- Intramuscular fat
- Connective tissue
- Myofibrillar degradation
Tenderness is a byproduct trait

• Most of the known contributing factors to meat tenderness also have functions in the living animal

    ▪ Selection for improved tenderness is often antagonistic to growth and efficiency

• Despite importance, tenderness is a difficult trait to market
When selecting for tendernessness

Divergent selection with bulls tested to be tough and tender
Olson, Johnson, and West, 2000
http://ufdcimages.uflib.ufl.edu/AA/00/00/04/12/00001/folsonselmeatten.pdf

<table>
<thead>
<tr>
<th>Year</th>
<th>WBSF (lb)</th>
<th>EBV for WBSF (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tough</td>
<td>Tender</td>
</tr>
<tr>
<td>1</td>
<td>10.71$^a$ ± 0.51</td>
<td>8.82$^b$ ± 0.51</td>
</tr>
<tr>
<td>2</td>
<td>7.94$^c$ ± 0.60</td>
<td>7.10$^c$ ± 0.66</td>
</tr>
<tr>
<td>3</td>
<td>7.64$^d$ ± 0.66</td>
<td>7.54$^d$ ± 0.42</td>
</tr>
<tr>
<td>4</td>
<td>6.28$^e$ ± 0.46</td>
<td>5.93$^e$ ± 0.46</td>
</tr>
<tr>
<td>5</td>
<td>7.80$^f$ ± 0.42</td>
<td>5.97$^e$ ± 0.49</td>
</tr>
<tr>
<td>6</td>
<td>6.83$^h$ ± 0.49</td>
<td>6.17$^h$ ± 0.44</td>
</tr>
</tbody>
</table>

$^a$-$^u$ Means with the same superscript in the same row are not significantly different at P<0.05.
Implants reduce tenderness

$R^2 = 0.9797$

WBSF (lbs)

Number of implants

Scheffler et al. 2003
Marbling and Tenderness

Interaction of marbling and degree of doneness

Slice shear force (lbs)

Prime | Top Choice | Low Choice | Select | Standard

140°F - Blue line
160°F - Green line
170°F - Red line

Balance against feed costs?

Adapted from Lucherk et al 2016
Protein accumulation

- Fractional rates are highest in young animals
- Difference diminishes as animals approach maturity
- Increasing breakdown to improve tenderness may inadvertently slow down growth
- Challenge
  - How to find the balance between antemortem and postmortem breakdown?

Bergen & Merkel, 1991

Adapted by T Scheffler
Changes in Collagen with growth

• Abundance
• Amount of crosslinking

• Both increase with age
• Both higher in locomotion muscles

Fang et al. J Anim Sci. 77:120
Factors Influencing Tenderness in Steaks From Brahman Cattle

<table>
<thead>
<tr>
<th>Simple correlations of tenderness traits with other carcass and palatability traits of Brahman cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days of aging</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Carcass weight, kg</td>
</tr>
<tr>
<td>12th rib fat thickness, mm</td>
</tr>
<tr>
<td>Ribeye area, cm²</td>
</tr>
<tr>
<td>Lean maturity</td>
</tr>
<tr>
<td>Skeletal maturity</td>
</tr>
<tr>
<td>Lean color</td>
</tr>
<tr>
<td>Lean texture</td>
</tr>
<tr>
<td>Lean firmness</td>
</tr>
<tr>
<td>Marbling score</td>
</tr>
<tr>
<td>Hump height, cm</td>
</tr>
<tr>
<td>Raw lipids, %</td>
</tr>
<tr>
<td>Collagen, mg per g muscle</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Insoluble</td>
</tr>
<tr>
<td>Calpastatin, units/g muscle</td>
</tr>
<tr>
<td>Sarcomere length, µm</td>
</tr>
</tbody>
</table>

Calpain

- Calcium-activated protease (\(\mu\) and \(m\))
- Inhibited by calpastatin
- Important for muscle growth/ protein turnover

Troponin degradation by calpain; Wright et al 2018

Goll et al 1992
Other enzymes possibly involved in protein degradation

• Caspases?
• Cathepsins?
• Lysosomal proteases (cathepsins)?
• Ubiquitin proteasome?

Do their targets degrade post mortem?
Are they active post mortem?
Are they located near targets?
Inhibitors present, activators required?

Antemortem 7 d postmortem
Summary

• Consumer satisfaction is a function of flavor, juiciness, and tenderness
  ▪ Beef isn’t going to out price other proteins, it needs to be more satisfying

• Need to improve meat quality and/or better sort product
  ▪ As sorting gets better, how will that impact the valuation of your cattle?

• Tenderness needs to improve, but not at the detriment of other economically important traits
Thank you

jmscheff@ufl.edu

@UFloridaBrahman