BEEF YIELD GRADING:  
History, Issues, and Opportunities

Ty Lawrence  
June 2016

Beef Grading History

• 1950’s  
  – Interest in objective yield measurement

• 1952 RMC  
  – Adopted “(1) length of body, (2) length of hind leg, (3) circumference of round, (4) depth of body, (5) length and width of ribeye, (6) area of ribeye, and (7) three thicknesses of fat over the ribeye” as yield estimation measures

• 1956 ASAP meetings  
  – Pierce, Strong, Van Zandt, and Murphey reported a yield study of 459 beef carcasses

AMSA, 2016; Murphey et al. (1960)

• 1960 ASAP meetings  
  – Murphey, Hallett, Tyler, and Pierce reported a yield study of 162 beef carcasses  
    • Chicago (boning establishment and major packer)  
    • Steers, heifers, and cows  
    • Prime, Choice, Good, Stand., Comm., Util., Cutt./Can.  
    • 350-900 pound carcasses  
    • Bone-in and boneless  
    • 1/4” fat trim on thick cuts, 1/8” fat trim on thinner cuts  
    • 17 independent variables measured

AMSA, 2016; Murphey et al. (1960)

• Initially %BCTRLRC converted to YG 1 to 10  
  – 2.3% range of major boneless retail cut yield  
  – Junction of YG 1-2 was 53.1%  
  – Junction of YG 9-10 was 34.7%

• Later, %BCTRLRC converted to YG 1 to 5  
  – 2.3% range of major boneless retail cut yield  
  – Range of outcomes narrowed toward lean

Murphey et al. (1960)

• YG equation was developed to estimate %BCTRLRC  
  \[ \text{YG} = 2.5 + 2.5 \times \text{Fat} + 0.2 \times \text{KPH} + 0.0038 \times \text{HCW} - 0.32 \times \text{REA} \]

1962 – Dual (QG/YG) grading concept  
  – Proposed April  
  – Began 01 July 1962 – one year trial

AMSA, 2016; Murphey et al. (1960); USDA (1997)

• June 1965 – All carcasses must be ribbed

AMSA, 2016; Murphey et al. (1960); USDA (1997)

• 1989 - YG and QG were uncoupled

AMSA, 2016; Murphey et al. (1960); USDA (1997)
Correlation of fat to % boneless yield

Abraham et al. (1968) \( r = -0.66 \)
Abraham et al. (1980) \( r = -0.68 \)
Reiling et al. (1992) \( r = -0.53 \)
Farrow et al. (2009) \( r = -0.39 \)

Correlation of KPH to % boneless yield

Abraham et al. (1968) \( r = -0.66 \)
Abraham et al. (1980) \( r = -0.35 \)
Reiling et al. (1992) \( r = -0.18 \)
Farrow et al. (2009) \( r = -0.44 \)

Correlation of REA to % boneless yield

Abraham et al. (1968) \( r = +0.18 \)
Abraham et al. (1980) \( r = +0.35 \)
Reiling et al. (1992) \( r = +0.51 \)
Farrow et al. (2009) \( r = +0.25 \)

Correlation of HCW to % boneless yield

Abraham et al. (1968) \( r = -0.50 \)
Abraham et al. (1980) \( r = -0.17 \)
Reiling et al. (1992) \( r = -0.03 \)
Farrow et al. (2009) \( r = -0.44 \)

Camera Grading History

- **1978** – GAO reports to Congress that USDA needed to “increase research efforts to develop instruments to accurately measure beef carcass characteristics”
- **1979** – USDA asks NASA and JPL to develop an instrument
- **1980** – USDA-ARS begins developing an instrument
  - Kansas State University awarded contract to develop first VIA instrument
- **Remainder of 1980’s**
  - Industry seeks other alternatives including NMR, NIR, ultrasound, and CAT-scan – VIA progress stopped
- **1994**
  - Focus shifted from ultrasound back to VIA

USMARC developed VIA system to predict retail weight and yield (Shackelford et al. 1998)
- Dual component (hot side and ribbed image) VIASCAN and CVS systems evaluated for yield grading (Cannell et al. 1999, Cannell et al. 2002)
- E+V VIA technology patented for determination of yield and quality parameters (Haagensen et al. 2001)
- VIA technology evaluated at USMARC for yield grading and prediction of intramuscular fat (Shackelford et al. 2003)
- VIA technology further investigated for USDA YG augmentation (Sasser et al. 2007)
- E+V VIA technology patented for prediction of yield and quality parameters through calculation of pixel area (Eger et al. 2004)
USDA approval of VIA

- 26Feb2001 – CVS/RMS approved for ribeye area
- 16Dec2003 – VBG2000/E+V approved for ribeye area
- 16Aug2005 – VBG2000/E+V approved for yield grade
- 02Nov2006 – VBG2000/E+V and CVS/RMS approved for marbling score
- 09Mar2007 – CVS/RMS approved for fat thickness
- 14Mar2007 – VBG2000/E+V approved for fat thickness

Woerner & Belk, 2008

Current U.S. Status

- Wide range since 2007
  - Not used
  - In-house use only
  - Sole determinant of YG
  - Used for both QG and YG w/ inspector approving each carcass

Video Image Analysis (VIA)

- Computer Instrument Use
- Increased Accuracy of Measures
- Repeatability Across Beef Processors

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Computerized Grading (RMS & E+V)

CVS/RMS or VBG2000/E+V??

Human vs VIA yield grade
Probability of YG4 stamp from USDA grader

66.5% at calculated 5

20.2% at calculated 4

Economics of yield grading

Carcass Value “Grid”

Maximum values for 06June2016

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<thead>
<tr>
<th>Hot carcass weight</th>
<th>Quality Grade</th>
<th>Yield Grade</th>
<th>Additional adjustments</th>
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<tr>
<td>400-500</td>
<td>1.0-2.0</td>
<td>+8</td>
<td>400-500 (-40)</td>
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<tr>
<td>501-600</td>
<td>1.0-2.0</td>
<td>+8</td>
<td>501-600 (-40)</td>
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<tr>
<td>601-900</td>
<td>Low Ch (0.00)</td>
<td>3.1-3.9</td>
<td>601-900 (0.00)</td>
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<tr>
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<td>Standard</td>
<td>3.1-3.9</td>
<td>1000-1050 (0.00)</td>
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<tr>
<td>1050+</td>
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<tr>
<td>Low Ch</td>
<td>(-40)</td>
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<td>(-24)</td>
</tr>
<tr>
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<td>(-20)</td>
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<tr>
<td>Dark cutter</td>
<td>(-55)</td>
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<tr>
<td>C+ maturity</td>
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USDA (2016a)

YG 1 and 2

YG 4 and 5

USDA (2016a)
Yield Grade Value

900 lb carcass

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<th>Value</th>
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<tr>
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<tr>
<td>2</td>
<td>34.2%</td>
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<td>3</td>
<td>46.3%</td>
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<td>4</td>
<td>10.8%</td>
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<td>5</td>
<td>1.6%</td>
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</table>

USDA (2016a), USDA (2016b)

28.7% of cattle are USDA yield graded

Inconsistencies and challenges

Cattle Feeding Technology/Change

Steers = 5 pounds/year

Heifers = 6 pounds/year

Hot Carcass Weight Trending Up

Steers = 5 pounds/year

Heifers = 6 pounds/year

Don Close

1950's Champion Steer State Fair of Texas

2015 Champion Steer State Fair of Texas
YG predicts 40% of the variation in red meat yield (beef-type cattle)

YG predicts 0% of the variation in Holstein red meat yield

Ribeye growth is different than expected

FAT

REA
Ty Lawrence, West Texas A&M University

June 15, 2016

BIF 2016 End Product Improvement Breakout Session

Potential modifications and other systems

Re-parameterization

- Separate beef-type and dairy-type cattle
  - Where do their crosses best fit?
- Represent entire carcass yield
- Represent current carcass weights
- Estimate KPH consistently or eliminate
- Develop estimate of intramuscular fat
- Value incremental yield changes
  - 60 to 80% red meat yield vs YG 1-5

New VIA measures predicted 68% of variation in red meat yield

Farrow et al. (2009)

Canada - Yield Grading

- Fat Thickness
  - Linear measure of backfat
- Muscle Score
  - Matrix of ribeye length and ribeye width

Lean % = 63.65
  * (1.05 x muscle score) – (0.76 x fat thickness, mm)

Japanese Yield Grading

Yield Grades
- A – 72% and greater
- B – 69-72%
- C – Less than 69%

Measured between the 6th and 7th ribs

Japanese Yield % =
  67.77
  + (0.130 x RSA, cm²)
  + (0.687 x PIB thickness, cm)
  + (0.012 x Cold left side to PIB)
  – (0.896 x FAT, cm)
Conformation Camera

- E – Excellent; all profiles convex to super convex; exceptional muscle development
- U – Very good; profiles on the whole straight; good muscle development
- R – Good; profiles straight to concave; average muscle development
- O – Fair; profiles straight to concave; average muscle development
- P – Poor; profiles straight to concave; poor muscle development

• 1 - indicative of carcass with little to no fat deposition across the loin and the round
• 5 - indicative of carcass with pronounced fat deposition across the loin and round

References


For More Information

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