Cattle & Carcass TRAINING

Fall 2020 Webinar – Part IV
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Use of Instrument Technology

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Development of the USMARC beef carcass grading camera
Steak Image Analysis
Prediction of cutability using image analysis variables and HCW

\[ R^2 = 0.89 \]
\[ n = 67 \]
Background

- ARS and IBP entered into a Cooperative Research and Development Agreement (CRADA) to adopt this technology for on-line application directly to beef carcasses
VBG2000

E+V, Germany
Camera Operation

Side-2. In this plant, Side-2 is the left side of the carcass.

Side-1. In this plant, Side-1 is the right side of the carcass.
Carcass ID acquired from trolley tracking system, bar coded tags, or manually-adjustable sequence counter.
Hot carcass weight obtained from a database query.
Preliminary yield grade

Fat thickness

In this case 12 mm or 0.48 in
Adjusted preliminary yield grade

= 

Adj fat thickness

In this case 12 mm or 0.48 in
The Ribeye area is equal to the Longissimus area. In this case, it is 16.8 in² or 108 cm².
Yield grade
1.0 = very lean
5.9 = very fat
Marbling score ≠ intramuscular fat %
Prediction of yield grade using image analysis variables and HCW

\[
y = 1.01x - 0.02
\]

- Calibration: \( n = 400 \)
- Prediction: \( n = 400 \)
- \( R^2 = 0.90 \)
- MAE = 0.26
- RSD = 0.33
Able to sort carcasses based on yield grade...

- The next 10 slides show variation in yield grade for images selected from 1,100 carcasses
- All 10 carcasses are from a narrow carcass weight range
  - 800 to 850 pounds
  - 363 to 386 kg
ID 183884
Wgt 839.0
PYG 2.7
ADJ 2.8
REA 18.1
YG 1.0
Marb SI 70
ID: 181444
Wgt: 826.0
PYG: 2.7
ADJ: 2.7
REA: 16.2
YG: 1.5
Marb: Sm 00

Weight: 826.0
Date: 02.03.06
Time: 10:56:00
REA: 16.20
CAL VG: 1.55
Marb: Sm 00
PYG: 2.7
Loin: 72.7%
Height: 181.3
Bread: 93.9
ID 182058

Wgt  854.0
PYG  3.1
ADJ  3.1
REA  14.7
YG   2.5
Marb SI 70
ID: 183122
Wgt: 859.0
PYG: 4.0
ADJ: 4.1
REA: 15.0
YG: 3.5
Marb: Mt 40
ID  213101
Wgt  859.0
PYG  3.4
ADJ  3.5
REA  11.5
YG   4.0
Marb Mt 10
• Able to sort carcasses based on ribeye area........
ID 183870
Wgt 596.0
PYG 3.7
ADJ 3.6
REA 6.4
YG 4.8
Marb Mt 50
ID: 213934
Wgt: 692.0
PYG: 4.4
ADJ: 4.5
REA: 9.1
YG: 5.4
Marb: Mt 90
ID 181742
Wgt 790.0
PYG 2.9
ADJ 3.1
REA 12.0
YG 3.1
Marb Sm 40
Able to sort carcasses based on marbling score...
Tr = “Traces” degree of marbling

A maturity carcass with Tr60 would qualify for U.S. Standard and typically would be sold as “no roll” or ungraded beef
Sl = “Slight” degree of marbling
A maturity carcass with Sl50 would qualify for U.S. Select
Sm = “Small” degree of marbling
A maturity carcass with Sm50 would qualify for U.S. Choice (Low Choice)
Mt = “Modest” degree of marbling
A maturity carcass with Mt50 would qualify for U.S. Choice (Average Choice)
Md = “Moderate” degree of marbling

A maturity carcass with Md60 would qualify for U.S. Choice (High Choice)
Slab = “Slightly Abundant” degree of marbling
A maturity carcass with Slab 70 would qualify for U.S. Prime (Low Prime)
Mab = “Moderately Abundant” degree of marbling

A maturity carcass with Mab50 would qualify for U.S. Prime (Average Prime)
Ab = “Abundant” degree of marbling
A maturity carcass with Ab50 would qualify for U.S. Prime (High Prime)
Able to identify dark cutter carcasses ...........
Able to identify more consistently tender carcasses...

Longissimus (strip loin and ribeye)
Validation phase

2A. Validation phase. Carcass-basis (best side) evaluation of all quality grade programs
n = 5,722 (~1,900 carcasses per camera)
Comparison of means; $P < 10^{-115}$
Comparison of % > 25 kg; $P < 10^{-53}$

- Predicted tender by VBG2000LED
  (Predicted SSF < 19 kg)
  n = 3,993 evaluations (carcasses × cameras)
  Mean = 18.4 ± 0.1 kg
  Range 7.5 to 47.3
  SD = 5.1 kg
  11.1% > 25 kg

- Not predicted tender by VBG2000LED
  (Predicted SSF ≥ 19 kg)
  n = 1,729 evaluations (carcasses × cameras)
  Mean = 22.2 ± 0.1 kg
  Range 12.5 to 58.0
  SD = 6.9 kg
  28.2% > 25 kg
Center-Cut Top Sirloin (Gluteus medius)

Top Sirloin @ 28 d postmortem.

Comparison of means; $P = 0.01$

Comparison of % > 22 kg; $P < 0.0001$

Predicted tender by VBG2000GigE
Mean = 16.8 ± 0.1 kg
Range 11.02 to 21.97 kg
SD = 2.2 kg
0% > 22 kg

Not predicted tender by VBG2000GigE
Mean = 17.8 ± 0.1 kg
Range 12.17 to 32.31 kg
SD = 3.4 kg
12.2% > 22 kg
Fat color
Who, what, when...

- The packing plants, NOT USDA, own and operate the cameras.
- Grading is voluntary
- Use of camera data for grading is voluntary
  - Most plants do not use USDA yield grades. Instead, these plants use the camera to determine vision yield grades.
  - Some plants use the camera for marbling assessment for quality grade determination but rely on certifying graders to conduct all aspects of program certification
  - Other plants use the camera for marbling assessment for quality grade determination and program certification
  - grader override
Every day in the plant

- System check
- USDA Marbling check – before each shift
System check

Faux ribeye card

- Fits on the camera so that the camera can image the faux ribeye just like it would image a real ribeye
- Checks ribeye area, fat thickness (PYG), and YG against reference values.
- Checks camera sharpness
System Check - Completion
System Check - OK

Camera 307

Sharpness-raw = 68 (684) Center = (280, 285)
USDA Marbling check

Ribeye images spanning range of marbling scores
• Test to make sure that the camera has not changed over time.
• Compares the values obtained to reference values assessed when the most recent (quarterly) servicing of the camera was performed.
• Each card is imaged 5 times and truncated statistics (mean and SD) are calculated by discarding the highest and lowest values.
USDA Marbling Check – Four Cards
USDA Marbling Check – High Card
USDA Marbling Check – Medium card
USDA Marbling Check – Low Card
USDA Marbling Check – All Checked
USDA Marbling Check - Statistics
USDA Marbling Check - Results

VBG 2000 - Beef Grading System

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<th>Tol</th>
<th>Marb</th>
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Check OK

Deficiency

Dark Cutter OK
Greater Omaha Packing

Washington Grown: Inside a Beef Slaughter Facility
Thank you for Participating

For more information on this webinar series and the USDA Cattle and Carcass Training Centers, visit: