Application of Carcass Ultrasound in Beef Production

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Steaks and roasts both saw decade-lows in in-home consumption over the past year.

In-Home Beef Consumption Trend by Cut

Annual Eatings Per Capita

Pt. Change ‘13 vs ‘08

-0.4

GROUND BEEF

STEAKS

*Other Cuts – Includes Cubes, Chipped, Chucked, Loin/Tenderloin, Stew Meat, and Unspecified beef

Data represents total beef consumption

Data for two years ending August

Source: The NPD Group/National Eating Trends/In-Home Database
During the recession, beef volumes declined less than overall traffic.

- Recovery for beef has been stronger than overall foodservice industry.

In MM Lbs.

<table>
<thead>
<tr>
<th>Year</th>
<th>Pounds (down 2% since 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>8,181</td>
</tr>
<tr>
<td>2009</td>
<td>7,894</td>
</tr>
<tr>
<td>2010</td>
<td>7,948</td>
</tr>
<tr>
<td>2011</td>
<td>7,855</td>
</tr>
<tr>
<td>2012</td>
<td>7,994</td>
</tr>
<tr>
<td>2013</td>
<td>8,072</td>
</tr>
</tbody>
</table>

In $MM (wholesale)

<table>
<thead>
<tr>
<th>Year</th>
<th>Dollars (up $7.5B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>$26,300</td>
</tr>
<tr>
<td>2009</td>
<td>$24,514</td>
</tr>
<tr>
<td>2010</td>
<td>$26,977</td>
</tr>
<tr>
<td>2011</td>
<td>$30,401</td>
</tr>
<tr>
<td>2012</td>
<td>$32,945</td>
</tr>
<tr>
<td>2013</td>
<td>$32,061</td>
</tr>
</tbody>
</table>

*At the operator purchases, or distributor sales level.
Source: Technomic, Inc.
Demand for High-Quality Beef

- **Demand for** Choice, Upper 2/3 Choice, and Prime is growing – in both domestic and global markets.
- **Strengthening demand** for high-quality beef is reflected by wider price spreads between quality grades.

Source: Randy Blach, Cattle-Fax
Serving steak, in particular, and even home made burgers seem to surface richly articulated & motivational triggers for beef. Many of these triggers connect directly back to the BIWFD campaign.

**Taste Trigger**
- Tender/juicy
- Thick/hearty
- Bold/Flavorful
- Melts in mouth
- Stands on its own (no cover needed)
- Filling
- Center of the plate/the star
- Taste in 1st bite

**Memories Trigger**
- Outdoor
- Grill/BBQ
- Fourth of July
- Birthdays
- Dinner date
- Reunion
- Social/family gathering
- Dad grilling

**Emotional Benefits**
- Luxury/special
- Belong/family
- “The best”
- “The original protein”
- Winner/Success
- All American “Deep down” tradition
- Progress
- Foundation
What Does It All Mean?

- What is the difference between prime, choice and select in the chance of a less than desirable eating experience?
  - **Prime** = 1% (1 in 100 chance of poor eating experience)
  - **Upper 2/3 choice** = 15% (3 in 20)
  - **Low Choice** = 37% (1 in 3)
  - **Select** = 71% (2 in 3)

Dr. Daryl Tatum, Colorado State University, 2011
Assure that 100% of breeding animals are accompanied by meaningful genetic data for production and end-product traits
Ultrasound measurements collected

- Ultrasound Backfat (12\textsuperscript{th} rib)
- Ultrasound Ribeye area
- Ultrasound Intramuscular fat
- Ultrasound Rump fat
12th rib backfat and Ribeye area
Potential applications of carcass ultrasound data

- Genetic Selection Tools / EPD’s
- Phenotypic Selection in Commercial Females
- Grouping Cattle by Body Composition
Selection Tools for Improving Carcass Traits in Beef Cattle

Are Ultrasound Measurements Acceptable Alternatives to Carcass Measurements?
Accuracy of Live Animal Ultrasound Measures

- Backfat: >.90
- Ribeye area: .85 - .90
- Marbling: .80 - .85

** You must use trained, certified technicians in order to obtain accurate ultrasound data. **
<table>
<thead>
<tr>
<th>Trait Combination</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREA, UREA</td>
<td>0.65</td>
</tr>
<tr>
<td>CFAT, UFAT</td>
<td>0.69</td>
</tr>
<tr>
<td>CIMF, UIMF</td>
<td>0.70</td>
</tr>
<tr>
<td>CWT, YWT</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Herring et al., 1995
### Heritabilities of carcass traits and ultrasound measures

<table>
<thead>
<tr>
<th>Trait</th>
<th>Carcass</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass Weight</td>
<td>.39</td>
<td>--</td>
</tr>
<tr>
<td>Backfat</td>
<td>.34</td>
<td>.28</td>
</tr>
<tr>
<td>Ribeye Area</td>
<td>.47</td>
<td>.32</td>
</tr>
<tr>
<td>Marbling</td>
<td>.46</td>
<td>.41</td>
</tr>
</tbody>
</table>

Bertrand et al., 2002
Genetic Correlations Between Ultrasound Carcass Traits in Bulls and Carcass Traits in their Progeny

- **Backfat** $>0.90$
- **Ribeye area** $>0.85$
- **Marbling** $\approx 0.60$

Bertrand et al., 2002
Genetic Trends for Carcass EPD's
Genetic Selection Based of Ultrasound Carcass EPD’s

- A 1.0 inch change in UBFAT EPD results in a 1.2 inch change in steer progeny carcasses.

- A 1.0 inch$^2$ change in UREA EPD results in 0.4 inch$^2$ change in steer progeny carcasses.

- A 1.0 % change in UIMF EPD results in nearly a full degree of marbling change in steer progeny.

Sapp et al., 2001
Other Genetic Relationships of Concern

- Selection for decreased backfat may result in decreased reproductive performance.
- Ribeye area is highly correlated to size and weight traits.
- Ultrasound marbling does not appear to be negatively associated with other carcass or performance traits.

Bertrand et al., 2002
Selecting for carcass value in commercial heifers

Can phenotypic selection for ultrasound marbling improve carcass value?
### Selection for Marbling in Steers Using Ultrasound Marbling in Bulls

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. sires</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>UIMF, %</td>
<td>3.75</td>
<td>1.70</td>
</tr>
</tbody>
</table>

Sapp et al., 2001
### Carcass traits of progeny selected for high and low Ultrasound Marbling

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steers</td>
<td>96</td>
<td>92</td>
</tr>
<tr>
<td>Carcass Weight, lbs</td>
<td>740</td>
<td>745</td>
</tr>
<tr>
<td>Backfat, in</td>
<td>.61</td>
<td>.60</td>
</tr>
<tr>
<td>Ribeye area, in²</td>
<td>11.6**</td>
<td>12.1</td>
</tr>
<tr>
<td>Marbling score</td>
<td>452**</td>
<td>408</td>
</tr>
<tr>
<td>Yield Grade</td>
<td>3.5</td>
<td>3.4</td>
</tr>
<tr>
<td>Quality Grade</td>
<td>Ch -**</td>
<td>Se +</td>
</tr>
</tbody>
</table>

*Sapp et al., 2001*
Relative Selection Emphasis

Melton, 1995
Summary

- Ultrasound measurements from yearling seedstock can be used to make genetic change in their progeny.
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- Caution must be used not to negatively impact other traits of economic importance, particularly reproductive performance.
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- The first step in developing a genetic improvement program for carcass traits is to determine the current performance level of your herd.
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- The first step in developing a genetic improvement program for carcass traits is to determine the current performance level of your herd.

- Once you have identified your current status and your target, ultrasound EPD’s can be used as genetic tools to improve the carcass characteristics of your herd.
Using ultrasound measures to sort feedlot cattle

Animal scientists regularly state that 25% of cattle in a pen are overfed and 25% of cattle are underfed.
Correlations between ultrasound measures over time and carcass traits

- Weaning
- Yearling
- Preharvest

BF    REA

Crews et al., 2002
Correlations between ultrasound measures over time and carcass traits

<table>
<thead>
<tr>
<th></th>
<th>BF</th>
<th>REA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning</td>
<td>0.67</td>
<td>0.86</td>
</tr>
<tr>
<td>Yearling</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td>Preharvest</td>
<td>0.86</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Crews et al., 2002
Prediction of time on feed to a constant 12th rib backfat

Prediction of USDA marbling score

Brethour, 2000
Ultrasound measures across time on feed in Hereford steers

- **Live weight**
- **Ribeye area**
- **12th rib back fat**
- **Marbling**

Brito, 2000
Max $R^2$ regression analysis showed that ultrasound marbling at 42 days accounted for 61% of the variation in USDA quality grade.

<table>
<thead>
<tr>
<th>Prediction of USDA Select</th>
<th>Prediction of YG 3 or better</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Select</td>
<td>Predicted 2-3</td>
</tr>
<tr>
<td>Graded Select</td>
<td>Graded 2-3</td>
</tr>
<tr>
<td>True Positive 20</td>
<td>True Positive 37</td>
</tr>
<tr>
<td>Predicted Choice</td>
<td>Predicted 2-3</td>
</tr>
<tr>
<td>Graded Select</td>
<td>Graded 4</td>
</tr>
<tr>
<td>False Negative 4</td>
<td>False Positive 5</td>
</tr>
<tr>
<td>Predicted Choice</td>
<td>Predicted 4</td>
</tr>
<tr>
<td>Graded Select</td>
<td>Graded 2-3</td>
</tr>
<tr>
<td>False Negative 4</td>
<td>False Negative 0</td>
</tr>
<tr>
<td>Sensitivity: 83%</td>
<td>Sensitivity: 100%</td>
</tr>
<tr>
<td>Specificity: 85%</td>
<td>Specificity: 17%</td>
</tr>
<tr>
<td>Accuracy: 84% (total 37 head)</td>
<td>Accuracy: 88% (total 43 head)</td>
</tr>
<tr>
<td>$X^2$=16.15 (P&lt;0.01)</td>
<td>$X^2$=10.34 (P&lt;0.01)</td>
</tr>
</tbody>
</table>

Brito, 2000
Economic analysis of sorting feedlot cattle using ultrasound

- Simulated sorting of cattle based on ultrasound and weight.
- Sorting criteria included: scan weight, back fat, % IMF
- Sorting returned about $15 – 25 per head
  - Growth and feed efficiency in the live animal
  - Fewer empty pen days in the feedlot
  - Fewer discounted carcasses

The benefits of sorting are gained when heterogeneous groups of cattle are sorted into more homogeneous groups.

Koontz et al., 2008
Summary

- Ultrasound measurements collected during feeding are predictive of carcass traits.
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- Accuracy of these predictions increases as the ultrasound measurement is taken closer to harvest.
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- Accuracy of these predictions increases as the ultrasound measurement is taken closer to harvest.

- Sorting feedlot cattle into homogenous groups using ultrasound and weight data has the potential to improve management decisions and increase profit for cattle feeders.
Questions?
Auto-interpretation of ultrasound images
### Image Slots

**Average Ribeye Area:** 10.03
**Average Backfat:** 0.27
**Ribeye Area / CWT:**
**Ribeye Ratio:** 0.45

### New Animal
- **Session ID:** 2009.06.0030_17:30:39
- **Animal VID:** 7632
- **Animal EID:**
- **Breed:** Angus
- **Weight:**
- **Sex:** Bull

### Load Session

### Options

### Trigger

### Exit
Using ultrasound as a research tool to measure tissue growth
Use of ultrasound to measure fat and muscle accretion rates in heifers

Smith et al., 2007
Use of ultrasound to measure fat and muscle accretion rates in slaughter cows

Lowe, 2009
Use of Ultrasound as a Genetic Selection Tool in Poultry
Preliminary correlation between US area and breast meat yield \( \sim 0.85 \)