Beef Cattle Feed Efficiency

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Outline

• Introduction
• Definitions of feed efficiency
• Feedlot closeout data
• Challenges we face
• New technology
• Cow efficiency
• Summary
Why all the buzz about efficiency?

- Decreasing acres for crop production
- Increasing world population
- Increased utilization of food for fuel
- Increasing feed cost (including forages)
- Other inputs increasing in cost (fuel, transportation, fertilizer)

Feed costs and profitability

- Feed costs have historically been 50-70% of the cost of production in beef enterprises
- As corn prices exceed $7 per bushel, feed costs nearly 80% of the cost in many feedlot operations
- A feed efficiency improvement of approximately 10% across the entire feedlot sector would reduce feed costs $1.2 Billion in 2011 (Weaber, 2011)
- Fewer resources used = improved global food security
A 1% improvement in feed efficiency has the same economic impact as a 3% improvement in rate of gain.

Measures of feed efficiency

- Gross feed efficiency: ratio of live-weight gain to dry matter intake (DMI)
  - 0.12 – 0.22 (higher number better)
- Feed conversion ratio (FCR): DMI to gain ratio
  - 4.5 – 7.5 (lower number better)
- FCR is a gross efficiency measurement – DOES NOT attempt to partition feed inputs into portions needed to support maintenance and growth requirements
Measures of feed efficiency

• Why not just select for FCR?
• FCR is negatively correlated with:
  – Postweaning ADG
  – Yearling BW
  – Cow mature size

Risks of selecting for FCR

• Selecting for improved FCR will indirectly:
  – Increase genetic merit for growth
  – Increase cow mature size
  – Increase feed costs for the cow herd
Measures of efficiency

• Residual Feed Intake (RFI)
  – The difference between actual intake and predicted intake based on animal’s gain, maintenance requirements for its body weight, and composition
  – NEGATIVE RFI IS GOOD!
    • Required less feed then predicted
  – Independent of growth and mature size
  – Linked to biologically relevant traits associated with feed efficiency
    • Digestibility, heat production, protein turnover

Measures of efficiency

• Residual Average Daily Gain (RADG)
  – The difference between actual gain and predicted gain based on animals intake, maintenance requirements for its body weight, and composition
  – POSITIVE RADG IS GOOD!
    • Gained more weight than predicted
  – Correlated to growth
On a feed:gain basis, beef cattle are least efficient compared to other livestock

< 2:1  < 3.5:1  > 6:1

Poultry Improvement

• 250% improvement in efficiency since 1957
Fifteen years of Iowa Feedlot Enterprise Records (Feed Efficiency, 1978-1992)

Feed/Gain (DM)

Year

Rate of Change -- .047 lb./year

Loy, 1993

1 pound improvement in FE/20 years

Fifteen years of Midwestern Feedlot Closeouts (Feed Efficiency, 600-800 lb. steers, 1988-2002)

Feed/gain (DM)

Year

Rate of Change -- .033 lb./year

Loy, 2004

1 pound improvement in FE/30 years
Midwestern Closeout Summaries
(Feed Efficiency, 7-800 lb. steers, last 10 years)

Land O’ Lakes/Purina Feeds, yearly closeout summaries
http://www.beeflinks.com/articles.htm

Past 10 Years of Feedlot Closeouts

Robert Botts, Elanco Beef
Conclusion—feedlot closeout data

- Little to no improvement in feed efficiency
- Improvement has slowed in past decade

Why are beef cattle less efficient?

- Feed higher fiber diets
Why are beef cattle less efficient?

• Rumen Fermentation
• Bacteria produce VFA’s
• Bacteria produce methane

Why are beef cattle less efficient?

• High maintenance requirement
• > 50% of feed intake used for maintenance
Why haven’t we improved efficiency?

- No selection for feed efficiency
- Why?
  - Individual feeding
  - Expensive facilities
  - High labor requirement
  - Lack of social interaction
  - Difficult to compare at varying body compositions

Advances in technology allowing improved feed efficiency measurement

- GrowSafe Units
  - Radio frequency ID
  - Wireless communication
  - Custom software giving < 2% error in feed intake
Advances in technology allowing improved feed efficiency measurement

- Ultrasound technology
- Repeated measurements:
  - 12th rib backfat
  - Rump fat
  - Marbling
  - Ribeye area

How does feedlot efficiency relate to cow efficiency?

- Most research is currently focused on feedlot
  - Logical place to start
  - Feedlots know how much feed they buy
  - Improvements will be easy to document
Beef cow efficiency

• What about cow efficiency?
  – ~70% of feed resources for cow herd
  – ~70% of feed for maintenance
  – 50% OF ALL FEED TO MAINTAIN COWHERD

• How do we define cow efficiency?
  – Pounds of calf weaned per unit of feed intake
  – What about reproduction
  – What about longevity

Maintenance energy

High Maintenance Cow
• High milk production
• High visceral organ weight
• High body lean mass
• Low body fat mass
• High output and high input

Low Maintenance Cow
• Low milk production
• Low visceral organ weight
• Low body lean mass
• High body fat mass
• Low output and low input
Environment

**Restricted feed resources**
- Favors more moderate size, moderate milk production
- “Low maintenance” breeds are most efficient
  - Angus, Red Poll
- High maintenance breeds are least efficient
  - Simmental, Charolais, Limousin, Gelbvieh

**Abundant feed resources**
- Favors larger, heavier milking biological types
- “High maintenance” breeds are most efficient
  - Simmental, Charolais, Limousin, Gelbvieh
- Low maintenance breeds are least efficient
  - Hereford, Red Poll, Angus**

Jenkins and Ferrell, 1994

Intake

- **Why not just select for intake?**
  - Who wants cows with extremely high intake?
  - Who wants cows with extremely low intake?
    - Does that mean we would have selected for cows with poor appetite or that don’t want to actively forage?
Variation in cow efficiency

<table>
<thead>
<tr>
<th></th>
<th>Small Cow</th>
<th>Big Cow</th>
<th>Moderate Cow</th>
<th>Moderate Cow</th>
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<td>BW, lbs</td>
<td>1186</td>
<td>1453</td>
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<td>Milk Production, lbs</td>
<td>15.8</td>
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<td>Hip Height, in.</td>
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<tr>
<td>BCS</td>
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<td>6.0</td>
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<td>DMI, lbs</td>
<td>56.6</td>
<td>45.4</td>
<td>54.4</td>
<td>35.8</td>
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</tbody>
</table>

Adcock et al., 2010

Beef cow efficiency

• Can we select for improved feed efficiency in the feedlot without having negative impacts on the cowherd?

• Or better yet is there a way to select for improved feed efficiency in feedlot that will improve cow efficiency?
Beef cow efficiency

• What about diet type?
  – Feedlot efficiency trials – high-energy, grain-based
  – Cowherd – moderate to low-energy, forage-based

• Why would they be the same?
  – Maintenance energy (heat production, protein turnover)

• Why might they be different?
  – Intake regulation
    • Grain – chemostatic
    • Forage – fill-regulated

Comparing RFI (forage vs. grain)
### Comparing Grain and Forage RFI (steers on grain/heifers on forage)

<table>
<thead>
<tr>
<th>Sire</th>
<th>Grain RFI</th>
<th>Forage RFI</th>
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<tbody>
<tr>
<td>A</td>
<td>-1.18</td>
<td>-1.2</td>
</tr>
<tr>
<td>B</td>
<td>-0.98</td>
<td>-0.33</td>
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<tr>
<td>C</td>
<td>-0.90</td>
<td>0.88</td>
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<td>D</td>
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<td>-0.28</td>
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<td>E</td>
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<tr>
<td>F</td>
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<tr>
<td>G</td>
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<td>-0.38</td>
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<tr>
<td>H</td>
<td>-0.16</td>
<td>-0.52</td>
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</table>

### Comparing Grain and Forage RFI (steers on grain/heifers on forage)

<table>
<thead>
<tr>
<th>Sire</th>
<th>Grain RFI</th>
<th>Forage RFI</th>
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<tr>
<td>O</td>
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<td>P</td>
<td>0.85</td>
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</table>
Forage vs. Grain

• Need to collect more data
  – Collecting forage and grain intake on 900 cattle over next 2 years
• Identify genetics that are superior for both
• Let the geneticists figure out how to select for it!!

Summary

• Changing dynamics put spotlight on efficiency
• Several definitions of feed efficiency
• Beef industry has made minimal progress
• New technology will facilitate progress
• Cow efficiency has unique challenges
• Still have much to learn!!