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 approached and exceeded $7 per bushel, feed costs were 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 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, body weight, and composition
  – **NEGATIVE RFI IS GOOD!**
    • Required less feed than predicted
  – Independent of growth and mature size
  – Linked to biologically relevant traits linked 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, 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)

Rate of Change-- .047 lb./year

1 pound improvement in FE/20 years

Loy, 1993
Fifteen years of Midwestern Feedlot Closeouts
(Feed Efficiency, 600-800 lb. steers, 1988-2002)

1 pound improvement in FE/30 years

Loy, 2004
Midwestern Closeout Summaries (Feed Efficiency, 700-800 lb. steers, last 10 years)

Rate of Change—none!

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

Kansas Feedlot Performance
and
Feed Cost Summary

Feed Efficiency

Lbs DMI / lb gain

Jan-90, Jan-91, Jan-92, Jan-93, Jan-94, Jan-95, Jan-96, Jan-97, Jan-98, Jan-99, Jan-00, Jan-01, Jan-02, Jan-03, Jan-04, Jan-05, Jan-06, Jan-07

Steers
Heifers

(Reinhardt, Waggoner, KSU)
Conclusion—feedlot closeout data

• The rate of improvement has slowed

• The genetics of feed efficiency is a largely untapped source of improvement
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 are beef cattle less efficient?

- No selection for feed efficiency
- Why?
  - Individual feeding
  - Expensive facilities
  - High labor requirement
  - Lack of social interaction decreases feed intake
  - 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
Why is feed efficiency important?

- Feed cost are 65-70% of all costs
- 1% improvement in feed efficiency = 3% improvement ADG
Understanding the components of feed efficiency

- More efficient cattle may have improved digestion or metabolism of nutrients, or
- More efficient cattle may utilize absorbed nutrients more efficiently
Understanding the components of feed efficiency

• Maintenance
  – Genetic and environmental component
  – Impacted by metabolic rate, cellular efficiency

• Production
  – Growth-impacted by body composition, nutrient partitioning
  – Fetal growth, milk production, body condition change
Beef cow efficiency

• What about cow efficiency?
  – ~70% of feed resources for cowherd
  – ~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, Angus, Red Poll

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>Measurement</th>
<th>Small Cow</th>
<th>Big Cow</th>
<th>Moderate Cow</th>
<th>Moderate Cow</th>
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<tbody>
<tr>
<td>BW, lbs</td>
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<td>1453</td>
<td>1306</td>
<td>1308</td>
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<tr>
<td>Milk Production, lbs</td>
<td>15.8</td>
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<td>17.8</td>
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<td>Hip Height, in.</td>
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<td>53.0</td>
<td>53.5</td>
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<tr>
<td>BCS</td>
<td>5.5</td>
<td>6.0</td>
<td>6.0</td>
<td>5.5</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>
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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 RFI 2007

<table>
<thead>
<tr>
<th>Sire</th>
<th>Grain RFI</th>
<th>Forage RFI</th>
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<tbody>
<tr>
<td>A</td>
<td>-.58</td>
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<tr>
<td>B</td>
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<td>-.03</td>
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<tr>
<td>C</td>
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<td>-.46</td>
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<tr>
<td>D</td>
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<tr>
<td>E</td>
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<td>.29</td>
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<tr>
<td>F</td>
<td>.95</td>
<td>.00</td>
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## Comparing RFI 2008

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<tr>
<th>Sire</th>
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<th>Forage RFI</th>
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</thead>
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<tr>
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<tr>
<td>G</td>
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<td>H</td>
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</table>
## Comparing RFI 2008

<table>
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<th>Forage RFI</th>
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</thead>
<tbody>
<tr>
<td>I</td>
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<tr>
<td>M</td>
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<tr>
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<tr>
<td>O</td>
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<td>-0.47</td>
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<tr>
<td>P</td>
<td>0.85</td>
<td>0.61</td>
</tr>
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</table>
Forage vs. Grain

- Continue to collect data
- Identify genetics that are superior for both
- Let the geneticists figure out how to select for it!!
Summary

• Changing dynamics force producers to look at efficiency
• Several definitions of feed efficiency
• Beef industry has made minimal progress in efficiency
• New technology will facilitate progress
• Cow efficiency has unique challenges
• Still have a lot to learn!!