OPTIMIZING BEEF CATTLE NUTRITION FROM CONCEPTION TO CONSUMPTION

“Optimización de la nutrición de ganado de carne desde la concepción hasta el consumo”.

CONFERENCIA INTERNACIONAL ENSMINGER PARA LA GANADERÍA
13 y 14 de mayo de 2016.

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Cow-Calf Specialist
Iowa State University
Cost of Production

- Feed: 51%
- Fixed Capital: 16%
- Operator Labor: 10%
- Operating Costs: 8%
- Deprec., tax, insur.: 5%
- Vet: 5%
- Operating Capital: 3%
- Hired Labor: 2%
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 cow exposed
  – Pounds of calf weaned per cow exposed per unit of feed energy consumed
Nutrition & Reproduction

• Fertility #2 factor in determining profitability in cow-calf herd
  – Second to only feed costs
  – Open cows make you no money and cost you valuable resources to keep around

• Beef cows should be managed to optimize inputs
  – The better the nutrition, the more likely they are to reach their genetic potential
    • Cannot exceed genetic potential
Why reproductive efficiency is so critical?

- Estimated that reproductive failure costs the cattle industry (beef and dairy) $1 BILLION annually in the U.S. alone (Bellows et al., 2002).

- 1% improvement in reproductive performance will generate up to a 3 fold greater return on investment for cow/calf producers than a one percent improvement in production and/or product performance.

- 5x more important than product quality

- 5x more important than growth
lbs. of calf per cow exposed = \frac{\text{total lbs. weaned}}{\# \text{ females exposed}}

- Indicator of reproductive performance, genetic selection, nutritional management
- Example 1:
  - Total lb. of calves at weaning = 28000 lb.
  - # of cows exposed to bull = 50
  - % weaned = 90% (45/50)
  - Average weaning wt. = \frac{28000}{45} = 622 \text{ lb.}
  - lb. of calf per cow exposed = \frac{28000}{50} = 560 \text{ lb.}
lbs. of calf per cow exposed \(=\) \(\frac{\text{total lbs. weaned}}{\# \text{ females exposed}}\)

- Indicator of reproductive performance, genetic selection, nutritional management

Example 2:
- Total lb. of calves at weaning = 24880 lb.
- # of cows exposed to bull = 50
- % weaned = 80% (40/50)
- Average weaning wt. = 24880 / 40 = 622 lb.
- lb. of calf per cow exposed = 28000 / 50 = 498 lb.
Break-even prices at various levels of production and annual costs of production.

<table>
<thead>
<tr>
<th>Calf Crop (%)</th>
<th>Weaning Weight (lb.)</th>
<th>Pounds of calf per cow</th>
<th>Annual costs per cow</th>
<th>Break-Even Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$700</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>550</td>
<td>495</td>
<td>$1.41</td>
<td>$1.61</td>
</tr>
<tr>
<td>90</td>
<td>495</td>
<td>445.5</td>
<td>$1.57</td>
<td>$1.80</td>
</tr>
<tr>
<td>90</td>
<td>440</td>
<td>396</td>
<td>$1.76</td>
<td>$2.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$800</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>550</td>
<td>440</td>
<td>$1.59</td>
<td>$1.82</td>
</tr>
<tr>
<td>80</td>
<td>495</td>
<td>396</td>
<td>$1.76</td>
<td>$2.02</td>
</tr>
<tr>
<td>80</td>
<td>440</td>
<td>352</td>
<td>$1.99</td>
<td>$2.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$900</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>550</td>
<td>385</td>
<td>$1.81</td>
<td>$2.08</td>
</tr>
<tr>
<td>70</td>
<td>495</td>
<td>346.5</td>
<td>$2.02</td>
<td>$2.31</td>
</tr>
<tr>
<td>70</td>
<td>440</td>
<td>308</td>
<td>$2.27</td>
<td>$2.60</td>
</tr>
</tbody>
</table>

Adapted from Beverly and Sprott; Texas A & M
Calving Distribution

Scenario 1

Scenario 2

Scenario 3

# of Calves Born

Day 0          Day 60

60 day Calving Season

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Extension and Outreach
Iowa Beef Center
Yearly calving interval

*To have 1 calf every 365 d, have ~80 d for the cow to conceive after calving (365-285 = 80)
*Cows that calve late in the calving season, this will be a challenge

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Iowa Beef Center
So what is the answer?
Body Condition Score (BCS)

Photo Crystalyx.com
Pregnancy affected by BCS at calving

Percent of cows pregnant the subsequent breeding season according to BCS at calving. Adapted from Selk (ANSI-3283).
BCS and Postpartum interval

Houghton et al., 1988
When is nutrition (BCS) important?

• Pre-calving?
• Post-calving?
• Start of breeding season?
• During breeding season?
Nutrient partitioning

1. Basal metabolism
2. Activity
3. Growth
4. Energy reserves
5. Pregnancy
6. Lactation
7. Additional energy reserves
8. Estrous Cycles and initiation of pregnancy
9. Excess reserves

Short and Adams 1988
Things we forget in the beef industry

Figure 1. Average daily gain (lbs/day) of heifers weaned and developed on range (Range) compared to heifers weaned and developed in a drylot (Normal). All heifers were moved to the same pasture on May 18th (*P = 0.06; **P < 0.05)

Perry et al., 2009
Environment change and heifer activity

Figure 2. Daily activity for heifers developed in a dry-lot (Lot) and on pasture (Pasture) prior to AI (Figure 2a) and following AI (Figure 2b) when heifers were placed on a common pasture.

Perry et al., 2013
Dry-lot to pasture: impact on AI pregnancy rates

Perry et al., 2013

P < 0.05

59.4

49.1

Experienced Grazers

Naïve Grazers
Effect of weight change first 21 d following AI

Contrasts:
- Gain vs Lose + Maintain – P = 0.04
- Maintain vs Lose – P = 0.69

Arias et al., 2012
Post breeding nutrition effect on embryo quality

Weaning

Common Wt Gain

Control

Restricted

5-d CO-Synch + CIDR

Estrus

Day 0 TAI

Day 6 Embryo Flush

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Iowa Beef Center
## Results

### Effect of post-Al nutrition on day 6 embryo characteristics

<table>
<thead>
<tr>
<th>TRT</th>
<th>n&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Embryo Recovery (%)</th>
<th>Embryo Stage (n&lt;sup&gt;b&lt;/sup&gt;)</th>
<th>Embryo Quality (n&lt;sup&gt;c&lt;/sup&gt;)</th>
<th>Dead Cells (n)</th>
<th>Total Cells (n)</th>
<th>Percent Live Cells (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>46</td>
<td>70.8 (46/65)</td>
<td>4.4 ± 0.16</td>
<td>2.2 ± 0.19</td>
<td>7.9 ± 1.04</td>
<td>66.9 ± 5.05</td>
<td>80.9 ± 4.19</td>
</tr>
<tr>
<td>RES</td>
<td>42</td>
<td>62.1 (42/66)</td>
<td>3.7 ± 0.16</td>
<td>2.9 ± 0.19</td>
<td>9.5 ± 1.11</td>
<td>47.9 ± 5.41</td>
<td>69.7 ± 4.39</td>
</tr>
</tbody>
</table>

P-value: .  .  < 0.005  < 0.05  ns  < 0.01  < 0.10

<sup>a</sup> Defined as embryo number; not heifer with the exception of recovery rate

<sup>b</sup> Stage of development (1-9; 1 = UFO; 9 = expanded hatched blastocyst; per IETS Standards)

<sup>c</sup> Quality of embryo (1-5; 1 = excellent; 5 = degenerate; per IETS Standards)

Kruse et al., 2013
Long term effects of cowherd nutrition

*Developmental Programming*
Developmental Programming

• Aka, "Fetal Programming"
• Basically, how does cow nutrition and management affect offspring long-term?
Managing cow body condition

Appropriate Calving Body Condition

- Dystocia
- Return to Estrus

Calf Performance!
Phenotype = Genotype + Environment

Breeding programs

Selection emphasis
EPDs
Genotype

Nutrition
Health management
Heat/cold stress
Environment

Begins at mating

Genotype

Phenotype

Or maybe earlier!

Environment

Developmental Programming

Maternal environment affects developing offspring

- Undernutrition likely results in impaired development and potential long-term consequences

Maternal environment

Offspring effects
Percent of Energy Requirements for Fetal Growth

- 7% during mid gestation
- 29% during late gestation

Day of pregnancy

NRC, 2000
Impact of pre-calving energy level on calving difficulty and birth weight

Adapted from Laster, 1974

P < 0.05
## Effect of Prepartum Energy Levels on Cow Productivity

<table>
<thead>
<tr>
<th></th>
<th>Continuous Low Energy</th>
<th>Low 70 days High Last 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt. Change (lbs.)</td>
<td>- 142</td>
<td>- 22</td>
</tr>
<tr>
<td>Calf BW (lbs.)</td>
<td>59</td>
<td>67</td>
</tr>
<tr>
<td>Calf Survival (%)</td>
<td>71</td>
<td>100</td>
</tr>
<tr>
<td>Scours Treated (%)</td>
<td>52</td>
<td>33</td>
</tr>
<tr>
<td>Scours Deads (%)</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Wean. Wt. (lbs.)</td>
<td>295</td>
<td>320</td>
</tr>
</tbody>
</table>

Corah et al, J Anim Sci - 1975
Heifer BCS and Calf Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to Stand (min.)</td>
<td>---</td>
<td>59.9</td>
<td>63.6</td>
<td>43.3</td>
<td>35.0</td>
</tr>
<tr>
<td>Total Colostrum (mls.)</td>
<td>750</td>
<td>1525</td>
<td>1112</td>
<td>1411</td>
<td>---</td>
</tr>
<tr>
<td>Calf IgG$_1$ (mg/dl)</td>
<td>1788</td>
<td>1998</td>
<td>2179</td>
<td>2310</td>
<td>2348</td>
</tr>
<tr>
<td>Calf IgM (mg/dl)</td>
<td>160</td>
<td>146</td>
<td>157</td>
<td>193</td>
<td>304</td>
</tr>
</tbody>
</table>

Odde - 1992
Milk Production?

![Graph showing milk production trends over the days of lactation.](Meyer et al., 2011)

- **Y-axis**: Milk yield, g
- **X-axis**: Day of lactation
- **Legend**:
  - Red squares: 60% Control
  - Blue circles: Control
  - Green triangles: 140% Control
Feedlot Health

% Treated in the Feedlot

- **No Supplement**: 11.5%
- **Protein Supplement**: 1.5%

**P < 0.05**

% Treated in the Feedlot

- **Cottonseed meal**: 48%
- **High RUP Self-fed**: 16%

**P < 0.05**

Larson et al., 2009; Mulliniks et al., 2007
Quality Grades

Larson et al., 2009

P < 0.05

Choice

Upper 2/3 Choice

% Upper 2/3 Choice

No Supplement

Protein Supplement

No Supplement

Protein Supplement

71

85

20.8

39.3

P < 0.05

P < 0.05
Reproductive Performance of Daughters

Pregnancy Rate as Heifers

<table>
<thead>
<tr>
<th>No Supplement</th>
<th>Protein Supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%</td>
<td>93%</td>
</tr>
</tbody>
</table>

77% from supplemented dams calved in first 21 days (vs. 49%)

Martin et al., 2007; Funston et al., 2008
The Big Picture of Programming

Maternal nutrition and environment

Fetal growth and organ development

Calf growth and organ function

Health
  Growth and efficiency
  Carcass composition
  Reproductive performance
In short:

Inadequate nutrition for the cowherd has lasting impacts on all phases of production…….and ultimately the bottom line for every operation.
Questions?

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