Supplementation of Beef Cattle on Pasture

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Supplementation Strategy

GOAL #1A
Address Nutrient Deficiencies!

GOAL #1B
Modify Grazing Behavior!
Outline for Today’s Talk

- Production environment
- Pasture quality
- Supplement type
- Supplementation frequency
- Ionophores
- Cool- vs. warm-season forages
- Livestock distribution & forage utilization
Outline for Today’s Talk

• Production environment
Brazil Statistics for Beef Production

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth rate</td>
<td>60%</td>
</tr>
<tr>
<td>Weaning rate</td>
<td>54%</td>
</tr>
<tr>
<td>Age at first calving</td>
<td>48 months</td>
</tr>
<tr>
<td>Calving Interval</td>
<td>21 months</td>
</tr>
<tr>
<td>Slaughter age</td>
<td>48 months</td>
</tr>
<tr>
<td>Slaughter rate</td>
<td>17%</td>
</tr>
<tr>
<td>Beef production</td>
<td>30 kg/ha/year</td>
</tr>
</tbody>
</table>

Adapted from Faccio Carvalho (2006)
Brazil Annual Precipitation, Temperature, & Climate

Temperature and Precipitation

- Annual Precipitation (cm)
  - 0 50 100 150 200 250 300

- Temperatures:
  - Approx. 28°C
  - Approx. 18°C
  - Approx. 22°C
Brazil Grazing Characteristics

Pasture Types in RS

- Native
- Improved Native
- Perennial
- Winter Annual
- Summer Annual

% Farms
% of Cow Herd

- < 100 ha
- 100 to 1,000 ha
- > 1,000 ha

Source: Adapted from SEBRAE/SENAR/UFRGS - Diagnóstico da bovinocultura de corte do RS
Outline for Today’s Talk

• Production environment
• Pasture quality
  – In relation to animal requirements
Forage CP of Western & South Western U.S. Rangelands, Tall Fescue Pasture, & Native Pasture in Rio Grande do Sul

Adapted from Beck et al. (2008); Vaz (1998); DelCurto (1997); Alves Filho (1995); McCracken et al. (1993); Vavra & Raleigh (1976)
Pasture Quality Indices

- Standing biomass
- CP
- Minerals
- NDF
- ADF
- TDN
- Digestibility
Pasture Sampling Techniques
Fecal Sampling
Visual Observation of Pasture & Feces

1: 6-8% Crude Protein, 53-67% TDN
2: 9-11% Crude Protein, 60-70% TDN
3: 12-15% Crude Protein, 62-74% TDN
4: 16-19% Crude Protein, 66-74% TDN
5: 20-28% Crude Protein, 68-84% TDN
Historical Knowledge/Past Research

- Ranch/Allotment records
- Neighbors
- University extension; EMBRAPA
- Nutritional consultants
- Feed industry representatives
Climate Variability & Forage Quality

86% of Annual Mean Precipitation

167% of Annual Mean Precipitation

Fig. 5. Percent crude protein of 7 grasses (light lines) and the mean and SE (dark heavy line) across grasses sampled over 8 monthly intervals at 6 different sites in the sagebrush steppe near Burns, Ore. in 1992 and 1993. Dashed horizontal lines (---) depict a 7.5% CP level.
Outline for Today’s Talk

- Production environment
- Pasture quality
- Supplement type
Supplement Form and Intake

Supplement Type

- Dry
- Liquid
- Block

Non-Consumers vs. Intake Variation (CV)

47% ↑

94% ↑

Adapted from Bowman & Sowell (1997)
Supplement Delivery Methods

• Hand-fed
  ➢ Small amounts on a regular basis
  ➢ Rapid consumption
  ➢ Low cost per pound nutrient
  ➢ Labor commitment

• Self-fed (liquid, block, tub, salt limiting, etc.)
  ➢ Large amounts periodically
  ➢ Slow consumption over an extended period of time
  ➢ Minimal labor commitment
  ➢ Inconsistent intake
  ➢ Expensive per pound nutrient
Natural Protein vs Urea (NPN)

• Natural protein is better than NPN – Right?

Not Always!
Urea vs Natural Protein - Steer Calves

Forage-based diet; 5.5% CP; 9% CP diet with supplementation

Adapted from Raleigh & Wallace (1963)
Urea vs Natural Protein - Heifers

Adapted from Pate et al. (1995)

- Body Weight @ Breeding, kg
  - Urea vs Urea/Feather Meal
  - P < 0.05

- Pregnancy Rate, %
  - Urea vs Urea/Feather Meal
  - P < 0.05
Urea Replacing SBM - Cows

L (P < 0.01)  Q (P = 0.05)

Tallgrass prairie, 4.1% CP

Adapted from Farmer et al. (2004)
Urea vs Natural Protein - Cows

Adapted from Cooke & Arthington (2008)

- Cow BCS Change
  - Urea: P = 0.34
  - Natural (CSM/Feather Meal)

- Pregnancy Rate, %
  - Urea: P = 0.43
  - Natural (CSM/Feather Meal)
Energy Supplementation of Cattle Consuming Forage-Based Diets
Energy Supplementation of Cattle Consuming Forage-Based Diets

- Starch-based supplements can normally be offered up to 0.5% of BW without a reduction in forage intake and digestibility (Bowman and Sanson, 1996; Garcés-Yépez et al., 1997)

- Fiber-based supplements can be offered up to 0.8% of BW without negatively impacting forage intake and digestibility (Garcés-Yépez et al., 1997)

- Supplemental fat should be limited to 2 to 3% of diet DM (Hess et al., 2008)
Energy Supplementation of Cattle on Pasture

Energy Supplementation (citrus pulp/rice meal) of Beef Heifers - Cool Season Pasture

Type of Energy Supplement & Steer Performance - Wheat Pasture

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Starch(^a)</th>
<th>Fiber(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steers/ha</td>
<td>1.24</td>
<td>1.65</td>
<td>1.65</td>
</tr>
<tr>
<td>Initial kg/ha</td>
<td>260</td>
<td>346</td>
<td>345</td>
</tr>
<tr>
<td>Forage Allowance, kg/hd</td>
<td>1,600</td>
<td>1,045</td>
<td>1,025</td>
</tr>
<tr>
<td>Supplement, % BW</td>
<td>-</td>
<td>0.71</td>
<td>0.72</td>
</tr>
<tr>
<td>ADG, kg</td>
<td>0.97(^b)</td>
<td>1.00(^c)</td>
<td>1.07(^d)</td>
</tr>
<tr>
<td>Beef gain, kg/ha</td>
<td>138(^b)</td>
<td>189(^c)</td>
<td>202(^d)</td>
</tr>
</tbody>
</table>

\(a\): supplemented treatments were stocked 33% greater than Control  
\(b, c, d\): means in a row without a common superscript are different (P < 0.05)  

Adapted from Frizzo (2003)

Columns without a common letter differ (P < 0.05)

Adapted from Horn et al. (1995)
Energy Supplementation & Reproductive Efficiency

- Energy-based supplements can improve performance and reproductive efficiency of cows and developing heifers
- Supplements favoring propionate synthesis (starch-based) may decrease age at puberty
- Supplemental fat pre-breeding as been inconclusive in respect to reproductive performance beyond the energy contribution
- PUFA supplementation post-breeding increases pregnancy rate
Starch-Based Energy Supplement Pre-Breeding - Heifers

Adapted from Ciccioli et al. (2005)
PUFA Supplementation after Timed-AI

Adapted from Lopes et al. (2011)
Mineral Supplementation Needed?

- Diet & soil analyses
  - Wet chemistry, important interactions
- Blood & other tissue analyses (liver, muscle, bone, etc.)
- Secretions (saliva)
- Excretions (milk, urine, feces)
- Appendages (hair, hoof, fleece, etc.)

Information from any one of these, of its own accord, is rarely conclusive!
Impact of Decline in the Trace Mineral Status of Ruminants

- **Observed Response**
  - Adequate
  - Subclinical
  - Clinical

- **Mineral Status/Deficiency**
  - Immunity & Enzyme Function
  - Maximal Fertility & Growth
  - Normal Fertility & Growth

Adapted from Wikse (1992)
### Potential Consequences of Mineral Deficiencies

<table>
<thead>
<tr>
<th>Observation</th>
<th>P</th>
<th>Ca</th>
<th>Mg</th>
<th>K</th>
<th>Fe</th>
<th>Cu</th>
<th>Zn</th>
<th>Se</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower conception rate</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased calving rate</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced milk production</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced weaning weights</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smaller/weaker calves</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor herd health</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass tetany</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retained placenta</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in hair coat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
What Should My Strategy Be?

Target Level of Mineral in the Body

120  90  60  30

Days to Reach Target

Critical Times of Year?
Inorganic Only?
Inorganic + Organic?
Antagonists?
Performance Expectations?
Outline for Today’s Talk

• Production environment
• Pasture quality
• Supplement type
• Supplementation frequency
CP Supplementation Frequency

CON vs Supp: P < 0.01

N Balance, g/kg BW

Supplement intake variation (%)

Adapted from Schauer et al. (2005)

Adapted from Bohnert et al. (2002); 5% CP Forage
CP Amount & Supplementation Frequency

Adapted from Bohnert et al. (2012); 2.4% CP Forage

Adapted from Van Emon et al. (2012); 4.9% CP Forage
## Supplementation Costs – 30 day Period

<table>
<thead>
<tr>
<th></th>
<th>0.45 kg of SBM/head</th>
<th>0.23 kg of SBM/head</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>5 Days</td>
</tr>
<tr>
<td>Fuel Cost ($)(^a)</td>
<td>360</td>
<td>72</td>
</tr>
<tr>
<td>Labor Cost ($)(^b)</td>
<td>630</td>
<td>126</td>
</tr>
<tr>
<td>Supplement Cost ($)(^c)</td>
<td>1,800</td>
<td>1,800</td>
</tr>
<tr>
<td>Total Costs ($)</td>
<td>2,790</td>
<td>1,998</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Daily</th>
<th>5 Days</th>
<th>10 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor/Fuel Cost Reduction</td>
<td>-</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Supplement Cost Reduction</td>
<td>-</td>
<td>-</td>
<td>50%</td>
</tr>
<tr>
<td>Total Cost Reduction</td>
<td>-</td>
<td>28%</td>
<td>32%</td>
</tr>
<tr>
<td>Total Benefit ($)</td>
<td>-</td>
<td>792</td>
<td>891</td>
</tr>
</tbody>
</table>

\(^a\) calculated as 3 gallons/supplementation day at $4.00/gallon
\(^b\) calculated as 2.5 hours/supplementation day at $8.40/hour
\(^c\) calculated for a 300 cow herd; soybean meal at a cost of $400/ton

Bohnert et al. (2012)
Effect of Supplementation Frequency on Cow Performance - Energy

ADG, Kg

Daily

Alt Day

P < 0.01

Adapted from Kartchner & Adams (1982)
Effect of Supplement Frequency & Type on Steer Performance - Energy

ADG, kg

0,00 0,10 0,20 0,30 0,40 0,50 0,60

Molasses 3x/wk

Citrus Pulp Daily

Citrus Pulp 3x/wk

9.1% CP Hay

Columns without a common letter differ (P < 0.05)

Adapted from Cooke et al. (2007)
Effect of Supplementation Frequency on Heifer Performance - Energy

Supplementation frequency × week interaction: P = 0.01

Supplementation frequency × week interaction: P = 0.02

Adapted from Moriel et al. (2012)
Outline for Today’s Talk

- Production environment
- Pasture quality
- Supplement type
- Supplementation frequency
- Ionophores
Ionophores & Forage-Based Diets: ADG

y = 1.81x - 0.009x² (P < 0.01)
R² = 0.71  n = 22
comparisons = 46

y = 1.99x - 0.01x² (P < 0.01)
R² = 0.63  n = 10
comparisons = 15

Adapted from Bretschneider et al. (2008)
Ionophores & Forage-Based Diets: Feed Efficiency

Adapted from Bretschneider et al. (2008)
Ionophores & Forage-Based Diets: Forage Quality

Adapted from Bretschneider et al. (2008)
Virginiamycin and Performance of Grazing Cattle

**Forage Allocation**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Kg DM/100 Kg BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt/Min</td>
<td>9,0</td>
</tr>
<tr>
<td>Salt/Min + Virg.</td>
<td>9,7</td>
</tr>
<tr>
<td>Protein</td>
<td>9,3</td>
</tr>
<tr>
<td>Protein + Virg.</td>
<td>8,9</td>
</tr>
</tbody>
</table>

Stocking rate: 2 AU/ha

**Animal Performance**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>ADG (Kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt/Min</td>
<td>0,30</td>
</tr>
<tr>
<td>Salt/Min + Virg.</td>
<td>0,38</td>
</tr>
<tr>
<td>Protein</td>
<td>0,34</td>
</tr>
<tr>
<td>Protein + Virg.</td>
<td>0,43</td>
</tr>
</tbody>
</table>

Columns without a common letter differ (P < 0.05)
Virginiamycin and Economic Performance of Grazing Cattle

**Economic Return**

<table>
<thead>
<tr>
<th></th>
<th>R$/Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt/Min</td>
<td>R$ 85</td>
</tr>
<tr>
<td>Salt/Min + Virg.</td>
<td>R$ 104</td>
</tr>
<tr>
<td>Protein</td>
<td>R$ 89</td>
</tr>
<tr>
<td>Protein + Virg.</td>
<td>R$ 113</td>
</tr>
</tbody>
</table>

Columns without a common letter differ (P < 0.05)

Adapted from Bruning (2013)
Outline for Today’s Talk

• Production environment
• Pasture quality
• Supplement type
• Supplementation frequency
• Ionophores
• Cool- vs. warm-season forages
CP Supplementation is Assumed to Increase Intake of Low-Quality (< 7% CP) Forage

<table>
<thead>
<tr>
<th>Supplement CP, %</th>
<th>Forage Intake Increase, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15</td>
<td>3</td>
</tr>
<tr>
<td>15 to 20</td>
<td>10</td>
</tr>
<tr>
<td>20 to 30</td>
<td>21</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>44</td>
</tr>
</tbody>
</table>

Adapted from Mathis et al. (2007)
Background

- CP supplementation of warm season forage routinely increases forage intake by >40% (DelCurto et al., 1990; Koster et al., 1996; Mathis et al., 1999)

- CP supplementation of cool season forage normally doesn’t alter forage intake (Horney et al., 1996; Mathis et al., 2000; Bohnert et al., 2002; Currier et al., 2004; Schauer et al., 2005; Schmidt et al., 2006)
Forage Intake - C3 vs C4

Adapted from Bohnert et al. (2011)

C3 = 6.3% CP; C4 = 5.7% CP

UnSupp vs Supp: P < 0.01
C4 vs C3: P < 0.01
Supp vs Type: P < 0.01

Forage Intake, % BW

C4

C4+Supp

C3

C3+Supp

47% ↑
Differences in Quality Parameters of C3 and C4 Forages

<table>
<thead>
<tr>
<th>Item</th>
<th>Tallgrass Prairie (C4)</th>
<th>Bluegrass Straw (C3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP, %</td>
<td>5.7</td>
<td>6.3</td>
</tr>
<tr>
<td>NDF, %</td>
<td>69.8</td>
<td>66.4</td>
</tr>
<tr>
<td>NFC, %</td>
<td>9.3</td>
<td>17.0</td>
</tr>
<tr>
<td>WSC, %</td>
<td>8.8</td>
<td>14.1</td>
</tr>
<tr>
<td>NDF Degradability, %</td>
<td>41</td>
<td>47</td>
</tr>
<tr>
<td>RDP, % of CP</td>
<td>66</td>
<td>85</td>
</tr>
</tbody>
</table>

Adapted from Bohnert et al. (2011)
Outline for Today’s Talk

• Production environment
• Pasture quality
• Supplement type
• Supplementation frequency
• Ionophores
• Cool- vs. warm-season forages
• Livestock distribution & forage utilization
Where do your cattle actually graze?

Nutritional quality often varies within pasture
Change in Forage Utilization with Molasses Block Supplementation

Adapted from Bailey & Welling (1999)

- Moderate Terrain: ≈ 12% SLOPE
- Difficult Terrain: ≈ 19% SLOPE

P < 0.01
Altered Riparian Area use with strategic supplementation

**McDougald et al. (1989)**
- Supp = 50% less riparian utilization

**Freeman et al. (2006)**
- Improved cow/calf performance
- Decreased utilization of riparian vegetation (late summer)

**George et al. (2008)**
- No Supp = 37.0% of time grazing riparian
- Supp = 14.5% of time grazing riparian
Summary

- Understand your environment and ranch infrastructure
- Determine animal requirements & deficiency of nutrient(s)
  - Supplement ONLY when necessary
  - Determine the type of supplement that works best for your situation
- Supplementation can be used to modify grazing behavior/distribution
Questions?

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