Livestock Nutrition and Forage Quality

Patrick Davis, Ph. D.
MU Extension Livestock Specialist
Johnson County
Introduction

- Livestock Nutrition
- Forage Quality
- Accessing Forage Quality
Livestock Nutrition

• Nutrients required
  – Water
  – Energy
    • Carbohydrates and Fats
  – Protein
  – Minerals
  – Vitamins
Livestock Nutrition

• Water
  – 60 to 70% of animals live weight
  – related to feed intake
    • 3 lbs of water for every lbs of feed
  – Death results in loss of 20% of water
  – Live longer without feed than water
    • 60 d vs 7 d

Ohio State University
Fact Sheet ANR-13-02
Livestock Nutrition

- **Water**
  - Helps perform body function
  - Eliminates waste products
  - Regulates blood osmotic pressure
  - Produce milk and saliva
  - Transport nutrients, hormones and other chemical messages within the body
  - Aids in temperature regulation
## Livestock Nutrition

<table>
<thead>
<tr>
<th>Animal class</th>
<th>Temperature, °F</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40° F</td>
<td>60° F</td>
<td>70° F</td>
<td>80° F</td>
<td>90° F</td>
</tr>
<tr>
<td>600 lb calf</td>
<td>5.3</td>
<td>6.6</td>
<td>7.8</td>
<td>8.9</td>
<td>12.7</td>
</tr>
<tr>
<td>Lactating cow</td>
<td>11.4</td>
<td>14.5</td>
<td>16.9</td>
<td>17.9</td>
<td>16.2</td>
</tr>
<tr>
<td>Winter, dry cow</td>
<td>6.7</td>
<td>8.3</td>
<td>9.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NRC. 2000, adapted from Winchester and Morris, 1956
Livestock Nutrition

- Water Sources
  - Waterer, pond, trough
  - Feed stuffs
Livestock Nutrition

• Energy
  – Carbohydrates
    • Main source of energy
    • Sugars, starches and cellulose
    • Sources
      – Grains
        » Concentrates high energy and low fiber
      – Forages
        » Roughages low in energy and high in fiber
Livestock Nutrition

• **Energy**
  
  – Fats and oils
    
    • Found in plants and animals
    • 2.25 times the energy of CHO
    • They serve as concentrated storage places for energy
      
      – When the animal is in a negative energy balance they pull from these places to serve their energy needs
    
    • Essential fatty acids are derived from fats and required to produce hormones
Livestock Nutrition

- Sources of fats and oils
  - Animal
  - Oil seeds
Livestock Nutrition

Gross Energy
- Fecal energy

Digestible Energy
- Urine
- Gas

Metabolizable Energy
- Heat Increment

Net Energy for Production
- Maintenance
- Gain
- Pregnancy
- Lactation
Livestock Nutrition

• Maintenance Energy Requirements
  – Nutrients required to stay alive
    • No productive function
      – Growth
      – Lactation
      – Pregnancy
  – \( \text{NE}_{\text{m}} = 0.077 \text{ Mcal} \times (\text{EBW kg})^{0.75} \)
Livestock Nutrition

Effects of BW on Maintenance Energy Requirements

1000 to 1200 = +10.7%
1000 to 1400 = +20.9%

<table>
<thead>
<tr>
<th>BW (lb)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>13.7</td>
<td>14.6</td>
<td>14.1</td>
<td>13.1</td>
<td>12.1</td>
<td>11.4</td>
<td>10.9</td>
<td>8.15</td>
<td>8.64</td>
<td>9.45</td>
<td>10.7</td>
<td>12.5</td>
</tr>
<tr>
<td>1200</td>
<td>15</td>
<td>16</td>
<td>15.4</td>
<td>14.4</td>
<td>13.5</td>
<td>12.7</td>
<td>12.2</td>
<td>9.26</td>
<td>9.75</td>
<td>10.6</td>
<td>11.8</td>
<td>13.6</td>
</tr>
<tr>
<td>1400</td>
<td>16.3</td>
<td>17.2</td>
<td>16.7</td>
<td>15.7</td>
<td>14.7</td>
<td>14</td>
<td>13.5</td>
<td>10.3</td>
<td>10.8</td>
<td>11.6</td>
<td>12.9</td>
<td>14.6</td>
</tr>
</tbody>
</table>

NEm Mcal/day
# Livestock Nutrition

<table>
<thead>
<tr>
<th>Type / Breed</th>
<th>Maintenance Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>English / Angus, Hereford</td>
<td>1</td>
</tr>
<tr>
<td>Dairy / Holstein, Jersey</td>
<td>1.2</td>
</tr>
<tr>
<td>Continental</td>
<td></td>
</tr>
<tr>
<td>Limousin, Charolais, Chianina</td>
<td>1.0</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>1.1</td>
</tr>
<tr>
<td>Simmental, Braunvieh</td>
<td>1.2</td>
</tr>
<tr>
<td>Bos indicus</td>
<td></td>
</tr>
<tr>
<td>Brangus</td>
<td>0.95</td>
</tr>
<tr>
<td>Brahman</td>
<td>0.90</td>
</tr>
</tbody>
</table>

*NRC, 2000*
Livestock Nutrition

Effects of Heat Stress on Maintenance Energy Requirements

- 60 degrees: +4.2%
- 70 degrees: +6.2%
- 80 degrees: +9.8%
- 90 degrees: +13.4%
- 100 degrees: +13.4%

Mcal NEm / day

Stockers

UNIVERSITY OF MISSOURI Extension
Live. And Learn.
Livestock Nutrition

1300 pound cow
Energy requirements

Mcal NE_m / day

Months since calving

Mcal NE_m / day

Pregnancy
Lactation
Maintenance

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Extension
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Livestock Nutrition

1st calf heifer
Energy requirements

Mcal NE_{m} / day

Months since calving

- Growth
- Pregnancy
- Lactation
- Maintenance

UNIVERSITY OF MISSOURI Extension
Live. And Learn.
Lactation affects on energy demand

Livestock Nutrition

Months since calving

NEm Mcal / day

15 lbs

20 lbs

25 lbs
Livestock Nutrition

Residual Feed Intake

• Residual Feed Intake
  – Actual FI – Predicted FI
  – At a specific body weight and gain

• The most efficient calves consumed
  – 23% less feed than average cattle
  – 29% less feed than least efficient group

<table>
<thead>
<tr>
<th>Group</th>
<th>Intake</th>
<th>ADG</th>
<th>RFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>17.6</td>
<td>3.1</td>
<td>-1.57</td>
</tr>
<tr>
<td>Average</td>
<td>22.9</td>
<td>3.3</td>
<td>+0.56</td>
</tr>
<tr>
<td>Bottom</td>
<td>24.9</td>
<td>3.2</td>
<td>+1.69</td>
</tr>
</tbody>
</table>
Livestock Nutrition

Energy required for gain
650 lb calf

Mcal / day

ADG, lb / day

0 0.5 1 1.5 2 2.5

NEg

NEm

0 1 2 3 4 5 6 7 8 9 10

NEg

NEm
Livestock Nutrition

Energy required for 1.5 lb ADG
150 day grazing season

Calf weight, lb / day

Mcal / day

NEg
NEm
Livestock Nutrition

• **Protein**
  – Built of amino acids
    • Over 20 different amino acids
      – 10 essential acids
        » PVT TIM HALL
  – Uses
    • Muscle and Tissue development
    • Composes hormones and enzymes
Livestock Nutrition

**Protein Types**

- **Crude Protein:** N×6.25
- **UIP or RUP:** Protein that bypasses the rumen
- **DIP or RDP:** Protein degraded in the rumen
- **Microbial Protein:** Protein produced in the rumen
- **Metabolizable protein**
  - Protein used by the animal
- **Indigestible protein**
  - Protein loss in feces

Beef Cattle Manual, 2008
Livestock Nutrition

• Degradable protein
  – Rumen microbial population will use this to digest fiber
  – Deficiency will reduce forage digestion
    • Is reduced in heat damaged forages or feed supplements
  – Comes from forage, feed, or recycled
    • Feed supplement may contain NPN
Livestock Nutrition

• Degradable protein
  – Could be excessive in lush high protein spring pastures or cover crop fields
  • These forages are low in fermentable CHO
  • Adding a fermentable carbohydrate
    – Increase microbial protein production
      » Improve growth and milk production
    – Detoxify urea reducing toxicity problems
Livestock Nutrition

• Factors that influence protein requirements
  – Age
    • Young vs mature
  – Physiological state
    • growing cattle vs finishing cattle
    • lactating cattle vs dry cattle
Livestock Nutrition

- **Minerals**
  - Macro
    - Large amounts and expressed as %
  - Trace Minerals
    - Small amounts expressed in ppm

- **Vitamins**
  - Fat Soluble
  - Water Soluble
Livestock Nutrition

• Mineral/Vitamins
  – Small portion of diet but important for life
  – Required for
    • Bone formation
    • Construction of muscles, blood cells, internal organs and enzymes
    • Develop proper immunity to diseases
    • Normal growth, production and reproduction
    • Fight stress, disease and maintain good health
## Livestock Nutrition

### Supplemental Macro Mineral Levels

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mature</th>
<th>High Mag</th>
<th>Growing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt, %</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>2</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>0.5</td>
<td>-</td>
<td>0.5</td>
</tr>
</tbody>
</table>

2-4 oz / head / day intake
Livestock Nutrition

• Salt supplementation
  – 25% salt provides 50-100% of daily need
  – Requirement
    • 0.6 oz growing
    • 1.2 oz lactating
  – When mineral intake is excessive mix salt with mineral
Livestock Nutrition

• Phosphorus supplementation
  – Forage phosphorus levels less than the following require supplementation
    • 0.18% dry cow
    • 0.27% lactating cow
    • 0.27% growing calf
  – Feeding 3 lbs of DDGS is equal to 4 oz of 10% phosphorus mineral
Livestock Nutrition

- Phosphorus supplementation
  - P concentration is greater when
    - Plant is vegetative
    - Animals can selectively graze
  - Consider P supplements when
    - Low soil fertility
    - Drought stress
    - Frosted forage
Livestock Nutrition

• Magnesium Supplementation
  – Grass tetany caused by
    • Excessive K in lush forage
    • Difficulty mobilizing bone Mg
    • Excessive non-protein nitrogen supplements
    • Low calcium intake
  – Provide High – Mg mineral 30 days prior to green up
Livestock Nutrition

• Potassium supplementation
  – Weathered forages are low in K
  – Utilize a 0.5 to 0.8% K mineral to supplement forages
  – Remove K supplementation during early spring through fall
# Livestock Nutrition

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mature</th>
<th>High Mg</th>
<th>Growing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper, ppm</td>
<td>1500</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Manganese, ppm</td>
<td>3000</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Zinc, ppm</td>
<td>3500</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Iodine, ppm</td>
<td>60</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Cobalt, ppm</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Selenium, ppm</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

*2-4 oz / head / day intake*
## Livestock Nutrition

### Supplemental Vitamin Level

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Cows, IU / lb</th>
<th>Calves, IU / lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>250,000</td>
<td>125,000</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>25,000</td>
<td>12,500</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Livestock Nutrition

• Vitamin supplementation
  – Vitamin
    • A – Green, growing forage
    • D – Sun and skin conversion
    • E – Green, growing forage
  – Supplement dormant or weathered forages
Forage Quality

• Forage quality is related to intake
  – Maturity
  – Stem to leaf ratio
  – Length of time they are eating
Forage Quality

Maturity

Increase maturity = increase NDF = decrease intake
# Forage Quality

## Nutrient Value of Fescue Hay at Different Maturities

<table>
<thead>
<tr>
<th>Maturity</th>
<th>NDF (%)</th>
<th>TDN (%)</th>
<th>CP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K31 Early Bloom</td>
<td>64</td>
<td>60</td>
<td>18</td>
</tr>
<tr>
<td>K31 Mature</td>
<td>73</td>
<td>52</td>
<td>11</td>
</tr>
</tbody>
</table>

*Beef Magazine, 2013 Feed Composition Tables*
Forage Quality

Species

Increase Stem to leaf ratio = increase in NDF = decrease in intake
## Forage Quality

### Nutritive Values of Different Fresh Forages

<table>
<thead>
<tr>
<th>Feed stuff</th>
<th>%DM</th>
<th>NDF (%)</th>
<th>TDN (%)</th>
<th>CP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fescue K31</td>
<td>29</td>
<td>64</td>
<td>64</td>
<td>15</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>24</td>
<td>46</td>
<td>61</td>
<td>19</td>
</tr>
<tr>
<td>Red Clover</td>
<td>24</td>
<td>44</td>
<td>64</td>
<td>18</td>
</tr>
<tr>
<td>Orchard Grass Early Bloom</td>
<td>24</td>
<td>54</td>
<td>65</td>
<td>14</td>
</tr>
<tr>
<td>Timothy Pre-Bloom</td>
<td>26</td>
<td>59</td>
<td>64</td>
<td>11</td>
</tr>
</tbody>
</table>

*Beef Magazine, 2013 Feed Composition Tables*
Forage Quality

Plant Parts

1st bite: leaves with low fiber

2nd bite

3rd bite: stems with high fiber

More bites increases Stem to leaf ratio = increases NDF = decreases intake
Accessing Forage Quality

- Testing Your forage
- Measuring Your forage
- Watching Animal Condition and Performance
- Looking at the feces
Accessing Forage Quality
Measuring Forage

UCM Prussing Forage Coverage 5-6-2013

<table>
<thead>
<tr>
<th>Paddocks</th>
<th>8</th>
<th>4</th>
<th>6</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>7</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 1</td>
<td>2082</td>
<td>2195</td>
<td>2245</td>
<td>2320</td>
<td>2807</td>
<td>2844</td>
<td>3281</td>
<td>3406</td>
</tr>
</tbody>
</table>

lbs DM/acre
Accessing Forage Quality

Measuring Your Forage
Measured and photographed 5-23-2013

Paddock 8
1945 lbs DM/ac

Paddock 6
3419 lbs DM/ac

Paddock 7
3918 lbs DM/ac

Paddock 5
4855 lbs DM/ac

Photos were from the UCM Prussing Farm
Accessing Forage Quality

Body Condition Score

- Access at
  - Calving
    - 6 or >
  - Breeding
    - 5 or >
  - Weaning
    - 4 or >

Body Condition Score 4  Body Condition Score 6
http://www.cowbcs.info/photogallery.html
Accessing Forage Quality

Dr. Tom Troxel
University of Arkansas

14.8% CP
28.2% fiber
53.2 % TDN
Low fiber
Easily digested

5.1 % CP
31.5% fiber
53.7% TDN
Very low protein
decreased
digestibility

8.8% CP
32.8% Fiber
46.3% TDN
Low energy

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Accessing Forage Quality
UCM Prussing Farm 5-23-2013

What is the Forage Quality?
Conclusion

• Nutrient Requirements
  – Identify animal requirements
  – Match those to forage resources
  – Use supplements economically

• Forage quality
  – Quality is relate to intake and manage such that you optimize intake
Conclusion

• Accessing Forage Quality
  – Identify Forage Quality
    • Use tools
      – Identify forage coverage, growth, and quality
      – Understand digestibility and usage of that forage
  – Evaluate Animal Performance and Condition
    • Use this as a assessment of forage quality and culling factor
Questions

Contact Information

Dr. Patrick Davis, Livestock Specialist
University of Missouri – Extension Johnson County
135 W. Market, Warrensburg, MO, 64093
PHONE: 660-747-3193 FAX: 660-747-9867
E-MAIL: davismp@missouri.edu
WEB: extension.missouri.edu/johnson