Dairy Nutrition for the Pasture–based Cow

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Characteristics of Pasture

• 18 - 34% Protein
  • High soluble protein

• 0.66 - 0.80 Net Energy

• 30 – 55% NDF

• Low non-fiber carbohydrates
  • 12-24%
<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Predominantly Grass (Cool season)</th>
<th>Grass with Legumes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring</td>
<td>Summer</td>
</tr>
<tr>
<td>Crude Protein (CP), % DM</td>
<td>21-25</td>
<td>18-22</td>
</tr>
<tr>
<td>RUP&lt;sup&gt;b&lt;/sup&gt;, % of CP</td>
<td>20-25</td>
<td>25-30</td>
</tr>
<tr>
<td>Sol. P&lt;sup&gt;c&lt;/sup&gt;, % of CP</td>
<td>35-40</td>
<td>25-30</td>
</tr>
<tr>
<td>ADF&lt;sup&gt;d&lt;/sup&gt;, % DM</td>
<td>24-28</td>
<td>28-34</td>
</tr>
<tr>
<td>NDF&lt;sup&gt;e&lt;/sup&gt;, % DM</td>
<td>40-45</td>
<td>48-55</td>
</tr>
<tr>
<td>Hemicellulose, % DM</td>
<td>17-21</td>
<td>21-25</td>
</tr>
<tr>
<td>Cellulose, % DM</td>
<td>16-20</td>
<td>21-26</td>
</tr>
<tr>
<td>NE, Mcal/lb</td>
<td>0.72-0.78</td>
<td>0.66-0.72</td>
</tr>
<tr>
<td>Non-fiber carbohydrate (NFC), %DM</td>
<td>15-20</td>
<td>12-15</td>
</tr>
<tr>
<td>Fat, % DM</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>Ash, %DM</td>
<td>7-9</td>
<td>7-9</td>
</tr>
<tr>
<td>Ca, % DM</td>
<td>0.50-0.75</td>
<td>0.50-0.75</td>
</tr>
<tr>
<td>P, % DM</td>
<td>0.30-0.35</td>
<td>0.30-0.35</td>
</tr>
<tr>
<td>Mg, % DM</td>
<td>0.15-0.20</td>
<td>0.18-0.24</td>
</tr>
<tr>
<td>K, % DM</td>
<td>2.0-3.5</td>
<td>2.5-3.5</td>
</tr>
<tr>
<td>S, % DM</td>
<td>0.16-0.22</td>
<td>0.18-0.26</td>
</tr>
</tbody>
</table>
A cow can consume 1.2% of BW as cell wall (NDF)
# Availability of Components

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>DIGESTIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Carbohydrate</td>
<td>100</td>
</tr>
<tr>
<td>Starch</td>
<td>90+</td>
</tr>
<tr>
<td>Protein</td>
<td>90+</td>
</tr>
<tr>
<td>Pectin</td>
<td>98</td>
</tr>
<tr>
<td>Cellulose</td>
<td>Variable</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>Variable</td>
</tr>
<tr>
<td>Lignin</td>
<td>Indigestible</td>
</tr>
</tbody>
</table>
Characteristics cont.

• As quality decreases, good quality forage will be selected if abundant choice

<table>
<thead>
<tr>
<th></th>
<th>DM</th>
<th>CP</th>
<th>NDF</th>
<th>ADF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>22.9</td>
<td>18.8</td>
<td>42.7</td>
<td>28.7</td>
</tr>
<tr>
<td>Masticate</td>
<td>14.1</td>
<td>20.8</td>
<td>38.1</td>
<td>25.9</td>
</tr>
</tbody>
</table>

Pasture Intake

Biting rate (BR) \times Grazing Time \times Intake/bite = \text{Pasture Intake}
Factors Affecting Grazing

- Animal factors
  - Size
  - Production
  - Genetic merit

- Pasture factors
  - Height
  - Density
Effect of supplementation on grazing

- **Grazing time**
  - Concentrate consistently decreases GT
    - Arriaga-Jordan & Holmes
      - Barley 2.2 lb/d GT 467 min
      - Barley 13.2 lb/d GT 424 min
      - Difference of 43 minutes in GT
    - Bargo et al.
      - Corn 1.8 lb/d GT 609 min
      - Corn 18.9 lb/d GT 534 min
      - Difference of 75 minutes in GT
Effect of supplementation on grazing

- **Grazing time**
  - Average of studies in Table 2
    - Average supplementation 9 lb/day (range 1.8-19.1 lb/d)
    - Grazing time reduced by **34 minutes**
    - Biting rate and bite size not affected
  
  - 1 lb decrease in DMI = 2 lb decrease in milk
Substitution Rate

- lb pasture intake substituted per lb concentrate intake
- Research trials Table 3
  - Range of 0.14 to 0.65
Type of supplement – Forage

- **Mayne and Wright (1998)**
  - Grass silage supplementation
    - Substitution rate of 0.84 to 1.02 lb/lb grass silage
    - Is it prudent to feed hay to cows on adequate pasture?
  - Concentrate supplementation
    - Substitution rate of 0.11 to 0.50 lb/lb of concentrate.
Type of supplement

- Starch or Fibrous

- **Table 4** lists several studies evaluating DMI, milk production and composition

- **Starch sources:**
  - Corn, cassava, barley or combination of barley/wheat/corn

- **Fiber sources:**
  - Oatfeed, beet pulp either alone or combined with soy hulls or citrus pulp
Type of supplement – Starch or Fibrous

- Inconsistent effects of S vs F
  - Delahoy et al. (2003)
    - Conc. Fed at 1 lb/4 lb milk produced
    - Conditions forced mechanical harvest and bringing to cows during part of the trial
    - Forage quality was an issue

<table>
<thead>
<tr>
<th>Concentrate type</th>
<th>DMI. Lb/d Level</th>
<th>Pasture</th>
<th>Total lb/d</th>
<th>Milk lb/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>18.0</td>
<td>26.6</td>
<td>44.7</td>
<td>60.7</td>
</tr>
<tr>
<td>Beet pulp/soy hull</td>
<td>18.0</td>
<td>26.4</td>
<td>44.4</td>
<td>60.3</td>
</tr>
</tbody>
</table>
## Type of supplement

- **Starch or Fibrous**

- **Sayers (1999)**

<table>
<thead>
<tr>
<th>Concentrate type</th>
<th>Level</th>
<th>Pasteur</th>
<th>Total</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>S (barley/wheat/corn)</td>
<td>11.0</td>
<td>27.7\textsuperscript{a}</td>
<td>38.7\textsuperscript{a}</td>
<td>68.6\textsuperscript{a}</td>
</tr>
<tr>
<td>F (beet/citrus pulp)</td>
<td>11.0</td>
<td>29.5\textsuperscript{b}</td>
<td>40.5\textsuperscript{b}</td>
<td>68.0\textsuperscript{a}</td>
</tr>
<tr>
<td>S (barley/wheat/corn)</td>
<td>22.0</td>
<td>9.5\textsuperscript{c}</td>
<td>42.9\textsuperscript{c}</td>
<td>76.1\textsuperscript{b}</td>
</tr>
<tr>
<td>F (beet/citrus pulp)</td>
<td>22.0</td>
<td>10.9\textsuperscript{d}</td>
<td>46.0\textsuperscript{d}</td>
<td>77.4\textsuperscript{b}</td>
</tr>
</tbody>
</table>

\textsuperscript{a,b,c,d} Means with different superscripts differ (P < 0.05)
# Starch Content & Degradation Rates

<table>
<thead>
<tr>
<th>Feed</th>
<th>Starch Content</th>
<th>Starch Degradation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% DM</td>
<td>Range</td>
</tr>
<tr>
<td>Corn</td>
<td>76</td>
<td>72-78</td>
</tr>
<tr>
<td>Barley</td>
<td>64</td>
<td>60-74</td>
</tr>
<tr>
<td>Oats</td>
<td>58</td>
<td>52-69</td>
</tr>
<tr>
<td>Wheat</td>
<td>70</td>
<td>67-77</td>
</tr>
<tr>
<td>Milo</td>
<td>71</td>
<td>68-78</td>
</tr>
</tbody>
</table>
Level of supplementation

- Table 2 supplementation range of 1.8 to 19.1 lb/day
  - Pasture DMI decreased by 13%

- Table 5
  - Average all studies and supplementation increases milk production about 9.7 lb/d, or 22% compared with pasture only
  - Does not take into account pasture DMI
## Level of Supplementation

<table>
<thead>
<tr>
<th></th>
<th>0.0</th>
<th>11.0</th>
<th>22.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain DMI</td>
<td>30.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pasture DMI</td>
<td>30.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>43.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total DMI</td>
<td>30.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>38.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>43.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Milk, lb/d</td>
<td>48.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>59.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>66.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>FCM, lb/d</td>
<td>48.2</td>
<td>51.0</td>
<td>51.5</td>
</tr>
<tr>
<td>Fat %</td>
<td>3.89&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.50&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.08&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Protein %</td>
<td>2.85&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.95&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.05&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Milk/DMI</td>
<td>1.60</td>
<td>1.54</td>
<td>1.54</td>
</tr>
</tbody>
</table>

Rumen Undegradable Protein Supplementation

Dairy Forage Research Center

- 26 cows, 21-109 DIM
- Roasted SB & HM Ear Corn, 17.6-18.7 lb/day
- 61-63 lb milk/day
- NOT SIGNIFICANT

Penn State

- 24 cows, 68 DIM
- NOT SIGNIFICANT
- Corn, barley, CG meal & animal protein blend, 19.6 lb/day
- 75-78 lb milk/day
- NOT SIGNIFICANT
Rumen Undegradable Protein Supplementation

Argentina
- 34 cows, 13-36 DIM
- Pelleted Sunflower or Fishmeal, 11.0 lb/day
- 49-53 lb FCM milk/day
- Significant at P < 0.08

Argentina
- 18 cows, 1st eight weeks of lactation
- Soybean Meal or Bloodmeal, 14.5 lb/day
- 55-64 lb milk/day
- SIGNIFICANT at P < 0.02
Fat supplementation on pasture

- Inconsistent research results
- 3 studies showed a positive effect (full fat rapeseed, hydrogenated fish fat and hydrogenated oil)
- 3 studies showed no effect (Ca salts and soybean oil)
Conclusions

- Feeding the grazing cow
  - Forage Quality
  - Forage Intake
  - Compliment With Grain
    - Energy
    - Protein ??
  - Vitamins & Minerals
Conclusions

- Feeding the grazing cow
  - Substitution rate
    - 0.14 to 0.65 lb pasture/lb supplementation
      - Can be used to maintain pasture wedge
    - Higher levels will require ingredient adjustments
  - Ingredients in supplement
    - 60 to 70% corn
      - Other cereal grains can be used, consider starch degradation rates
    - 30-40% fibrous type feeds
      - Soy hulls most economical in Missouri
Conclusions

- Feeding the grazing cow
  - Level of supplementation
    - 8-15 lb/cow/day
    - Higher levels will require ingredient adjustments
  - Rumen undegradable protein
    - Research inconclusive
  - Added fat
    - Limited research in a grazing situation
    - 2.25 X the energy compared to CHO and protein
    - Include, add slowly to the ration
K.I.S.S.

It’s not just about grass, it’s all about forage quality and INTAKE, INTAKE, INTAKE!!!!!