Feeding to minimize acidosis and laminitis in dairy cows

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Practices Aimed at Improving Cow Health

- Total Mixed Rations
- Diet Formulation
  - Feed Additives
- Bunk Management
- Cow Comfort

Normal
- Ruminal pH
- Fiber digestion
- Milkfat test
- Cud chewing
- Rumen mat

Prevent
- Off-feed
- LDA
- SARA
- Laminitis
SARA
Sub-Acute Rumen Acidosis

- >25% of cows sampled via rumenocentesis 4-8 hrs post TMR meal with pH < 5.5 (Nordlund, 2004)

- Ruminal pH function of (Allen, 1997)
  - VFA production from fermentation of CHO
  - VFA neutralization by salivary & dietary buffers
  - VFA removal by absorption or passage
SARA & Laminitis

- SARA a prevalent problem
- Laminitis
  - Major source of lameness
  - Linked to SARA
Why is SARA prevalent?
Ruminal Acid Production

Salivary Buffer Flow
Some Potential Errors in Feed Delivery & Bunk Management

- Feed sampling & analyses
- Ingredient dry matter adjustments
- TMR particle size
- Grain type, moisture, & processing
- Ingredient feeding rates
- Mixing errors & over-mixing
- Sorting
- Practices that promote slug feeding
Feeding to **minimize** acidosis and laminitis in dairy cows
Diet Carbohydrate Guidelines
Importance of Fiber

- Chewing Activity & Saliva Production
- Rumen pH and VFA
- Rumen Fill & Mat Formation
- Milk Fat Test
- Acidosis & Laminitis
- DA
<table>
<thead>
<tr>
<th>Min NDF - Forage</th>
<th>Min NDF - Diet</th>
<th>Max NFC - Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>19%</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td>18%</td>
<td>27%</td>
<td>42%</td>
</tr>
<tr>
<td>17%</td>
<td>29%</td>
<td>40%</td>
</tr>
<tr>
<td>16%</td>
<td>31%</td>
<td>38%</td>
</tr>
<tr>
<td>15% (expect MFD)</td>
<td>33%</td>
<td>36%</td>
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</table>

NRC, 2001
<table>
<thead>
<tr>
<th>Min NDF - Forage</th>
<th>Min NDF - Diet</th>
<th>Max NFC - Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>19%</td>
<td>27%</td>
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<td>17%</td>
<td>29%</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>31%</td>
<td>38%</td>
</tr>
<tr>
<td></td>
<td>33%</td>
<td>36%</td>
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</tbody>
</table>

NRC-01 adapted to provide margin of safety
<table>
<thead>
<tr>
<th>Min. NDF-F</th>
<th>40% NDF</th>
<th>45% NDF</th>
<th>50% NDF</th>
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<td>19%</td>
<td>48%</td>
<td>42%</td>
<td>38%</td>
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<tr>
<td>18%</td>
<td>45%</td>
<td>40%</td>
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</tr>
<tr>
<td>17%</td>
<td>43%</td>
<td>38%</td>
<td>34%</td>
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</table>
Forage Replacement
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>peNDF%</th>
<th>Replaces per 5 lb. DM</th>
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<tbody>
<tr>
<td>Medium length silage replaced</td>
<td>38</td>
<td>--</td>
</tr>
<tr>
<td>Corn gluten feed</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td>Distillers grains</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td>Malt sprouts</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td>Whole cottonseed</td>
<td>45</td>
<td>5.0</td>
</tr>
<tr>
<td>Ingredient</td>
<td>NDF%</td>
<td>NFC%</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Shelled corn</td>
<td>10</td>
<td>75</td>
</tr>
<tr>
<td>Corn:SBM (65:35)</td>
<td>12</td>
<td>58</td>
</tr>
<tr>
<td>Corn gluten feed</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>Distillers grains</td>
<td>40</td>
<td>16</td>
</tr>
<tr>
<td>Malt sprouts</td>
<td>47</td>
<td>23</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>60</td>
<td>18</td>
</tr>
<tr>
<td>Whole cottonseed</td>
<td>50</td>
<td>3</td>
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</table>
Ruminal Starch Degradability

- Type of grain
  - Barley or Wheat > Corn

- Harvest/Storage Method
  - High-Moisture > Dry
  - For High-Moisture, > with > moisture content

- Processing
  - Ground > Rolled; > with > fineness of grind
  - Steam-Flaked > Dry Rolled; varies with flake density
  - Rolled > Unrolled Corn Silage; varies with roll setting
What’s being mixed?
Percentage deviation across bunker face on nine New York dairies *(Stone & co-workers, 2003)*

<table>
<thead>
<tr>
<th>% Deviation</th>
<th>DM</th>
<th>NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Haylage (9)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td>Min</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Max</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td><strong>Corn Silage (11)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Min</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Max</td>
<td>55</td>
<td>19</td>
</tr>
</tbody>
</table>
Failure to make ingredient DM adjustments causes nutrient delivery errors

- Infrequent DM measurement and ration adjustment
- Error in on-farm DM determinations or adjustments

Causes swings in ratio of F:C on DM basis
Nutrient delivery errors arise because of errors in ingredient feeding rates

- Communication error between nutritionist, herd manager, and feeder

- Feeder error
  - free lancing
  - cover up of an error
  - honest mistake
TMR Management & Feed Inventory Programs

- EZfeed
- DHI-Provo
- FeedWatch
  - Valley Ag Software
- Feed Supervisor
  - K.S. Dairy Consulting
- TMR Tracker
- Digi-Star
Use of TMR Management & Feed Inventory Programs

- **Potential Benefits**
  - Can reduce operator error
  - Can improve batch to batch & day to day consistency

- Lock desired recipe for each batch in scale
- Record amount of each ingredient added to batch
- Record total batch amount delivered to each pen
What’s coming out of the mixer?
NFC Content of High Group TMRs

N (N=83)

NFC, % of DM

?
TMR Mixing Errors

- Scale error
- Batch size too small (i.e. transition rations?)
- Batch size greater than mixing capacity of mixer
- Trying to mix too much hay in batch (dispensing?)
- Improper sequencing of ingredients into mixer
- Under mixing or mixing for too short a time (causes inadequate mixing)
- Over mixing or mixing for too long a time (causes unmixing and particle size reduction)
TMR Particle Size?

- 8-10% top screen (6% if dry hay or straw)
- <50% pan
Over Mixing and TMR Particle Size on 49 WI Dairy Farms
Possin et al., 1995

<table>
<thead>
<tr>
<th>% Coarse Particles in TMR</th>
<th>Goal (minimum)</th>
<th>&lt; 15 min. mixing</th>
<th>&gt; 15 min. mixing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8% - 10%</td>
<td>7.6%</td>
<td>4.8%</td>
</tr>
<tr>
<td></td>
<td>% Coarse Particles in TMR</td>
<td>Laminitis Incidence %</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------</td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td>High Incidence Herds</td>
<td>3.5%</td>
<td>28.8%</td>
<td></td>
</tr>
<tr>
<td>Low Incidence Herds</td>
<td>7.9%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>
What’s in the bunk?
TMR Sorting?
TMR Particle Size

>10-15%? What size?
Cows sort by pushing with their nose (6” wide). Particles half this length (<3”) are not as easily sorted. (Armentano)
What do the refusals look like?
Options when sorting found:

- Process TMR finer
- Feed less of TMR more often
- Reduce targeted refusal
- Add less hay to mix
- Process hay finer
- Use higher quality hay
- Use hay that is more pliable
- Process corn silage
- Add water to mix
- Add LFS to mix
Slug Feeding
Bunk management practices that cause cows to eat fewer and larger meals faster (slug feeding) may increase incidence of SARA & laminitis.
Adverse Bunk Management Practices

- Limited bunk space (<1.5 ft. per cow)
- Limited feed access time (<16 - 20 h per day)
- Combination of above
- Combination of above with use of lock-ups
- Restricted feeding vs. feeding for refusal
- Inconsistent feeding schedule
- Infrequent TMR push-up
- Excessive bunk competition
Cow Comfort
<table>
<thead>
<tr>
<th>Rumen</th>
<th>pH</th>
<th>35% C</th>
<th>65% C</th>
<th>35% C</th>
<th>65% C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.1</td>
<td>5.6</td>
<td>6.4</td>
<td>6.1</td>
<td></td>
</tr>
</tbody>
</table>

Mishra & co-workers, 1970
Heat Stress & Lower Rumen pH

- Less rumination
- More slug feeding?
- More sorting?

- Heat stress cows spend less time in stalls
<table>
<thead>
<tr>
<th>Cow Comfort</th>
<th>SARA</th>
<th>Likelihood of Laminitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Good</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Poor</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Poor</td>
<td>High</td>
<td>High</td>
</tr>
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Feed Additives
Feed Additives with Potential for Reducing SARA

- **Rumensin**
  - > meal frequency and < average meal size in feedlot cattle
  - Reduced lactic acid concentrations in vitro
  - Inhibition of, lactic acid producer, *Streptococcus bovis*

- **Dietary Buffers**
  - Neutralize diet & ruminal acidity
  - Reduce post-feeding decline in ruminal pH

- **Direct-Fed Microbials**
  - Targeted for enhancing ruminal lactate utilization
Feed Additives with Potential for Improving Hoof Health

- Biotin
- Complexed Trace Minerals
Transition Cow Diets
Importance Regarding SARA & Laminitis

- Adapting microbial population in the rumen prior to consumption of high-energy high-group diets

- Increasing absorptive capacity of ruminal papillae prior to consumption of high-energy high-group diets
<table>
<thead>
<tr>
<th>Pre High NE&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Pre High NE&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Pre Low NE&lt;sub&gt;L&lt;/sub&gt;</th>
<th>Pre Low NE&lt;sub&gt;L&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Low NE&lt;sub&gt;L&lt;/sub&gt;</td>
<td>Post High NE&lt;sub&gt;L&lt;/sub&gt;</td>
<td>Post Low NE&lt;sub&gt;L&lt;/sub&gt;</td>
<td>Post High NE&lt;sub&gt;L&lt;/sub&gt;</td>
</tr>
<tr>
<td>2.0&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

0=no hemorrhages; 3=severe hemorrhages; 4=exposed sole ulcers

Pre=24d; Post=21d
Visit UW-Madison Dairy Science Department website @
http://www.wisc.edu/dysci/