Lowering Cost of Production with Feed Efficiency and Cow Comfort

Rick Grant
W. H. Miner Agricultural Research Institute
Chazy, NY
Modern Day Embodiment of William Miner’s Vision

“It goes without saying that agriculture is the fundamental occupation . . . No other occupation is as important to the human race, nor requires such a wide range of practical and technical knowledge as farming . . .

It has to do with our very existence – the production of food and conservation of the soil.”

1915 Heart’s Delight Farm Yearbook
Miner Institute Programs

- Applied Nutrition
- CPM-Dairy
- Transition Mgmt
- Crops/Forage
- Cow
- Environment
- Cow Comfort & Behavior
Miner Institute Dairy Herd

- 300-cow Holstein herd: teaching & research
- ~31,500-lb RHA, 3x, rbST
- Productive, healthy herd underpins education and research programs
Where is Miner Institute?
Reducing Your Cost of Production

- You can focus on many areas, but two big ones are:
  - Feed (≈40-50% of total COP)
  - Vet & health costs (≈10% of OC)

### Forage Quality
- Fiber digestibility
- Starch digestibility
- Higher forage diets

### Cow Comfort
- Resting
- Eating
- Ruminating

### Profitability
- Greater SCM/DMI
- Better health
- Lower COP
High Quality Forage & Dairy Cow Performance

- As **nutritive value** of forage increases:
  - DMI increases
  - Milk yield increases
  - Greater microbial protein production and milk protein output
  - Peak milk & persistency increase
  - Efficiency (SCM/DMI) increases
  - Less body weight loss in early lactation
  - Better body condition
How do you get the most out of your high quality forage?

- **High efficiency** of feed use:
  - Greater digestibility of forage means more feed nutrients go toward milk/body condition and **not into the manure!**

- Improving efficiency of nutrient use is more cost-effective than trying to remove feed ingredients.
  - Herd target: **1.4 to 1.7**
  - Each 0.1 unit change is worth ~$0.24/cow/day (Hutjens, 2010)
What Can Reduce Cow’s Efficiency Response to Highly Digestible Forage?

- Poor silage fermentation
- Palatability, intake problems
- Improper ration formulation
- Feed mixing, consistency, delivery, sequencing
- Feeding environment
  - Poor rumen health
  - Cow comfort!

And there’s more …
## Responses to Forage NDF Digestibility

<table>
<thead>
<tr>
<th>Response</th>
<th>High (62.9%)</th>
<th>Low (54.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, lb/d</td>
<td>51.0</td>
<td>47.9</td>
</tr>
<tr>
<td>4% FCM, lb/d</td>
<td>63.5</td>
<td>58.9</td>
</tr>
<tr>
<td>Milk fat, %</td>
<td>3.43</td>
<td>3.35</td>
</tr>
<tr>
<td>Milk pro, %</td>
<td>2.93</td>
<td>2.90</td>
</tr>
<tr>
<td>BW change</td>
<td>0.81</td>
<td>0.31</td>
</tr>
</tbody>
</table>

(Oba and Allen, 1999)
Forage Digestible NDF and Performance

- For every 1 percentage-unit increase in NDF digestibility:
  - +0.40 lb DMI
  - +0.51 lb milk
  - +0.55 lb 4% FCM
  - +0.06 lb BW

- You can feed a higher forage diet without sacrificing milk yield
You cannot replace poorly digestible forage NDF with purchased starch and expect equal milk yield (and it’s more expensive)!
## Alfalfa quality and dairy cow performance

<table>
<thead>
<tr>
<th>Forage NDF, %</th>
<th>4% fat-corrected milk (lb/d)</th>
<th>% Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>71</td>
</tr>
<tr>
<td>40</td>
<td>86.0</td>
<td>87.1</td>
</tr>
<tr>
<td>42</td>
<td>77.2</td>
<td>77.2</td>
</tr>
<tr>
<td>52</td>
<td>64.7</td>
<td>66.2</td>
</tr>
<tr>
<td>60</td>
<td>69.5</td>
<td>64.7</td>
</tr>
</tbody>
</table>

(Kawas et al., 1991)
Response to forage digestibility varies by milk production level: So, target its use!
Response to High-NDFd Corn Silage by Milk Production Level

Allocate high NDFd forages to highest producing cows and fresh cows

~60 lb/d
Targeted allocation of forages & multiple groups/diets

- Cows varying in milk yield vary greatly in response to diet; practice “precision feeding”
  - Early lactation, higher producers respond positively to highly digestible diets; later lactation cows don’t
- Multiple diets allow you to target appropriate forages and grains to specific groups of cows
- Allows management of BCS while maximizing milk yield
  - Diets that minimize over-conditioned late lactation cows DO NOT allow cows to attain genetic potential for milk yield
- Proper grouping & allocation of feed improve efficiency, lower COP
Must get the most out of our corn silage and higher-priced corn grain!
Optimizing corn starch digestion (Hoffman, 2008)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Correlation with starch availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle size</td>
<td>-0.70</td>
</tr>
<tr>
<td>Moisture</td>
<td>-0.53</td>
</tr>
<tr>
<td>Endosperm type</td>
<td>-0.46</td>
</tr>
</tbody>
</table>

Grain particle size > Grain/silage moisture > Endosperm type
Optimizing Corn Silage Starch Digestion

- 3/4-in TLC, 2-3 mm roller clearance
- **All kernels crushed**, especially silage >33% DM
- Penn State Particle Separator
  - 10-15% top screen
  - 50+% second screen
  - <35% pan
- **Corn Silage Processing Score**
  - % starch passing through 4.75-mm screen
  - Target ~70%

≤5% starch
Fecal starch and digestibility

- 4.5% fecal starch $\sim$ 90% starch digestibility
- 1%-unit decrease in fecal starch $\sim$ 1 pound more milk
- Range in starch: 2.3 – 22.4%

(Ferguson, 2006)
Forage quality and milk production; Nebraska Field Study (20 herds; tie & free stall)

<table>
<thead>
<tr>
<th></th>
<th>Improved Forage Quality</th>
<th>No Improvement in FQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk, % increase</td>
<td>9.8%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Feed costs, $/cow/year</td>
<td>-20%</td>
<td>-10%</td>
</tr>
<tr>
<td>Total benefits, $/cow/year</td>
<td>$269</td>
<td>$176</td>
</tr>
</tbody>
</table>
Making the Most of Highly Digestible Forages

- High quality forage **DOES NOT ASSURE** high milk production and low COP
- But low quality forage **GUARANTEES** low milk production and high COP
Is there a relationship between comfortable cows and lower cost of production?

- Positive relationship between components of cow comfort and milk, SCM/DMI, growth, health, and reproduction

- Quote to ponder: “There is an easy way to make 30,000 pounds and a hard way.”
  - Easy way: comfortable cows fed high quality forage
Role of management and herd performance (Bach et al., 2008)

- 47 herds with similar genetics were fed same TMR
- Milk yield varied by ±29 lb/d
  - Mean milk yield = 65 lb/d
- Non-dietary factors accounted for 56% of variation in milk yield
  - Age at first calving
  - Feeding for refusals (64.1 vs 60.6 lb/d)
  - Feed push-ups (63.7 vs 55 lb/d)
  - Stalls: cow, stocking density
Stalls per cow and milk production in 47 herds fed same TMR (Bach et al., 2008)

Milk yield = 20.4 + 7.5 x stall/cow

$R^2 = 0.32$
Three Major Behaviors

- **Eating**
  - 3-5 h/d

- **Resting**
  - 12 h/d
  - CCI>85%

- **Rumination**
  - 7-9 h/d
  - ½ of resting cows

- Requirements for all three must be met for optimal efficiency, health, and COP!
Cows have strong behavioral need to rest ...

- Cows sacrifice feeding to make up lost resting
- Cows spend more time waiting in alleys to lie down than eating when overstocked
- Negative effects of short periods of deprivation are cumulative

Resting: 12-14 h/d “Vitamin R”
Lying deprivation, cow welfare, and cost of production

- Increased cortisol, stress response
- Reduced growth hormone & milk yield
- Unnatural feeding behavior, reduced rumination, compromised rumen health
- Increased standing
  - Predisposes cows to sole hemorrhages, lameness
Common ways to reduce cow well-being on the farm ...

- Excessive time outside pen (>3.5 h/d)
- Mixing of primi- and multiparous cows
- >1 h/d in headlocks, esp. fresh cows
- Short pen stays during transition – social turmoil
- Lack of exercise
- Uncomfortable stalls – tie or free stalls
- Inadequate feed availability
- Overcrowding, excessive competition
- Inadequate heat stress abatement
Time away from pen and cow response: Do time budgets matter?

- **3 h/d versus 6 h/d outside pen**
  - Adjusted pen size versus parlor capacity
  - Mixed primi- and multiparous cows
  - 100% stocking density

- **Comparing 3 versus 6 h/d:**
  - Cows gained 2.6 h/d rest, 5.0 lb/d milk
  - First-calf heifers gained 4.1 h/d rest, 7.9 lb/d milk

(Matzke, 2003)

➢ Effect on COP?
Effect of competition with older cows on first-calf heifers . . .

- At ~100% stocking density:
  - DMI reduced by 10%
  - Resting reduced by 20%
  - Milk reduced by 9% (Kongaard and Krohn, 1980)
  - Greater loss of BW by 30 DIM
  - Reduced FCM/DMI by 30 DIM (Bach et al., 2006)
  - Less drinking, rumination, and milk fat % (Bach et al., 2007)

➢ Effect on COP?
Transition Cow Environment: Behavior and Health Responses

- Overcrowding bunk (>80-90%) in close-up pen
  - reduces feed intake
  - increases DA incidence
  - reduces milk yield of 1st-calf heifers
- >2 pen moves during transition doubles DA rate; “social turmoil”
- Overcrowding bunk in fresh pen increases feeding rate

Effect on COP?
Cost of overcrowding: summary of cow responses

- **Changes in these behaviors:**
  - Greater aggression & displacements at feed bunk
  - Greater feeding rate
  - Reduced resting time
  - Increased idle standing in alleys
  - Decreased rumination
  - Subordinate (i.e. primiparous and lame cows) most affected

- **May result in these economic losses:**
  - Less milk yield
  - Lower milk fat
  - Greater SCC
  - More health disorders
  - Increased lameness
  - Fewer cows pregnant

➢ Effect on COP?
Are the stalls comfortable?
Stall Softness and 305-d Milk Production (lb/yr; Ruud et al., 2010)

<table>
<thead>
<tr>
<th>Parity</th>
<th>Concrete (1)</th>
<th>Rubber (2)</th>
<th>Soft Mat (3)</th>
<th>Multi-layer mat (4)</th>
<th>Mattress (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13,338&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13,369&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13,572&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14,106&lt;sup&gt;d&lt;/sup&gt;</td>
<td>13,746&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>15,255&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15,048&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,649&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16,139&lt;sup&gt;e&lt;/sup&gt;</td>
<td>15,893&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>16,086&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,997&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16,498&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16,744&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16,788&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>&gt;3</td>
<td>15,767&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,811&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16,221&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15,943&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16,500&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mean</td>
<td>14,799&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14,749&lt;sup&gt;a&lt;/sup&gt;</td>
<td>15,149&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15,464&lt;sup&gt;e&lt;/sup&gt;</td>
<td>15,382&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- Survey of 1,923 farms in Norway; related to greater lying times
Make smart bedding decisions (Tucker et al., 2009)

- Cows prefer more compressible (softer) lying surface
- +3 min/d lying time for each additional 2 lb sawdust shavings
  - 6 to 52 lb/stall: +1.1 h/d lying
- +12 min/d lying time for each additional 2 lb straw
  - 2 to 15 lb/stall: +1.2 h/d lying
- +12 min/d lying time for each additional 1/2 inch of sand
Adjust your attitude!

Are you a source of comfort or stress for your cows?
Effect of fear on residual milk (dePassille and Rushen, 1999)
Empathy with cattle pain and milk production (Kielland et al., 2010)

Group 1 = 4.9; Group 2 = 6.7 on 1 to 10 scale (lower score = greater empathy with cattle pain)
Effect of milker behavior on milk production

- Seabrook (1984)
  - 13% more milk with gentle vs aversive handling

- Hanna et al. (2006)
  - 3.6% more milk with milking team that had greater positive vocal and physical contact with cow

- Doesn’t cost a dime.
Five Things to Do Today to Lower Long-Term Cost of Production

1. Feed high quality forage
   High NDF digestibility = more milk per pound of feed & higher forage diets

2. Monitor CSPS to ensure optimal starch digestion and minimize need for purchased grain

3. Monitor feed efficiency rather than cutting out diet ingredients

4. Group cows and strive toward “precision feeding” for forages and concentrates

5. Assess resting time and stall comfort
   Adjust bedding, stall design
Bottom Line

- Herds with similar genetics fed the same diet differ in milk by ±29 lb/day
- You need high quality forage, properly processed, in a well-formulated diet fed in an optimal environment.

“T’ll never contented anymore.”

Listen to your cows
Thank you