MANAGING PROTEIN IN DAIRY DIETS TO MINIMIZE NITROGEN LOSS FROM MANURE TO THE ENVIRONMENT

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PROBLEMS ASSOCIATED WITH EXCESS RELEASE OF N COMPOUNDS INTO THE ENVIRONMENT

1. Nitrate contamination of ground water

2. Over-fertilization of coastal zones and excess algae growth

3. Ammonia (plus nitrous oxide) release into atmosphere, resulting in:
   a. Acid rain
   b. Formation of particulates
   c. Excess deposition of N forms on fragile ecosystems
MISSISSIPPI RIVER NITROGEN 
(CAST, 1999)

– About 2 million tons of N flows down the river each year. (originates from agricultural practices, human sewage, nonagricultural fertilizer use, and precipitation)

– About 2-3 lbs N lost each year per acre from agricultural lands to the river.

– Lost N has a fertilizer value of about $410 million.
Percent of Dietary N

- Milk: 24%
- Feces and Urine: 76%
- Volatilized Dairy Cows: 30%
- Carcass: 13%
- Feces and Urine: 87%
- Volatilized Feedlot Steers: 55%
THE DAIRY AND FEEDLOT BEEF INDUSTRIES CAN REDUCE N LOSSES.

1. Reduce N excretion by feeding less protein.

2. Reduce volatile N losses during collection, storage and field application of manure.

3. Use of crop rotations that provide opportunity for utilizing manure N.
REDUCING DIETARY PROTEIN REDUCES VOLATILE N LOSSES
Strategies for Lowering Protein Content of Dairy Diets

1. Fine tune and balance supply of Rumen Undegraded Protein (RUP) and Rumen Degraded Protein (RDP).
2. Enhance microbial protein synthesis in the rumen.
3. Fine tune and balance supply of rumen undegraded methionine (and lysine).
4. Group animals according to milk production level.
Fine Tune and Balance Supply of Rumen Undegraded Protein (RUP) and Rumen Degraded Protein (RDP)

Tools available for assisting with this:

a. NRC Nutrient Requirements of Dairy Cattle (2001)
b. Cornell Net Carbohydrate Net Protein System
EXAMPLE OF HOW CHOICE OF DIET INGREDIENTS AFFECTS DIETARY CRUDE PROTEIN REQUIREMENT (NRC 2001).

Cow producing 45kg milk/d - 90 DIM

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>CP Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>55% Forage</td>
<td>20.8%</td>
</tr>
<tr>
<td>All Alfalfa Silage</td>
<td></td>
</tr>
<tr>
<td>Ground high moisture shelled corn</td>
<td></td>
</tr>
<tr>
<td>Soybean meal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15.8%</td>
</tr>
<tr>
<td>Half Alfalfa Hay - Half Corn Silage</td>
<td></td>
</tr>
<tr>
<td>Dry ground shelled corn</td>
<td></td>
</tr>
<tr>
<td>Blood meal, distillers grains, meat bone</td>
<td></td>
</tr>
</tbody>
</table>
PROTEIN — MORE LIMITING THAN ENERGY IN ALFALFA
### SUMMARY OF ANIMAL RESPONSE TO FEEDING OF HEATED SOYBEANS¹ (SOCHA, 1991).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Milk</th>
<th>Change in Milk fat</th>
<th>Change in milk protein</th>
<th>Dry matter intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roasted soybeans</td>
<td>3.5 (16)²</td>
<td>+.06 (16)</td>
<td>-.07 (16)</td>
<td>-.2 (16)</td>
</tr>
<tr>
<td>Extruded soybeans</td>
<td>2.9 (20)</td>
<td>-.17 (19)</td>
<td>-.06 (17)</td>
<td>+.2 (18)</td>
</tr>
</tbody>
</table>

¹Soybean meal or unheated soybeans served as the control.

²Number in parenthesis is the number of comparisons.
Increase the Amount of Microbial Protein Synthesized in the Rumen

1. Fine grinding or steam flaking of corn grain
2. Feeding high moisture shell corn
3. Roller milling of corn silage (kernel processing)
4. Feeding more highly digested forages, such as brown midrib-3 corn silage, or macerated alfalfa.
Improve Balance of Amino Acids by Feeding Rumen Protected Methionine (or Lysine)
AVERAGE RESPONSE TO FEEDING PROTECTED AMINO ACIDS
(Summary of 12 trial comparisons by Garthwaite et al, 1998)

Dry matter intake (lb) + 1.1
Milk (lb) + 1.1
Milk protein (%) + .15
Milk fat (%) + .06
HOW MUCH CAN WE REDUCE DIETARY PROTEIN, THUS DECREASING THE AMOUNT OF NITROGEN IN FECES AND URINE?
LAW OF DIMINISHING RESPONSE

Maximum Profit

Requirement for Maximum Production

Milk Production vs. Dietary Protein Content
MILK YIELD AND NITROGEN EXCRETION OF LACTATING COWS FED DIFFERENT DIETARY PROTEIN LEVELS DURING A COMPLETE LACTATION

<table>
<thead>
<tr>
<th>Treatment</th>
<th>15.4 → 16.0</th>
<th>17.4 → 16.0</th>
<th>17.4 → 17.9</th>
<th>19.3 → 17.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cows</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Milk yield (lb/44wk)</td>
<td>22,123</td>
<td>23,828</td>
<td>24,409</td>
<td>24,490</td>
</tr>
<tr>
<td>Intake N (lb/44wk)</td>
<td>391</td>
<td>416</td>
<td>470</td>
<td>471</td>
</tr>
<tr>
<td>Milk N (lb/44wk)</td>
<td>113</td>
<td>108</td>
<td>113</td>
<td>117</td>
</tr>
<tr>
<td>Manure N (lb/44wk)</td>
<td>278</td>
<td>308</td>
<td>357</td>
<td>354</td>
</tr>
</tbody>
</table>
Week of lactation

Milk Yield (kg/d)

- 15.4-16.0
- 17.4-16.0
- 17.4-17.9
- 19.3-17.9
Week of lactation

Milk Protein (%)

- 15.4-16.0
- 17.4-16.0
- 17.4-17.9
- 19.3-17.9
REALISTIC GOAL FOR LACTATION DIETS

Reduce dietary CP by 10-15%

This reduces manure N by 13-20%

This reduces N vulnerable to volatilization by 30-35%
DISTRIBUTION OF N BETWEEN URINE AND FECES (% OF EXCRETED N)

<table>
<thead>
<tr>
<th>Urine</th>
<th>Feces</th>
</tr>
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<tbody>
<tr>
<td>45-60</td>
<td>40-55</td>
</tr>
</tbody>
</table>

What will reduce proportion of N in urine?

- Reduce dietary protein
- Balance for rumen undegraded and degraded protein
- Supplement protected amino acids
LOSS OF NITROGEN DURING COLLECTION, STORAGE AND FIELD APPLICATION OF MANURE FROM A FREE STALL BARN
Pounds of nitrogen fed, secreted and excreted, and volatilized during a 305 day lactation by a cow producing 20,000 lbs milk.

409 (Consumed in Feed)

99 (Secreted in Milk)  310 (Excreted in Manure)

62 (Volatile in Barn and from Manure Storage)  248 (Spread on Land)

59 (Volatile with Surface Application in the Field)  189 (Incorporated into Soil)
HOW MUCH CAN WE REDUCE NITROGEN VOLATILIZATION?

- Injection or incorporation of manure in the field can reduce volatilization by 50-80% compared to surface application.

- Frequent scraping of the barn*

- Covering of manure storage (plastic sheeting or floating mat composed primarily of bedding materials)*

* The two combined may reduce manure collection and storage losses by 10-20%
Field incorporation of manure and improved manure handling could reduce total ammonia emissions by ~ 38%, or about 45 lb N per cow per year.
SUMMARY

1. Nitrogen release into the environment is a growing issue, and will likely have an important impact on livestock producers.

2. Fine tuning of dietary RUP and RDP, enhancing microbial protein synthesis in the rumen, selective use of rumen protected methionine, and grouping of cows are approaches to reducing dietary protein.
SUMMARY con’t

3. We can reduce dietary protein (N) by a modest amount (10-15%), but this can have a big effect on reducing N volatilized to the atmosphere (30-35%)

4. Good management of manure, such as incorporation of manure into the soil, along with diet management, will be important to achieve reduced emissions of ammonia to the atmosphere.