Targeted Feeding Strategies to Reduce Nitrogen Losses and Ammonia Emissions from Dairy Cows

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Efficiency of utilization of feed N in Holstein dairy cows (846 diets)

Average
Milk
Nitrogen
Feed to milk N conversion ratio

Milk yield or MNE

Hristov et al., 2005

Effect of dietary crude protein on milk yield and milk N efficiency (simulation based on 1,700 diets)

Hristov & Huhtanen, 2008

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Effect of dietary crude protein on N losses (simulation based on 1,700 diets)

Hristov & Huhtanen, 2008

N losses in the ruminant – volatility of excreted N

Colmenero and Broderick, 2006

Effect of crude protein on urinary urea excretion

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Ammonia emissions:
Crude protein level in the diet

Roy Huntley, EPA, personal communication

Published ammonia emission rates

Hristov et al., 2007

N mass-balance study

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Typical ammonia emission pattern in vitro

Ammonia in manure  Ammonia in collection solution

Lee et al., unpublished

Crude protein levels study - diets

<table>
<thead>
<tr>
<th>Composition (DM)</th>
<th>Control</th>
<th>LowCP</th>
<th>ExLowCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein, %</td>
<td>17.6</td>
<td>15.2</td>
<td>14.4</td>
</tr>
<tr>
<td>NEL, Mcal/kg</td>
<td>1.55</td>
<td>1.51</td>
<td>1.51</td>
</tr>
<tr>
<td>NDF, %</td>
<td>30</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Forage NDF</td>
<td>25</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>NFC, %</td>
<td>44</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>MP balance, g/d</td>
<td>+15</td>
<td>+16</td>
<td>+18</td>
</tr>
<tr>
<td>RDP balance, g/d</td>
<td>+570</td>
<td>+1</td>
<td>-369</td>
</tr>
</tbody>
</table>

Agle et al., 2008

Urinary N excretion

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Agle et al., 2008

Cumulative ammonia losses from manure as affected by diet CP

Van der Stelt et al., 2008

Protein and energy interaction

Hristov et al., unpublished

When the requirements of the cow for AA are not met, production suffers

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Ammonia emissions:
Energy density of the diet

Agle et al., 2008

Energy density study - diets

<table>
<thead>
<tr>
<th>Composition (DM)</th>
<th>Control</th>
<th>High-energy diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage, %</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>Crude protein, %</td>
<td>17.9</td>
<td>17.8</td>
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<tr>
<td>RDP, %</td>
<td>12</td>
<td>12</td>
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<tr>
<td>NEL, Mcal/kg</td>
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<td>1.83</td>
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<tr>
<td>NDF, %</td>
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<td>25</td>
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<tr>
<td>Forage NDF</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>NFC, %</td>
<td>39</td>
<td>47</td>
</tr>
</tbody>
</table>

Agle et al., 2008

Cumulative ammonia losses from manure

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Take-home message

- Dietary CP concentration is the most important single factor determining milk N efficiency
  - Rumen N balance should be reduced to improve N efficiency
- Feeding diets with lowered CP & ruminally-degradable protein concentrations will decrease urinary N excretion
  - In one study, cumulative ammonia losses from manure were reduced by 38%
- In one study, increasing energy density of the diet reduced ruminal ammonia concentration and relative urinary N losses, but had no effect on cumulative ammonia losses from manure

References


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