Effect of Quebracho-Chestnut Tannin Extracts at Two Dietary Crude Protein Levels on N Partitioning in Lactating Dairy Cows

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INTRODUCTION

- Ammonia (NH₃) emission from manure is highly correlated with urinary urea nitrogen (N) excretion, which is most vulnerable to volatilization after conversion to NH₃ in the barn floor (Muck and Richards, 1983).
- Previous studies have shown that, when fed separately, tannins obtained from Quebracho (Dawson et al. 1999; Komolong et al., 2001) or Chestnut (Sliwinski et al., 2004) tree extracts can decrease urinary N excretion.

OBJECTIVE

- Our objective was to determine the effects of a dietary tannin mix on N partitioning and whether responses were affected by the level of dietary CP.

MATERIALS AND METHODS

EXPERIMENTAL PROTOCOL

- Eight multiparous Holstein cows (708 ± 41 kg of BW; 125 ± 41 DIM) were randomly assigned to a diet of 15.5 or 16.8% CP (%DM) and to one of four levels of tannin mix on N partitioning and whether responses were affected by the level of dietary CP.
- A tannin extract mixture from Quebracho and Chestnut trees extracts fed at a level that does not compromise animal performance might be used as a dietary strategy to reduce excretion of environmental labile urinary N in manure.

STATISTICAL ANALYSIS

- Model included effects of period, dietary CP, dietary tannin, cow (within dietary CP), dietary CP x dietary tannin interaction, and period x dietary CP interaction.
- All terms were considered fixed except for cow (within dietary CP) and residual error.
- Significance was declared at P ≤ 0.05 and tendency for 0.06 < P ≤ 0.10.
- For none of the reported measurements, the dietary CP x dietary tannin interaction reached significance.

RESULTS

Table 1. Effect of tannin content and dietary CP level on N utilization, manure excretion and total tract apparent digestibility.

<table>
<thead>
<tr>
<th>Item</th>
<th>0</th>
<th>0.45</th>
<th>0.90</th>
<th>1.80</th>
<th>SEM</th>
<th>Diet L</th>
<th>Q</th>
<th>15.5</th>
<th>16.8</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N intake, g/d</td>
<td>622</td>
<td>613</td>
<td>610</td>
<td>608</td>
<td>19.7</td>
<td>0.94</td>
<td>0.60</td>
<td>0.78</td>
<td>606</td>
<td>621</td>
<td>18.8</td>
</tr>
<tr>
<td>Milk N, % N intake</td>
<td>27.6</td>
<td>29.6</td>
<td>27.9</td>
<td>27.1</td>
<td>2.0</td>
<td>0.80</td>
<td>0.65</td>
<td>0.59</td>
<td>30.0</td>
<td>26.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Fecal output, kg/d</td>
<td>35.9</td>
<td>37.6</td>
<td>40.9</td>
<td>48.3</td>
<td>2.6</td>
<td>0.03</td>
<td>0.05</td>
<td>0.01</td>
<td>63</td>
<td>50</td>
<td>3.4</td>
</tr>
<tr>
<td>Urine output, kg/d</td>
<td>30.8b</td>
<td>30.5a</td>
<td>30.9</td>
<td>27.9</td>
<td>1.3</td>
<td>0.01</td>
<td>0.01</td>
<td>0.08</td>
<td>29.5</td>
<td>30.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Manure N, g/d</td>
<td>427</td>
<td>435</td>
<td>452</td>
<td>427</td>
<td>15.0</td>
<td>0.18</td>
<td>0.99</td>
<td>0.05</td>
<td>425</td>
<td>446</td>
<td>18.5</td>
</tr>
<tr>
<td>UN:FN = Urinary N to fecal N ratio where urinary N and fecal N are expressed in g/d.</td>
<td>1.05a</td>
<td>0.89b</td>
<td>0.86c</td>
<td>0.72d</td>
<td>0.1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>0.33</td>
<td>0.66</td>
<td>1.10</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Objective: A-B  a–d Least squares means within the same row with different superscripts differ (P < 0.05).

Figure 1. Effect of tannin extracts (A) and dietary CP level (B) on N partitioning. Vertical bars represent SEM.

DISCUSSION AND SUMMARY

- In this trial, tannin inclusion level and dietary CP content did not affect N intake, milk N, or N efficiency.
- Increasing tannin level increased fecal output but reduced urine excretion, resulting in similar total manure production.
- Relative to control, urinary N to fecal N ratio was decreased by 18% at the two intermediate tannin levels and by 31% at the 1.8% tannin inclusion rate.
- Feeding tannins increased fecal N output, but only at 1.80% of dietary DM was effective in reducing urinary N and urinary urea N excretion.
- Although manure N (fetal + urinary N: 435 g/d) remained unaltered, lowering dietary CP from 16.8 to 15.5% reduced urinary N excretion by 28%. Almost all the additional N (65 g/d per cow) excreted on the 16.8% CP diet, relative to the amount excreted in the 15.5% CP diet, was in the form of urea-N.

CONCLUSION

- A 1.3% unit reduction in dietary CP decreased urinary N excretion by 28%. All of the additional N (65 g/d per cow) excreted on the 16.8% CP diet relative to the amount excreted in the 15.5% CP diet, was in the form of urea-N.

REFERENCES


Note: For data on the effect of tannin on performance and in-vitro NH₃ emission, please see abstracts T427 and W331, respectively.