Effect of hydrolyzable tannin extract on bovine milk production and composition

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Abstract

A herd of twenty dairy cows was divided into two equal groups according to their initial milk production and their stage of lactation. At the start of experiment (1st sampling, June 20th, 2004) both groups received the same diet, based on pasture, which was supplemented with compound feed. After that date one group received 4 kg of compound feed (control group, CON), while other group received the same amount of compound feed mixed with 120 g of chestnut extract (treatment group, TRE). Milk production records and milk composition (fat, protein and urea) were obtained every 14 days from June 20th to October 25th, 2004 (9 sampling days). No significant differences (P>0.05) between treatments in milk production and milk fat, milk protein and milk urea content were found within any of sampling days. However milk urea nitrogen was somewhat lowered with the diet containing chestnut tannins, which could indicate a decreased rumen protein degradability, resulting in a lowered ammonia concentration in the rumen.

Keywords: cattle, tannins, milk production, milk composition.

Introduction

The result of excessive rumen degradability of plant proteins are large amounts of ammonia, which have to be eliminated from the body in form of urea. The transformation of ammonia into the urea is energetically wasteful and this could be the reason why in the summer months milk production decrease. However, large amounts of ammonia can cause also the rumen alkalosis, which results in lower nutrient, especially fiber, degradation and lower microbial protein synthesis. The overall results are lower fat and protein contents in the milk.

Excessive degradability of proteins could be reduced by the use of heat and various chemicals. The use of heat is very expensive, thus most often the chemicals, such as formaldehyde, are used. However, the formaldehyde is carcinogenic and, in addition, its incorrect use can lower the absorption of amino acids from intestine (Ashes et al., 1984). Another way to protect proteins against excessive degradation in the rumen is the use of tannins, which form reversible complexes with proteins. These complexes are not degraded at pH values present in rumen (Mangan, 1988, Butter et al., 1999), but they disintegrate at pH values of the abomasum and small intestine (Jones and Mangan, 1977).

The aim of present work is to establish if the supplementation of dairy cows with hydrolysable tannins improves milk yield and milk composition.

Material and methods

A herd of twenty dairy cows was divided into two equal groups according to their initial milk production and their stage of lactation. At the start of experiment (1st sampling day, June 20th, 2004) both groups received the same diet, where the main component was pasture, supplemented with 4 kg of compound feed. From that day on one group of cows received the same diet as at the start of experiment (control group, CON), while second group received the same quantity of compound feed containing 30 g/kg of chestnut tannin extract (treatment group, TAN). Milk production records and
milk composition (fat, protein and urea) were obtained every 14 days from June 20th to October 24th, 2004, when the grazing season ended.

Results and discussion

The results of the experiment are presented in Table 1. The highest milk yield was obtained for CON group at 3rd sampling day (23.0 kg d⁻¹), while the lowest milk yield was recorded at the last, 9th sampling day for TRE group (16.9 kg d⁻¹). The differences in milk yield between CON and TRE within sampling days were not significant (P>0.05). These results are in accordance with the results of Orešnik (1996), who also used chestnut tannins, and Maasdorp et al. (1999), who used leaves of Calliandra calothyrsus, containing condensed tannins. On contrary, Maasdorp et al. (1999) found, that feeding the leaves of Leucaena leucocephala in Acacia boliviana (both containing condensed tannins) increased milk yield for 1.83 and 0.58 kg/day, respectively. Woodward et al. (1998) also found that condensed tannins of Lotus corniculatus increased milk yield of dairy cows for 35 % comparing with the control group receiving Lolium sp.

Table 1: Production and composition of milk in cows receiving diets with (TRE) or without (CON) tannin extract at different sampling days.

<table>
<thead>
<tr>
<th>Sampling day</th>
<th>Milk yield (kg d⁻¹)</th>
<th>Milk fat (%)</th>
<th>Milk protein (%)</th>
<th>Milk urea (mg 100 mL⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONᵃ</td>
<td>TREᵃ</td>
<td>CON</td>
<td>TRE</td>
</tr>
<tr>
<td>1</td>
<td>20.0</td>
<td>19.4</td>
<td>3.58</td>
<td>3.74</td>
</tr>
<tr>
<td>2</td>
<td>22.2</td>
<td>22.2</td>
<td>3.68</td>
<td>4.03</td>
</tr>
<tr>
<td>3</td>
<td>23.0</td>
<td>20.2</td>
<td>3.72</td>
<td>4.15</td>
</tr>
<tr>
<td>4</td>
<td>20.2</td>
<td>19.0</td>
<td>3.53</td>
<td>3.67</td>
</tr>
<tr>
<td>5</td>
<td>21.9</td>
<td>18.9</td>
<td>4.19</td>
<td>3.80</td>
</tr>
<tr>
<td>6</td>
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<td>19.5</td>
<td>4.04</td>
<td>3.86</td>
</tr>
<tr>
<td>7</td>
<td>20.7</td>
<td>22.1</td>
<td>3.89</td>
<td>3.97</td>
</tr>
<tr>
<td>8</td>
<td>19.2</td>
<td>18.8</td>
<td>3.84</td>
<td>4.10</td>
</tr>
<tr>
<td>9</td>
<td>18.7</td>
<td>16.9</td>
<td>3.82</td>
<td>4.05</td>
</tr>
</tbody>
</table>

ᵃ CON = control group of animals; TRE = animals receiving tannin extract in their diet.

Milk composition (milk fat and milk protein) did not differ between two groups within each sampling day (Table 1). The greatest difference in milk fat contents between Con and TRE group was obtained at the 3rd sampling day (3.15 and 4.15 % for CON and TRE group, respectively), while that in milk protein contents at the 2nd sampling day (3.24 and 3.41 % for CON and TRE group, respectively). Generally TRE group had slightly higher content of milk fat and milk protein, but differences were never statistically significant (P>0.05). On contrary, Orešnik (1996) stated that supplementation of the diet with tannins could influence degradability of proteins in the rumen, which should affect the milk composition. In his experiment Orešnik (1996) proved that the supplementation of the diet with chestnut tannins increased milk protein content for 0.15 %. This is in accordance with the results of Bhatta et al. (1999), who demonstrated that a supplementation of the diet with condensed tannins containing seed husks of Tamarindus indica, improved milk protein content by 0.04 % (from 3.49 % to 3.53 %; P<0.07). In the milk produced with cows fed on Lotus corniculatus (containing condensed tannins) the concentration of milk protein was 0.30 % higher than in control group. Woodward et al. (1998) also noted that condensed tannins from Lotus corniculatus did not have any effects on milk fat content, which agrees with our results (Table 1). If tannins decrease the degradability of proteins, which could be very high in pasture based diets, this should be reflected on the milk urea content. We found that milk urea content was always lower in the milk of TRE group, except at 5th sampling day (Table 1, Figure 1). Even if these differences between TRE and CON group within a sampling day were not statistically significant (P>0.05) we are convinced that chestnut tannins affect digestion and metabolism of proteins.
Figure 1: Urea content (mg/100 ml) in milk of groups of dairy cows receiving diets with (TRE) or without (CON) tannin extract at different sampling days.

Conclusions

There are several reasons why tannins in the diet of dairy cows did not have any pronounced effects on milk yield and composition. The first possible reason is the concentration of tannins in the diet. It is well known that concentrations up to 5 % of diet dry matter may have beneficial effects on animal performances, while in our experiment the concentration of tannin extract was only about 0.7 % (about 0.5 % tannins, determined by the coagulation with skin powder), indicating that the concentration may be too low. Other important effects on milk production and composition are stage of lactation and parity. In such a small herd as we used (20 lactating animals) it is very difficult to select animals which had initially the same milk production and were contemporarily in the same stage of lactation and the same parity.

References
