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Effect of roughage level and source in diets on the risk of reversing fat and protein percentages in goat milk

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SUMMARY – In France, for several years, reversions of fat and protein percentages have appeared in milks of intensively fed goats from 4-5 months to 7-8 months of lactation. Values of protein percentages are higher than fat percentages; which has unfavourable effects on cheese quality. Consequently we tried to assess the dietary effects on the percentage reversion risks. Two fibre sources, lucerne hay or dehydrated unground blocks were compared at a low and high roughage/concentrate ratios (R/C) in a 2 x 2 factorial experiment carried out in a Latin square design during 4 periods of 4 weeks. Thirty two Saanen and Alpine goats in the 3rd month of lactation were allotted in 4 groups balanced in milk yield and composition. The mixed complete diet was composed with lucerne hay (A) or dehydrated lucerne blocks (D) at 60% (H) or 30% (L) total DM, beet pulp silage (20% H or 35% L) and concentrates (soya oilmeal and bafey 20% H or 35% L). The level of dry matter intake was not significantly different (2.95, 2.94, 2.88, 2.99 kg DM/d respectively for AH, AL, DH, DL diets) but the intake of net energy was higher in AL and DL diets than in AH and DH diets. The milk yield was significantly higher in L diets limited in roughages (3.48 kg milk/d for L diets vs 3.10 kg milk/d for H diets). The type of lucerne had no affect on milk yield. Fat percentage tended to be lower in L diets than H diets; D lucerne significantly decreased fat percentage only with L diets. D diets tended to increase protein percentages. The reversions of fat and protein percentages were significantly more frequent in L diets than in H diets, and unsignificanly in D than in A diets. In conclusion, the R/C ratio is more efficient to provoke reversions of fat and protein percentages in high yielding dairy goats than the physical presentation of lucerne when goats were received a diet rich in roughages but the effect of physical presentation tends to be higher when the F/C ratio is low.

Key words: Dairy goat, composition of milk, forage/concentrate ratio, type of roughage.

Introduction

Usually French consumers consider goat cheeses as gastronomic products which are bought for familial or friendly parties. But since several years, some criticisms have appeared about the quality of...
goat cheeses: the cheese paste is granulous and not fine enough; goat cheeses are short of goaty flavours. The consumer observations have become frequent simultaneously with the apparition of reversions of fat and protein percentages in milks of goats flocks in intensive conditions, particularly in mid lactation from 4-5 to 7-8 months of lactation (Morand-Fehr, 1996). The fall of cheese quality would be due to reversions of fat and protein percentages (Danieau, 1998), which can have various causes: incomplete milkings, genetic improvement principally trended to increase protein production, and unbalanced diets in fat and fibrosity (Morand-Fehr, 1996; Morand-Fehr et al., 1998). As in an inquiry (Nourtier, 1997) milk percentages reversions were observed where goat farmers replaced hays by deshydrated roughages, the effects of the forage/concentrate ratio and the physical presentation of roughages were tested in the present experiment.

Material and methods

Thirty two Saanen and Alpine adult goats in the third month of lactation at the beginning of the experiment were alloted in 4 groups of 8 goats balanced on milk production and composition (fat and protein percentages). They were placed in individual crates. The experiment was carried out in a Latin square design and lasted 12 weeks divided in 4 periods of 3 weeks.

All the goats were given mixed diets during all the experiment. Two nutritional factors were tested in 2 x 2 factorial design: roughage/concentrate (R/C) ratios 60/40 (H) and 30/70 (L), two types of roughages lucerne hay of good quality (A) vs deshydrated unground lucerne blocks (D) containing 66% 4 mm and more sized particles. All the diets were composed of lucerne, over-pressed beet pulp silage and concentrates (barley, soya oilmeal, minerals and vitamins) (Table 1); their water content was about 55%. So goats were received ad libitum. Individually each experimental diets (AH, AL, DH and DL) during one of the four periods in two daily distributions. The distributed quantities were calculated so that refusals were less than 10%.

Table 1. Composition of experimental diets

<table>
<thead>
<tr>
<th>Type of lucerne</th>
<th>Experimental diets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AH Hay</td>
</tr>
<tr>
<td>Ratio R/C</td>
<td>60/40</td>
</tr>
<tr>
<td>Composition % DM</td>
<td></td>
</tr>
</tbody>
</table>

Lucerne          | 60                 | 30                 | 60                   | 30                   |
Beet pulp silage | 20                 | 35                 | 20                   | 35                   |
Concentrate      | 20                 | 35                 | 20                   | 35                   |
(Barley, soya meal)

The adaptation of goats to experimental diets lasted 2 weeks. During the 3rd week of each period, a sample of each diet was taken off for chemical analysis to calculate net energy value (UFL/kg DM), the level of intake and milk production were individually measured for 5 days and milk fat and protein percentages of each goat twice.

Results and discussion

The 4 experimental diets were well accepted. The level of dry matter (DM) intake around 3 kg DM goat day (Table 2) was satisfying for goats producing 3-4 kg milk in mid-lactation (Sauvant et al., 1991). The levels of DM intake were not significantly influenced by experimental diets but the net energy intake was significantly higher energy content of the AH and DH diets rich in concentrates. Consequently the milk yield of goats received AL and DL diets was higher because the milk yield depends closely of the net energy intake of goats (Hadjipanyiotou and Morand-Fehr, 1991). The
physical presentation of lucerne had no significant effect on goat milk yield. As shown in Table 3, the fat percentage of goat milk tended to be lower in L diets than diets due to the lower fibrosity of L diets.

Table 2. Effect of R/C ratio and type of lucerne on intake and milk yield of dairy goats

<table>
<thead>
<tr>
<th>Experimental diets</th>
<th>Significance of diet effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of lucerne</td>
<td>AH AL DH DL</td>
</tr>
<tr>
<td>Ratio R/C</td>
<td>60/40 30/70 60/40 30/70</td>
</tr>
<tr>
<td>Level of DM intake (kg/d)</td>
<td>2.95 2.94 2.88 2.99 NS</td>
</tr>
<tr>
<td>Level of NE intake (UFL/d)</td>
<td>2.40a 2.80b 2.39a 2.88b *</td>
</tr>
<tr>
<td>Milk yield (kg/d)</td>
<td>3.08a 3.46b 3.12a 3.50b *</td>
</tr>
</tbody>
</table>

†UFL: Feed unit for milk (net energy).

a,b In the same line, the values which have not a same subscript are significantly (P < 0.05) different.

*P < 0.05, NS = non significant.

Table 3. Effect of R/C ratio and type of lucerne on milk composition in dairy goats

<table>
<thead>
<tr>
<th>Experimental diets</th>
<th>Significance of diet effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of lucerne</td>
<td>AH AL DH DL</td>
</tr>
<tr>
<td>Ratio R/C</td>
<td>60/40 30/70 60/40 30/70</td>
</tr>
<tr>
<td>Fat percentage (FP) (%)</td>
<td>3.21a 3.10ab 3.20a 2.95b *</td>
</tr>
<tr>
<td>Protein percentage (PP) (%)</td>
<td>31.2 3.17 3.20 3.20 NS</td>
</tr>
<tr>
<td>Difference FP – PP (%)</td>
<td>+0.9a –0.8ab +0.2ab –2.4b *</td>
</tr>
<tr>
<td>Frequency of percentage reversions (% in number goat-week)</td>
<td>33.3 78.8 45.5 75.8</td>
</tr>
</tbody>
</table>

a,b In the same line the values which have not a same subscript were significantly (P < 0.05) different.

NS = non significant, *P ≤ 0.05.

Consequently it was probable that the production of acetate in rumen that is the main precursor of C4-C16 milk fatty acids was more limited (Morand-Fehr et al., 1991). The type of lucerne did not influence fat percentages when goats were received diets rich in roughages (AH and DH diets) but deshydrated lucerne decreased significantly fat percentages of goat milk when the R/C ratio was low in diets. Probably the level of fibrosity in AH and DH diets was sufficiently high to get an effect of deshydrated lucerne containing 66% long particles only; so its fibrosity was lower than in lucerne hay. The fibrosity of AL and DL diets low in roughages was limited, an extra decrease of fibrosity due to deshydrated lucerne was probably sufficient to decrease rumen pH and acetate production. In fact, these results showed an significant interaction between the level and the type of roughages.

The effects of experimental diets on protein percentages were not significant but diets containing deshydrated lucerne tended to increase protein percentages. Consequently the difference fat percentage-protein percentage were higher with H diets than D diets. The frequency of percentage reversions were upper when goats were received diets with low R/C ratios. The frequency about 75% is very high and risks to have bad consequences on cheese quality. This high frequency is due to the physiological period (3-7 months of lactation) favorable to percentage inversions (Nourtier, 1997) and the experimental goat flock which have a high aptitude to present percentage reversions.
Conclusion

Nutritional factors can increase the frequency of fat and protein percentage reversions, particularly the R/C ratio but when this ratio is low, the type of roughage, particularly roughage with a limited fibrosity can increase the frequency of percentage reversion.

References