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Rumen fermentation in yearling rams fed different rations

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Abstract. To establish the effect of different dietary lipid and protein content on rumen fermentation in yearling rams, three rations have been tested. The main component in them was ground barley and meadow hay (ration I), plus a different lipid and protein source – sunflower meal (ration II) or sunflower expeller (ration III). Rations were offered twice a day – at 8:00 AM and 1:00 PM. Nine Blackhead Pleven yearling rams, weighing 45.2 kg at the beginning of the experiment were divided into 3 groups of 3 animals each. Twenty days prior to the trial, the animals were fitted with cannulae of the dorsal rumen sac. Rumen content was sampled for 4 consecutive days, three times a day: before feeding, 2.5 h and 5 h after feeding. The following parameters were investigated: pH, ammonia concentrations and volatile fatty acid concentrations. The addition of 0.200 kg sunflower meal (ration II) and 0.200 kg sunflower expeller (ration III) to baseline ration consisting of 1.0 kg meadow hay and 0.8 kg barley mash did not affect significantly rumen pH of yearling rams. For all three rations, rumen pH decreased considerably (p<0.001) 2.5 hours after feeding. Feeding rations with sunflower meal or sunflower expeller resulted in increased rumen ammonia concentrations both before (p<0.001, p<0.01), and after feeding (p<0.001, p<0.01). The highest levels of this parameter after feeding was observed for sunflower expeller ration. The total amount of volatile fatty acids in the rumen of experimental animals increased after feeding (p<0.05, p<0.01, p<0.001) for all rations tested. The relatively highest levels were established in the group fed sunflower meal-containing ration.

Keywords: rumen fermentation, sheep digestion, volatile fatty acids

Introduction

During the evolutionary development of ruminants, their digestive tract has improved and adapted for a maximum extent of breakdown and utilisation of rough plant feeds. Rumen microbial populations produce enzymes degrading almost all chemical bonds of polysaccharides of plant cell walls. As a result of the replication and metabolic activity of rumen microflora, polysaccharides and simpler sugars in plant feeds are converted to monosaccharides – mainly glucose. Volatile fatty acids (VFA), obtained from carbohydrate digestion in ruminants are the most important for energy metabolism. The amount of fatty acids produced in the fore stomachs of ruminants depends on several factors – type of the ration, ratio of feed ingredients, the sources of primary nutrients and their preliminary technological processing (Sivkova, 2007). Other factors are the age of animals, the size and activity of rumen microbial populations (Enev, 1996), dietary supplementation of nutritional preparations – biotechnological products (Radev, 1999), exogenous enzyme preparations (Sivkova, 2007) etc. Rumen parameters such as pH, osmotic pressure, carbohydrate level, have also an influence on total VFA concentrations (Sutton, 1981).

Ammonia is an end product of plant and animal protein degradation in the rumen and a source off amino acids synthesis for many rumen bacterial species. Its rumen concentrations vary within a large range. They are largely dependent on the extent of protein breakdown, metabolic activity of rumen microflora, evacuation rate of nutrient masses to the abomasum, the rate of absorption through the ruminal wall and the level of microbial protein synthesis (Hristov et al, 2005), which are particularly determined by the species, breed and age of the animal, ration composition, concentrate/roughage ratio, time and frequency of feeding etc. The hydrogen ions rumen concentrations (rumen pH) are strongly correlated to rumen VFA levels and total rumen ammonia concentrations.

Regardless of the existing sophisticated mechanisms for dietary energy transformation, the ingested feed is not completely utilised – a considerable part of the ration is lost as non-digested nutrient wastes with faeces, methane produced in the rumen and large intestine, thus increasing the interest of researchers to seek an efficient way for optimisation of digestion and intermediate metabolism, improvement of fattening potential and meat traits in ruminants with minimum feed expenditure. The modification of processes in the rumen could be successfully achieved by changing the dietary roughage/concentrate ratio, feeding rations that provide enough carbohydrates and protein to rumen microflora as well as finding optimal compositions of rations.

The purpose of this study was to investigate the effect of different levels lipid and protein content in ration on rumen fermentation in small ruminants through determination of main rumen fermentation indices – rumen pH, ammonia and volatile fatty acid concentrations.

Material and methods

An experiment was conducted to evaluate the effect of rations with different lipid and protein levels on rumen fermentation in the experimental base of the Animal Physiology unit to the Faculty of Agriculture, Trakia University, Stara Zagora. Three rations, conditionally termed ration I, ration II and ration III were tested. All they were based on ground barley and meadow hay (ration I). The others were supplemented with a different protein and lipid source – sunflower meal (ration II) or sunflower expeller (ration III) contained 1.00 kg meadow hay, 0.800 kg barley mash and 0.200 kg sunflower expeller. Rations were offered twice daily – 8:00 AM and 1:00 PM.
The chemical composition and amounts of rations is presented in Tables 1 and 2.

The experiment was performed with nine yearling rams from Blackhead Pleven breed, with initial average body weight 45.2 kg. They were divided in three groups of three animals each. The animals were housed indoor, in individual boxes with constant access to water and salt licks. Twenty days prior to the trial, the animals were fitted with cannulae of the dorsal rumen sac according to Aliev (1960). A 10-day adaptation period to the new ration was allowed.

Rumen content was sampled for 4 consecutive days, three times a day: before feeding, 2.5 h and 5 h after feeding for determination of hydrogen ions, volatile fatty acids and ammonia concentrations. Rumen content was collected with a 100-ml pipette, introduced always at the same depth through the cannula. Studied parameters were assayed according to routine methods as previously described (Radev, 1999).

The results of experiments were processed by Statistica for Windows software (Stat. Soft. Inc., 1994) and Microsoft Excel 2007. Graphs were built using Microsoft Excel 2007.

Table 1. Composition and amounts of consumed feed (ration I, II, and III)

<table>
<thead>
<tr>
<th>Feed</th>
<th>kg</th>
<th>DM intake kg</th>
<th>Ration I</th>
<th>Ration II</th>
<th>Ration III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadow hay</td>
<td>1.00</td>
<td>0.882</td>
<td>90.3</td>
<td>283</td>
<td>19</td>
</tr>
<tr>
<td>Barley mash</td>
<td>1.00</td>
<td>0.899</td>
<td>96.0</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>2.00</td>
<td>1.781</td>
<td>186.3</td>
<td>333</td>
<td>36</td>
</tr>
<tr>
<td>Meadow hay</td>
<td>1.00</td>
<td>0.882</td>
<td>90.3</td>
<td>283</td>
<td>19</td>
</tr>
<tr>
<td>Barley mash</td>
<td>0.800</td>
<td>0.719</td>
<td>77.0</td>
<td>40</td>
<td>14</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>0.200</td>
<td>0.178</td>
<td>65.0</td>
<td>55</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>2.00</td>
<td>1.779</td>
<td>232.3</td>
<td>378</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 2. Chemical composition of feeds

<table>
<thead>
<tr>
<th>Feed</th>
<th>DM(%)</th>
<th>Crude protein</th>
<th>Crude fibre</th>
<th>Crude fat</th>
<th>NFE</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadow hay</td>
<td>88.20</td>
<td>9.03</td>
<td>28.30</td>
<td>1.90</td>
<td>47.97</td>
<td>1.00</td>
</tr>
<tr>
<td>Barley mash</td>
<td>89.90</td>
<td>9.60</td>
<td>5.00</td>
<td>1.70</td>
<td>72.30</td>
<td>1.30</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>88.80</td>
<td>32.50</td>
<td>27.50</td>
<td>1.50</td>
<td>21.60</td>
<td>5.70</td>
</tr>
<tr>
<td>Sunflower expeller</td>
<td>89.70</td>
<td>31.10</td>
<td>16.90</td>
<td>8.80</td>
<td>26.70</td>
<td>6.20</td>
</tr>
</tbody>
</table>

Results and discussion

Rumen pH

Hydrogen ion concentrations in the rumen of experimental animals (pH) followed the classical trend to decrease (p<0.001, p<0.01) after feeding all tested rations (Figure 1). The pH of rumen contents is relatively constant. It varies between 5.4 and 7.4 (Peikov, 2001). It is maintained by the high buffering capacity of rumen content and the transportation of acid metabolites to the abomasum.

In this study, rumen pH values varied between 5.65 (5 hours after feeding) to 6.24 (before feeding). According to several researchers, rumen pH after intake of high-concentrate rations were between 5.6 and 6.2, with lower values when rapidly fermentable diets were offered (Krause et al., 1998, Beauchemin et al., 2000). The ruminination during the night and the excessive salivation resulted in higher pre-feeding morning rumen pH values. The fermentation of ingested feed led to lower pH values in post feeding animals (рН) followed the classical trend to decrease (р<0.001, р<0.01) after feeding all tested rations (Figure 1).

The pH of rumen relationship with all ration types. After feeding ration I composed of barley, meadow hay and sunflower meal, pre-feeding rumen pH was 6.24, whereas its values after feeding decreased to 5.95 by the 2.5th
hour (p<0.001) and to 5.88 (p<0.01) by the 5th hour. Before feeding ration III, average rumen pH was 6.26. Its values were statistically significantly lower 2.5 h after feed intake 5.75 (p<0.001). Five hours after feeding the ration with barley, meadow hay and sunflower expeller, rumen pH was still low 5.83 (p<0.001). Rumen pH values measured at studied intervals with all three rations were comparable regardless of their composition, decreasing in post-feeding hours (p<0.001, p<0.01). There were no statistically significant differences among rations at each time interval.

Ammonia concentrations

Rumen ammonia concentrations vary according to the ration type, the time and frequency of feed intake, the rate of enzymatic degradation of proteins and non-protein nitrogen compounds, the rate of ammonia uptake through the ruminal wall and the evacuation rate to the subsequent gastrointestinal tract compartments (Hristov et al., 2005). A number of authors have reported lower rumen ammonia concentrations after dietary supplementation with sugars (Obara et al., 1991) or starch (Rémont et al., 2002). Other however observed no influence of added sugar on rumen ammonia levels (McCormick et al., 2001, Sannes et al., 2002).

The results of the present study are somewhat similar to data of Hristov et al. (2005), who observed a reduction in rumen ammonia with rations supplemented either with glucose or starch and increased ammonia levels when both substances were added. The provision of easily fermentable foods in the view of authors lowers ammonia concentrations in the rumen due to reduction of formation rates or increased microbial protein synthesis. Beet, being an easily fermentable food, provides energy to microbial microflora and increased protein synthesis rate. The addition of sunflower meal to the ration maintained rumen ammonia levels between 8.42 mg/100 ml and 22.63 mg/100 ml. These levels, according to Awawdeh et al. (2005) are normal for fermentation and synthesis processes occurring into the rumen.

Figure 2 presents rumen ammonia concentrations in experimental yearling rams. Animals fed ration I had an average rumen ammonia pre-feeding level of 7.78 mg/100 ml. Two and a half hours later, the levels remained almost the same 7.79 mg/100 ml. At the later study period, rumen ammonia decreased insignificantly to 6.34 mg/100 ml. The initial rumen ammonia levels in animals fed ration II were 16.62 mg/100 ml. They decreased to 13.83 mg/100 ml 2.5 hours after feeding. Five hours after feeding the ration containing barley, meadow hay and sunflower meal (ration II), mean rumen ammonia concentrations were 8.07 mg/100 ml, i.e. statistically significantly lower (p<0.001). The pre-feeding rumen ammonia levels in the group fed sunflower expeller ration III were 12.98 mg/100 ml. This parameter increased (p<0.01) compared to respective values in group I. Two and a half hours after feeding, rumen ammonia increased to 15.74 mg/100 ml. The levels were again statistically significantly higher (p<0.001) compared to those after feeding ration I. Five hours after feeding ration III, rumen ammonia decreased to 10.43 mg/100 ml, values that were higher (p<0.05) compared to the levels by the 5th hours after ration I intake.

The established differences in rumen ammonia concentrations were most probably due to the different intensity of carbohydrate and protein breakdown after feeding the three rations, as well as the different rate of its utilisation by rumen microflora. The concentrations are also influenced by the intensity of ammonia absorption through the ruminal wall into the bloodstream. The highest observed rumen ammonia levels – after feeding ration II – is due to the sunflower meal as dietary protein source. Even the addition of sunflower expeller however (ration III) resulted in pre-feeding rumen ammonia concentrations higher by more than 5 mg/100 ml (p<0.01). A similar trend was present – decrease in post feeding hours with rations I and II, and increase 2.5 hours after feeding ration III.

Total volatile fatty acids

Data about the total amount of volatile fatty acids in the rumen are presented on Figure 3. The total VFA concentration before feeding ration I was 72.92 mmol/l. Two and half hours after feeding VFA levels increased significantly (p<0.05) to 93.65 mmol/l. At the later study interval they increased to 95.31 mmol/l (p<0.01).

The total amount of rumen VFA before intake of ration II was 73.54 mmol/l, which increased to 110.73 mmol/l 2.5 hours after the feeding (p<0.01). Five hours after feeding a ration with barley, meadow hay and sunflower meal (ration II), average rumen VFA concentration was 101.35 mmol/l. Unlike the level in the group fed ration I, feeding ration II resulted in lower VFA concentrations with time after the morning feeding of experimental yearling rams. The total amount of rumen VFA before feeding expeller-containing ration (ration III) was 72.80 mmol/l. With this ration too, rumen VFA increased (p<0.001) to 101.49 mmol/l. Two and a half hours after the morning feeding, the trend towards reduction in total VFA
The addition of 0.200 kg sunflower meal and 0.200 kg sunflower expeller to the base diet of 1.0 kg meadow hay and 0.8 kg barley mash did not alter significantly rumen pH of yearling rams. All three rations decreased rumen pH (p<0.001) 2.5 hours after feeding.

Feeding rations containing sunflower meal and expeller resulted in higher rumen ammonia concentrations both before (p<0.001: p<0.01: p<0.001), as well as after feeding (p<0.001: p<0.01). The highest levels of this parameter was observed with sunflower expeller ration.

The total volatile fatty acid content in the rumen of experimental animals increased (p<0.05: p<0.01: p<0.001) after feeding the three tested rations. The relatively highest rumen VFA concentrations were demonstrated after feeding the ration containing sunflower meal.

**References**


Enev E, 1994. Effect of rumen deamina on digestion and productivity of sheep. Thesis for DSc, Trakia University, Stara Zagora (Bg).


Sivkova K, 2007. Digestion processes in ruminants depending on ration composition and structure. Thesis for DSc, Trakia University, Stara Zagora (Bg).


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**Names and affiliation of authors**

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