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Baiba Osmane  
*Latvia University of Agriculture, Latvia*

Imants Jansons  
*Latvia University of Agriculture, Latvia*

Aleksandrs Jemeljanovs  
*Latvia University of Agriculture, Latvia*

Sallija Cerina  
*Latvia University of Agriculture, Latvia*

Liga Proskina  
*Latvia University of Agriculture, Latvia*

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Legumes – a high quality protein source in Latvian animal feeds

Baiba Osmane, Imants Jansons, Aleksandrs Jemeljanovs, Sallija Cerina and Liga Proskina

Latvia University of Agriculture, Research Institute of Biotechnology and Veterinary Medicine "Sigra", Sigulda, Latvia

www.sigra.lv
Contact email: sigra@lis.lv

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Introduction

Farms in Latvia have an insufficient amount of protein in a feed for herbivorous animals. To tackle this issue, plants containing high protein content should be cultivated in grass mixtures. Legumes are rich in protein and play an important role on farms with dairy livestock. It is advisable to have at least 30-50% of legumes in mixtures with grass for grazing animals and to conserve fodder for the winter period, which lasts from November to May. As well as being rich in protein, legumes have a high dry matter digestibility (TDN) and high energy content (NEL). While legumes during the optimal mowing period (early flowering) have a high-buffer capacity (BC) of 600 - 700 mEq/kg and a low fermentation coefficient (FC) of 13 - 18, they contain less carbohydrates than grasses and consequently, have poor fermentability (Osmane et al. 2008, Jemeljanovs 2006, Mustafa et al. 2003, Wilkins et al. 2000).

Therefore, they need to be included with grasses to make silage or hay. Latvian farmers use legumes in grass mixtures about from 20 species of different clover (Trifolium), alfalfa (Medicago sativa), eastern galega (Galega orientalis) and the annual legumes, peas (Pisum sativum), vetch (Vicia sativa) and cowpeas (Phaseolus vulgaris), each with a varied biochemical and microbial composition and requiring different requirements for cultivation and fodder conservation.

Methods

Surveys were conducted on 6 randomly selected farmers’ fields that used both organic and conventional systems in Latvia during summer (2006 – 2011). We analysed chemical composition of different legumes at different plant development stages for feed value, buffering capacity (BC) and fermentation coefficient (FC) (n=60). Statistical analyses were performed using SPSS 17.0 software, with treatment differences considered significant at the P<0.05 level.

Results

Biochemical composition of grasses and legumes changed during vegetative growth (Tables1-3). When the amount of legumes in swards increased from 45-60%, composition of protein in feed DM increased from 19-23%, furthermore, improving the composition of protein by non-essential amino acids. The ensilibility of the red clover–timothy fresh material was satisfactory in the budding stage (F-35). Accordingly, preserving of the amino acid amount observed in the silage was high – from 92.7-97.1% during vegetative growth. The inclusion of clover in combination with grasses in mixtures increased the amount of feed intake, because it contained lower fibre content. If white clover content in swards is 50%, the amount of forage intake increased by 10-20%.

In Table 1 it can be seen that the highest NEL was for red clover and trefoil at the start of blooming, but DM was higher for galega and red clover. Galega also had the highest crude protein content. Accordingly the ensilage result will be better with this legume at the start of blooming.

In Table 2 it can be seen that better quality silage is obtained from all herbage types at the flowering stage of vegetation, when buffer capacity was lower and the ratio of crude protein and carbohydrate was more balanced.

According to Table 3, the indicated mixtures have a good fermentability after drying, so the quality of silage should be high. Pea silage and soybean silage have a similar ruminal degradability of DM (average 69%), crude protein (83%) and NDF (average 35%). Significant differences were detected between pea and bean compared with grass mixture protein content (data not presented).

Conclusion

Grass-legume mixtures have good fermentability after drying, so the quality of silage made from them is likely to be high. Cows should be fed additionally with a smaller amount of peas and beans mixed with oats to improve the provision of protein in feed rations.
Table 2. Indicators of fermentability and fermentation for green herbage of red clover, eastern galega and a timothy-red-clover mixture at budding and flowering (n = 16).

<table>
<thead>
<tr>
<th>Herbage type</th>
<th>Development phase</th>
<th>Buffer capacity (mEq/kg)</th>
<th>Fermentation coefficient</th>
<th>Crude protein:carbohydrate ratio</th>
<th>Fermentability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red clover</td>
<td>Budding</td>
<td>536</td>
<td>40</td>
<td>1.0 : 0.8</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Flowering</td>
<td>294</td>
<td>64</td>
<td>1.0 : 1.0</td>
<td>Good</td>
</tr>
<tr>
<td>Eastern galega</td>
<td>Budding</td>
<td>655</td>
<td>35</td>
<td>1.0 : 0.5</td>
<td>Very poor</td>
</tr>
<tr>
<td></td>
<td>Flowering</td>
<td>549</td>
<td>39</td>
<td>1.0 : 0.6</td>
<td>Poor</td>
</tr>
<tr>
<td>50% Timothy-50% red clover mixture</td>
<td>Budding</td>
<td>498</td>
<td>42</td>
<td>1.0 : 0.8</td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Flowering</td>
<td>365</td>
<td>55</td>
<td>1.0 : 1.0</td>
<td>Very good</td>
</tr>
</tbody>
</table>

Table 3. Fermentability parameters of green herbage of grass-legume mixtures (n = 16).

<table>
<thead>
<tr>
<th>Mixture type</th>
<th>Type of green herbage</th>
<th>Dry matter %</th>
<th>Buffer capacity (mEq/kg)</th>
<th>Fermentation coefficient</th>
<th>Carbohydrates (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Timothy-50% red clover mixture</td>
<td>Fresh</td>
<td>20</td>
<td>543</td>
<td>40</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Dried</td>
<td>30</td>
<td>270</td>
<td>54</td>
<td>143</td>
</tr>
<tr>
<td>50% perennial ryegrass -50% white clover mixture</td>
<td>Fresh</td>
<td>20</td>
<td>492</td>
<td>44</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Dried</td>
<td>35</td>
<td>236</td>
<td>55</td>
<td>121</td>
</tr>
<tr>
<td>50 % mixed grass-50% clover mixture</td>
<td>Fresh</td>
<td>20</td>
<td>504</td>
<td>42</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>Dried</td>
<td>35</td>
<td>218</td>
<td>57</td>
<td>161</td>
</tr>
</tbody>
</table>

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