Phosphorus Supplementation of Ammoniated Rice Straw on Rumen Fermentability, Synthesised Microbial Protein and Degradability in Vitro

Mardiati Zain, N. Jamarun and A. S. Tjakradidjaja

Abstract—The effect of phosphorus supplementation of ammoniated rice straw was studied. The in vitro experiment was carried out following the first stage of Tilley and Terry method. The treatments consisting of four diets were A = 50% ammoniated rice straw + 50% concentrate (control), B = A + 0.2% Phosphor (P) supplement, C = A + 0.4% Phosphor (P) supplement, and D = A + 0.6% Phosphor (P) supplement of dry matter. Completely randomized design was used as the experimental design with differences among treatment means were examined using Duncan multiple range test. Variables measured were total bacterial and cellulolytic bacterial population, cellulolytic enzyme activity, ammonia (NH3) and volatile fatty acid (VFA) concentrations, as fermentability indicators and synthesized microbial protein, as well as degradability indicators including dry matter (DM), organic matter (OM), neutral detergent fibre (NDF), acid detergent fibre (ADF) and cellulose. The results indicated that fermentability and degradability of diets consisting ammoniated rice straw with P supplementation were significantly higher than the control diet (P < 0.05). It is concluded that P supplementation is important to improve fermentability and degradability of rations containing ammoniated RS and concentrate. In terms of the most effective level of P supplementation occurred at a supplementation rate of 0.4% of dry matter.

Keywords—ammoniated rice straw, phosphorus, fermentability, degradability and synthesized microbial protein.

I. INTRODUCTION

In vitro fermentability and degradability of diets were determined by methods described in [7, 8] respectively. A completely randomized design was used as experimental design consisting of four treatments. Data were analyzed by ANOVA using the GLM procedure. Differences between the control treatment and P supplementation treatment were analyzed by Duncan multiple range test (DMRT) [9].
III. RESULT AND DISCUSSION

Table shows results of P supplementation effects on bacterial population and other variables of rumen fermentability. Effects of treatments were significant (P<0.05) for ammonia and total VFA concentrations. Data on in vitro degradability of ammoniated RS are presented in the table and show that the addition of P at different level affected all degradability variables (P<0.05).

<table>
<thead>
<tr>
<th>Variable</th>
<th>P Supplementation (%DM)</th>
<th>0</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesised microbial protein (%g)</td>
<td>0.19</td>
<td>0.18</td>
<td>0.21</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>N-NH₃ (mM)</td>
<td>11.09</td>
<td>10.02</td>
<td>9.25</td>
<td>8.80</td>
<td></td>
</tr>
<tr>
<td>Total VFA (mM)</td>
<td>88.75</td>
<td>91.82</td>
<td>106.87</td>
<td>111.87</td>
<td></td>
</tr>
<tr>
<td>Dry matter degradability (%)</td>
<td>52.91</td>
<td>54.85</td>
<td>57.66</td>
<td>60.79</td>
<td></td>
</tr>
<tr>
<td>Organic matter degradability (%)</td>
<td>54.69</td>
<td>58.43</td>
<td>60.18</td>
<td>62.69</td>
<td></td>
</tr>
<tr>
<td>NDF degradability (%)</td>
<td>39.31</td>
<td>41.58</td>
<td>43.94</td>
<td>50.91</td>
<td></td>
</tr>
<tr>
<td>ADF degradability (%)</td>
<td>27.99</td>
<td>32.78</td>
<td>37.59</td>
<td>40.30</td>
<td></td>
</tr>
<tr>
<td>Cellulose degradability (%)</td>
<td>29.47</td>
<td>33.04</td>
<td>38.74</td>
<td>41.61</td>
<td></td>
</tr>
</tbody>
</table>

Means within rows with the same superscript letter are significantly different at P<0.05

Ammonia concentrations decreased from 11.09 mM in control diet to 10.02, 9.25 and 8.80, respectively in rations B, C and D which consisted of S supplements at 0.2, 0.4 and 0.6% on dry matter. Differences in ammonia concentration among treatment diets were significant (P<0.05). Reverse results from ammonia concentrations were obtained in total VFA concentrations. The addition of P supplement increased total VFA concentrations from 88.75 mM in diet A to 98.12 in diet B, 106.87 mM in diet C and 111.87 mM in diet D. Total VFA concentrations differed significantly between all rations (P<0.05), except that between rations C and D.

The present results demonstrate that addition of P supplement at diet had reduced ammonia concentration, and increased total bacterial population. Although the treatments did not produce significant effect on cellulolytic bacterial population, the supplements had increased cellulolytic enzyme activity which subsequently increased total VFA concentration. This means that cellulolytic rumen bacteria were present in small population in liquid phase used as samples for counting cellulolytic bacterial numbers; most of cellulolytic bacteria may be attached to fibrous components in solid phase samples. The results also indicate that P plays important role in rumen microbial growth and cellulolytic enzyme activity which increased fibre degradation and total VFA concentration. These results had agreed with the works reported by [10]. Comparisons among diets supplemented with P, the best results in fermentability study had been obtained at 0.4% P supplement. This ratio was the same that was obtained by [2] who suggested that the best P supplement to beef cattle was 0.4-0.5% on dry matter on diet low quality roughage.

in vitro degradability

Data on in vitro degradability of ammoniated RS are presented in the Table 2. The addition of P at different level on dry matter affected all degradability variables (P<0.05). Control diet (A) had the lowest DM, OM, NDF, ADF and cellulose degradabilities (P<0.05). An increase in P supplementation from 0.2% (B) 0.4% (C) and 0.6% (D) increased the degradabilities of DM, OM, NDF, ADF and cellulose, and the increase in degradabilities of DM, OM, and fibrous fractions followed linear patterns with the levels of S supplementation.

The present results in degradabilities of DM, OM and fibrous fraction of diets consisting of ammoniated RS and concentrate were in association with the increase in total VFA concentration as affected by P supplementation. These indicate that P supplementation had promoted rumen bacterial growth and cellulolytic enzyme activities which increased fermentability and degradability of diets consisting ammoniated RS and concentrate. This study has also shown that diets consisting of ammoniated RS were deficient in P, and P supplementation is important to improve fibre degradation of fibrous feedstuffs. The present results were in agreements with the results of (11:12). The last researchers had indicated that improvement in fibre degradation by P supplementation occurred through its specific stimulation on growth of rumen cellulolytic bacteria and anaerobic rumen fungi. The present study has suggested that the best result was obtained by supplementing P at 0.4% on dry matter.

IV. CONCLUSION

Fermentability and degradability of rations containing ammoniated RS and concentrate. The effects occurred through reduction in ammonia concentration, increase in total bacterial population, cellulolytic enzyme activity, total VFA concentration, and degradabilities of DM, OM, and fibrous fraction. The best level of P supplementation is obtained at a 0.4% on dry matter.

ACKNOWLEDGMENT

This work was supported by an Insentif Riset Dasar Programme at Ministry of Research and Technology, Republic of Indonesia in 2007.

REFERENCES


