THE EFFICACY OF N-HYDROXYMETHYL-METHIONINE-Ca (HMM-Ca) AS A METHIONINE SUPPLEMENT FOR WOOL GROWTH

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SUMMARY

Effects of N-hydroxymethyl-methionine-Ca (HMM-Ca) on sheep were examined in three experiments. In experiment 1, 24 Merino ewes were offered 1100 g/day of a lucerne-oat grain based pellet. 12 sheep served as controls and 12 sheep were supplemented with 4.43 g/day HMM-Ca (equivalent to 3 g DL-methionine). HMM-Ca increased wool growth ca. 11% in two successive 8-week periods, but these differences were not significant (P>0.05). No significant effects on the characteristics and composition of wool were found. In experiment 2, the sheep consumed 900 g/day of a pellet consisting mainly of milling by-products. Supplements of 3 g/day methionine given as HMM-Ca or as Liquimet for 8 weeks did not significantly increase wool growth (P>0.05). In experiment 3, 6 g methionine (given as HMM-Ca, Liquimet or DL-methionine) were injected directly into the rumen of Merino wethers and blood samples were collected up to 6 hours after the treatments. Cystine and methionine levels in plasma were not significantly elevated by any of the treatments (P>0.05).

The current studies indicate that HMM-Ca does not enhance wool growth when included in the diet, suggesting that little methionine from HMM-Ca reaches the abomasum.

INTRODUCTION

The possibility of increasing the postruminal availability of S-amino acids by dietary supply of methionine derivatives which could resist microbial degradation in the rumen has been investigated by several workers (Digenis et al. 1974; Buttery et al. 1977; Langer et al. 1978). One such derivative, N-hydroxymethyl-DL-methionine-Ca (HMM-Ca), has been suggested as the most promising for this purpose (Richardson et al. 1976; Kaufmann and Lopping 1979). However, the existing studies are equivocal and the stability of this derivative in the rumen has also been questioned (Schelling et al. 1976; Robert et al. 1987). The efficacy of HMM-Ca as a source of methionine for sheep was examined in a series of experiments.

MATERIALS AND METHODS

Sheep, diets and treatments

In experiment 1, 24 Saxon Merino ewes were given two types of pellets, namely 'basal' and 'supplementary'. The basal pellet contained 36.56% oat grain, 54.85% milled lucerne, 3.66% molasses, 1.83% calcium carbonate, 1.83% dicalcium phosphate, 0.91% NaCl and 0.37% vitamin premix. The supplementary pellet consisted of 11.36% HMM-Ca (with 67.7% DL-methionine), 2.27% NaCl, 6.0% moist molasses, 48.18% milled lucerne and 32.18% oat grain. After a 4-week preliminary period, the sheep were divided into two equal liveweight groups of 12. The sheep in group 1 received 1100 g/day of the basal pellets (89.9% DM), while those in group 2 were given 1050 g basal pellets plus 52 g/day of the supplementary pellets (88.3% DM). Wool growth was measured over two 8-week periods.

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For experiment 2, a basal pelleted diet was provided by Coprice Pty Ltd (Leeton, N.S.W.). The pellet consisted of 20% rice pollard, 20% citrus pulp, 40% ground hulls, 10% lupins, 2% lime, 2% salt, 1% urea and 0.125% vitamin premix. Following a 3-week preliminary period, the sheep (from experiment 1) were allocated to 3 equal liveweight groups of 8 and were offered 900 g/day (90.9% DM) of the pellets. The first 8 weeks served as a control period and in the second 8-week period, the sheep in group 1 served as controls, those in group 2 were drenched with 7.5 ml/day of Liquimet (40% methionine, 6.2% Na and 54% H2O) and those in group 3 were supplemented with 4.43 g/day HMM-Ca (equivalent to 3 g DL-methionine added directly). HMM-Ca was mixed with molasses and hand-fed whenever a sheep refused to take it.

In experiment 3, 6 Merino wethers were offered ca. 1100 g/day of the basal pellet from experiment 1 for 4 weeks. Blood samples were collected on 3 days during the fifth week. The sheep were fed once daily at around 1630-1700 h so as to eliminate the influence of feed intake on plasma amino acid levels. Pre-treatment blood samples (0 min) were taken from the jugular vein at around 0900 h and placed in heparinized tubes. DL-Methionine (6.0 g) and HMM-Ca (8.86 g) were separately suspended in 50 ml of water and drenched into the rumen with a 100-ml syringe fitted with a long rubber tube; 15 ml Liquimet was directly drenched into the rumen. Blood samples were then collected at intervals of 60 min, 210 min and 360 min after the treatments. Following immediate centrifugation at 3500 g for 10 min, the supernatants were transferred into plastic vials and 30 mg solid sulphosalicylic acid/ml plasma was added. Finally the deproteinized plasma samples were recentrifuged and stored at -20°C until analyzed.

Measurements and analyses

In experiment 1, wool growth rate was obtained by using the dyebanding technique (Wheeler et al. 1977). In experiment 2, the midside-patch method (Chapman and Wheeler 1963) was used to measure wool growth rate. Fibre diameter was measured on the FFDA (Fineness of Fibre Diameter Analyzer). Staple strength was tested on the Agritest Staple Breaker. The amino acid composition of wool, feed and plasma was determined with an automatic amino acid analyzer. Statistical significance was assessed using standard methods of analysis of variance and covariance.

RESULTS

Experiment 1

Amino acid analysis revealed that the basal pellet contained 0.28% methionine and 0.19% cystine, whereas the supplementary pellet contained 4.94% methionine and 0.20% cystine. Therefore, the treatment group actually received an extra 2.1 g/day methionine in the form of HMM-Ca. There was an increase in wool growth (g clean dry wool/d/sheep, designated as CDW) of ca. 11% for both periods 1 and 2 (Table 1). These differences, however, were not significant (P>0.05). Also, no effects were found in mean fibre diameter (MFD), staple length (SL), staple strength (SS) and S-amino acid contents of wool (Table 1; methionine=MET and cystine=CYS).

Experiment 2

Supplements of 3 g/day methionine given as HMM-Ca or as Liquimet did not significantly increase wool growth (Table 2; P>0.05).

Experiment 3

No differences (P>0.05) in plasma cystine levels were found up to 6 hours after the treatments (Fig.1). In contrast, plasma methionine levels were elevated by
DL-methionine and Liquimet to a similar extent, and to a lesser extent by HMM-Ca (Fig.1). However, these increases also were not significant (P>0.05).

Table 1 The effect of HMM-Ca on the growth rate, characteristics and S-amino acid contents of wool (means ± s.e.; n=12 where not stated)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CDW (g/d)</th>
<th>MPD (mm)</th>
<th>SL (mm/8 wk)</th>
<th>SS (N/ktex)</th>
<th>MET (%; n=9)</th>
<th>CYS (%; n=9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>4.03</td>
<td>17.0</td>
<td>11.44</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Group</td>
<td>(0.28)</td>
<td>(0.45)</td>
<td>(0.22)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>HMM-Ca</td>
<td>4.50</td>
<td>17.7</td>
<td>11.79</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Suppl.</td>
<td>(0.29)</td>
<td>(0.40)</td>
<td>(0.29)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Period 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>4.32</td>
<td>17.4</td>
<td>12.08</td>
<td>58.4</td>
<td>0.52</td>
<td>10.99</td>
</tr>
<tr>
<td>Group</td>
<td>(0.26)</td>
<td>(0.57)</td>
<td>(0.26)</td>
<td>(1.9)</td>
<td>(0.009)</td>
<td>(0.130)</td>
</tr>
<tr>
<td>HMM-Ca</td>
<td>4.71</td>
<td>17.8</td>
<td>12.40</td>
<td>58.3</td>
<td>0.50</td>
<td>11.17</td>
</tr>
<tr>
<td>Suppl.</td>
<td>(0.32)</td>
<td>(0.33)</td>
<td>(0.32)</td>
<td>(2.5)</td>
<td>(0.010)</td>
<td>(0.141)</td>
</tr>
</tbody>
</table>

Table 2 The effects of HMM-Ca and Liquimet on the growth rate and characteristics of wool (means ± s.e.; n=8)

<table>
<thead>
<tr>
<th>Wool growth (mg/cm²/d)</th>
<th>Staple length (mm/8 wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMM-Ca</td>
<td>0.310 (0.038)</td>
</tr>
<tr>
<td>Liquimet</td>
<td>0.312 (0.027)</td>
</tr>
<tr>
<td>Control</td>
<td>0.286 (0.043)</td>
</tr>
</tbody>
</table>

![Graphs](image)

Fig. 1. Methionine and cystine levels in plasma of Merino wethers ruminally injected with DL-methionine, HMM-Ca and Liquimet
DISCUSSION

Wool growth rate, wool characteristics and wool cystine content were not significantly affected by dietary supplements of HMM-Ca (providing 2–3 g/day DL-methionine) either added as an ingredient of a pelleted diet or added in its loose form. As little as 0.6 g methionine reaching the abomasum has been reported to increase the sulphur content of wool significantly (Reis 1967), whereas, the increase in wool cystine content in the current experiments was negligible. Also, no significant changes were found in the plasma methionine and cystine levels in sheep up to 6 hours after a ruminal injection of HMM-Ca (equivalent to 6 g DL-methionine). Both DL-methionine and Liquimet increased the plasma methionine levels to a greater extent than did HMM-Ca. This result would indicate that the large amounts of methionine injected directly into the rumen as single doses may have caused a partial bypass of the methionine or a direct absorption of the methionine from the rumen. Furthermore, the lower values of plasma methionine with HMM-Ca, compared with ordinary DL-methionine or Liquimet, may suggest that HMM-Ca was not directly absorbed from the rumen. The possibility of using HMM-Ca as a methionine source has been investigated by other workers (Buttery et al. 1977; Robert et al. 1987). It is likely that the methionine contained in HMM-Ca is available for post-ruminal absorption. Thus, Robert et al. (1987) demonstrated that when HMM-Ca was infused into the abomasum of sheep, it significantly increased the plasma methionine level, but failed to increase it when given orally. This indicates that HMM-Ca can be utilized as a methionine source for ruminants if it reaches the abomasum.

The nature of the diet may influence the efficiency of HMM-Ca being utilized by ruminants. However, the present studies show that HMM-Ca is only slightly, if at all, protected from degradation in the rumen, and it would not appear to be an effective source of methionine for wool growth.

ACKNOWLEDGEMENTS

Degussa Pty Ltd provided the experimental materials and assayed the amino acid composition of wool and feed samples. Mr. P.J. Connell of the Division of Animal Production, CSIRO kindly carried out the plasma amino acid analysis. They are gratefully acknowledged.

REFERENCES