THE ROLE OF RUMEN MODIFIERS IN SUPPLEMENTARY FEEDING PROGRAMMES IN NORTHERN AUSTRALIA

J.A. LINDSAY*, B. GULBRANSEN**, J.F. KIDD*, N. STANDFAST** and T.J. MULLINS*

SUMMARY

Several of the growth enhancing feed additives classed as rumen modifiers were evaluated when added to dry season supplements offered to cattle in northern Australia. Rumen modifiers increased liveweight gain (LWG) by up to 0.17 kg/d. This occurred in both pen feeding and pasture grazing experiments. Rumen modifiers have a place in supplementary feeding programmes either to enhance LWG or to reduce the cost of supplementation. Side benefits such as the coccidiostat effects may also be important in some situations.

INTRODUCTION

Rumen modifiers are defined as feed additives which alter the fermentation pattern and hence the production of volatile fatty acids within the rumen. The usual effect is to enhance propionate production but they may also improve the nitrogen economy of the animal. Commercial formulations of monensin, lasalocid and avoparcin are currently registered for use in beef cattle in Queensland. This paper discusses the role of these rumen modifiers as additives to supplementary feeds offered to beef cattle in northern Australia.

Requirement for supplementary feeding

The growth of beef cattle in the dry tropics of northern Australia is characterised by a period of rapid liveweight gain during the wet season followed by liveweight loss as the dry season progresses. The extent of this liveweight loss is determined by shower activity and the time at which the next wet season starts. It is common for growing cattle to lose as much as 20% of body weight and in severe years breeders and young cattle may even die.

Although native pasture is usually abundant during the early dry season its fibrous nature and low N content limits intake by the animal. The accepted remedy is to feed supplementary N to boost intake and also feed energy if pasture becomes scarce. The common supplements are urea, urea plus molasses and protein meal such as meat meal or cottonseed meal. Molasses is the most common source of supplementary energy.

* Queensland Dept Primary Industries, Swan’s Lagoon, Millaroo 4807
** Queensland Dept Primary Industries, Brian Pastures, Gayndah 4625

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BOVATEC Registered trademark of Roche Products Pty Limited.
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Due to the high cost of these supplements especially in the inland areas there is an incentive to reduce costs by improving the efficiency with which these supplements are used by the animal. Improved efficiency of use of the supplement means that less supplement is required and less pasture is eaten for the same improvement in body condition and liveweight.

Supplements are usually fed solely to ensure the survival of susceptible animals, but they can also be used to boost annual liveweight gains. The current economic climate is conducive to spending money on growing cattle to ensure that they reach market weights more quickly or are heavier at a given age, allowing access to further markets.

Conduct of experiments to evaluate the role of rumen modifiers

Both pen studies and pasture grazing experiments were conducted. The pen studies simulated the conditions of a dry season pasture and low quality hay (0.4% N, 45% DMD) was usually used. The animals were Bos indicus crossbred steers or heifers typical of the region (5/8 Brahman). The cattle were penned or grazed in groups and supplements were fed daily or twice weekly. Liveweight measurements were made weekly or fortnightly in pen studies and four to six weekly in the grazing studies.

High energy molasses based diets

In some situations paddock feed is limited and graziers resort to feeding higher levels of molasses based rations. It is well known that molasses tends to produce an inefficient butyrate type ruminal fermentation when fed to cattle (Marty and Preston, 1970). In our initial study we used monensin and avoparcin to enhance propionate production and so boost performance on molasses based rations (Table 1).

Table 1 Mean liveweight gain (LWG) and fresh molasses intake of growing steers fed molasses based diets containing monensin and avoparcin.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Active ingredient (mg/kg molasses)</th>
<th>Molasses intake** (kg/day)</th>
<th>LWG (g/day)</th>
<th>FC**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experiment 1 (Mullins et al. 1986)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>2.1a</td>
<td>236a*</td>
<td>13.8a</td>
</tr>
<tr>
<td>Monensin</td>
<td>45</td>
<td>2.9b</td>
<td>401b</td>
<td>10.0b</td>
</tr>
<tr>
<td><strong>Experiment 2 (Lindsay, Mullins and Dodemaide, unpublished)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>3.7</td>
<td>301a</td>
<td>15.9a</td>
</tr>
<tr>
<td>Monensin</td>
<td>50</td>
<td>3.2</td>
<td>429b</td>
<td>10.0b</td>
</tr>
<tr>
<td>Avoparcin</td>
<td>58</td>
<td>3.4</td>
<td>395b</td>
<td>11.4b</td>
</tr>
<tr>
<td>Avoparcin</td>
<td>03</td>
<td>3.0</td>
<td>453b</td>
<td>10.8b</td>
</tr>
</tbody>
</table>

* Means within experiment with dissimilar superscripts are significantly different (P<0.05)
** Feed conversion ratio (kg feed required/kg LWG)
*** Ration included molasses plus 3% urea fed ad libitum and 800 g chaffed hay plus 300 g (Expt 2) or 400 g (Expt 1) cottonseed meal fed daily.
With high intakes of molasses based diets the addition of either monensin or avoparcin significantly increased liveweight gain (LWG) and improved feed conversion ratio. The inclusion of monensin also eliminated bloating and reduced the risk of molasses toxicity.

**Survival supplements**

The common supplements which are fed to ensure survival are urea, molasses plus 8% urea (M8U) and protein meals such as cottonseed meal. A series of experiments measured the response to adding rumen modifiers to supplements of M8U, cottonseed meal (CSM) and urea plus protected protein (UPP).

Results from the pen studies are shown in Table 2.

Table 2 Effect of adding avoparcin to protein and energy supplements fed to cattle in pens.

<table>
<thead>
<tr>
<th>Supplement</th>
<th>LWG (kg/day)</th>
<th>Supplement Intake (kg/d)</th>
<th>Roughage dry matter intake (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>-0.07a*</td>
<td>0</td>
<td>3.1</td>
</tr>
<tr>
<td>CSM</td>
<td>0.19b</td>
<td>0.5</td>
<td>4.0</td>
</tr>
<tr>
<td>CSM + avoparcin</td>
<td>0.34c</td>
<td>0.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Experiment 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nil</td>
<td>-0.40a</td>
<td>0</td>
<td>1.24a</td>
</tr>
<tr>
<td>UPP</td>
<td>0.09cd</td>
<td>0.57</td>
<td>2.14b</td>
</tr>
<tr>
<td>UPP + avoparcin</td>
<td>0.17d</td>
<td>0.57</td>
<td>2.63e</td>
</tr>
<tr>
<td>M8U</td>
<td>-0.02b</td>
<td>1.5</td>
<td>2.30cd</td>
</tr>
<tr>
<td>M8U + avoparcin</td>
<td>0.15de</td>
<td>1.5</td>
<td>2.55de</td>
</tr>
</tbody>
</table>

* Within experiments and within columns, means with different superscripts are significantly different (P<0.05).

The addition of avoparcin to these supplements increased LWG by between 0.08 kg/d and 0.17 kg/d when compared with supplement alone. This finding is similar to that obtained in Europe on better rations (Mudd and Smith, 1982) and demonstrates the improved efficiency of use of the diet by the animals given avoparcin.

A pen study using M8U showed that the addition of monensin at 50 mg/kg increased LWG from 0.06 to 0.14 kg/d when steers were offered ad libitum hay and M8U. The addition of 150 mg/d lasalocid to either CSM or M8U supplements for steers grazing native pasture increased LWG by 0.04 and 0.08 kg/d respectively.

Further results were obtained in grazing studies (Table 3).
Table 3 Responses to the addition of avoparcin to supplements fed to cattle grazing dry season native pastures.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Supplement intake (kg/d)</th>
<th>LWG (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>0</td>
<td>0.32a*</td>
</tr>
<tr>
<td>M8U</td>
<td>1.2</td>
<td>0.35a</td>
</tr>
<tr>
<td>MSU + avoparcin</td>
<td>1.2</td>
<td>0.44bc</td>
</tr>
<tr>
<td>UPP</td>
<td>0.57</td>
<td>0.40b</td>
</tr>
<tr>
<td>UPP + avoparcin</td>
<td>0.57</td>
<td>0.48c</td>
</tr>
</tbody>
</table>

Experiment 1 (Lindsay and Kidd, unpublished)

Liveweight gain in the dry season was increased by up to 0.09 kg/d when avoparcin was fed with either M8U or CSM supporting the findings from the pen studies.

Three rumen modifiers were compared in a grazing study using cottonseed meal plus urea (UPP) as the supplement (Table 4). The levels chosen were those found to be optimum from our previous work.

Table 4 Liveweight responses when one of three rumen modifiers is added to urea protected protein supplement and offered to weaner steers grazing dry season native pasture (Lindsay and Kidd, unpublished)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Intake of active ingredient (mg/d)</th>
<th>Supplement intake (kg/d)</th>
<th>LWG (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP</td>
<td>0</td>
<td>0</td>
<td>0.24ay**</td>
</tr>
<tr>
<td>UPP</td>
<td>0</td>
<td>0.57</td>
<td>0.36b</td>
</tr>
<tr>
<td>UPP + avoparcin</td>
<td>200</td>
<td>0.57</td>
<td>0.45bx</td>
</tr>
<tr>
<td>UPP + lasalocid</td>
<td>150</td>
<td>0.57</td>
<td>0.41bx</td>
</tr>
<tr>
<td>UPP + monensin</td>
<td>100</td>
<td>0.57</td>
<td>0.37b</td>
</tr>
</tbody>
</table>

** Superscripts a or b indicate significance at P<0.05 and x and y at P<0.01.

There was a significant increase in LWG when the UPP was fed but no further significant response due to the addition of any of the rumen modifiers although there was a trend for LWG to increase up to 0.09 kg/d when avoparcin was added.
Side benefits of incorporating rumen modifiers in supplements

Our results show that incorporating monensin into molasses-based diets eliminates bloating. Monensin is less palatable and its inclusion in molasses diets reduces intake and the rate of consumption, so reducing the risk of molasses toxicity. Several studies (Parker et al. 1986) have shown; the benefit of monensin in controlling coccidiosis in young weaners. It can be expected that lasalocid will also act as a coccidiostat (Fitzgerald and Mansfield, 1979) under these conditions. The main side benefit of avoparcin is the noticeable improvement in coat condition which may increase prices paid at store sales.

Delivery systems and frequency of feeding

Rumen modifier premixes have usually been designed for the feedlot market. The commercial formulation includes a relatively inert carrier such as ground rice husk. This means that rumen modifiers are usually given to the animal in the dry form, although liquid supplements and blocks can also be used. The main exceptions are monensin, which is also available in a controlled release capsule (Rumensin ABC*) for individual long term dosing, and avoparcin, which is water soluble and so can also be delivered via the drinking water. Several dispensers currently available make water medication commercially practicable.

In all of the pasture work reported here the rumen modifiers were fed twice weekly. However, one pen trial at Brian Pastures Research Station (Standfast and Gulbransen, unpublished) showed that spraying avoparcin onto hay increased LWG to the same extent, whether applied daily, twice weekly or weekly. In this work the weekly intakes of avoparcin were the same, irrespective of the frequency of application.

Practical considerations

We have demonstrated that the feeding of a rumen modifier with dry season supplements and high energy molasses based diets can improve the LWG of beef cattle by up to $0.17$ kg/d. The economic importance of these improvements in LWG can be estimated by assuming appropriate values for costs and returns. We calculated nett returns (bonuses) assuming that LWG was valued at $1.10$/kg and the commercial prices for each rumen modifier were used. Nett returns ranged from $3.50$ per head when lasalocid was added to MSU to $14.20$ with the addition of monensin to high energy molasses diets (Table 5). In practice many graziers aim to maintain the liveweight of their cattle rather than increase liveweight, and further studies are required to establish whether use of a rumen modifier will actually allow levels of supplementation to be reduced without reducing LWG.

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Table 5 Calculated benefits of adding a rumen modifier to dry season supplements offered to young cattle for 100 days.

<table>
<thead>
<tr>
<th>Supplement</th>
<th>Rumen modifier</th>
<th>Liveweight advantage over control (kg/head)</th>
<th>Cost of Rumen modifier ($/100 days)</th>
<th>Bonus after costs ($/head)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High energy molasses diet</td>
<td>Monensin</td>
<td>15</td>
<td>2.34</td>
<td>14.20</td>
</tr>
<tr>
<td></td>
<td>Avoparcin</td>
<td>15</td>
<td>6.39</td>
<td>9.60</td>
</tr>
<tr>
<td>Protected protein in dry season</td>
<td>Avoparcin</td>
<td>12</td>
<td>3.30</td>
<td>9.90</td>
</tr>
<tr>
<td></td>
<td>Lasalocid</td>
<td>8</td>
<td>0.90</td>
<td>7.90</td>
</tr>
<tr>
<td>M8U in dry season</td>
<td>Avoparcin</td>
<td>12</td>
<td>3.30</td>
<td>9.90</td>
</tr>
<tr>
<td></td>
<td>Monensin</td>
<td>8</td>
<td>0.99</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>Lasalocid</td>
<td>4</td>
<td>0.90</td>
<td>3.50</td>
</tr>
</tbody>
</table>

CONCLUSIONS

Rumen modifiers can improve the LWG of beef cattle in tropical Australia when fed with dry season supplements or high-energy molasses diets. They bring real improvements in LWG, but more work is needed to test their potential for reducing the quantity and cost of supplements fed, while maintaining animal performance. In some situations the side benefits of adding a rumen modifier can be just as important as the improvement in LWG. Young weaners, for example, may benefit from the addition of monensin or lasalocid to control coccidiosis.

ACKNOWLEDGEMENTS

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REFERENCES