Protein:energy ratios have renewed attention for heifer development

By AL KERTZ

The effect of dietary protein to energy ratios for growing dairy heifers has gotten renewed attention over the last five years. A recent article (Gabler and Heinrichs, 2003a) evaluated another aspect of this ratio.

In general, heifers are fed their diet ad libitum. There is some difference of opinion as to whether dry matter intake (DMI) should be restricted so as to limit growth without fattening. With high-quality forages available today and the high level of DMI by heifers, this is not an academic issue. Some diets require the use of lower-quality roughages to dilute energy content; otherwise, energy intake is too great, resulting in fattening when diets are fed ad libitum.

The objective of the study by Gabler and Heinrichs (2003a) was to determine the dietary crude protein (CP):metabolizable energy (ME) ratio for optimal growth and development in prepubertal Holstein heifers between 275 and 515 lb. bodyweight. Sixty Holstein heifers, averaging 123-125 days of age at the start of the study, were used. The study was initiated following a two-week period in which heifers were adapted to Calan gates for individual feeding while being group housed in a naturally ventilated barn with a bedding pack.

Corn silage and grass hay comprised 34 and 26% of diet dry matter (DM) with soybean meal being the main supplemental protein source. Four treatments had the same ME level of 1.18 Mcal/lb. for each dietary CP level of 12.0, 15.1, 17.4 and 19.7%. This resulted in ratios of 48.3, 59.1, 67.5 and 76.5 g CP/Mcal ME. The amount of ration offered to each heifer was adjusted weekly to achieve the target average daily gain (ADG) of 1.76 lb. Feeding period length was 140 days. Results are in Table 1.

1. Performance of heifers

<table>
<thead>
<tr>
<th>CP:ME, g CP/Mcal ME</th>
<th>48.3</th>
<th>59.1</th>
<th>67.5</th>
<th>76.5</th>
<th>CV, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial bodyweight, lb.</td>
<td>276</td>
<td>270</td>
<td>281</td>
<td>274</td>
<td>11.6</td>
</tr>
<tr>
<td>Final bodyweight, lb.</td>
<td>502</td>
<td>518</td>
<td>530</td>
<td>511</td>
<td>12.6</td>
</tr>
<tr>
<td>ADG, lb. per day</td>
<td>1.62</td>
<td>1.78</td>
<td>1.79</td>
<td>1.70</td>
<td>15.2</td>
</tr>
<tr>
<td>DMI, lb. per day</td>
<td>7.27</td>
<td>7.51</td>
<td>7.66</td>
<td>7.46</td>
<td>11.4</td>
</tr>
<tr>
<td>DM, % of bodyweight</td>
<td>1.97</td>
<td>1.98</td>
<td>1.95</td>
<td>2.00</td>
<td>5.9</td>
</tr>
<tr>
<td>Feed:gain</td>
<td>4.76</td>
<td>4.42</td>
<td>4.35</td>
<td>4.33</td>
<td>14.8</td>
</tr>
<tr>
<td>PUN, mg/dl</td>
<td>9.9</td>
<td>13.3</td>
<td>14.9</td>
<td>16.6</td>
<td>21.5</td>
</tr>
</tbody>
</table>

There were no significant linear, quadratic or cubic contrast effects for body weight and ADG. Amount of DMI did show a quadratic effect (P < 0.04) by treatments, but not as a percent of body weight. There was a linear decrease (P < 0.02) in amount of feed required per unit of gain accompanied by a higher (P < 0.01) plasma urea nitrogen (PUN) level with increasing CP:ME.

The authors used the National Research Council’s (NRC) dairy model (2001) to evaluate ADG. The model underestimated energy-allowed ADG by an average 33% with a linear trend by treatments of 39, 36, 31 and 25%, respectively. ME required for observed ADG, according to the model, averaged 13% more than required for the observed ADG with a linear trend of 19, 12, 10 and 12% by treatments, respectively.

Interestingly, as the ratio of CP:ME increased, the model came relatively closer to predicting the observed ADG. However, even at the highest CP:ME ratio, the model considerably over-predicted energy required for ADG.

Absolute DMI did show a quadratic effect (P < 0.04), but this small numerical effect did not hold up when DMI was calculated as a percentage of body weight. The linear effect (P < 0.02) of increasing feed efficiency (i.e., less feed required per unit of gain) shows some positive effect to the higher protein level. However, the linear increase (P < 0.01) of PUN indicates that there was likely an increased loss of urinary nitrogen as well. Thus, it appears that as the CP:ME ratio increased, there was not enough ME intake to potentially utilize the higher dietary CP levels for greater growth.

Now for the caveat in this study. The authors observed that the limited feeding level in this study, in order to achieve the targeted ADG of 1.76 lb., resulted in the rapid consumption by the heifers of...
the entire ration within three hours of feeding. The 2001 NRC-projected DMI values from table 14-13 ranged from 2.5 to 2.8% of bodyweight for similar bodyweight heifers as used in this study. So, limited intake did result in the targeted ADG, but it also may well have limited the effect of increasing CP:ME as the authors acknowledged.

Growth measurements showed a similar pattern as the performance parameters (Table 2).

The lack of significant differences (P < 0.05) indicates several points. First, there were no differences due to dietary treatments, but it also indicates that differences were most likely limited because of DMI limitation. This is supported by the very low coefficient of variation (CV) for all categories. It is not likely that genetic differences were that narrow in these heifers, but rather more likely that the ability to express genetic differences was limited by DMI and nutrition level. CP intake was certainly not limiting at the higher levels, but total energy for greater ADG would have been.

Sejrsen et al. (2000) found that genetic variation alone accounted for a range of 0.2 lb. ADG in comparing the bottom and top 10% of heifers in their studies when the same ration was fed.

The authors acknowledged that in a previous study (Lammers and Heinrichs, 2000) there was a linear increase (P < 0.01) in ADG along with increased (P < 0.01 or 0.02) DMI, feed efficiency, hip width, hip height, wither height and heart girth growth when increasing CP:ME from 46 to 54 and to 61. However, they rightly attributed this difference to the restricted ADG in this 2003a study. Dietary energy level was similar in both studies, but DM from corn silage was 10% higher and CP levels were 11.8, 13.8 and 15.6% in the 2000 study. However, the main difference was that DMI as a percentage of bodyweight averaged about 2.37 for each treatment in the 2000 study. Consequently, ADG of 2.22, 2.27 and 2.44 lb., respectively, were considerably higher than the 1.76 lb. in the 2003a study.

Body condition scores (BCS) were a bit higher at 3.1-3.2, indicating the possible borderline beginning of some fattening. These heifers were about 74 days older than in the 2003a study; so a higher BCS may be partially expected with greater age along with higher DMI and ADG. Lastly, the highest CP:ME of 61 in the 2000 study is consistent for that age and bodyweight as recommended by VandeHaar (2001) and addressed in a previous Feedstuffs column (Kertz, 2002).

Two subsequent studies (Gabler and Heinrichs, 2003b; Gabler and Heinrichs, 2003c) lent supporting evidence for this CP:ME ratio as optimal based on rumen nitrogen dynamics and nutrient utilization.

The Bottom Line

The ratio of CP:ME is a good benchmark for diets with growing heifers, but the absolute level of CP and ME coupled with DMI will largely determine body growth results and the appropriateness of the feeding program.

REFERENCES


