High Energy Digestible Fiber-based Diets Improve Efficiency in Growing Heifers

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Abstract
An inherent challenge of long hauled, highly stressed calves is decreased feed intake upon destination arrival. Highly stressed, newly received stocker calves not consuming adequate amounts of energy are prone to a variety of disorders such as Bovine Respiratory Disease Complex and decreased performance throughout the feeding period. One mechanism that can be used to increase energy intake upon arrival is to make the diet more energy dense. Often times, this is accomplished by the addition of cereal grains high in fermentable carbohydrate including starch. Unfortunately, this has also been linked to increasing morbidity due to metabolic disorders. The goal of this study was to analyze the effects of limit-fed diets containing increasing amounts of energy from highly digestible fiber in by-product feeds on health and performance of newly received stocker calves.

Keywords
wet corn gluten feed, health, limit-feeding

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This cattle nutrition is available in Kansas Agricultural Experiment Station Research Reports: https://newprairiepress.org/kaesrr/vol3/iss1/19
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Introduction
An inherent challenge of long hauled, highly stressed calves is decreased feed intake upon destination arrival. Highly stressed, newly received stocker calves not consuming adequate amounts of energy are prone to a variety of disorders such as Bovine Respiratory Disease Complex and decreased performance throughout the feeding period. One mechanism that can be used to increase energy intake upon arrival is to make the diet more energy dense. Often times, this is accomplished by the addition of cereal grains high in fermentable carbohydrate including starch. Unfortunately, this has also been linked to increasing morbidity due to metabolic disorders. The goal of this study was to analyze the effects of limit-fed diets containing increasing amounts of energy from highly digestible fiber in by-product feeds on health and performance of newly received stocker calves.

Key words: wet corn gluten feed, health, limit-feeding

Experimental Procedures
Four loads, containing 370 crossbred heifers assembled from Tennessee and Alabama sale barns and combined at a Dickson, TN order buyer facility (initial body weight = 491 ± 37 lb) were received at the Kansas State University Beef Stocker Unit in the summer of 2016. On arrival cattle were weighed and given an individual animal identification number. The following morning cattle were vaccinated against common viral and clostridial diseases (Pyramid 5 + Plesponse, Vetmedica, St. Joseph, MO; Baytril 100, Bayer Healthcare, Animal Health Division, Shawnee Mission, KS; Vison 7 with Somnus, Merck Animal Health, Madison, NJ) and dewormed (Safeguard, Merck Animal Health, Madison, NJ). Each load represented a block that was stratified by weight and randomly assigned to 8 pens. Pens were randomly assigned to one of 4 treatments with 8 pens per treatment (10-13 heifers per pen). The 4 treatments supplied 45, 50, 55, and 60 Mcals net energy for gain/100 lb of feed. The 45 treatment was provided ad libitum and the other 3 were fed at decreasing levels based on the intake of 45 treatment as follows: 50 treatment fed at 95%, 55 treatment at 90%, and 60 treatment at 85%. All treatments were formulated to contain 40% wet corn gluten feed on a dry matter basis (Table 1).
Treatments were fed each morning at approximately 7:00 a.m. Before feeding each day, all bunks containing refusals were cleaned and their contents weighed. Actual dry matter consumption was calculated for the control group to dictate feed delivery to the other treatments as described above. The duration of the trial was 55 days including a 14-day gut fill equalization period in which the 45 treatment diet was fed to all animals. Animals were weighed on days 0, 14, 27, 41, and 55. Performance and health data were analyzed in the MIXED procedure of SAS (version 9.3; SAS Institute, Cary, NC) with the fixed effect of dietary treatment and the random effect of block. The pen was the experimental unit.

**Results and Discussion**

The effects of energy density of the diets and intake are shown in Table 2. Overall, cattle performed similarly on all treatments and there were no differences in morbidity or mortality. However, interactions were detected between dietary treatment and efficiency of feed conversion since the animals performed similarly on varying levels of dry matter intake.

**Implications**

Limit feeding high-energy diets based primarily on highly digestible fiber from by-product feeds such as wet corn gluten can offer a more efficient approach to feeding newly received calves without increasing morbidity or mortality. The possibility of decreased step-up or transition diets traditionally used to adapt feeder calves to a higher-energy finishing ration on entry to the feedlot could offer additional benefit since these calves would presumably be adapted to a higher-energy ration beforehand.
### Table 1. Experimental diets

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Treatment¹</th>
<th>100% dry matter basis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45/100</td>
<td>50/95</td>
</tr>
<tr>
<td>Dry-rolled corn</td>
<td>8.57</td>
<td>19.08</td>
</tr>
<tr>
<td>Low-energy supplement</td>
<td>6.43</td>
<td>6.92</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>22.50</td>
<td>17.00</td>
</tr>
<tr>
<td>Prairie hay</td>
<td>22.50</td>
<td>17.00</td>
</tr>
<tr>
<td>Wet corn gluten feed</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Calculated nutrient content**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>45/100</th>
<th>50/95</th>
<th>55/90</th>
<th>60/85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter, %</td>
<td>73.5</td>
<td>73.2</td>
<td>72.9</td>
<td>72.6</td>
</tr>
<tr>
<td>Protein, %</td>
<td>16.39</td>
<td>15.94</td>
<td>15.52</td>
<td>15.07</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.91</td>
<td>0.86</td>
<td>0.82</td>
<td>0.79</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.53</td>
<td>0.54</td>
<td>0.55</td>
<td>0.56</td>
</tr>
<tr>
<td>Salt, %</td>
<td>0.32</td>
<td>0.35</td>
<td>0.38</td>
<td>0.41</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>1.39</td>
<td>1.24</td>
<td>1.11</td>
<td>0.96</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>0.26</td>
<td>0.25</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>Fat, %</td>
<td>2.89</td>
<td>2.99</td>
<td>3.08</td>
<td>3.18</td>
</tr>
<tr>
<td>Acid detergent fiber, %</td>
<td>21.41</td>
<td>17.62</td>
<td>14.17</td>
<td>10.38</td>
</tr>
<tr>
<td>Net energy main, Mcal/cwt</td>
<td>73.21</td>
<td>79.08</td>
<td>84.34</td>
<td>90.09</td>
</tr>
<tr>
<td>Net energy gain, Mcal/cwt</td>
<td>45.28</td>
<td>50.40</td>
<td>55.01</td>
<td>60.06</td>
</tr>
</tbody>
</table>

¹First number is net energy for gain in Mcal/100 lb dry matter. Second number is dry matter intake as percent of 100.
Table 2. Effects of dietary net energy for gain and intake on newly arrived heifer performance and health

<table>
<thead>
<tr>
<th>Item</th>
<th>Treatment¹</th>
<th>45/100</th>
<th>50/95</th>
<th>55/90</th>
<th>60/85</th>
<th>SEM²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0 body weight, lb</td>
<td></td>
<td>490</td>
<td>493</td>
<td>490</td>
<td>491</td>
<td>5.37</td>
</tr>
<tr>
<td>Day 14 body weight, lb</td>
<td></td>
<td>539b</td>
<td>528bc</td>
<td>520bc</td>
<td>515c</td>
<td>8.70</td>
</tr>
<tr>
<td>Day 27 body weight, lb</td>
<td></td>
<td>555b</td>
<td>555b</td>
<td>549bc</td>
<td>545c</td>
<td>9.35</td>
</tr>
<tr>
<td>Day 41 body weight, lb</td>
<td></td>
<td>590</td>
<td>591</td>
<td>585</td>
<td>586</td>
<td>7.27</td>
</tr>
<tr>
<td>Day 55 body weight, lb</td>
<td></td>
<td>614</td>
<td>617</td>
<td>616</td>
<td>623</td>
<td>8.21</td>
</tr>
<tr>
<td>Day 14 average daily gain, lb/day</td>
<td></td>
<td>3.48b</td>
<td>2.48</td>
<td>2.15</td>
<td>1.70</td>
<td>0.33</td>
</tr>
<tr>
<td>Day 27 average daily gain, lb/day</td>
<td></td>
<td>2.40b</td>
<td>2.29bc</td>
<td>2.20bc</td>
<td>2.00c</td>
<td>0.22</td>
</tr>
<tr>
<td>Day 41 average daily gain, lb/day</td>
<td></td>
<td>2.44</td>
<td>2.39</td>
<td>2.31</td>
<td>2.31</td>
<td>0.13</td>
</tr>
<tr>
<td>Day 55 average daily gain, lb/day</td>
<td></td>
<td>2.26</td>
<td>2.25</td>
<td>2.29</td>
<td>2.40</td>
<td>0.11</td>
</tr>
<tr>
<td>Day 14 dry matter intake, lb/day</td>
<td></td>
<td>10.60b</td>
<td>10.07bc</td>
<td>9.70c</td>
<td>9.00d</td>
<td>0.62</td>
</tr>
<tr>
<td>Day 27 dry matter intake, lb/day</td>
<td></td>
<td>12.24b</td>
<td>11.34c</td>
<td>10.85cd</td>
<td>10.14d</td>
<td>0.54</td>
</tr>
<tr>
<td>Day 41 dry matter intake, lb/day</td>
<td></td>
<td>13.67b</td>
<td>12.60c</td>
<td>11.92cd</td>
<td>11.25d</td>
<td>0.50</td>
</tr>
<tr>
<td>Day 55 dry matter intake, lb/day</td>
<td></td>
<td>14.51b</td>
<td>13.51c</td>
<td>12.88cd</td>
<td>12.51d</td>
<td>0.46</td>
</tr>
<tr>
<td>Day 14 feed:gain</td>
<td></td>
<td>3.16</td>
<td>4.60</td>
<td>4.72</td>
<td>9.18</td>
<td>1.93</td>
</tr>
<tr>
<td>Day 27 feed:gain</td>
<td></td>
<td>5.19</td>
<td>5.06</td>
<td>5.19</td>
<td>5.29</td>
<td>0.41</td>
</tr>
<tr>
<td>Day 41 feed:gain</td>
<td></td>
<td>5.67</td>
<td>5.32</td>
<td>5.31</td>
<td>4.91</td>
<td>0.32</td>
</tr>
<tr>
<td>Day 55 feed:gain</td>
<td></td>
<td>6.48b</td>
<td>6.11bc</td>
<td>5.65cd</td>
<td>5.22d</td>
<td>0.22</td>
</tr>
<tr>
<td>Day 14 gain:feed</td>
<td></td>
<td>0.329b</td>
<td>0.241bc</td>
<td>0.225c</td>
<td>0.182c</td>
<td>0.0333</td>
</tr>
<tr>
<td>Day 27 gain:feed</td>
<td></td>
<td>0.197</td>
<td>0.201</td>
<td>0.202</td>
<td>0.196</td>
<td>0.0158</td>
</tr>
<tr>
<td>Day 41 gain:feed</td>
<td></td>
<td>0.179b</td>
<td>0.189bc</td>
<td>0.195bc</td>
<td>0.206d</td>
<td>0.0105</td>
</tr>
<tr>
<td>Day 55 gain:feed</td>
<td></td>
<td>0.156b</td>
<td>0.166bc</td>
<td>0.178cd</td>
<td>0.192d</td>
<td>0.0064</td>
</tr>
<tr>
<td>Day 14 intake as % of body weight</td>
<td></td>
<td>2.06b</td>
<td>1.97bc</td>
<td>1.92c</td>
<td>1.79d</td>
<td>0.09</td>
</tr>
<tr>
<td>Day 27 intake as % of body weight</td>
<td></td>
<td>2.34b</td>
<td>2.16c</td>
<td>2.09d</td>
<td>1.96d</td>
<td>0.08</td>
</tr>
<tr>
<td>Day 41 intake as % of body weight</td>
<td></td>
<td>2.53b</td>
<td>2.32c</td>
<td>2.22cd</td>
<td>2.09d</td>
<td>0.07</td>
</tr>
<tr>
<td>Day 55 intake as % of body weight</td>
<td></td>
<td>2.63b</td>
<td>2.43c</td>
<td>2.33cd</td>
<td>2.25d</td>
<td>0.06</td>
</tr>
</tbody>
</table>

¹First number is net energy for gain in Mcal/100 lb dry matter. Second number is dry matter intake as percent of 100.
²SEM=standard error of the mean.
³bcdMeans within a row with uncommon superscripts differ (P<0.05).