Effects of Dietary Energy Density on Carcass Composition and Beef Palatability Characteristics

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Effects of Dietary Energy Density on Carcass Composition and Beef Palatability Characteristics

Gary L. Bennett

Introduction

Currently there is increased emphasis on production of lean beef with desirable palatability characteristics. Changes in both the type of animal produced and the feeding and management of these animals may be needed to efficiently produce this product. One change in feeding that could be made is the energy density of the feed, measured as megacalories of metabolizable energy per pound (Mcal ME/lb). At low energy densities, the amount of feed that can be consumed limits the animal’s intake of metabolizable energy.

Over the past two decades, several experiments at MARC have examined a number of factors, including energy density, that can affect carcass composition and palatability. The purpose of this report is to review these experiments and summarize the effects of energy density on carcass composition and palatability traits.

Experiments

Essential features of seven experiments comparing effects of dietary energy on carcass composition or meat palatability are shown in Table 1. More than 1,800 cattle were used in the seven experiments. Energy densities ranged from 1.09 Mcal ME/lb (77% corn silage, 20% alfalfa haylage) to 1.45 Mcal ME/lb (83% corn, 11% corn silage). Energy density was varied primarily by changing the proportions of corn silage and either corn or other grain. Most cattle used were steers. Several experiments used breeds with a range in mature size. This allowed the researchers to see if the effects of energy density were the same for different growth potentials.

Results

Percentage differences in daily wt gain, daily feed intake, and feed conversion (lb of feed per lb of gain) between the highest and lowest energy density rations are shown in Table 2. Higher energy rations resulted in higher rates of gain in every experiment. Higher energy rations also tended to increase daily intake of ME and reduce the lb of feed needed per lb of gain. Results from one experiment (VII) suggested that larger type cattle increased growth rate and ME intake more than smaller types when energy density was increased, while results from another (II) suggested the opposite.

Carcass measurements were compared at equal carcass wt, equal time on feed, or at equal percentage fat in the rib section (Table 3). Higher energy rations resulted in higher percentages of fat in the rib or greater fat depth when compared at either the same carcass wt or days on feed. Experiment VII compared carcasses at the same percentage of fat in the rib section and showed that carcasses from higher energy rations were lighter, while experiment VI showed no difference in carcass wt. Higher

Table 1—Essential features of seven experiments comparing energy densities of rations

<table>
<thead>
<tr>
<th>Experiments</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. animals</td>
<td>387</td>
<td>150</td>
<td>385</td>
<td>444</td>
<td>248</td>
<td>72</td>
<td>162</td>
</tr>
<tr>
<td>Breeds or mature sizes</td>
<td>Small</td>
<td>Large</td>
<td>Hereford</td>
<td>X Angus, Chianina, Charolais</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
</tr>
<tr>
<td>Sex</td>
<td>steers</td>
<td>steers</td>
<td>steers</td>
<td>steers</td>
<td>steers</td>
<td>steers</td>
<td>steers</td>
</tr>
<tr>
<td>Initial age, mo</td>
<td>8.5</td>
<td>8.5</td>
<td>post-weaning</td>
<td>post-weaning</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial wt, lb</td>
<td>567</td>
<td>586</td>
<td>456</td>
<td>505</td>
<td>536</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>Days on feed</td>
<td>266-315</td>
<td>232-308</td>
<td>244</td>
<td>287</td>
<td>194</td>
<td>174-238</td>
<td>270</td>
</tr>
<tr>
<td>Energy densities, Mcal ME/lb</td>
<td>1.09</td>
<td>1.32</td>
<td>1.21</td>
<td>1.22</td>
<td>1.26</td>
<td>1.44</td>
<td>1.37</td>
</tr>
<tr>
<td>Variable components</td>
<td>Corn &amp; corn silage</td>
<td>Corn &amp; corn silage</td>
<td>Grain &amp; corn silage</td>
<td>Grain &amp; corn silage</td>
<td>Corn &amp; corn silage</td>
<td>Corn &amp; corn silage</td>
<td></td>
</tr>
</tbody>
</table>

References

energy density resulted in lower percentage of trimmed retail product or estimated cutability (experiments I, II, III, IV, V).

Experiment I also compared deferred feeding to putting cattle directly into the feedlot. These cattle were fed a low energy ration (0.99 Mcal ME/lb) for 134 days, grazed for 134 days, and then fed higher energy rations in the feedlot. The deferred cattle had 5 to 10% more retail product than steers put directly into the feedlot when compared at the same carcass wt.

Sequential slaughter dates and analyses of experiments I and II allowed for interpretation of changes in trimmed retail weights. In experiment I, the gain in trimmed retail wt was .57 lb/day for the lowest energy density and .60 lb/day for the highest energy density. The difference in carcass growth rate was much greater than this and leads to the conclusion that much of the increased growth rate was due to faster deposition of fat. In experiment II, the avg difference of 60 lb soft tissue wt between carcasses from high and low energy rations was composed of 49 lb fat and only 11 lb protein and water. This result also suggests that much of the increase in growth rate from high energy rations is due to additional increase in fat. Experiments III and IV, evaluated at the same number of days on feed, also showed little difference in nonfat carcass wt between higher and lower density rations.

Taste panel scores and mechanical tenderness of beef were evaluated in three of the experiments (Table 4). There was little difference in taste panel scores or tenderness of beef produced by high and low energy density rations. When compared at the same age, beef produced on high energy rations had higher marbling, but this did not correlate with better taste panel scores.

**Discussion**

It is clear from these experiments that increased energy density of a ration resulted in faster growth rate. It also appeared that a disproportionate amount of this extra growth is fat and not retail meat. However, a large proportion of carcass wt gain is fat even when lower energy rations are fed. Experiments need to be conducted with large numbers of cattle in order to consistently detect this difference. Taste panel scores of beef produced from lower energy rations were not different from those fed higher energy rations, if the lower energy rations did not greatly restrict change in weight of retail meat.

The pricing of beef carcasses and grain will ultimately be the determining factor in deciding the energy density of rations. Lower energy densities will be economically viable when payment is based on retail product wt rather than on carcass wt. Pricing of the carcasses is an important consideration because increasing the energy density of rations in these experiments increased carcass wt but did not appreciably increase wt of retail product.

Current work in the Production Systems Unit is directed toward incorporating results from several areas of research into computer simulation models of growth, carcass composition, and palatability. Computer models will then be used to determine the best ways to efficiently produce lean beef with desirable eating characteristics.