Take Home Message

- The main reason for feeding barley to feeder cattle is to improve gains by providing a concentrated source of energy which comes from the starch.
- About 90% of this starch is degraded in the rumen.
- Rapid starch degradation in the rumen is believed to be undesirable since it lowers rumen pH, depresses fibre digestion, causes liver abscesses and digestive disturbances such as acidosis, rumenitis and bloat.
- It may be possible to select barleys with slower rates of degradation for feeding to cattle since differences in dry matter (DM) degradation rates between barley varieties have been reported.

Introduction

Barley is the major cereal grain used for feeding beef cattle in Alberta. About one third of the barley produced in Alberta is fed to beef cattle. In spite of this, only limited research has been conducted on the factors affecting the feeding value of barley. Future barley breeding programs should consider nutritional quality to a greater extent than in the past.

Some researchers have reported differences in feed value among cultivars of barley for cattle. These have included differences of 10% for average daily gain (ADG), 5% for feed DM:gain ratio, and 10% for digestible energy (DE). Although the reasons for these differences have not been determined, it has been suggested that head morphology (two-row, six-row), growth habit (winter, spring), and intended end-use (malting, feed) are probably the most useful indicators of barley nutritional quality. Limited research is available comparing the feeding value of two-row vs. six-row or malt vs. feed barley in cattle diets in the same experiment. Hulless barley has become available as a feed grain in recent years and has proven to be superior to hulled barley for monogastric animals. Limited studies are available in which hulless barley has been fed to cattle.
A recent University of Alberta trial (24) measured the effects of several factors which might affect feedlot performance of barley;
- barley variety and type:
  - two-row vs. six-row,
  - hulless vs. hulled,
- malting vs. feed type.

These studies measured:
- rate of barley DM degradation in the rumen,
- and total tract digestibilities among barley varieties on:
  - dry matter intake,
  - average daily gain,
  - and DM intake:gain ratio.

The eight varieties of barley used in the experiment varied with respect to:
- bushel weight (BW; 44-54 lb/bu),
- crude protein (CP; 10.3-14.8%),
- acid detergent fibre (ADF; 5.2-8.0%),
- kernel hardness
- DM degradability after 0 - 24 hours in the rumen,
- and total tract digestibility of:
  - DM (80.5-87.4%),
  - organic matter (82.4-88.7%),
  - and nitrogen (73.7-84.8%).

Digestible energy (DE) also varied among varieties (1.42-1.57 Mcal/ lb).

No differences in dry matter intake (DMI), average daily gain (ADG), DMI:gain ratios or carcass characteristics were detected between steers fed the eight varieties of barley (Table 1).

There was as much variation in steer performance within the same barley variety as between varieties, as seen with the two lots of Duke and Harrington barley. In contrast, other researchers have observed differences in feed DMI:gain ratios among different barley cultivars for finishing cattle. In addition, differences in DMI, ADG, hot carcass weight, backfat, and rib eye area between barley cultivars fed to steers have been reported. Although the differences in feeding value among barley varieties for ruminants are small they are still economically important, especially in a period of high grain prices. We may see greater differences among barley varieties in the future as plant breeders select varieties based on their feeding value for ruminants.
### Table 1. Effect of barley variety and type on steer performance and carcass characteristics.

<table>
<thead>
<tr>
<th>Barley Variety</th>
<th>Type</th>
<th>ADG</th>
<th>DMI</th>
<th>F/G</th>
<th>Carcass Wt (lb)</th>
<th>Dressing %</th>
<th>Cutability Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duke</td>
<td>6 Row Feed</td>
<td>3.52</td>
<td>23.9</td>
<td>6.63</td>
<td>693</td>
<td>57.3</td>
<td>62.3</td>
</tr>
<tr>
<td>Condor</td>
<td>Hulless Feed</td>
<td>3.30</td>
<td>23.4</td>
<td>6.84</td>
<td>691</td>
<td>58.2</td>
<td>61.6</td>
</tr>
<tr>
<td>Ellice</td>
<td>2 Row Malt</td>
<td>3.54</td>
<td>21.7</td>
<td>6.38</td>
<td>684</td>
<td>57.9</td>
<td>61.7</td>
</tr>
<tr>
<td>Harrington</td>
<td>2 Row Malt</td>
<td>3.45</td>
<td>23.6</td>
<td>6.85</td>
<td>691</td>
<td>58.5</td>
<td>61.8</td>
</tr>
<tr>
<td>Duke</td>
<td>6 Row Feed</td>
<td>3.45</td>
<td>23.4</td>
<td>6.76</td>
<td>691</td>
<td>57.8</td>
<td>62.3</td>
</tr>
<tr>
<td>Virden</td>
<td>6 Row Feed</td>
<td>3.21</td>
<td>22.1</td>
<td>6.78</td>
<td>680</td>
<td>57.6</td>
<td>62.2</td>
</tr>
<tr>
<td>Bonanza</td>
<td>6 Row Feed</td>
<td>3.39</td>
<td>21.4</td>
<td>6.71</td>
<td>671</td>
<td>57.2</td>
<td>62.3</td>
</tr>
<tr>
<td>Abee</td>
<td>2 Row Feed</td>
<td>3.39</td>
<td>22.5</td>
<td>6.75</td>
<td>689</td>
<td>57.6</td>
<td>60.8</td>
</tr>
<tr>
<td>Leduc</td>
<td>6 Row Feed</td>
<td>3.43</td>
<td>22.8</td>
<td>6.69</td>
<td>686</td>
<td>57.8</td>
<td>61.7</td>
</tr>
<tr>
<td>Harrington</td>
<td>2 Row Malt</td>
<td>3.28</td>
<td>21.9</td>
<td>6.71</td>
<td>689</td>
<td>58.0</td>
<td>62.1</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

### Effect of 2 vs 6 Row Barley Type

<table>
<thead>
<tr>
<th>Type</th>
<th>ADG</th>
<th>DMI</th>
<th>F/G</th>
<th>Carcass Wt (lb)</th>
<th>Dressing %</th>
<th>Cutability Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Row</td>
<td>3.41</td>
<td>22.4</td>
<td>6.64</td>
<td>689</td>
<td>58.0</td>
<td>61.6</td>
</tr>
<tr>
<td>6 Row</td>
<td>3.39</td>
<td>22.7</td>
<td>6.67</td>
<td>684</td>
<td>57.6</td>
<td>62.2</td>
</tr>
<tr>
<td>Hulless</td>
<td>3.30</td>
<td>23.4</td>
<td>6.84</td>
<td>691</td>
<td>58.2</td>
<td>61.6</td>
</tr>
<tr>
<td>Difference</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

### Effect of Malt vs Feed Barley Type

<table>
<thead>
<tr>
<th>Type</th>
<th>ADG</th>
<th>DMI</th>
<th>F/G</th>
<th>Carcass Wt (lb)</th>
<th>Dressing %</th>
<th>Cutability Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malting</td>
<td>3.41</td>
<td>22.1</td>
<td>6.66</td>
<td>684</td>
<td>57.9</td>
<td>61.9</td>
</tr>
<tr>
<td>Feed</td>
<td>3.39</td>
<td>23.0</td>
<td>7.25</td>
<td>689</td>
<td>57.7</td>
<td>61.8</td>
</tr>
<tr>
<td>Difference</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Trial Weight Range - In weight 800 lb to average finish weight of 1188 lb. Individual animals may have bloated a number of times, but were only counted once. NS: not significant.

$^1$ADG = average daily gain; DMI = dry matter intake; F/G = feed DMI: gain ratio

Source: Ramsey (24)

---

**Two-row vs. six-row barley**

No differences in steer DMI, ADG, DMI:gain or carcass characteristics were detected between two-row and six-row barley (Table 1). However digestibilities of DM, organic matter and DE were about 2% higher in the two-row barleys compared to the six-row barleys. While some US research reports agree with these results, others have observed that steer performance, carcass parameters, as well as diet digestibility, were greater when Clark (two-row malting cultivar) was fed than when Cougar (six-row malting cultivar) was fed. Similarly, others found that Camelot and Harrington (two-row cultivars) had higher ADG and lower feed:gain ratios for ruminants compared to Hesk and Steptoe (six-row cultivars). It has been suggested that head morphology (two-row vs. six-row) had the most influence on nutrient composition and in most cases the composition of two-row...
barley is superior to six-row barley. However, any advantage of two-row barley over six-row barley may be related to plumper kernels, and a higher BW of the two-row barley. It has been demonstrated that two-row barley has, on the average, 3.3 lb/bu higher BW, 5 g higher kernel weight, and 30% more plump kernels than six-row barley. It is difficult to make any clear recommendation to feed two-row vs. six-row barley due to conflicting results, however feedlots may be selecting more two-row barley inadvertently by discounting light weight barley.

Hulless vs. hulled barley

There is limited information available on the nutritive value of hulless barley for cattle. US work has shown that hulless barley compares favourably with corn as a sole grain source in beef cattle finishing diets. The presence or absence of hulls did not influence performance in the feedlot or carcass characteristics in the U of A trial (Table 1). In a US trial, cattle fed hulless (Condor) barley had an 8.6% lower feed intake than for covered (Leduc) barley. Diet net energy was 5.6% greater for hulless barley. However in this particular trial, animals fed hulless barley had a greater incidence of liver abscess (167%), and lower ruminal pH. No differences in ADG or feed:gain ratios between hulless and covered barley were found. Based on the very limited information that is available, the higher net energy content does not appear to result in improved animal performance. The reduced feed intake, likely caused by a reduction in rumen pH, appears to explain the lack of difference in performance of cattle fed hulless barley compared to hulled varieties.

Malting vs. feed barley

Malting and feed barley appear to have similar feed value for steers as measured by feedlot performance and carcass characteristics (Table 1). There were no differences in the digestibility of malting and feed barley. These results do not support the suggestion that intended end use (malting vs. feed) is one of the most useful indicators of barley nutritional quality.

Relationship between rate and extent of digestion and feedlot performance

Recent U of A research could not detect any relationship between barley degradability in the rumen or total tract digestibility among varieties and DM intake, ADG or DM intake:gain ratio. Similarly, there was no relationship between rate of barley DM degradation in the rumen (33.0-57.7% per
hour) and the DMI:gain ratio. DMI:gain ratios were also not related to barley DM disappearance in the rumen after 0, 2, 4, 8 or 12 hours. This may be because of the relatively narrow range in these parameters; for example there were only 6% differences among varieties in the amount of DM degraded after 2 and 4 hours in this study, whereas another study has shown differences of 26% and 17% in DM degradability in unselected barley varieties after 2 and 4 hours, respectively. A negative correlation between barley DM disappearance in the rumen after 24 hours and DM intake:gain ratios for steam and dry rolled barley was shown in prior U of A research.

The literature is unclear concerning the potential effects of differing rumen degradability rates on ADG and feed:gain ratio. However, as ruminal degradation rate of barley DM increased, the incidence of bloat increased. This is a strong indication that a faster breakdown of the grain in the rumen is undesirable in terms of animal health. Other work has suggested that barley grain may be degraded too rapidly in the rumen, contributing to acidosis, rumenitis and bloat. A slower rate of starch breakdown in the rumen would also allow more to escape the small intestine. In one study starch digested in the small intestine was used 30% more efficiently than starch digested in the rumen. Increased animal performance may result from a decreased rate of ruminal starch degradation, and slower ruminal degradation rates may reduce the incidence of subacute acidosis. In contrast, other work has shown that starch digested in the rumen provided 6 MJ more energy daily to steers than when the starch was digested in the small intestine. To repeat, the research results are not clear.

There is other evidence that cereal grain may even be degraded too slowly in the rumen in some circumstances. Boss et al. (5) found that the rate of degradation of Harrington barley was 71.4% faster than Medallion or Gunhilde barley. However, the ADG of cattle fed Harrington barley was 8.0% higher than those fed Medallion or Gunhilde barley. Feed DM intake to gain ratios were not significantly different between steers fed the three barleys (Medallion 6.3, Harrington 6.6 and Gunhilde 6.8). Despite an extremely rapid rate of ruminal degradation, Harrington barley provided superior feedlot performance compared with Medallion or Gunhilde barleys.
Conclusions

No differences in the feeding value of different samples of barley grain, two-row vs. six-row, hulless vs. hulled, or malt vs. feed barley of similar BW have been detected in Alberta grown varieties fed to steers. Also no relationship between rate of barley DM degradation in the rumen, or total tract digestibility and rate or efficiency of gain has been demonstrated in steers fed Alberta grown varieties. However, the amount of barley degraded after 12 hours in the rumen was associated with increased bloating of the steers. This result and correlations between barley DM disappearance in the rumen after 24 hours and DMI:gain ratios indicate that rate of degradation may be important. More research is required to determine what the optimum rate of degradation for cattle is and how to achieve this rate: by selecting varieties of barley with slower rates of ruminal digestion; using mixtures of different grains; using appropriate processing methods; and using grains appropriate for the level and source of roughage.

References


