

Project Summary

Timed Protein Restrictions in Feedlot Diets to Alter Adipose Deposition with the Goal to Increase Marbling in Beef Carcasses

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Background

Data reported by the U.S. Department of Agriculture (USDA) Agricultural Marketing Service (AMS) shows that the percentage of beef carcasses grading USDA Prime or USDA Choice has decreased over time from 1974 to 2004. The 2005 National Beef Quality Audit cited insufficient marbling as the number-one quality challenge in the beef industry according to purveyors, restaurateurs and supermarket operators.

Finding methods to enhance marbling may be an important management tool to produce more carcasses that fit into more desirable quality grades. Managing dietary crude protein during the finishing phase of cattle may change their growth pattern, and as a result may be one way to increase marbling deposition.

Methodology

Two feeding trials were conducted at feedlot facilities at South Dakota State University. The first trial that was begun in December 2006 included Angus-cross steers (n = 96) and the second trial, which started in June 2007, included Limousin-cross steers (n = 96).

The steers were subjected to two different treatments and were fed either a low crude protein ($11.7\% \pm 0.5$) or high crude protein ($15.5\% \pm 0.6$) ration that was delivered during two feeding phases, (initial period and final phase). The change from the initial phase to the final phase occurred when the steers reached 56 percent or 54 percent of their total weight gain for the Angus-cross and Limousin-cross, respectively. As a result, there were four treatments in the trial:

1. High initial phase, high final phase (Hi-Hi);
2. High initial phase, low final phase (Hi-Lo);
3. Low initial phase, high final phase (Lo-Hi);
4. Low initial phase, low final phase (Lo-Lo).

The researchers collected performance data, carcass characteristics and ultrasound measurements for all of the steers. Crude fat and Warner-Bratzler shear force values were also collected. A trained sensory panel evaluation was conducted on the strip loin samples and a consumer panel evaluation was conducted with ground beef samples.

Findings

The Hi-Lo group gained more weight per day (3.59 pounds) than the Lo-Hi (3.44 pounds) and Lo-Lo (3.35 pounds), however the differences in end weights among the groups were not statistically different. In summarizing the performance data, the researchers concluded that restricting protein during the first half of the feeding period generally resulted in poorer performance characterized by lower average daily gain (ADG) and reduced feed conversion. However, the protein-restricted steers that were fed a high-protein diet during the second half of the feeding period (Lo-Hi) generally caught up with the steers that had been on the high-protein diet throughout the trial.

Ribeye area was not statistically different among treatments at the end of the finishing period, according to ultrasound measurements. At the end of the initial phase, the steers on the low protein

diet had numerically lower backfat (low protein 0.28 inches versus high protein 0.35 inches), and more intramuscular fat (low protein 3.86 percent versus high protein 3.75 percent). Breed-type of the steers in the two trials also influenced the outcome as the Angus-cross steers had smaller REA and more intramuscular fat.

There were no differences among treatments for intramuscular fat. The researchers also developed a ratio of marbling to backfat (“MRatio”) and there were no differences in this value among the treatments from the end of the initial phase to the end of the final phase. However, the magnitude of the change in MRatio from the end of the initial phase to the end of the final phase indicated that the steers switched to a high protein level deposited more backfat in relation to intramuscular fat. The results of the ultrasound measurements suggested to the researchers that excess protein, either during the initial phase or the finishing phase, would result in more fat being deposited into subcutaneous depots than into intramuscular depots.

When measuring carcass characteristics, the timed protein restriction resulted in altered fat deposition, particularly subcutaneous and internal fat. Steers receiving the Hi-Hi treatment had a higher adjusted fat thickness value, higher percentage kidney, pelvic and heart (KPH) fat and ultimately a higher, less desirable yield grade compared to the other treatments. Marbling was unaffected by treatments both visually (USDA marbling scores) and quantitatively (intramuscular fat percentage).

Implications

In summarizing the carcass data, restricting protein during the first half of the finishing period was not effective at increasing marbling levels as the researchers had initially hypothesized. Additionally, feeding high protein throughout the entire feeding period resulted in higher levels of external fat with no improvement in marbling, resulting in a lower marbling to external fat ratio.

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