Investigating the Effects of Transportation in Beef Cattle on the Development of a Blood Test that will Forecast USDA Carcass Quality and Yield Grade

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Abstract

Leptin and insulin-like growth factor I (IGF-I) serum level concentrations were investigated in relation to transportation and their association to beef carcass quality and yield grades prior to transportation (at the feedlot) and at harvest. We observed that serum leptin levels significantly dropped from the feedlot to the packing plant, while IGF-1 levels significantly increased.

Introduction

Most beef fed-cattle producers get paid based on USDA carcass yield and quality grades. The producers’ ability to accurately predict when cattle are at their optimum profitability point is far more an art than a science. To date there are no consistent prediction methods for cattle producers to utilize in their production practices. In 2005, the National Beef Quality Audit concluded that one of the major challenges that they were facing was with beef quality, meaning there was a lack of uniformity and consistency in the beef products. The cattle with more excess fat, which is equivalent to USDA yield grades 4 and 5, were another of the other major industry problems. The audit stated that of the 32.4 million cattle harvested in the US in 2005, 14.5% of those were USDA yield grade 4 or 5. Of these cattle, 40.5% had a quality grade of select or lower, which is the least desirable (i.e. lowest paid) USDA quality grades. This means that a large percentage of the US cattle population that goes to harvest has too much external fat (i.e. USDA yield grades of 4 or 5), and not enough intramuscular fat (i.e. fat within the muscle, Quality Grades Select and Standard). It is very hard for producers and others in the beef industry
to have uniform cattle with both of these traits, traits that seem to be at opposite ends of the spectrum. Research has recently been conducted utilizing blood hormone profiles in an attempt to build a “tool” which would provide producers with the science needed to become more accurate predictors of USDA quality and yield grades in their live cattle and thus enable them to optimize profitability. This research builds off previous research findings and will further evaluate how cattle transport durations from the feedlot to the packing plant influence these hormone levels and thus their abilities to accurately predict USDA carcass yield and quality (endocrine profile sorting system or EPSS). The following steps will be taken to collect the proper data to answer this question:

1. Collect blood samples from approximately 106 feedlot cattle at the feedlot (collaborate with West Texas A&M University), the day of slaughter.
2. Collect final carcass data (needed to determine USDA Quality and Yield Grades) from all cattle studied in Approach 1.
3. Analyze blood samples for serum concentrations of hormones of interest (leptin and insulin-like growth factor-1) which will provide predictive information in regards to muscle and fat deposition.
4. Determine if transport duration should be included as a variable in the final prediction model.

The phenotype of an animal is determined by its: a) genetics and b) environment. In beef cattle the phenotype of most interest is the final USDA carcass yield and quality grades of the carcass, which among other variables use external and intramuscular fat deposition as criteria for assigning said grades. The more intramuscular fat deposition and the less external fat
deposition present in the beef carcass the more money the producer will receive from the packing plant. We know from decades of research that an animal’s endocrine system (hormones) is indicative of how that animal’s genetics are responding to a given environment. In effect, the hormonal changes that occur within an animal is that animal’s internal system of communicating to itself as to when to reproduce, when to grow, how much to grow, how much to eat, as well as every other bodily function.

**Methods**

This long-term goal of this research is to test the predictive value of an EPSS in beef cattle, generated from data collected 30-60 d prior to slaughter, prior to transportation (PTT), and at slaughter (S) on USDA slaughter quality and yield grades. This specific study will focus on the reaction of leptin and igf-1 to a 45 minute transport from feedlot to packing plant in order to gain insight on the effect transportation may have on our EPSS. Leptin and insulin-like growth factor-1 (IGF-1) are major determinants of protein and fat deposition. By analyzing the aforementioned hormones PTT and at S, a better understanding of how these hormones are altered during transport can be achieved. In addition a better understanding of calf body composition during growth can be determined (Maccario et al., 2000; Hornick et al., 2000), with the ultimate goal of establishing an equation (EPSS) useful in the prediction of animal performance and final carcass composition.

*Feedlot and Harvest Stage.* For this research, we collaborated with West Texas A & M University where they raise a fairly uniform lot of cattle (i.e. black cattle), who regularly ship to a short transport slaughter facility (45 minutes from feedlot to harvest facility). Random samples of calves were chosen from the feedlot at West Texas A & M University for the study. Blood
samples were collected by Heather Duoss, under the supervision of Dr. Duane Keisler, from cattle the day of slaughter, a few hours before loading on the truck to go to the packing plant (PTT), and at slaughter (S). The blood serum was collected and stored for later hormonal analysis. At slaughter, blood was collected and serum stored for hormonal analysis. The West Texas A & M University Carcass Date Collection Team collected all relevant carcass data (12th rib ribeye area, 12th rib back fat thickness, USDA marbling scores, and % kidney, pelvic and heart fat) from each animal at harvest in order to generate proper USDA quality and yield grade.

**Blood & Data Analysis.** Bovine-specific radio-immunoassays for insulin-like growth factor-1 and leptin have been developed in a collaborator’s lab (Dr. Duane Keisler, University of Missouri—Columbia) and were used to analyze all serum samples collected. Hormonal data differences between transport and slaughter serum levels, within USDA quality and yield grades, were analyzed and incorporated into a statistical modeling approach (SAS), along with information in order to assess the best approach to forecast final USDA quality and yield grades.

**Timeline.** Cattle entered the feedlot in mid to late summer 2009. The PTT blood was collected and stored with the S blood. The carcass data was collected within 1-3 d of the PTT and S blood collection by West Texas A & M University Carcass Data Collection Team. Hormone analysis assays were contracted and finished at the University of Missouri-Columbia.

The hypothesis of this research is that a short transportation (< 1 hour) will cause a significant drop in serum IGF-1 and leptin levels in finished beef cattle.
Results

*Leptin*

Like hypothesized the leptin serum levels did drop from the PTT to S.
These are the leptin levels further broken down within the various USDA quality and yield grades.

*Means within USDA Quality Grades lacking a common letter differ (P < 0.05)
*Means within USDA Quality Grades lacking a common letter differ (P < 0.05)
IGF-1 results did contradict the hypothesis by increasing from PTT to S.

*Means lacking a common letter differ (P = 0.01)
These are the IGF-1 further broken down within the various USDA quality and yield grades.

*Means within USDA Quality Grades lacking a common letter differ (P = 0.005)
Means within USDA Yield Grades lacking a common letter differ (P = 0.03)
Discussion

This research project is just a section of an overall long term research goal. The long term overall research goal is to be able to create a tool that beef producers will be able to utilize so they will be able to approximately forecast what USDA quality and yield grade their beef cattle will be before they are transported to the packing facility. The benefits of this tool to the producer are enormous. This could save the producer money as well as give them a higher return on their cattle. Understanding how these hormone levels react to transport is crucial in determining the next phase of the broader research question. Most importantly the current study has accentuated the need for us to begin to gather thousands of samples prior to shipment in order to develop a more accurate prediction model. Relying on previous samples collected at harvest would not afford us the accuracy in predicting yield and quality grade categories we are seeking in our prediction model due to the significant changes that occur in hormone levels as a result of transport even as short as 45 minutes.

Conclusion

Leptin (from the Greek *leptos*, meaning thin) is a protein hormone with important effects in regulating body weight, metabolism and reproductive function. Leptin is expressed predominantly by adipocytes, which fits with the idea that body weight is sensed as the total mass of fat in the body (Colorado State, 1998). Leptin is the main hormone that regulates overall weight gain and control. The hypothalamic region of the brain, which is where hunger is controlled, receives signals from the leptin hormone when the animal is hungry or full. When satiety is reached, leptin levels will be at their highest. When the body senses hunger, the leptin levels will be lower. The beef cattle were not with feed for about 24 hours, which could have
caused the leptin levels to drop from PTT to S. Another theory that needs to be investigated is if this drop is due to satiety signals or the dynamic nature of fat stores changing during times of fasting.

IGF-1 is the hormone that is primarily involved with lean deposition in cattle. IGF-1 has shown to have a great deal of importance in skeletal muscle propagation, particularly throughout normal growth and development. IGF-1 stimulates protein metabolism in the skeletal muscle. IGF-1 is directly proportional to the marbling (intramuscular fat) in the beef cattle. Other than IGF-1 having a known inverse relationship with leptin levels the reason why IGF-1 serum levels increased from PTT to S is unknown.
Sources Cited


