ENDOCRINE PROFILE SEPARATION OF UNITED STATES DEPARTMENT OF AGRICULTURE BEEF CARCASS GRADES

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Introduction

Geary *et al.*, (2003) reported correlations between serum leptin and 12th rib back fat, USDA yield grade, marbling score, kidney-pelvic-heart fat (KPH), and USDA quality grade in beef cattle. McFadin *et al.*, (2003) found positive correlations between serum leptin and 12th rib back-fat, USDA yield grade, and marbling score in beef cattle. The results of these trials suggest that serum leptin concentrations could be used as a means to predict beef carcass merit prior to harvest. Likewise, bovine GH and IGF-I have been documented as endocrine regulators for lean muscle growth in cattle. Trenkle and Topel (1978) reported correlations between GH, percent carcass fat, and percent carcass muscle. Anderson *et al.*, (1988) reported negative correlations with percentage of carcass fat, GH, and IGF-I in beef bulls; however, the true role of these hormones relative to carcass merit, merits further study. The objectives of this project were to 1) evaluate endocrine hormone (leptin, IGF-I, GH) concentrations from a random allotment of United States commercial beef cattle relative to beef carcass composition and quality and 2) evaluate gender differences of leptin, IGF-I, and GH concentrations across carcass compositional endpoints.

Materials and Methods

Cattle were randomly selected from a commercial abattoir immediately after exsanguination on March 30, 2004, May 17, 2004, August 17, 2004, and January 3, 2005. The total number of young, A-maturity steers and heifers used in the final analysis was 995 and 757, respectively. No pre-harvest information was gathered for any of the cattle prior to initiation on the project. The random selection of cattle was assumed to represent the general population of market cattle sold through the commercial abattoir (based on McKenna *et al.*, 2002).

Blood samples were collected at exsanguination in a 15 ml sterile polypropylene conical tube, allowed to clot for 30 min at room temperature, and then placed on ice and transported 3.5 h to the University of Missouri. Samples were centrifuged at 2,500 X g for 45 min. After centrifugation, serum was pippetted from tubes, placed in 48 well plates (5 mL/well; ABgene, Inc., Rochester, NY), and stored at -20° C until analyses. Leptin concentrations were determined by a double-antibody RIA as described by Delavaud *et al.*, (2000). Leptin assay inter- and intra-assay coefficients of variation were 2 and 3% (n = 5 and 35, respectively). Insulin Growth Factor-I and GH concentrations were assayed as described by Lalman *et al.*, (2000). The IGF-I assay inter-and intra-assay coefficients of variation were 3 and 3% (n = 9 and 27, respectively). Bovine GH assay inter- and intra-assay coefficients of variation were 2 and 2% (n = 7 and 38, respectively).

Hot carcass weight (HCWT) was recorded prior to entry into the chill for approximately 24 h at 2°C. After chilling, carcasses were ribbed at the 12th/13th rib interface and allowed to bloom. Marbling score and skeletal maturity were recorded for determination of USDA quality grade and ribeye area, subcutaneous fat thickness, and the percentage kidney, pelvic, and heart fat were combined with HCWT to determine USDA yield grade. The GLM procedure of SAS (SAS Inst. Inc., Cary, NC) was utilized to test the fixed effects of kill day and gender. Least squares means of leptin, IGF-I, and GH were evaluated for least significant differences across USDA quality and yield grade categories.

Results and Discussion

Sample population. Yield grade within the present trial was distributed as follows: Yield Grade 1 (15.3 %), Yield Grade 2 (40.1 %), Yield Grade 3 (35.6 %), Yield Grade 4 (8.0 %) and Yield Grade 5 (0.9 %). The average USDA quality grade for the present study was low choice (not shown in tabular form) with a marbling score of small10.

Serum leptin. The average serum leptin concentration was less (P = 0.008) for steers (10.9 ng/mL) than heifers (11.9 ng/mL; Figure 1). Heifers had lighter weight carcasses (331.9 vs. 352.2 kg, P < 0.0001), greater 12th rib fat depth (1.3 vs. 1.1 cm, P < 0.001), greater KPH (2.5 vs. 2.4 %, P < 0.001), and more marbling (Small40 vs. Small10, P < 0.001) than steers. Statistical evaluation of the gender heifer leptin concentration across yield grade classification. Due to the low number of steers (n = 3) and heifers (n = 13) representing yield grade 5 carcasses, yield grade 4 and 5 classifications were combined. As carcass cutability declined (increase in numeric yield grade) in steer carcasses, leptin concentration continued to rise; each yield grade category differed (P < 0.05) from the previous. A different pattern emerged for heifers. Yield grade 1 carcasses differed from yield grades 2 and 3, however, yield grades 3, 4, and 5 did not differ (P > 0.05). The observance of this leptin plateau indicates the possibility that in young heifers as the proportion of whole body fat increases, leptin concentration will elevate in a like manner until it reaches a break point at or near the yield grade 3 classification.

Bovine growth hormone. Steers had greater (P < 0.001) serum GH concentrations than heifers (Figure 3). With the steer carcasses having numerically lower yield grades and heavier hot carcass weights it would be an obvious factor attributing to gender based differences. Evaluation of the gender × yield grade interaction term in the GH model approached a trend (P = 0.11). Figure 4 displays steer and heifer GH concentration across yield grade classification (pooling yield grades 4 and 5). There appears to be a larger numeric decline in GH concentration as young steers of the same carcass maturity decline in carcass cutability (higher yield grade classification and more total carcass fat). Young heifers of similar age possess lower concentrations of GH at each yield grade category and appear to have less of a decline in GH concentration with increased adiposity.

Insulin-like growth factor-I. Mean IGF-1 concentration in steers (16.70 ng/mL) were greater ($P < 0.001$) than heifers (12.0 ng/mL; Figure 3). Yield grade ($P < 0.001$) and gender ($P < 0.001$) were associated with IGF-I concentrations at the point of exsanguination, but the interaction term (gender × yield grade) was not ($P = 0.24$). Although the interaction term of gender × yield grade was not significant ($P = 0.24$), an interesting numeric distribution is presented for steers versus heifers (Figure 5).

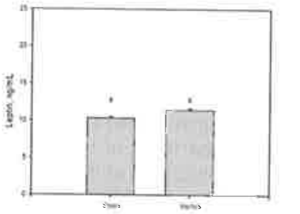

Figure 1: Main effect of gender on serum leptin concentration. Bars differ at P<0.05).

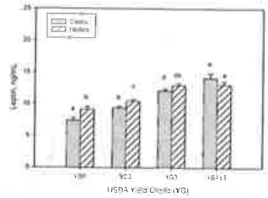

Figure 2: Interactive effect of gender and yield grade (P= 0.08) on serum leptin concentration. Bars differ at P<0.05).

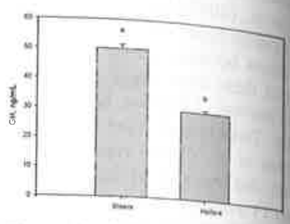

Figure 3: Main effect of gender on serum GH concentration. Bars differ at $P < 0.05$).

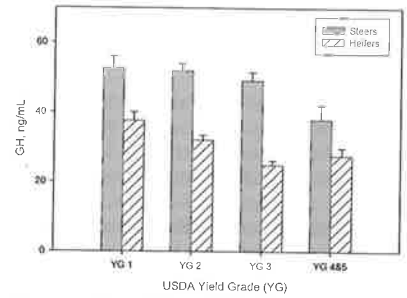

Figure 4: Interactive effect of gender and yield grade (YG; P = 0.11) on serum GH levels.

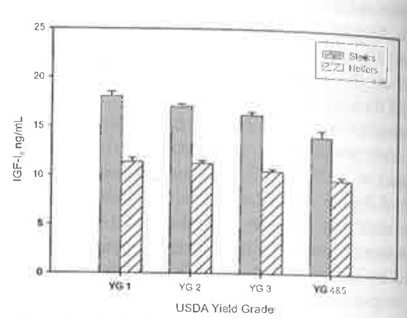

Figure 5: Interactive effect of gender and yield grade (YG; P = 0.24) on serum IGF-I levels.

Conclusions

As discussed above, previous research clearly demonstrates the decline of anabolic hormones with age. In the present study, it can be assumed that all animals used in the investigation were of similar chronological age based on carcass maturity scores. Heifers of the same age appear to possess more stable GH (Figure 4) and IGF-I (Figure 5) levels across carcass cutability (yield grade) classification, while their castrated counterparts have higher serum concentrations of these anabolic hormones yet appear to decline to a greater degree with declining carcass cutability.

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