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Evaluation of Growth-Based Predictions of Carcass Fat and Marbling at Slaughter Using Ultrasound Measurements[1]

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ABSTRACT

Carcass data from serially slaughtered steers fed different dietary energy sources during backgrounding were used to formulate equations relating carcass fat thickness (FT) and marbling (MRB) score to hot carcass weight (HCW). Relationships between fat depot accretion and HCW were similar among diets. Pooled data resulted in linear relationships between fat deposition and HCW. These equations and a second system of equations, based on published results, were used to predict final FT and MRB score from unrelated steers. Ultrasound FT and MRB score were collected at d 142 and d 226 of the trial. Carcass traits were predicted from carcass weight gain and ultrasound at d 142 or 226. Percentage differences between predicted and actual values were analyzed with slaughter group, breed, sex, treatment, and 2-way interactions in the model. Ultrasound timing influenced prediction accuracy for FT and MRB score ($P < 0.05$). Marbling score accuracy increased with scan proximity to slaughter, and FT was within 10% at 158 or 180 d before slaughter. Breed affected MRB score accuracy ($P = 0.04$) and was within 6% for calves with Angus influence, but was more than 20% for Brahman-influenced calves. Sex influenced MRB score accuracy ($P > 0.01$) and FT accuracy ($P > 0.01$). Growing program influenced FT accuracy from ultrasound at d 142 ($P > 0.01$), underestimating pasture-fed cattle by 58.4%, but did not affect MRB score accuracy from either session. Accuracy of FT and MRB score predictions from growth-based equations is influenced by ADG between ultrasound and end point, breed, and sex, although scans up to 120 d preslaughter may be accurate.

Key words: ultrasound, cattle, marbling, fat thickness, growth

INTRODUCTION

Beef carcass value is influenced by the amount and distribution of adipose tissue. Although increasing amounts of marbling (**MRB**) typically increase carcass value, excessive increases in carcass fat thickness (**FT**) decrease value. Therefore, a certain amount of production risk is associated with feeding strategies designed to enhance intramuscular accretion by prolonging the finishing period. An accurate prediction of carcass fat deposition would allow producers to mitigate losses in potential carcass value caused by increased carcass waste while maximizing MRB and carcass weight. Body composition changes over a feeding period and ADG values are reflective of those changes (Owens et al., 1995). Brethour (2000) used ultrasound measurements to predict body composition as a function of time on feed. However, because time on feed is related to ADG, and ADG varies with environmental conditions, diet composition, and other factors, a time-based model used to predict the carcass end point may produce variable results if ADG or other conditions vary independently of time. Owens et al. (1995) established the relationship between empty BW and BW. This relation-

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ship provides estimates of hot carcass weight (**HCW**) gain from observed BW gain or ADG. Bruns et al. (2004) quantified changes in fat thickness and marbling score relative to the change in HCW in steers during a finishing program. It has been well documented that dietary energy source influences FT and MRB deposition (Schoonmaker et al., 2004; Rhoades et al., 2007). The objective of this study was to use carcass measurements from serially slaughtered steers fed different dietary energy sources during the backgrounding period to develop equations relating carcass FT and MRB deposition to HCW. A subsequent objective was to apply derivatives of these equations to predict carcass traits of beef cattle grown under different production systems by using ultrasound measurement and growth as the basis for projection.

MATERIALS AND METHODS

Experiment 1

Twenty-five Angus steers (223 ± 25 kg) were randomly assigned to receive either a grain-based or hay-based diet after weaning (8 mo) for 120 d. Bermuda grass (*Cynodon dactylon*) hay containing 9.5% CP was fed free choice for 8 d after the steers were transported to the Texas AgriLife Research-McGregor Center (McGregor, TX). Four steers were slaughtered immediately (d 0). Of the remaining 21 steers, 8 were assigned to receive a high-energy, corn-based diet (**CBD**) containing 48% ground corn, 20% ground milo, 15% cottonseed hulls, 6.5% molasses, 6% cottonseed meal, 3% limestone, trace mineral salt, vitamin premix, and 1.5% monensin on a DM basis for 120 d. Feeding this diet resulted in an average BW gain of 0.85 kg/d. The remaining steers (n = 13) were offered coastal bermudagrass hay ad libitum, supplemented daily with NPN in a cooked molasses carrier, and an amount of the CBD to sustain a gain of 0.72 kg/d (hay-based diet, **HBD**). The HBD was offered for 120 d after weaning. After the 120-d treatment period, all steers were fed the CBD until slaughter. Randomly selected subsets of steers from each treatment group were serially slaughtered at 120, 240, and 300 d postweaning. Cattle were transported to the Rosenthal Meat Science and Technology Center, Texas A&M University, for slaughter. Postslaughter HCW, FT, LM area, KPH percentage, MRB, lean maturity, and skeletal maturity were collected after a 48-h chill by Texas A&M University personnel.

Data were analyzed using linear regression, and all analyses were performed using the Mixed Linear Models procedures of SAS (SAS Institute Inc., Cary, NC). The regression models contained HCW and HCW^2 (quadratic form) or only HCW (linear form) as independent variables, and MRB or FT as the dependent variable. Regression analyses were conducted separately for the CBD- and HBD-fed treatment groups; when parameters were not statistically different among treatment groups based on post hoc *t*-tests among β coefficients for common predictor variables, data were pooled to develop a general equation. Marbling score at slaughter from 1 steer from the CBD treatment group was identified as an outlying observation based on residual analysis. The residual of the outlying observation was 2.5 SD away from the overall MRB mean. This data point was removed from the subsequent analyses.

Experiment 2

Calves (n = 113) sired by Mashona bulls from dams produced in a 3-breed diallele mating system (Angus, Brahman, and Romosinuano) were early weaned (mean age = 74 d), preconditioned for 40 d, and transported from central Florida to the Texas AgriLife Research-McGregor Center (McGregor, TX) for growing and finishing. Cattle ranged in age from 90 to 200 d at arrival and included steers and heifers. Calves were stratified by breed type and sex and assigned to a confinement growing program in a feedlot or to a forage-based growing program on pasture for an average of 141 d. The feedlot-treated cattle were fed a grain-based diet containing 48% ground corn, 20% ground milo, 15% cottonseed hulls, 6.5% molasses, 6% cottonseed meal, 3% limestone, trace mineral salt, and vitamin premix, and 1.5% monensin on a DM basis during the growing phase. The pasture-treated cattle were grazed on a coastal bermudagrass pasture and supplemented daily with cottonseed meal during the growing phase. After the 141-d growing phase, all cattle received the high-energy CBD described previously until slaughter.

Ultrasound FT and intramuscular fat were measured twice for each animal. Fat thickness over the 12th rib and intramuscular fat percentage between the 12th- and 13th-rib location were measured at each ultrasonographic scanning session by an Ultrasound Guidelines Council field-certified technician, using an Aloka 500V instrument with a 17-cm 3.5-MHz transducer (Aloka Co. Ltd., Wallingford, CT). Images were collected and interpreted using Beef Image Analysis Pro software (Designer Genes Inc., Harrison, AR). Ultrasound intramuscular fat was converted to an MRB score for use in the prediction analysis, as reported by Wilson et al. (1998):

$$\text{MRB score} = 54.928 \text{ intramuscular fat } \% + 164.97. \quad [1]$$

Initial ultrasound measurements were collected on d 142 of the trial (**US1**), which corresponded to 158, 207, and 264 d before slaughter for slaughter groups 1, 2, and 3, respectively. The second ultrasound scan was made on d 226 (**US2**), corresponding to 74, 123, and 180 d before slaughter for groups 1, 2, and 3, respectively. Body weights were collected at 28-d intervals throughout the course of the study and at each ultrasound scan session.

Cattle were sorted into respective outcome groups based on an ultrasound estimate of FT and BW. Targeted FT thickness at slaughter for