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Relationship Between Ultrasonically Measured Beef Cow Carcass Traits and Lifetime Productivity

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Introduction

Ultrasound is widely used in seed stock production, commercial operations, and in feed yards to predict carcass merit. It also has been used to assess the value of individuals as parents in the seed stock industry. Ultrasound has several advantages as a technique to evaluate body composition: it is relatively inexpensive; it produces results more rapidly compared to progeny testing programs; and data are less prone to selection bias than direct carcass data collection. Ultrasound measures of ribeye area and proportion of intramuscular fat are accurate predictors of their corresponding carcass traits in fed slaughter cattle. Thus, average heritability estimates of ultrasonically measured ribeye area and intramuscular fat are moderate to high. Moderate to high heritability allows seed stock breeders to select replacement animals with confidence based on ultrasound measurements.

A large body of research has evaluated the use of sire and ultrasound measures as predictors of progeny carcass measurements and growth. In contrast, little research has examined the use of ultrasonically measured compositional traits as a means of predicting cow productivity and subsequent progeny performance. The objective of our experiment was to examine the use of ultrasound measures of intramuscular fat and ribeye muscle depth as a means of predicting lifetime cow productivity and progeny performance. Specifically, we wished to determine whether ultrasound measurements of intramuscular fat and ribeye muscle depth obtained from yearling heifers were related to calf birth weight, calf weaning weight, cow pregnancy rate, and calving interval.

Experimental Procedures

Angus-cross heifers (n = 160) were retained from the KSU Agricultural Research Center–Hays herd or purchased from two sources with similar genetics and breeding seasons and managed as a contemporary group. Females were developed in a drylot and had free-choice access to a grower diet and clean water. At approximately 1 year of age, measurements of heifer intramuscular fat and ribeye muscle depth at the 12th to13th rib interface were obtained by an experienced technician. Ultrasound images were generated using an Aloka 500V (Aloka Co., Ltd, Wallingford, CT). Images were collected by a single technician with software from the Cattle Performance Enhancement Company (CPEC, Oakley, KS). Backfat thickness, intramuscular fat, and ribeye muscle depth were estimated using image analysis software integral to the CPEC product. Marbling scores were coded such that 4.0 = slight^{00} (low select) and 5.0 = small^{00} (low choice). Measurements of intramuscular fat and ribeye muscle depth from yearling heifers were categorized into low, medium, and high groups (<3.88%, 3.88 to 5.33%, and >5.33%, respectively, for intramuscular fat and <17.24 in., 17.24 to 20.48 in., and >20.48 in., respectively, for ribeye muscle depth).

Following breeding at approximately 14 months of age, heifers were managed in a spring-calving, native range-based production system with a 12-month calving interval for the duration of the 4-year study (2004 to 2007). Each year, females were mass-mated following estrous synchronization and exposed to Angus bulls 10 days later for the duration of a 45-day breeding season. Pregnancy rate to artificial insemination (AI) was determined 31 to 35 days after fixed-time AI with transrectal ultrasonography. Cows were examined for pregnancy in August each year via rectal palpation and non-pregnant females were removed from the herd. Calves were weighed at birth and weaning. Weaning weights were adjusted for age of calf, age of dam, and sex of calf.

Results and Discussion

Pregnancy rate was not related to cow intramuscular fat, ribeye muscle depth, or intramuscular-fat grouping ($P>0.05$); however, more cows became pregnant in the high and medium ribeye muscle depth grouping compared to the low ribeye muscle depth grouping ($P<0.04$; Table 1). Heavier muscling may be associated with greater fertility. In contrast, heavier muscling may have been secondary to a superior plane of nutrition between weaning and breeding. Calving interval was not related to cow intramuscular fat, ribeye muscle depth, intramuscular fat grouping, or ribeye muscle depth grouping ($P>0.05$).

Calf body weight at birth was not related to dam intramuscular fat, ribeye muscle depth, intramuscular fat grouping, or ribeye muscle depth grouping ($P>0.05$). Calf 205-day adjusted body weight was not related to dam ribeye muscle depth, intramuscular-fat grouping, or ribeye muscle depth grouping ($P>0.05$); however, calf 205-day adjusted calf body weight increased as dam intramuscular fat increased ($P<0.05$). These data suggest that heifer intramuscular fat was associated with greater progeny body weight at weaning. Based on these data, each 1% increase in intramuscular fat was associated with an 8.58-lb increase in calf body weight at weaning. Cow intramuscular fat was not related to pregnancy rate, calf birth weight, or calving interval. Moreover, cow ribeye muscle depth and intramuscular fat grouping were not related to pregnancy rate, calf birth weight, calf 205-day adjusted body weight, or calving interval.

Implications

Ultrasound measures of ribeye muscle characteristics in yearling heifers can predict some aspects of cow and calf performance. Further analyses appear to be warranted as more production records are obtained from these females.

Table 1. Relationship between ribeye muscle depth in heifers at 1 year of age and production measures collected from 2 to 5 years of age

	Ribeye muscle depth group*, mean ± SE		
Trait	Low (<17.24 in)	Medium (17.24 to 20.48 in)	High (>20.48 in)
Calf birth weight, lb	82 ± 2.2	79 ± 0.7	78 ± 1.5
Calf 205-day adjusted body weight, lb	512 ± 14.5	526 ± 9.7	535 ± 12.5
Calving interval, days	351 ± 5.1	344 ± 4.0	346 ± 4.9
Pregnancy rate, %	78.0[a]	91.0[b]	88.0[b]

* Ribeye muscle depth was measured at approximately 1 year of age with ultrasound; heifers were categorized into high, medium, or low ribeye muscle depth groups.
[ab] Within a row, means without a common superscript differ at P<0.05.

Table 2. Relationship between amount of intramuscular fat in the ribeye mucle in heifers at 1 year of age and production measures collected from 2 to 5 years of age

	Intramuscular fat group*, mean ± SE		
Trait	Low (<3.88%)	Medium (3.88 to 5.33%)	High (>5.33%)
Calf birth weight, lb	79 ± 1.5	81 ± 0.7	79 ± 1.5
Calf 205-day adjusted body weight, lb	519 ± 11.7	526 ± 10.0	537 ± 12.8
Calving interval, days	344 ± 4.7	346 ± 4.2	342 ± 4.7
Pregnancy rate, %	92.7	89.4	84.9

* Intramuscular fat in the ribeye muscle was measured at the 12th to 13th rib interface at approximately 1 year of age with ultrasound. Heifers were categorized into high, medium, or low intramuscular-fat groups.