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Ultrasound Scanning to Measure Body Composition in Beef Cattle

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Introduction

Real-time ultrasound technology has advanced to the state whereby accurate measurements of several body composition traits can be made on live beef animals. These traits include 12th-13th rib fat thickness, rump fat thickness, ribeye area and intramuscular fat percentage (marbling). Each of these traits is significant in the determination of quality and red meat yield for individual animals, and each is at least moderately heritable. Accurate collection and interpretation of images is critical to the successful application of ultrasound. Accuracy is highly dependent upon the ultrasound technician's skill. Only certified, highly skilled technicians should be retained for the collection and interpretation of images. Many breed associations publish a list of technicians who have demonstrated proficiency and have received certification status. They also have additional guidelines for ultrasound that are breed specific, especially for age of cattle to scan and factors for adjusting data to a common age endpoint.

Ribeye area. Ribeye area is an important measurement in determining yield grades on a carcass. Accurate live animal ultrasound estimation of ribeye area is dependent on the quality of the image collected and the skill of the image interpreter. Ribeye area is measured by placing the ultrasound transducer at position B as illustrated in Figure 1.

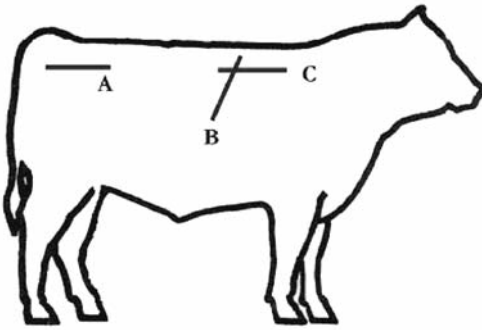

Figure 1. Areas of interest for ultrasound evaluation of body composition characteristics: A – rump fat image; B – cross-sectional image for ribeye area and 12th-13th rib fat thickness; C – longitudinal image for intramuscular fat.

12th-13th rib fat thickness. The ultrasound rib fat thickness measurement can be made from the same image (position B) used to estimate ribeye area. Fat thickness at the 12th-13th rib is measured at a point three-fourths of the distance from the medial end of the longissimus dorsi muscle (12th-13th rib interface) and perpendicular to the surface of the hanging ribbed carcass. Ultrasound

Figure 2. A 3.5 Mhz linear ultrasound probe, commonly used in the collection of beef carcass measurements.

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scanning protocol requires the collection of an image made between the 12th-13th ribs using a 3.5 MHz linear-array transducer (Figure 2) and standoff guide (Figure 3) that conforms to the curvature of the animal's back.

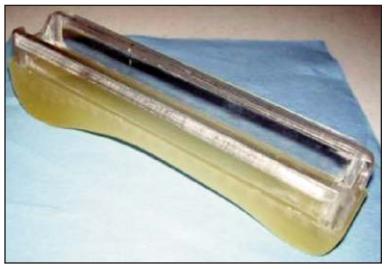

Figure 3. Standoff pad for attachment to ultrasound probe for collection of ribeye image.

Rump fat thickness. Rump fat thickness is a fat deposit that is highly related to 12th-13th rib fat thickness (genetic correlation exceeding 0.70). This measurement can be beneficial when scanning very lean animals such as yearling bulls and can be used to improve the overall accuracy of external fat estimation. To collect this image, the ultrasound transducer should be placed at position A as illustrated in Figure 1, which is aligned directly between the hooks and pins without a standoff guide.

Percent intramuscular fat. Percent intramuscular fat (% IMF) is a trait that is highly correlated with USDA Marbling Score. It is the most difficult of all ultrasound traits to measure accurately. Equipment calibration, animal preparation, electrical power signal noise, existence of atmospheric radio waves and transducer-animal contact are some of the factors that can influence measurement accuracy. A minimum of four independent images should be collected, and the resulting % IMF predictions should be averaged for this trait. The % IMF measurement is made from an image collected across the 11th-13th ribs (or 12th-13th ribs) at a lateral position from the animal's midline at a point three-fourths of the distance from the medial end of the longissimus dorsi muscle (position C as illustrated in Figure 1).

Figure 4. Example ultrasound image of the ribeye muscle (Longissimus dorsi) taken at location B in Figure 1.

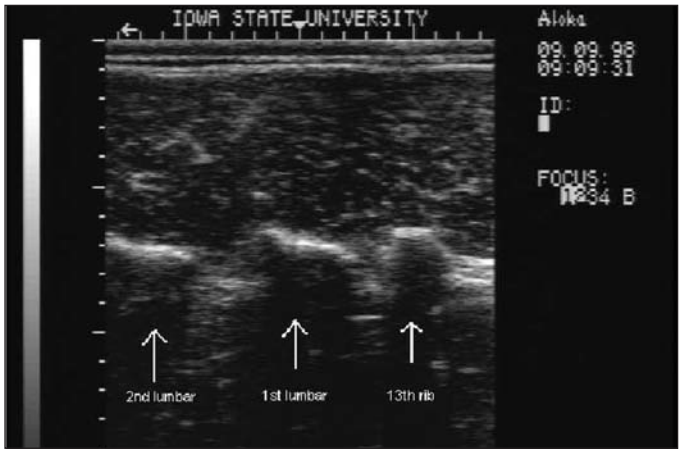

Figure 5. Example ultrasound image of the ribeye muscle (longissimus dorsi) taken at location C in Figure 1. This image is used to predict percent intramuscular fat (marbling score).

When to scan seedstock. Body composition measures determined from individual animal ultrasound images must be adjusted to a common endpoint for accurate genetic comparisons. The endpoint must have relevance to traits of economic importance in the carcass. Research has shown that yearling bulls and developing replacement heifers can be scanned at approximately 365 days of age to provide a good indication of how sibling steer and heifer mates will perform in the carcass. Most breed associations have developed an age-at-scanning window that must be met in order for the data to be used in national cattle evaluation.

When to scan feedlot cattle. The endpoint for adjusting ultrasound measures in feedlot animals will vary by breed association ultrasound program. Generally, the scanning endpoint should be consistent with the association's carcass data collection program and associated endpoint. Endpoints might include (a) scanning all animals within a feedlot contemporary group when the group averages 0.35 inches of external fat thickness over the 12th-13th rib, (b) scanning all animals when a contemporary group achieves some average designated age or average weight endpoint or (c) scanning all animals within a contemporary group just prior to the time when the first animals within the group are to be harvested.

Adjustment factors. Adjusting individual animal ultrasound measures to a common endpoint allows for the fairest comparison among animals within a contemporary group. Factors such as an animal's age, age of dam, weight and weight gain may affect its ultrasound measures. Therefore, a scanning weight should be recorded within seven days of when cattle are scanned. Gut fill can have a significant impact on an animal's weight when compared

to contemporaries, creating a biased measurement and comparison. Therefore, the scanning weight should be an empty body weight taken when the animal has been held off feed overnight. Many adjustment formulas may also use rate of gain to adjust ultrasound measurements to a common endpoint. It is recommended that an additional weight and date be recorded at weaning for seedstock animals being measured at one year of age, and for feedlot animals a weight and date should be recorded when animals go on feed.

Contemporary groups. The development of body composition EPDs requires that scanned animals be associated with a well-defined contemporary group. Animals of the same sex, reared and managed together up until the time of scanning, form a contemporary group. Additionally, it is suggested that breeders define only calves that are within a 60-day age window as a contemporary group. Scanning contemporary group definition includes the following: herd code, weaning date or weaning lot date, weaning management group (pasture, creep, non-creep, etc.), scanning date or scanning lot date and post-weaning management group designation. The lot date is used in lieu of actual measurement date when weaning or scanning of a contemporary group must occur over consecutive days. For animals scanned at a central test facility, the contemporary group definition for an animal must include its herd of origin and other birth and weaning contemporary group information. National cattle evaluation requires that performance records be tied across contemporary groups or herds. The pedigree relationship matrix used in the prediction methodology allows for many indirect ties to be established. However, the best ties are made when sires have progeny represented across contemporary groups, herds and years. All scanning contemporary groups must have at least two sires represented, and at least one of those sires should be used in another herd that is also participating in scanning for national cattle evaluation.

Facilities and animal preparation. It is the breeder's responsibility in most cases to ensure that the cattle handling facilities for scanning are adequate for animal restraint and for safety of the animal handlers, ultrasound technician and the cattle. A squeeze chute with fold-down side panels is required for scanning beef cattle. The chute should be located under a roof that can block direct sunlight and provide protection from rain or other inclement weather conditions. A clean and grounded power signal (110v) is required chute-side. It is best if the electrical circuit is a dedicated line to the chute, free from the interference of other electrical equipment such as motors. Most ultrasound equipment does not operate efficiently and accurately

Table 1. Acceptable Scanning Ages

Breed	Yearling Bulls	Developing Heifers	Feedlot Steers and Heifers
	days		
Angus	320-440	320-460	320-460
Brangus	310-430	310-430	310-430
Braunvieh	320-410	320-410	320-410
Charolais	320-430	320-430	320-430
Chianina	320-440	320-460	320-460
Gelbvieh	320-410	320-410	320-410
Hereford	330-530	330-530	330-530
Limousin	300-450	300-450	300-450
Maine-Anjou	300-440	300-440	300-440
Murray Grey	320-410	320-410	320-410
Red Angus	320-440	320-460	320-460
Salers	330-450	330-450	330-450
Shorthorn	320-440	320-460	320-460
Simmental	300-440	300-440	300-440
BIF Guidelines	320-410	320-410	320-410

when the ambient air temperature falls below 45°F. The breeder should make provisions to keep the facility heated in these situations. Animals are to be clipped at the scanning site to enhance contact between the transducer and wave-guide and the hide. Length of hair coat should be no more than ½ inch in the area to be scanned.

Equipment. Currently in the United States, most beef cattle scanning is done with an Aloka 500 V with a 17cm linear array 3.5 MHz transducer or with a Classic Scanner 200 with a 18 cm linear array 3.5 MHz transducer. The type of ultrasound equipment and software used to collect and interpret ultrasound images can have an impact on measurement accuracy.

Image interpretation. As in scanning, accurate interpretation of real-time ultrasound images for external fat thickness, ribeye area and % IMF requires a high degree of skill by ultrasound technicians. Within the industry, there currently are two methods of processing images. First, technicians are solely responsible for the collection and subsequent interpretation of images. Second, a centralized processing facility may work with field technicians with the primary objective of interpreting images and reporting the data. Each method should strive to provide an accurate and timely assembly of data. There are programs currently recognized within the beef cattle industry that technicians can participate in to obtain training and certification in beef cattle scanning and interpretation.

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