EVALUATION OF ULTRASOUND FOR PREDICTION OF CARCASS FAT THICKNESS AND RIBEYE AREA IN FEEDLOT STEERS

M.T. Smith[1], J.W. Oltjen[2], H.G. Dolezal[2], D.R. Gill[3] and B.D. Behrens[4]

Story in Brief

Three hundred fifteen yearling beef steers were ultrasonically measured for backfat thickness and ribeye area. Live animal ultrasound measurements were then compared to actual carcass measurements to determine the accuracy of these values. Estimates of backfat thickness were within one-tenth of an inch of actual 75% of the time and ribeye area was predicted within one square inch 37% of the time. Fat thickness was underestimated on fatter cattle and ribeye area was underpredicted on heavier muscled steers. These results suggest that ultrasonic measurements of backfat are quite accurate in determining carcass fat thickness, but ribeye area estimates are imprecise.

(Key Words: Ultrasound, Carcass Measurements, Feedlot Steers.)

Introduction

Before the beef industry moves to a value-based marketing system, a means of accurately identifying individuals with superior performance and carcass traits is required. Recent research suggests that ultrasound technology may be beneficial in quantifying these traits of interest. Ultrasound involves transmitting high frequency sound waves through the hide of the live animal. These sound waves are reflected at varying rates due to differences in density among the primary tissue types (bone, muscle, fat). Estimates of backfat and ribeye area of the live animal are then determined from the cross-sectional image that is produced. The ability of ultrasound to accurately estimate carcass parameters in live animals is important because it would facilitate the development of genetic values for carcass traits for the seedstock producer and aid in sorting for optimal endpoints for the feedlot

---

[1]Graduate Student [2]Associate Professor [3]Regent's Professor
[4]Research Associate

operator. Accuracy appears to be technician dependent and varies considerably. Correlations of live and carcass ultrasonic measurements for back fat and ribeye area have been reported from .42 to .92 and .47 to .86, respectively (Houghton, 1988). Therefore, the objective of this study was to evaluate ultrasonic measurements of backfat and ribeye area taken prior to slaughter for prediction of actual carcass values.

Materials and Methods

The 315 yearling steers used in this experiment were part of a feeding trial conducted to determine the effect of virginiamycin, a feed-grade antibiotic, on performance and carcass characteristics of feedlot steers (Smith et al., 1989). Steers were slaughtered in two groups. The first group (Kill 1) were fed a total of 135 days, while the second group (Kill 2) were fed 149 days. Five days prior to slaughter, steers were scanned using an Aloka 210DX ultrasound unit equipped with a 3 megahertz transducer. The images produced were recorded on video tape and later viewed to determine carcass backfat (USBF) and ribeye area (USREA) estimates. Carcass backfat (BF) and ribeye area were measured at the 12th and 13th rib interface 24 hours post mortem. Carcass ribeye area was determined using a standard dot grid (GREA) for both kill groups. In addition, acetate tracings (TREA) of the longissimus dorsi muscle were obtained from carcasses of Kill 1 steers. An electronic digitizing board was used to determine the area of these tracings. Means and standard deviations for parameters of interest in this study are presented in Table 1.

For purpose of analysis, ultrasonic ribeye area estimates were multiplied by two correction factors so that the mean ribeye area predictions were equal to observed means as determined by either grid (GREA) or tracing (TREA). Ribeye area was also predicted as a function of shrunk final weight (BWREA) using linear regression.

Table 1. Description of steer data used for analysis.

Parameter	n	Mean	Standard deviation
Initial weight, lb	315	690.3	54.6
Final weight, lb	315	1063.0	79.8
Carcass weight, lb	315	729.8	55.5
Backfat, in	315	.54	.18
GREA[a], in^2	315	12.15	1.25
TREA[b], in^2	200	12.62	1.28

[a]Ribeye area using a standard dot grid.
[b]Ribeye area digitized from acetate tracings.

Results and Discussion

Simple correlations (r) between predicted (USBF, USREA, BWREA) and observed values (BF, GREA, TREA) are presented in Table 2. Ultrasonic estimates of backfat were highly correlated with actual values (r=.81) and appear to be accurate predictors of carcass backfat thickness. The relationship between predicted and observed ribeye area, however, was moderate to low depending upon method of determining actual values (r=.43, GREA; r=.20, TREA). Improper placement of the transducer by the technician, poor image resolution or inaccurate interpretation of the image produced may explain these low values. Changes in muscle configuration during processing and onset of rigor mortis may also affect ribeye area and thus accuracy of ultrasonic estimates. Interestingly, ribeye area predicted from final weight showed a stronger relationship to actual values than did ultrasonic estimates (r=.54, GREA; r=.47, TREA).

Due to differences in backfat thickness and ribeye area configuration that exist between the standing animal and the hanging carcass, many argue that precision of ultrasound estimates should be determined by assessing the relative frequency in which estimates are within a given range of actual carcass parameters. In this study, ultrasonic backfat thickness was estimated within one-tenth of an inch 75 percent of the time and within two-tenths of an inch 92 percent of the time (Table 3). Steers with actual fat thickness less

Table 2. Correlations of predicted and observed BF and REA[a].

	BF	USBF	GREA	TREA	USREA	BWREA
BF	1.00	.81	-.17	-.14	.09	.21
USBF		1.00	-.07	-.05	.13	.23
GREA			1.00	.89	.43	.54
TREA				1.00	.20	.47
USREA					1.00	.42
BWREA						1.00

[a]See text for explanation of symbols.

Table 3. Cumulative frequency distribution (%) of ultrasound carcass backfat measurement error.

Range of absolute residual, in	All data	Actual backfat, in	
		<.5	>.5
<.05	48	56	42
<.10	75	82	68
<.20	92	98	88
<.30	99	100	99
<.40	100	100	100

than .5 inches were estimated within one-tenth of an inch 82 percent of the time compared to 68 percent for those with actual fat thickness greater than .5 inches. Ultrasonic ribeye area estimates (GREA) were within one square inch 37 percent of the time compared to 59 percent for estimates of ribeye area as determined by weight of the animal (Table 4).

To illustrate the relative accuracy of ultrasonic measurements, residuals (predicted minus observed values) were plotted against actual measurements of carcass backfat and ribeye area. As shown in Figure 1, there is a tendency to underpredict backfat thickness on fatter cattle. This is most likely due to misinterpretation of fat layers that normally develop as an animal increases in fatness. Ribeye area is generally overpredicted for carcasses with actual longissimus muscle areas of less than 11 square inches and is underpredicted for carcasses with actual ribeye areas over 13 square inches (Figure 2).

Results of this study demonstrate that ultrasonic measurements made prior to slaughter are accurate for estimating carcass backfat thickness, yet imprecise in predicting ribeye area. In fact, predicting ribeye area as a function of live weight proved more accurate than ultrasound estimates. While ultrasonic measurements of backfat appear useful in estimating composition of growth and possibly preliminary yield grade of feedlot steers prior to slaughter, they are of little use in determining quality grade. This is due to the relatively low correlation between backfat and marbling (r=.16) observed in this study. These results question the use of ultrasound in determining differences in longissimus muscle area in feedlot steers and suggest caution in making breeding or management decisions from ribeye area estimates generated from this technology.

Table 4. Cumulative frequency distribution (%) of carcass ribeye area measurement error[a].

Range of absolute residual, square in	Comparison		
	USREA and TREA	USREA and GREA	BWREA and GREA
< .25	8	8	15
< .50	17	18	31
< .75	27	28	44
<1.00	36	37	59
<1.50	50	48	79
<2.00	62	60	90
<3.00	83	84	100
<5.00	95	98	100

[a]See text for explanation of symbols.

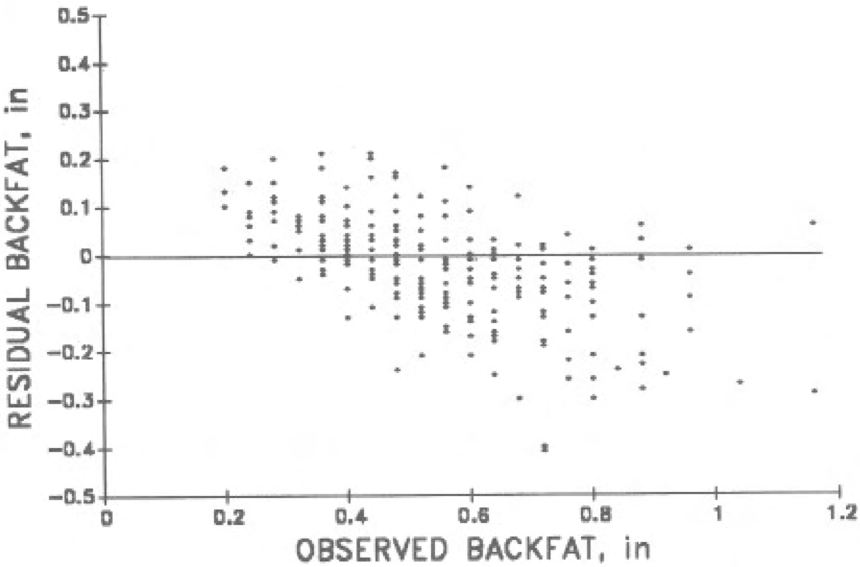

Figure 1. The relationship of residual (ultrasonically predicted minus observed) backfat and observed backfat of feedlot steers.

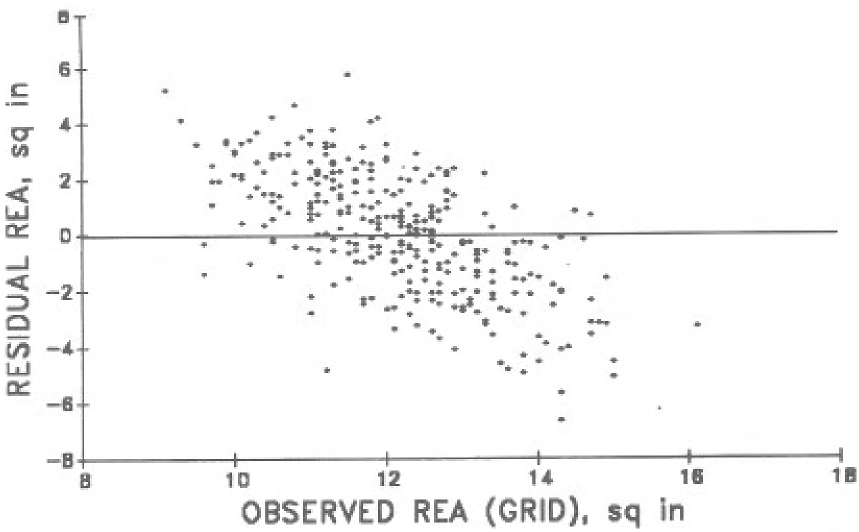

Figure 2. The relationship of residual (ultrasonically predicted minus observed) ribeye area and observed ribeye area of feedlot steers.

Literature Cited

Houghton, P.L. 1988. Application of ultrasound in commercial feedlots and beef breeding programs. Proceedings of Beef Improvement Federation annual convention.

Smith, M.T. et al. 1989. The effect of virginiamycin on performance of feedlot cattle. Okla. Agr. Exp. Sta. Res. Rep. MP-127:137.