Beef Research Report, 1996 | Animal Science Research Reports

1997

Estimating Ribeye Area Using a Longitudinal Ultrasound Image of the 12th and 13th Rib Section

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Extension Number: ASL R1334

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Abstract
A study was performed to determine the feasability of using a measurement of ribeye depth (RED) from a longitudinal ultrasound image to estimate ribeye area (REA). The correlation between RED obtained with ultrasound and REA from a tracing was high for both implanted (r = .49) and non-implanted (r = .45) steers. The mean bias between predicted REA and actual REA was not different from zero. This analysis shows that RED could be an accurate indicator of REA.

Keywords
ASL R1334

Disciplines
Animal Sciences

Estimating Ribeye Area Using a Longitudinal Ultrasound Image of the 12th and 13th Rib Section

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Summary

A study was performed to determine the feasability of using a measurement of ribeye depth (RED) from a longitudinal ultrasound image to estimate ribeye area (REA). The correlation between RED obtained with ultrasound and REA from a tracing was high for both implanted (r = .49) and non-implanted (r = .45) steers. The mean bias between predicted REA and actual REA was not different from zero. This analysis shows that RED could be an accurate indicator of REA.

Introduction

Measurements by ultrasound currently are being used in the feedlot industry to sort cattle into uniform outcome groups. Sorting cattle into these groups allows the cattle to be marketed as a more uniform group.

The most extensively used sorting system in the feedlot sector today is one that was originally developed by John Brethour at the Kansas State University Experiment Station in Fort Hays Kansas. This system sorts cattle into like outcome groups and makes economic decisions based on live weight and a measurement of backfat and intramuscular fat (marbling) taken approximately 100 days before slaughter. A computer model calculates the backfat thickness and estimates marbling from a longitudinal image taken two inches off the midline over the 12th and 13th rib section. Although backfat is probably the single most important indicator of carcass merit in this model, adding some component representative of muscling in the animal may improve the sorting capability and economic decision-making power of this system for different marketing programs.

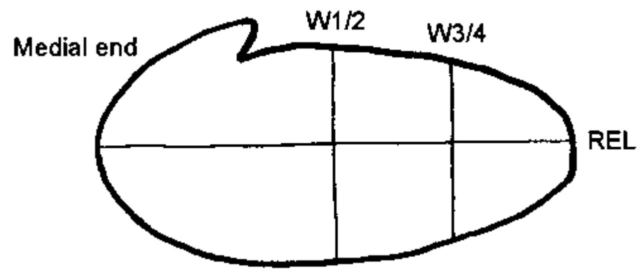
One key component to this system is the high speed at which it can be used. Feedlots using a sorting system are interested in putting cattle through at a rapid rate. This rapid rate precludes the possibility of obtaining ribeye area by tracing ultrasound images. Because only a longitudinal image is currently taken, for practical reasons a method was sought to estimate ribeye area from an ultrasound measurement of ribeye depth (RED).

Materials and Methods

Model development

Data from 136 Continental crossbred steers were used in the analysis. The data were measurements obtained from a tracing of each ribeye at slaughter and a longitudinal ultrasound image taken just before slaughter. The measurements from the carcass tracings included ribeye area (REA), which was measured using a planimeter, length of the ribeye (REL), width of the ribeye at the halfway mark (W1/2), and width of the ribeye at the three-quarter mark (W3/4) from the medial end as shown in Figure 1. RED was the distance from below the backfat to the top of the ribs (Figure 2) obtained by placing the transducer two inches off the midline and parallel to the *Longissimus* muscle of the live animal. A correlation procedure (PROC CORR) in SAS® was used to produce means and correlations.

Figure 1. Carcass ribeye area tracing illustrating the length (REL) and both width (W1/2 and W3/4) measurements.



Data from the 136 animals were used to develop equations for implanted and non-implanted steers that would predict REA from RED. This was accomplished by regressing REA on RED using the general linear models procedure (PROC GLM) in SAS®.

Model validation

Data from another group of 86 Continental crossbred steers were used to test the bias of the prediction equations for implanted and non-implanted steers. Bias was the difference between the predicted and actual values from the REA tracings.

Results and Discussion

Correlation coefficients for implanted (n = 82) and non-implanted (n = 54) steers are summarized in Table 1. Ribeye depth from ultrasound was correlated to REA (r = .49 and r = .45) and W1/2 (r = .53 and r = .45) from the carcass REA tracings for implanted and non-implanted cattle, respectively. The strong relationship between RED and W1/2 seems logical, because the two measurements were taken at approximately the same location. Different placement of the transducer could improve the correlation between RED and REA, because the measurements from the ribeye tracings (W1/2, and W3/4) had much higher correlations to REA than did RED (Table 1).

Figure 2. Longitudinal ultrasound image of the 12th and 13th rib section showing the ribeye depth (RED) measurement.

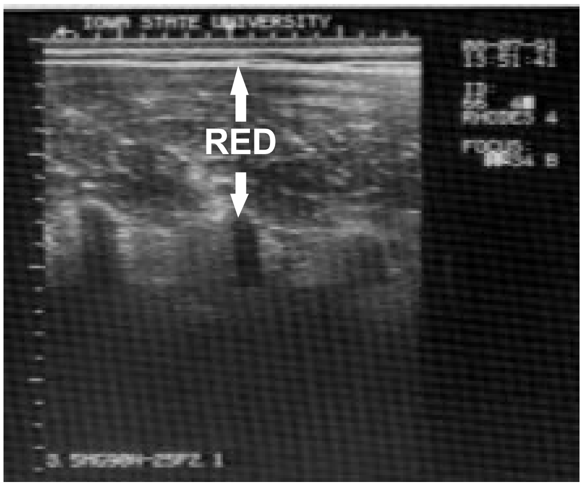


Table 1. Pearson correlation coefficients (n = 54).

	Implanted		Non-implanted	
	REA	RED	REA	RED
REA	1	.49	1	.45
W1/2	.77	.53	.7	.45
W3/4	.69	.35	.76	.3
RED	.49	1	.45	1

The linear model used to predict REA from RED is described as

$$\text{Predicted REA} = a + b_1X$$

where, a is the intercept, b_1 is the slope, and X is the RED measurement from ultrasound. Constant values used in the prediction model are summarized in Table 2. The regression model was highly significant ($p < .01$) for implanted and non-implanted steers. Means of actual REA, predicted REA, and bias from the 86 implanted and non-implanted steers used to validate the model are shown in Table 3. The model predicted a difference of .93 square inches ($p < .01$) in REA between the implanted and non-implanted steers, compared with a difference of .95 square inches ($p < .01$) from the tracings. The mean bias between predicted REA and actual REA was .25 square inches and .27 square inches for implanted and non-implanted steers. This bias was tested using a *t* statistic and was not different from 0 for either implanted ($p > .36$) or non-implanted ($p > .32$) steers.

This study was done to investigate the possibility of using a longitudinal ultrasound image to predict actual REA rather than develop an all-inclusive model for predicting REA. Further study with larger numbers of cattle, more diverse biological types, and a range of different ages is needed.

Table 2. Values used in linear prediction model.

	Intercept	b_1	R-square
Implanted	5.91044	3.10610	.240
Non-implanted	7.26848	2.25865	.206

Table 3. Means and standard deviations of actual REA, predicted REA, and bias.

	Implanted			Non-implanted		
REA	n	mean	sd	n	mean	sd
Actual	46	13.94[a]	1.547	40	12.99	1.506
Predicted	46	14.19[a]	.934	40	13.26	.822
Bias	46	.25[b]	1.864	40	.27	1.705

[a] Means within the row differ ($p < .01$).
[b] Means within the row are not different from 0 ($p > .3$).

Implications

Ribeye area of carcasses is used as an estimator of lean product yield. When the surface of the ribeye is not exposed, as in non-destructive evaluation of carcasses or with live animals, a longitudinal ultrasound image might be used to measure depth of the ribeye muscle to predict REA.

Acknowledgements

The assistance of Rod Berryman, research center superintendent; Julie Roberts, secretary; Deborah Bleile, laboratory technician; and animal caretakers at the ISU Beef Nutrition Research Center is appreciated.