

# Use of a Digital Camera to Collect Carcass Data from Experimental Cattle

## A.S Leaflet R1650

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### Summary

**A digital camera was used to obtain digital images of beef carcasses moving on the rail in commercial beef packing plants. These images were satisfactory for measurement of backfat thickness and area of ribeye. The measurements were closely correlated with the same two measurements taken from tracings on acetate paper of fat thickness and area of ribeye made on carcasses moving on the rail.**

### Introduction

Collecting accurate carcass measurements in a large beef packing plant is difficult because the measurements usually have to be made while the carcass is moving on the rail in areas of the coolers where lighting is often inadequate. We considered photography as an alternative method by capturing images of each carcass that could be measured outside of the cooler. Film capacity limits the number of images that could be taken with conventional still photography. The cold temperature of the cooler would limit the use of most video cameras. Finally our attention was drawn to digital cameras coupled with computer image analysis software. Another alternative is to use real-time ultrasound to make the measurements prior to slaughter. The purpose of this paper is to present our preliminary experience with use of a digital camera to collect an image of the cross section between the 12<sup>th</sup> and 13<sup>th</sup> ribs of each carcass and measurement of thickness of backfat and area of ribeye using a commercially available image analysis software program. Data obtained with the digital camera are compared with measurements from tracings on acetate sheets and images obtained with ultrasound.

### Materials and Methods

The carcasses used in this study were from a group of thirty-five crossbred yearling steers fed a corn-based finishing diet for 145 days. Ten days before slaughter the steers were scanned between the 12<sup>th</sup> and 13<sup>th</sup> ribs with a Pie Scanner 210 using a 3.5 MHz 18-cm linear array transducer to measure fat thickness and area of ribeye. Twenty-four hours following slaughter, ribeye area and fat thickness were traced on acetate paper as the carcasses moved on the rail after being cut between the 12<sup>th</sup> and 13<sup>th</sup> ribs and before reaching the federal grader. Immediately after passing the grader, a digital image of each carcass was obtained while

the carcass continued to move on the rail. An Olympus D-600L digital camera with through the lens focusing was mounted on a stainless steel support with a light bar and a rectangular frame to set on the cut surface of the carcass (Figure 1). The camera was set on standard quality (640 x 512 pixel resolution) and macro focusing to increase speed of saving the images between carcasses and to position the camera close to the cut surface. The camera was equipped with an 8 MB SmartMedia® card, which could store up to 100 images with the level of compression used.

The digital images taken by the ultrasound scanner were downloaded to a computer file and stored on Zip disks. Measurements of backfat and muscle area were measured with Eview, a software program provided by Pie Medical. From the tracings on the acetate sheets, backfat thickness was measured with a ruler and muscle area with a beef grid. Digital images were downloaded from the camera to a computer file and stored on Zip disks. SigmaScan Pro 3.0 was used as software to obtain measurements of fat thickness and muscle area from the images. The software was calibrated by placing a ruler in several images.

Thirty-one carcasses hanging on the rail were also measured to further validate the image analysis method by comparing traditional methods of obtaining carcass information with the digital camera. These carcasses were not moving, but were pushed close together in an area with reduced lighting. The ribeye area and subcutaneous fat thickness of each carcass were traced on an acetate sheet and later measured with a beef grid or traced with a planimeter. Digital images were also obtained from each of the carcasses and ribeye area and backfat were measured from the images as described.

The three methods of obtaining carcass measurements were compared with linear regression analysis. The data from the validation part of the study were analyzed by linear regression and calculation of correlation coefficients.

### Results and Discussion

An example of an ultrasound image taken from a live animal is shown in Figure 2. The fat layer located between the hide and the muscle is obvious. The cross-sectional view of the ribeye muscle is less obvious, but with experience can be seen and measured. An image of the cut surface between the 12<sup>th</sup> and 13<sup>th</sup> ribs obtained with the digital camera is shown in Figure 3. The subcutaneous fat layer, ribeye area along with other muscles, and marbling in the muscle are all obvious. Measurement of fat thickness and ribeye area from the digital image is shown in Figure 4.

The results of regression analysis of the three methods are given in Figures 5, 6 and 7 for backfat and in Figures 8,

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9 and 10 for ribeye area. There was an excellent relationship between the measurements from the tracings on the acetate sheets and the images taken with the digital camera. There was somewhat more variation in measurements of ribeye area than thickness of backfat. We think there is more error involved with obtaining the tracings on the acetate sheets, because of the movement of the carcasses and in some cases poor light. There were similar relationships between measurement from ultrasound images and measurements from images of the carcasses obtained with the digital camera or from tracings on the acetate sheets. Ultrasound tended to underestimate fat thickness and ribeye area and the difference becomes greater with more backfat or larger ribeye area. Measurements of ribeye area from ultrasound images can vary due to how the animal is standing and to poor image quality, which occurs more frequently with larger and fatter animals. Thickness of subcutaneous fat between the 12<sup>th</sup> and 13<sup>th</sup> ribs of the hanging chilled carcass

may not be an accurate measure of subcutaneous fat over the same area in the standing animal.

The results of the validation study are given in Table 1 and the regression equations in Table 2. The data indicate that measurement of ribeye area with a grid at the plant and from the digital image were similar and these two measurements different from the measurement of the tracing on acetate sheets. This difference may have been due to the personnel involved in the study. Measuring the carcass with the grid and from the digital image were done by one individual. Another individual made the tracings. Measuring thickness of backfat on the carcass with the ruler tended to be more variable than the tracing or digital image. The most accurate data should be obtained with the digital camera if the camera is focused, placed correctly on the carcass and the software properly calibrated.

**Table 1. Means and variation of different methods of measuring ribeye area (REA) and thickness of backfat (BF) of beef carcasses (31 carcasses).**

	<u>REA-GC</u>	<u>REA-GA</u>	<u>REA-PA</u>	<u>REA-D</u>	<u>BF-RC</u>	<u>BF-RA</u>	<u>BF-D</u>
	sq. in.	sq. in.	sq. in.	sq. in.	in.	in.	in.
Average	12.5	13.0	12.8	12.8	.50	.50	.43
SE	.26	.34	.33	.28	.041	.027	.028
Maximum	15.0	17.3	17.4	16.0	1.10	.83	.83
Minimum	9.1	9.4	9.4	9.1	.20	.20	.18

GC = Measured with grid on the carcass.  
 GA = Measured with grid on the tracing on the acetate sheets.  
 PA = Measured with planimeter on the tracing on the acetate sheets.  
 D = Measured from the digital camera image.  
 RC = Measured with ruler on the carcass.  
 RA = Measured with ruler on the tracing on the acetate sheets.

**Table 2. Linear regression equations relating the different methods of measuring ribeye area (REA) and thickness of backfat (BF) of beef carcasses.**

Regression equation	r	P
BF-RC = 0.064 + 0.867 (BF-RA)	0.58	.007
BF-RC = 0.041 + 1.17 (BF-D)	0.85	.0001
BF-RA = 0.223 + 0.642 (BF-D)	0.65	.0001
REA-GC = 4.13 + 0.639 (REA-GA)	0.85	.0001
REA-GC = 4.05 + 0.656 (REA-D)	0.95	.0001
REA-GA = -0.183 + 1.03 (REA-GC)	0.99	.0001
REA-GA = -0.254 + 1.04 (REA-D)	0.84	.0001
REA-PA = 0.316 + 0.978 (REA-D)	0.83	.0001

See Table 1 for identification of measurements.

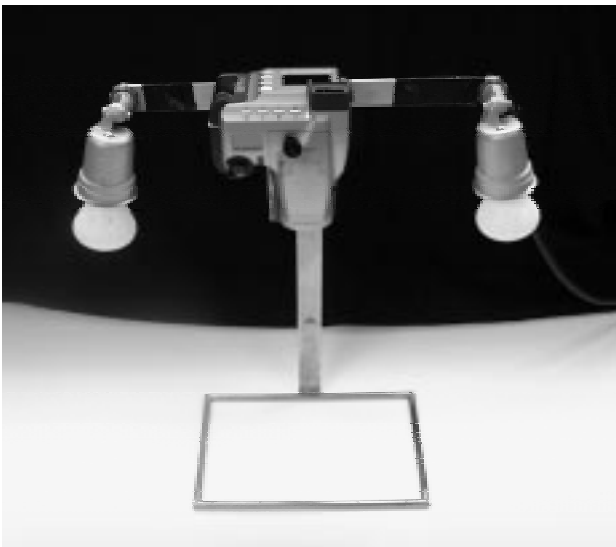
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Meat scientists at the USDA Meat Animal Research Center have recently reported a high correlation between the area of fat and muscle in a digital image of a steak cut from the carcass and the yield of retail meat. We think more careful placement of the base of our camera support on the carcass will allow us to make similar estimates of carcass yield. The software program we used in this study would measure area of fat and muscle within the ribeye (i.e. marbling), except we have not been able to completely eliminate all the reflection from the cut surface of the rib (see the reflection in the lower left portion of the muscle in Figure 3. This glare can be corrected by adjustment of the light source on the camera stand.

The software we are using is not automated. With proper macros some parts of the analysis can be automated. For example it should be possible to measure area of fat and muscle in the area of the base of the camera automatically. We think that it will be possible to use analysis of digital images to estimate the value of beef carcasses. Another

**Figure 1.** The portable camera stand used to obtain digital images of carcass between the 12<sup>th</sup> and 13<sup>th</sup> ribs.



potential value of collecting digital images is to use them as an educational tool to provide information to feedlots and producers so they can see examples of their animals.

## Implications

**The use of a digital camera and measurements of the images with image analysis software can be used to more easily and more accurately collect routine beef carcass data from research animals in large beef packing plants.**

## Acknowledgments

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**Figure 2.** Ultrasound image from between the 12<sup>th</sup> and 13<sup>th</sup> ribs showing ribeye area and backfat.

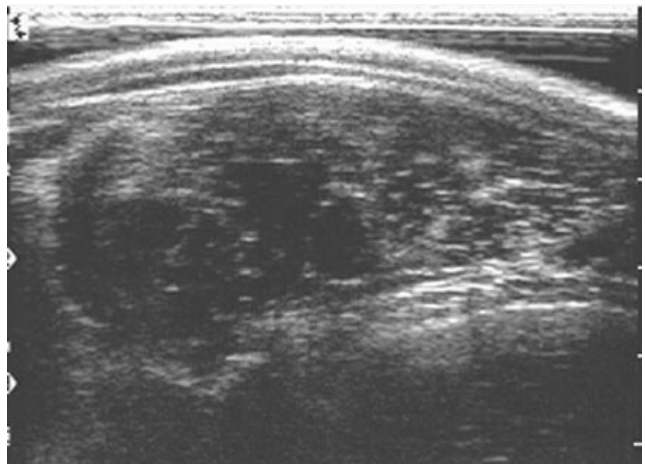


Figure 3. Image taken with digital camera showing ribeye area and backfat.

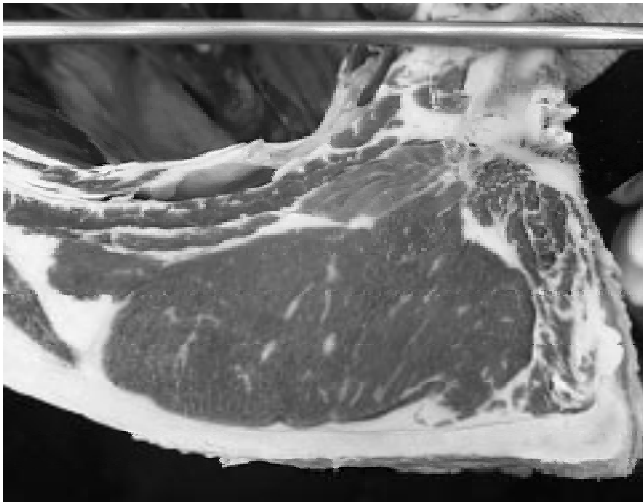


Figure 4. Image shown in Figure 3 after processing with computer software to measure thickness of backfat (line in lower right quadrant) and fill in of the ribeye to measure area.



Figure 5. Relationship of backfat measured from digital images and from tracings on acetate sheets.

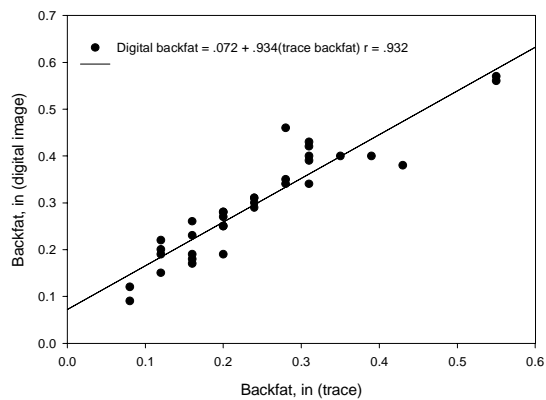


Figure 6. Relationship of backfat measured from ultrasound images and from digital images.

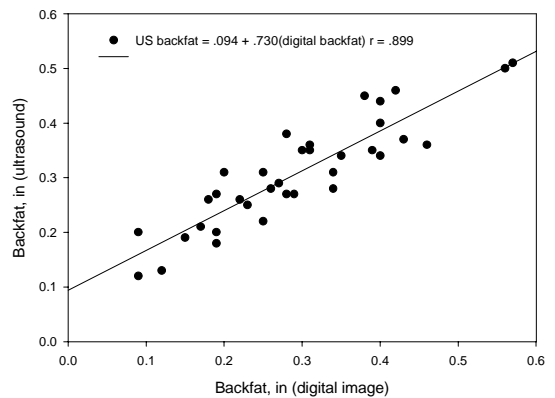


Figure 7. Relationship of backfat measured from ultrasound images and from tracings on acetate sheets.

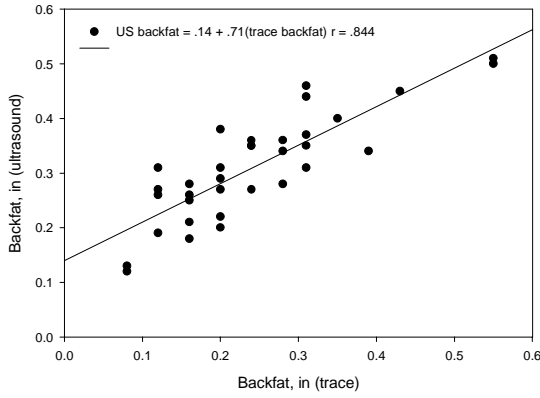


Figure 8. Relationship of ribeye area measured from digital images and from tracings on acetate sheets.

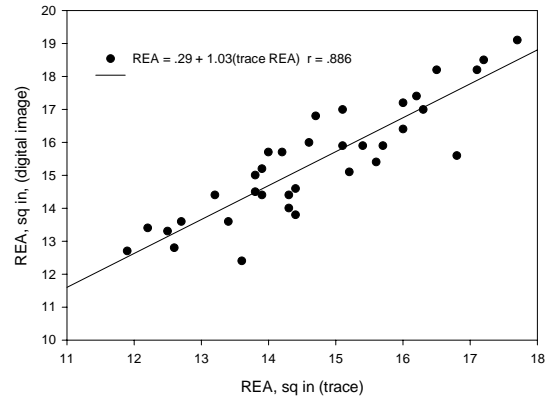


Figure 9. Relationship of ribeye area measured from ultrasound images and from digital images.

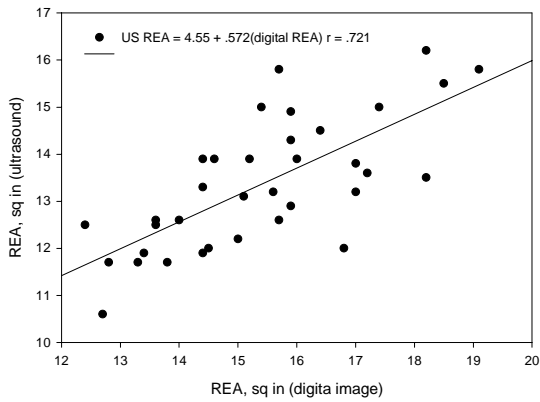


Figure 10. Relationship of ribeye area measured from ultrasound images and from tracings on acetate sheets.

