Comparison of Ultrasound and Carcass Measures to Predict Percentage of Beef Retail Product from Four Primal Cuts – Final Report

A.S. Leaflet R1827

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Summary

The objective of this study was to determine how real-time ultrasound (RTU) measurements would compare with carcass measurements to predict the percentage of retail product from the four primals (PRP4P). Data were collected on market ready cattle (n=471). Traditional carcass measures collected were: 1) hot carcass weight (HCW), 2) 12-13th rib fat thickness (CFAT), 3) 12-13th rib ribeye area (CREA), and 4) percentage of kidney, pelvic, and heart fat (CKPH). Live animal ultrasound measures collected were: 1) scan weight (SCANWT), 2) 12-13th rib fat thickness (UFAT), 3) 12-13th rib ribeye area (UREA), 4) subcutaneous fat thickness over the termination of the *biceps femoris* in the rump (reference point) (URFAT), 5) depth of the *gluteus medius* below the reference point (URDEPTH), and 6) area of the *gluteus medius* anterior to the reference point (URAREA). A model to predict PRP4P was developed for both carcass and RTU measures. Significant measures ($P < 0.001$) for the carcass data were CFAT, CREA, and CKPH with a model $R^2 = 0.297$. HCW was not a significant trait in the carcass data model ($P = 0.171$). Significant measures ($P < 0.001$) for the RTU data were SCANWT, UFAT, UREA, and URDEPTH with a model $R^2 = 0.448$.

Introduction

The percentage of retail product in the four primals is a very economically important trait for the beef industry. However, it is also a very challenging trait to measure directly because of difficulty maintaining identity of carcasses or cuts within many of today's carcass fabrication facilities. Therefore, prediction equations such as the USDA yield grading equation are often used. The objective of this study was to determine how RTU measurements would compare to carcass measurements to predict PRP4P. With the recent interest in RTU to evaluate seedstock for body composition traits, there is interest in comparing the abilities of RTU and carcass measures for their ability to predict PRP4P. The retail product equation based on carcass traits was developed using cattle with large variations in fat cover. This in turn made fat thickness the driving factor for percent retail product equations. More recent research has indicated that feedlot operators are trying to manage external fat more efficiently, and market cattle with a more consistent fat cover. This should increase the importance of muscle measurements for retail product equations. In particular, this study was interested in determining if nontraditional RTU measures of lean in the rump can be added to increase the accuracy of prediction of PRP4P.

Materials and Methods

Source of Data

Data for this study were obtained from market cattle (n = 471) consisting of Angus bulls, Angus steers, and crossbred steers. RTU images were collected by centralized ultrasound processing (CUP) qualified technicians within one week prior to harvest. One of two ultrasound technologies were used: 1) a Classic Scanner 200 equipped with a 3.5 MHz 18 cm linear array transducer (n = 387), or 2) an Aloka 500V equipped with a 3.5 MHz 17 cm linear array transducer (n = 84). RTU live animal measurements taken were: 1) SCANWT, 2) UFAT, 3) UREA, 4) URFAT, 5) URDEPTH, and 6) URAREA. There were two images collected to acquire these measures: a cross-sectional image between the 12-13th ribs (Figure 1), and a longitudinal image slightly above a line from the hooks to the pins, in line with the *shaft of the ileum* (Figure 2).

Figure 1. Cross-sectional ultrasound image taken between the 12-13th ribs.

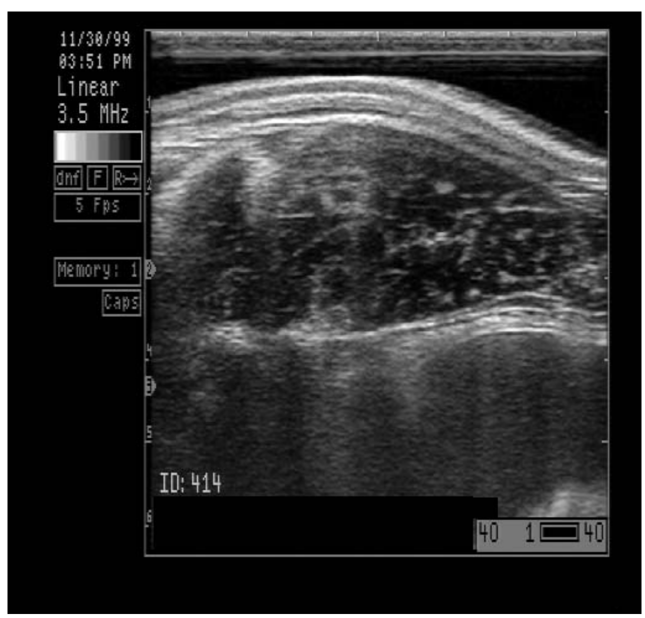
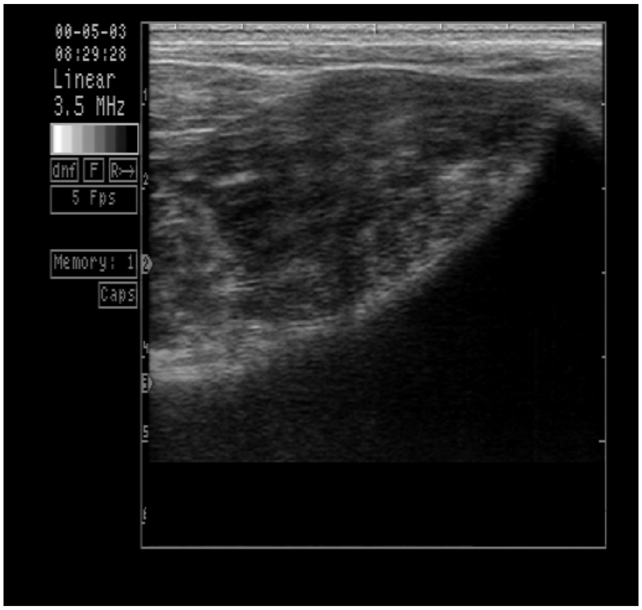


Figure 2. Longitudinal ultrasound image taken in the rump region.



Routine carcass measurements were collected at the harvesting facility approximately 24 to 48 hours post mortem by experienced personnel. Carcass measurements taken were: 1) HCW, 2) CFAT, 3) CREA, and 4) CKPH.

The carcasses were transported to a fabrication site, Jim's Wholesale Meats, Harlan, IA. The right side of each carcass was then fabricated into retail ready cuts, with weights recorded for bone, fat, retail cuts, and lean trim. PRP4P was calculated by adding lean weights from the closely trimmed retail cuts in the four primals and the lean trim weight (adjusted to 85% lean) from the four primals, and then expressing this as a percentage of the side weight.

Data Analysis

A prediction equation for PRP4P was developed through stepwise regression for live measures and for carcass measures. Significance level for a variable to enter the model was set at $P < 0.50$, and significance for a variable to remain in the model was set at $P < 0.10$. Means and standard deviations for each of the variables are given in Table 1. Significant measures for the carcass data were CFAT, CREA, and CKPH. Significant measures for the RTU data were SCANWT, UFAT, UREA, and URDEPTH. Partial R^2 and P-values for each variable in both models are given in Table 2.

Results and Discussion

These data indicate that RTU live measures of body composition predict PRP4P more accurately than routine carcass measures. The traditional carcass prediction equations include HCW in the percentage retail product equation, however these data did not have HCW as a significant factor for predicting PRP4P ($P = 0.171$). The RTU model included the similar traits of ribeye area and fat cover over the 12-13th rib, which are the traits that ultrasound was originally used to investigate, in addition to live weight. There may be some advantage to including nontraditional RTU measures of body composition (which are not obtainable in the carcass) by scanning in the rump region because URDEPTH was significant ($P < 0.001$) in the prediction of PRP4P.

Ultrasound measures have higher coefficients than carcass measures for fat thickness over the 12-13th rib and 12-13th rib ribeye area. An ultrasound measurement of one inch fat or one square inch of ribeye area have a stronger impact on the prediction of retail product which will come from the animal than a corresponding carcass measurement of one inch of fat or one square inch of ribeye area.

Looking at the relationship between fat thickness and ribeye area within both carcass measures and ultrasound measures is important as well. A 0.1 in. reduction in carcass fat thickness, is equivalent to increasing carcass ribeye area by 0.94 in.^{2}. Whereas a 0.1 in. reduction in ultrasound fat thickness is equivalent to increasing ultrasound ribeye area by 1.55 in.^{2}.

Implications

Many of today's seedstock are being evaluated by RTU for body composition traits. To date the prediction of PRP4P in live animals has been based on using coefficients developed from carcass data, and then making some underlying assumptions about the cattle. Some of the assumptions under these conditions were standard dressing percentages and standard CKPH values. Evidence now exists that ultrasound measures in live cattle can more accurately predict PRP4P than the carcass yield grading equation. This should allow for a more accurate prediction of PRP4P to be made on seedstock that are being selected throughout the industry. With this increased accuracy of selection comes some concern as to what traits are creating the shifts in PRP4P, as ultrasound fat measures seem to be even more influential than carcass fat measures.

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ISU Beef Nutrition Research Farm, Ames, IA
ISU McNay Research Farm, Chariton, IA
ISU Armstrong Research Farm, Lewis, IA

Table 1. Means and standard deviations of observed variables.

Variable	Mean	Std. Dev.
PRP4P(%)	52.65	1.93
SCANWT(lb.)	1212.66	95.59
UFAT(in.)	0.41	0.13
UREA(in.^{2})	12.98	1.25
URFAT(in.)	0.38	0.13
URDEPTH(in.)	3.49	0.33
URAREA(in.^{2})	10.24	1.52
HCW(lb.)	741.57	60.09
CFAT(in.)	0.42	0.16
CREA(in.^{2})	12.72	1.33
CKPH(%)	1.98	0.34

Table 2. Independent variables for prediction of percent retail product from the four primals.

Variable	Coefficient	Partial R^2	Model R^2	P-Value
CARCASS	52.4468			
CFAT(in.)	-3.5354	0.164	0.164	<0.001
CKPH(%)	-1.5592	0.069	0.233	<0.001
CREA(in.^{2})	0.3742	0.064	0.297	<0.001
RTU	50.7596			
UFAT(in.)	-8.3466	0.299	0.299	<0.001
UREA(in.^{2})	0.5372	0.091	0.391	<0.001
SCANWT(lb.)	-0.0044	0.029	0.420	<0.001
UDEPTH(in.)	1.0707	0.028	0.448	<0.001