PREDICTION OF RETAIL BEEF YIELD FROM REAL TIME ULTRASOUND SCANS RECORDED AT WEANING, THE COMMENCEMENT OF FINISHING AND PRE-SLAUGHTER

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SUMMARY

A total of 977 feedlot and pasture finished cattle from the Cattle and Beef Industry CRC straight breeding program were slaughtered at domestic, Korean and Japanese market specifications. They were weighed and scanned using real time ultrasound equipment to measure fat depth and eye muscle area (EMA) at three stages of growth. Within finish by market categories models were generated to predict percent retail beef yield from scanning measurements. Predictive accuracy improved as the time between measurement and slaughter decreased. Of the RTUS measurements, fat depth was found to be the most important predictor of yield.
Keywords: Beef cattle, ultrasound, carcass yield prediction.

INTRODUCTION

Real time ultrasound scanning (RTUS) can provide accurate measurements of fat depth and EMA in live cattle. A review of published scanning accuracy's (Wilson 1995) found good correlations between RTUS fat depth and EMA and the corresponding carcass measurements ($r > 0.86$ and 0.76 respectively).

A limited number of studies have examined the relationship between live cattle RTUS measurements and carcass yield. Griener *et al.* (1995) found that a pre-slaughter prediction equation which contained RTUS fat depths and EMA, visual muscle score (based on a nine point system) and liveweight accounted for 67.5% of the variation in percent retail beef yield (%RBY). Wolcott *et al.* (1996) also found RTUS measurements to be a useful tool for predicting %RBY. However both these studies used cattle across a wide range of carcass weights and fatness. In practice RTUS technology will generally be used within a production system, focusing for example on pasture fed animals to meet domestic specifications, or feedlot animals to meet Japanese specifications. There is a need to establish the accuracy and stability of the relationship between RTUS measurements and %RBY within these specific production environments. If stable relationships across a range of production systems are established at slaughter, it then becomes important to examine how early in an animal's life meaningful RTUS measurements can be collected. It may be that measurements recorded as early as weaning may be useful as either a management tool for better matching animals to market specifications, or as a means of identifying stock of superior genetic merit.

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This study examined the accuracy of RTUS measurements taken at three stages of growth (weaning, the commencement of the finishing phase and pre-slaughter) to predict %RBY. The stability of regression coefficients for RTUS measurements to predict %RBY across three very different market categories was also examined.

MATERIALS AND METHODS

Details of the design of a pure breeding program used by the Cattle and Beef Industry Co-operative Research Center (CRC) have been presented by Robinson (1995). From this program, a subset of 977 animals (791 steers and 186 heifers) from four *Bos taurus* breeds (Angus, Hereford, Murray Grey and Shorthorn), sourced from 18 breeding properties were used for this study. Animals were purchased from the different properties at weaning and allocated to the following treatments:

- 4 backgrounding nutritional treatments,
- 2 nutritional finishing regimes (feedlot and pasture),
- 3 market category slaughter weights (400kg for domestic market, 520kg for Korean and 600kg for Japanese markets).

Cattle were scanned using an Aloka 500 scanner at three times: as weaners on arrival at the growout property, at entry to the finishing phase (300kg liveweight for domestic market cattle and 400kg for cattle finished to export market specifications), and pre-slaughter. At each scanning, full live weight was measured along with RTUS measurements of fat depth and eye muscle area from images at the $12/13^{th}$ rib site. Fat depth was measured using the scanner's inbuilt callipers and images of EMA stored on video tape for later computer image analysis.

The left side of all carcasses was boned out to standard retail specifications, where primal cuts were trimmed to 3mm coverage of subcutaneous fat. Manufacturing meat, which comprised all the lean trim, was cored and fat content determined using a rapid microwave method (Anon. 1983). Retail beef yield was defined as the total weight of trimmed boneless retail cuts, plus the weight of adjusted manufacturing trim, expressed as a percentage of recovered side weight.

The accuracy of RTUS measurements at weaning, entry to growout and pre-slaughter to predict %RBY was examined within market category/finish subclass using a generalised least squares multiple regression model. Breed, backgrounding treatments and sex were included as fixed effects, and RTUS measurements (fat depth and eye muscle area), liveweight and age at scanning were fitted as covariates.

RESULTS AND DISCUSSION

In general, as time between scanning and slaughter increased, predictive accuracy of using RTUS measurements to predict %RBY declined. The R^2 s in Table 1 indicated that weaning scans were only useful predictors of %RBY for cattle finished to domestic market specifications. An exception to this trend was observed for weaning scan measurements on cattle finished on pasture to Japanese market weights. It is likely that the low numbers in these cells may have contributed to this anomaly. Age (in days) at scanning was included in all models and was only found to have a significant influence on predicted %RBY for animals slaughtered for the domestic market.

As fat depth and live weight increased, there was a commensurate reduction in RBY%, whilst the opposite was observed in the case of EMA. Fat depth was found to be the most important predictor of %RBY, being significant in almost all equations. Measurements of EMA and liveweight were less important as yield predictors and large differences in these traits were required before they produced significant changes in predicted %RBY (Table 1).

These results are consistent with other studies (Griener *et al.* 1995, Williams 1995, Wolcott *et al.* 1996), and indicated that the predictive accuracy of live animal and RTUS measurements improved as time of measurement approached slaughter. Furthermore, relationships between fat depth and %RBY were relatively stable across the three market categories, although this tended to break down as the time between scanning and slaughter increased.

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Table 1. Regression coefficients (standard error), coefficients of determination (R^2), residual standard deviations (RSD) and animal numbers (N) for the prediction of percentage retail beef yield (%RBY) from RTUS measurements of fat depth (mm) and eye muscle area (EMA, cm^2) and liveweight (kg) recorded at three scanning times for feedlot and pasture finished animals slaughtered at domestic, Korean and Japanese market specifications

Time of		Feedlot Finishing			Pasture Finishing		
Scanning	Parameter	Domestic	Korean	Japanese	Domestic	Korean	Japanese
Weaning							
	Fat Depth	**-0.47 (0.11)**	**-0.52 (0.25)**	**-0.57 (0.24)**	**-0.40 (0.16)**	**-0.64 (0.19)**	**-0.90 (0.25)**
	EMA	0.05 (0.03)	0.09 (0.06)	0.07 (0.06)	0.06 (0.04)	0.02 (0.05)	-0.04 (0.09)
	Live Weight	**-0.02 (0.01)**	-0.01 (0.01)	0.00 (0.01)	**-0.01 (0.01)**	-0.00 (0.01)	0.00 (0.02)
	R^2	0.56	0.15	0.10	0.53	0.35	0.63
	RSD	1.40	2.20	2.44	1.47	1.69	1.74
	N	129	124	123	110	105	39
Growout							
	Fat Depth	**-0.28 (0.12)**	**-0.44 (0.12)**	-0.38 (0.20)	**-0.54 (0.16)**	**-0.73 (0.14)**	**-1.03 (0.36)**
	EMA	0.04 (0.03)	**0.12 (0.03)**	0.04 (0.03)	0.02 (0.04)	0.06 (0.04)	-0.04 (0.09)
	Live Weight	**-0.01 (0.01)**	**-0.02 (0.01)**	**-0.03 (0.02)**	-0.00 (0.01)	-0.01 (0.01)	-0.00 (0.01)
	R^2	0.58	0.28	0.35	0.60	0.42	0.46
	RSD	1.50	2.04	2.13	1.35	1.59	2.09
	N	157	157	130	100	112	44
Pre Slaughter							
	Fat Depth	**-0.32 (0.07)**	**-0.43 (0.05)**	**-0.40 (0.05)**	**-0.50 (0.08)**	**-0.46 (0.06)**	**-0.54 (0.12)**
	EMA	**0.10 (0.02)**	0.02 (0.02)	0.01 (0.02)	**0.06 (0.01)**	0.03 (0.02)	0.03 (0.07)
	Live Weight	**-0.01 (0.00)**	-0.00 (0.00)	0.01 (0.01)	-0.00 (0.00)	-0.00 (0.00)	0.01 (0.01)
	R^2	0.56	0.44	0.56	0.70	0.51	0.60
	RSD	1.53	1.85	1.76	1.38	1.45	1.81
	N	178	190	128	152	115	43

Regression coefficients shown in bold were significantly different from zero ($P<0.05$)