

## Prediction of beef carcass and selected primal subcutaneous fat yields using data from images captured on-line in abattoir

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**Introduction** Current grading methods for fat yield in UK abattoirs are limited to subjective fat classification score based on the EUROP based system. Video image analyses (VIA) methods have previously been employed commercially to estimate fat classification and carcass yield in other EU countries. Recently, fat trim yield has been strongly predicted ( $R^2 = 0.8$ ) by VIA system (Vote *et al.*, 2009) and fat thickness measured manually has shown to correlate with intramuscular fat content (Indurain *et al.*, 2009). Carcass and primal fat-yield information would be commercially useful in determining the quality and value of primal cuts. The aim of this study was to assess the potential of predicting half carcass and selected primal-cut subcutaneous fat yield using features extracted from high-resolution carcass digital images taken on-line at chain speed.

**Material and methods** Cross-bred steers and heifers ( $n = 29$ ; sired by either Aberdeen Angus or Limousin bulls) were used in this study. The animals were slaughtered at an average carcass weight and age at slaughter of 340 (SD = 33.7) kg and 584 (SD = 60.0) days, respectively. Images were captured of left exterior and right interior carcass side, both orthogonal to carcass split dissection plane adjacent to grading area of the line using a high resolution digital camera (2592 by 1944 pixel) capturing colour images. All images were spatially corrected for distortion to enable dimensional extraction. Software processing algorithms were developed using Inspector analysis package (v8, Matrox Electronic. Systems. Ltd, Quebec) to automatically segregate and estimate measure of total subcutaneous fat covering over left half carcass as a planar projected area (CARFA – mm<sup>2</sup>). Linear dimensions of subcutaneous fat depths were measured manually on images, adjacent to carcass landmark areas 4<sup>th</sup> rib (4RFD), 8<sup>th</sup> rib (8RFD), 13<sup>th</sup> rib (13RFD) and 3<sup>rd</sup> lumbar (3LFD) on right half carcass, measured as mm. At 48 h after slaughter, left carcass sides were split into primal cuts that were vacuum packed and subsequently dissected to components. Total weight (g) of subcutaneous fat of half carcass and sample primals: forerib and sirloin (subdivided into 11<sup>th</sup>-12<sup>th</sup> rib section, 13<sup>th</sup> rib section and lumbar section) were collected. Half carcass and selected primal-cuts' subcutaneous fat yield were predicted using as independent variables: 1) CARFA, by means of Simple Linear Regression and 2) 4RFD, 8RFD, 13RFD, 3LFD and CARFA, using Partial Least Square Regression. Internal full leave-one-out cross-validation was performed and the predictive ability of the calibration models was evaluated in terms of coefficient of determination ( $R^2$ ) and Root Mean Square Error of Cross-Validation (RMSECV) using The Unscrambler program (v8.5.0, Camo, Trondheim, Norway).

**Results** Calibrations for subcutaneous fat yield of half carcass and selected primal-cuts are presented in Table 1. Estimated projected carcass subcutaneous fat area did not seem to offer any prediction for subcutaneous fat yield of both half carcass and all primal components ( $R^2$  range: 0.01 to 0.02). Adding 4 linear measures of subcutaneous fat depths as independent variables significantly increased the accuracy of prediction in all cases with  $R^2$  ranging from 0.48 to 0.62.

**Table 1** Descriptive and prediction statistics for subcutaneous fat yield of half carcass and selected primal-cuts of beef

Y variable		X variables			Prediction		
	Range	Mean	SD		ns	$R^2$	RMSECV
Subcutaneous fat (g)	6370-16935	10844	2557	CARFA	1	0.02	2798.7
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	3	0.48	2224.9
Forerib	345-1450	854	287.1	CARFA	1	0.01	302.3
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	3	0.62	206.7
Sirloin	565-1930	1160	406.2	CARFA	1	0.01	411.5
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	3	0.55	329.7
11-12 <sup>th</sup> rib sirloin	145-560	306	118.4	CARFA	1	0.02	123.5
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	3	0.37	112.5
13 <sup>th</sup> rib sirloin	85-325	170	59.8	CARFA	1	0.01	62.8
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	4	0.58	47.3
Lumbar Sirloin	310-1275	684	258.6	CARFA	1	0.01	272.4
				4RFD + 8 RFD+ 13RFD+ 3LFD + CARFA	3	0.53	215.1

**Conclusions** Data extracted from high resolution digital images (higher than typical commercial VIA systems) can predict with moderate accuracy subcutaneous fat yield of both half carcass and high value primal cuts. With further development, such as high resolution imagery over whole carcass to accurately assess fat thicknesses in addition to the subcutaneous fat area, this technique could estimate with higher accuracy fat yields relating to carcass quality.

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