COMPUTED TOMOGRAPHY HAS IMPROVED PRECISION FOR PREDICTION OF INTRAMUSCULAR FAT PERCENT IN THE STRIPLOIN IN CATTLE COMPARED TO MANUAL GRADING

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I. INTRODUCTION

The amount of intramuscular fat (IMF) % in meat is linked to eating quality assessments for tenderness, juiciness and flavour [1, 2]. The use of Meat Standards Australia (MSA) grading for grading carcasses is important in the beef industry to predict eating quality [3]. The MSA Model uses Marbling Score as an estimate of IMF% and is visually graded at the cranial end of the striploin (*M. longissimus lumborum*). The accuracy of marbling score for predicting IMF% is not well documented, yet given that it is captured by a human grader and at a single site of measurement, it is likely that it suffers from imprecision and inaccuracy between MSA graders. On this basis there is an opportunity to introduce a rapid and more accurate in-plant measurement of IMF%. This study investigated the ability of MSA marbling score and CT to predict IMF% in the cranial aspect of the M. longissimus lumborum, testing the hypothesis that CT will predict IMF% with greater precision than MSA marbling score.

II. MATERIALS AND METHODS

Striploins were obtained from 32 steers and 32 cows processed at a commercial abattoir with a range of IMF%, MSA marbling scores, hot carcass weights (HCWT), ossification scores (Table 1). Following slaughter, striploins were dissected from the carcass to remove the *M. longissimus lumborum*. A 6cm sample of the muscle was excised at the 12th rib and trimmed of fat and samples CT scanned using a Siemen's Sensation 64 scanner (0.6mm slice thickness, matrix 512 x 512, 140 kV, 157 mA).

Table 1. Carcass data including mean ± standard deviation, minimum and maximum values for M. longissimus lumborum hot standard carcass weight (kg), ossification score, and Meat Standards Australia (MSA) marbling score.

	Hot carcass weight (kg)	**Ossification score**	**Meat standards Australia Marbling Score**	**Intramuscular fat %**
Mean ± SD	318.6 ± 56.3	259.1 ± 172.2	425.5 ± 253.7	7.3 ± 5.2
Min, Max	224.0, 443.0	130.0, 590.0	253.7, 1120.0	1.8, 21.1

Samples were freeze dried using a ScanVac CoolSafeTM freeze drier (LabogeneTM, Vassinerod, Denmark) and IMF % of each muscle sample determined using a near infrared procedure (NIR). NIR measurements were taken using a Spectro Star 2400 and all samples were subsequently calibrated against chloroform solvent extraction.

Image J (version 1.37v, National Institutes of Health, Bethesda, MD, USA, used in conjunction with Microsoft Excel) was used to process the images with pixel information obtained from all CT images. The pixel density information and standard deviation of pixel density was used to predict chemical IMF% in a general linear model (SAS Version 9.1, SAS Institute, Cary, NC, USA). As a comparison with industry standards for IMF% prediction, general linear models were created with MSA marbling score and HCWT included as covariates.

III. RESULTS AND DISCUSSION

The MSA marbling score had good precision for predicting IMF% (Table2: Model 1, $R^2 = 0.81$, RMSE = 2.47), although this was less than that of CT (Table 2: Model 5, $R^2 = 0.89$, RMSE = 1.91). The use of HCWT alone offers moderate prediction of IMF% in the *M. longissimus lumborum*, ($R^2 = 0.39$, RMSE = 4.44). There was minimal improvement in the precision of IMF% prediction when HCWT was used in conjunction with MSA marbling score or the CT scanning information. The inclusion of other parameters such as ossification score and eye muscle area did not improve the ability to predict IMF%.

Table 2 . F-values, coefficient, intercept, coefficient of determination (R-square), and root mean square error (RMSE) for models predicting intramuscular fat % in beef using Meat Standards Australia (MSA) marbling score, hot carcass weight (kg) and computed tomography (mean and SD of pixel density).

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
			F Values		
Average pixel density	-	-	-	221.7**	213.81**
Standard Deviation	-	-	-	498.45*	292**
Hot carcass weight (kg)	-	41.55**	0.67	-	8.8**
MSA marbling score	278**	-	144.7**	-	-
			Coefficients and intercepts		
Average pixel density	-	-	-	-0.59	-0.56
Standard Deviation	-	-	-	-0.94	-0.85
Hot carcass weight (kg)	-	0.06	0.01		0.01
MSA marbling score	0.02	-	0.02	720.9	678.5
Intercept	-0.31	-11.8	-1.82		
			Precision estimates		
R^2	0.81	0.39	0.81	0.89	0.9
RMSE	2.47	4.44	2.48	1.91	1.8

IV. CONCLUSION

Computed tomography offers a rapid and precise method for prediction of IMF%. In support of our hypothesis, the precision to which CT predicts IMF% in this data set is better than the current industry standard which utilises MSA marbling score, and is similar to the precision of other CT techniques published for beef [4]. The use of CT to determine IMF% in a commercial setting is a realistic proposition for the future, especially given the advances in technology which make rapid CT assessment a possibility. Future studies will validate this method in hot samples across a larger data range.

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