

The potential of dual energy x-ray absorptiometry to predict overall liking of the loin grill in lamb (#131)

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Introduction

Dual energy x-ray absorptiometry (DEXA) has been used for the accurate determination of body composition in production animals including sheep. Gardner et al [1] showed that an on-line abattoir installation of a DEXA system can accurately and precisely predict lamb carcass composition using DEXA R values. Medical DEXA systems have been used to detect changes in bone mineral density in humans, and between calves and yearling cattle [2]. Beef carcass maturity at slaughter is an important Meat Standards Australia (MSA) input, with significant impacts on eating quality which is assessed visually using ossification score and also using chronological age. Bone regions within DEXA images of lambs likely reflect changing bone mineral content, which may associate with age and/or maturity and subsequent eating quality. Therefore, we hypothesise that bone DEXA measures will reflect lamb maturity and can therefore be a predictor of sheepmeat eating quality.

Methods

Lambs in this study (n = 80) were slaughtered at a commercial abattoir and ranged in age from 208 to 309 days. Their carcasses were trimmed according to AUSMEAT standards and ranged in hot carcass weight from 14.9 to 28.7 kg. Lamb carcasses were DEXA scanned following slaughter using an on-line DEXA system operating at abattoir chain speed [1], with the ratio of the photon attenuation for corresponding pixels within the low and high energy images used to calculate an R value for each pixel [3]. Pixels representing soft tissue were used to estimate carcass lean meat yield % (LMY%) [1]. In addition, bone regions of the carcass were isolated from DEXA images using Image J (version 1.44p) for all bone, femur, humerus and lumbar vertebrae. The mean DEXA R and Standard Deviation of pixels in these bone regions was determined (DEXA R Mean and DEXA R SDev).

From each carcass, samples for eating quality assessment were collected from the *M. longissimus lumborum* (loin) and prepared and cooked according to standard MSA eating quality protocol. Additionally, a 45g sample of the loin was collected for determination of intramuscular fat (IMF) %.

Lamb overall liking scores were analysed using general linear models (SAS Version 9.1, SAS Institute, Cary, NC, USA), with bone DEXA R Mean and/or DEXA R SDev tested as covariates to predict eating quality. These models were also tested with LMY% and IMF% included as covariates to assess the independence of DEXA bone values from these terms.

Results

The bone DEXA region with greatest prediction of loin overall liking was the lumbar vertebrae DEXA R values. The DEXA derived LMY%, Lumbar DEXA R Mean and Lumbar DEXA R SDev were all significant predictors of overall liking (Table 1: Models 1, 2, 3).

Across the decreasing range of Lumbar DEXA R SDev, the overall liking of the loin increased by 8.3 eating quality units (Figure 1), with similar magnitudes observed for the effect of Lumbar DEXA R Mean and LMY% (9.8 and 10.3 units). The precision of prediction of loin grill overall liking was greatest using Lumbar DEXA R SDev and LMY% (Table 1, Model 4: R² 0.12, RMSE 7.7). The inclusion of loin IMF% in this model did not impact the significance of the other terms.

There was no significant correlation of Lumbar DEXA R SDev with LMY% and IMF%, however moderate correlation of DEXA R Mean (R = 0.37 and -0.27) with these terms.

Conclusion

This is the first time that DEXA has been used to predict consumer eating quality in lamb. The increase in loin overall liking associated with decreasing lumbar DEXA R Mean and SDev represents substantial improvement given the total range of loin overall liking was 33 scores. Lack of correlation of lumbar DEXA R SDev to LMY% and loin IMF % indicates this term described aspects of loin overall liking independent to that attributed to these phenotypic measures. In contrast, lumbar DEXA R Mean partly reflects LMY%, which has previously been associated with reduced lamb eating quality [4]. A lack of differentiation in bone DEXA measures between age groups makes it difficult to understand the biology underpinning the link between DEXA and eating quality. These results suggest there may be potential for commercial DEXA systems within processing plants to predict aspects of eating quality and provide new inputs into a lamb MSA eating quality prediction model.

1. Gardner, G., et al., Calibration of an on-line dual energy X-ray absorptiometer for estimating carcass composition in lamb at abattoir chain-speed. Meat science, 2018. **144**: p. 91-99.
2. López-Campos, Ó., Juárez, M., Larsen, I.L., Prieto, N., Roberts, J., Dugan, M.E.R., Aalhus, J.L. Dual energy x-ray absorptiometry as a rapid and non-destructive method for determination of physiological maturity scores in steers. in International Congress of Meat Science and Technology. 2018. Melbourne, Victoria, Australia.
3. Pietrobelli, A., et al., Dual-energy X-ray absorptiometry body composition model: review of physical concepts. American Journal of Physiology-En

ocrinology And Metabolism, 1996. **271**(6): p. E941-E951.

4. Pannier, L., et al., Associations of sire estimated breeding values and objective meat quality measurements with sensory scores in Australian lamb. Meat Science, 2014. **96**(2, Part B): p. 1076-1087.

	Model 1	Model 2	Model 3	Model 4	Model 5
F-Values					
Lean %	5.98*	-	-	6.16*	3.93*
Lumbar DEXA Mean R	-	6.65*	-	-	0.08
Lumbar DEXA R SDev	-	-	4.43*	4.67*	1.55
Coefficients and intercepts					
Intercept	110.15	236.83	116.1	159.54	179.47
Lean %	-0.74	-	-	-0.73	-0.68
Lumbar DEXA Mean R	-	-122.4	-	-	-21.65
Lumbar DEXA R SDev	-	-	-690.11	-688.55	-588.14
Magnitude of effect (max predicted – min)					
	11.4	9.7	8.3	15.2	15.1
Precision estimates					
R2	0.07	0.08	0.05	0.12	0.12
RMSE	7.84	7.78	7.88	7.7	7.7

*P<0.05

Table 1 F-values, coefficient, intercept, coefficient of determination (R-square), and root mean square error (RMSE) for models predicting overall liking for the loin using lean meat yield %, Lumbar DEXA R Mean and DEXA R SDev.

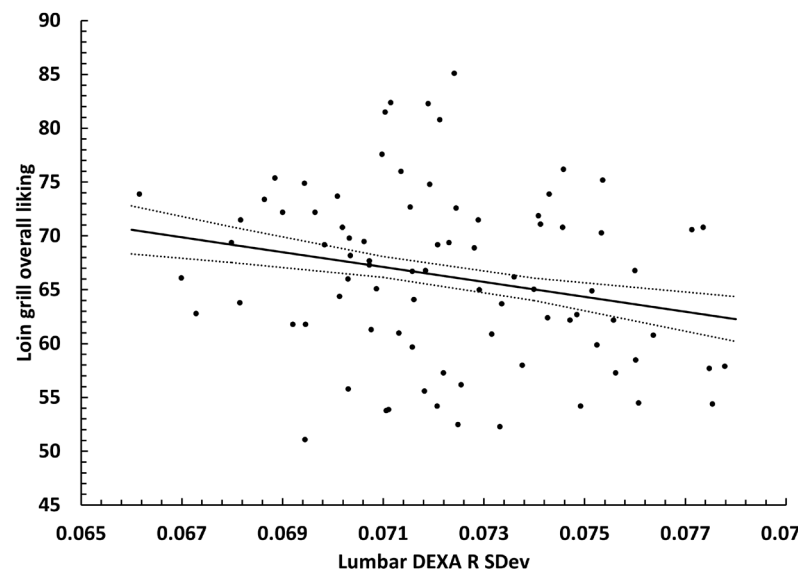


Figure 1 Predicted loin grill overall liking using Lumbar DEXA R SDev ($P < 0.05$) (Model 3). Dots represent residuals from the predicted means (solid line) \pm SD (dotted lines).

Notes
