P-08-14

Improved accuracy of Dual Energy X-ray Absorptiometry prediction of lamb carcass composition using unattenuated image space adjustment (#172)

Stephen L. Connaughton[1], Fiona Anderson[1], Khama Kelman[1], Andrew Williams[1], Sean Starling[2], Graham E. Gardner[1]

[1] Murdoch University, School of Veterinary and Life Sciences, Murdoch, Australia; [2] Meat and Livestock Australia, North Sydney, Australia

Notes

Introduction

An online Dual Energy X-ray Absorptiometry (DEXA) has shown good precision when predicting carcass fat % determined from computed tomography (CT) (Gardner et al. 2018), demonstrated across phenotypically and genetically divergent lamb populations (Connaughton et al. 2017). However, multiple studies indicate DEXA prediction of the same lamb carcass over several days is variable (Gardner et al. 2018, Connaughton et al. 2018). This inaccuracy appears to be related to a drift in the detector readings due to constant operation of the DEXA, demonstrated by preliminary analysis of unattenuated pixel values within images captured during a standard day's operation. Therefore, we hypothesised that adjusting for this drift by continuous sampling of pixels in unattenuated regions of each image would resolve this inaccuracy.

Methods

Two experiments were undertaken to assess the calibration of an online abattoir DEXA system installed in Bordertown, South Australia. The first experiment had 10 carcasses scanned 5 times in immediate succession at the start and end of a day, while in the second experiment 30 carcasses were scanned once at the end of the day for 3 consecutive days. Computed tomography (CT) Fat % was predicted for each carcass by DEXA via the method described in Gardner et al. 2018. To test a new calibration method that accounts for detector drift, this prediction process was repeated with the inclusion of an adjustment based on the ratio of the unattenuated pixel values recorded in the current image, and those captured in a calibration scan at the start of the day. An increasing unattenuated value from the base value of 4095 led to a ratio-based adjustment down of each pixel within the image, including pixels containing tissue. A linear mixed effects model was used (SAS 9.1, SAS Institute, USA) to assess the mean carcass CT Fat % predictions within all groups in each experiment, before and after application of this adjustment.

Results

Prior to adjustment using the new calibration method, there were marked differences between the mean carcass CT Fat % predictions at the start of the day versus the end of the day (*P*<0.01, see Table, Experiment 1), and between days (*P*<0.01, see Table, Experiment 2). These differences became insignificant after applying the new calibration method (see Table).

		Scan Run - Experiment 1						Scan Day - Experiment 2		
		1	2	3	4	5		Wed	Thurs	Fri
Before Cali-bration	AM	19.4^{a}	18.5^{a}	18.6^{a}	18.9^{a}	18.7^{a}		-	-	-
PM	23.2^{b}	23.4^{b}	23.2^{b}	23.5^{b}	23.4^{b}		10.3^{a}	11.9^{b}	23.0^{c}	
After Cali-bration	AM	22.2^{c}	21.3^{c}	21.0^{c}	21.1^{c}	21.0^{c}		-	-	-
PM	22.4^{c}	22.5^{c}	22.5^{c}	22.4^{c}	22.5^{c}		21.3^{d}	21.0^{d}	20.8^{d}	

Conclusion

In support of our hypothesis, a calibration using the unattenuated image area of each image reduced the differences in CT Fat % over time. This result indicates that the changes in the unattenuated space within images throughout the course of a day, or over several days, could be due to progressive sensitization of the x-ray detectors over a period of repeated exposure, or a subtle increase in outputted beam kV from the x-ray tube over a period of repeated activation. Future work will focus on the inclusion of a previously utilized synthetic phantom into all images to provide superior calibration throughout the day, and will also focus on detecting and adjusting for hardware discrepancies. This work will result in improved prediction accuracy of carcass composition, providing a more robust lean meat yield measurement device for the Australian lamb industry, and improve confidence in the measurement technology.