Long term repeatability of beef DEXA lean meat yield measures

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Lean meat yield (LMY) is an important determinant of beef carcase value. However, the current Australian standard of using fat depth measured at a single point (P8 or rib fat) to estimate whole carcase LMY is imprecise and inaccurate (Williams et al. 2017). A novel abattoir dual energy X-ray absorptiometry (DEXA) system has been developed to precisely measure LMY in lamb carcases (Gardner et al. 2018) and may be able to improve LMY measurement in beef. A beef DEXA system has been developed, trained to differentiate the fat composition of tissues and thereby output a DEXA value representing LMY for beef sides scanned at abattoir line-speed. However, the repeatability of this system needs to be demonstrated before DEXA can provide reliable LMY data to the beef supply chain. While the DEXA system produces highly repeatable LMY values of cold beef sides scanned multiple times within 15 minutes (Calnan et al., 2019), the repeatability of beef sides scanned on the slaughter floor (hot), or with up to 3 days of chilling has not been assessed. We hypothesise that predictions of carcase LMY from the beef DEXA system will be highly repeatable when carcase sides are scanned hot and following 12 to 60 hours of chilling.

Nineteen beef sides of variable weight (81.5 - 216 kg) and fatness (1 - 28 mm P8 fat depth) were selected from slaughter floor at Teys Lakes Creek abattoir. Sides were DEXA scanned within 90 minutes of slaughter and returned to the chiller overnight before repeat DEXA scanning 12 hours later. The chilled sides were then DEXA scanned 12 hourly over 60 hours, each side being scanned 6 times in total, in a random order. The DEXA system was calibrated before sides were scanned. The DEXA system was comprised of 2 X-ray tubes pulsed at 140kV, and 2 sets of detectors. Each detector set contained ZnSe and CsI scintillants separated by a Cu filter enabling the acquisition of high and low energy images. The detector sets were positioned vertically to capture the full length of a beef side. The upper and lower DEXA images of each beef side were calibrated and analysed separately. A mean DEXA value was determined for each image via threshold removal of the bone-containing pixels and applying relationships previously established between DEXA values, chemical fat % and tissue thickness. The standard deviation (SD) of repeat DEXA scans was calculated and the influence of scan order and time were assessed using general linear mixed models in SAS.

DEXA values of beef sides scanned ranged from 71.0 to 102.4 and from 75.01 to 104.9 in upper and lower detector images (Fig. 1). In line with our hypothesis, the DEXA system produced highly repeatable measures of carcase LMY over the 60-hour scanning period, with repeat scans of the same side producing a SD in DEXA value of only 0.57 on the upper and 0.62 on the lower detector (Fig. 1). This variation represents around 2% of the unit range in DEXA values. The order of scanning did not impact DEXA values ($P<0.05$), and while DEXA values did vary between repeated scans ($P<0.05$), there were no consistent changes to DEXA values over time.

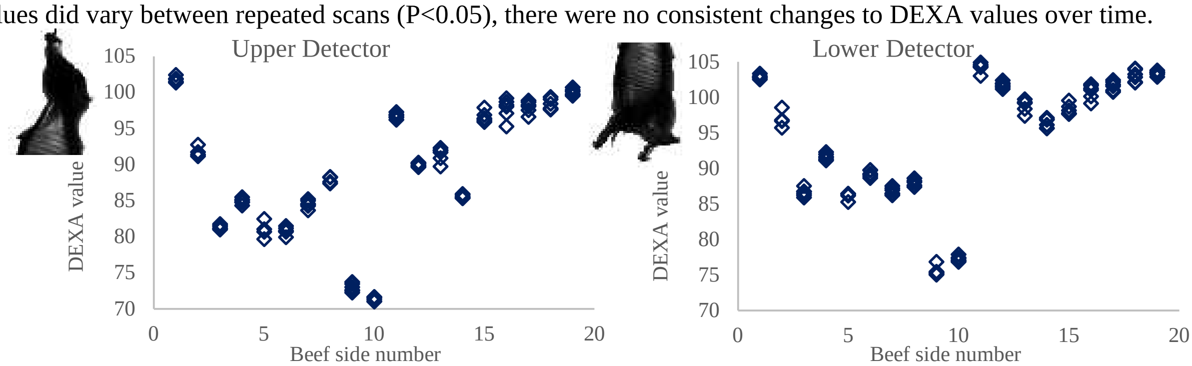

Figure 1. Upper and Lower detector DEXA values calculated from 6 repeat DEXA scans of 19 beef sides.

These results demonstrate that the prototype beef DEXA system can produce highly repeatable images of beef sides in a commercial setting, whether sides are scanned hot or cold following 12 to 60 hours of chilling. These results instil beef industry confidence that DEXA systems can be used to scan beef sides, either hot, or up to 3-days post-mortem, to feedback LMY data to the supply chain and to enable carcase sorting for optimised fabrication. Furthermore, the X-ray data will assist automated de-boning of beef sides.

References

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