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# Using Dual Energy X-Ray Absorptiometry (DXA) For A Rapid, Non-Invasive Carcass Fat and Lean Prediction in Beef

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## Objectives

The objective of this study was to evaluate the potential use of the dual energy X-ray absorptiometry (DXA) for estimating total lean, fat and bone content of beef carcasses and main primal cuts.

## Materials and Methods

To represent the majority of commercial cattle, the animal population used ($n = 316$) to develop and validate the prediction models was selected within a grid based on live weight at slaughter and grade fat. Following normal commercial slaughter and chilling, left carcass sides were fabricated using the Institutional Meat Purchase Specifications (IMPS) for Fresh Beef Products, Series 100. The primals collected included the chuck (IMPS #113), rib (IMPS #103), brisket (IMPS #118), flank (IMPS #193, non-trimmed), foreshank (IMPS #117), loin (IMPS #172A), round (IMPS #158A) and plate (IMPS #121). Each primal cut was scanned with a Lunar iDXA unit (GE Lunar Lunar Prodigy Advance, General Electric, Madison, WI, USA) using the whole body scan option on standard mode to estimate DXA fat, lean and bone tissues. After scanning, all left primal cuts were fully dissected into subcutaneous fat, intermuscular fat, body cavity fat, lean, and bone and then weighed.

## Results

Regression and partial least square regression (PLSR) were used to evaluate the relationship of DXA lean, fat and bone values from primal cut scans to cut-out values from manual dissection. Using linear regression, $R^2$ (i.e., the % of variation accounted for by the model) for total carcass lean, fat and bone were 0.88, 0.95 and 0.53, respectively. Within individual primals, $R^2$ for lean, fat and bone ranged from 0.26 to $R^2 = 0.90$, with the highest $R^2$ generally for fat, and the lowest predictions generally for bone. Industry applications of this technology for total lean, fat and bone would be expected to achieve these levels of prediction robustness.

Using PLSR analyses, which consider all the DXA scan information from all primals as independent variables, overall $R^2$ for total carcass lean and fat were both 0.98. PLSR improved the lean prediction for most of primal cuts yielding $R^2$ over 0.94 for the brisket, foreshank and flank. The highest $R^2$ were observed for the chuck ($R^2 = 0.99$), round ($R^2 = 0.98$) and loin ($R^2 = 0.97$). Similar to lean, PLSR increased the $R^2$ for fat predictions; with all being higher than 0.91, excluding the foreshank ($R^2 = 0.77$). The highest $R^2$ for fat were observed for the flank ($R^2 = 0.98$), rib, plate and loin ($R^2 = 0.97$).

## Conclusion

DXA was able to be used to develop robust equations for estimating total lean and fat in carcasses normally encountered in the market. Both linear and PLSR equations will provide realistic estimations of the potential utility of DXA within an industry environment, to improve estimations of lean meat yield. In research, DXA coupled with PLSR will also be able to replace manual cut-outs which are destructive, time consuming and costly.

 