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Dual Energy X-Ray Absorptiometry as a Rapid and Non-Destructive Method for Determination of Lean, Fat and Bone Content in Livestock

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Objectives

To implement dual energy X-ray absorptiometry (DXA) as a platform technology, calibrations and development of robust equations to attain precision and accuracy are required before using for routine predictions of carcass yields in livestock. This manuscript summarized results of ongoing research where DXA has been used to estimate lean, fat, and bone carcass composition in beef, pork and lamb.

Materials and Methods

From a wide range of carcasses, a total of 334 beef (230 crossbred finished steers and 104 cows), 212 pork and 155 lamb carcasses were used to build calibration equations within each population. Left carcass sides were scanned with a Lunar iDXA unit and then dissected into lean, fat, and bone and weighed. Partial least square regression was used to carry out the prediction equations for lean, fat and bone values from primal cuts scans (independent) and actual lean, fat and bone obtained through the full dissection (dependent). The predictive ability of the models was evaluated in terms of coefficient of determination (R^2) and root mean square error of calibration (RMSE).

Results

The PLSR results between actual and DXA estimated lean and fat values showed high relationship ($R^2 > 0.97$) across all the species. Within beef, the present results suggest that DXA capacity to estimate carcass composition is independent of maturity. With regard to the bone predictions, PLSR analyses also improved the relationship for bone predictions compared to simple regression models previously developed at this institution or single pass scans for pork and lamb. Observed R^2 values for predicting bone were slightly lower than those for lean and fat estimations, particularly in those carcasses with smaller bone sizes such as pork ($R^2 = 0.889$) and lamb ($R^2 = 0.870$).

Conclusion

The results suggest that DXA technology can reliably estimate carcass composition in livestock, particularly for lean and fat estimations. Using PLSR analyses, suitable models for research have been developed from main primal scan data. However, further studies to externally validate the prediction accuracy and to obtain calibration curves for specific retail cuts or carcass cut-outs specifications are needed. Prediction accuracies for industry applications using single pass scans will also be needed.