# Estimating visceral mass in a new method to predict body composition of sheep

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Management of sheep and cattle to maximise carcass and meat quality requires estimation of their body composition, subject to a changing nutritional environment. Following Soboleva *et al.* (1999), and Oltjen *et al.* (2006), Oddy *et al*. (2019) outlined a dynamic model to estimate change in protein and fat content of sheep in response to change in energy intake. The model does not use terms for maintenance and efficiency as in current feeding systems, but derives heat production (HP) from metabolisable energy intake (MEI), and the energy contained in muscle and visceral protein. Retained energy (RE), the difference between MEI and HP, is partitioned between deposition of protein in viscera (heart, lungs, liver, kidneys, spleen, and gastrointestinal tract) and remaining non-visceral tissues (called muscle); any remaining RE is deposited as fat. It is important to explicitly represent viscera because it accounts for at least half of the animal component of whole body heat production, but is approximately 10% of empty body protein. Moreover, viscera responds to MEI and the concentration of ME in the diet (M/D) more quickly than the remainder of the empty body.

To more accurately estimate HP (and hence RE) requires a method to describe the trajectory of visceral protein accretion (dv/dt). The equation is expressed in energy terms where 1 g protein = 23.8kJ.

$$dv/dt = p_v (v^* - v)$$

where dv/dt = rate of change of viscera protein (kJ/d), v* = dynamic attractor for viscera protein (kJ), v = energy in visceral protein (kJ) and $p_v$ a constant for partitioning energy into viscera (initial value 0.1).

The dynamic attractor for visceral mass, v*, is in practice the mass of viscera protein, expressed as energy, achieved after an animal has been on the same diet for at least 5 weeks. It can be estimated as:

$$v^* = c_1\, MEI + c_2\, m^{0.75} - c_3\, M/D$$

where MEI = ME intake (kJ/d), m = muscle protein (kJ), M/D = ME concentration in diet (MJ/kg DM).

Data to estimate v* were obtained from Oddy and Hegarty (1994) and Hegarty *et al.* (1999). The equation $v^* = 0.581(\pm 0.0283se)*MEI + 1.999(\pm 0.128)*m^{0.75} - 250.4(\pm 78.4)*M/D$ fitted the data with $R^2 = 99\%$. Using this equation and the measured MEI, m and M/D in Winter (1971) and Oddy et al (1997) showed that measured energy content of protein in viscera = 3356(±463) + 0.697(±0.031)* v* (estimated as above) with an $R^2 = 85.4\%$ When this construct was used in the simplified model of body composition it contributed to an improvement in root mean square prediction error (RMSPE) of empty body weight (EBW), protein and fat compared to that derived from the (CSIRO, 2007) equations, indicating improved predictive ability of the new model. For the data of Oddy and Hegarty (1994) the new model had RMSPE for 5.4, 6.2 and 13.9% of mean for EBW, protein and fat respectively compared to RMSPE of 8.1, 9.0 and 18.9% of mean for estimates of EBW, protein and fat using CSIRO (2007).

These results indicate that the method described above to estimate the dynamic attractor for visceral protein in sheep and subsequently represent changes in visceral mass in response to amount and energy content of feed and animal maturity, contributes to improved estimation of body composition of sheep. This will eventually assist development of better methods to estimate cost of feeding and carcass yield and quality attributes of meat in live animals.

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