Using indices of skeletal maturity to better understand musculoskeletal development in sheep

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Animal maturity is an important concept in the meat industry, with emphasis on producing less mature (i.e. "physiologically younger") animals with superior carcase characteristics such as greater tenderness and lower fatness. Unfortunately the concept of 'maturity' remains poorly defined. Where specified, 'maturity' usually refers to some proportion or index expressed relative to the mature state, in which the animal is in anatomical and/or compositional equilibrium. However indices of maturity referenced to body weight or composition (e.g. muscle:bone ratio) are problematic for assessing genotypic effects in modern prime lamb production, where terminal sires may be selected for specific compositional traits such as rapid muscle growth or low body fat. In such cases it may be preferable to define other indices such as *skeletal* maturity, by staging development in relation to longitudinal bone growth and mineral maturation.

Data for this experiment were derived from biometric measurement and ash analysis of fore and hindlimb bones from Sheep CRC Resource Flock 1 serial slaughter (average age 110, 235, 410 and 660 days). This flock consisted of five divergent crosses of Merino (M), Border Leicester (BL) and Poll Dorset (PD), including PD sires selected for high growth or eye muscle depth EBVs (MPDg and MPDm), all maintained on the same nutritional plane throughout the experiment.

Initial results indicate significant differences in bone growth, in particular the pronounced bone hypotrophy associated with sire EBVs for high muscling compared to more general selection for growth (Figure 1).

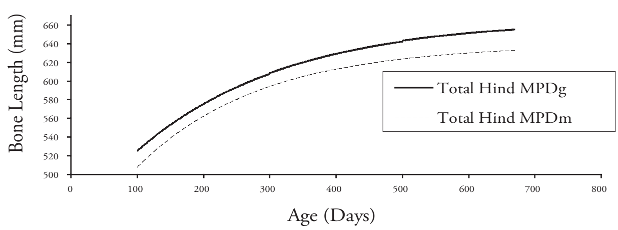

Fig. 1. Proportions of total hindlimb length predicted from growth curves modeled by Brodie's equation.

The shorter mature bone length of the MPDm group dictates that these animals are earlier maturing in terms of skeletal growth (i.e. limb length relative to mature length). However, MPDm lambs retained a bone mineral profile (especially Mg^{2+} content [Ravaglioli, 1996]) more consistent with that of physiologically less mature animals (Figure 2), a result consistent with other indices of physiological maturity such as tooth eruption. By contrast, the bigger MBL and MBLPD crosses show relative skeletal *immaturity*, which contrasts with their obviously rapid physiological maturation.

Future analysis will be aimed at describing more complex indices of skeletal growth (e.g. growth plate analysis, limb bone proportions) to further test whether genetic influences on skeletal maturation may in fact be independent of physiological maturation rate.

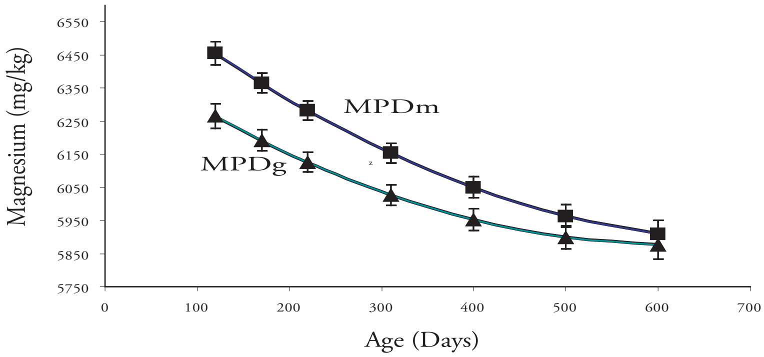

Fig. 2. Age-related decline in metacarpal cortical bone Mg++ as predicted from growth curves modeled by Brodies equation.

Ravaglioli, A., Krajewski, A., Celotti, G. C., et al., 1996. Mineral evolution of bone. Biomaterials 17(6), 617–622.