POOR NUTRITION *IN UTERO* AND PRE-WEANING REDUCED LEAN TISSUE AND INCREASED FAT TISSUE MASS IN ADULT MERINO SHEEP

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Suboptimal nutrition during key periods of development *in utero* can reduce birth weight and have permanent adverse impacts on the production potential and health of the progeny. Greenwood *et al.* (1998) demonstrated that low birth weight lambs are fatter up to 20 kg liveweight when compared with lambs with normal birth weights but evidence is limited on whether this persists through to heavier weights. We hypothesised that such effects would be evident at mature size, given that small human babies tend to have significantly reduced muscle mass and higher overall body fat content in adult life (reviewed by McMillen *et al.* 2005).

The experiment used progeny from the 'Lifetime Wool' project (Thompson and Oldham 2004). Twenty four single born adult wethers were selected from ewes that experienced extreme differences in nutrition during pregnancy and lactation; the average condition score of the 'Low' and 'High' ewes was 2.7 *v* 2.6 at joining, 2.3 *v* 2.8 at Day 90 of pregnancy, 2.4 *v* 3.4 at lambing and 2.1 *v* 3.1 at weaning. Lambs from the 'Low' group were significantly lighter ($P<0.001$) at birth (4.6 *v* 5.9 kg) and at weaning (14.7 *v* 22.2 kg) than those from the 'High' group. After weaning all wethers were grazed together and differences in liveweight between groups persisted until almost 2 years of age. At about 3.5 years of age, the wethers were allocated to 6 blocks of 4 individual pens in an animal house. They were initially offered a maintenance ration of oaten hay that was replaced over 1 week with step-wise increases in the amount of a roughage-based pellet (10.9 MJ/kg; 16.5% CP). The amount of pellets offered was increased gradually to *ad libitum* during the second week and then maintained at this level for 8 weeks. Feed intake was measured daily and liveweights weekly. Back fat and eye muscle depth was measured using ultrasound in weeks 1, 4 and 7, and whole body composition was measured at the end of the experiment using dual energy x-ray absorptiometry (DXA).

The 'Low' group grew slower than the 'High' group during the first 4 weeks of *ad libitum* feeding (172 *v* 238 g/d; $P<0.01$) and this trend continued over the 8-week period (131 *v* 173 g/day; $P=0.06$). There were no significant differences between groups in average intake (1.51 *v* 1.65 kg DM/day) or feed conversion efficiency (11.4 *v* 10.0 kg intake/kg gain). This was also the case for average depth of back fat (4.2 *v* 3.9 mm) and eye muscle (30.3 *v* 28.8 mm) measured on 3 occasions at the C-site after correction for liveweight. However, there were significant differences in lean and fat tissue mass measured by DXA; on average, after correction for liveweight, the proportion of fat was greater (33.8 *v* 24.0%; $P<0.001$) and lean was less (63.1 *v* 72.0%; $P<0.001$) for the 'Low' than 'High' groups. There were no significant differences in ash content.

Body composition of adult wethers was most closely related to their liveweight. After correcting for differences in liveweight, lambs that were smaller and grew more slowly to weaning had less lean tissue ($r^2 = 0.65$; $P<0.001$) and were fatter ($r^2 = 0.62$; $P<0.001$) at mature size. More than 80% of the variance in the proportions of fat and lean was explained by differences in liveweight of progeny (PLW; kg), ewe liveweight at joining (ELW_0; kg) and changes in ewe liveweight between joining and day 90 of pregnancy (LWC_0-90; kg) and day 90 and lambing (LWC_90-L; kg).

Fat (%) = -5.0 (± 7.26) + 1.12 (± 0.118) PLW – 0.60 (± 0.128) ELW_0 – 0.67 (± 0.128) LWC_0-90 – 0.58 (± 0.143) LWC_90-L ($r^2 = 0.827$; $P<0.001$)

Lean (%) = 102.2 (± 6.04) – 1.00 (± 0.098) PLW + 0.50 (± 0.107) ELW_0 + 0.54 (± 0.107) LWC_0-90 + 0.50 (± 0.119) LWC_90-L ($r^2 = 0.839$; $P<0.001$)

These results indicate that nutrition *in utero* and pre-weaning affects the physiology and body composition of mature Merino wethers. The effects on total body fat and lean were not evident from measurements of back fat and eye muscle depth measured by ultrasound. The extra fat that resulted from nutritional stresses early in life was probably located in the abdominal region, which is significant because central obesity has been linked to increased incidence of metabolic, cardiovascular and other diseases (McMillen *et al*. 2005). The importance of these nutritionally mediated effects on early-life programming of body composition during adulthood in the context of developing practical ewe feeding systems and marketing systems requires further investigation.

GREENWOOD, P.L., HUNT, A.S. and BELL, A.W. (1998). *J. Anim. Sci.* **76:** 2354-67.
McMILLEN, I.C., ADAMS, C.L. and MUHLHAUSLER, B.S. (2005). *J. Physiol*. **565:** 9-17.
THOMPSON, A.N. and OLDHAM, C.M. (2004). *Anim. Prod. Aust.* **25:** 326.

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