

Effects of birth weight and postnatal nutrition on neonatal sheep: II. Skeletal muscle growth and development^{1,2}

P. L. Greenwood^{3,4}, A. S. Hunt⁵, J. W. Hermanson⁶, and A. W. Bell⁷

Department of Animal Science, Cornell University, Ithaca, New York, 14853-4801

ABSTRACT: This study investigated effects of birth weight and postnatal nutrition on growth and development of skeletal muscles in neonatal lambs. Low (L; mean \pm SD 2.289 \pm .341 kg, n = 28) and high (H; 4.840 \pm .446 kg, n = 20) birth weight male Suffolk \times (Finnsheep \times Dorset) lambs were individually reared on a liquid diet to grow rapidly (ad libitum fed, ADG 337 g, n = 20) or slowly (ADG 150 g, n = 20) from birth to live weights (LW) up to approximately 20 kg. At birth, weight of semitendinosus (ST) muscle in L lambs was 43% that in H lambs; aggregate weights of ST and seven other dissected muscles were similarly reduced. In ST muscle of L lambs, mass of DNA, RNA, and protein were also significantly reduced to levels 67, 60, and 34%, respectively, of those in H lambs. However, myofiber numbers of ST, tibialis caudalis, or soleus muscles did not differ between the L and H birth weight lambs and did not change during postnatal growth. During postnatal rearing, daily accretion rate of dissected muscle was lower in L than in H lambs. Accretion of muscle

per kilogram of gain in empty body weight (EBW) was reduced in the slowly grown L lambs compared with their H counterparts, although the difference was less pronounced between the rapidly grown L and H lambs. Throughout the postnatal growth period, ST muscle of L lambs contained less DNA with a higher protein:DNA ratio at any given muscle weight than that of H lambs. Slowly grown lambs had heavier muscles at any given EBW than rapidly grown lambs. Content of DNA and protein:DNA ratio in ST muscle were unaffected by postnatal nutrition, but RNA content and RNA:DNA were greater and protein:RNA was lower at any given muscle weight in rapidly grown lambs. Results suggest that myofiber number in fetal sheep muscles is established before the presumed, negative effects of inadequate fetal nutrient supply on skeletal muscle growth and development become apparent. However, proliferation of myonuclei may be influenced by fetal nutrition in late pregnancy. Reduced myonuclei number in severely growth-retarded newborn lambs may limit the capacity for postnatal growth of skeletal muscles.

Key Words: Lambs, Nutrition, Birth Weight, Skeletal Muscle, Myofibrils, Nucleic Acids

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Introduction

Reduced myofiber number in fetal lambs has been reported due to severe maternal undernutrition during early-mid and late pregnancy (Everitt, 1968) or from commencement of gestation (Swatland and Cassens, 1973). In contrast, moderate undernutrition of ewes

during early pregnancy did not affect muscle development of offspring (Nordby et al., 1987), and myofiber number was unaffected in twin fetuses that were 11% lighter than singletons at 140 d of gestation (McCoard et al., 1997).

Despite these studies, it has not been conclusively established whether myofiber number is reduced by more commonly encountered conditions, such as growth retardation due to placental insufficiency or moderate undernutrition during late gestation when rapid fetal growth normally occurs. Most, if not all, studies that

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⁴Present address: NSW Agriculture Beef Industry Centre, University of New England, Armidale NSW 2351, Australia.

⁵Present address: Department of Animal Science, University of Maryland, College Park, MD 20742.

⁶Department of Biomedical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853.

⁷To whom correspondence should be addressed. (Phone: 607/255-5497; fax: 607/255-9829; E-mail: awb6@cornell.edu.

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