EFFECT OF MATERNAL NUTRITION DURING EARLY AND MID-GESTATION ON FETAL GROWTH

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Kate Cooper

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ABSTRACT

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It is generally assumed that, because the fetus has a small nutritional requirement relative to that of the dam in early gestation, differential maternal nutrition at this time is unlikely to influence fetal growth. Hence the dogma that females in early gestation need not be provided with nutrients additional to those required by comparable nonpregnant females. However, the effects of nutrition during early gestation on fetal and placental growth and development, and hence birth weight, have not been studied extensively. Nor does the current dogma take into account the fact that the placenta has a different pattern of growth from the fetus. Hence this study sought to further examine the effects of maternal nutrition during early and mid-gestation on placental and fetal growth.

The first study was conducted over two years, with crossbred heifers managed for High (H, 0.6 kg/day) or Low (L, 0.1 kg/day) liveweight gains from mating until day 140 of gestation. Treatments were then reversed so that effects of nutrition during early gestation were not confounded by differences in maternal live weight at calving. Averaged across years, maternal live weights (kg, Mean±SE, n=60) were (H vs L) 393.5 ± 4.3 vs 362.1 ± 4.3 ($P<0.001$) at day 140 of gestation and 417.6 ± 4.5 vs 408.7 ± 4.3 ($P>0.05$) at term. Calf birth weights were 31.1 ± 0.5 vs 31.4 ± 0.5kg and weaning weights (average calf age = 90 ± 14.4days) were 91.3 ± 2.0 vs 89.7 ± 2.0 (both $P>0.05$).

A second study using breeding ewes was designed to determine more directly whether early placental development and fetal growth may be modulated by nutritional manipulation of the female during early and mid-gestation, and so eliminated the potential for the dam to compensate for earlier treatments during late gestation.

Mixed-age Romney ewes (average live weight 54.5 ± 0.4 kg), pregnant to a synchronised oestrus, were allocated to three nutritional treatment groups (n = 20/group), Low (L = 0.5 maintenance (M)), Control (C = 1.0M) and High (H = 1.5M)

from days 21 to 101 of gestation. Maintenance requirements for a 50 kg ewe were assumed to be approximately 0.9 kg DM/ewe/day (10 MJ ME/day) at a concentration of 11 MJ ME/kg DM. Ewes were weighed weekly, slaughtered at the end of treatment, and fetal and placental measurements recorded.

Live weights were significantly ($P<0.001$) different at slaughter (L, 45.8 ± 1.4 kg; C, 56.8 ± 1.4 kg; H, 69.1 ± 1.4 kg). At day 101 of gestation, measures of fetal and placental growth and development were (C vs H group): Uterus (minus fetus and fluids) (1290.7 ± 67.0 vs 1475.4 ± 64.8 g, $P<0.05$); fetal weight (1280.8 ± 38.0 vs 1379.8 ± 35.2 g, $P<0.05$); total placentome weight (631.0 ± 30.7 vs 702.9 ± 29.7 g, $P<0.01$) and total placentome number (102.6 ± 3.2 vs 93.4 ± 3.1 g, $P<0.05$). Low levels of maternal nutrition did not significantly influence these parameters (L vs C).

It is concluded that high levels of maternal nutrition in early and mid-gestation enhance fetal and placental growth and development in sheep, while low levels are without effect compared to ewes fed at maintenance. Thus there may be advantages to high levels of maternal nutrition in early and mid-gestation though the possible effects of compensation in later gestation, as may have occurred in the beef cow trial, are yet to be studied in sheep.

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°C	degrees celsius
%	percentage
µg	microgram
C	control (group)
CIDR	controlled internal drug releaser
cm	centimetre
CRL	crown rump length
d	day
DM	dry matter
DOP	dressing out percentage
g	gram
H	high (group)
kg	kilogram
L	low (group)
LWT	live weight
ME	metabolisable energy
MJ	megajoules
mm	millimetre
TGUW	total gravid uterus weight
vs	versus

Statistical:

n	number of experimental units
NS	non-significant (P>0.10)
SE	standard error of the mean