The Effect of Heifer Nutrient Intake During Gestation on Foetal Development

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Protein is the most limiting nutrient for beef production in the Australian rangelands. Maternal under-nutrition is a common pathway that leads to intra-uterine growth restriction of the fetus in many species including cattle (Cafe *et al.* 2006; Freetly *et al.* 2000). Previous studies of bovine fetal development have used slaughter of the dam and fetal recovery (Prior *et al.* 1979), however ultrasonographic assessment methods are preferable due to the associated costs of feeding and maintaining each individual dam. The aim of this investigation was to examine the effects of heifer protein intake during the first two trimesters of gestation on fetal growth using transrectal real-time ultrasonography.

Bos indicus cross heifers (n=120) were inseminated with semen from the same bull on a single day and allotted to 4 treatment groups. These were fed high (H=13.5%) or low (L=4.8%) crude protein diets during the first and second trimesters. A total of 71 heifers calved (LL n=19, LH n=17, HL n=18, HH n=17). Fetuses were monitored on a total of 8 occasions between days 39 and 235 of gestation. Only those heifers that carried the fetus until term are included in the results, giving a total of 568 measurement events.

The mean vertical diameter of the eye socket (OV) throughout gestation was significantly greater in HH and LH compared with HL and LL ($P<0.001$) fetuses. There was a weak tendency for the overall mean biparietal diameter (BPD) of HH and LH fetuses to be greater than HL and LL fetuses ($P=0.092$). Significant statistical comparisons of treatment group means of fetal body measurements taken at individual time points throughout gestation are given in Table 1.

Table 1. Means and standard deviations of significant results of statistical comparisons of treatment group means of fetal body measurements taken during the first two trimesters of gestation. P-values generated from linear contrasts of pairwise comparisons and combinations of treatment group means

Day	Measure (cms)	HH	HL	LH	LL	*P*-value
39	CRL	1.76 ± 0.27	1.81 ± 0.32	1.51 ± 0.27	1.61 ± 0.29	0.0007[a]
	TC	4.04 ± 0.34	4.00 ± 0.18	4.45 ± 0.29	4.24 ± 0.26	0.002[a]
	UM	1.14 ± 0.15	1.23 ± 0.12	1.15 ± 0.09	1.09 ± 0.08	0.049[b], 0.03[c]
123	CNL	7.76 ± 0.40	7.23 ± 0.43	8.18 ± 0.60	7.38 ± 0.62	0.01[d]
	BPD	5.25 ± 0.52	5.15 ± 0.29	5.36 ± 0.53	4.91 ± 0.41	0.03[d]
	UM	1.81 ± 0.10	1.93 ± 0.13	1.77 ± 0.17	1.86 ± 0.15	0.051[d]
150	OV	2.05 ± 0.26	1.97 ± 0.18	2.18 ± 0.26	1.94 ± 0.16	0.02[d]
	OH	1.95 ± 0.21	2.10 ± 0.08	2.11 ± 0.13	2.26 ± 0.21	0.02[e]

a = HH/HL v LH/LL; b = HL v HH/LH/LL; c = LL v HL/LH; d = HH/LH v HL/LL; e = HH v HL/LH/LL
CRL = crown-rump length; TC = thoracic cross-section; UM = umbilical cord diameter; CNL = crown-nose length; OH = horizontal eye socket diameter

The results demonstrate that bovine fetal growth, as determined using transrectal real-time ultrasonography, is susceptible to maternal nutrient intake as early as day 39 of gestation. Furthermore, the plasticity of bovine fetal development enables delays in fetal growth due to maternal nutrient restriction in the first trimester of gestation to be compensated for by increased maternal nutrient intake in the second trimester. However, increased maternal nutrient intake in the first trimester does not protect against delayed fetal growth in the event of maternal nutrient restriction in the second trimester.

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