Maternal nutrition of beef cattle at pasture mediates long-term consequences for offspring primarily through effects on growth early in life

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This study tested the hypothesis that there are long-term consequences for offspring due to nutrition of the dam, beyond effects that result from variation in growth early in life (see Greenwood and Cafe 2007).

Hereford cows were mated in consecutive years to Piedmontese or Wagyu sires. When confirmed pregnant, cows (n = 513) commenced low or high pasture quality and availability treatments until parturition and/or weaning. At weaning, offspring (n = 240) within steer and heifer cohorts were selected into 4 early-life growth groups (Low-Low, Low-High, High-Low and High-High), resulting in multi-modal distributions based on maternal nutrition and offspring growth to birth and weaning. Subsequent growth, efficiency, carcass and beef quality characteristics were determined (Table 1). Stepwise regression was used to test whether there were effects of the cow's nutrition during pregnancy and lactation, over and above effects due to birth and weaning weight. The model included covariates for birth (B) and weaning (W) weight and age at measurement (A), and fixed effects of nutrition during pregnancy (P) and lactation (L), calf sex (S), year (Y) and sire breed (G). First order interactions between fixed effects, and between covariates and fixed effects were included in the analyses.

Maternal nutrition during pregnancy affected B; maternal nutrition during lactation and pregnancy affected W, over and above differences due to birth weight. In contrast, for live weights at feedlot entry and exit and carcass weight (C), there were significant linear effects of B and W, as well as effects of G, S and Y, but no effects of P and L. The average differences of 6 kg in B due to P and 53 kg in W of calves due to L both translated into differences of about 20 kg in C, 11-12 kg in retail meat yield and 6 kg of fat trim. At the same C, heavier cattle at weaning had more fat trim and reduced retail yield. There were few interactions, except that at the same C, high P nutrition had lower eye muscle for Piedmontese-sired (Low 95.7 vs High 88.4 cm^2) but not Wagyu-sired cattle (Low 85.7 vs High 85.7 cm^2). No significant effects on net (residual) feed intake were found.

Table 1. Effects of birth and weaning weights (coefficients) and maternal nutrition (means) at pasture during pregnancy (Preg) and lactation (Lact). n = 228 for all traits except feedlot exit weight (n = 227) and net (residual) feed intake (n = 146)

	Mean	Birth wt slope/kg	Wean wt slope/kg	Preg nutrition Low	Preg nutrition High	Lact nutrition Low	Lact nutrition High	Model R^2 %; terms[3]
Birth wt (kg)	33.7	NA[1]	NA	29.8	35.8*	NA	NA	33.2; P G S
Weaning wt (kg)	188.8	2.26*	NA	179.1	190.6[#]	158.3	211.5*	62.5; L B A S P
End background wt (kg)	514	2.88*	0.62*	ns	ns	ns	ns	68.8; W B S
Feedlot exit wt (kg)	678	4.51*	0.63*	ns	ns	ns	ns	69.4; B Y W
Carcass wt (kg)	382	2.58*	0.38*	ns	ns	ns	ns	67.5; B Y W G
Net feed intake (kg/d)	0	ns	ns	ns	ns	ns	ns	0
US Marble score	446	ns	ns	ns	ns	ns	ns	40.8; G S
Eye muscle area[2] (cm^2)	89.7	ns	ns	See	text	ns	ns	48.8; C×Y P×G
Retail yield[2] (kg)	249.1	ns	-0.08*	ns	ns	ns	ns	95.2; C G W
Fat trim[2] (kg)	55.5	ns	0.08*	ns	ns	ns	ns	62.5; G W C S
Bone[2] (kg)	67.6	ns	ns	ns	ns	ns	ns	85.8; C S Y
LD shear force (kg)	4.05	ns	ns	ns	ns	ns	ns	14.0; Y S

[1]Not applicable; [2] Adjusted to constant carcass weight; [3] See text for all terms; * P<0.001, [#] P<0.01, ns P>0.05

Overall, the long-term effects of maternal nutrition at pasture on offspring were primarily mediated through the effects on growth early in life. There were few influences of maternal nutrition beyond these early-life growth-related effects within the pasture-based beef production systems used in this study.

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