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Late Gestation Supplementation Impacts Primiparous Beef Heifers and Progeny

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Summary

A two-year study utilizing primiparous heifers evaluated the influence of rumen undegradable protein (RUP) supplement level on heifer and progeny performance. Heifers were individually fed meadow hay and no supplement (CON), 1.8 lb/day (DM) dried distillers based (HIGH) supplement, or 1.8 lb/day (DM) dried corn gluten feed based (LOW) supplement during late gestation. Heifers from HIGH and LOW groups had greater final BW, DMI, ADG, and G:F compared to CON heifers. Calves from HIGH dams had greater pre-breeding BW and LOW calves had greater weaning BW compared to CON calves. Feedlot initial BW was greater for HIGH and LOW calves compared to CON calves. However, final BW and carcass characteristics were similar among treatments. Providing RUP supplementation during late gestation increased heifer final BW and ADG. Calves from supplemented dams had increased pre-breeding, weaning, and initial feedlot BW compared to CON calves.

Introduction

Past research indicates late gestation protein supplementation influences multiparous cow progeny performance, carcass quality, and health (*2006 Nebraska Beef Cattle Report*, pp. 7-9; *Journal of Animal Science,* 2009, 87: 1147-1155). These results support the fetal programming hypothesis, which suggests that maternal environment during gestation can influence progeny postnatal growth and health. The objective of the current study was to evaluate the effects of RUP supplementation levels on primiparous heifer production and subsequent progeny growth, feed efficiency, and carcass quality.

Procedure

Primiparous Heifer Management

The University of Nebraska–Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in this experiment.

Pregnant heifers were placed in a Calan Broadbent individual feeding system and acclimated for approximately 25 days prior to the beginning of supplementation. Heifers were fed meadow hay (Year 1 = 11.3% CP, DM; Year 2 = 8.0% CP, DM) from early November to mid February (Year 1 = 84 days; Year 2 = 80 days) and provided no supplement (CON; Year 1 = 12; Year 2 = 13), 1.8 lb/day (DM) of a dried distillers grain based supplement (HIGH; Year 1 = 13; Year 2 = 14) or 1.8 lb/day (DM) of a dried corn gluten feed based supplement (LOW; Year 1 = 13; Year 2 = 13). Supplements were designed to be isonitrogenous (29% CP, DM), isocaloric, but differ in RUP with HIGH (59 % RUP) having greater levels of RUP than LOW (34% RUP). After the individual feeding period, heifers were placed in a drylot for calving. All heifers were artificially inseminated (AI) using a fixed-timed AI protocol, and pairs were moved 27 miles to a commercial ranch in the Nebraska Sandhills for summer grazing. A single bull was placed with heifers approximately 10 days after AI for 60 days.

Calf Feedlot Management

Prior to weaning, steers and heifers were returned to the West Central Research and Extension Center (WCREC), grouped separately and limit fed a starter diet for 5 days at 2.0% BW prior to determining initial BW. Implants were administered providing 20 mg of estradiol benzoate and 200 mg progesterone (Synovex S) to steers and 20 mg of estradiol benzoate and 200 mg testosterone to heifers (Synovex H). Calves were transitioned to a common finishing diet of 48% dry-rolled corn, 40% corn gluten feed, 7% prairie hay, and 5% supplement (DM) over a 21-day period. Approximately 100 days prior to slaughter, calves were implanted with 28 mg estradiol benzoate and 200 mg trenbolone acetate (Synovex Plus). Calves were slaughtered at a commercial abattoir 189 days after feedlot entry with HCW and carcass data collected after a 24-hour chill.

Calf DMI was calculated using a modified DMI prediction equation established by Tedeschi et al. (*Journal of Animal Science,* 2006, 84: 767-777) where DMI = (4.18 + (0.898 x ADG) + (0.0006 x ($MBW^{0.75}$) + (0.019 x EBF)) ÷ 0.4536 where EBF represents empty body fat percentage. Empty body fat percentage was calculated using the equation developed by Guiroy et al. (*Journal of Animal Science,* 2001, 79: 1983-1995) where EBF = 17.76107 + (11.8908 x 12th rib fat depth) + (0.0088 X HCW) + (0.81855 x [(marbling score/100) + 1] – (0.4356 x longissimus muscle area).

Statistical Analysis

Heifers were offered hay and supplement on an individual basis (Year 1 = 38; Year 2 = 40), therefore animal was considered the experimental unit and supplement the treatment. Data were analyzed using PROC MIXED and PROC GLIMMIX of SAS (SAS Inst., Inc., Cary, N.C.) with a $P \leq 0.05$ considered significant. The statistical model for heifers included treatment as the fixed effect with pen and year as random effects. The statistical model for calves included dam treatment as the fixed effect with sex included as a covariate and sire included as a random effect. Year was included in the calf analysis for birth weight and pre-breeding calf BW.

Results

Primiparous Heifer Production

Primiparous heifer performance data are reported in Table 1. Heifers in the HIGH and LOW groups had greater

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Table 1. Effects of supplementation on primiparous heifer performance and progeny calf body weights.

	Treatment[1]				
Item	CON	HIGH	LOW	SEM	*P*-value
n	25	27	26		
Initial age, day	617	617	621	17	0.72
Initial BW, lb	993	983	986	34	0.73
Final BW, lb	1089	1122	1122	11	0.05
Pre-breeding BW, lb	958	977	986	16	0.28
ADG, lb	1.19[a]	1.71[b]	1.67[b]	0.47	< 0.01
DMI, lb/day	19.81[a]	20.83[b]	20.71[a,b]	1.53	0.04
NE DMI, lb/day	10.40[a]	11.41[b]	11.35[b]	0.21	< 0.01
RFI[2]	-0.439	-0.038	-0.067	0.07	< 0.01
G:F	0.062[a]	0.084[b]	0.083[b]	0.029	< 0.01
Calving date, Julian day	59	59	60	1.23	0.57
Gestation length, day	277	276	277	1.01	0.88
Calf birth BW, lb	73	71	73	2.75	0.79
Calving ease	1.48	1.40	1.49	0.19	0.92
Calf vigor	1.40	1.56	1.77	0.28	0.55
Pre-breeding calf BW, lb	223[a]	240[b]	239[a,b]	5.06	0.03
Weaning BW, lb[3]	525[a]	561[a,b]	575[b]	14	0.04

[1]Primiparous heifers individually fed meadow hay and no supplement (CON), 1.8 lb/day (DM) distillers grain based supplement (HIGH), or 1.8 lb/day (DM) dried corn gluten feed based supplement (LOW) during late gestation.
[2]RFI calculated based on NE DMI.
[3]Calf weaning BW based on Year 1 data only.
[a,b]Means without a common superscript differ ($P \leq 0.05$).

Table 2. Effect of supplementation on primiparous heifer progeny feedlot performance and carcass characteristics.

	Treatment[1]				
Item	CON	HIGH	LOW	SEM	P-value
n	10	11	12		
Initial BW, lb	560[a]	602[b]	606[b]	14	0.04
Reimplant BW, lb	875	893	903	22	0.51
Final live BW, lb	1329	1319	1340	27	0.84
End BW, lb[2]	1305	1303	1330	32	0.72
ADG					
Initial to re-implant, lb/day	3.99	3.67	3.77	0.16	0.20
Re-implant to slaughter, lb/day	3.89	3.78	3.86	0.16	0.88
Total ADG, lb/day	3.94	3.71	3.83	0.13	0.44
DMI[3]	18.50	18.05	18.25	0.28	0.48
G:F	0.212	0.205	0.209	0.0004	0.37
RFI	0.009	0.006	-0.014	0.01	0.23
HCW, lb	822	821	838	20.05	0.72
Empty body fat, %[4]	29.11	28.93	28.09	0.68	0.49
Marbling score[5]	727	680	663	26.55	0.21
12-th rib fat, in	0.80	0.79	0.72	0.05	0.49
LM area, in^2	13.55	13.89	14.11	0.37	0.56
Yield grade	3.62	3.57	3.39	0.20	0.66
Quality grade, % Sm[6] or greater	100.0	100.0	100.0	—	1.00
Quality grade, % Md[7] or greater	91.0	67.7	60.7	15	0.27

[1]Dams individually fed meadow hay and no supplement (CON), 1.8 lb/d (DM) distillers grain based supplement (HIGH), or 1.8 lb/d (DM) dried corn gluten feed based supplement (LOW) during late gestation.
[2]Calculated from hot carcass weight and adjusted to a common dressing percent (63.0%).
[3]DMI calculated using a modified prediction formula presented by Tedeschi et al. (2006) where DMI = (4.18 + (0.0898 x ADG) + (0.0006 x (MBW$^{0.75}$) + (0.019 x EBF)) ÷ 0.4536.
[4]EBF calculated using the prediction formula presented by Guiroy et al. (2001) where EBF = 17.76107 + (11.8908 x 12th rib fat depth) + (0.0088 X HCW) + (0.81855 x [(marbling score/100) + 1] – (0.4356 x LM area).
[5]Where 500 = small^0.
[6]Sm = small quality grade, USDA low Choice.
[7]Md = modest quality grade, USDA average Choice.
[a,b]Means without a common superscript differ ($P \leq 0.05$).

($P = 0.05$) final BW compared to CON heifers; however, pre-breeding BW was similar for all groups. Average daily gain, DMI, DMI based on feed NE, and G:F were greater ($P < 0.05$) for HIGH and LOW heifers compared to CON heifers. However, CON heifers had improved ($P < 0.01$) RFI compared to HIGH and LOW heifers.

Calf Production

Calf BW at pre-breeding was greater ($P = 0.03$) for calves from HIGH dams compared to calves from CON dams (Table 1). Preliminary data for calf weaning BW (Table 1) suggest greater ($P = 0.04$) BW for calves from LOW dams compared to calves from CON dams, while calves from HIGH dams only tend ($P = 0.10$) to differ from CON calves. Preliminary data for calf feedlot performance and carcass data are reported in Table 2. Initial feedlot BW was 46 and 42 lb greater ($P = 0.04$) for calves from LOW and HIGH dams compared to calves from CON dams; however, at re-implant there was no difference in BW among treatments. Preliminary data suggests no differences in feedlot performance or carcass characteristic among treatments.

There was no difference in primiparous heifer performance when comparing the two levels of RUP supplemented during late gestation. However, HIGH and LOW heifers had increased final BW, ADG, and G:F compared to CON heifers. Calves from LOW dams had greater weaning BW, and calves from both supplemented groups had greater initial feedlot BW compared to calves from CON dams. These data suggest fetal programming effects on calf BW from primiparous heifers fed protein supplement during late gestation.

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