Effects of maternal metabolizable protein supplementation during the last 50 days of gestation on male and female offspring performance post-weaning[1]

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The objectives of this trial were to determine the effects of maternal metabolizable protein supplementation in ewes during the last 50 days of gestation on male and female offspring performance post-weaning. Results suggest restricting MP intake to 60% of requirements to ewes during late gestation may negatively impact F1 offspring growth and reproductive performance, beginning with F1 birth weights.

INTRODUCTION

Crude protein supplementation not only allows dams to maintain BW and BCS, but appears to improve offspring performance (Stalker et al., 2006; Larson et al., 2009). Crude protein supplementation to the dam is just one method of improving livestock performance during gestation. Metabolizable protein has been defined as the protein and amino acids that are digested and absorbed post-ruminally (Burroughs et al., 1975). Since MP is the protein directly available to the dam, it may be an indicator of how protein intake during gestation will ultimately affect offspring performance both pre- and post-weaning. However, there has been minimal research conducted on the effects of MP intake during late gestation in sheep on offspring performance.

We hypothesized that the greater proportion of the diet that is composed of MP would yield improved offspring growth by potentially increasing nutrient transfer by the placenta or by increased nutrients within the milk. Therefore, the objectives were to evaluate isocaloric diets with increasing levels of MP during late gestation on male and female offspring performance post-weaning.

PROCEDURES

All procedures were approved by the NDSU Animal Care and Use Committee. This study was conducted at the Hettinger Research Extension Center in Hettinger, ND.

Ewes. On d 100 ± 8 (SD) of gestation, using the average of the initial weights (d 99 and 100 of gestation), ewes were stratified by BW, BCS, age, and expected lambing date to one of three isocaloric dietary treatments (Table 2; n = 7): **100MP1**: 100% of the MP requirements on a DM basis during the last 4 weeks of gestation of a ewe carrying twins (NRC, 2007); **60MP1**: 60% of 100MP1; and **80MP1**: 80% of 100MP. Isocaloric dietary treatments (Table 2; n = 4) in year 2 were: **60MP2**: 60% of MP requirements; **100MP2**: 100% of the MP requirements; and **140MP2**: 140% of MP requirements on a DM basis of a ewe carrying twins during the last 4 weeks gestation (NRC, 2007). Once ewes had lambed, the ewes and lambs were intermingled between dietary treatments where they were maintained on a lactation ration (Table 1).

Lambs. In both years, lambs were weighed and tagged within 24 h of birth; sex, lambing assistance, and lamb vigor were also recorded. Lambs were then moved with the ewes to grouping pens and had full-access to creep pellet and water prior to weaning. At 14 days of age and at weaning all lambs were vaccinated for tetanus and *Clostridium Perfringens* types C and D (CD-T; Bar Vac CD-T, Boehringer Ingelhein, Ridgefield, CT), tails were docked, and ram lambs were castrated. Lambs were weaned at 69 ± 5 d (SD) of age in year 1 and at 61 ± 12 (SD) d of age in year 2 and weighed.

Feedlot. In year 1, at 89 ± 5 (SD) days of age and in year 2, at 102 ± 11 (SD) days of age, wether lambs were revaccinated for CD-T and placed in the feedlot. In both years, wethers were allotted by maternal dietary treatment and blocked by weight (heavy and light) into one of two pens per maternal dietary treatment. Wethers were fed approximately 85% whole, shelled corn and 15% commercial market lamb pellet diet (Table 3). The feedlot ration was balanced to meet or exceed CP and NE requirements of growing lambs (NRC, 2007). Wethers were fed a mixed diet ad libitum via bulk feeders. Lambs had continuous access to fresh water and shade. In year 1, wether lambs were shipped to the Iowa Lamb Corporation (Hawarden, IA) or the NDSU Meat Lab (Fargo, ND) for carcass measurements. In year 2, all wethers were shipped to Superior Farms (Denver, CO).

Ewe lambs. In both years, F1 lambs were fed a mixed diet ad libitum via bulk feeders (Table 3). In year 1, between 108 ± 10 (SD) and 236 ± 10 (SD) days of age, F1 growth performance was measured. Body weights were taken every 14 days throughout the 128 day period. Growth performance in year 2 was measured from 63 ± 13 (SD) day of age to 191 ± 20 (SD) days of age. Body weights were taken at the beginning (d 0) and at the end (d 128) of the 128 day period. F1 breeding began at 259 ± 10 (SD) days of age in year 1 and 256 ± 9 (SD) days of age in year 2. F1 were maintained in a single flock during the 51 day breeding period. Rambouillet rams (n = 10) were fitted with marking harnesses and were introduced to the flock. Breeding harness crayons were changed to a different color on d 18 and 35 days post-ram introduction. Rams were removed from the pen 51 days after the rams were introduced. In both years, pregnancy was confirmed via ultrasonography 45 days after the rams were removed. In both years, lambs of F1 dams (**F2**) were treated similarly as lambs from ewes discussed previously.

Statistical analysis. Feedlot performance, carcass characteristics, F1 performance, and F1 reproductive efficiency were analyzed utilizing the MIXED procedures of SAS (SAS Inst. Inc., Cary, NC). When a significant F-test was observed ($P \leq 0.15$), pre-planned comparisons of linear and quadratic contrasts were utilized to partition treatment effects. Significance was set at $P \leq 0.05$ and tendencies at $P \leq 0.10$.

RESULTS

Year 1

Wethers. There was no effect ($P \geq 0.33$; Table 4) of maternal dietary treatment on initial BW, final BW, ADG, G:F, or morbidity. There was a quadratic effect ($P = 0.04$) for days on feed, with the 80MP1 lambs being on feed longer than the 60MP1 and 100MP1 lambs. A quadratic effect ($P = 0.05$) was also observed for DMI, with the 80MP1 wethers consuming less feed than the 60MP1 and 100MP1 wethers. There was no effect ($P \geq 0.27$; Table 4) of maternal MP intake during late gestation on carcass measurements, except a linear tendency ($P = 0.06$) for flank streaking to increase in wethers as MP increased in the late gestation ewe diet.

Ewe lambs. Weaning BW and ADG from birth to weaning, weaning to the end of the 128 d growth period, birth to the end of the 128 d growth period, initial BW, final BW, and ADG during the 128 day growth period were not altered ($P \geq 0.22$; Table 5) due to maternal MP dietary treatment. There was a quadratic effect ($P = 0.003$) for F1 birth weight, with the F1 offspring from 80MP1 ewes having increased birth weights compared with F1 from 60MP1 and 100MP1 ewes. The total percentage of F1 lambing, F1 lambing in the third 17 days of the lambing period, lambing rate, or on birth weight of F2 was not different ($P \geq 0.22$; Table 5) due to maternal dietary treatment. However, a quadratic effect ($P = 0.02$) was observed for the percentage of F1 being marked for breeding during the first 17 day breeding cycle with F1 born to ewes fed 80MP1 being increased compared with F1 born to ewes fed 60MP1 and 100MP1. F1 lambing to the first 17 day breeding cycle was increased linearly ($P = 0.001$) as MP intake increased in the maternal diet during late gestation. The percentage of F1 lambing during the second 17 day breeding cycle decreased linearly ($P = 0.02$) as MP intake in the maternal diet increased during late gestation

Year 2

Wethers. In year 2, there was no effect ($P \geq 0.12$; Table 6) of maternal dietary treatment on initial BW, final BW, ADG, G:F, or morbidity. There was a linear increase ($P = 0.04$) in DMI as maternal MP increased from 60 to 140% of MP requirements. Carcass characteristics were not affected ($P \geq 0.40$; Table 6) by ewe MP intake during late gestation.

Ewe lambs. Average daily gain during the 128 day growth period, from birth to the end of the 128 day growth period, and F1 birth weights were not altered ($P \geq 0.17$; Table 7) by maternal MP treatment. However, there tended ($P = 0.09$) to be a quadratic effect on weaning weights, where F1 from 100MP2 ewes tended to be increased compared with F1 from 60MP2 and 140MP2 ewes. There was a quadratic effect ($P = 0.01$) for ADG from birth to weaning of F1 from ewes consuming 100% of MP requirements being increased compared with F1 from ewes fed 60 and 140% of MP requirements. There tended to be a quadratic effect ($P = 0.07$) for final BW at the end of the growth period, where F1 from 100MP2 ewes weighed more on d 128 of the growth period compared with F1 from 60MP2 and 140MP2 ewes. There was no effect ($P \geq 0.76$; Table 7) of maternal MP treatment on the total percentage of F1 lambing or the percentage of F1 lambing to the first, second 17 days of the lambing season, and lambing rate. There tended to be a quadratic effect ($P = 0.09$) for F1 from ewes fed 100MP2 having increased F1 breeding during the first 17 days of breeding compared with F1 from 60MP2 and 140MP2 ewes. F1 from 60MP2 and 100MP2 fed ewes gave birth to heavier ($P = 0.05$) lambs than F1 from 140MP2 fed ewes. Birth weights of F2 born to F1 were reduced linearly ($P = 0.04$) as grand-dam MP intake increased during late gestation.

DISCUSSION

Performance during the feedlot phase in the current study was not affected by maternal MP intake. Previously, Larson et al. (2009) observed no differences in steer ADG, DMI, or G:F due to maternal dietary CP supplementation. Additionally, Stalker et al. (2006) reported no differences in calf ADG, DMI, or G:F during the finishing phase due to maternal CP supplementation. Overall, the current results suggest that feedlot performance in sheep may not be altered by maternal MP intake during late gestation.

Similar to the current results, Stalker et al. (2006) did not observe any differences in steer carcass measurements due to maternal CP supplementation during late gestation on steer offspring. However, similar to year 1, Larson et al. (2009) observed increased marbling scores steers born to cows that were supplemented with CP during late gestation. The current results suggest that maternal MP intake in isocaloric diets may have little impact on carcass characteristics of wether offspring.

To our knowledge, there has been little research conducted evaluating the feeding of MP or CP during late gestation in ruminants on their effects of female offspring post-weaning. Martin et al. (2007) observed an increase in adjusted 205 d BW, prebreeding BW, and BW at pregnancy diagnosis in heifers born to cows that were supplemented with CP during late gestation. As our results suggest, restricting MP intake to 60% of requirements to ewes during late gestation may negatively impact F1 offspring growth and reproductive performance, beginning with F1 birth weights.

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Table 1. Nutrient composition of fescue straw and lactation ration in years 1 and 2

	Fescue Straw[1]		
Item	Year 1	Year 2	Lactation Ration[2]
Diet, % DM	64.51	56.51	100.00
DM, %	83.05	77.61	64.37
NEm, Mcal/kg	2.22	2.12	—
CP, % of DM	3.04	3.07	11.52
MP, % of DM	1.95	1.97	—
NDF, % of DM	79.85	81.13	48.05
ADF, % of DM	48.97	51.10	27.16
Ash, % of DM	9.49	7.78	8.59

[1]Ewes were fed fescue straw in each year to limit metabolizable protein intake.
[2]Ewes were fed a common ration during lactation across all dietary treatments; 28.5% oats, 28.5% haylage, 42.9% chopped hay.

Table 2. Ingredient and nutrient composition of dietary supplements fed to ewes in year 1 and 2

	Year 1[1]			Year 2[2]		
Item	60MP1	80MP1	100MP1	60MP2	100MP2	140MP2
Ingredient, % DM						
Corn	18.50	15.00	5.00	30.00	19.00	—
DDGS[3]	7.00	20.00	30.00	4.00	24.00	43.00
Soyhulls	9.50	—	—	9.00	—	—
Trace mineral[4]	0.49	0.49	0.49	0.49	0.49	0.49
Nutrient composition						
DM, %	88.75	89.34	89.68	88.64	90.19	92.16
NEm, Mcal/kg	2.00	2.22	2.14	2.05	2.19	2.06
CP, % of DM	13.16	20.21	25.13	10.21	18.67	28.68
MP, % of DM	8.41	13.01	16.31	6.54	11.96	18.37
NDF, % of DM	31.03	30.73	39.79	29.64	31.40	45.34
ADF, % of DM	15.69	7.45	10.49	13.87	8.68	13.34
Ash, % of DM	3.22	3.48	4.55	3.53	3.80	5.13

[1]Maternal diets (DM basis) were balanced for mature ewes baring twins during the last 4 weeks of gestation according to NRC (2007). Treatments: 60MP1: 60% of metabolizable protein of 100MP1; 80MP1: 80% of the metabolizable protein 100MP1; and 100MP1: 100% of the metabolizable protein requirement.

[2]Maternal diets (DM basis) were balanced for mature ewes baring twins during the last 4 weeks of gestation according to NRC (2007). Treatments: 60MP2: 60% of metabolizable protein of 100MP2; 140MP2: 140% of the metabolizable protein of 100MP2; 100MP2: 100% of the metabolizable protein requirement.

[3]Dried distillers grains with solubles

[4]Trace mineral content: 16.0-17.0% Ca; 8.0% P; 21.0-23.0% Salt; 2.75% Mg; 3 ppm Co; 5 ppm Cu; 100 ppm I; 1,400 ppm Mn; 20 ppm Se; 3,000 ppm Zn; 113,500 IU/kg Vitamin A; 11,350 IU/kg Vitamin D; and 227 IU/kg Vitamin E.

Table 3. Ingredient and nutrient composition of diets fed to feedlot wether lambs and ewe lambs in years 1 and 2

	Wethers		Ewe Lambs
Item	Year 1	Year 2	
Ingredient, %			
Oats	—	—	60.0
Whole corn	84.4	84.7	20.0
Market lamb pellet[1]	15.6	15.3	20.0
Nutrient composition			
DM, %	89.06	89.54	91.1
CP, % of DM	13.12	13.50	22.3
NDF, % of DM	13.48	22.93	23.8
ADF, % of DM	3.42	4.23	10.1
Ash, % of DM	4.59	5.52	10.5

[1]Commercial Market Lamb Pellet contained: 0.22 g/kg Chlortetracycline; 38.0% CP; 3.75-4.75% Ca; 0.6% P; 3.0-4.0% salt; 1.2 ppm Se; 52,863 IU/kg Vitamin A; 5,286 IU/kg Vitamin D; and 209 IU/kg Vitamin E.

Table 4. Effects of maternal metabolizable protein supplementation on feedlot performance and carcass characteristics of wethers in year 1

	Maternal Dietary Treatment[1]					Orthogonal Contrasts[4]	
Item	60MP1	80MP1	100MP1	SEM[2]	*P* – value[3]	Linear	Quadratic
Feedlot							
Initial BW, lb	64.4	62.2	65.7	4.59	0.85	0.82	0.60
Final BW, lb	153.9	150.8	146.6	3.51	0.33	0.14	0.89
Days on feed, d	127	133	123	3.8	0.10	0.38	0.04
ADG, lb/d	0.71	0.68	0.66	0.02	0.40	0.18	0.93
DMI, lb/lamb/d	3.31	3.17	3.28	0.04	0.13	0.84	0.05
G:F, lb gain:lb DMI	0.23	0.22	0.21	0.01	0.64	0.36	0.79
Morbidity,[5] %	6.4	20.5	20.2	9.1	0.33	0.22	0.43
Carcass characteristics							
HCW, lb	79.6	77.2	75.6	2.01	0.33	0.14	0.88
Dressing Percentage, %	51.8	51.2	51.4	0.44	0.53	0.53	0.38
LM area, in^2	2.74	2.74	2.73	0.08	0.95	0.76	0.94
Back fat thickness, in	0.28	0.31	0.28	0.02	0.27	0.43	0.14
Body wall thickness, in	1.10	1.06	1.06	0.04	0.72	0.42	0.92
Leg score[6]	12	12	12	0.2	0.84	0.61	0.74
Conformation score[6]	12	12	12	0.2	0.64	0.98	0.35
Flank streaking[7]	362	365	395	13.5	0.13	0.06	0.36
Quality grade[6]	12	12	12	0.1	0.38	0.17	0.98
Yield grade[8]	3.3	3.5	3.2	0.3	0.54	0.85	0.27
BCTRC,[9] %	44.79	44.94	48.56	2.01	0.34	0.19	0.48
WBSF,[10] lb	7.23	6.00	6.19	0.68	0.40	0.30	0.40

[1]Maternal dietary treatment: 60MP1: 60% of metabolizable protein of 100MP1; 80MP1: 80% of the metabolizable protein 100MP1; and 100MP1: 100% of the metabolizable protein requirement.
[2]Greatest SEM presented (n = 31 for 60MP1, n = 33 for 80MP1, and n = 24 for 100MP1).
[3]*P*-value for the F test of the mean.
[4]*P*-value for linear and quadratic effects of increasing metabolizable protein concentrations.
[5]Percentage treated for illness during the feedlot phase.
[6]Leg score, conformation score, and quality grade: 1 = cull to 15 = high prime.
[7]Flank streaking: 100-199 = practically devoid; 200-299 = traces; 300-399 = slight; 400-499 = small; 500-599 = modest.
[8]Yield grade = (back fat thickness × 10) + 0.4.
[9]Percent boneless, closely trimmed, retail cuts (% BCTRC) = [49.936 – (0.0848 × HCW, lb) – (4.376 × back fat thickness, in) – (3.53 × body wall thickness, in) + (2.456 × LM area, in^2)].
[10]Warner-Bratzler shear force.

Table 5. Effects of maternal metabolizable protein supplementation on ewe lamb growth and reproductive performance in year 1

	Maternal Dietary Treatment[1]					Orthogonal Contrasts[4]	
Item	60MP1	80MP1	100MP1	SEM[2]	*P* – value[3]	Linear	Quadratic
Birth weight, lb	9.9	11.5	10.8	0.31	0.002	0.05	0.003
Weaning BW, lb	40.1	43.9	42.3	2.16	0.41	0.41	0.28
ADG, lb/d							
Birth to weaning	0.42	0.49	0.46	0.029	0.37	0.36	0.26
Weaning to final[5]	0.60	0.60	0.60	0.015	0.78	0.55	0.74
Birth to final[5]	0.55	0.57	0.55	0.013	0.43	0.86	0.20
Growth period[6]							
Initial BW, lb	68.6	73.9	67.2	3.31	0.29	0.22	0.13
Final BW, lb	139.6	146.9	139.1	3.68	0.22	0.16	0.08
ADG, lb/d	0.55	0.57	0.57	0.018	0.80	0.61	0.55
Breeding in first 17 days,[7] %	50	84	67	9.3	0.03	0.15	0.02
Total lambing,[8] %	70	68	67	9.5	0.96	0.78	0.98
Lambing to first 17 days,[9] %	0	0	32	7.3	0.001	0.001	0.07
Lambing to second 17 days,[9] %	86	65	52	11.2	0.05	0.02	0.75
Lambing to third 17 days,[9] %	14	35	16	9.8	0.22	0.89	0.08
Lambing rate,[10]	0.73	0.80	0.81	0.12	0.88	0.64	0.83
Lamb birth weight, lb	10.6	10.6	10.4	0.44	0.85	0.64	0.78

[1]Maternal dietary treatment: 60MP1: 60% of metabolizable protein requirements; 80MP1: 80% of metabolizable protein requirements; and 100MP1: 100% of metabolizable protein requirements.
[2]Greatest SEM presented (n = 30 for 60MP1, n = 25 for 80MP1, and n = 36 for 100MP1).
[3]*P*-value for the F test of the mean.
[4]*P*-value for linear and quadratic effects of increasing metabolizable protein concentrations.
[5]Weaning to final indicates the ADG from weaning to the final BW measured on d 128 of the 128 day growth period. Birth to final indicates the ADG from birth to the final BW measured on d 128 of the 128 day growth period.
[6]Growth period that was 128 days in length to measure growth performance of the ewe lambs.
[7]Percentage of ewe lambs per treatment having breeding marks in the first 17 days of the breeding season.
[8]Total percentage of ewe lambs lambing per ewe lamb exposed per maternal dietary treatment.
[9]Percentage of ewe lambs lambing that were bred during the first 17 days post-ram turnout, the second 17 days post-ram turnout, or the third 17 days post-ram turnout.
[10]Lambing rate: number of lambs born per ewe exposed to the rams.

Table 6. Effects of maternal metabolizable protein supplementation on feedlot performance and carcass characteristics of wethers in year 2

	Maternal Dietary Treatment[1]					Orthogonal Contrasts[3]	
Item	60MP2	100MP2	140MP2	SEM[2]	*P* – value[3]	Linear	Quadratic
Feedlot							
Initial BW, lb	55.8	62.4	65.0	4.59	0.36	0.18	0.71
Final BW, lb	131.6	138.2	139.4	4.87	0.48	0.27	0.65
ADG, lb/d	0.53	0.55	0.53	0.02	0.82	0.79	0.59
DMI, lb/lamb/d	2.25	2.31	2.47	0.07	0.09	0.04	0.66
G:F, lb gain:lb DMI	0.24	0.24	0.22	0.02	0.60	0.35	0.73
Morbidity,[4] %	13.6	31.8	9.1	10.0	0.12	0.69	0.04
Carcass characteristics							
HCW, lb	71.9	71.2	71.2	2.84	0.99	0.89	0.92
Dressing percentage, %	49.9	49.4	49.3	0.46	0.62	0.38	0.65
LM area, in^2	2.56	2.54	2.59	0.09	0.94	0.83	0.81
Back fat thickness, in	0.28	0.28	0.24	0.02	0.56	0.30	0.96
Body wall thickness, in	1.10	0.91	0.98	0.06	0.40	0.41	0.29
Leg score[5]	12	12	12	0.3	0.55	0.54	0.39
Conformation score[5]	12	12	12	0.3	0.86	0.59	0.93
Flank streaking[6]	396	409	398	18.2	0.83	0.96	0.54
Quality grade[5]	12	12	12	0.3	0.78	0.97	0.48
Yield grade[7]	3.2	3.0	2.9	0.25	0.56	0.30	0.96
BCTRC,[8] %	45.16	45.69	45.69	0.38	0.50	0.30	0.53

[1]Maternal dietary treatment: 60MP2: 60% of metabolizable protein of 100MP2; 100MP2: 100% of the metabolizable protein requirement; and 140MP2: 140% of the metabolizable protein requirement.
[2]Greatest SEM presented (n = 20 for 60MP2, n = 22 for 100MP2, and n = 20 for 140MP2).
[3]*P*-value for the F test of the mean.
[4]*P*-value for linear and quadratic effects of increasing metabolizable protein concentrations.
[5]Percentage treated for illness during the feedlot phase.
[5]Leg score, conformation score, and quality grade: 1 = cull to 15 = high prime.
[6]Flank streaking: 100-199 = practically devoid; 200-299 = traces; 300-399 = slight; 400-499 = small; 500-599 = modest.
[7]Yield grade = (back fat thickness × 10) + 0.4.
[8]Percent boneless, closely trimmed, retail cuts (% BCTRC) = [49.936 – (0.0848 × HCW, in) – (4.376 × back fat thickness, in) – (3.53 × body wall thickness, in) + (2.456 × LM area, in^2)].

Table 7. Effects of maternal metabolizable protein supplementation on ewe lamb growth and reproductive performance in year 2

	Maternal Dietary Treatment[1]					Orthogonal Contrasts[4]	
Item	60MP2	100MP2	140MP2	SEM[2]	*P* – value[3]	Linear	Quadratic
Birth weight, lb	9.9	9.9	10.4	0.46	0.62	0.43	0.52
Weaning BW, lb	32.4	37.3	35.3	1.61	0.07	0.14	0.09
Final BW,[5] lb	131.2	139.1	126.1	4.76	0.14	0.37	0.07
ADG, lb/d							
Birth to weaning	0.40	0.44	0.37	0.02	0.03	0.25	0.01
Weaning to final[6]	0.51	0.55	0.51	0.02	0.48	0.79	0.23
Birth to final[6]	0.49	0.51	0.46	0.02	0.17	0.55	0.07
Breeding in first 17 days,[5] %	84	94	70	9.0	0.12	0.18	0.09
Total lambing,[6] %	19	28	26	10.2	0.76	0.57	0.65
Lambing to first 17 days,[7] %	86	88	83	15.4	0.98	0.91	0.86
Lambing to second 17 days,[7] %	14	13	17	15.4	0.98	0.91	0.86
Lambing rate[8]	0.23	0.33	0.26	0.12	0.78	0.80	0.52
Lamb birth weight, lb	10.4	10.4	7.9	0.86	0.05	0.04	0.14

[1]Maternal dietary treatment: 60MP2: 60% of metabolizable protein requirements; 100MP2: 100% of metabolizable protein requirements; and 140MP2: 140% of metabolizable protein requirements.
[2]Greatest SEM presented (n = 31 for 60MP2, n = 18 for 100MP2, and n = 23 for 140MP2).
[3]*P*-value for the F test of the mean.
[4]*P*-value for linear and quadratic effects of increasing metabolizable protein concentrations.
[5]Final BW observed at the end of the 128 day growth period beginning at weaning.
[6]Weaning to final indicates the ADG from weaning to the final BW measured on d 128 of the 128 day growth period. Birth to final indicates the ADG from birth to the final BW measured on d 128 of the 128 day growth period.
[5]Percentage of ewe lambs per treatment having breeding marks in the first 17 days of the breeding season.
[6]Total percentage of ewe lambs lambing per ewe lamb exposed per maternal dietary treatment.
[7]Percentage of ewe lambs lambing that were bred during the first 17 days post-ram turnout and the second 17 days post-ram turnout.
[8]Lambing rate: number of lambs born per ewe exposed to rams.