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THE PERFORMANCE OF LACTATING BEEF COWS SUPPLEMENTED WITH INCREASING AMOUNTS OF UNDEGRADABLE INTAKE PROTEIN

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Story in Brief

Two experiments were conducted (Exp. 1, n=63; Exp. 2, n=72) using Hereford and Hereford x Angus cows grazing Oklahoma winter tallgrass prairie to determine the effects of increasing supplemental undegradable intake protein (UIP) on performance. For each experiment, following parturition (February and March), cows were blocked by body condition score (BCS) and calving date and randomly assigned to one of four dietary treatments. For Exp. 1, treatments were formulated to provide 396 g of degradable intake protein (DIP) with increasing amounts of UIP (211, 274, 337, and 400 g, respectively). For Exp. 2, treatments were formulated to provide 281 g of DIP with 142, 196, 248 and 301 g of UIP, respectively. Cows were individually fed 1.59 kg of supplement 6 d/wk, and body weight and BCS were determined biweekly until the end of supplementation. Milk production was determined 30 and 45 d postpartum. Concentration of progesterone was quantified weekly in plasma samples to determine interval to first normal luteal function (PPI). In each experiment, weight loss, BCS loss and PPI were not influenced by treatment. In Exp. 2, there was a linear decrease in weight gain of calves post-treatment to weaning as supplemental UIP increased, and a quadratic effect of additional UIP on milk production at 30 d postpartum. We conclude that increasing supplemental UIP did not influence performance of cows or calves grazing Oklahoma winter tallgrass prairie.

Key Words: Beef Cows, Undegradable Intake Protein, Native Forage

Introduction

In Oklahoma, spring calving beef cows often graze dormant native range the first few months postpartum. Protein and energy content of Oklahoma dormant native range is less (Waller et al., 1972) than the nutrient requirements of a lactating cow, thus cows often lose substantial amounts of weight and condition during the late winter or early spring period. The current metabolizable protein (MP) system (NRC, 1996) predicts protein requirement of a cow based on estimates of protein that is degraded within the rumen (DIP) as well as protein that escapes the rumen undegraded (UIP). However, traditional protein supplements are formulated using the crude protein system (NRC, 1984). This system assumes that all proteins are equally degraded within the rumen. Therefore, they may contain enough degradable protein to meet the animals DIP requirement, but may not contain enough total protein to meet the UIP requirement, thus resulting in an MP deficiency. Therefore, the objective of this experiment was to determine if feeding a supplement with additional UIP would increase postpartum performance of spring calving beef cows grazing dormant tallgrass prairie.

Materials and Methods

Two experiments were conducted using lactating Hereford and Hereford x Angus cows (Exp. 1, n=63; Exp. 2, n=72) to determine the effects of increasing supplemental UIP on performance. For both experiments, cows grazed native winter tallgrass prairie at the Range Cow Research Center near Stillwater, OK. Following parturition (February and March) cows were blocked by weight (Exp. 1, 483 ± 18 kg; Exp. 2, 531 ± 6 kg), body condition score (Exp. 1, BCS = 5.6 ± .2; Exp. 2, BCS = 5.5 ± .4; 1 = emaciated and 9 = obese) and calving date (Exp. 1, March 12; Exp. 2, February 24) and randomly assigned to one of four dietary treatments (Table 1).

Treatments for Exp. 1 were control (C), control + 63 g of additional UIP (C+63), control + 126 g of additional UIP (C+126), control + 189 g of additional UIP (C+189). Treatments were formulated to provide 396 g of DIP while supplying increasing amounts of UIP (211, 274, 337 and 400 g/d, respectively). Due to lack of response in Exp. 1, supplements for Exp. 2 were formulated such that the control supplement provided adequate DIP, but less MP than the control supplement of Exp. 1. Treatments for Exp. 2 were control (C), control + 53 g of additional UIP (C+53), control + 106 g of additional UIP (C+106), control + 159 g of additional UIP (C+159). Treatments were formulated to provide 281 g of DIP while supplying increasing amounts of UIP (142, 196, 248 and 301 g/d, respectively). In each experiment, cows were individually fed 1.59 kg/d of supplement 6 d/wk. Body weight and BCS were determined biweekly until the end of supplementation (Exp. 1, April 18; Exp. 2, April 8), and monthly from the end of supplementation to weaning (Exp. 1, October 7; Exp. 2, October 1). Calf weights were determined at birth and every month until weaning.

Forty cows from each experiment were used to determine milk production at 30 and 45 d postpartum using the weigh-suckle-weigh technique. Three weigh-suckle-weighs were conducted within a 24-h period. The total of the three were used to estimate daily milk production.

In each experiment, beginning 30 d postpartum, weekly blood samples were collected from each cow into tubes containing EDTA. Plasma was obtained by centrifugation and stored a □20^{0}C. Plasma concentrations of progesterone were quantified by radioimmunoassay. Cows with two consecutive weeks of plasma progesterone ≥ 1 ng/mL were defined as exhibiting normal luteal function. A postpartum interval (PPI) was defined for each cow as the number of days from calving until initiation of normal luteal function.

Least squares analysis of variance for a randomized complete block design was used to determine the effects of supplemental treatment on cow weight change, BCS change, calf weight change, and PPI. A split-plot analysis of variance was used to determine the effects of supplemental treatment and days postpartum on milk production with individual animal as the experimental unit. Orthogonal contrasts for linear, quadratic, and cubic effects were tested in each case.

Results and Discussion

Increasing supplemental CP (Lusby and Wettemann, 1988) or UIP (Miner et al., 1990; Dhuyvetter et al., 1993) have been shown to decrease weight and BCS loss of cows grazing winter range. In each of the current studies, weight loss and BCS loss were not different between the supplemental treatment groups (Table 2). Others also report no difference in weight or BCS change with increased supplemental UIP (Tripplett et al., 1995; Lardy et al., 1999). In the current studies, the time from calving to availability of high quality spring forage may have been too limited to allow cows to respond to supplemental treatments.

In some experiments, beef cows supplemented with additional UIP had greater milk production (Hibberd et al., 1988; Lardy et al., 1997). In Exp. 1, supplemental treatment did not influence milk production. However, in Exp. 2, additional UIP exhibited a quadratic effect (P<.06) on milk production at 30 d postpartum, but had no effect at 45 d postpartum (Table 3.) When mean milk production between the two periods was evaluated, there was a linear effect (P<.07) for decreased milk production from cows supplemented with increased UIP (Table 3). This agrees with other reports that increased supplemental UIP did not influence milk production of mature cows, and decreased milk production of first calf heifers (Tripplett et al., 1995). Furthermore, in Exp. 2, there was a linear decrease in weight gain of calves (P<.08) post-treatment to weaning as supplemental UIP increased (Table 4), indirectly indicating that mean milk production was decreased. Also there was a quadratic (P<.05) effect of supplemental treatment on weight gain of calves from calving to weaning.

First calf heifers supplemented with additional UIP had greater first service conception rates (Tripplett et al., 1995). Furthermore, cows supplemented with increased amounts of UIP had shorter postpartum intervals (Wiley et al., 1988). However, in each current experiment, the interval to first normal luteal function was similar (Exp. 1, 54 ± 4 d; Exp. 2, 86 ± 4 d) for cows on all supplemental treatments (Table 3). This agrees with Dhuyvetter et al. (1993) who determined that the postpartum interval was not different for cows supplemented with additional UIP. This lack of response to supplemental treatments is consistent with the weight and BCS changes. In Exp. 2, although not significant (*P*=.19), there was almost a 17-d decrease in the postpartum interval for cows fed the moderate UIP supplements compared with the control-supplemented cows. Small numbers of cows on each treatment may have prevented significant differences.

During the late winter and early spring period, lactating beef cows have rapid weight loss prior to the availability of green forage. In this study, additional supplemental UIP did not alter performance of beef cows grazing native winter range during this time. We conclude that metabolizable protein requirements were met by microbial protein, forage UIP and 142 g of supplemental UIP.

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Table 1. Supplement compositions (DM basis).

------------------------------------Experiment 1--------------------------------------				
	Treatment[1]			
Item	Control	C+63	C+126	C+189
Soybean meal, %	81.93	72.79	62.77	52.77
Soybean hulls, %	9.40	5.65	2.62	1.27
Blood meal, %	-	4.55	9.15	13.18
Corn gluten meal, %	-	8.08	16.27	23.44
Molasses, %	2.89	2.92	2.89	2.92
Amount fed, g/d	1360	1360	1360	1360
CP supplied, g/d	608	670	732	797
DIP supplied, g/d	396	396	396	396
UIP supplied, g/d	211	274	337	400
NEm, Mcal/d	2.59	2.59	2.59	2.61
-------------------------------------Experiment 2--------------------------------------				
	Treatment[2]			
Item	Control	C+53	C+106	C+159
Soybean meal, %	54.50	45.73	37.73	28.91
Soybean hulls, %	41.80	37.43	32.70	28.67
Blood meal, %	-	3.53	6.92	10.46
Corn gluten meal, %	-	9.61	18.86	28.34
Molasses, %	3.69	3.69	3.71	3.71
Amount fed, g/d	1365	1365	1362	1362
CP supplied, g/d	424	477	530	581
DIP supplied, g/d	282	281	281	280
UIP supplied, g/d	142	196	248	301
NEm, Mcal/d	2.46	2.44	2.43	2.42

[1]Control=211 g UIP, C+63=274 g UIP, C+126=337 g UIP, and C+189=400 g UIP.

[2]Control=142 g UIP, C+63=196 g UIP, C+126=248 g UIP, and C+189=301 g UIP.

Table 2. Body condition score and weight changes of cows grazing dormant native range and supplemented with increasing amounts of UIP.

--Experiment 1-------------------------------------

	Treatment[1]				
Item	Control	C+63	C+126	C+189	SE
Initial body weight, kg	500	476	473	481	18
Cow weight changes, kg					
Calving to end treatment, 37 d	-33	-35	-31	-32	5
End treatment to weaning, 173 d[a]	12	5	9	-1	7
Calving to weaning, 211 d	-21	-30	-23	-33	7
Initial body condition score	5.6	5.6	5.6	5.6	.18
Cow BCS changes					
Calving to end treatment, 37 d	-.66	-.64	-.83	-.77	.16
End treatment to weaning, 173 d	.04	-.14	.03	-.08	.18
Calving to weaning, 211 d	-.62	-.78	-.80	-.85	.19
--Experiment 2--------------------------------------					
	Treatment[2]				
Item	Control	C+53	C+106	C+159	SE
Initial body weight, kg	528	538	515	542	12
Cow weight changes, kg					
Calving to end treatment, 43 d	-62	-63	-64	-70	5
End treatment to weaning, 176 d	52	48	51	57	5
Calving to weaning, 219 d	-9	-15	-13	-16	6
Initial body condition score	5.5	5.5	5.5	5.5	.2
Cow BCS changes					
Calving to end treatment, 43 d	-.63	-.56	-.72	-.67	.11
End treatment to weaning, 176 d	.07	.16	.25	.09	.13
Calving to weaning, 219 d	-.57	-.40	-.49	-.59	.11

[1]Control=211 g UIP, C+63=274 g UIP, C+126=337 g UIP, and C+189=400 g UIP.

[2]Control=142 g UIP, C+63=196 g UIP, C+126=248 g UIP, and C+189=301 g UIP.

[a]Linear tendency (*P*<.11) for cow weight gain to decrease with increased UIP.

Table 3. Least squares means for milk production and postpartum

interval of beef cows grazing dormant native range and supplemented with increasing amounts of UIP.					
--------------------------------------Experiment 1--------------------------------------					
	Treatments[1]				
	Control	C+63	C+126	C+159	SE
Milk Production					
30 d postpartum, kg/d[a]	8.40	8.35	8.94	8.76	.87
45 d postpartum, kg/d	7.08	7.45	6.98	7.45	.71
Average, kg/d[b]	7.74	7.90	7.90	8.10	.65
Postpartum interval, d	57.7	55.4	51.1	53.4	4.3
--------------------------------------Experiment 2--------------------------------------					
	Treatments[2]				
	Control	C+53	C+106	C+159	SE
Milk Production					
30 d postpartum, kg/d[a]	6.32	6.73	7.14	5.51	.45
45 d postpartum, kg/d	6.27	5.95	5.10	5.40	.45
Average, kg/d[b]	6.30	6.34	6.14	5.45	.49
Postpartum interval, d	97.3	80.5	80.9	87.6	9.1

[1]Control=211 g UIP, C+63=274 g UIP, C+126=337 g UIP, and C+189=400 g UIP.

[2]Control=142 g UIP, C+63=196 g UIP, C+126=248 g UIP, and C+189=301 g UIP.

[a]Quadratic effect (*P*<.06) for cows fed the C+53 and C+106 supplements to have greater milk production.

[b]Linear effect (*P*<.07) for decreased milk production from cows supplemented with increased UIP.

Table 4. Body weight changes of calves from cows grazing dormant native range and supplemented with increasing amounts of UIP.					
----------------------------------Experiment 1---------------------------------					
	Treatment[1]				
Item	Control	C+63	C+126	C+189	SE
Calf birth weight, kg	43	41	42	42	1
Calf weight changes, kg					
Calving to end treatment, 37 d	31	35	34	36	3
End treatment to weaning, 173 d	144	137	138	138	6

Calving to weaning, 211 d	176	172	172	174	8
---------------------------------Experiment 2----------------------------------					
	Treatment[2]				
Item	Control	C+53	C+106	C+159	SE
Calf birth weight, kg	41	40	39	40	1
Calf weight changes, kg					
Calving to end treatment, 43 d	22	20	19	18	2
End treatment to weaning, 176 d[a]	153	147	145	141	4
Calving to weaning, 219 d[b]	174	162	160	165	5

[1]Control=211 g UIP, C+63=274 g UIP, C+126=337 g UIP, and C+189=400 g UIP.

[2]Control=142 g UIP, C+63=196 g UIP, C+126=248 g UIP, and C+189=301 g UIP.

[a]Linear effect (P<.08) for weight gain of calves to decrease as UIP supplementation increased.

[b]Quadratic effect (P<.05) of UIP supplementation of cows on weight change of calves from birth to weaning.