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Influence of propionate salt levels on young cow reproductive performance[1]

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SUMMARY

A supplementation study was conducted to evaluate level of propionate salt (Ca-propionate) on young cow performance over two years. One hundred-twenty cows were allocated to one of three treatments at calving. Propionate salt was incorporated in a protein supplement at a rate of 0, 80 or 160 g/d. Cows were individually supplemented twice weekly at 2 lbs/d. In year 1, cows had access to pasture and hay. In year 2, cows had access to a native range pasture. Blood was collected weekly and analyzed for progesterone (P_4) to determine postpartum interval (≥1 ng P_4/ml). Weights and body condition scores (BCS) were assigned at calving, end of supplementation, start of breeding season, and weaning. Cow weight and BCS changed over time through the study ($P < 0.01$ but was not affected ($P > 0.10$) by treatment. Calf weight was not different ($P > 0.10$) between treatments. Calf weight increased through the study ($P < 0.01$). Pregnancy rates did not differ between treatments ($P > 0.10$ but were affected by cow age ($P<0.01$, 77% and 100% for 2- and 3-year-olds, respectively). In year 1, the percentage of cows initiating estrous cycles before the breeding season was greater ($P<0.05$) for cows receiving 160 g (47.6%) compared to 0 g (15.6%) of propionate salt and tended to be greater than cows receiving 80 g ($P<0.10$, 20.0%). Based on ultrasonography, 3-year-old cows conceived earlier ($P<0.01$, 184 d) than 2-year cows (207 d). In year 2, postpartum anestrous interval ($P = 0.70$), percentage of cows initiating estrous cycles before the breeding season ($P = 0.54$), conception rate to AI ($P = 0.68$), and season-long pregnancy rates ($P = 0.87$) were not different among treatments. In summary, propionate salt can influence reproductive performance, however, response is not consistent.

INTRODUCTION

Producers often indicate that young cows are difficult to get rebred without additional harvested feeds. Lalman et al. (1997) indicated that positive energy balance postpartum is essential for prompt rebreeding of heifers calving in thin condition. Funston (2008) stated the inadequate protein can suppress estrus and ovulation in beef cattle. The first limiting nutrient in cows grazing dormant winter range is protein (Wallace, 1987; Lardy et al., 1998; Hollingsworth-Jenkins, 1996) and protein supplementation has improved cow performance (Miner et al. 1991). Endecott et al. (2007) supplemented 2- to 4-year olds cows with glucogenic precursors postpartum and reported that addition of glucogenic precursor to a protein supplement decreased days to first estrus in postpartum 2-year-old range cows. Additionally, Waterman, et al. (2006) reported increasing metabolizable protein from ruminally undegradable protein (RUP) with or without propionate in a supplement fed to 2 year-old cows increased decreased postpartum interval, however, pregnancy rates were not different. Knowing that the inclusion of propionate salt in a protein supplement improved reproductive performance in young cows grazing New Mexico rangeland, we evaluated the influence of propionate salt on young beef cow reproductive performance within the South Dakota rangeland environment.

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MATERIALS AND METHODS

Experimental Design

Studies were conducted over 2 consecutive years at SDSU research stations. The year 1 experiment was conducted at the Cottonwood Range Livestock Research Station near Philip, SD and year 2 experiment was conducted at the Antelope Range and Livestock Research Station near Buffalo, SD. Both stations are representative of Northern Great Plains mixed-grass prairie. Sixty 2- and 3- yr old cows (920 lbs; BCS = 4.46) were used in year 1, and 60 2-yr old cows (835 lbs; BCS = 3.94) were used in year 2. Although at different locations between years, cows were from the same cow herd and had similar genetics.

Prior to calving, cows were managed as one herd. Cows were managed in a small paddock close to the headquarters prior to calving, so assistance could be provided if required. After calving (≤ 3 d) cows were allocated to one of three supplementation treatments and moved to the experimental pasture. Cows had access to native pasture and hay in year 1. Hay (6.9% CP, 59.7% TDN) was provided due to limited available standing forage. At the Antelope Station in year 2, cows had access to a native range pasture (300 acres) where primary grasses were western wheatgrass, needle and thread, green needlegrass and blue grama.

In both years, cows were blocked by expected calving date and randomly assigned to one of the three propionate salt (Ca-Propionate; NutroCal, Kemin Industries) treatments. The three supplements were formulated on an as-fed basis to be isocaloric and isonitrogenous (Table 1). Propionate salt was incorporated into the protein supplement that was fed twice weekly at 2 lbs/d for 45 or 54 days in year 1 and 2, respectively.

Table 1. Ingredient and chemical composition of protein supplement (% of DM).

	Supplement (g/d Propionate Salt)		
Item	0	80	160
	------------------------(%) --------------------------		
Soybean Meal	46.8	46.8	46.8
Wheat Midds	24.2	24.2	24.2
Field Peas	7.5	7.5	7.5
Molasses	7.5	7.5	7.5
NutroCal[a]	0	7.0	14.0
Limestone	14.0	7.0	0
Year 1			
CP, %	29.02	30.58	27.57
NDF, %	14.95	16.39	17.07
ADF, %	7.14	7.69	7.56
TDN, %	78	78	78
Year 2			
CP, %	30.70	32.53	31.64
NDF, %	14.92	14.83	17.02
ADF, %	6.18	6.57	7.05
TDN, %	78	78	78

[a] NutroCal, Kemin Industries, Inc., Des Moines, IA; source of Ca-propionate

Measurements

Measurements were obtained similarly in both years. Cows were weighed and assigned a BCS at calving, end of supplementation (Suppl), start of breeding season (Breeding) and weaning. Calves were weighed at birth, branding and weaning.

Blood samples were collected weekly starting at 10 days postpartum by venipuncture using a 10 mL vacutainer tubes (Fisher Scientific, Pittsburgh, PA). Blood was kept on ice until centrifuging at 3000xg for 20 minutes to harvest plasma. Plasma was stored at -20° C until assayed for progesterone (Engel et al., 2008). Return to estrous was determined when progesterone was greater than 1 ng/mL.

In year 1, bulls were placed with cows for a 60-d breeding season. Cows were synchronized with the Select Synch + Controlled Internal Drug Releasing device (CIDR) protocol. Cows were artificially inseminated (AI) at 72 h after CIDR removal and, in year 2, bulls were placed with cows 10 days following AI for a 60-d breeding season. Pregnancy rates were determined by transrectal ultrasonography at weaning in both years and, in year 2, AI pregnancy rates were determined 35 d following AI.

Statistical Analysis

Each year was analyzed as a separate experiment because of changes in location and age groups between years. Cow BW, BCS, ADG, BCS change, calf BW, calf ADG, postpartum interval, and days to conception response to level of supplemental propionate salt were analyzed in a randomized complete block design using the MIXED procedure of SAS (PROC MIXED, SAS Institute, Cary, NC). Cows were stratified into blocks by calving date and randomly assigned within each block to propionate salt treatments. Block was considered a random effect. Fixed effects were treatment, period, treatment x period, and cow age (year 1 only). Calf sex was treated as a fixed effect and calf birthdate as a covariate. Least squares means were calculated and linear and quadratic polynomial contrasts were constructed to evaluate the influence of increasing levels of propionate salt. Period (calving, Suppl, Breeding and weaning) was considered a repeated measure. Reproductive responses were analyzed using the GLIMMIX procedure of SAS. In year 1, level of supplementation, cow and the cow age by level of supplement interaction were analyzed. In year 2, only level of supplementations was analyzed.

RESULTS AND DISCUSSION

No differences in cow weight ($P \geq 0.11$; Table 2) and BCS ($P \geq 0.17$; Table 2) were found between treatments in either year. Cow weight changed through the study ($P < 0.01$; Table 3). Waterman et al. (2006) also reported that cow BW was not different between protein supplements with or without propionate salt treatments. In year 1, cow ADG had a treatment by period interaction ($P < 0.05$): ADG displayed a quadratic response ($P < 0.05$) to levels of propionate salt during the supplementation period with 80 g displaying the highest ADG, but no response during the Suppl to Breeding or Breeding to weaning periods. In year 2, cow weight change differed by period ($P < 0.01$); cows lost weight during the supplementation period (-0.70 lbs/d), and gained from Suppl to Breeding (11.2 lbs/d) and Breeding to weaning (0.84 lbs/d). Cow BCS changed through the study ($P<0.01$; Table 3). In year 1, cows BCS increased during supplementation ($P<0.01$, 0.42) and decreased from Breeding to weaning (-0.17).

Table 2. Influence of Propionate Salt level on Animal and Reproductive Performance.

	Year 1			Year 2		
	Propionate salt level, g/d					
	0	80	160	0	80	160
Cow BW, lb	1023	986	987	859	876	874
Cow ADG, lb	1.28	1.32	1.30	1.73	1.65	1.80
Cow BCS	4.8	4.8	4.7	4.2	4.2	4.2
BCS change	0.14	0.08	0.06	0.20	0.20	0.32
Calf BW, lb	250	240	245	239	238	239
Calf ADG, lb	2.11	2.00	2.06	1.83	1.88	1.83
Estrous cycling at initiation of breeding	16	20	47	60	60	50
AI conception rate				37	30	25
Pregnancy rate	95	85	85	75	80	80

Table 3. Influence of Period on Spring Calving Beef Cow Performance and Their Calf Performance

	Year 1[a]					Year 2[a]				
	Initial	Suppl	Brand	Breed	Wean	Initial	Suppl	Brand	Breed	Wean
Cow BW, lbs[c]	920	975		1030	1044	835	794		873	976
Cow BCS[bc]	4.5	4.9		4.9	4.7	3.9	4.1		4.1	4.7
Calf BW, lbs[c]	79		223		433	78		202		435

[a] Initial = within three days of calving, Suppl = last day of supplementation period, Brand = day calves were branded, Breed = first day of breeding season, Wean = day calves were weaned. Supplementation period was 45 and 54 days in year 1 and 2, respectively.
[b] Body Condition Score on a 9-point scale (1 = emaciated to 9 = extremely obese).
[c] P-value < 0.01

Calf weight was not different ($P \geq 0.38$) among treatments. Calves gained an average of 350 lbs/d through the study.

Pregnancy rates did not differ between treatments ($P \geq 0.90$; Table 2) in either year. In year 1, there was no effect of cow age ($P = 0.97$), but based on ultrasonography, 3-year-old cows conceived earlier ($P < 0.01$, 183.7 d) than 2-year cows (207.0 d). Furthermore, the percentage of cows initiating estrous cycles before the breeding season was greater ($P = 0.04$) for cows receiving 160 g (47.6%) compared to 0 g (15.6%) propionate salt and tended to be greater than cows receiving 80 g ($P = 0.07$, 20.0%). In year 2, only 2-year old cows were used, and the percentage of cows initiating estrous cycles before the breeding season was not different among treatments ($P = 0.28$). Endecott et al. (2007) and Waterman et al. (2006) reported decreased days to first estrus with propionate salt supplements, which we observed in year 1 but not year 2.

Propionate salt did not influence cow BW, BCS or calf BW. Propionate salt supplementation influenced reproductive performance in year 1, not in year 2. Lack of significant differences in animal performance between propionate salt treatments could be due to 1) year to year variation in for forage quality and quantity and/or 2) age of animals. Year 1 had both 2 and 3 year old cows, but year 2 only had 2 year old cows on the project. In New Mexico, where propionate salt has been beneficial, cows have been grazing dormant rangeland during the breeding season (Waterman, 2006; Endecott, 2007) and do not reach their lightest body weight until after the beginning of the breeding season. Based on the results of this project propionate salt has limited value for improving young cow's reproductive performance when grazing Northern Great Plains rangelands and breeding during the forage growing season.

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