Effects of Prepartum Ruminally Protected Choline Supplementation on Performance of Beef Cows and Calves

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Introduction

Prepartum supplementation of spring-calving beef cows is a vital part of cow-calf enterprises, often affecting subsequent reproductive success. Most research in the area of prepartum supplementation has focused on provision of either energy or protein; only modest attention has been given to the use of supplemental micronutrients. One such micronutrient is choline.

Choline is classified generally as a B vitamin and is an essential nutrient. Phosphatidylcholine and other choline-containing lipids maintain the structural integrity of cellular membranes and play a vital role in metabolism of dietary fat. Choline-containing phospholipids are also important precursors for intracellular-messenger molecules and cell-signaling molecules critical to the reproductive process.

Choline is commonly found in feedstuffs and forages but is highly degradable in the rumen. For choline supply to be increased effectively, it must be offered in a form that is resistant to ruminal digestion. This can be achieved by encapsulating choline in lipid. Therefore, the objective of our study was to evaluate the effect of prepartum ruminally protected choline supplementation on cow and calf performance.

Experimental Procedures

Angus-cross cows and heifers (n = 438; initial body weight = 1,173 lb) were blocked by age, body condition score, and expected calving date and randomly assigned to one of two supplement treatment groups: (1) a 40% crude protein mixture of corn and soybean meal with ruminally protected choline, or (2) 40% crude protein mixture corn and soybean meal with no ruminally protected choline (Table 1). Treatments were applied during the 60-day period immediately preceding the earliest predicted calving date. Cows were fed 5.2 lb per head per day of their respective supplement 6 times per week. The average daily feeding rate of choline for treated cows was 0.16 oz per cow per day.

Cows were evenly distributed by treatment, body condition score, and expected calving date into 4 native tallgrass prairie pastures with approximately 47 cows per pasture (23 or 24 per treatment group per pasture). Cattle were gathered from their pastures at 7:00 a.m., sorted into pens by treatment, fed their allotted amount of supplement, and allowed one hour to consume the supplement. Cows continued to receive supplements until calving. After that time, all cows were moved to a separate pasture and fed the control supplement.

Ultrasound measurements of ribeye muscle characteristic were collected at the beginning and end of the supplementation period. Backfat thickness, ribeye muscle depth, and intramuscular fat measurements were taken along the spine between the 12th and 13th rib interface using an Aloka 500V (Aloka Co., Ltd., Wallingford, CT). Cow body weights and body condition scores were measured at calving, 15 days prior to estrous synchronization, at estrous synchronization, at artificial insemination (AI) pregnancy check, at weaning, and at final pregnancy check. Calf body weights also were measured at these times.

Ovulation was synchronized using the Co-synch + CIDR protocol and cows were subsequently mass mated via timed AI. Cows were exposed to bulls 10 days after AI for the remainder of a 60-day breeding season. Conception to AI was determined via ultrasound 30 days after AI and final pregnancy rate was determined via rectal palpation 60 days after end of the breeding season.

Results and Discussion

Cow body weights, body condition scores, backfat thicknesses, and intramuscular fat percentages were similar ($P \geq 0.25$) between treatments at the onset of supplementation and at final pregnancy diagnosis. Cows fed ruminally protected choline tended to lose 0.03 inches more ($P=0.10$) ribeye muscle depth between the onset of the trial and the conclusion of the supplementation period. Conception to AI and final pregnancy rates were not affected ($P \geq 0.19$) by treatment (Table 2). Early season average daily gain, overall average daily gain, and adjusted 205-day body weight of calves was similar ($P \geq 0.39$) between treatments. Calves born to dams fed ruminally protected choline had slightly greater ($P=0.05$) average daily gain during the latter part of the grazing season than calves born to dams fed the control supplement (Table 3).

Implications

Under the conditions of our study, prepartum supplementation with ruminally protected choline had only minor effects on performance of beef cows and calves.

Table 1. Nutrient analysis of ruminally protected choline (RPC) or control (CON) supplements fed to beef cows during the prepartum period (dry matter basis)

Item	RPC	CON
Corn, %	50	50
Soybean meal, %	50	50
Dry matter, %	89.22	88.59
Crude protein, %	40.66	37.12
Calcium, %	0.3	0.22
Phosphorus, %	0.57	0.54
Neutral detergent fiber, %	10.26	9.91
Acid detergent fiber, %	4.27	4.45
Starch, %	12.35	15.78

Table 2. Performance response of beef cows fed ruminally protected choline (RPC) or control (CON) supplements during the 60-day prepartum period

Item	RPC	CON	SE	P-value
Cow body weight change 01/22 to 10/05, lb	16.5	10.2	4.05	0.80
Cow BCS[a] change 01/22 to 10/05, BCS units	0.44	0.53	0.038	0.25
Change in ribeye muscle characteristics				
12th rib backfat, in.	-0.01	-0.002	0.05	0.88
Ribeye muscle depth, in.	-0.04	-0.01	0.45	0.10
Intramuscular fat, %	-0.01	-0.02	0.03	0.39
Timed-AI pregnancy, %	45.8	44.7	-	0.83
Overall pregnancy, %	87.5	91.6	-	0.19

[a] Body condition score, 1 to 9 scale (1 = thin, 9 = very fat)

Table 3. Performance response of calves born to beef cows fed ruminally protected choline (RPC) or control (CON) supplements during the 60-day prepartum period

Item	RPC	CON	SE	P-value
Early average daily gain (ADG; birth to 08/01), lb	2.4	2.4	0.02	0.09
Late ADG (08/02 to 10/05), lb	2.3	2.2	0.02	0.05
Overall ADG (birth to 10/05), lb	2.3	2.3	0.01	0.64
Adjusted 205-day body weight, lb	576.4	571.1	3.5	0.51