Negative DCAD During a 42-day Dry Period

W. Weich[1], E. Block[2], and N. Litherland[1]
[1]Department of Animal Science, University of Minnesota, St. Paul, MN
[2]Arm and Hammer Animal Nutrition

Feeding low dietary cation-anion difference (DCAD) rations to dairy cows three weeks prior to calving is used to reduce the risk of hypocalcemia and milk fever in post-partum dairy cows. Previous studies (Block, 1983; Siciliano-Jones, 2008) have shown significantly higher blood calcium (Ca) at calving as a result of feeding DCAD lowering feed additives during this period prior to parturition. Lowering diet DCAD induces a metabolic acidosis of the cow in which Ca is resorbed from bone into blood to compensate, while also providing for Ca lost in colostrum and milk production. Maintaining levels of available Ca help the cow avoid hypocalcemia, also aiding in enhancing immune response/skeletal muscle function and smooth muscle function of the gut, uterus and teat end (Kimura, 2006, DeGaris, 2007).

Research on the effects of pre-partum DCAD on hypocalcemia suggests that feeding positive DCAD diets plays a detrimental role on Ca resorption from the bone due to metabolic alkalosis, increasing the risk for hypocalcemia (Goff, 1997). Moderate energy high-fiber (MEHF) diets based on wheat straw and corn silage are inherently low in potassium and therefore have a lower DCAD. Combining a shortened dry period of 42d (vs. 60d) and a negative DCAD diet may allow producers the opportunity to manage a single group dry cow program to reduce the risk of post-partum hypocalcemia by modulating pre-partum DCAD for the entire dry period.

To our knowledge, research on the effects of reducing pre-partum DCAD in MEHF diets for greater than 21d has yet to be conducted. Objectives for this trial were to determine if decreasing DCAD is beneficial for cows fed MEHF diets, as well as, to determine if the number of days (21 vs. 42d) low DCAD MEHF diets are fed pre-partum has positive effects on post-partum performance and mineral homeostasis. Additionally, questions related to the cow's ability to adapt to extended exposure (>21d) to negative DCAD diets would also be answered.

Sixty Holstein and Holstein-cross multiparous dairy cows housed in a tie-stall barn were randomly assigned to one of three treatments (n=20) forty-two days prior to expected calving. Treatment assignments were balanced by body weight, body condition, parity, breed and previous lactation 305ME. Dietary treatments included: 1) Control (CON, DCAD= +123 mEq/ kg DM), 2) 21d Bio-Chlor (21BIO, DCAD= +123/-158 mEq/ kg DM), 3) 42d Bio-Chlor (42BIO, DCAD= -158 mEq/ kg DM), with all treatments containing 38.7% corn silage, 22.9% chopped wheat straw, 17.4% protein mix, 12.1% chopped alfalfa, 6.0% QLF supplement and 2.8% fine ground corn on a dry matter basis. Pre-partum diets were similar in nutrient composition and averaged 17.0% crude protein, 42.0% neutral detergent fiber and 1.48 mcal/kg DM. Two isonitrogenous protein mixes: 1) Control (97.5% soybean meal) and 2) Bio-Chlor (52.8% Bio-Chlor, 45.8% soybean meal) were used for the high and low DCAD diets, respectively. Controls received the high DCAD ration for the entirety of the dry period. 21BIO received the high DCAD ration for the first 21d of the dry period, and then switched to the low DCAD ration 21d from expected parturition. 42BIO received the low DCAD ration for the whole dry period. Dietary treatments were fed once daily at approximately 1300 h. After calving all cows received a common lactation diet (16.6% CP, 31.6% NDF, 1.7 mcal/kg) through day 56. Urine pH for 21BIO and 42BIO were significantly lower ($P < 0.01$) when compared with CON cows, demonstrating effectiveness of DCAD adjustments with Bio-Chlor. Pre- and post-partum data sets were analyzed separately using Mixed models with repeated measures and orthogonal contrasts. Preliminary data are presented in Table 1. Pre-partum dry matter intake (DMI) did not differ among treatments (P = 0.49) and averaged 13.4, 13.9 and 12.8 ± 0.7 kg/d for CON, 21BIO and 42BIO, respectively. Post-partum DMI averaged 17.4, 18.0 and 19.5 ± 1.1 kg/d and were similar among treatments. Milk yield was measured daily through 56 d in milk and followed similar trends to DMI; averaging 37.6, 39.1 and 42.7 ± 2.3 kg/d for CON, 21BIO and 42BIO with 42BIO tending to produce more milk (P = 0.09) when contrasted with CON. Serum from days -7, -3, -1, 1 and 7 relative to calving showed no differences in ionized calcium among treatments. Biopsies of liver were collected on days -14, 7 and 14 and concentrations of total lipids, triglycerides and glycogen were similar for all treatments. Circulating non-esterified fatty acid (NEFA) concentrations increased after calving and was similar among treatments. This research suggests that using low DCAD strategies coupled with a MEHF diet during a 42d dry period had positive effects on post-partum performance with increased milk production.

Table 1. Preliminary trial results for cows fed diets varying in DCAD for 21 or 42 days.

Variable	Treatment				P-value		
	Control	21-Day Bio-chlor	42-Day Bio-chlor	SEM	Trmt	Week	Trmt x Week
Days dry	44.8	41.0	43.7	2.4	0.48	---	---
Urine pH[1]	8.1	6.9	6.6	0.1	0.01	0.01	0.01
Prepartum DMI, kg/d	13.4	13.9	12.8	0.7	0.49	0.01	0.08
Postpartum DMI, kg/d	17.4	18.0	19.5	1.1	0.34	0.01	0.94
Milk[2], kg/d	37.6	39.1	42.7	2.3	0.23	0.01	0.70
FCM 3.5%[3], kg/d	40.1	41.0	41.5	2.6	0.91	0.01	0.84
Pre-partum iCa[4], mmol/L	1.19	1.19	1.21	<0.1	0.68	0.12	0.77
Post-partum iCa[5], mmol/L	1.16	1.15	1.18	<0.1	0.50	0.01	0.79
Pre-partum EB[6], Mcal/d	5.2	5.4	3.8	1.2	0.54	0.01	0.04
Post-partum EB[6], Mcal/d	-8.7	-7.7	-6.0	1.9	0.55	0.01	0.22
Pre-partum Glycogen[7], mg/g	52.5	46.8	58.7	5.7	0.30	---	---
Post-partum Glycogen[8], mg/g	22.1	23.3	26.5	2.6	0.43	0.01	0.11
Pre-partum Triglyceride[7], %	0.6	0.7	0.4	0.1	0.22	---	---
Post-partum Triglyceride[8], %	5.5	4.1	3.9	0.9	0.34	0.82	0.84
Pre-partum NEFA[9], mmol/L	0.2	0.3	0.2	<0.1	0.76	0.01	0.24
Post-partum NEFA[10], mmol/L	0.6	0.6	0.6	0.1	0.91	0.01	0.77

[1]Urine samples taken at weeks -5, -3,-2 and -1.
[2]Milk through 56 DIM.
[3]Milk through 28 DIM.
[4]Blood sampled at days -7, -3 and -1.
[5]Blood samples at days 1 and 7.
[6]EB=Energy balance.
[7]Liver sample at day -14.
[8]Liver sampled at days 7 and 14.
[9]Blood sampled at days -28, -21, -14, -7, -3, -1.
[10]Blood sampled at days 1, 7, 14, 21.

Research supported by gifts from Church and Dwight and the Minnesota Experiment Station.

Notes