

The effect of prepartum negative dietary cation-anion difference and serum calcium concentration on blood neutrophil function in the transition period of dairy cows

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Introduction

Hypocalcemia and impaired immune function are recognized risk factors for clinical disease in the transition period of dairy cows. At the onset of lactation, calcium homeostasis is disrupted by redirection of calcium for colostrum production, which triggers a substantial decrease in the blood calcium concentration for 1 to 4 days. Blood calcium concentration is associated with neutrophil function, which turn is associated with the risk of retained placenta, metritis, and mastitis. Negative Dietary CationAnion Difference (DCAD) diets fed during the prepartum period increase postpartum blood calcium concentrations and reduce the risk of disease.

Our objectives were to assess the effects of a negative dietary cation-anion difference (DCAD) on phagocytosis (P) and oxidative burst (OB) function of circulating neutrophils and to determine the associations of serum ionized (iCa) and total calcium concentrations (tCa) with P and OB. We hypothesized that multiparous cows fed a negative DCAD prepartum would have greater serum ionized (iCa) and total calcium concentrations (tCa), and thus improved P and OB.

Materials and Methods

From 3 wk before expected parturition until calving, 38 healthy multiparous cows from 3 farms were randomly assigned to negative DCAD (NEG; -100 mEq/kg DM; n = 21) or a control diet (CON; 12 mEq/kg DM; n = 17). Urine pH was measured weekly and in NEG was 6.3 ± 0.8 with 76% of 21 samples < 7 and 62% < 6.5. Each farm was on 1 treatment or the other. P, OB, iCa, and tCa were measured at -7, 1, and 4 DIM. Blood iCa was measured with a portable analyzer (Vet-Stat) and serum tCa was measured in a diagnostic laboratory. Mean fluorescence intensity for P (MFIP) and OB (MFIOB),

and the shift of percentage of active cells for P (PP) and OB (POB) were measured in isolated, stimulated neutrophils via flow cytometry. Outcomes were assessed with mixed linear regression models accounting for repeated measures.

Results

There were no significant differences between treatments in the 4 neutrophil function outcomes. Although MFIOB varied over time, there were no interactions of treatment with time for any outcome. iCa and tCa did not differ between NEG and CON. Mean \pm SE iCa concentrations were: -7 DIM, 1.23 ± 0.02 vs. 1.21 ± 0.02 ; 1 DIM, 1.07 ± 0.02 vs. 1.02 ± 0.02 ; 4 DIM, 1.16 ± 0.02 vs. 1.17 ± 0.02 mmol/L, respectively; and for tCa: -7 DIM 2.39 ± 0.04 vs. 2.44 ± 0.05 ; 1 DIM, 2.01 ± 0.04 vs. 1.97 ± 0.05 ; 4 DIM, 2.33 ± 0.04 vs. 2.32 ± 0.05 mmol/L, respectively. The proportion of blood samples with tCa < 2.15 mmol/L at -7, 1 and 4 DIM was 5%, 76%, and 13%, respectively, with no differences between NEG and CON (P > 0.7). However, iCa tended to be weakly positively correlated with MFIOB at -7 DIM. There was no association between tCa and P or OB.

Significance

In this sample of clinically healthy cows, we did not observe the hypothesized differences in aspects of innate immune function in multiparous cows fed a negative DCAD in the close-up dry period.