

Periparturient Effects of Feeding a Low Dietary Cation-Anion Difference Diet on the Metabolism of High-Producing Dairy Cows

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Introduction

Feeding rations with low dietary cation-anion difference (DCAD) to dairy cows during late gestation is a commonly used strategy in large herds to prevent periparturient hypocalcemia. Although the efficacy of low DCAD rations in reducing the incidence of clinical hypocalcemia is well documented, it is not clear whether the ensuing metabolic acidosis is associated with deleterious side effects during the transition period. The objective of the study presented here was to determine the effect of fully compensated metabolic acidosis on calcium and phosphorus homeostasis, insulin responsiveness, and insulin sensitivity as well as on indices for protein metabolism.

Materials and Methods

Twenty multiparous Holstein-Friesian dairy cows were assigned to one of two treatment groups and fed a low DCAD ration (DCAD = -9 mEq/100 g, group L) or a control ration (DCAD = +11 mEq/100 g, group C) for three weeks before calving. After calving, all cows were fed the same ration formulated to meet the dietary requirements of high yielding early lactating dairy cows. Blood samples and urine samples were obtained periodically between 14 days before to 14 days after calving. Intravenous glucose tolerance tests and volumetric urine collection over 24 h were conducted shortly before calving as well as seven and 14 days post-partum.

Results

Cows fed the low DCAD ration had significantly lower urine pH and higher net acid excretion (NAE) be-

fore calving but blood pH and bicarbonate concentration was unaffected. The plasma Ca concentration corrected for plasma protein concentration on the day after calving was significantly higher in cows on the low DCAD diet when compared to control animals. Urinary Ca and P excretion were positively associated with urine NAE and negatively associated with urine pH. Whereas metabolic acidosis resulted in a six fold increase in urinary Ca excretion, the effects of metabolic acidosis on renal P excretion were small. A decline of plasma protein and globulin concentration during the periparturient period was observed in both groups, but was more pronounced in cows in group L resulting in significantly lower total protein and globulin concentrations in cows on low DCAD diets after calving. Intravenous glucose tolerance tests conducted before and after calving did not reveal group differences in insulin response or insulin sensitivity.

Significance

Our results indicate that fully compensated metabolic acidosis increased the Ca flux resulting in increased urinary calcium excretion before and increased plasma Ca concentration on the day after calving, whereas the effect on P homeostasis were mild and unlikely to be of clinical relevance. The clinical relevance of the negative effect of metabolic acidosis on the plasma protein and globulin concentration is unclear but warrants further investigation.