The effect of feeding zeolite A during the prepartum period on serum mineral concentrations in multiparous Holstein Cows

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M280

Introduction

- Most cows undergo some level of hypocalcemia in the immediate postpartum period, with 40 to 70% of multiparous cows developing subclinical hypocalcemia (**SCH;** Reinhardt et al., 2011; Caixeta et al., 2015; Neves et al., 2017).
- Feeding prepartum rations low in Ca can improve Ca status postpartum (Kichura et al., 1982) but is difficult to achieve with commonly used feedstuffs in the US (Goff, 2006).
- In European studies, feeding zeolite A for the 2 weeks prior to calving has been shown to bind to dietary calcium and improve blood Ca status in the days following parturition (Thilsing et al., 2006; Pallesen et al., 2008). Effects of this feeding strategy in a 3 wk prefresh program have not been demonstrated.

Objective

- To determine the effect of feeding multiparous Holstein cows synthetic zeolite A for 3 wk prior to expected calving on peripartum serum mineral status.

Materials & Methods

- 55 multiparous Holstein cows (2nd lactation = 24, 3rd+ lactation = 31) were enrolled 28 d prior to expected calving and randomly assigned to 1 of 2 dietary treatments (**trt**) starting at 21 d prior to expected calving;
  - Control (**CON**; n = 29) – 40% CS, 33% wheat straw, and 27% concentrate mix
  - Experimental (**EXP**; n = 26) – CON diet with the addition of synthetic zeolite A (X-Zelit, Protekta Inc., Lucknow, Ontario, CA/Vilofoss, Graasten, DK) at 3.3% of DM, targeting 500 g/d as fed
- Blood was collected 1x/wk from enrollment until 7 d prior to expected calving, daily from 7 d prior to expected calving until 7 DIM, 3x/wk from wk 2-4, and 2 samples collected within 24 h of calving and a subset were analyzed for Ca, P, and Mg concentrations.
- Prepartum and postpartum data were analyzed separately. Data analyzed over time were subjected to repeated measures ANOVA using the MIXED procedure in SAS v.9.4, the REPEATED statement for time, and *P* values were corrected for multiple comparisons using Tukey HSD. Least squares means and standard errors are reported.
  - Fixed effects were trt, time, parity (2nd vs. 3rd+), all 2-way interactions, and random effect was cow within trt.
- The difference in prevalence of SCH between trt x d was tested with Fisher's exact test.

Results

Table 1. Chemical composition (mean ± SD) of the CON, EXP, and postpartum diets. Weekly TMR samples were composited over 4-wk intervals for wet chemistry analysis (Cumberland Valley Analytical Services, Hagerstown, MD).

	Prepartum		
Nutrient	CON	EXP	Postpartum
CP	13.6 ± 1.0	13.5 ± 0.7	16.4 ± 0.4
NDF	46.4 ± 1.4	46.0 ± 1.7	30.6 ± 2.8
Starch	16.8 ± 1.7	16.3 ± 0.3	26.1 ± 1.6
Sugar	3.2 ± 0.8	3.3 ± 0.4	3.3 ± 0.5
Fat	2.24 ± 0.13	2.25 ± 0.30	2.64 ± 0.24
Ash	6.12 ± 0.53	7.99 ± 0.36	9.14 ± 0.49
Ca	0.68 ± 0.05	0.65 ± 0.03	1.00 ± 0.07
P	0.39 ± 0.03	0.38 ± 0.02	0.38 ± 0.01
Mg	0.42 ± 0.05	0.42 ± 0.03	0.51 ± 0.04
K	1.14 ± 0.06	1.12 ± 0.04	1.91 ± 0.11
S	0.25 ± 0.00	0.24 ± 0.01	0.46 ± 0.04
Na	0.14 ± 0.03	0.50 ± 0.04	0.82 ± 0.04
Cl	0.31 ± 0.03	0.30 ± 0.03	0.53 ± 0.03
DCAD (mEq/100 g of DM)	11.03 ± 2.06	26.87 ± 1.71	40.75 ± 2.54
NE_L (Mcal/kg)	0.66 ± 0.01	0.65 ± 0.01	0.73 ± 0.02
MP (g/kg of DM)[1]	87.24	85.41	123.04
MP intake (g/d)[2]	1274	1196	2689

[1]Formulated value predicted by Cornell Net Carbohydrate and Protein System v. 6.55

[2]Based on actual intakes during the prepartum and postpartum period and predicted MP concentrations

Results

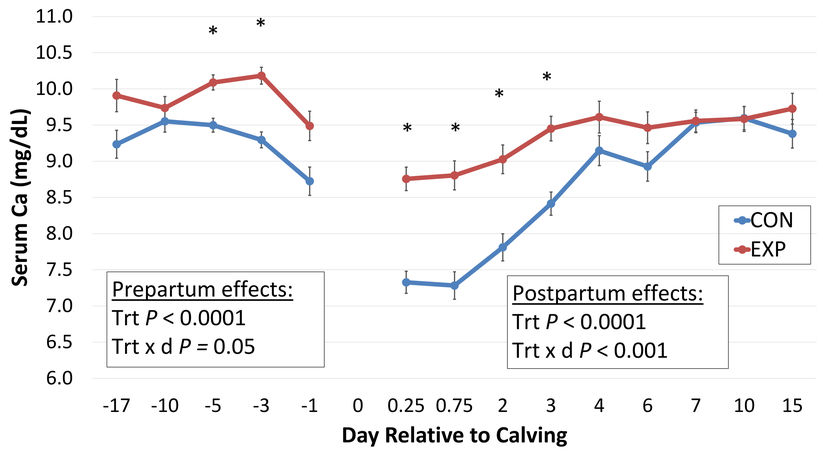

Figure 1. Serum calcium concentrations in the peripartum period for cows fed EXP and CON diets. Significant differences ($P \leq 0.05$) within day are depicted with an asterisk (*).

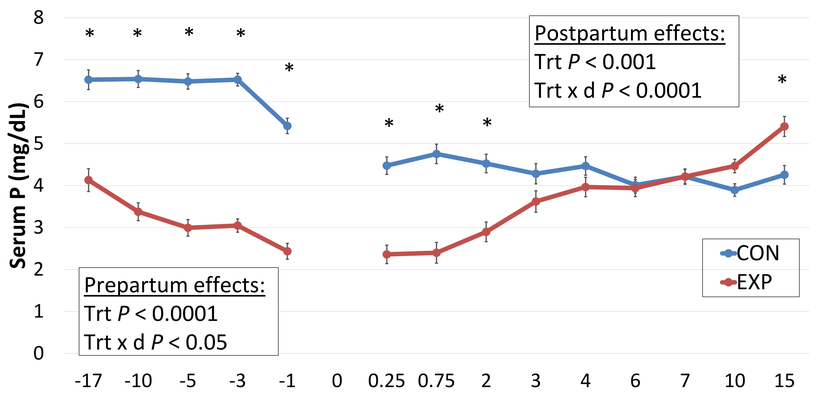

Figure 2. Serum phosphorus concentrations in the peripartum period for cows fed EXP and CON diets. Significant differences ($P \leq 0.05$) within day are depicted with an asterisk (*).

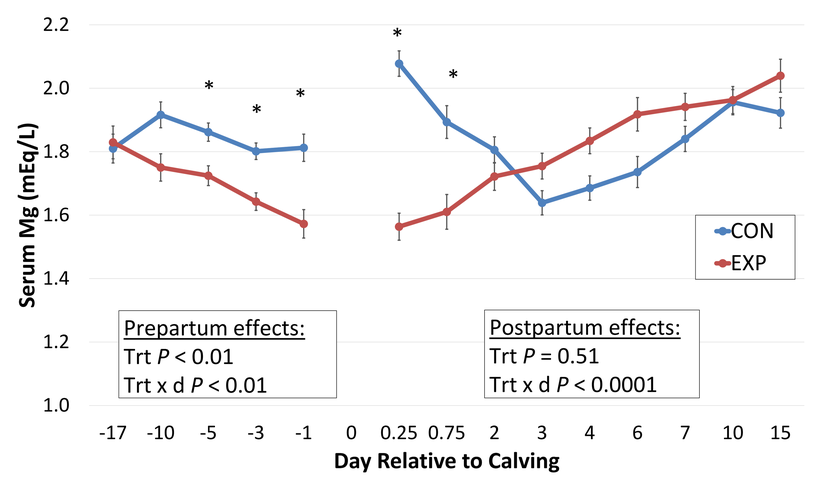

Figure 3. Serum magnesium concentrations in the peripartum period for cows fed EXP and CON diets. Significant differences ($P \leq 0.05$) within day are depicted with an asterisk (*).

Results

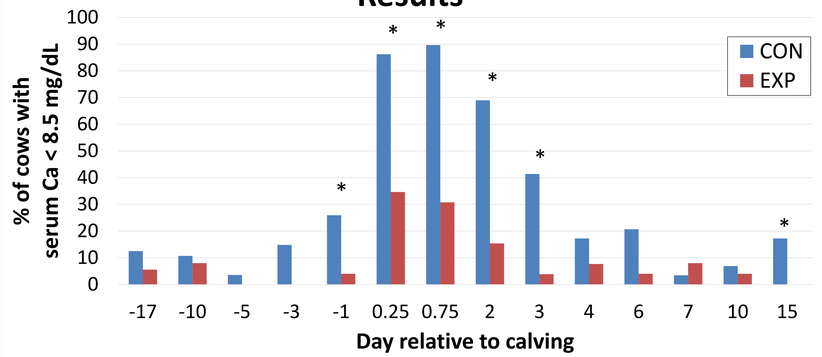

Figure 4. Prevalence of hypocalcemia (serum Ca < 8.5 mg/dL) by sampling time point. Significant differences ($P \leq 0.05$) within day are depicted with an asterisk (*).

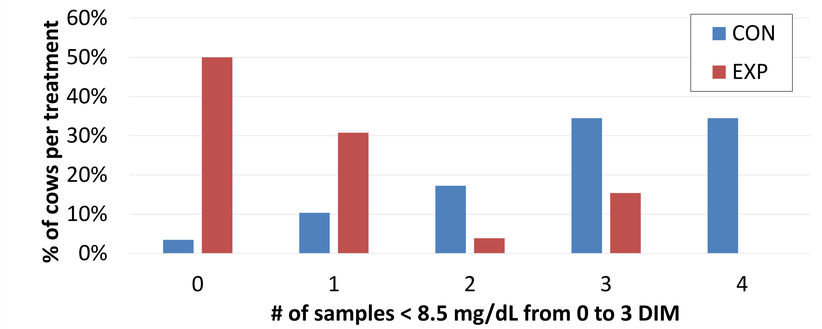

Figure 5. Number of serum samples per cow with a Ca concentration < 8.5 mg/dL between 0 and 3 DIM. Cows with no samples < 8.5 mg/dL were considered eucalcemic and cows with all 4 samples < 8.5 mg/dL were considered to have chronic SCH.

Conclusions

- Serum Ca concentrations were higher for cows fed EXP compared to CON during both prepartum and postpartum periods; differences were greatest during the immediate periparturient period.
- Serum P concentrations were lower for cows fed EXP compared to CON during both prepartum and postpartum periods; differences were greatest prepartum and during the immediate postpartum period.
- Serum Mg concentrations were lower for cows fed EXP compared to CON during the prepartum and immediate postpartum periods.
- The prevalence of SCH in cows fed EXP was lower than cows fed CON during the immediate periparturient period and cows fed EXP did not experience chronic SCH while 35% of CON fed cows were affected.
- Normal Ca concentrations (≥ 8.5 mg/dL) were maintained in 50% of EXP fed cows from 0 to 3 DIM compared to 3% of CON fed cows.
- Supplementing synthetic zeolite A for 3 wk before expected parturition resulted in improved Ca status around calving yet it is unclear as to the biological impact of reduced P and Mg concentrations around calving.

Acknowledgements

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