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Effect of serum calcium status at calving on survival, health, and performance of postpartum Holstein cows and calves under certified organic management

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ABSTRACT

The study objective was to assess the effect of hypocalcemia (HYPO; ≤2.0 mmol/L) of the dam at calving on survival, health, and performance of lactating dairy cows and their calves under certified organic management. Prepartum dairy cows (primiparous, n = 445; multiparous, n = 328) from 1 dairy herd were monitored (prepartum pen) for imminent signs of parturition (appearance of amniotic sac outside the vulva) until birth. All calves were subject to the same newborn care, colostrum management, and failure of passive transfer assessment (serum total protein ≤5.5 mg/dL). Serum total calcium of cows was determined in samples taken within 2 h after calving. To define HYPO cows after calving, a cut-point of total serum Ca concentration with optimal sensitivity and specificity to predict metritis or calf diarrhea was established by using the receiver operator characteristic. The effect of HYPO on survival (died or culled within 60 DIM), health status, and pregnancy per artificial insemination (PAI) for first services of lactating cows were analyzed using the GLIMMIX procedure of SAS. Additionally, the effect of HYPO at calving on days in milk (DIM) at first service (DIMFS), milk yield (kg), milk components (percent fat and protein), and somatic cell count were analyzed for the first 3 Dairy Herd Improvement Association (DHIA) tests using the MIXED procedure of SAS (SAS Institute Inc., Cary, NC). The effect of parity (primiparous and multiparous), body condition score at calving, and manure hygiene score at calving were also included in the statistical models. The effect of HYPO at calving on calf survival, serum total protein, and diarrhea within 10 d of age were assessed using GLIMMIX procedure of SAS. The overall prevalence of HYPO was 14.6% (2.7% for primiparous and 30.8% for multiparous cows). Cows experiencing HYPO at calving had greater proportion of metritis (25.1 vs. 14.7%) and culling within 60 DIM (15.9 vs. 6.8%) compared with non-HYPO cows, respectively. For the first 3 DHIA tests, milk yield and components did not differ between HYPO and non-HYPO cows. The DIMFS as well as proportion of cows with dystocia, births of twins, mastitis, and PAI at first service were not different between HYPO and non-HYPO cows. The proportion of stillbirth, weaned calves, and serum total protein did not differ between calves born from HYPO or non-HYPO cows. However, calves born from HYPO cows had greater incidence of diarrhea (49%) than calves born (33.3%) from non-HYPO cows. Findings from the present study showed that HYPO at calving had significant health implications for both dams and calves under certified organic management.

Key words: organic dairy, hypocalcemia, metritis, calf health

INTRODUCTION

Clinical hypocalcemia, also known as milk fever in postpartum dairy cows, significantly increases the risk for retained fetal membranes, ketosis, metritis, displaced abomasum, and mastitis (Curtis et al., 1983). According to the National Animal Health Monitoring System, the overall incidence of milk fever in US dairy herds is 4.9% (USDA, 2008). The incidence of clinical hypocalcemia increases with the age of cows, and it was found in 1% of first-lactation cows and 4, 7, and 10% of Holstein cows in their second, third, and fourth or greater lactation, respectively (Reinhardt et al., 2011). Similarly, the incidence of subclinical hypocalcemia in

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postpartum cows increases with the age of cows, and it was present in 25% of first-lactation cows and 41 to 54% of cows in their second or greater lactations (Reinhardt et al., 2011). Lactating dairy cows experiencing subclinical hypocalcemia had leukocytes with a compromised ability to fight infections, increasing the risk for developing metritis and thus reducing reproductive performance (Kimura et al., 2006; Martinez et al., 2012).

Sparse literature exists on the incidence of clinical or subclinical hypocalcemia of postpartum cows under certified organic management and on the effect of calcium status of dams at calving on survival, health, and performance of calves. Calves born from hypocalcemic cows have been reported to be at greater risk of developing diarrhea and respiratory events during the neonatal period compared with calves born from non-hypocalcemic cows (Planski and Abrashev, 1987). However, information on pre- and postpartum nutrition diets as well as colostrum management and diagnosis of health conditions was not available. Therefore, the objective of the current study was to assess the effect of hypocalcemia (**HYPO**) of dams at calving on survival, health, and performance of lactating dairy cows and their calves under certified organic management. The hypothesis was that dairy cows experiencing HYPO at calving would have greater proportions of postpartum metritis and culling within 60 DIM. Furthermore, we hypothesized that a greater proportion of calves born from cows with HYPO at calving would have diarrhea compared with calves born from non-HYPO cows.

MATERIALS AND METHODS

Animals, Feeding, and Facilities

Briefly, dairy cows and heifers were housed in barns with access to dry-lot (prepartum) free-stall barns (postpartum) with access to dry lot and milked thrice daily at approximately 8-h intervals. Cows were fed twice daily, in the morning and afternoon, with a TMR formulated to meet or exceed dietary nutritional requirements for lactating and dry dairy cows (NRC, 2001). Additionally, all cows had access to pasture (mixture of alfalfa, ryegrass, and orchardgrass, as well as triticale, wheat, and sorghum). The ingredient and nutrient composition of formulated pre- and postpartum diets (DM basis) are provided in Table 1.

At 1 d of age, female calves were moved to a calf-raising facility and were housed individually in calf hutches. The calves were fed 8 L of pasteurized milk twice daily in the morning (4 L) and afternoon (4 L). This study was conducted from May 2013 through August 2013. The experimental procedures used in this study were reviewed and approved by the Institutional Animal Care Use Committee, The Ohio State University.

Management of Dry Cows, Calving, and Colostrum

Weekly, a list of cows was obtained based on their calving dates using on-farm computer records (PCDART, Raleigh, NC). Pregnant cows were dried-off 60 ± 3 d before the expected calving date and moved into a far-off dry pen immediately after last milking. All cows were moved to prepartum pens 21 ± 3 d before the expected calving date and were closely monitored by on-farm personnel for signs of parturition every 1 h (Schuenemann et al., 2013) and calved within their pen (dry-lot). Calving ease of cows (assistance provided at birth) was recorded using a 4-point scale (1 = no assistance provided; 2 = light assistance by 1 person without the use of mechanical traction; 3 = mechanical extraction of the calf with an obstetric calf-puller; and 4 = severe dystocia, surgery or fetotomy needed; Schuenemann et al., 2011a). Furthermore, calving date and time and stillbirth were recorded. Immediately after calving, all cows had their BCS assessed on a 5-point scale with 0.25-unit increments (Ferguson et al., 1994) by the same person from the research team.

Table 1. Ingredients and nutrient composition (% unless otherwise noted) of pre- and postpartum diets (DM basis)

Item	Prepartum	Early postpartum
Ingredient		
Grass hay	45.12	5.51
Wheat straw	—	0.95
Alfalfa hay	25.72	28.73
Corn silage	10	16.07
Grain mix	15.93	46.14
Mineral mix	3.19	2.49
Nutrient profile		
NE_L (Mcal/kg)	1.30	1.62
CP	11.78	18.8
NDF	45.79	28.39
ADF	30.78	21.23
Starch	13.79	26.69
Ca	1.43	1.33
P	0.34	0.39
Mg	0.42	0.36
K	1.47	1.28
Na	0.25	0.42
Cl	1.10	0.38
S	0.36	0.23
DCAD (mEq/100 g of DM)[1]	−5.30	25.6

[1]Calculated as follows: DCAD = (mEq of Na + mEq of K) − (mEq of S + mEq of Cl). The water contribution of Na (6.72 mg/kg), K (<1 mg/kg), Cl (14.5 mg/kg), and S (10 mg/kg) was considered for DCAD (Cumberland Valley Analytical Service, Hagerstown, MD).