Dairy Research Summary

DRECA
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How does Low Blood Calcium Close to Calving Relate to Health, Production and Reproduction in Dairy Cows?

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Why is this important?

During the transition period, dairy cows experience reduced feed intake, negative energy balance and reduced immune function leading to a high incidence of disease around the time of calving. Onset of lactation also increases energy demand by 2.5 fold and calcium (Ca) requirements by 2-fold. While milk fever, or hypocalcemia, is only diagnosed in approximately 5% of dairy cows, sub-clinical hypocalcemia (SCH) is present in approximately 50% of multiparous cows.

Sub-clinical hypocalcemia is associated with reduced immune function and feed intake, as well as increased incidence of transition diseases (retained placenta, ketosis, and metritis). While previous research has also found an association between SCH and imparied production and reproduction, results are inconsitent. With such a large proportion of cows at risk for hypocalcemia and the risks to animal health and performance, it is important to understand the relationship between SCH and nutritional status of cows during the transition period.

The objectives of this study were to (1) investigate factors associated with serum Ca concentration, and (2) examine its relationship with serum concentrations of macro minerals, metabolic and nutritional profiles, incidence of health disorders, and productive and reproductive outcomes in dairy cows.

What did we do?

A total of 398 Holstein cows (111 primiparous and 287 multiparous) from 11 dairy herds in Alberta were enrolled in the study. Blood samples were taken between 2 and 7 days in milk (DIM) and analysed for macro minerals, metabolites, and liver enzymes. Cows were categorized as either High-Ca (> 2.10 mmol/L; n = 262) or Low-Ca (≤ 2.10 mmol/L; n = 136). Cows were monitored daily for health and incidence of retained placenta, metritis, displaced abomasum, ketosis and mastitis were recorded. Production measurements included milk yield at 25 and 90 DIM, as well as 305-day mature equivalent (ME) milk yield. Reproduction outcomes were cyclicity (presence of a corpus luteum) by 35 DIM, pregnancy to first AI and pregnancy by 150 DIM.

Table 1. Differences in production measures and health outcome between Low- and High-Ca cows.

	Low-Ca	High-Ca	*P*-Value
Lactation Length (d)	285	312	0.03
Milk Yield 25 DIM (kg)	714	794	0.01
Peak Yield (kg)	41	42	0.56
Milk Yield 90 DIM (kg)	3,214	3,314	0.11
305-d ME Yield (kg)	10,475	10,625	0.51
Sick (%)	80	55	< 0.01
Culled (%)	1	2	< 0.01
Dead (%)	6	3	0.19

*A p-value ≤ 0.05 indicates a significant statistical difference.

What did we find?

In total, 34% of cows were categorized as Low-Ca (77% multiparous). There was no association between pre-calving BCS with blood Ca concentrations. Low-Ca cows had lower blood concentrations of magnesium, sodium, potassium, total proteins and cholesterol. Additionally, Low-Ca cows had greater concentrations of urea, aspartate aminotransferase (AST), betahydroxy-butyrate (BHB), non-esterified fatty acids (NEFA) and haptoglobin. In general, Low-Ca cows had impaired production and health outcomes in early lactation (Table 1). Low-Ca cows also had a greater incidence of transition diseases (Figure 1) and had a tendency for reduced reproductive performance in early lactation (Figure 2).

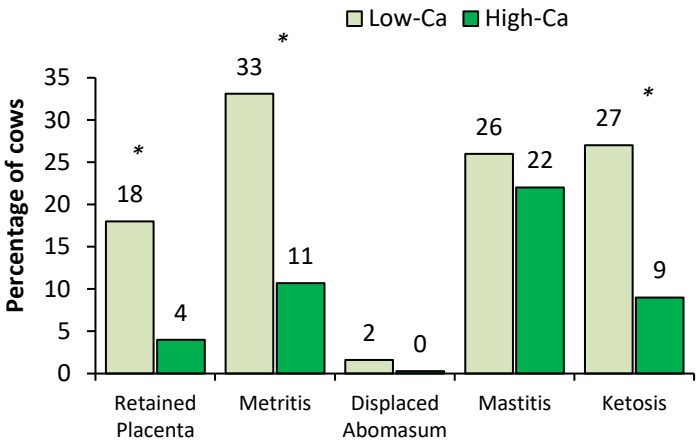

Figure 1. Differences in disease incidence between Low- and High-Ca Cows. A '*' indicates a significant difference.

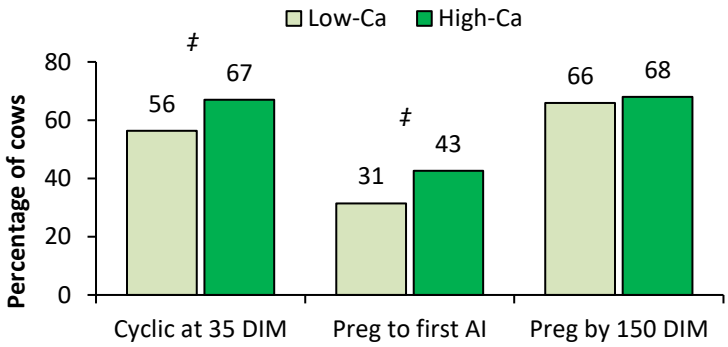

Figure 2. Differences in reprodutive outcome between Low- ad High-Ca cows. A 'ǂ' indicates a tendency for difference.

What does this mean?

Decreased concentrations of cholesterol and increased concentrations of AST, BHB and NEFA all indicate a negative energy balance in Low-Ca cows. These metabolites are associated with reduced dry matter intake (DMI), increased fat mobilization and impaired liver function. Additionally, reduced concentrations of magnesium, sodium and potassium indicate that low Ca concentrations were not primarily due to impaired Ca mobilization or absorption, and may also point towards a reduced DMI. Magnesium is needed for Ca metabolism in cows and can only be absorbed through the diet. Cows categorized as Low-Ca also had increased markers of inflammation (haptoglobin) and increased incidence of disease postpartum. In addition, production and reproduction were impaired in early lactation but did not carry over to later lactation. Although these results do not indicate a causal relationship, they do suggest that ensuring adequate blood Ca concentrations and DMI after calving is essential for a smooth transition period.

Summary Points

- Cows had blood samples taken between 2 to 7 days in milk and were categorized as Low-Ca or High-Ca
- Low-Ca cows had lower serum concentrations of macro minerals and greater concentrations of markers for fat mobilization and inflammation.
- Low-Ca cows had a greater incidence of postpartum disease and impaired reproduction.

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