

DAIRY RESEARCH

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Detecting cows with subclinical hypocalcemia will be important to avoid long-term issues, including milk production losses and decreased reproductive performance.

Calcium and fresh cows

Subclinical metabolic diseases impair the transition period and impact future milk production and reproductive success.

These diseases result from insufficient adaptation to the demands of milk production. The cow must at least double the amount of calcium that was provided for fetus development. The cow has multiple sites to draw and preserve calcium: from stored calcium in bones, through absorption from the diet in the intestine, and by minimized excretion in the kidney. This requires an intricate hormonal response, which takes days to maximize, while calcium drain occurs in hours. Subclinical hypocalcemia (SCH), a drop in blood calcium below the normal range with no clinical sign of disease, results from this delayed response. It is highly prevalent and affects 47% of mature cows and 25% of first lactation cows.

Impact of SCH is attributed to impaired cellular functions that depend on calcium (e.g. activation of immune cells and muscle contraction) and includes: decreased immune function, increased risk of uterine disease, lower conception rates at first service, increased odds of displaced abomasum and decreased early lactation milk production.

The ability to detect cows with SCH is the first step to minimize occurrence. This requires measurement of blood calcium since no clinical signs are present. Blood calcium can be measured as two different fractions: ionized calcium, which is readily available, or total calcium, which includes calcium that is unavailable because it is bound to other components in the blood. Despite that ionized calcium is thought to better represent the cow's calcium status, total calcium is typically measured because analysis is more economical and doesn't require cumbersome sample collection. Since unavailable forms of calcium are relatively stable (about 50% of total calcium), it is assumed that total calcium measurement is sufficient. However, some evidence indicates that the relationship between these calcium fractions is different in the time around calving, possibly due to the huge change in calcium metabolism.

Our lab investigated the relationship between ionized and total calcium immediately after calving. The objectives were to characterize the relationship between ionized and total calcium, and to determine if ionized calcium better reflects the calcium status of the cow. Samples taken repeatedly from cows in the five days following calving showed that ion-

ized calcium constituted 53% of total calcium, very close to the assumed 50%. Ionized calcium was 57% of total calcium in the samples taken 24 hours after calving. This increase in proportion of ionized calcium immediately after calving may lead to some discrepancies when cows are diagnosed with SCH using different calcium fractions (since cutpoints for SCH diagnosis using ionized calcium are calculated as 50% of the total calcium cutpoint).

To address whether ionized calcium was a better indication of the calcium status of the cow, both forms of calcium were considered as predictors of the cow's neutrophil oxidative burst, a measure of immune cell killing ability. Minimum blood calcium measured during the sampling period (either total or ionized) explained the magnitude of the oxidative burst response that was mounted (with a greater killing ability at greater calcium concentrations). Ionized calcium did not show an advantage over total calcium to explain this outcome. This suggests that total calcium is sufficient in practical situations to reflect the functional calcium available to the cow.

The diagnostic lab is used in research to measure blood total calcium and has little application on-farm because of analysis cost and turn around time. The IDEXX VetTest may have on-farm potential because analysis is relatively economical and blood total calcium results can be obtained within 30 minutes of sample collection. VetTest measurements of blood total calcium were highly correlated to the diagnostic lab measures with a slight bias. To diagnose SCH reliably (compared to the diagnostic lab measurements using a cutpoint of ≤ 8.0 mg/dL) the cutpoint for total calcium measured by the VetTest had to be increased to 8.9 mg/dL.

Detecting cows with SCH will help avoid issues associated with poor calcium status postcalving, such as milk production losses and decreased reproductive performance. Total calcium is able to reflect the calcium status of fresh cows similarly to ionized calcium and is sufficient to diagnose SCH. □

FYI

■ **Brittany Sweeney** is a Ph.D. student, **Elizabeth Martens** is an Undergraduate Honors Researcher, and **Thomas Overton** is a Professor of Dairy Management in the Department of Animal Science at Cornell.