New research from Cornell University has identified a cut-point for blood calcium concentrations in prepartum cows that can be used to predict which cows are more likely to develop subclinical hypocalcemia (SCH) at calving. In the study, cows with a blood calcium concentration of ≤2.4 mmol/L at one week prior to calving were 40% more likely to be SCH at calving. Subclinical hypocalcemia was defined as a blood calcium concentration of ≤2.1 mmol/L.

“Our goal with this research was to better define subclinical hypocalcemia in the periparturient period,” explains Jessica McArt, assistant professor in the Department of Population Medicine and Diagnostic Sciences at Cornell University. “We would like to be able to identify cows in the prepartum period that we can manage differently to improve their transition into lactation.” This research is another step in that direction.

The research, which was reported in the May 2017 Journal of Dairy Science, utilized 296 cows at two New York dairies to identify risk factors for SCH. Prepartum total blood calcium status, parity and herd were found to be significant predictors.

At one week prepartum, all multiparous animals with a blood calcium concentration of ≤2.4 mmol/L were 40% more likely to be classified as SCH at parturition. When just third or greater parity cows were considered, they were 70% more likely to be classified as SCH at parturition.

Blood samples also were collected within four hours of calving. Results from the 296 cows showed that at calving 2% of first lactation cows, 40% of second lactation cows and 66% of third or greater lactation cows had a blood calcium concentration of ≤2.1 mmol/L and were diagnosed as SCH.

Cows in Herd B were 50% more likely to be classified as SCH than cows in Herd A. While there were some management differences between the two herds, McArt believes the lack of a negative DCAD diet in Herd B was a large contributor to the increased prevalence of SCH in Herd B; 42% vs. 24.7% for Herd A. Dairy A fed a prepartum diet with a DCAD of -6.9 mEq/100g of dry matter. Dairy B changed its prepartum diet partway through the observation period, but cows were always fed a prepartum diet with a positive DCAD.

“I’m a big proponent of feeding a negative DCAD diet in the close-up ration as well as keeping the stocking density in the fresh pen under 85%,” says McArt. “These management strategies, along with optimizing cow comfort during the transition period, go a long way for disease prevention.”

LAMENESS A FACTOR TOO

In addition to testing for blood calcium, cows were locomotion scored within one week of calving. Subclinical hypocalcemia at calving and locomotion score were significant predictors of SCH at two days in milk.

Cows with normal blood calcium (>2.1 mmol/L) at calving and not lame served as a reference point. In comparison:

- Cows with normal blood calcium at calving but were lame were 3.2 times more likely to be SCH at two days in milk.
- Cows that were SCH at calving (<2.1 mmol/L) but not lame had the same 3.2 times higher risk to be SCH at two days in milk.
- Cows that were SCH at calving and lame were 3.4 times more likely to be SCH at two days in milk.

These results show that lame cows with normal blood calcium at calving are more likely to develop SCH in early lactation. In addition, when cows are SCH at calving, being lame doesn’t really increase their risk for persistent SCH at two days in milk. McArt’s theory is that lame cows do not have the same intakes as non-lame cows and are thus not able to take in as much calcium as non-lame cows, thus the continued issues with hypocalcemia. Pen changes after calving also may increase social turmoil and further limit access to the bunk for the newly-fresh lame cow.
LOOKING FORWARD
Research on transition cows is ongoing at Cornell and at several other research institutions. This new cut point for blood calcium can be used to identify a subset of cows a week prepartum that are more likely to develop SCH at calving. This in turn may allow researchers to better understand SCH and to develop strategies to improve cows’ transition.

Cornell researchers are currently trying to determine the best timing of blood sampling relative to calving to classify SCH and what blood calcium threshold should be used to define it. “There has been some debate on the threshold for SCH without consistent supporting data,” explains McArt. Several research groups are currently working on this. In all of the research, the goal remains the same: A healthy transition for every cow.

FROM THE MATERNITY PEN
Gestation Length Impacts Both Dam and Calf

Researchers at the University of Florida conducted an observational study to characterize gestation length in Holstein cows and to evaluate the association between abnormal gestation length and health, productive and reproductive performance of cows and on the survival and reproduction of heifer calves. The mean gestation length was 276 days with a standard deviation of 6 days. In the study, gestation length was recorded as average (AGL) 276 days ± 6 days; short (SGL) 256-269 days; and long (LGL) 283-296 days.

Results include:
- The incidence of retained fetal membranes in cows with SGL was 3-fold greater in primiparous cows and 7-fold greater in multiparous cows than in the respective parity groups with AGL and LGL cows.
- Short GL cows had the highest incidence of morbidity by 90 days in milk (DIM) and the highest culling rate by 300 DIM regardless of parity.
- Cows with AGL produced more milk than cows with SGL or LGL; 84.9 lbs, 80.7 lbs and 83.1 lbs of milk per day in the first 300 DIM respectively.
- The highest mortality rate for heifer calves was 10% by 300 days of age for those born from SGL cows. When culling was added, the proportion of heifers that left the herd by 300 days of age was 13.6% SGL calves, 17.2% for LGL calves and 10.8% AGL calves.

The message is clear; deviations from an AGL of 276 days resulted in marked increases in morbidity, reduced milk production and reproductive performance for Holstein cows. It also drastically reduced the number of heifer calves available for herd replacements.

For more details, please see “Association among Gestation Length and Health, Production, and Reproduction in Holstein Cows and Implications for Their Offspring,” in the April 2017 Journal of Dairy Science at https://doi.org/10.3168/jds.2016-11867

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CONSULTANTS CORNER

Methionine and Choline Improve Immune Response

For years it has been widely accepted that cows experience immunosuppression around parturition. But a growing body of research challenges that assumption. In fact, the immune system of periparturient dairy cows appears to be dysfunctional, with some of its functions being reduced but others being hyper-reactive.

Methionine and choline are both essential nutrients in the transition cow diet. Methionine supports milk protein production, and choline has been shown to boost milk yield and minimize fatty liver. Methionine, and several of its metabolites, also helps support and boost immune function. In addition, choline can be used as a methyl donor to regenerate methionine. At the University of Illinois we conducted a study to determine if rumen-protected methionine (RPM) or rumen-protected choline (RPC) would affect cows’ innate immune response during the periparturient period.

For the experiment, whole blood inflammatory response to a challenge with lipopolysaccharide (LPS) E.Coli O111:B4 was measured in 33 multiparous Holstein cows that remained clinically healthy throughout the transition period. A low and high dose of LPS were used—low to simulate ranges detected in healthy or clinical animals and high to record the maximum response of the immune system.

No evidence of immune system suppression was found throughout the entire transition period. In cows supplemented with RPM or RPC results showed clear evidence of enhanced immune function, increased phagocytosis capacity in monocytes and greater levels of oxidative burst activity in both neutrophils and monocytes compared to control cows. (Increases in phagocytosis capacity and oxidative burst activity indicate the white blood cells’ ability to destroy more bacteria/pathogens.)

There were also some differences between cows supplemented with RPM and RPC. In cows supplemented with RPM, the whole blood inflammatory response to LPS was dampened. The inflammatory response in RPC-supplemented cows was similar to that of control cows. RPM supplementation also increased phagocytosis capacity of neutrophils (the most abundant type of white blood cells) and affected the immune and antioxidant status of cows before calving; choline supplementation did not.

This data supports a growing body of evidence that indicates cows do not undergo a generalized period of immunosuppression during transition—at least not at the systemic level. Instead our data indicates that cows experience a systemic hyper-response around parturition, which is probably linked to oxidative stress. In this study, RPM supplementation was able to dampen this hyper-response, most likely acting on the oxidative stress of the animal, or indirectly through methionine’s immunologically active metabolites of glutathione and taurine (cellular antioxidants).

We already know that methionine and choline are important amino acids for dairy cows. This new research highlights their ability to stimulate the immune system during the transition period, thus adding to their importance in ration formulation for dairy cows.

To learn more about methionine and choline’s influence on the immune system please see “Supplementation with Rumen-Protected Methionine or Choline During the Transition Period Influences Whole-Blood Immune Response in Periparturient Dairy Cows,” in the May 2017 issue of the Journal of Dairy Science. Available online at: https://doi.org/10.3168/jds.2016-11812

To learn more about the benefits of supplementing cows with RPM and RPC please see “The Facts About Choline and Methionine for Transition Cows,” in the May issue of Dairy Nutrition Plus. Available online at: http://www.dairynutritionplus.com/enewsletter/nutrition-plus/2017-May.asp

New Frontiers in Amino Acid Research

Amino acids are well known as building blocks of protein. But that’s just one role. Recent research has clearly demonstrated several novel roles of amino acids, says Ranga Appuhamy, assistant professor of dairy nutrition at Iowa State University. Given this new information, Appuhamy says, “it’s high time to update our current knowledge about amino acid requirements of dairy cows and the models that we currently use to quantify those requirements.”

First, all 20 amino acids are equally important. Methionine and lysine may be the most talked about, but every protein formed—muscle, hemoglobin or milk—contains all 20 amino acids. An insufficient amount of any one can impede or slow protein synthesis. Altering the position of any single amino acid in the sequence of a polypeptide chain will cause the protein to lose its function. Cows can synthesize 10 amino acids. The rest must be supplied in the diet, which is why they are called essential. However, every single amino acid is essential for living cells to perform protein synthesis.

Amino acids also act as a cellular signal that regulates how fast or slow a protein will be synthesized. Research from Virginia Tech has shown that leucine, isoleucine and methionine all increased the rate of milk protein synthesis independently of each other, yet none of these amino acids were limiting as building blocks for protein synthesis (Appuhamy et al., 2012). Another study showed that milk protein synthesis rates can control the rate of amino acid uptake from blood to the mammary gland (Bequette et al., 2000). This indicates that the percentage of absorbed amino acids that are utilized for milk protein synthesis can be quite variable and thus disagrees with the constant percentages used in current nutrition models such as NRC-2001. Overall, these results show that the current protein and amino acid requirement models used to formulate diets may be oversimplified, or at a minimum inadequately represent the underlying biology, explains Appuhamy.

Under certain circumstances, some amino acids become limiting. Two studies have demonstrated that in times of heat stress lactating dairy cows benefit from rumen-protected glutamine. It boosts milk protein yield, has anti-inflammatory properties, is a major source of energy for gut tissues and is used as a substrate for glucose synthesis (Caroprese et al., 2013 and Gao et al., 2017). While cows can synthesize glutamine, it appears that during times of heat stress, cows cannot make enough to meet the increased demand.

Another example is arginine. It becomes limiting during illness. Arginine can be extensively utilized for the production of nitric oxide, which in turn increases blood flow to infected tissues and stimulates the proliferation of immune cells. While this is well-documented in humans and monogastic animals, this is a new area of research for ruminants.
QUALITY CORNER

True Nutrition with Benitz Dairy

The Benitz family always strives to improve. That’s why they introduced DCAD to their western Wisconsin dairy. “I knew the potential of our herd, but we weren’t going to get there without doing more for our transition cows,” said co-owner Tim Benitz.

But when they tried an extreme approach to the nutritional practice, problems arose. “Being overly aggressive wasn’t working. We were suddenly seeing lots of sick cows,” said nutritionist Gary Drinkman.

Over-supplementation with anions led to over-acidification and unexplainable problems. Tim Benitz and his father, Jim, considered cutting out anionic supplementation altogether and returning to a non-acidifying diet. But they still wanted better for their herd, and DCAD done right was the key to improving their cows’ transition into lactation.


Now they keep their cows partially acidified with pH levels just under 7, and they monitor pH less often than their previous program required. Freshening issues have disappeared, and cows are taking off better at calving. “DCAD with SoyChlor isn’t extra management. It’s less time treating problems,” Tim said. “It just works.”