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NEW RESEARCH ON PREPARTUM DIETARY CALCIUM AND URINE PH

New research presented at the American Dairy Science Association virtual meeting in June sheds new light on two important questions for prepartum cows fed a negative DCAD diet—the effect of dietary calcium source on urine pH and the relationship of urine pH to calcium status at calving. The benefits of feeding a negative DCAD diet prepartum have been well established (Santos et al., 2019). However, the debate continues on the topics of dietary calcium, including calcium source, amount fed and its role when utilizing a DCAD strategy, and on the optimal urine pH for prepartum cows.

THE QUESTION OF CALCIUM

Researchers at Kansas State University designed an experiment to determine the effect of dietary calcium carbonate on the metabolic acid-base status of cows and to measure urinary calcium excretion in moderately acidified dry cows. Current recommendations on the amount of dietary calcium to feed prepartum cows ranges from no supplemental calcium up to 200 grams per day, explains Holly Fujan, graduate student, and Barry Bradford, professor of dairy management and nutrition at Michigan State University (formerly at Kansas State University).

The primary goal was to determine if increasing the intake of calcium carbonate would affect measures of acid-base status, including urine pH, blood bicarbonate reserve and blood base excess, and whether any effects were related to the intake of calcium or the intake of carbonate from the calcium carbonate. Effects on blood ionized calcium (iCa), sodium and potassium concentrations were also evaluated. Secondary goals were to determine if added calcium carbonate affected dry matter intake or urinary calcium excretion. Previous research by Diehl et al., (2018), Horst and Goff (1997) and National Research Council (2001) has raised questions about potential negative impacts.

A total of 21 pregnant, multiparous, far-off dry cows were enrolled in the study. Far-off dry cows were used to ensure that all cows had time to complete all three treatments before calving. For the first 5 days, cows were fed the same basal diet with a calculated DCAD of -60 mEq/kg of DM. All cows' urine pH was checked daily to make sure that the amount of anion supplement (SoyChlor) included in the ration was yielding a urine pH between 6.0 and 7.0. On

day 6 cows were randomly assigned to 1 of 3 treatment protocols. Treatments included no supplemental calcium carbonate (average dietary Ca = 0.75% of DM), moderate calcium carbonate supplementation (average dietary Ca = 1.2% of DM) and high calcium carbonate supplementation (average dietary Ca = 1.8% of DM). The additional calcium carbonate was top dressed and mixed into the basal TMR twice daily. Each treatment period lasted 7 days—3 days for acclimation, 4 days for sample and data collection. Results include:

- Incremental addition of calcium carbonate did not affect DMI or water intake.
- Urine pH increased linearly with increasing calcium carbonate supplementation. Urine pH averaged 6.41 on the basal diet, 6.62 with moderate calcium carbonate supplementation and 6.73 for high calcium carbonate supplementation.
- There was no difference in the amount of calcium excreted in urine by cows on the high calcium supplementation vs. moderate or no supplementation. This indicates that the calcium from calcium carbonate may not have been absorbed into the blood.
- The fact that no additional calcium was excreted in urine as the intake of calcium carbonate increased, and that urine pH increased linearly as the intake of calcium carbonate increased, suggests that the carbonate, not the dietary calcium, had a neutralizing effect that increased urine pH.
- Calcium carbonate supplementation did not have any effect on the acid-base status of the blood, nor on the minerals in the blood, including iCa levels.

In the study, the more calcium carbonate added to the diet, the higher the cows' urine pH. The linear correlation observed indicates that if you feed high levels of calcium carbonate to moderately acidified prepartum cows urine pH may not accurately reflect the acid-base status of the cows, says Fujan and Bradford. The resulting rise in urine pH from feeding supplemental calcium carbonate may compel producers to feed additional anions in order to achieve their target urine pH. But when cows are moderately acidified, as

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NEW RESEARCH ON PREPARTUM DIETARY CALCIUM AND URINE PH

they were in this study, more anions may not be needed. Instead, the urine pH may be lowered by removing supplemented calcium carbonate from the diet. (ADSA Abstract M135, J. Dairy Sci 103 Suppl.1, p 207.)

OPTIMAL URINE PH

Researchers from the University of Georgia and universities in Chile and Argentina teamed up to identify the optimal urine pH needed in prepartum cows to prevent milk fever. A total of 345 cows on a grazing dairy in Chile were eligible for the study. At 30 days before expected calving date cows were moved to a prepartum lot where 80% of diet DM came from a mixed ration and the other 20% of diet DM came from pasture. The mixed ration had a calculated DCAD of -109 mEq/kg of DM.

Only cows that were fed the anionic supplement for at least one week before calving were included. Sixty cows were used for data analysis. Blood samples were collected within 6 hours of calving. Researchers examined the interaction between urine pH and plasma total calcium. Results include:

- There is a quadratic effect of urine pH on plasma total calcium (tCa).
- tCa was higher when prepartum urine pH was between 6.0 and 7.5.
- tCa was lower when prepartum urine pH was below 6.0 or above 7.5.

Researchers concluded that cows with a prepartum urine pH below 6.0 or greater than 7.5 had a lower concentration of plasma tCa and tended to have a higher concentration of β -hydroxybutyrate (BHB). While feeding an anionic diet to induce a mild metabolic acidosis has been shown to minimize hypocalcemia and improve transition cow health, care must be taken to feed at the right level to avoid over-acidifying cows or not delivering enough anions to provide positive benefits to the cows, explains Pedro Melendez, associate professor and field investigator in the College of Veterinary Medicine at the University of Georgia. The target urine pH producers should strive for in prepartum cows fed a negative DCAD diet is between 6.0 and 7.0. (ADSA Abstract #42, J. Dairy Sci 103 Suppl.1, p 17.)

References available online at www.dairynutritionplus.com/enewsletter/nutrition-plus/2020-September.asp

HAPPENINGS

Introducing Harrington as Director of Sales and Marketing, Animal Nutrition

Landus Cooperative, the manufacturer of SoyPlus and SoyChlor, recently announced the promotion of Mary Harrington to director of sales & marketing for Animal Nutrition.

For the past six years Harrington has supported the SoyPlus and SoyChlor sales team in a marketing and communications role. In her new position, she will develop and coach regional sales managers and oversee domestic and international marketing for the farmer-owned cooperative's dairy feed ingredient product line.



MARY HARRINGTON

"I feel privileged to work with this great team as we continue to focus on delivering high quality products and service. I am excited to work with this business in a new capacity and look forward to meeting our customers and learning more about opportunities to serve their needs," said Harrington.

The Landus animal nutrition team focuses on delivering quality, consistency and supply chain reliability to producers, and placing farmer-owners at the center of our business by elevating the value of their commodities. Harrington's sales team markets SoyPlus and SoyChlor in the U.S., Canada, Mexico and countries around the globe.



FROM THE MATERNITY PEN

Third Trimester Insults Have Long-Term Impacts

If you want the calves born on your dairy to have healthy, productive lives then your dry period management needs to be top notch. Mounting evidence indicates that insults that occur during the last trimester—nutrient deficiencies, environmental insult or pathogen exposure—can have long-term negative impacts on calves after they are born.

That's because insults that occur in the third trimester can silence or alter genetic signaling in the growing fetus which can influence the animal for life. Research by Skibiell et al., (2018) shows that heat stress during the third trimester leads to significant changes in the methylation patterns in the still developing calf. (Methylation alters the efficiency of genetic signaling but not the genetic code.) When the efficiency of genetic signaling has been altered, reductions in animal performance occur. And these reductions in performance, as well as the changed methylation patterns, are passed on to at least two subsequent generations of offspring (Almeida et al., 2019).

That makes getting dry period management right even more important, explains Geoff Dahl, professor of dairy science, University of Florida. While this is still an emerging area of research, several factors have been identified as vital for protecting fetal development in the third trimester.

Feed choline. Dry cows fed choline during the close-up period delivered calves that experienced significantly improved health and growth, had increased calf survival rates and improved immune status (Zenobi et al., 2018 a,b).

Keep dry cows healthy. Research in beef cattle showed that disease and fever in cows during late gestation impacts the calf's response to disease challenge. Heifer calves exposed in utero to disease and fever in late gestation had a longer duration of fever and sickness when challenged than herdmates that were not exposed in utero (Burdick Sanchez et al., 2017).

Minimize heat stress. Ongoing research at the University of Florida has shown that late gestation heat stress in the cow negatively impacts calf performance. Lower immune status, poorer health and reductions in milk yield through the first three lactations have been shown. And these reductions in performance have been passed on to the next two generations.

Perhaps it's time to start thinking about dry cow management as an investment in the health and performance of your calves and future cows. To learn more on this topic, please see "Managing Calf Health and Performance in utero" available at <https://wcds.ualberta.ca/wp-content/uploads/sites/57/2020/03/p141-148-Dahl-WCDS2020-ManagingCalfHealthAndPerformanceInUtero.pdf>

CONSULTANTS CORNER

Nutrition Strategies to Improve Transition Cow Success

It's no wonder that the transition to lactation doesn't always go smoothly for cows. Peak disease incidence occurs shortly after calving which also coincides with the time of greatest negative energy balance, the peak of blood concentrations of nonesterified fatty acids and the greatest acceleration of milk yield. It's a perfect storm that cows must weather in order to remain in the herd as healthy, productive animals.



PHIL CARDOSO
University of Illinois

Proper nutritional strategies during the dry, close-up and fresh-cow periods are paramount for cows to make a successful transition into lactation and for improving their health, milk production and reproduction, explains Phil Cardoso, associate professor of animal science, University of Illinois. Volumes of research have been conducted over the last few decades to identify the nutritional requirements for each stage. Cardoso was part of a group that recently reviewed all of the research and developed a list of scientifically proven, well-established dietary strategies that should be considered to improve transition cow performance. You can read the full review in the *Journal of Dairy Science* at <https://doi.org/10.3168/jds.2019-17271>.

CONTROLLED-ENERGY DIET

During the early dry period, research and on-farm results show that feeding a controlled energy diet yields positive results. Controlled energy diets, also called the "Goldilocks" diet, should be formulated to 1.30 to 1.39 Mcal of NE_L /kg of DM. These diets incorporate straw or low-quality grass hay with the primary forages fed in the lactation diet. This allows cows to eat their fill without over consuming energy, and the rumen remains adapted to the types of ingredients that will be fed in the lactation diet. Benefits include fewer post-partum health problems, fewer assisted calvings, greater dry matter intake around parturition and improved reproductive performance.

NEGATIVE DCAD DIETS

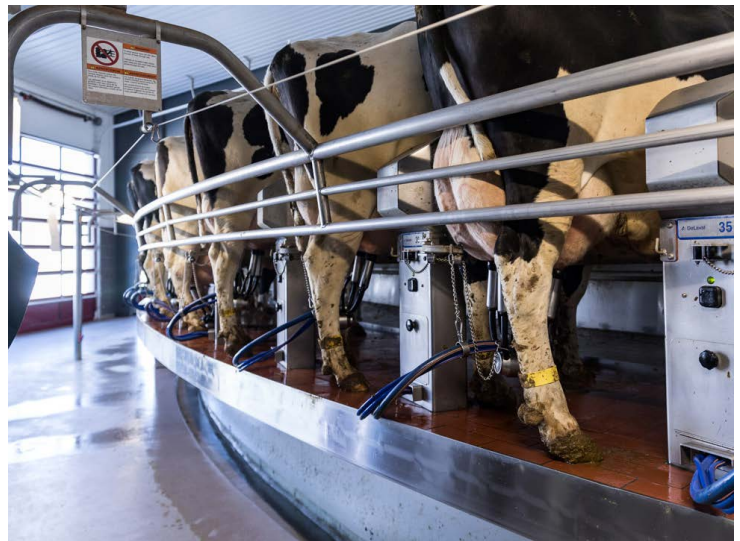
Feeding a negative dietary cation-anion diet (DCAD) starting 21 days before calving minimizes clinical and subclinical hypocalcemia. To work, negative DCAD diets must induce a mild metabolic acidosis that lowers cows' urine pH which helps prepare cows' own natural mechanisms to pull calcium from the bones to meet the increased calcium demand at the start of lactation. Goff & Koszewski (2018) determined that beneficial changes to blood calcium begin when urine pH is 7.5 or less. Research is ongoing to determine the optimal urine pH (partially acidified diets with a urine pH of 7.0 to 6.0 or fully acidified diets with a urine pH of 6.0 to 5.5) and the dietary calcium concentration to include when feeding a negative DCAD diet. Despite optimum levels not yet being identified, research and on-farm experience clearly show that when prepartum cows are metabolically acidified beneficial results include improved blood calcium concentration at calving, reduced incidence of hypocalcemia and of uterine diseases and improved lactation performance in multiparous cows.

AMINO ACIDS

Amino acids are building blocks for protein synthesis and also function as signaling molecules. Methionine and lysine were the first amino acids identified as limiting factors in dairy cows.

They limit optimal milk production. Methionine has also been identified to affect reproductive performance. For example, research shows that methionine-supplemented cows have less pregnancy loss from day 28 to day 61 after artificial insemination (Toldeo et al., 2015). Methionine supplementation also impacts oocyte quality and causes extra lipid formulation which may improve early embryonic survival rates (Acosta et al., 2016 & 2017). Research continues to further refine our understanding of all the roles that amino acids play and to identify which ones may be limited in the diet.

If some of your cows fail to achieve the goal of being healthy, productive cows that breed back and stay in the herd long-term you might want to explore some of the nutritional considerations mentioned herein. Years of research and on-farm use demonstrate that controlled energy diets, negative DCAD diets and balancing rations for amino acids can help get your cows off to a better start into their next lactation.



BEYOND BYPASS

Mid-Lactation Cows Get Boost from SoyPlus

Researchers at Kansas State University compared a novel high-protein corn product with 56% crude protein against three other protein sources commonly used to feed high-producing dairy cows. The three other protein sources were solvent extracted soybean meal (SBM), canola meal plus a bypass protein supplement (3 lbs/day SoyPlus) and SBM plus a bypass protein supplement (5.1 lbs/day SoyPlus). All diets were formulated for equal concentrations of crude protein (16.8% of DM) and then balanced to meet cows' metabolizable lysine (79.5 g/d) and methionine (225 g/d) requirements. The SBM diet was formulated to deliver 5.7% RUP. The two diets with soy bypass protein were formulated to deliver 6.8% RUP to match the RUP content of the high-protein corn product.

A total of 24 multiparous high-producing Holstein cows were enrolled in the study at about 111 days in milk. Each treatment period was 28 days, 25 for acclimation and 3 for data collection. The high-protein corn product did not yield production results similar to the other diets. Instead, cows fed the high-protein corn product produced less milk and consumed less crude protein which suggests they sorted against the protein source. Researchers believe there may have been some Maillard product formation during the production process.

Despite the disappointing results for the high-protein corn product, the other three diets fed did yield several results worth noting.

- Cows fed the soy bypass protein with either canola meal or soybean meal produced an average of 5 lbs more milk per day than cows on the soybean meal diet without added bypass protein. They also produced an average of 10.5 lbs more milk per day than cows fed the high-protein corn product.
- Replacing some solvent extracted soybean meal with SoyPlus bypass protein boosted milk production in mid-lactation cows.
- In the diet where canola meal was a primary protein source, adding some SoyPlus boosted and helped maintain milk production later into lactation.
- Cows fed SoyPlus as part of the diet required less supplemental lysine and methionine to meet dietary requirements.

To read the full study in the *Journal of Dairy Science*, go to <https://doi.org/10.3168/jds.2019-17939>



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QUALITY CORNER

New Website Coming Soon

Our website is changing, but the products and team you know and trust are staying the same. For the past six years Landus Cooperative's dairy feed ingredient product line—including SoyPlus and SoyChlor—has been promoted via its own website at www.dairynutritionplus.com. We will soon migrate that content onto our primary company website, at www.LandusCooperative.com. This will enable users to continue to access the same information about SoyPlus, SoyChlor and PasturChlor, while also learning more about the farmer-owned cooperative manufacturing these products.

Landus Cooperative (formerly West Central Cooperative) first introduced SoyPlus to the marketplace in 1984, and developed and released SoyChlor 14 years later. Since then quality, consistency and supply chain reliability have remained core values of the business. As a farmer-owned cooperative, quality has always gone beyond just the SoyPlus and SoyChlor manufacturing processes. It starts in the fields where our Iowa soybean growers raise quality crops.

Watch for updates from our team as we transition our SoyPlus, SoyChlor and PasturChlor product information onto the existing Landus Cooperative website this fall at www.LandusCooperative.com.

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