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DCAD Developments in Prepartum Dairy Rations

The concept of lowering Dietary Cation-Anion Difference (DCAD) in the diets of late-pregnant dry cows to prevent hypocalcemia has been known in dairy nutrition for more than three decades. But researchers continue to learn more about how DCAD works, how it can be improved, and the value it can add to dairy herds.

David Beede, PhD, Professor of Animal Science at Michigan State University, says the calcium demands on just-fresh cows are enormous. “At calving, cows suddenly require roughly double the amount of calcium needed when they were dry,” he explains. “They need to bring at least 30 g of calcium per day into the blood stream, which must come from intestinal absorption and bone resorption. That’s a formidable physiological task.”



Clinical hypocalcemia occurs when blood calcium drops below 5.5 mg/dL. Now, a growing body of research suggests that subclinical hypocalcemia is a widespread and often undetected condition that also damages dairy herds. “Any level of hypocalcemia — whether it is clinical or subclinical (blood calcium less than 8.0 mg/dL) — can kick-start the cascade of the fresh-cow disorder complex,” says Beede.

Lowering DCAD in the prefresh ration, via manipulation of the concentrations of the cation and anion mineral elements, helps cows mobilize calcium via bone resorption and stimulates increased blood calcium. For herds struggling with clinical hypocalcemia, lowering the close-up DCAD improves herd health even if the endpoint is not particularly low—for example, dropping

from +30 mEq/100g to 0 mEq/100g. But as a broader industry target, Beede recommends a prefresh DCAD goal of -10 mEq/100g, adding that a target of -15 mEq/100g might be preferable sometimes to accommodate biological variation among animals or in herds experiencing more hypocalcemia-related problems.

Beede cites a recent study in which researchers from the University of Florida (2012; J. Dairy Sci. 95:7158-7172) defined a blood serum calcium cut-point of 8.6 mg/dL for cows with metritis compared with cohorts without metritis. However, he notes that this does not mean that the standard diagnostic threshold (8.0 mg/dL) for defining clinical or subclinical hypocalcemia should be changed. More research is needed to definitively characterize the associations of particular early fresh cow blood calcium thresholds with various early postpartum metabolic disorders.

Choosing which cationic and anionic minerals to manipulate DCAD also has been addressed to some extent. Beede's preferred equation is $[DCAD = (Na^+ + K^+) - (Cl^- + S^{2-})]$. He recommends lowering potassium and sodium in the close-up ration as much as possible before manipulating the other side of the equation with anionic additives. He also recommends supplementing close-up diets with 1.0% calcium and 0.38% magnesium.

"Initially, 'anionic salts' were our only option for raising the anionic content of close-up rations," says Beede. "Often, prepartum intake was reduced with the salts. Now, we have the availability of several commercial anionic supplements that are more palatable and cause fewer intake problems."

Still, it is important to monitor close-up dry cow feed intake to ensure that all animals are consuming the beneficial ration. Jay Giesy, Dairy Specialist with Cargill Feed and Nutrition based in central New York, says this is most often accomplished on-farm with urine pH screening. "On-farm pH meters or test paper usually make urine pH simpler to monitor than blood calcium," says Giesy. "The easier it is to perform a screening like this, the more likely it will be routinely implemented in herds."

Giesy recommends evaluating urine pH of 10 to 12 cows in the dry pen on a weekly basis. Ideally, those samples would be collected three to four hours after feeding, and would be taken from cows that have been on the low-DCAD ration for at least a week. His goal is a urine pH of 6.0 to 6.5. "Be sure to evaluate not just the average, but the variability among those samples," Giesy advises. "Averages can be deceiving, and if you have a lot of outliers on either end, then the ration probably is not being consumed consistently through the group."

It is important to consider potential associations and interactions of DCAD with other nutritional factors in the close-up period. Beede notes, for example, it is well known that supplemental magnesium is critical because calcium mobilization from bone is magnesium-dependent. Potassium can blunt magnesium absorption in the rumen; therefore, reducing dietary potassium and thus also the DCAD, and increasing dietary magnesium will help reduce risk of a hypomagnesemia-like condition and hypocalcemia. Also, increasing dietary calcium in close-up rations with a properly targeted DCAD (-10 mEq/100 g) may be a consideration. Controlled research to-date shows no benefit to increasing calcium above 1.0% of dry matter in the close-up ration.

SoyChlor[®] Helps Reach DCAD Targets

SoyChlor[®] is a valuable tool for dry-cow DCAD ration formulation, providing supplemental chloride, the most effective dietary anion for reducing DCAD.

The chloride in SoyChlor[®] is dispersed at the molecular level throughout a palatable blend of grain co-products.

SoyChlor[®] also contains beneficial amounts of highly bioavailable calcium and magnesium — critical elements for DCAD success.

The true protein (not NPN as in some blends of anionic salts and other commercial products) in SoyChlor[®] supplies the cow with metabolizable protein at a time of critical need, when ruminal synthesis of microbial protein may be compromised. SoyChlor[®] is easy to incorporate into premixes, or to hand-add at the farm for fine-tuning the level of metabolic acidification.

CONSULTANT'S CORNER

Launching Successful Lactations With DCAD

*By Jay Giesy, PhD, PAS
Dairy Specialist
Cargill Feed and Nutrition, Trumansburg, N.Y.*



Lowering the Dietary Cation-Anion Difference (DCAD) in dry-cow rations is a practice I studied in graduate school, and one that I have employed since I started working in the dairy nutrition field 13 years ago. I became a believer in the practice via the research we performed at the University of Idaho. Multiple trials evaluated the impact of DCAD levels on urinary pH, blood calcium, milk fever incidence and fresh cow performance. Then, in a more intensive trial, we fed four levels of DCAD from +25 mEq/100g to -25 mEq/100g and then mimicked the calcium drain that cows experience immediately postpartum with a jugular EDTA infusion that bound blood calcium.

With serial blood sampling during and after infusion, we saw a linear relationship between DCAD level fed and cows' ability to avoid a drop in blood calcium and to recover from the drop in calcium. Cows fed the lowest level of DCAD required more of a challenge before reaching a common threshold of blood calcium and those cows recovered more quickly after the challenge.

In my field experience, herds with the most successful transition health have taken at least some measure to manage prefresh DCAD concentration. Dairy producers in our region have become very creative with the diverse dietary components they now use to develop negative-DCAD TMRs. Many producers are utilizing low-potassium forages, such as chopped straw and grass hay or haylage. I recommend sampling forages at least monthly to keep a handle on their nutritional profiles, especially the elements that affect DCAD. After controlling forage K levels, nutritionists often use moderate levels of anionic salts and supplement with products that reduce DCAD with less risk of palatability problems (like SoyChlor).

Ideally, I like to see prefresh cows on negative-DCAD diets for three weeks. Heifers, when they are commingled with multiparous dry cows, seem to benefit from an additional week on the prefresh diet. Although postpartum clinical hypocalcemia is less common in heifers, performance and health of first-calf heifers is strong when fed the low DCAD diets.

Many herds monitor urinary pH prior to calving as a leading indicator of dietary DCAD performance. When herds make ration changes to attempt to lower prepartum DCAD and have disappointing results, I first look at urine pH levels and their distribution to assess whether or not cows are responding to the ration. Often the key challenge is consistent intake, which may be hampered by overcrowding, frequent pen changes, diet particle sorting or palatability

issues due to over-acidification. A ration that is too dry (>45-50% DM) or has particle length that is too long (>12 to 15% top screen) are common causes of sorting, which often can be remedied by adding water and more effectively mixing the TMR.

It is easy to focus so much effort on formulating the “perfect” ration and forget about the other critical factors that impact the ultimate success of dietary strategies like negative prepartum DCAD. Cow comfort; access to feed; TMR mixing and delivery practices; and social order in the dry pen all can influence the impact of a well-designed ration. But if we pay attention to both formulating the ration and making sure it gets consumed, it is worth the effort to balance prepartum rations for negative, low DCAD.

BEYOND BYPASS

Using Liquid Feeds and Sugars

Adding sugar to lactating dairy rations is a double-edged sword, according to Ohio State University researcher Jeffrey Firkins. “On one hand, added sugar can provide a blast of energy to ‘jump start’ the ruminal process,” says Firkins. “But excess sugar intake could cause a burst of acid production that promotes acidosis.”

Firkins says modern feeding methods employing TMRs with multiple feedings or push-ups throughout the day reduce the “ruminal blast” effect that might be achieved if added sugars were consumed directly and in one daily dose. Thus, he says, “we should be formulating diets that have a proper ratio of rumen degraded carbohydrate relative to effective fiber, then fine-tuning this concept according to different farms’ forage and grain sources and managerial capacities.”

After evaluating a large body of research on the subject, Firkins offers the following observations and advice regarding feeding the industry standard of 2.5 to 5% supplemental sugar to lactating rations:

- Keep non-fiber carbohydrate (NFC) inclusion at < 37% in corn-silage-based diets; up to < 40% in alfalfa-based diets.
- Starch inclusion should be < 25% for corn silage diets, but perhaps can be higher in alfalfa or grass diets.
- When NFC and especially rumen-degraded starch are kept at these moderate concentrations, sugars are more likely to stimulate DMI, NDF digestibility and milk-fat production.
- Adding sugars to diets with Rumensin[®] does not increase the risk of milk-fat depression.
- Sugars — particularly when in the form of liquid feeds applied to the TMR — should help reduce sorting both against forage and for the fines.
- Ruminal and post-ruminal effects of sugar addition plus feedbank management for group-fed cows can promote an overall potential benefit in milk production and efficiency.

[®]Rumensin is a registered trademark of Elanco Animal Health.

Maternity Pen

Strategies to Improve Colostrum Yield

Can prefresh nutrition affect the amount of colostrum produced by fresh cows? Researcher Noah Litherland, PhD and his team at the University of Minnesota conducted a study to find

out.

Litherland became interested in the subject after observing the alarmingly low colostrum yields from cows on moderate-energy, high-fiber prefresh rations. Such rations have proven to be beneficial in reducing metabolic disorders associated with excessive prepartum energy intake. But low colostrum yields can be a barrier to newborn calves receiving the recommended 10 to 12% of their bodyweight in their first feeding. Indeed, the NAHMS 2007 study indicates that only 40% of newborn heifer calves are receiving this volume of colostrum or more.

The Minnesota study looked at 60 multiparous Holstein and crossbred cows, balanced in four groups by 305ME and parity. The four nutrition treatments, fed from dry-off until calving (41+2 days), included:

- Wheat straw plus corn (WSC)
- Wheat straw plus molasses-based liquid feed (WSL)
- Grass hay plus corn (GHC)
- Grass hay plus molasses-based liquid feed (GHL)

The two rations containing forages-plus-corn resulted in greater starch consumption, while the two rations of forages-plus-liquid resulted in greater sugar consumption. First-milking colostrum yields were:

- WSC = 20.24 lbs.
- WSL = 21.12 lbs.
- GHC = 19.8 lbs.
- GHL = 23.98 lbs.

Second-milking colostrum yields also were higher for the sugar-versus-starch groups.

The research team concluded that prepartum dietary sugar supplementation tended to increase colostrum yield and colostrum solids yield. They also suggested that colostrum yield may be a predictor of circulating NEFA and liver triglycerides, and could serve as a tool to identify cows that are at risk for excessive liver lipid deposition (fatty liver syndrome). They concluded that careful prepartum nutrition management could not only improve colostrum yield, but also identify potentially at-risk animals.

QUALITY CORNER

What's Your Pre-Partum Calcium Status?

Not necessarily a conversation you normally hear around the dairy, right? But as Dr. Beede from Michigan State University points out, any degree of hypocalcemia at calving can initiate a downward spiral of costly problems for the lactating dairy cow. So why isn't calcium status of fresh cows checked more frequently and regularly? Good question! It isn't hard to do. A syringe or vacuum tube of blood from a few cows, a simple metabolic profile that can be performed in many veterinarian offices, and within a day you have tremendous insight into the calcium status of fresh cows on your farm. No other investment of time and money can yield so much beneficial information for so little cost. Knowledge is power, and knowing the calcium status of your fresh cows will tell you whether or not you are falling victim to this hidden, serious problem.

HAPPENINGS

QS or “Quality Scheme for Food.” is a quality assurance scheme that not only inspects products but, the entire production process — from farm to shop. QS requirements cover, amongst others, the use of pesticides, animal husbandry and feeding, the adherence of the cold chain just as the traceability of foodstuffs.



406 First Street
Ralston, IA 51459
(800) 843-4769
www.west-central.com