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Dairy herds with high rates of metabolic disorders may benefit from an anionic salt program.

Anionic Salt Programs for Close-Up Dry Cows

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Dairy farmers can improve long-term milk production by having a well-managed program for dry cows during the last 3 weeks before calving. In herds with high incidences of metabolic disorders, anionic salts may be a key to reducing milk fever, retained placentas and abomasal displacements.

Even in well-managed herds, with cows in proper body condition and with low incidences of clinical milk fever and ketosis, an additional 500 to 1,000 pounds of milk may be gained in subsequent lactation by avoiding subclinical hypocalcemia.

The most critical time in a dairy cow's production cycle is the first few days postpartum. How she performs during this time sets the stage for her complete lactation performance. A major factor is how she adapts from the dry cow group into the fresh pen. Cows that experience metabolic disorders at this time produce less and are more susceptible to secondary health disorders such as ketosis, mastitis, retained placenta, displaced abomasum and uterine prolapse. A smooth transition from the dry period into lactation is critical in achieving high peak milk production.

A primary management goal for this period is to control subclinical hypocalcemia and "droopy cow syndrome." Cows with these disorders expel fetal membranes late, have weak appetites and milk poorly. Consider the changes cows experience around the time of calving: hormonal profiles shift; the fetus relocates before birth, decreasing the cow's gut capacity; and the mammary gland prepares for lactation. And then she is expected to increase milk production from none to more than 70 pounds a day within a few weeks.

At calving, a cow producing 20 to 25 pounds of colostrum loses 23 grams of calcium in a single milking, or about nine times the amount in her entire plasma calcium pool. Two-thirds

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of all mature cows are estimated to be hypocalcemic at calving. Drops in plasma calcium pools cause hypocalcemia.

Calcium is vital to smooth muscle contraction. Therefore, postpartum subclinical hypocalcemia affects the reproductive tract's involution process, and gut motility. Normal blood calcium is 8 to 12 milligrams per decaliter (mg/dl). Blood calcium reduced to 7.5 or 5 mg/dl can lower abomasal motility by 30 and 70 percent, respectively. Reduced abomasal motility from low blood calcium lowers feed intake and displaces the abomasum.

Traditionally, hypocalcemia was thought to be caused by improper dietary calcium levels in the dry period. High calcium intakes in the dry period (more than 70 grams of calcium per day) were thought to suppress the cow's ability to use bone stores at calving, thereby inducing milk fever.

However, recent research suggests that potassium may play a significant, if not primary, role in subclinical and clinical hypocalcemia. If prepartum diets are high in calcium or potassium, consider an anionic salt program in the close-up dry-cow ration.

Anionic salts are minerals with a high proportion of anions. Anions are negatively charged; cations are positively charged. Living tissue maintains a balance of anions and cations to achieve neutrality. Thus, the balance of anions and cations in a feed should be near neutral.

However, certain cations and anions greatly affect the body's metabolic processes. In particular, the cations sodium and potassium and the anions chloride and sulfur are considered to greatly influence the acid-base status in the body. The dietary cation-anion difference (DCAD) concept quantifies the major cations and anions in diets. A negative DCAD diet contains more equivalents of anions than cations; a zero DCAD diet indicates balanced equivalents; and a positive DCAD diet contains more cation equivalents.

Research recommends a DCAD of 10 to 15 milliequivalents per 100 grams of dry matter for close-up dry cows. To calculate DCAD in milliequivalents per 100-gram ration of dry matter, use the following formula:

[(% sodium/0.023) + (% potassium/0.039)] — [(% chloride/0.0355) + (% sulfur/0.016)]

A ration using typical forages and concentrates generally has a positive DCAD. Adding anionic salts (magnesium sulfate, calcium sulfate, ammonium

Using anionic salts to manipulate DCAD

Keep these guidelines in mind when using anionic salts to manipulate the dietary cation-anion difference (DCAD):

- Know the macromineral (potassium, calcium, sulfur, chloride) content of all feeds in the diet. Wet chemistry techniques are recommended for accurate mineral analysis.
- Calculate the DCAD of the diet (see formula above). Manipulate the initial DCAD by optimizing low-potassium forages; the lower the initial DCAD, the less anionic salts needed to achieve desired DCAD balance. Many forages have high potassium contents (2.0 to 4.0 percent of DM). Consider designating certain fields for dry cow forage production and apply no manure to these fields.
- Supplement with calcium sulfate, ammonium sulfate, magnesium sulfate or a combination until total dietary sulfur reaches 0.4 percent.
- Add calcium chloride, magnesium chloride, ammonium chloride or a combination until the DCAD is 10 to 15 milli-equivalents per 100 grams of dry matter, following these guidelines:
  - ✔ Set dietary magnesium at 0.4 percent.
  - ✔ Raise dietary chloride to 0.5 to 0.6 percent; these levels appear to affect dry matter intake little. Dietary chlorine levels above 0.8 percent may reduce feed intake.
  - ✔ When using ammonium salts, check nonprotein nitrogen levels to avoid ammonia toxicity. Minimize ammonium salt use in diets with more than 70 to 75 percent of total protein in the degradable form.
  - ✔ Raise dietary calcium to 1.5 to 1.8 percent of dry matter (dietary supplementation between 150 and 200 grams calcium per day).
  - ✔ Set dietary phosphorus at about 0.4 percent (dietary supply between 35 and 50 grams of phosphorus per day).
- Monitor the urine pH of close-up dry cows weekly (or whenever forage base changes) to ensure that the acid-base status is being maintained. Use at least five cows; the more cows the better. If average pH is above 6.5, the ration is not affecting acid-base status enough to significantly alter blood calcium concentrations at calving. If pH is between 5.5 and 6.5 and dry matter intake is acceptable, then continue the current diet. However, if pH is less than 5.5 or dry matter intake has declined, remove some anionic salts.
- Keep total nonprotein nitrogen at less than 0.25 percent of total crude protein and keep degradable intake protein below 70 percent.

sulfate, calcium chloride, ammonium chloride and magnesium chloride) is the only way to achieve a negative DCAD. Use these salts only for the close-up dry-cow group. Do not feed heifers anionic salts. The potential lowering of dry matter intake that can occur when anionic salts are fed outweighs the possible benefits from feeding anionic salts to heifers. Springing heifers normally have fewer problems with milk fever and hypocalcemia, making anionic salts less beneficial to them.

Determining DCAD helps producers estimate a diet's influence on an animal's acid-base status. Anionic diets induce a subacute metabolic acidosis. How anionic salts improve post-calving calcium status is unclear. However, several body systems respond to this dietary manipulation and work together to stabilize plasma calcium pools, including the kidney (controls urinary calcium excretion), intestine (absorbs dietary calcium) and bone (stores calcium).

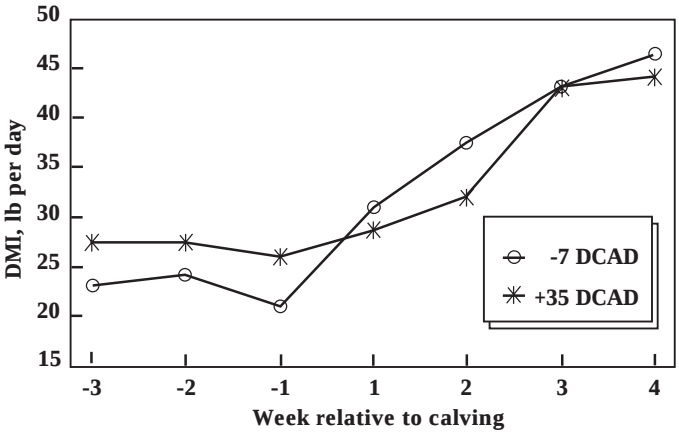
Feeding negative DCAD diets the last 3 weeks before calving can increase blood calcium. Research has shown that cows fed negative DCAD diets eat more feed in early lactation (Figure 1). University of Idaho research found that cows fed a negative DCAD diet took in less feed prepartum, but more postpartum than cows fed a positive DCAD diets. Furthermore, the negative DCAD diet increased blood calcium, apparently offsetting any harm from reduced intake prepartum.

When selecting anionic salts, consider the source. Some may have higher bioavailability, which increases the likelihood that enough minerals will be absorbed. Do not use sodium chloride or potassium chloride because they are neutral salts that contribute both anions and cations to the balance. They do not affect DCAD.

Although dietary DCAD is relatively easy to calculate, monitoring urine pH of close-up dry cows is a more accurate way to determine the diet's impact on an animal's acid-base status. The goal in feeding anionic salts is to lower blood pH, which usually raises blood calcium. Because urine pH drops with blood pH, a good indicator of blood pH is the more easily determined urine pH.

Producers can quickly and easily monitor urine pH on the farm using pH paper or a pH meter. The urine pH of close-up cows eating negative DCAD rations should be between 5.5 and 6.5. If urine pH is higher than 6.5, lower the DCAD level, either by decreasing dietary potassium levels or increasing sulfur or chlorine in the diet. A urine pH lower than 5.5 means that anionic salt intake is too high; lower salt levels to avoid reduced feed intake, displaced abomasum and kidney overload. Table 1 matches urine pH range with metabolic status.

Figure 1. Effect of DCAD on dry matter intake on cows around the time of calving.



DMI - Dry matter intake
DCAD - Dietary cation-anion difference
Source: Joyce, et. al., 1997, Journal of Dairy Science, 80:2866

Table 1. Relationship of dietary DCAD, urine pH, and metabolic status of dairy cows.

Close-up ration DCAD	Urine pH of close-up dry cows	Acid-base status of close-up dry cows	Calcium status of fresh cows
Positive	8.0 to 7.0	Alkalosis	Low blood calcium
Negative	6.5 to 5.5	Mild metabolic acidosis	Normal blood calcium
Negative	Below 5.5	Kidney overload crisis	

Source: Davidson et al., 1995. Hoard's Dairyman 140:16:634.

Because problems can occur when anionic salts are fed, producers absolutely must monitor the close-up pen and control feeding of anionic salts precisely. Use a total mixed ration to ensure that intake of anionic salts is adequate. Feed the diet free choice, giving animals access to feed throughout the day. In general, do not pasture dry cows being fed anionic rations because you cannot control or monitor the total feed intake.

Field reports indicate that some herds have had serious health problems when fed anionic salts. In severe cases, animals have died when anionic salts were misfed, probably because they ate too little dry matter because of excessive anionic salt feeding. These cases stress the importance of accurately monitoring feed intake of prepartum cows.

Unless you monitor dry matter intake and anionic salts consumption, do not feed anionic salts. Dry

matter intake normally declines as parturition nears, so anionic salts can further depress dry matter intake to the point that metabolic disorders arise. If animals take in significantly less dry matter near parturition, they can be predisposed to such metabolic disorders as displaced abomasum, milk fever, and ketosis. Feed anionic salts only to close-up dry cows. This necessitates having a minimum of two dry cow groups. Also, as mentioned before, separate springing heifers from cows and do not feed them anionic salts.

Summary

Feeding negative DCAD diets the last 3 weeks of the dry period can help reduce droopy cow syndrome. But remember to follow the guidelines, particularly regarding farm-specific ration formulation, intake monitoring and urinary pH evaluation, or you may do more harm than good. Proceed only under the guidance of a nutritionist or veterinarian.

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