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Managing Transition Cows for Better Health and Production

G. Bethard and S. Stokes

The most critical time in the life of a dairy cow is the first few days postpartum. How well she moves from low to high performance during this time depends on how she is managed during her transition from the dry cow group into the fresh pen. Proper nutrition management during the transition period is critical to avoid metabolic disorders and achieve high milk peaks and high production throughout lactation.

This publication discusses common metabolic disorders of transition cows and suggests prevention strategies based on proper feed management.

Metabolic disorders associated with poor transitions

Metabolic disorders result from disruption of a cow's internal biochemical processes. Examples include problems caused by improper levels of minerals (e.g., calcium) in the blood or improper rumen pH. Cows that recover from a metabolic disorder are less productive and more susceptible to secondary health disorders such as ketosis, mastitis, retained placenta, and uterine prolapse.

Common metabolic disorders in transition cows include rumen acidosis, milk fever, and displaced abomasum (Table 1). Each of these is discussed below.

Rumen acidosis

Subclinical rumen acidosis can trigger problems of varied severity. Indications or signs may include off feed, roller-coaster intake patterns, low milk fat, sporadic diarrhea, laminitis, and a high incidence of displaced abomasum. These problems often are blamed on other causes such as poor bunk management and/or poor forage quality.

A cow may experience lower than normal ruminal pH due to low daily intake and/or high fermentable carbohydrate (e.g., starch) intake during the transition period. This low rumen pH puts her at a higher-than-average risk of clinical rumen acidosis. The influence of overall dietary fermentable carbohydrate on rumen pH is a major link between nutrition, acidosis, and subsequent laminitis (infection of the hoof's laminae). Limiting high-energy diets and maintaining high intake of quality forages reduces the risk of acidosis.

Milk fever

Also known as parturient paresis, milk fever generally occurs at or near calving, particularly in high-producing cows. It is characterized by unconsciousness and paralysis. Cows with severe hypocalcemia also are more prone to retained placentas, uterine prolapse, and mastitis. If untreated, most cows with milk fever die within a day.

This problem is estimated to occur at a rate of 5 to 10 percent nationwide (Horst, 1986). The economic loss associated with milk fever has been estimated at $334 per occurrence (Guard, 1996), including cost of treatment and milk production losses. Incidence tends to increase with age and is higher in Jerseys than in Holsteins.

Milk fever results from severe hypocalcemia (low blood calcium). Most cows experience mild hypocalcemia after calving because of changes in the cow's need for calcium. In some cases, however, hypocalcemia becomes severe and leads to milk fever.

During the dry period, calcium requirements are minimal, but immediately after calving, the cow exports large amounts of calcium into milk. This sudden drain of calcium must be countered by increased calcium absorption from the gut or calcium resorption (mobilization) from bone, the body's calcium storehouse. Bone resorption occurs when absorption from the gut supplies less calcium than required. Hypocalcemia results when both calcium

Greg Bethard, technical service specialist, Monsanto Dairy Business; and Sandy Stokes, Extension dairy specialist, Texas A&M University, Stephenville. This publication replaces EM 8624 and WREP 13, both titled *Dry Cow Feeding and Management*.

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Table 1.—*Identification of fresh cow problems*.

Problem	Primary cause	Treatment	Prevention
Rumen acidosis	Depressed ruminal pH	Ruminal buffers	Close-up dry cow and fresh cow ration management
Milk fever	Drop in blood calcium	Calcium gluconate IV	Close-up dry cow and fresh cow ration management; oral calcium gel at calving
Displaced abomasum	Low dry matter intake	Surgery	Close-up dry cow and fresh cow ration management
Ketosis	Low energy intake	Dextrose IV, oral propylene glycol	Close-up dry cow and fresh cow ration management
Hardware	Ingestion of sharp object	Magnet on mixer/feeder wagon—rumen magnet	Watch for foreign material in feeds

absorption and bone resorption are insufficient to meet calcium demands.

Absorption of calcium in the gut occurs primarily in the small intestine and is facilitated by 1,25 dihydroxyvitamin D_3, a product of the body's metabolism of vitamin D. Calcium resorption from bone is influenced by 1,25 dihydroxyvitamin D_3, parathyroid hormone, and blood calcium. As blood calcium drops, parathyroid hormone is released, which in turn enhances calcium resorption from bone.

Methods for treating milk fever involve elevating blood calcium. For example:

- For "downer" cows, treatment normally consists of 8 to 10 g of intravenous calcium.
- Because of the role of 1,25 dihydroxyvitamin D_3 in calcium absorption and resorption, some experts recommend administering large quantities of vitamin D orally before calving to alleviate hypocalcemia.
- Calcium gels have been administered successfully to supplement blood calcium. The gels typically contain calcium chloride or calcium propionate. Calcium chloride can cause ulceration of the mouth and digestive tract and may induce severe metabolic acidosis and reduce dry matter intake (DMI). Calcium propionate has the advantage of containing propionate, a natural by-product of rumen fermentation and a readily available energy source for the cow.

Displaced abomasum (DA)

Displaced abomasum means the abomasum migrates to the left or right side. The gut may become twisted, resulting in partial blockage of the digestive tract. DA usually occurs within 1 month of calving and may be the primary problem or a secondary condition of another metabolic disorder. Fresh cows with low DMI and those whose ration is changed quickly are at greater-than-average risk of DA.

Reduced abomasal action also can lead to displaced abomasum. Reduced abomasal action can be the result of low blood calcium (hypocalcemia) because of the vital role calcium plays in muscle contraction. Normal blood calcium is 8 to 12 mg/dl. When blood calcium falls to 7.5 mg/dl, abomasal action is reduced 30 percent; at 5 mg/dl blood calcium, it falls 70 percent (Daniel, 1983).

To minimize the risk of DA, it's important to maintain DMI, maintain proper acid-base balance (see page 3), and watch for symptoms of milk fever.

Managing transition diet and feed

A proper diet during the transition period can help prevent the metabolic disorders discussed above. For management purposes, the transition cow is identified in two distinct phases: close-up dry cows (last 3 weeks precalving) and fresh cows (first 2 weeks in milk).

The close-up dry cow

During this period, the key objectives are to maintain adequate feed intake and to maintain a proper acid-base balance within the cow's body. Strategies for accomplishing both are discussed below.

Maintaining adequate feed intake

Feed intake usually decreases in the final 5 to 10 days before calving, and can be as much as 35 percent lower than in the early dry cow. Prepartum declines in feed intake have been attributed to several factors, including hormone fluctuations and repositioning of the fetus in preparation for calving.

At the same time that intake is decreasing, however, nutrient requirements are increasing because of the growing calf. Thus, maintaining adequate intake is important. As discussed above, inadequate dry matter intake is associated with displaced abomasum and other problems.

The fiber content of feed can have a significant effect on intake. Figure 1 illustrates that mature cows fed a high-fiber diet (66 percent neutral detergent fiber, NDF) ate 6 lb less dry matter than did cows fed a diet containing moderate levels of fiber (43 percent NDF). Furthermore, cows in their first lactation receiving the 43 percent NDF diet consumed substantially less feed than did mature cows on the same diet.

Two factors to consider in formulating close-up rations are nutrient profiles and feed ingredients. Table 2 shows example nutrient profiles for close-up cows. Note that the fiber content is reduced in the close-up dry cow diet, while nonfiber carbohydrate is increased.

Ingredients included in the fresh cow ration should be introduced in the close-up ration. A rule of thumb is the halfway point. For example, if the first group a cow joins after calving gets 6 pounds of cottonseed, she should get 3 pounds of cottonseed in the close-up period. The same applies for fermented feeds and fat products. Buffers are an exception to this rule; they should not be fed at any time during the dry period.

Maintaining acid-base balance

Living tissues in plants and animals maintain acid-base neutrality by balancing anions and cations. Anions are negatively charged ions; cations are positively charged ions.

The net sum of anions and cations in a feed must be neutral. Even when they are balanced, however, certain cations and anions have larger effects on metabolic processes in the body than do others. In particular, the cations sodium and potassium and the

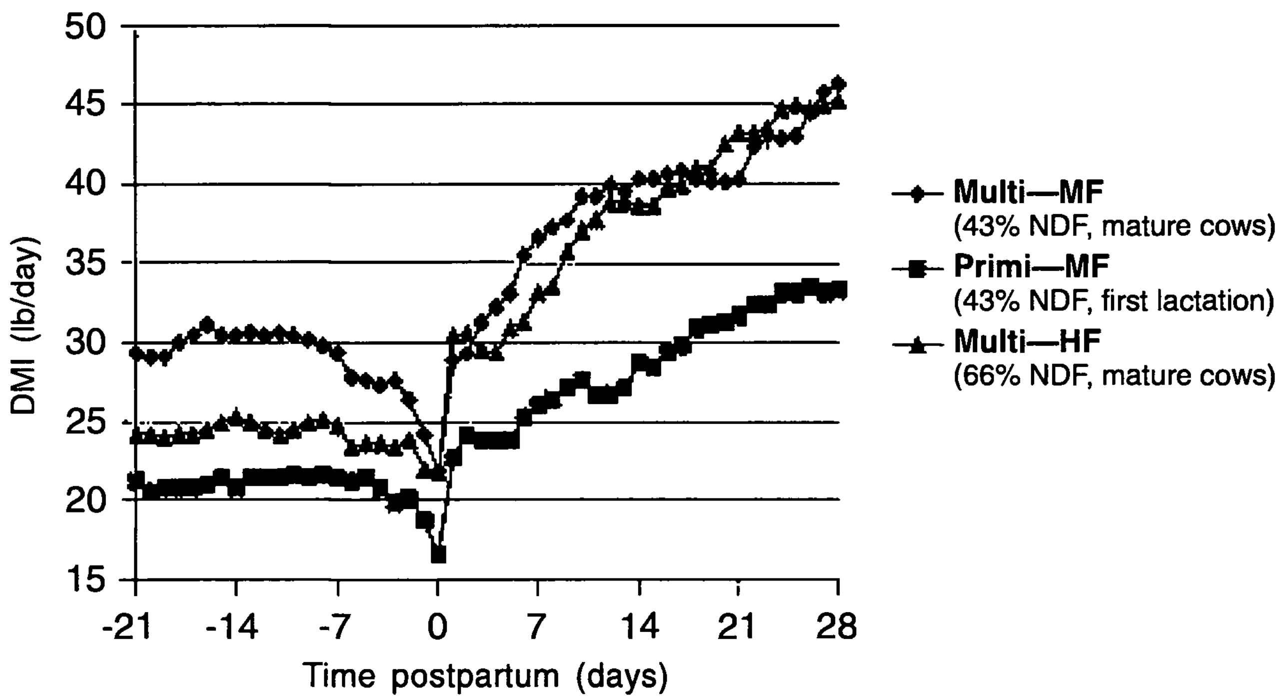

Figure 1.—Effect of dietary fiber level and age on dry matter intake during transition.

Table 2.—*Nutrient guidelines for transition rations.*

	Far-off dry cow	Close-up dry cow	Fresh cow
NE (Mcal/lb)	0.57–0.60	**0.68–0.70**	0.77
Crude protein, %	12–13	**14–16**	18
NDF, %	40	**35–40**	28–30
Nonfiber carbohydrate, %	25	**30–35**	35–38
Fat, %	3	**4**	5

NE = net energy
NDF = neutral detergent fiber

anions chloride and sulfur are considered a major influence on the body's acid-base status.

In dry cows, the relative amounts of these ions are particularly important because of their indirect effect on blood calcium levels. Although the mechanisms are not completely understood, a diet high in chloride and sulfur ions (anions) induces metabolic (systemic) acidosis and lower blood pH, which in turn cause elevated blood calcium.

Horst et al. (1997) suggest that metabolic acidosis increases responsiveness to parathyroid hormone, thus increasing calcium resorption from bone. Horst et al. also suggest that parathyroid hormone receptors in bone function better at low blood pH. These effects are beneficial in close-up cows, which need increased calcium resorption to balance the calcium exported to milk.

The dietary cation-anion difference (DCAD) concept attempts to quantify the major cations and anions in the diet and to estimate the influence a diet will have on the acid-base status of the animal. DCAD normally is expressed using milliequivalents of the major cations and anions as follows:

(sodium + potassium) – (chloride + sulfur)

A negative DCAD diet contains more equivalents of anions than cations, a zero DCAD diet contains equal equivalents, and a positive DCAD diet contains more cation equivalents. See the box on page 5 for details on how to calculate DCAD and adjust a feed ration accordingly.

To improve calcium resorption in dry cows (and thus reduce the risk of milk fever and DA), a negative DCAD diet can be beneficial. Researchers from Michigan State University have recommended a DCAD of -10 to -15 milliequivalents per 100 g dry matter for close-up dry cows (Davidson et al., 1995). Horst et al. (1997) summarized six studies and concluded that milk fever prevention is highest when DCAD is -5 to -10 milliequivalents per 100 g dry matter.

Rations formulated using typical forages and concentrates often are high in potassium (a cation) and generally have a positive DCAD. Thus, consider adding an anionic salt program to the close-up dry cow ration, especially if the herd is experiencing problems with metabolic disorders such as milk fever, retained placentas, and abomasal displacements. Anionic salts (magnesium sulfate, calcium sulfate, ammonium sulfate, calcium chloride, ammonium chloride, and magnesium chloride) are minerals that have a high proportion of strong anions. Adding these salts or other commercial products containing chloride is the only way to achieve a negative DCAD.

Recent work suggests chloride may be the most effective anion (Goff and Horst, 1998). However, high levels of chloride can cause reduced DMI. Chloride levels of 0.5 percent have little effect on DMI, but most diets require closer to 0.6 percent chloride for effective DCAD. Chloride levels greater than 0.8 percent create a risk of DMI depression.

A premix of anionic salts and added calcium with a carrier such as soybean meal or ground corn is ideal. A premix avoids improper mixing of anionic salts and allows rapid changes in the anionic salt content of the diet.

Remember that the purpose of feeding anionic salts is to decrease blood pH, which usually increases blood calcium. Thus, to measure the effectiveness of the anionic salt program, you need to monitor blood pH, which is done most easily by monitoring urine pH. Because urine pH drops as blood pH drops, it is a good indicator of blood pH. Thus, an anionic diet should result in a lower urine pH than a cationic diet.

Table 3 illustrates the relationship between urine pH of close-up dry cows and DCAD of diet. In Table 3, the optimal situation is a negative DCAD diet that results in mild metabolic acidosis, normal blood calcium, and urine pH between 5.5 and 6.5. Horst et al. (1997) concurred, suggesting that urine pH of close-up dry cows should be between 5.5 and 6.2. Many commercial nutritionists recommend the average urine pH of a close-up group on an anionic salt program should be 5.5 to 6.0 (Jersey cattle) or 6.0 to 6.5 (Holstein cattle).

Urine pH can be monitored on the farm using pH paper or a pH meter. These values can help determine the effectiveness of the DCAD diet and prevent problems from forage changes or excessive intake of anionic salts. If urine pH is less than 5.5, anionic salt intake is excessive and should be reduced to prevent reduced feed intake, displaced abomasum, and kidney overload.

Although supplementing close-up dry cow diets with anionic salts can reduce the incidence of milk fever, there are two potential problems that must be considered. First, anionic salts significantly increase feed costs for the close-up group. Second, they are very unpalatable and can reduce DMI. Dry matter intake normally declines as calving approaches, and anionic salts can further depress DMI to the point where metabolic disorders, such as displaced abomasum, milk fever, and ketosis, arise. Research by Goff and Horst (1998) suggests that, unlike straight anionic salt formulations, commercial products containing chloride might not depress DMI.

Field reports indicate that some herds had serious health problems when anionic salts were fed. In severe cases, animals died when anionic salts were fed incorrectly. This could be a result of reduced DMI from excessive anionic salt feeding.

Formulating close-up diets using DCAD

1. To calculate DCAD, first have a macromineral (sodium, potassium, calcium, sulfur, chlorine) analysis for all feeds in the diet. Wet chemistry techniques are recommended for accurate mineral analysis.
2. Select forages that are low in potassium. This results in a lower DCAD, which reduces the amount of anionic salts needed to achieve the desired negative DCAD.
3. Calculate DCAD of diet in milliequivalents per 100 g of ration dry matter using the following formula:

   [(% sodium/0.023) + (% potassium/0.039)] – [(% chloride/0.0355) + (% sulfur/0.016)]
4. To achieve a negative DCAD, use either commercial chloride-containing products or anionic salts. If you use products containing chloride, begin with the manufacturer's recommendations. If you use anionic salts, start with magnesium sulfate, as it is the most palatable. Add until total magnesium is 0.4 percent of dry matter.

   Next, add calcium sulfate and/or ammonium sulfate until sulfur is 0.4 to 0.5 percent of dry matter. Last, add calcium chloride and/or ammonium chloride until DCAD is -5 to -15 milliequivalents per 100 g dry matter. Chloride levels should be limited to less than 0.8 percent of the ration to avoid intake depression.

   When selecting anionic salts, consider the source. Some sources may be more easily absorbed by the body. Don't use sodium chloride or potassium chloride. They contribute both anions (sodium or potassium) and cations (chloride) to DCAD calculations, making their effect neutral.

   When you use ammonium salts, check nonprotein nitrogen levels to avoid ammonia toxicity. Minimize ammonium salts in diets with more than 70 to 75 percent of the protein in the degradable form.
5. Elevate calcium to 1.5 to 1.8 percent of dry matter. Negative DCAD diets increase urinary calcium excretion, so more calcium is needed in the diet.
6. After a week of feeding anionic salts, monitor urine pH of close-up dry cows. If pH is above 7.0, you can add more chloride-containing products or anionic salts until the desired pH is reached. If pH is 5.5 to 6.5 and DMI is acceptable, continue with the current diet. If pH is less than 5.5 or DMI has declined, remove some of the anionic salts.

Table 3.—*Relationship between DCAD, urine pH, and acid-base status of close-up dry cows, and calcium status of fresh cows (Davidson et al., 1995).*

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	7.0 to 8.0	Alkalosis	Low blood calcium
Negative	***5.5 to 6.5***	***Mild metabolic acidosis***	***Normal blood calcium***
Negative	below 5.5	Kidney overload crisis	

The precision required for success with an anionic salt program warrants the advice of a consulting nutritionist or veterinarian. Because serious problems can result when anionic salts are fed, close monitoring of the close-up pen and precise control over feeding are necessary. Feeding anionic salts is not recommended in cases where DMI is not measured or where consumption of anionic salts cannot be monitored.

When feeding anionic salts, use a total mixed ration to ensure adequate intake of anionic salts. The diet should be fed free-choice with animals having access to feed throughout the day.

Only close-up dry cows should be fed anionic salts. Field reports suggest that hypocalcemic cows often do not respond to treatment if anionic salts have been fed throughout the entire dry period. Thus, there must be at least two dry cow groups. Just as important, the feeding of anionic salts should be stopped after calving.

Heifers should not receive anionic salts (Moore et al., 1997). With heifers, the potential for DMI depression outweighs the possible benefits of anionic salts. Springing heifers normally have fewer problems with milk fever and hypocalcemia, making anionic salts less beneficial for them. Moore et al. (1997) reported that Holstein heifers in their study were not hypocalcemic after calving.

The fresh cow

A well-managed close-up dry cow with adequate body condition (3.5 on a scale of 1 to 5) enters the fresh cow pen with minimal complications. Getting the cow on a steady feeding pattern post-calving is the key to minimizing her risk of metabolic problems. A well-managed transition cow should have 85 to 90 percent of her peak appetite and be ready to leave the fresh pen by 2 weeks after calving.

Ideally, a fresh cow pen simply is a smaller pen where cows can be monitored more closely for metabolic problems and other disorders associated with calving. Early fresh cows should have plenty of access to feedbunk and stall space to encourage appetite and overall health. This is not the group to crowd!

If the close-up dry cow ration is on target, the fresh cow ration will mirror closely the high cow ration. However, cows in the fresh pen may benefit from additional long hay and other ingredients such as yeast, probiotics, and/or chelated minerals.

A popular management technique for promoting feed intake in fresh cows is to have a small, rotating group of super-fresh cows (less than 3 weeks in milk). The goal is to provide a minimal stress environment, while carefully monitoring these cows for early signs of metabolic problems. However, if only moderate levels of energy and protein are fed in this ration, it is important not to leave super-fresh cows in this pen too long, to avoid inducing metabolic problems.

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