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## Abstract

Reducing cull rates and improving fertility in early lactation has a dramatic effect on the profitability of many dairies. Continuing research on transition cow nutrition has led to the development of an array of nutritional strategies to prevent disorders during the transition period. It is important, however, to realize that some of these strategies have similar modes of action, and as such, their effects are not likely to be additive. Producers should work with their nutritionist and veterinarian to identify the most prevalent transition problems in the herd and review options for preventing those disorders.; Dairy Day, 2007, Kansas State University, Manhattan, KS, 2007; Dairy Research, 2007 is known as Dairy Day, 2007



## Keywords

Dairy Day, 2007; Kansas Agricultural Experiment Station contribution; no. 08-127-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 984; Dairy; Transition period; Monensin; Choline; Propylene glycol; Vitamin E

# NUTRITIONAL STRATEGIES FOR A HEALTHY TRANSITION TO LACTATION: AN UPDATE

***Barry Bradford***


## Summary

Reducing cull rates and improving fertility in early lactation has a dramatic effect on the profitability of many dairies. Continuing research on transition cow nutrition has led to the development of an array of nutritional strategies to prevent disorders during the transition period. It is important, however, to realize that some of these strategies have similar modes of action, and as such, their effects are not likely to be additive. Producers should work with their nutritionist and veterinarian to identify the most prevalent transition problems in the herd and review options for preventing those disorders.


(Key words: transition period, monensin, choline, propylene glycol, vitamin E.)

## Introduction

Despite significant advances in nutritional management of dry cows in recent years, the transition period remains the most challenging component of the production cycle for dairy cattle. Disorders such as mastitis, metritis, displaced abomasum, ketosis, and fatty liver are common during the transition period, often resulting in high cull rates and contributing to poor fertility in early lactation. The following is a brief update on the latest strategies being employed to improve the health of transition dairy cows.

## Energy Density and Forage Quality

Excessive body condition at calving is clearly a major risk factor for metabolic disorders during the transition period, and all dairies should focus on limiting body condition gain during late lactation and in far-off dry cows (21 to 60 days before calving). Substantial disagreement, however, remains on the question of whether "steam-up" rations are necessary for close-up cows (the final 21 days before calving).

The logic behind the steam-up approach is simple. Immediately switching a cow from a forage-based ration to a high-concentrate ration can cause problems, particularly acidosis and variable feed intake. The steam-up ration is intended to provide time for the rumen to adapt to a higher-grain diet before lactation begins. In contrast, research at the University of Illinois has demonstrated that low-energy diets incorporating wheat straw can be fed throughout the dry period without causing problems during the transition to lactation. These rations are formulated for 40 to 50% forage neutral detergent fiber (from corn silage, straw, and alfalfa hay) and have $NE_L$ values of about 0.62 Mcal/lb of dry matter. Based on these studies, some nutritionists have concluded that a steam-up ration is unnecessary, allowing formulation of a single ration for all dry cows.

On the other hand, numerous studies have supported the idea that steam-up rations can improve metabolic health in early lactation. Two of the most complete studies compared rations providing approximately 0.59 versus 0.74 Mcal $NE_L$/lb of dry matter, primarily by altering fiber and starch concentrations. Both of these studies found that the higher-energy, close-up rations increased feed intake and energy balance after calving. As a result, steam-up rations limited the increase in plasma non-esterified fatty acids (NEFA) and liver triglycerides in early lactation, which is expected to decrease the incidence of fatty liver, ketosis, and possibly other disorders.

How should we reconcile these findings? It may be that each approach provides a distinct benefit for transition cows. Incorporating a slowly-digested fiber source (such as wheat straw) in the close-up ration maintains ruminal fill during short periods of reduced feed intake, helping to prevent displaced abomasum and reducing risk of acidosis when cows begin eating again. In contrast, higher-energy diets provide an opportunity to adapt ruminal microbes to an increase in digestible carbohydrates before the lactation ration is introduced. Perhaps more importantly, steam-up rations typically increase propionate production, providing more glucose precursors to the liver as lactation begins.

The ideal close-up ration may incorporate a slowly-digested fiber source within a relatively high-energy ration. Proportions of neutral detergent fiber and starch in close-up rations can be close to those of a lactation ration, with perhaps 1/3 of the dietary forage replaced with an ingredient such as wheat straw or prairie hay. Feeding a low-energy ration to far-off cows followed by this type of steam-up ration for the final 21 days of the dry period may minimize the incidence of transition cow disorders. Alternatively, facilities and labor situations on certain farms may make a single-group dry cow program a better option. In either case, producers need to ensure cows are actually consuming the ration that is being fed. Ingredients such as wheat straw typically need to be chopped to reduce particle size to 2 inches or less, and the ration must be moist enough to prevent cows from sorting.

## Choline

Availability of a rumen-protected choline (RPC) product has spurred a great deal of interest in the potential for choline to prevent fatty liver in transition cows. Choline is an essential component of the machinery responsible for the exporting triglycerides from the liver, and if a lack of choline availability limits this process, then RPC may prevent triglyceride accumulation in the liver.

Recent studies have strengthened the evidence that RPC can be an effective tool to limit fatty liver. Feeding RPC slowed the rate of liver triglyceride accumulation in feed-restricted cows and also increased the rate of triglyceride clearance from the liver in cows recovering from feed restriction. Many more experiments have demonstrated a positive effect of RPC on milk production in early lactation. One recent study of 182 transition cows found that RPC increased milk production by 2.6 lb/day during the first 60 days of lactation. Interestingly, this production response was entirely due to a 9.7 lb/day response to RPC in overweight cows (body condition score $\geq 4.0$), with no production response among cows with body condition scores $< 4.0$. This dramatic benefit among the overconditioned cows underscores the importance of solving metabolic problems to improve productivity.

Based on the strength of these new studies, herds with overconditioned cows, or those having a large incidence of ketosis, should consider utilizing RPC in their transition diets.

Most studies with RPC have supplemented cows at about 60 grams per cow/day during the close-up period and through the first 3 to 4 weeks of lactation.

## Glucose Precursors

Feeding or drenching glucose precursors remains a popular approach to ketosis prevention. Given the cost of supplements such as propylene glycol (PG) and calcium propionate, however, the decision to use these nutrients should be made carefully.

Studies have consistently shown that drenching cows with PG has positive effects on metabolic health. Drenching with PG provides the cow with compounds that can be used for glucose synthesis, resulting in increased plasma concentrations of glucose and insulin. This, in turn, decreases plasma NEFA and ketone concentrations. Because drenching transition cows is a labor-intensive process that is impractical on many farms, some dairy producers simply incorporate PG into fresh cow rations. Unfortunately, there is little evidence that dietary PG provides the same benefits as drenching with PG. The problem with delivering PG in the diet is that ruminal microbes are capable of metabolizing PG, and if small amounts of PG are consumed throughout the day, most of it is degraded before it can be absorbed. This problem is avoided with oral drenches because a large amount is delivered at once, allowing the majority of the PG to be absorbed before it is metabolized in the rumen.

Calcium propionate has been evaluated as another potential glucogenic ingredient, and it remains stable when included in the ration. Few experiments with calcium propionate, however, have shown any benefit for metabolic health, and no production responses have been observed. Although propionate is an important glucose precursor in dairy cows, dietary calcium propionate has only an incremental effect on total propionate absorption by the cow. Furthermore, excessive propionate uptake is known to suppress feed intake. Therefore, inclusion of calcium propionate in transition cow diets is not warranted.

For farms with ketosis problems, appropriate facilities, and sufficient labor, drenching cows with PG several times in the first week of lactation may be beneficial. One benefit of the drenching protocol is that individual cows can be targeted for treatment rather than treating all fresh cows. Cows with excessive body condition, or those affected by disorders such as displaced abomasum or retained placenta, are logical candidates. It is recommended that each cow targeted for treatment be drenched with 500 cc of PG for at least 2 days.

## Monensin

Monensin was approved for use in lactating dairy cows several years ago. Although the only approved market claim for monensin is that it increases feed efficiency, many dairies are interested in its potential effects on energy status of transition cows.

The evidence for a beneficial effect of monensin on transition cow health is substantial. The most convincing study included 1,317 cows on 45 farms, in which cows randomly assigned to monensin treatment were administered a controlled-release capsule (CRC) beginning 2 to 4 weeks prior to calving. In this study, CRC administration decreased the collective incidence rate of retained placenta, displaced abomasum, and clinical ketosis by 30%.

Unfortunately, monensin is not available in the CRC form in the U.S. The question, then, is whether incorporating monensin in close-up or fresh cow rations can provide the same benefit. In particular, concerns exist that

the decrease in feed intake that commonly occurs during the week of calving may limit monensin intake enough to decrease its beneficial effects.

One published study has compared transition cow responses to monensin delivered in the diet versus CRC's. Although only the CRC significantly improved body condition in early lactation, dietary monensin was just as effective as the CRC at decreasing plasma ketone concentrations. Taking into account past studies demonstrating that dietary monensin can decrease plasma NEFA and ketones in early lactation and decrease time to first service, including monensin in transition cow rations likely provides at least some of the benefits observed in CRC-treated cows. Dairies wishing to incorporate monensin into transition cow diets should do so at the rate of 22 mg/kg of dry matter.

## Antioxidants

In the 1990s, a number of reports documented the ability of supplemental vitamin E and selenium to decrease the incidence of mastitis in early lactation. Recently, a meta-analysis showed that supplemental vitamin E is also effective at preventing retained placenta. Several studies have also associated low plasma vitamin E concentrations with increased incidence of fatty liver and displaced abomasum. Therefore, it is recommended that transition cows be fed at least 1,500 IU of vitamin E per day and that dry and fresh cow rations include 0.3 ppm of selenium.

## Future Research

Several other ingredients are attracting renewed interest for their potential benefits in transition cows. Glycerol is becoming more available as the biodiesel industry grows and is often the lowest-cost glucose precursor available. Initial experiments, however, evaluating the effects of glycerol on transition cows have not demonstrated any health or production benefits. Encapsulated niacin is another product with promise for preventing fatty liver and ketosis. Niacin that survives the rumen clearly limits NEFA release from adipose tissue, but no reports exist that have evaluated effects of encapsulated niacin on transition cows. In the next several years, new research on both glycerol and encapsulated niacin should provide more insight into the efficacy of these ingredients.