Transition cow research: what makes sense today?

by Elliot Block

TRANSITION COW nutrition and management have received much attention in recent years because of its importance in the productivity and health of cows. The problem our research scientists face is their ability to gather enough cows of similar productivity characteristics in one place to conduct research. Because of this difficulty, we have used animals outside of this short time frame and tried to simulate the same conditions that exist in the true transition cow. This method has given us a deeper understanding of the problems faced by these cows, but has also led to some confusion in interpreting data.

It is now well established that dry matter intake (DMI) decreases as calving approaches. DMI can decrease from 2.0 percent of body weight in the first few weeks of the dry period to 1.4 percent of body weight 7 to 10 days before calving. This 30 percent decrease appears to occur very rapidly in the transition period. During the three weeks after calving, DMI will increase at the rate of 1.5 to 2.5 kilos per week, with mature cows increasing faster than first lactation animals. However, individual cow variation in DMI decrease prepartum and DMI increase postpartum is enormous.

The decrease in prepartum DMI has classically been attributed to rapid growth of the fetus taking up abdominal space and displacing rumen volume. However, there is no doubt that hormonal and other physiological factors have the most important impact on this phenomenon. During the last week of pregnancy, nutrient demands by the fetal calf and placenta are at their greatest, yet DMI may be decreased by 10 to 30 percent compared to the early dry period.

A number of profound physiologic changes occur in the transition cow that modify her metabolism drastically. Rapidly increasing demands of the fetus and development of the mammary glands, including the initiation of synthesis of milk components, are causing these changes.

Rumen Function

It is not unusual for a high producing cow in the first 100 days in milk to consume 22 kilos of dry matter per day, of which more than half is concentrates, without posing any particular problems if the diet is well balanced. However, this same diet consumed by a fresh cow can cause severe ruminal acidosis. The major difference in rumen function between these two stages of lactation can explain the different responses to the same diet.

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During the dry period, cows generally consume a diet that is principally composed of forages and is more fibrous than the diet offered in lactation. This nuance affects rumen function in two ways. First, rumen flora are adapted to a diet that is low in non-fiber carbohydrates (NFC) during the dry period, allowing for a large population of cellulolytic bacteria and a low population of amylolytic bacteria. Because amylolytic bacteria generate lactic acid, their decrease is accompanied by a decrease in the bacteria that utilize lactic acid.

If the ration is changed abruptly at calving, the capacity of the rumen flora to metabolize lactate (the principal acid responsible for acute rumen acidosis) is at a minimum at the start of lactation. Lactate-producing bacteria increase in numbers rapidly as the amount of NFC in the diet increases, but lactate-utilizing bacteria adapt more slowly (3 to 4 weeks). Therefore, the risk of lactate accumulation in the rumen is high with abrupt changes from high to low fiber diets. Further, it is a known phenomenon that as DMI increases, rate of passage from the rumen increases.

After calving (when DMI is relatively low) rate of passage is slow, allowing for greater fermentation and acid accumulation in the rumen. If dietary NFC increases abruptly at calving, with high levels of fermentable carbohydrates, the amount of volatile fatty acids (VFA) produced far exceeds the capacity of the rumen to absorb them, leading to elevated concentrations of VFAs in the rumen. This situation leads to subacute rumen acidosis, which contributes to reduced dry matter intake and feed digestibility, as well as laminitis in the early postpartum period.

Health problems associated with the transition period

All of the conditions described favor the occurrence of health problems during the transition period. The principal ones are:

- Disorders related to energy metabolism (fatty liver, ketosis, subacute and acute ruminal acidosis).
- Disorders related to mineral metabolism (milk fever, sub-clinical hypocalcemia, udder edema).
- Problems related to the immune system (retained placenta, metritis, mastitis).
- Reproductive failure.

The transition period is marked by major hormonal changes. While these hormones are causing a reduction in DMI there is an increase in nutrient requirements by the cow to support fetal growth, mammogenesis, and lactogenesis. This increase in demand is partially met by the DMI and partially by the mobilization of body tissues.

Although the hormonal milieu will drive a certain amount of this body mobilization, excessive body catabolism is undesirable for health, reproduction, and milk production. It is, therefore, essential to pay particularly close attention to the formulation of rations in the transition period both pre- and post-partum.

Energy demands of gestating cows reach 1.3 to 1.5 times the maintenance requirements by the end of gestation. The growth of fetal tissues follows an exponential curve beginning in the third trimester of pregnancy. During both the prepartum and postpartum transition period cows require more energy than they are able to consume, resulting in negative energy balance and loss of body weight to supply the necessary energy, even in healthy cows.

It is obvious that preventing a decline in dry matter intake prepartum, increasing it rapidly postpartum, and making certain that energy density is as high as possible in both transition phases, are the most important control points for these cows.

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Conclusions:

While we feel that we have a grasp of a transition cow's needs, it is not clear how we should meet them. Obviously there are many different successful manners to feed the transition cow. While these appear divergent, there are several commonalities that lead to the following messages:

Protein

1. Protein should be evaluated on a metabolizable protein (MP) basis. Prepartum transition cows need about 1,100 to 1,200 grams per day of MP, while first and second lactation animals need 1,200 to 1,400 grams per day. Underfeeding will result in low start-up milk and reduced peaks, as well as compromising the immune system.

2. Diets that are low in fermentable carbohydrate (starch) will need a significant amount of rumen bypass metabolizable protein having a good amino acid profile.

Carbohydrates

1. To mitigate the reduction in dry matter intake in the prepartum transition period, starch levels should be kept at or below 22 percent. The lower the starch the more critical will be the bypass metabolizable protein due to reduced rumen microbial fermentation.

2. Postfresh cows should not be fed starch levels that would be more normal later in the early lactation phase (25+ percent), because rumen rate of passage is slower and there is more chance for acidosis. Keep starch below 25 percent and total NFC around 35 to 38 percent.

Fat

1. Since there is no specific need to increase energy density prepartum by using fat instead of carbohydrate, but there appears to be a metabolic benefit to adding unsaturated fatty acids to the intestine, some amount of fat appears warranted. A source of rumen inert or bypass unsaturated fatty acids, not exceeding 0.25 pounds per cow per day, will help with immune function and overall energy metabolism postpartum.

2. In the post-fresh period research shows that unsaturated fatty acids in the intestine can improve immune and reproductive function. However, it is still not ideal to replace carbohydrates with a lot of fat. Keep levels to 0.25 pounds per cow per day, and be careful of rumen active fats in oilseeds and corn byproducts so as not to trigger a milkfat depression.

Minerals

1. Dietary magnesium should be maximized in pre- and post-fresh rations to 0.4 percent dry matter.

2. Prefresh calcium should be lower than typical (less than 0.6 percent if possible) if managing for a 21-day pre-fresh transition period, and increased to 0.8 to 1 percent post-fresh.

3. DCAD should be less than zero pre-fresh (-10 to -15 meq/100g DM if forages vary in potassium levels).

4. DCAD should be highly positive post-fresh, which can be achieved by:

– Keeping chlorine and sulfur to minimal levels.

– Removing excess salt.

– Maximizing sodium buffers to 0.5 pounds (or more) per cow per day (dietary sodium should not exceed 0.8 percent of the diet).

– Increasing dietary potassium without adding potassium chloride or potassium sulfate to reach the desired DCAD of 35-45 meq/100g dry matter.