

Nutritional Management of Dairy Cows During the Transition Period

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INTRODUCTION

We define the transition period as the period 2 - 4 weeks prior to calving through 2 - 4 weeks after calving. Intake depression pre-calving and slow intake ascent post-calving are observed during this period, thereby compromising the nutritional status of transition cows.

Potential consequences of an inadequate transition program include:

- metabolic disorders--milk fever, fatty liver, and ketosis
- reproductive disorders--retained placenta (RP) and metritis
- digestive disorders--subclinical rumen acidosis (SARA) and displaced abomasum (DA)
- rapid and excessive loss of body condition in early lactation
- low peak milk yields
- poor fertility
- high veterinary costs
- high involuntary cull rates.

Practices in the nutritional management of dairy cows during the transition period will be discussed in this paper.

ENERGY

There is a 30% decline in dry matter intake (DMI) prior to calving, and for the first few weeks of the subsequent lactation DMI is 20% - 30% below peak lactation DMI. Energy requirements for maintenance and pregnancy increase during the last month prior to calving, and energy requirements for milk production increase abruptly with calving and are high in early lactation. Inadequate energy intake relative to requirements causes mobilization of body fat, which elevates plasma nonesterified fatty acid (NEFA) concentrations. Excessive body fat mobilization can lead to fatty liver. Michigan

workers reported that elevated NEFA prior to calving was a risk factor for RP, ketosis, DA, and mastitis in the subsequent lactation.

One strategy for enhancing energy intake is to feed a diet that is more energy dense. An energy density of .71 - .73 Mcal NE_l/lb. DM is recommended for the pre-fresh diet. This diet should be fed for the last three weeks prior to calving. If springing 1st-lactation heifers are managed in a group separate from mature cows, they should be fed this diet for the last five weeks prior to calving because they have higher energy requirements than mature cows due to growth. Typically, high-group diets contain .78 - .80 Mcal NE_l/lb. DM. Using a stair step approach to transitioning, an energy density of .76 - .78 Mcal NE_l/lb. DM is recommended for the post-fresh diet. This diet should be fed for 2 – 4 weeks post calving. Feeding management practices that help maximize DMI, and thereby increase energy intake, should be emphasized throughout the transition period.

Body Condition

Cows should freshen with a body condition score (BCS) of 3.5 (range from 3.25 to 3.75). Proper conditioning needs to be done mainly before dry off.

Over-conditioned cows, those that freshen with a condition score of 4 or 4+, undergo greater depression of DMI pre-calving and have slower DMI ascent and lower peak DMI post-calving, and are more prone to fatty liver, ketosis, and DA. Also, these cows often exhibit rapid and excessive weight loss in early lactation leading to poor fertility. New York workers reported 1st service conception rates of 17% for cows losing more than a point of BCS versus 65% and 53% for cows losing <0.5 or 0.5 – 1.0 BCS points, respectively, over the first 5 weeks post-calving.

Thin cows, those that freshen with a condition score of 3 or 3-, do not have enough energy coming from body fat mobilization to support high levels of milk production. There is normally enough energy contributed from body fat mobilization in early lactation to support 1,000 to 1,500 lb. of milk production.

Carbohydrates

Potential benefits of increasing the energy density of pre-fresh diets via supplementation of non-fiber carbohydrates (NFC) include: increased DM and energy intakes and reduced body fat mobilization, plasma NEFA, liver triglyceride, and plasma beta-hydroxybutyrate (BHBA). Other potential benefits include adaptation of the rumen microbial population to higher starch diets and stimulation of rumen papillae growth for increased volatile fatty acid (VFA) absorption. We recommend 35% - 40% NFC (DM basis) in pre-fresh diets. This is usually achieved through the feeding of high-starch concentrates. These concentrates should be limited to no more than 40% - 50% of total ration DM, .75% of body weight, or 10 - 12 lb. DM per cow per day.

Another supplementation strategy being used in the field for pre-fresh cows is the feeding of high-fiber concentrates. Missouri researchers reported that replacement of

30% of the grass hay in a corn silage – grass hay pre-fresh diet with soy hulls increased DMI pre-calving, reduced BCS loss pre-calving, and increased milk production in the subsequent lactation. One Midwest-based feed company reports good success from their pre-fresh diet recommendation of 5 lb. grass hay (as fed basis) and 12 lb. high-fiber concentrate (as fed basis) with the rest of the diet from corn silage. There is a lack of published research data comparing high-starch concentrates versus high-fiber concentrates as supplements in pre-fresh diets. Fiber sources with high ruminal fermentability (i.e. soy hulls or beet pulp) should be used if the high-fiber concentrate supplementation strategy is employed.

Transition diets should contain adequate coarse particles to support good chewing activity and rumen fill. Diets with 8% - 10% of particles on the top screen of the Penn State – Nasco shaker box are recommended for both pre-fresh and post-fresh cows. Inclusion of 3 – 5 lb. of hay in the TMR for transition cows can help meet our coarse particle recommendation. Sorting of the transition-cow TMR should be monitored closely. This evaluation can be done via a particle separation of the mixed diet, the bunk mix at 8 – 12 hours post feeding, and the refusal. If sorting is a problem, then one or more of the following may need to be considered: feeding smaller amounts of TMR more frequently, processing hay finer, using hay that is more pliable, addition of water to dry TMR, and using a liquid-molasses product to tie up the fines.

Post-fresh diets should not be formulated with less than 21% neutral detergent fiber (NDF) from forage. Ohio State workers compared post-fresh diets that contained 17%, 21%, or 25% NDF from forage. Milk production and DMI of post-fresh cows were highest on the 21% NDF from forage diet. We recommend 35% - 40% NFC (DM basis) in post-fresh diets. Whole cottonseed, soy hulls, and beet pulp are good ingredients for limiting starch and NFC concentrations in post-fresh diets. Whole cottonseed also contributes significant effective fiber.

Fat

Feeding supplemental fat has been explored as a means of increasing the energy density of transition diets with the aim of increasing energy intake. In Wisconsin trials, fat supplementation of pre-fresh diets did not reduce liver triglyceride or plasma BHBA and actually tended to increase these measures. In a multi-state review of transition cow intake studies, pre-fresh cows fed high-fat (4% of DM) diets had lower DMI than those fed low-fat (2.5% of DM) diets. We do not recommend fat supplementation of pre-fresh diets above normal basal diet fat concentrations of 2% - 3% (DM basis). Fat supplementation of post-fresh diets has not always increased energy intake or energy balance because of depression of DMI. Also, milk yield is often not improved by feeding high-fat diets to post-fresh cows. We recommend 5% - 6% total fat (DM basis) in post-fresh diets using a combination of fat sources for supplementation.

PROTEIN

Although this topic has undergone much recent research and review, the current body of evidence seems to suggest that a 12% – 14% crude protein (CP) diet (DM basis) is adequate for pre-fresh cows. If springing 1st-lactation heifers are managed in a group separate from mature cows, their diet should contain 14% CP (DM basis) because they have higher protein requirements than mature cows due to growth. This may also necessitate formulating diets for pre-fresh groups that contain both mature and springing 1st-lactation heifers to 14% CP (DM basis) so that the protein requirements of the heifers in the group are met. Feeding pre-fresh diets containing 16% CP or more may be detrimental, especially if the protein is highly degradable and the cows are prone to fatty liver. We recommend 18% - 19% CP (DM basis) with 35% - 40% of CP as undegraded or bypass protein in post-fresh diets to off set the low DMI of fresh cows.

ADDITIVES

Anionic salts

Anionic (chloride and sulfate) salts are often used in pre-fresh diets to counteract the effects that high dietary potassium (K) and sodium (Na) concentrations have on increasing hypocalcemia. Reducing K and Na concentrations and the use of anionic salts lowers the cation-anion difference (DCAD) of pre-fresh diets, which helps control milk fever, RP, DA, and ketosis. Because the addition of large amounts of anionic salts to the diet may depress DMI, we recommend that restriction of dietary potassium and sodium concentrations be considered first. Feeding forage with a high K content is often the culprit causing high DCAD diets. Alfalfa normally has a high K content (2%-4% of DM) and, depending on soil fertility, grass and small grain forages may also test this high. Corn silage normally has a low K content (about 1% of DM), and can be used to dilute out high-K forages in the diet. Other strategies for lowering dietary K content include the purchase of low-K hay and targeted soil fertility for the production of low-K forage. The K content of forages is highly variable making routine testing a must. Near infrared analysis is not very accurate for minerals. Commonly used anionic salts include ammonium chloride, ammonium sulfate, magnesium sulfate (epsom salts), calcium sulfate (gypsum), and calcium chloride. Because chloride salts are more effective acidifiers of blood and urine than sulfate salts, the use of calcium chloride, ammonium chloride, and hydrochloric acid have become more common. Hydrochloric acid is difficult to handle in feed mills or on dairies, but is commercially available through the feed product SoyChlor[®]. Another alternative source of anions (both chloride and sulfur) that is commercially available is the feed product Bio-Chlor[®]. The use of magnesium sulfate in anionic salt mixtures is still common because it is a good source of magnesium and is more palatable than most other salts. The efficacy of anionic salt mixtures can be evaluated by measuring urine pH, which should average between 6.0 and 6.5 in Holstein cows for control of milk fever. The recommended calcium concentration in pre-fresh diets containing anionic salts is 1.0% - 1.2% (DM basis). Pre-fresh diets should contain .4% magnesium (DM basis). Anionic salt products should not be fed to post-fresh cows.

Vitamin E

Vitamin E is an antioxidant with substantial effects on immune function. The supplementation of vitamin E along with selenium is important in the control of RP and mastitis. Ohio State workers recommend 1000 and 500 IU/cow/day supplemental vitamin E for dry and lactating cows, respectively. The legal inclusion rate for selenium is .3 ppm (DM basis). In a recent report with low selenium diets (.14 ppm, DM basis), Ohio State workers saw less clinical mastitis (3% versus 13% of quarters) when transition cows were supplemented with vitamin E at 4000 versus 1000 IU/day pre-fresh and 2000 versus 500 IU/day post-fresh.

Niacin

Although a common additive in transition diets at the rate of 6 – 12 grams/cow/day for a supposed role in the prevention of ketosis through reduced body fat mobilization, recent trials evaluating this practice have not shown beneficial effects on plasma glucose, NEFA, and BHBA or liver triglyceride. A summary of 13 trials showed that dietary niacin supplementation increased milk production in early lactation (< 100 DIM) in 8 of those trials by an average of 6.5%. Efficacy in mid and late lactation was not as consistent or as good. The cost of supplemental niacin is about one cent per gram.

Propylene glycol and propionate salts

Propylene glycol is a glucose precursor that elicits an insulin response and reduces the mobilization of body fat when administered to transition cows. It is generally administered as a once daily oral drench of 10 – 16 ounces per cow for several days around the time of calving. Administering propylene glycol mixed in a TMR was not found to be effective. Because of its high cost and administration difficulties, propylene glycol is usually targeted to over-conditioned cows and cows that are off-feed. There is interest in the use of propionate salts in transition cow diets as a glucose precursor. Sodium propionate should not be used in pre-fresh diets because it will elevate DCAD. There is limited research showing reduced serum NEFA and reduced urine ketones in response to adding calcium propionate at the rate of 4 ounces/cow/day to transition diets. Calcium propionate also enhances bunk stability and because of this may improve DMI in situations where heating of the TMR in the feed bunk is a problem.

Ionophores

Feeding or bolus dosing monensin to transition cows has been shown to reduce plasma NEFA and BHBA and the incidence of clinical and subclinical ketosis. Ionophores are currently only approved for use in dairy replacement heifer rations.

BST

Penn State workers injected Posilac[®] once every 14 days until calving starting 28 days prior to expected calving date. This reduced plasma NEFA and BHBA prior to calving, but liver triglyceride content was unaffected. Milk yield was higher in the subsequent

lactation for cows that received BST during the pre-fresh period. These findings were not repeatable in a follow-up experiment by this group. It was suggested that the response might be related to BCS at calving with the greatest response expected in over-conditioned cows. This protocol involves off-label use of BST and can not be recommended.

Buffers

Sodium bicarbonate (BICARB) is recommended at the rate of 1% of lactation TMR DM to buffer acidity in the diet and acid production in the rumen. A mixture of BICARB and magnesium oxide (3:1 ratio of BICARB:MAGOX) elicits a better response than either fed alone. Potassium bicarbonate can substitute for sodium bicarbonate as a ruminal buffer in the lactation TMR, and also supplements needed potassium in high corn silage diets. Free-choice BICARB may benefit early lactation or high producing cows and cows under heat stress, but may need to be mixed with salt to limit its intake and should not replace what is provided in the TMR. Sodium or potassium buffers should not be fed to dry cows, because of effects of elevated DCAD on hypocalcemia.

Choline and MHA

Interest in choline and MHA (methionine hydroxy analog) for transition cows relates to their role as methyl donors in the formation of lipoproteins for export of fat from the liver. A source of ruminally-protected choline (RPC) is available commercially. Research at Missouri with RPC and Wisconsin with MHA found no benefit to supplementing transition-diets with RPC or MHA.

Yeast Products

Yeast products are often targeted to transition cows to stabilize their rumen environment as they shift from low- to high-energy diets. Several research trials have shown increased DMI and reduced loss of body weight and condition score in transition cows that were supplemented with yeast products.

Bacterial direct-fed microbials

Numerous bacterial products that contain lactobacillus or streptococcus organisms are marketed for transition cows. They are available in several forms including powders for feed incorporation, pastes, boluses, or liquids. They are most commonly used in therapeutic protocols for sick and/or off-feed cows. Their efficacy as a transition-cow ration additive has not been well researched, and there is insufficient data to recommend routine diet supplementation.

Metal Amino Acid Complexes

A summary of 11 trials showed that dietary supplementation with zinc methionine (ZinPro[®]) increased milk and FCM yields 2.8 and 2.6 lb./cow/day, respectively, on

average. Hoof health was improved by dietary supplementation with ZinPro[®] in an Illinois trial and 4-Plex[®] (complexed zinc, manganese, copper and cobalt) in a New York field trial. Days open and services per conception were not improved by dietary supplementation with 4-Plex[®] in a recent publication by Tennessee researchers. The cost of supplementing metal amino acid complexes is 2 - 5 cents/cow/day.

Biotin

Supplementing the B-vitamin biotin at 20 mg/cow/day has been shown to improve hoof health in several trials. Milk yield increases of 2-3 lb./cow/day have been observed, but not in all trials. The cost of supplementation is 5 - 7 cents/cow/day. Several months of supplementation will be required to improve hoof health.