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Time to Regroup!

There are great differences in nutrient requirements and animal physiology between cows in early and late lactation. This, along with recent limitations in the use of rbST, high cost of feeds, current relatively high milk price, and the need to reduce nitrogen excretion, means potential profits can be realized by adding another ration to a single TMR system.

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Many producers have abandoned feeding multiple totally mixed rations (TMRs) to milking cows after they leave the fresh group (or after calving) despite great differences in nutrient requirements and animal physiology between cows in early and late lactation. This has happened at an accelerated rate over the last 10 years for various reasons including convenience and labor savings and the availability of recombinant bovine somatotropin (rbST) to help prevent over-conditioned cows. Recent limitations in use of rbST, as well as recent changes in the long term forecast for cost of feeds, the growing importance of reducing nitrogen excretion, and the current relatively high milk price are reasons to reevaluate this management strategy. The purpose of this article is to identify and discuss factors that should be considered when evaluating grouping strategies on your farm.

Manage Body Condition

The most important reason to consider feeding more than one ration to lactating cows in your farm is to manage body condition without limiting milk yield. Over-conditioned cows are at high-risk for culling during the next lactation because of metabolic disorders, poor health and reproductive failure. When only one lactation ration is fed, it must be formulated to limit over-conditioning in late lactation. However, diets that prevent excessive body condition in late lactation, also limit milk yield of high-producing cows. Feeding one ration to all cows is a compromise between achieving higher peak milk yield and managing body condition.

Much of the success of the single TMR strategy is because of the use of rbST. As lactation proceeds, milk yield declines and energy is increasingly partitioned to body stores to restore condition. With a single TMR formulated for the higher yielding cows, other lower yielding cows gain condition more rapidly and become over-conditioned. Use of rbST limits over-conditioned cows by partitioning more energy to milk and away from body condition. Because many herds have abandoned use of rbST, managing body condition will be more challenging when a single TMR is fed. To effectively manage body condition of later lactation cows with a single TMR, the diet typically must be less fermentable and more filling, limiting milk yield of high-producing cows.

Benefits of Grouping

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Potential effects of grouping on profitability increase with higher feed and milk prices. While recent relatively high milk prices are unlikely to be sustained, feed prices are likely to remain high for the foreseeable future because of increased export of crops due to the cheap US dollar and use of crops for biofuel production. Grouping cows by their physiological responses to diets can increase profitability by improving milk yield, increasing efficiency of milk production, and reducing culling of over-conditioned cows. Nutrient utilization increases as nutrients required for maintenance are diluted across more milk production. Less nitrogen (N) will be excreted as waste when lower producing cows are offered rations with a lower crude protein (CP) concentration that more closely matches their requirements. Decreasing CP concentration by 2 percentage units for 120 d per lactation (last trimester) will result in about 20 lb less N excreted/cow per year.

Effects on Milk Production

The limitation on milk yield from a single TMR system varies from farm to farm and is dependent primarily upon variation in milk yield among cows. This is because response to diet change varies greatly among cows varying in milk yield. We found that cows ranging from about 50 to 120 lb/d of 3.5% fat-corrected milk responded very differently to a reduction in ration forage content from 67% to 44% of ration DM. Milk yield was not affected by change to the lower forage ration for cows producing less than about 90 lb/d, but milk yield was limited by the higher forage ration for cows producing more than 90 lb/d. For cows with milk yield above 90 lb/d, the high forage diet limited milk yield to an increasingly greater extent with greater milk yield with up to 20 lb/d lower 3.5% fat-corrected milk for the highest producing cows. Dry matter (DM) intake was greater for cows fed the low-forage diet, so income over feed costs decreased for cows producing less than 90 lb/d, but improved greatly for cows producing over 90 lb/d of milk.

Milking cows vary in nutrient requirements according to milk yield and growth but factors affecting feed intake and partitioning of energy also change as lactation proceeds. Because of this, quite different diets are required to optimize production for high producing cows in early lactation compared to cows in late lactation. High producing cows have a great drive to eat and feed intake is limited primarily by gut fill. Because lactose, which is produced from glucose in the mammary gland, drives milk yield, high-producing cows require greater glucose production by the liver. The liver can produce much more glucose as the starch content of diets increase (primarily from cereal grains) and high-producing cows thrive on highly fermentable diets. In high-producing cows little energy is partitioned to body condition and most is used for milk production because both insulin concentration in the blood and insulin sensitivity of tissues are low.

In contrast, highly fermentable diets can depress feed intake, cause excessive weight and condition gain, and result in

milk fat depression for lower producing cows. As production declines throughout lactation, gut fill becomes less of a limitation on feed intake and cows can be fed higher forage rations without limiting milk yield. Feed intake becomes increasingly limited by the fermentability of the diet; highly fermentable diets that are necessary to attain high milk yield can depress feed intake as milk yield declines. Glucose demand declines because less is needed to produce milk lactose, and blood glucose concentration increases, stimulating greater secretion of insulin. Insulin signals body tissues to produce fat, partitioning energy to body condition at the expense of milk yield. Tissue sensitivity to insulin increases as growth hormone; and, consequently, milk yield, declines. Because insulin concentration and insulin sensitivity increase as lactation progresses, more energy is partitioned to body tissues at the expense of milk. Highly fermentable diets increase plasma glucose and insulin to a greater extent as milk production declines. Therefore, while highly fermentable diets are necessary to achieve high milk yield in early lactation, they depress milk yield and result in more rapid body fattening in late lactation.

Lower producing cows also are more prone to milk fat depression when fed highly fermentable diets. We evaluated production response to a change in diet fermentability by comparing highly fermentable high-moisture corn and less fermentable dry corn and found that the effect of diet on milk fat response was opposite for high-producing and low-producing cows. When ration fermentability was increased, milk fat concentration decreased up to 1 percentage unit for the lower producing cows but increased up to 1 percentage unit for the higher producing cows. Milk fat depression can result in more rapid gain in body condition as energy spared by reduced milk fat production is available to body tissues.

Optimal Forage

The filling effect of diets is determined almost entirely by the concentration and digestion characteristics of forage fiber. Other diet ingredients (e.g., grains, protein and fat supplements, and high fiber byproduct feeds) digest and pass from the rumen much more quickly than forage fiber. It is important to note that it is the concentration of forage fiber in the ration, not the fiber concentration of the forage that is important because high-fiber forages can be supplemented with more concentrate. While forage fiber is very filling compared to other components of rations, the filling effect of forage fiber varies greatly because of great differences in digestion characteristics among sources. Across many experiments, a one-unit increase in digestibility of forage fiber (measured in vitro or in situ) corresponded to an increase of 0.55 lb of 3.5% fat-corrected milk yield within forage family. However, feed intake and milk yield response to enhanced fiber digestibility benefits higher yielding cows to a greater extent than low producing cows. We found that fat-corrected milk yield response varied from 0 to nearly 2 lb/d for each percentage increase in forage in vitro fiber digestibility as milk yield of cows increased from 70 to 120 lb/d. In addition,

fiber from a perennial grass such as orchardgrass is much more filling than fiber from an annual grass such as corn silage or a legume such as alfalfa, despite its greater digestibility, because of its slower passage rate from the rumen. Because of this, perennial grasses and mixed legume-grass forages should be limited in rations of high producing cows with intake limited by gut fill. Forages containing significant concentrations of perennial grass would be better targeted to lower producing cows whose feed intake is less limited by gut fill.

Feed Costs

Ration cost might be greater when a single TMR is fed to all cows because more expensive ingredients that benefit high producing cows are fed to all cows for the entire lactation. While forages now cost more to grow than in the recent past because of higher input costs (e.g., fuel and fertilizer), even when purchased they cost less than most other ration ingredients averaging \$0.05 to \$0.07 per lb of DM. Corn grain at \$5.00 a bushel equates to \$0.10 per lb of DM, soybean meal at \$340 per ton is almost twice as much at \$0.19 per lb of DM, and bypass protein sources and most fat sources are more expensive yet. Some fat sources now cost as much as \$0.60 per lb of DM! In addition, expensive feed additives that may enhance production in early lactation might be less effective in later lactation. Because energy and protein requirements decline with milk yield and feed intake is less limited by gut fill, lower cost forages and other feeds can be fed to lower producing cows if at least two TMRs are fed to lactating cows. This decreases feed costs for up to one-third of each lactation.

Benefits of a Single TMR

Feeding a single TMR to all milking cows allows grouping by reproductive status (possibly requiring self-locking stanchions in fewer pens), one less ration to be formulated, possible labor savings, and elimination of cows getting fed the wrong diet. Labor savings depend upon how mixer capacity is matched to pen and (or) herd size. In some situations, there will be little or no savings in labor for one vs. two TMRs because the same number of batches must be mixed per day. However, when partial capacity mixes must be made to feed more than one TMR, labor will be saved with a single TMR. Additionally, topping off feed bunks might require more labor if partial batches must be mixed. Milk yield and health might be compromised for cows inadvertently ending up in the wrong pen when more than one TMR is fed requiring additional management for prevention. Another perceived benefit of a single TMR is eliminating the drop in milk yield when cows change diets. However, proper ration formulation can minimize the reduction or even increase production after switching rations as discussed below.

Decreased Milk Yield when Changing Groups

Movement to a different group might decrease milk yield because of social adjustment, diet change, or both. Movement

according to reproductive status with a single TMR system can result in a temporary decrease in milk yield until cows are socially adjusted, which is normally of short duration, lasting only a few days. However, many producers recall more sustained reductions in milk yield following a group change because of the diet and this is one of the main reasons they prefer a single TMR system. Although the diet might be formulated to provide adequate energy, protein, minerals and vitamins according to recommendations, ration formulation programs do not account for effects of feeds on energy intake and partitioning. If the diet is too fermentable, feed intake and milk fat production might be depressed and insulin will increase partitioning more energy to body condition at the expense of milk yield. Careful consideration of diet ingredients is necessary to prevent decreased milk yield following a ration change. Increasing energy intake with highly digestible fiber from grass or low-lignin corn silage (e.g., BMR) and more slowly fermented starch (dry ground corn) will allow more energy to be partitioned to milk rather than body condition allowing higher energy diets while limiting over-conditioned cows.

How Many Groups and when to Switch?

Our understanding of how cows vary in their response to diet changes is just beginning and more information will be available to help devise grouping strategies as time progresses. However, for two different lactation groups, body condition score should be used to prevent “train wrecks” from over-conditioned cows in the early part of the next lactation. Cows should be fed a low-fill, highly fermentable diet until they reach a body condition score of 3 to 3.25. This will allow for a slight further increase in body condition in late lactation. Cows with signs of low ruminal pH (e.g., low milk fat and very loose manure) should be switched sooner to improve ruminal and total tract digestibility by increasing ruminal pH. The later lactation diet should be formulated to maintain body condition while maximizing milk yield using highly digestible fiber from forage and byproduct feeds and more slowly fermenting grain sources.

Other Considerations

Several factors must be considered when determining the optimal grouping strategy on your farm. The extent of compromise between milk yield and management of body condition when feeding a single TMR depends primarily on variation of milk yield within the group but also upon age of cows. The extent of variation is dependent upon reproductive success because milk yield generally will be lower for cows with extended lactations. Because peak milk yield increases and persistency of milk yield declines with increased parity, there is greater variation in milk yield among older cows. Herds using a single TMR that will benefit the most from adding one or more groups are those that don't use rbST, have a

wide range in milk yield and age among cows, and those with mixer capacity matched to group size.

Conclusions

- Potential profits from increased milk yield, production efficiency, and nutrient utilization as well as decreased feed costs and culling can be realized by adding another ration to a single TMR system.
- Some of the real and perceived benefits of feeding a single TMR are relatively minor compared to the lost opportunity of not grouping cows according to their production response to diets.
- Increased feed cost and higher milk price, combined with not using rbST in many herds currently merits careful consideration of the benefits and costs of grouping systems.