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FEEDING THE HIGH PRODUCING COW

D. J. Schingoethe¹

Summary

Dairy cows must consume a lot of feed to achieve the levels of production expected today; however, the nutrient needs of dairy cows vary immensely between the dry period and peak lactation. Requirements for the former often can be met with forages alone, whereas the latter may require a considerable amount of high-energy feeds such as grains and supplemental fat and ruminally undegradable proteins of good quality that are digestible in the gastrointestinal tract. The challenge for a dairy feeding program is to meet the cow's nutrient needs while minimizing body weight loss, not causing digestive upsets, and maintaining health.

(Key Words: Cows, Lactating, Feeding, Energy, Protein.)

The Lactation and Gestation Cycle

The relationships between milk production, dry matter intake, and body weight changes typically observed during the normal lactation and gestation cycle are illustrated in Figure 1. Production increases rapidly, and peak (maximum) daily production is reached about 6 to 8 wk after calving. However, appetite lags behind production, such that maximum daily dry matter intake often does not occur until 12 to 15 wk postpartum. Thus, most cows are in negative energy balance for 8 to 10 wk and possibly as long as 20 or more wk for some high producers. The cow makes up

these nutrient deficits by "borrowing" from her body stores. Cows in good condition often lose 200 to 300 lb of body weight during early lactation, which is sufficient to support 1,500 to 2,000 lb of milk production. If that source of nutrients is not available, peak production and total lactational production will likely be less than optimal.

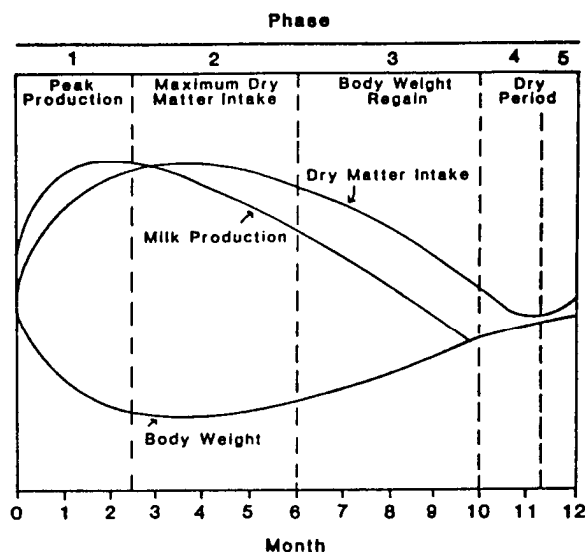


Figure 1. Milk Yield, Dry Matter Intake, and Body Weights of Cows during Phases of the Lactation-dry Period Cycle

After maximum dry matter intake is achieved, intake tends to follow production requirements and decreases as production decreases. But, there is still a lag in intake, only now the cow tends to consume more than she needs during later lactation.

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This allows her to regain the body weight lost in early lactation. The cow should regain most of this body weight during late lactation for optimal energetic efficiency, with most of the weight gain during the dry period being accounted for by fetal growth.

Feeding programs for the various phases of the lactation and gestation cycle will be discussed below. Discussion will start with the dry period (phases 4 and 5) and then proceed through lactation. Suggested ration specifications are in Table 1.

Dry Cow Rations

Feeding for high production actually starts during the dry period. Cows should consume enough during the dry period to maintain or get into good condition but not excessively fat. A body condition score of 3.5 to 4 at calving is ideal for high milk yield, fat test, and reproductive performance.

Dry cow rations can be quite simple but should consider the following items.

- 1) Feed a minimum of 1% of body weight as long-stem dry forage. Preferably, this should be grass hay because the excessive calcium and low phosphorus in legumes may increase the incidence of milk fever.
- 2) Avoid feeding corn silage free choice because it leads to excessive energy intake as well as increases the likelihood of displaced abomasum and fat cow syndrome.
- 3) Limit grain intake to amounts required to meet energy and protein needs.
- 4) Keep calcium intake under 100 g/day, while providing adequate amounts of phosphorus (35 to 40 g/day) to minimize the incidence of milk fever.

Increase grain intake in the last 1 to 2 wk prior to calving, so that at parturition a cow is consuming .5 to 1 % of her body weight as grain mix. This will help adapt the ruminal microorganisms to the higher energy diet that will be fed postpartum and may minimize the chances of milk fever and ketosis. You may also consider increasing the vitamin E content of this mix

to supply 500 to 1,000 IU/day and supplementing selenium to .30 ppm if you are in an area where selenium content of soils and feeds is low.

Rations for High Production

The most critical period for a dairy cow is from parturition until peak milk production. Thus, this presentation will concentrate on this phase of the lactation. But most ration considerations for early lactation apply to cows producing more than 5 lb of milk/100 lb of body weight during all stages of lactation. Each 1 lb increase in peak milk production usually means an additional 200 lb of milk production during the lactation. However, because appetite lags behind nutritional requirements, a negative energy balance usually occurs in the first two months of lactation. Ideally, body condition scores should not drop below 2 to 2.5 during lactation.

A successful phase 1 feeding program will maximize peak milk yield, utilize body weight as an energy source, minimize ketosis, and return cows to a positive energy balance by 8 to 10 wk postpartum. This is the period of lactation that requires the best in nutritional management. During this phase, positive responses to feed additives, special feed treatments, and special ration formulations are most likely to occur.

Maximizing dry matter (DM) intake is the key to high production. The objective during early lactation is to increase feed intake as rapidly as possible, so as to minimize the nutritional deficit, but not introduce ration changes so rapidly as to cause digestive upsets and off-feed. Conception rates will also be greater for cows in positive than in negative energy balance. Feed bunk management practices such as feeding more frequently, keeping the feed fresh, and having fresh water readily available encourage increased intake. Once the stress of calving has passed, grain intake can be increased by 1 to 1.5 lb/day. Or, if

total mixed rations are fed, the forage to concentrate ratio can be gradually decreased to a minimum of 40% forage. At higher concentrate proportions, maintaining the recommended minimum of 18 to 19% acid detergent fiber may be difficult.

Maximum DM intake may reach 3.5 to 4% of body weight for most cows, with some cows consuming more than 5%. Don't be surprised to see some high producers consuming 55 to 60 lb or more of DM daily.

With higher DM intakes, the percent protein needed in the diet can be lower than that needed in early lactation, because the cow is now getting all of her needed energy as well as her needed protein supplied by the diet. The proportion of grain in the total diet can also be lower, because the rumen microorganisms can utilize more forage. Increased microbial protein synthesis stimulated by the greater DM intake, coupled with lower dietary protein percentages, means that these cows are less likely to benefit from bypass protein than they would have in early lactation.

Protein. Cows can compensate for much of their deficit in energy intake by "borrowing" the remaining needed energy from body fat; however, they cannot borrow very much protein. Thus, most of their protein must be supplied in the diet. When energy intake equals energy requirements, a diet containing 16 to 17% crude protein will meet protein requirements for most cows. However, in early lactation, 18 to 20% crude protein may be needed to meet protein requirements when energy intake is not supplying all of the cow's needs.

Early lactation cows are most likely to benefit from ruminally undegraded (bypass) proteins. You should maximize rumen microbial protein synthesis, because it is higher quality and cheaper than most feed proteins. The protein requirement of cows producing up to 5 lb milk/100 lb body

weight usually can be met by rumen microbial protein synthesis plus normal amounts of bypass protein. Cows producing more than this amount of milk will likely benefit when 35 to 40% of the crude protein is ruminally undegradable. But the bypass protein must be digested in the gastrointestinal tract and provide the needed amino acids in order to increase production. Some high bypass protein supplements available are poorly digested or may be deficient in certain limiting amino acids. Nonprotein nitrogen (NPN) supplements will not be efficiently used by these cows, although NPN utilization can be improved by increasing the amount of fermentable carbohydrates in the diet.

Energy. Increasing the energy density ($NE_{Lactation}$) of the diet to more than .78 Mcal/lb of DM also helps the early lactation cow more nearly meet her energy requirements. This can be achieved to a certain extent by increasing the amount of concentrates fed. Maximum microbial synthesis usually can be achieved with 35 to 40% of DM as nonstructural carbohydrates; higher grain diets are more apt to cause acidosis, digestive upsets, and milk fat depression.

Supplemental dietary fat may allow you to increase energy density of the diet while maintaining adequate fiber intake. Increased production from feeding supplemental fat during the first several months of lactation often persists throughout lactation. Most grains and forages contain 2 to 4% fat, but diets can easily contain 5 to 7% fat without causing digestive upsets or reductions in feed intake. All fat sources — oilseeds, animal fats, and dry fat products — are equally effective in boosting the energy density of diets and increasing production. Soybeans should be heated if feeding more than 4 to 5 lb/head are fed daily, but other oilseeds need no processing. Although oilseeds effectively increase production, feeding vegetable oils can drastically reduce milk fat percentages. Feed handling may be a consideration with cottonseed and animal fats. Unsaturated fat

sources such as soybeans and sunflower seeds can improve the marketability of dairy products by increasing the proportion of unsaturated fatty acids in milk fat.

There are several dietary recommendations when feeding supplemental fat.

- 1) Increase the calcium content to more than .9% of DM and the magnesium to about .3%.
- 2) Provide adequate amounts of crude protein to maintain an acceptable protein: energy ratio. As a guideline, for each 1 lb of supplemental fat fed, increase the crude protein 1%, preferably from sources low in ruminal degradability.
- 3) Provide adequate amounts of fiber and fermentable energy. Milk protein content is typically reduced when supplemental fat is fed. The reasons are not entirely known, but you don't want to further aggravate the problem by feeding a diet that is deficient in protein or fermentable energy.

Feed Additives. Any feed additives that may increase production and/or animal health are most likely to be effective in early lactation. Buffers, such as sodium bicarbonate (NaHCO_3), alone or in combination with magnesium oxide, can be helpful during early lactation. Cows fed ensiled forages, especially of small particle size, and high amounts of soluble carbohydrates will likely benefit from 100 to 200 g/day of NaHCO_3 or its equivalent. The primary benefit is from maintaining ruminal pH, which minimizes acidosis, reduces digestive upsets, and results in increased DM intake.

Other feed additives such as niacin can also be beneficial during phase 1, but they will likely be of minimal benefit at other times. Niacin supplementation during the late dry period and early lactation will likely increase feed intake and reduce the chances of ketosis.

Mid and Late Lactation

These phases should be the easiest to manage because the cow is pregnant, nutri-

ent intake equals or exceeds requirements, and milk production is declining. Late lactation is the time to replace the weight lost during early lactation, so that the cow is in good condition at drying off, but also to maintain milk persistency as great as possible. Keep in mind that young cows are still growing and, thus, need additional nutrients for growth as well as for weight regain. The usual guidelines for estimating nutrient requirements for growth are 20% of maintenance requirements for 2-year-olds and 10% of maintenance for 3-year-olds.

During this phase, you have an opportunity to minimize feed costs by increasing the forage to concentrate ratio to match nutrient needs based on milk production and body condition and by utilizing NPN. A lower protein content is likely sufficient because the protein to energy ratio needed for weight gain is less than the ratio needed for milk production. Nonprotein nitrogen sources can be utilized for a portion of the crude protein needs of these cows, whereas bypass proteins will be less cost effective than in earlier lactation when production was higher.

Managing with bST

Cows injected with bovine somatotropin (bST) should be fed and managed the same as any high producing cows. A production increase of 10 to 15%—the same increase as if switching from 2X to 3X milking—may occur, so the cows should be handled accordingly. DM intake will ultimately increase 3 to 5% to provide for the increased production. However, appetite lags behind the increased production just as in early lactation. Thus, ration considerations for early lactation need to be considered for more of the lactation. I would not recommend using bST before a cow is in positive energy balance. Thus, I wouldn't use bST before 50 to 60 days postpartum and maybe not until after the cow has reached peak DM intake and may already be bred.

Table 1. Recommended Nutrient Content of Dry Matter in Diets for Dairy Cattle¹

Nutrient	Dry, pregnant cows	Lactating Cows			
		Early lactation ²	100	Milk yield, lb/d	
				70	35
Energy, NE _L , Mcal/lb	.57	.76	.78	.73	.66
Crude protein, %	12	19	18	16	13
Fiber (minimum)					
Acid detergent fiber, %	27	21	19	21	21
Neutral detergent fiber, %	35	28	25	28	28
Minerals					
Calcium, %	.39	.77	.66	.58	.45
Phosphorus, %	.24	.48	.42	.36	.30
Vitamins					
A, IU/lb	1,800	1,800	1,450	1,450	1,450
D, IU/lb	540	450	450	450	450
E, IU/lb	7	7	7	7	7

¹Adapted from NRC for dairy cattle (1989).

²First three weeks of lactation.