

Department of Animal Science



FEEDING THE DAIRY COW DURING LACTATION

Dairy Cattle Production 342-450A

Feeding the Dairy Cow during Lactation

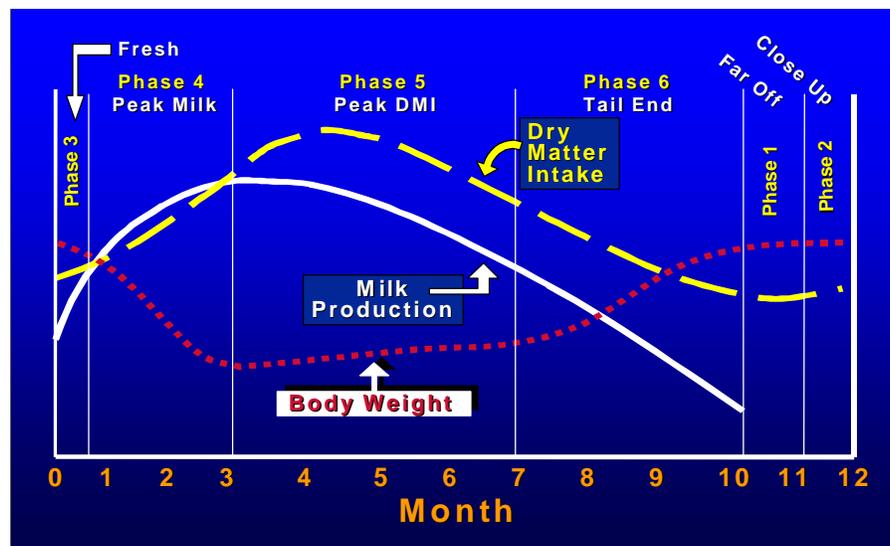
There are main stages in the lactation cycle of the dairy cow:

- 1- Early lactation (14-100 days)
- 2- Mid lactation (100 to 200 days)
- 3- Late lactation (200-305 days)

1- Early lactation

Nutrient Requirements of Dairy Cows in Early-lactation

Early lactation usually refers to the first 100 days of lactation. At the beginning of this phase, cows will achieve peak milk production (during the second month of lactation for Holstein cows), feed intake is lagging and cows are usually losing weight. At the end of early lactation, peak dry matter will be achieved and no weight losses occurring.

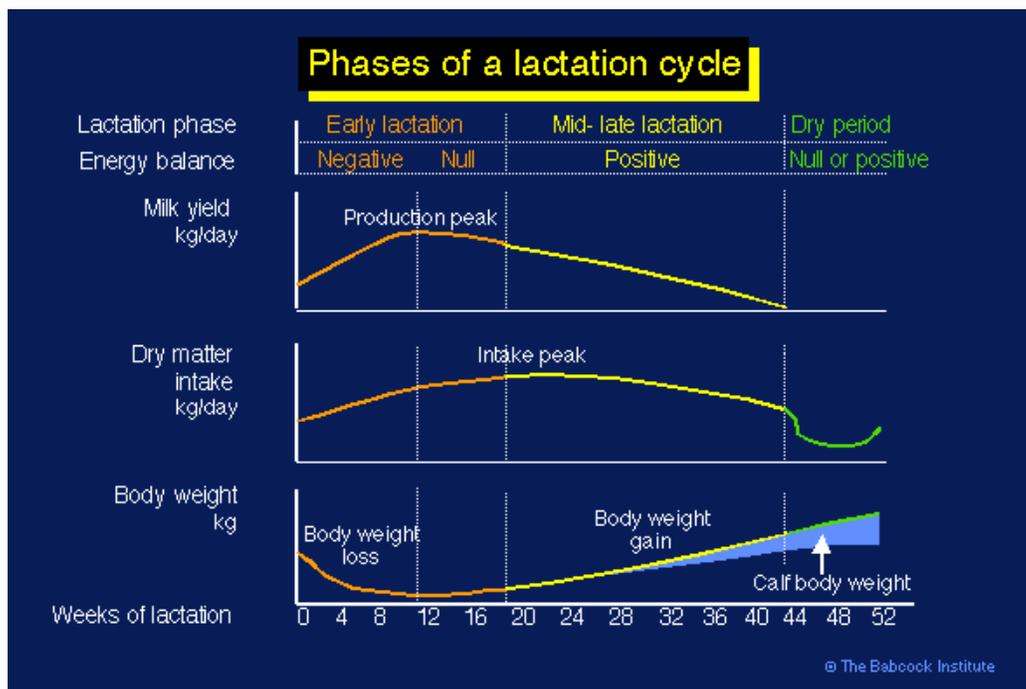


Rations for lactating dairy cows are usually formulated based on protein (e.g. CP) and energy (e.g. net energy for lactation) requirements. However, to achieve maximum production, dairy rations should be balanced for *effective fiber, non-structural carbohydrates, ruminal undegraded protein, soluble protein*. Dairy rations are usually formulated to maximize microbial yield and for requirements for ruminal undegraded amino acids. General guidelines for nutrient requirements for dairy cows at different stages of lactation are listed in Table 1. These guidelines are based on the 1989 and [2001 Nutrient Requirements of Dairy Cows](#) (published by the National Research Council). Detailed discussion on carbohydrate and protein requirements will be provided in separate chapters. The recommendations for feeding dairy cows in the following discussion is based on the assumption that total mixed rations are fed. Dairy cows should be divided into three groups according to stage of lactation (i.e. level of production). This implies that three different TMR should be fed to the herd (at least two TMR, one for the high producing group and one for the low producing group).

Body Weigh Loss During Early Lactation

During this period milk yield increases more rapidly than dry matter intake (peak production). The demand for energy is therefore higher than the amount of energy consumed. Thus the cow mobilizes body reserves and losses weight (negative energy balance).

The genetic potential is usually expressed during this period and the cow will be under pressure to produce a large amount of milk. However, the cow at this stage has a limited capacity to ingest the required amount of feed. Thus it is normal for the cow to mobilize body fat during early lactation. The ability of the dairy cow to mobilize body fats contributed to its genetic potential (i.e. cows with higher genetic potential will mobilize body fats for a longer period of time than cows with a lower genetic potential). During this period, the cow could lose as much as 0.7 kg/day.



Monitoring Dry Matter Intake During Early Lactation

Feed intake is the key factor in maintaining high milk production. Cows should be encouraged to maximize their intake during early lactation. Each additional kg of dry mater consumed can support 2-2.4 kg more milk. Feed intake by the dairy cow is influenced by many factors including level of production, forage quantity and quality, feed digestibility, feed processing, feeding frequency, consistency of ration ingredients etc.

<u>Time</u>	<u>1st lactation</u>	<u>2nd lactation</u>
Week 1	14	16 (2.5% BW)
Week 2	15-16	19 (2.9% BW)
Week 3	17	21 (3.4% BW)
Week 4	18	22 (3.6% BW)
Week 5	18-19	24 (4% BW)

How to calculate dry matter intake in dairy cows: The following equation can be used to calculate dry matter intake

$$DMI (\% \text{ body weight}) = 4.048 - 0.00387 \times \text{body weigh (kg)} + 0.0584 \times 4\% \text{ FCM (kg)}$$

Use the following equation to calculate 4% FCM

$$0.4 \times \text{actual milk yield in kg/day} + 15 \times \text{milk fat in kg/day}$$

- Maintaining good rumination is essential in early lactation. Thus it is important to feed at least 40% of the ration dry matter as forage. About half of the forage should have a particle length of at least 2.6 cm to effectively stimulate chewing. High quality forage should be fed during this period to improve dry matter intake. Neutral detergent fiber and acid detergent fiber levels should be set at 28 and 19%, respectively to maximize intake
- Major ration changes should be avoided. To avoid any digestive problems (e.g. acidosis, depressed intake), concentrates should be added gradually at a rate of about 0.5 to 0.7 kg/day for the first two weeks.
- Protein is very critical during early lactation as the amount of body protein that can be mobilized is very limited compared with body fat. ***Thus in early lactation, a dietary protein content of 17-19% is recommended.*** About 35-30% of dietary protein should be ruminally undegraded protein while 30% should be soluble protein. A guideline is to feed 0.5 kg of a 34 to 50% protein concentrates for every 5 kg of milk produced above 20 kg of milk.

Other Feeding Strategies for High Producing Cows

1- Cows usually eat after milking. Thus fresh feed should always be available in the feed bunk immediately to encourage feed consumption. High producing cows will eat up to 12

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meals per day, each averages 23 minutes. The best TMR dry matter is between 50-75%. Wetter or drier rations will limit intake

- 2- If concentrates are being fed separately from forages, they should be fed several times a day.
- 3- Feeds should be available to cows at least 20 hours per day
- 4- Hay should be fed before grain and / or protein supplement in the morning.
- 5- Protein supplements should be fed with energy sources and / or feed the energy source before protein
- 6- Forage should be checked to make sure it contains enough long fiber.
- 7- If two forages are being fed, it is preferable to mix them rather than feed them separately.
- 8- If intakes are below normal begin by checking the non-fiber carbohydrate level, forage particle size and water quality.

Feeding separately

While total mixed rations (TMR) get a lot of attention, many dairy producers still feed forage and concentrates separately. The concentrate component is usually fed only once or twice daily. This results in non-uniform supply of nutrients and inefficiencies of nutrient utilization can occur. Providing smaller and more frequent meals of concentrates may help stabilizing the rumen environment. Several management strategies can be used to improve milk production and cow health in component-fed herds.

- Avoid large variation in forage quality
- Feed forages frequently and push up feed frequently. This practice helps keep feed fresh and encourage cows to eat smaller meals more often.
- Feed some in the morning before cows have access to concentrates.
- Do not feed more than 2.5-3.5 kg of grain per feeding. Limiting the amount of grain fed at one time lowers the risk of creating acidotic conditions in the rumen due to rapid breakdown of carbohydrates in the rumen.
- Watch Particle size of grain. Finely ground grains breakdown rapidly in the rumen and can lead to acidosis problems.

Feeding frequency

Increased feeding frequency reduces daily variations in rumen pH and thus helps stabilizing the rumen environment. The proper range and consistency of ruminal pH is critical in fiber digestion.

Feeding sequence

Feeding frequency affects rumen function and cow performance. If forage and concentrates are being fed separately, forages should be fed first in the morning followed by a portion of the grain mix.

Feeding protein (e.g. soybean meal) and carbohydrate (e.g. corn) supplements together results in higher milk fat percentage than feeding them separately. This is because rumen microbes require both energy and protein to grow.

Mixing accuracy

A TMR or forage combination must be adequately mixed in order to provide a proper nutrient balance. When mixing small quantities of specific ingredients (e.g. minerals and vitamins), it may more appropriate to include them in a pre-mix where larger quantities can be added to the ration.

Chemical analysis of the ingredients must be accurate. Chemical analysis of TMR and calculated analysis of individual feed ingredients will vary, but they should be within a given range of variations. A comparison between actual and calculated dry matter of the TMR will give an indication of how ingredients are mixing.

2- Mid-lactation

Mid-lactation period is the period from day 100 to day 200 after calving. By the beginning of this phase, cows will have achieved peak production (8-10 weeks after calving). Peak dry matter intake has also occurred with no more weight losses (see figure 1). Cows should reach maximum dry matter intake no later than 10 weeks after calving. At this point, cows should be eating at least 4% of their body weight. The cow should be fed a ration that will maintain peak production as long as possible. For every 2 kg of expected milk production, large-breed cows should eat at least one kg of dry matter.

The main target during this period is to maintain peak milk productions as long as possible. For each extra kg of milk at peak production, the average cow will produce 200-225 kg more milk for the entire lactation. Thus the key strategy during mid lactation is to maximize dry matter intake. During this period the cow should be fed high quality forage (minimum 40 to 45% of the ration dry matter) and the level of effective fiber should be maintained at a level similar to that of early lactation.

Concentrates should not exceed 2.3% of body weight and sources of non-forage fibers such as beet pulp, distillers grains and cereal bran can replace part of the starch in the ration to maintain a healthy rumen environment.

Protein requirements during mid lactation are lower than in early lactation. Therefore rations for dairy cows in mid-lactation should contain 15-17% crude protein (Table 1).

During this period the cow should be bred to initiate a new pregnancy (60-70 days after calving).

3- Late-lactation

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This phase may begin 200 days after calving and end when the cow dries off. During this period, milk yield continues to decline and so does feed intake. However, the intake easily matches milk yield. The cow also gains weight during this period to replenish the adipose tissue lost during early lactation (see figure above). However, as lactation approaches an end, more of the increase in body weight is due to the increased size of the growing fetus.

Sources of protein and energy are not very critical during this period. Cheap rations can be formulated with non-protein nitrogen and a source of readily fermentable carbohydrates such as molasses. Nutrient requirements for dairy cows in late lactation are shown in Table 1.

Table 1. Nutrient guidelines for lactating dairy cows.

	Stage of lactation		
	Early	Mid	Late
Average milk yield (kg/d)	40	30	20
Dry matter intake (kg/d)	24-26	21-23	11-12
Crude protein (% DM)	17-19	15-16	13-15
Ruminal undegraded protein (% CP)	35-40	30-35	25
Soluble protein (% CP)	25-33	25-36	25-40
Neutral detergent fiber (% DM)	30-34	30-38	33-43
Acid detergent fiber (% DM)	19-21	19-23	22-26
Effective fiber (% NDF)	25	25	25
Net energy for lactation (Mcal/kg)	1.64	1.57	1.5
Non-fiber carbohydrates (% DM)	30-42	30-44	30-45
Total digestible nutrients (% DM)	72-74	69-71	66-68
Fat (maximum in DM)	5-6	4-6	3-5
Calcium (% DM)	0.8-1.1	0.8-1.0	0.7-0.9
Phosphorous (% DM)	0.5-0.9	0.4-0.8	0.4-0.7
Potassium (% DM)	0.9-1.4	0.9-1.3	0.9-1.3
Sodium (% DM)	0.2-0.45	0.2-0.45	0.18-0.45
Chlorine (% DM)	0.25-0.30	0.25-0.30	0.25-30
Sulfur (% DM)	0.22-0.24	0.20-0.24	0.20-0.22
Cobalt (mg/kg DM)	0.2-0.3	0.2-0.3	0.2-0.3
Copper (mg/kg DM)	15-30	15-30	12-30
Manganese (mg/kg DM)	60	60	50
Zinc (mg/kg DM)	80	80	70
Iodine (mg/kg DM)	0.8-1.4	0.6-1.4	0.6-1.2
Iron (mg/kg DM)	100	75-100	50-100
Selenium (mg/kg DM)	0.3	0.3	0.3
Vitamin A (1000 IU/day)	100-200	100-200	100-200
Vitamin D (1000 IU/day)	20-30	20-30	20-30
Vitamin E (IU/day)	600-800	400-600	400-600