



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 15, Issue 02, February 2026)

Current Dairy Cattle Feeding Practices in India

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Abstract-- The sciences of nutrition, biochemistry, and microbiology are combined with animal husbandry in the feeding of dairy animals. In this chapter, we will discuss nutrients and their importance for dairy cattle performance (growth and milk production). We will evaluate the diets of calves and heifers, and provide some brief practical dietary recommendations for dry and pre-partum cows.

Keywords--calves, dairy cows, heifers, nutrition

In India, after festivals like Sankranti, veterinarians are flooded with emergency calls to treat cows and buffaloes suffering from severe ketosis due to excessive consumption of rice and jaggery. If not treated promptly, they can even die. This suggests that the stomachs of cows and buffaloes, which consist of four compartments (rumen, reticulum, omasum, and abomasum), are not adapted to digest foods like grains and oilseed cakes.

Cows and buffaloes belong to the cattle category. Along with sheep, lamb, and goats, they have the ability to regurgitate and chew food, making them commonly referred to as ruminants. The process of regurgitating food occurs through the stomach grooves (reticulum) and is called cud. The purpose of rumination is to break down food into fine particles, digest plant cellulose with the help of enzymes in saliva, and prepare it for absorption by gut bacteria. These bacteria, with the help of enzymes called lysosomes secreted by the upper part of the stomach (abomasum), process the animal's food into a fermented form. Essentially, the stomach of a ruminant is a fermentation vessel where bacteria thrive. Maintaining a stable temperature and pH is crucial for this.

Any activity that reduces rumen motility, prevents food regurgitation, and alters the pH or temperature of the contents inside the stomach is detrimental to the animal's health. Cows and buffaloes produce approximately 100 to 150 liters of saliva during chewing. This alkaline saliva is crucial for maintaining the pH of the stomach and blood. Feeding animals excessive amounts of concentrated feed can lead to subclinical ketosis and reduce milk production. Research has also shown that feeding more feed increases milk production. Similar results have been observed in the Kolar and Chikkaballapur districts of Karnataka, India.

To illustrate the difference between ruminants and other monogastric animals, let's compare chickens raised for meat or eggs under intensive farming systems.

Birds are physiologically adapted to eat and digest seeds in their stomachs (called gizzards), not in their mouths, because they lack teeth. Therefore, eating grain seeds is a natural process, and it is appropriate to advise farmers to feed them grains and balanced concentrate feed.

Contrary to proven research and practical observations, dairy farmers continue to feed their cows and buffaloes wheat or rice bran, grains, oilseed cakes, balanced concentrate feed, and dry and green fodder chopped to a thickness of less than 1 inch! In fact, they are advised to do this to increase milk production from their animals. This does increase milk production in the short term. However, this increase is due to the fact that most cows and buffaloes in India suffer from negative energy and protein imbalances. Therefore, any diet that addresses the deficiency of either of these improves general health and, consequently, milk production. In fact, feeding these ingredients, along with limited water and fodder, does not even satisfy the animals, resulting in poor or unsatisfactory conditions. Limited quantities are fed because these feeds are expensive and must be purchased from outside sources in cash.

It is likely for these reasons that dairy producers in New Zealand and Australia do not feed their cows concentrate feed or straw feed, but instead practice extensive farming systems. This allows the animals not only ample time to graze on clover, a carbohydrate- and protein-rich grass, but also to rest and ruminate. In fact, these two countries are the world's cheapest producers of milk, followed by India, a strategic regional strength.

Furthermore, feeding ruminants concentrate feeds like grains puts them in competition with humans. This competition and the resulting increased demand drive up prices. The poultry sector is already a large consumer of grains, especially maize, and is in direct competition with humans, leading to severe shortages in the domestic market.

Therefore, feeding grains, oilseed cakes, balanced concentrates, and finely chopped green and dry fodder is not cost-effective and may even be harmful. Feeding green and nutrient-rich dry fodder in a 3:1 weight ratio of grass and legumes to cattle over 6-8 inches in length, intermittently, and allowing adequate time for rumination at evenly spaced intervals throughout the day, is an economical and sustainable way to feed and raise dairy animals.



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A high-yielding cow requires a diet that provides the nutrients necessary for high milk production. Carbohydrates, amino acids, fatty acids, minerals, vitamins, and water are all essential nutrients for a dairy cow to meet the demands of the mammary glands for producing milk and milk components. However, developing a high-yielding cow begins with the nutrition of the calf and heifer.

Dairy producers raise calves to replace cows that are removed from the herd for various reasons, such as mastitis (udder infection), inability to conceive (low fertility), foot and leg problems (low mobility), and low milk production. Another reason for removing cows from the herd is to sell them to other dairy producers. Dairy producers planning to increase herd size often increase the number of cows by introducing more heifers into the herd. This is called internal herd augmentation.

Environmental Effects on Colostrum: The temperatures cows experience before parturition impact colostrum quality and production. While developing a model to predict colostrum quality, increased colostrum quality was observed on days with temperatures above 25°C.⁶ In the laboratory, IgG concentrations are typically determined using a radial immunoassay. Similar results were observed in heat-stressed cows. However, these researchers found that heat-stressed and cool cows had similar colostrum quality, but their calves had lower IgG absorption.⁷ In this experiment, cows were exposed to similar temperature-humidity indices, but cool cows had access to sprinklers and fans, while heat-stressed cows did not. When calves began lactating, this effect resulted in reduced weight gain and milk production. These data suggest that although increased environmental temperature (>25°C) may increase colostrum quality, it reduces its absorption by calves. ⁷ Therefore, providing shade and fans to cows as a means of heat relief will increase the absorption of IgG and possibly other beneficial nutrients and growth factors.

Effects of Breed and Parity: Breed effects are observed with respect to colostrum quality. Generally, Holstein cows produce lower quality colostrum than Jersey cows. This is likely due to the thinner colostrum in the Holstein breed. Generally, first-time calving cows also produce lower quality colostrum. This is likely because the immune system of first-time calving cows is more unsophisticated than that of cows that have calved more frequently. This problem appears to be decreasing due to improved nutrition of these cows before calving. Recently, it has been observed that Jersey cows produce significantly less colostrum during the winter months in the Northern Hemisphere.⁸ This effect was more pronounced in cows that calved more than once and appears to be related to photoperiod (day length).

Colostrum Substitutes and Supplements: Often, lactating cows experience colostrum deficiency and require colostrum replacers. Research suggests that colostrum replacers are suitable if they are colostrum-based (dehydrated) and prepared according to instructions. However, it appears that while replacers are available, they are not as effective as lacteal-based colostrum replacers. Colostrum supplements should be avoided as they have little benefit on the day of birth, although they may be helpful to some extent in providing local immunity during the first days of life.

Feeding Milk and Milk Substitutes: Calves are fed milk or milk substitutes from the day after birth. Traditionally, milk was fed at a rate of 4 liters per day after morning and evening milkings. The same rate applies to milk substitutes. Milk substitutes are milk-based powders that must be converted into a solution containing approximately 10%-15% solids. Recently, the amount of milk and milk substitutes has been increased to 6 liters for Holstein calves. New techniques have been developed that allow calves to consume milk at will. With these techniques, feedings of more than 10 liters per day are common.

Milk in the Digestive System:

When a calf drinks milk, a change occurs in the anterior portion of its pre-ruminant stomach, resulting in the formation of an esophageal groove. This groove allows milk to bypass the anterior portion and go directly to the upper portion of the stomach for digestion.

Milk contains two types of proteins: casein and whey. Due to the presence of an enzyme called rennin in the acidic environment of the abomasum (lower part of the stomach) of a non-ruminant calf, casein forms a clump that slowly breaks down throughout the day. Whey does not clump and is quickly broken down and passed into the small intestine, where it undergoes further digestion and is eventually absorbed into amino acids, di- and tri-peptides, and other nutrients.

Starter Grains for Calves: For rumen development, it is essential to provide calves with palatable solid feed (calf starter grains). This is important because fermentation is essential for rumen development. Bacteria from the mother and the environment ferment solid feed and produce volatile fatty acids (VFAs). Butyrate, a four-carbon VFA, is most important for the development of the rumen epithelium (papilla). Feeding starter is essential for this. Because grain ferments faster than forage, feeding hay is not necessary at this stage of life. Calf starter typically consists of a pellet with whole, crimped, or steam-flaked grain. Some starters are entirely in pellet form, and feeding good quality hay is essential.



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In recent years, the development of high-protein milk substitutes (up to 32%) has led to a shift in the feeding method of milk substitutes. This is sometimes referred to as accelerated feeding programs. Furthermore, as self-feeding calves develop, they have been observed to consume over 10 liters of reconstituted milk per day. Results are fairly consistent, with calves fed a 28:20 (protein:fat) ratio milk substitute powder (approximately 1.3 kg per day) showing approximately 300 grams per day higher growth rates than calves fed a conventional (22:20) milk substitute powder (560 grams) (750 vs. 460 grams per day, respectively).¹² However, weaning can be difficult when calves are fed such high amounts of nutrient-rich milk powder. Weaning is usually determined by measuring how much starter grain the calf is consuming (227 grams per day for three consecutive days). Calves are often fed half of their milk replacer for seven days. This forces the calf to obtain most of its nutrients from the starter.

As a result, this is often a stressful time in a calf's life. Extensive research has been conducted to evaluate methods for effective weaning with less stress on calves. This has led to the use of a phased process in which calves are fed small amounts of milk replacer over several days. Calves fed high-protein milk replacer gained only 80–150 grams per day during this period, while conventionally fed calves gained approximately 640 grams per day. ¹² After weaning, there was no difference in average daily gain regardless of treatment. One aspect of feeding high-volume and high-protein milk replacer is the need for watering. While milk and milk substitutes pass through the rumen effectively, water consumed by the calf goes directly into the rumen. However, if water is not provided, the high protein and mineral content of milk substitutes can disrupt the osmotic balance, leading to dehydration. Research has shown that calves fed an accelerated milk replacement program increased their water intake compared to calves fed a traditional milk replacement diet.

Nutrient requirements of large breed heifers gaining 0.9 kg/d^a.

BW, kg	DMI, kg/d	ME, Mcal/d^b	CP, %	Ca, g/d	P, g/d
150	4.2	9.9	16.9	33	15
200	5.2	12.3	15.0	37	17
250	6.2	14.6	13.7	37	17
300	7.1	16.7	12.9	38	18
350	8.0	18.8	12.3	40	19
400	8.8	20.7	11.8	41	20
450	10.4	25.2	14.7	58	28
500	11.3	27.2	14.1	59	29
550	12.1	29.1	13.7	61	30
600	13.0	30.9	13.3	63	31
650	13.8	32.7	13.0	64	32

a

Adapted from Tables 14.13 and 14.15 from NRC. Nutrient Requirements of Dairy Cattle. 7th Rev. ed. National Acad. Press; 2001.

b

ME = metabolizable energy.

When calves are fed a high energy diet, there is a concern that there is increased mammary gland fat deposition during the prepubertal phase (<9 months).²² However, by reducing the amount of gain realized to 0.87 kg/d, problems of increased fat deposition in the mammary gland should be limited.

If cows are fed the proper amount of fat, milk production should increase during the early lactation period, sometimes increasing the fat content of the milk, but almost always decreasing the protein content of the milk. However, the increased milk production may also lead to an increase in the amount of milk protein (kilograms).



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The body condition of cows should improve after the peak lactation period. Fertility should also improve due to improved energy balance or improved concentrations of hormones involved in reproduction.

There are three theories about feed intake. The first is volume. Increasing the amount of NDF (non-dissolved fatty acids) in the diet reduces feed intake due to satiety signals from stretch receptors in the rumen wall.

The second theory is based on energy intake. Feed intake decreases when energy needs are met with a high-energy diet. This theory applies only during the final stages of lactation and the dry period, when cows can consume sufficient food to meet their calorie needs. The third, the most prevalent theory, is the oxygen consumption theory. As cows produce more milk, the need for blood to deliver oxygen to tissues increases, the heart has to pump faster, and oxygen consumption increases. The mammary glands receive more nutrients, which increases the need for nutrient absorption and, therefore, feed intake.

High-quality milk production from healthy dairy animals begins with calf nutrition and management. Proper nutrition and management will develop a dairy heifer into a high-producing cow that can produce milk according to its genetic potential. Providing cows with regular feeding, comfortable housing, and adequate water based on their performance can improve milk production, growth, and overall performance. Improving milk production will make the conversion of feed into milk more efficient, leading to better nutrient utilization, reduced waste, and helping maintain a sustainable dairy industry.

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