PIONEER FEEDS DAIRY CATTLE AND CALF FEEDING TECHNICAL INFORMATION.

1. STAGES IN LACTATION PERIOD IN DAIRY COWS

The lactation period is divided into four phases based on the cow's physiological cycle and nutrient requirements. Feeding should be based on these phases.

Phase 1: 1–70 days

The first phase lasts from calving to peak milk production, which occurs at about 70 days. During this phase of lactation, milk production increases rapidly such that the voluntary feed intake cannot meet the energy demand. This results in an energy deficit leading to use of body reserves and to weight loss (negative energy).

The health status and feeding of the cow during this phase are critical to its entire lactation performance. The cow should be fed so as to achieve peak production. If it does not peak, feeding later in the lactation period will not result in any appreciable increase in lactation yield.

In an attempt to maximize milk production while maintaining good health, the tendency is to feed high levels of concentrates in this phase. However, if excessive concentrates are added too rapidly to the rations of non-accustomed cows, they may lead to digestive disturbances (e.g. rumen acidosis, loss of appetite, reduced milk production and low milk fat content). It is therefore recommended that concentrates be limited to 50–60% of
diet dry matter, the rest being forage to ensure rumination (proper function of the rumen).
During this phase, buffers can be helpful for cows fed high levels of concentrates.

During this phase, a high-protein diet is important since the body cannot mobilize all the needed protein from itself, and microbial protein, which is synthesized in the rumen by
microbes, can only partially meet requirements. A protein content of 18% crude protein is recommended in rations for high-yielding cows.

Animals that are well fed during this phase come on heat and achieve a 365-day calving interval—a calf every year.

Phase 2: 71–150 days

The second phase lasts from peak lactation to mid-lactation. The voluntary dry matter intake is adequate to support milk production and either maintain or slightly increase body weight. The aim should be to maintain peak milk production for as long as possible with milk yield declining at the rate of 8–10% per month.

The forage quality should be high. A 15–18% whole ration crude protein content is recommended. Concentrates high in digestible fibre (e.g. wheat or maize bran rather than starch) can be used as an energy source.

Phase 3: 151–305 days

The third phase lasts from mid- to end-lactation, during which the decline in milk production continues. The voluntary feed intake meets energy requirements for milk production and body weight increase. The increase is because body reserves are being replenished, and towards the end of lactation, it is because of increased growth of the foetus. It is more efficient to replenish body weight during late lactation than during the
dry period. Animals can be fed on lower-quality roughage and more limited amounts of concentrate than during the earlier two phases.

Phase 4: Dry period (306–365 days)
This phase lasts from the time cow is dried to the start of the next lactation. The cow continues to gain weight primarily due to the weight of the foetus. Proper feeding of the cow during this stage will help realize the cow's potential during the next lactation and minimize health problems at calving time (e.g. ketosis, milk fever and dehydration.

2. DRYING A DAIRY COW

Drying off the dairy cow. The dry period is the most important phase of a dairy cow's lactation cycle. During this phase, the cow and her udder are prepared for the next lactation; hence any abnormalities during the dry period will have a negative effect on the cow's health and milk production after calving.

This period is called the dry period, and it includes the time between halting of milk removal (milk stasis) and the subsequent calving. Generally, 45 to 50 days is recommended. If less than 40 days, then milk yield in the next lactation will be decreased.
To minimize stress on the drying cow, consider the following options.

• Reduce feed intake to maintenance level (withdraw concentrates).
• If the cow is a low yielder, just stop milking. Pressure builds up in the udder and cuts off milk production.
• If the cow is a high yielder, practise intermittent milking, skipping some milking times (milk only in mornings) so as to reduce milk synthesis caused by pressure building up in the udder.
• Temporarily withdraw water or reduce the amount for very high yielders to reduce milk synthesis.
• After milking is stopped, treat (infuse) all the quarters with long-acting antibiotics to prevent mastitis from developing.

The aims of drying a cow are to:
• build up body reserves in time for the next lactation period—if a cow is not dried in time, milk production will be reduced during the next lactation period.
• allow the cow to regenerate alveolar tissue (milk-synthesizing tissue) that might have degenerated during the lactation period.
• save nutrients for the fast-growing foetus. During the last phase of pregnancy, the calf grows rapidly and the cow's drying saves nutrients for the calf's growth.At the time of drying, the cow should be fed a ration that caters for maintenance and

pregnancy, but 2 weeks before calving the cow should be fed on high-level concentrates in preparation for the next lactation. This extra concentrate (steaming) enables the cow to store reserves to be used in early lactation.
To avoid over-conditioning, cows should not be fed large amounts of concentrate. The aim is to achieve a body condition score of 3.5–4.0.

If the diet is richin energy, limit the intake of concentrates. Feeding bulky roughages can help increase rumen size to accommodate more feed at parturition (birth).
Before calving, feed concentrate progressively to adapt the rumen microbial population.
This will minimize digestive disturbances in early lactation when the diet changes to high concentrate.
The amount of calcium fed during the dry period should be restricted to minimize incidents of milk fever in early lactation. A ration providing 15 g of calcium per day for the last 10 days of the dry period or an intake of 30–40 g/day over the whole dry period should reduce the number of incidents.

This extra concentrate (steaming) enables the cow to store reserves to be used in early lactation. During this phase the cow may be fed good-quality forage or poor-quality supplemented with concentrate to provide 12% crude protein.

Transitional feeding (3 weeks before and after calving)
During the 3 weeks immediately before and after calving, the cow should be given high-energy, highly palatable and digestible feed (e.g. commercial dairy meal and maize
germ) or starchy feeds and molasses (this is also referred to as close-up feeding). This is to prepare the cow to consume large amounts of feed (for high milk production), accustom the rumen bacteria to high concentrate levels and prevent nutritional disorders (e.g. milk fever and ketosis) that are common in early lactation without over-fattening the cow.

This period is important because there is rapid growth of the unborn calf, regeneration of the mammary tissue and colostrum production.

3. FEEDING A LACTATING COW

Aim of feeding the dairy cow

Maximizing milk yield by meeting the cow's nutrient requirements is the aim of a feeding program. The nutrient requirements will largely depend on the amount of milk produced, which in turn depends on the stage of lactation—the period from calving. Other factors affecting nutrient requirements are pregnancy and maintenance. The amount required for maintenance is largely affected by the cow's weight, environmental temperature and activity.

Milk production follows a curve (lactation curve), hence the amount of nutrients required will depend on the point on the curve. During the dry period, the aim should be to feed
a diet that provides for the fast-growing foetus, deposition of an energy reserve and regeneration of the mammary gland.

Nutrient requirements of a lactating cow:

Energy

Quantitatively, energy is the most important nutrient considered during the formulation of dairy cow rations. Energy requirements of a lactating cow depend on

• maintenance—keeping the cow alive—which depends on body size (bigger cows require more), activity (walking long distances to graze increases the requirement) and environmental temperature (too cold or too hot increases the requirement)

• amount of milk the cow produces

• the energy content of milk, indicated by butter fat content—the higher the fat content, the more energy required

• reproductive condition—pregnant cows require more energy to cater for the growth of the calf.

Protein

Like energy, the protein requirement is dependent on milk yield, maintenance (replaces the amounts lost in urine, faeces and skin), growth and pregnancy. Protein is not stored in the body and any excess is removed.

Protein is an expensive component and overfeeding should be avoided to minimize the cost. In addition, extra energy, which would otherwise be used for milk production, is used to remove the extra protein (nitrogen) from the body in form of urea in the urine.At the same time, protein deficiency leads to reduced growth and milk yield.

Minerals

Dairy cattle require all minerals in their diet for optimal milk production, reproductive performance and health. Although classical mineral deficiency symptoms are rare, in many cases under- and overfeeding of certain minerals does occur.

Even small imbalances or deficiencies can develop into reproductive, health and milk production problems. As herd milk production increases, it will become more critical to balance and fine-tune the dairy cow's mineral and vitamin feeding program. Generally, the two sources of minerals include natural (organic) feeds (forages and grains) and inorganic mineral supplements to balance the minerals present in the forages and grains.

Vitamins

The dairy cow, like all ruminants, depends on rumen microorganisms to synthesize the water-soluble vitamins and vitamin K. Requirements for vitamins A, D and E must be satisfied from the diet.

Water

Although water is not a nutrient as such, it is essential for life. Water can be obtained from feed, from drinking or from within the body processes. Lactating cows need larger proportions of water relative to body weight than do most livestock species since 87% of milk is water. The amount required depends mainly on milk yield, moisture content of feed, amount of feed consumed and the environmental temperature.

Cows will drink more water if it is available at all times and when warm water is offered on cold days. Dairy cows suffer from a limited intake of water more quickly and severely than

from a deficiency of any dietary nutrient. Lack of water has a big effect on feed intake, especially if the feed is low in moisture.

4. DAIRY COW FEEDING SYSTEMS

Complete meals vs concentrate mix

Concentrates

Concentrates are rich in nutrients (energy and/or protein) and provide far more nutrients than an equivalent weight of roughage. They are low in fibre and usually have higher dry matter content. They include compounded commercial feeds (e.g. dairy meals, cubes and pellets) as well as single ingredients, such as pollard, maize germ meal or cottonseed cake.

Locally available concentrates for feeding dairy cows are of several types. The most common is the commercial dairy concentrate (referred to locally as Dairy Meal®). Concentrates can also be home made using locally available ingredients with the help of a nutritionist.

For home-made concentrates, the general rule is energy sources should form 70%, protein sources 29% and minerals/vitamins 1%.

The maximum amount of milk that can be produced without concentrate supplementation will depend on the quality of the pasture or forage, which has been reported to vary from 7 to 20 kg milk per day.

Total mixed rations

Total mixed ration is a blend of all of the constituents of a ration fed to a confined animal, mixed to prevent separation to a specific nutrient concentration and fed at free will to the cow. In the total mixed ration feeding system, the concentrates and roughage are mixed either by hand, in small-scale operations, or in a mixer wagon. Where a mixer wagon is used, the mix is often dispensed to the cow directly from the wagon.

Before a total mixed ration is formulated, the following information is needed:

Feedstuffs (ingredients)

- available feedstuffs
- moisture and nutrient content of feedstuffs
- cost
- attributes of feed (e.g. maximum allowed in feed mix, presence of undesirable substances)
- degree of processing required before mixing

Cow to be fed:

- body weight (to allow estimation of maintenance requirements and voluntary dry matter intake)
- expected milk yield

Total mixed ration feeding

A total mixed ration can be fed to cows using either the same ration to the whole herd (no grouping) or different rations to different groups. In a non-grouping system one mix is usually formulated to suit the high-yielding cows, the risk being overweight cows.

Grouping the cows improves the precision of the feeding. The cows can be grouped according to many criteria: yield, stage of lactation, first-calf heifers etc. The main drawback of grouping is the time spent moving the cows from one group to another as production changes. These group changes can result in reduced milk yield due to social adjustment. In addition, several mixes have to be prepared and dispensed to suit each group.

Total mixed ration exemplifies a complete meal. It is defined as a mixture of all diet ingredients formulated to a specific nutrient requirement, mixed thoroughly and fed ad libitum to the cow.
Concentrate mix is formulated to supplement a basal diet and thus it is not a balanced feed . Animals supplemented include those grazing or fed on a basal diet.

5. CALF FEEDING AND STAGES IN CALF RUMEN DEVELOPMENT

Aim of calf feeding
The aim of calf feeding should be to reduce the mortality (death) rate while maintaining a growth rate of at least 400 g/day. For bigger breeds (Friesian and Ayrshire) the aim should be to wean calves at 12 weeks at approximately 80 kg body weight.
The primary concern in rearing the newborn calf is to ensure it remains healthy. Feeding management addresses nutrient requirements and in the initial stages should be primarily directed at encouraging rumen development.

Stages of development of the calf rumen

Calf feeding is divided into four phases, depending on the development stage of the digestive system.
When the calf is born, the rumen is not functional and forms only a small proportion of the stomach. As such the calf cannot digest complex fibrous feeds. The calf is thus fed on liquid feeds and low-fibre solid feeds until the rumen develops. As these feeds are mostly milk or milk by-products, which are expensive, early rumen development to allow feeding of cheap feeds is desirable. Early development is stimulated by feeding solid feeds.
Concentrate feeding has been shown to stimulate development faster than fibrous feeds.

Colostrum phase (1–3 days)
The calf is born with low immunity (protection from pathogens found in the environment) and is therefore susceptible to infections. Colostrum is the first milk extracted from the mammary gland of the cow after calving. Colostrum is a source of antibodies that protect the calf from these pathogens. It is therefore imperative for calves to get this milk immediately after birth as the rate of absorption is highest within the first 3 days.

Pre-ruminant phase (4 days to 20–30 days)
During the pre-ruminant phase, the calf rumen is still not functional and the calf can only take in liquids. The calf cannot digest complex carbohydrates or complex protein and thus only milk or milk by-products should be fed. Milk replacers should contain simple proteins. Rumen development starts towards end of this phase.

Transition phase (2 to 3 weeks before weaning)

Rumen development continues. In addition to liquids, the calf should be encouraged to consume dry feeds, especially concentrates, as they are known to accelerate rumen development.

Post-weaning phase

In the post-weaning stage, the rumen is fully functional and the calf can handle fibrous material. However, the calves should be weaned on high-quality pasture and fodder to maintain a high growth rate. Water should be made available ad libitum