

# 16

## Nutrition and young stock

### **This chapter:**

Explains the nutritional needs of heifers in their three phases of development – milk-fed calf, weaned calf and yearling.

### **The main points in this chapter:**

- a system of heifer rearing should produce healthy animals that are able to grow to target live weight with minimum input costs
- calves must consume at least 4 L of high quality colostrum in their first six hours of life; calves must be hand-fed colostrum if they cannot suckle
- calves should be fed to promote rumen development using high quality concentrates plus limited roughages
- calves can be weaned by six weeks of age if they are eating 0.75 kg concentrates per day
- young calves cannot eat enough forage to sustain good growth rates – forages alone are not suitable for milk-fed calves or for weaned calves until they reach 200 kg live weight
- good heifer growth rates are important for milk production and fertility and to minimise calving difficulties – growth rate in Friesians after weaning should average 0.6 to 0.7 kg/d
- growth should be monitored regularly (preferably by weighing) to ensure that targets are being met
- forages should be high quality (11 MJ/kg DM of ME) if used as the sole food for heifers less than 12 months of age
- forages should be supplemented with concentrates when heifer growth rates fall below 0.5 kg/d.

Well-grown dairy heifers are a good investment in the milking herd. To ensure they grow to become productive and efficient dairy cows, their management must be carefully planned and begin the day they are born.

A well-managed heifer rearing system aims for:

- good animal performance with minimal disease and mortality
- optimum growth rates to achieve target live weights
- minimum costs of inputs, such as feed (milk, concentrates, forages), animal health needs (veterinary fees, drugs) and other operating costs (milk-feeding equipment) to achieve well-reared heifers
- minimum labour requirements
- maximum utilisation of existing facilities such as sheds for rearing and quality forages for feeding.

There is no single best way to milk-rear calves. All sorts of combinations of feeding, housing and husbandry can be successful in the right hands and on the right farm. Successful calf rearing is a specialist job requiring suitable facilities. It also requires a genuine concern for the welfare of young calves and quick responses to early symptoms of disease. If farmers are unable to commit the time and resources to rearing their own replacement heifers, they should seriously consider paying someone who is better placed to do a good job. The establishment of cow colonies (see Section 11.4.3 in Chapter 11) and the sharing of resources of farmers supplying a single dairy cooperative provide the opportunity for a specialist calf and heifer rearer to milk rear and grow out the replacement stock for many farmers.

The first three months are the most expensive period in the life of any dairy cow. During that time, mortality rates are high, up to 10% in many cases. Calves need protection from the extremes of sun, wind and rain no matter what the rearing system. Disease prevention and treatment can be costly during early life.

## 16.1 Rearing the milk-fed calf

With their undeveloped digestive tract, calves require the highest quality and the most easily digestible source of nutrients: whole milk or milk replacers. Unfortunately, these are also the most expensive feeds. The most effective way of minimising the high feed costs of calf rearing is through early weaning and reduced milk feeding.

The essence of good calf rearing depends on two major nutritional factors. First, an adequate intake of high quality colostrum within the first day of life and, second, feeding management to encourage early rumen development.

### 16.1.1 Colostrum feeding

Newborn calves are very susceptible to disease. Before they can develop their own immunity they are entirely dependent on the antibodies contained in their mother's milk. It is therefore vital that they receive adequate quantities of antibody-rich colostrum from their mothers or from other freshly calved cows.

Calves should have access to 4 L of colostrum within the first six hours of life. They will not need any additional milk for the next 12 to 24 hr. Any calf that is suspected of not having suckled in the first 3 to 6 hr should be hand-fed the colostrum. With sick or weak calves, colostrum may have to be administered by stomach tube. It is not difficult to stomach-tube young calves.

Frozen colostrum (which can be stored for 18 months) can be thawed out and used, or colostrum from a mature cow within the herd can be fed. Fresh colostrum can be refrigerated for 7 to 10 d. Ideally, colostrum should be tested for antibody concentration to ensure it is of sufficient quality to store.

The level of immunity passed on by the cow increases with her age, since older animals have been exposed to a greater range of infectious organisms to which they have developed antibodies.

Replacement heifers born to first calving cows may require additional stored colostrum from older cows to ensure they develop good disease immunity. Vaccinating cows prior to calving for *Escherichia coli*, *Clostridia* and *Salmonella* can enhance the immune properties of colostrum.

The longer calves spend with their dams, the greater their chances of contracting disease. Therefore, newborn calves should be separated from their dams as quickly as is practically possible.

### 16.1.2 Early rumen development

The rumen is non-functional in newborn calves, hence, all digestion must take place in the abomasum (or true stomach) and the small intestine. The weaned calf needs a fully functional rumen in order to be well adapted to a forage-based diet. Before weaning, it is important to promote rumen development, so as to avoid growth checks when calves are weaned.

Rumen development occurs through the digestion or fermentation of feeds (roughages and concentrates) by the rumen microbes. Calves should be encouraged to eat solid feeds at an early age, mainly through limiting their access to milk to 4 L/d. From the first week, roughage such as clean straw should be offered in combination with high-quality concentrates specially formulated for rearing calves.

Fresh forages are not good sources of roughage for milk-fed calves. Such forages contain too little fibre, and their very high water content prevents high intakes of feed energy in each mouthful. This limits the feed energy available for rapidly growing animals. Until their rumen capacity is larger, young calves just cannot eat enough fresh forage to sustain high growth rates.

## 16.2 A successful early weaning recipe for calf rearing

Dairy farmers generally want to feed their calves on the best quality feeds to give the calves a good start to life. However, most farmers feed too much milk for too long.

By continuing to feed milk longer than is necessary, farmers often feed 400 to 500 L of milk (or its equivalent in milk replacer solution) to each calf. They need only feed 200 L of milk or less. Furthermore, much of this milk can be colostrum from calving cows, making the milk feeding costs very low.

If calves are strong, healthy and kept warm and dry, they can be successfully reared on once daily feeding with 4 L of whole milk, or its equivalent in milk replacer. All calves should be offered a specially formulated calf meal from one week of age. Milking cow concentrate formulations do not contain sufficient protein to meet the needs of young calves.

Calves should have limited access to fresh forages. The key to this rearing system is giving the calves continuous access to clean straw as a source of roughage. Note this is clean straw, not good quality pasture hay or lucerne hay.

All calves must be given the opportunity to nibble on the straw even though they will eat very little of it. Straw will encourage rumen development rather than provide nutrients.

If better quality hay is fed in place of straw, calves will eat more roughage but at the expense of concentrate consumption. If good quality hay is fed, it should be limited to 100 to 200 g/calf per day. Clean drinking water must be available at all times.

Feeding milk only once each day helps the calves to develop an appetite for the concentrates. It is the concentrate rather than the milk that should provide the bulk of nutrients to keep the calf growing. Calves can be weaned off milk once they are consuming 0.75 kg/d of concentrates for two or three consecutive days. This usually occurs by about 6 to 8 weeks of age.

Provided calves are eating 0.75 kg/d of concentrates, milk feeding does not have to be reduced gradually. Calves should continue to be housed indoors during weaning.

This system rears the rumen rather than the calf. Systems that involve feeding more milk do not encourage early rumen development and hence calves must be older before they can continue to grow without milk.

It is important that each calf drinks its allocation of milk. Lower milk intakes will limit calf performance because of the inability of the young animal to compensate by eating more concentrates. As well as reducing growth rates, underfed calves may be more susceptible to diseases and other stresses during life. Higher milk intakes will discourage concentrate consumption.

Ideally, calves should be housed individually or in small groups. They should also be individually bucket-fed. There is no advantage in milk feeding using teats rather than buckets; it only creates extra work in keeping them clean.

### **Weaning age**

The age when milk is no longer fed should depend on the quality of feeds available. For example, Ibrahim (1988) suggested calves should be weaned at:

- 2 months, when quantity and quality of roughage and concentrates are good
- 4 months, when quantity and quality of roughage and concentrates are average
- 6 months, when quantity and quality of roughage and concentrates are poor
- 8 months, when suckling and cows are dried off.

Provided they are not adversely affected by disease or very poor feeding management, the growth rates of calves up to weaning is far less of an issue than their performance post-weaning. Prior to weaning calves are fed milk, which contains all the essential nutrients for healthy growth, whereas after weaning the quality and amount of dry feeds has the biggest influence on calf performance. Invariably farmers save their best quality feeds for their milking cows, meaning that young stock suffer from poor feeding management. Weaning programs developed for young stock in temperate regions, where feed quality is usually better, then require close scrutiny to ensure they will still allow weaned stock to achieve their target growth rates (see Section 16.4.1).

### **Concentrate quality**

Milk-fed and weaned calves require concentrates containing higher protein levels (18–20%) than do milking cows (16%). Low protein concentrates will not promote the same rate of rumen and body development in milk fed calves. Consequently two months may be too young for weaning such calves.

Throughout South-East Asia, most formulated supplements for milking cows are formulated to 16% CP, even though on closer investigation (J Moran unpublished 2003), they are frequently below this content. For convenience, many small holder dairy farmers also feed these concentrates to their young stock. Such formulations are far from ideal because of the higher protein requirements of young stock. Depending on the quality of the basal roughage fed post-weaning, 18% may even be insufficient for the concentrates.

Very rarely can small holder farmers purchase higher protein formulated concentrates. In many cases these farmers are not aware of the benefits for their young stock in supplementing available milking concentrates with additional protein supplements.

High protein concentrates may be available, but at great expense, as they have been formulated for pig and poultry incorporating high quality protein ingredients. It would be ideal if a few large scale feed mills, either owned by dairy cooperatives or agribusiness, could formulate calf and heifer mixes with higher protein contents, utilising better quality energy sources and additional minerals and vitamins for optimal growth of young stock. Compared to the higher demand of concentrates specially formulated for milking cows, the formulation of smaller batches of calf/heifer mixes would not be cost effective for small dairy cooperatives.

## **16.3 Management of weaned replacement heifers**

All too often, farmers rear their heifer calves carefully until weaning but neglect them thereafter. Calves that are poorly managed after weaning are disadvantaged for their entire life. Even if they are well fed after mating, their ultimate mature size is restricted and if they do put on extra weight, it tends to be fat. Most of the growth in skeletal size occurs before, not after, puberty.

Weaned heifers do, however, require less attention than milk-fed calves and milking cows. Dairy heifers need to be well fed between weaning and first calving. If growth rates are not maintained, heifers will not reach their target live weights for mating and first calving.

Undersized heifers have more calving difficulties, produce less milk and have greater difficulty getting back into calf during their first lactation. When lactating, they compete poorly with older, bigger cows for feed. Because they are still growing, they use feed for growth rather than for producing milk. Many studies have demonstrated the benefits of well-grown heifers in terms of fertility, milk production and longevity.

### **16.3.1 Fertility**

The onset of puberty, and commencement of cycling, is related to live weight more than to age. A delay in puberty means later conception. All heifers should achieve their target

weight before joining, because lighter heifers have lower conception rates. Calving problems depend more on heifer live weights at mating, than on live weights or body condition at calving. Frame size is determined early, so there is doubtful merit in the practice of feeding older heifers to make up for poor growth earlier in life.

Friesian heifers mated below 260 kg had 34% conception to first insemination compared to 58% for heifers mated weighing 300 kg or more. Of the smaller heifers, 24% had difficult calvings. This declined to 8% in heifers mated at 260 to 280 kg and was lowest in 340 to 360 kg heifers. Heifers underweight at mating required considerable assistance if in difficulty during calving.

### 16.3.2 Milk production

Increasing calving Live Weights (LWT) for Friesians from 360 to 460 kg increased milk production during the first lactation by 400 L (Freeman 1993). This production benefit extended into both the second lactation, with an extra 830 L/extra 100 kg LWT, and the third lactation, with an extra 840 L/extra 100 kg live weight. Heifers calving 100 kg heavier can increase their peak production by 5 L/d during the first lactation.

However, there is little point in rearing well-grown heifers then underfeeding them during their first lactation. Bigger heifers have higher maintenance requirements, which must be met before additional nutrients produce milk. Therefore, good heifer rearing systems should be considered only after feeding systems for milking cows have been developed. Many South-East Asian small holder farmers do not feed their cows well enough to justify producing bigger heifers.

### 16.3.3 Heifer wastage

Poorly grown heifers do not last long in the milking herd. They are more likely to be culled for poor milk yield or poor fertility during their first lactation.

Total herd costs can be greatly increased by this high rate of wastage. Producers should aim to lose (through deaths or culling) no more than 20% of their replacement heifers between weaning and their second lactation.

## 16.4 Targets for replacement heifers

### 16.4.1 Live weight

Traditional target weights are too low to ensure first lactation heifers achieve their productivity potential, particularly on farms where milking cows are well fed. Recommended live weights for Friesian and Jersey heifers at various ages are summarised in Table 16.1. Targets for Zebu or local breed heifers would be similar to those for Jerseys.

Puberty occurs in dairy heifers at 35% to 45% of mature weight, while conception can occur at 45% to 50% of mature weight. A dairy cow will attain her mature live weight in about the fourth lactation and the objective of rearing heifers is to produce an animal 80% to 85% of mature live weight by first calving. Wither height sticks or chest girth tapes are an alternative to scales but they are not as accurate and tend to overestimate live weights.

**Table 16.1** Target weights for Friesian and Jersey heifers at different ages

(Source: Moran 2002)

Age (months)	Friesian live weight (kg)	Jersey live weight (kg)
2–3 (weaning)	90–110	65–85
12	250–270	200–230
15 (mating)	300–350	250–275
24 (pre-calving)	500–520	380–410

### 16.4.2 Wither height

Wither height (or height at the shoulder) is a good measure of bone growth and frame size in heifers. Frame size can influence ease of calving and appetite of milking cows. Farmers should aim for wither heights in Friesians of 123 to 125 cm at 15 m and 133 to 135 cm at 24 m. Corresponding wither heights in Jerseys (and Zebus) are 110 to 112 cm at 15 m and 120 to 122 cm at 24 m.

### 16.4.3 Age of teeth eruption

It is easy to estimate the approximate age of a heifer by inspecting the state of her teeth. A calf may be born without teeth with the temporary cheek teeth erupting within a few days and the temporary incisor teeth within two weeks.

The age at which the pairs of permanent incisor teeth erupt is as follows:

- first incisor teeth 18 to 24 months
- second incisor teeth 24 to 30 months
- third incisor teeth 36 months
- fourth incisor teeth 40 to 48 months

The permanent cheek teeth erupt between 6 and 36 months, but are harder to identify than the incisor teeth. The age of eruption permanent incisor teeth can vary with feeding regime.



The author John Moran, checking the age of heifers from the eruption of their incisor teeth (Central Java, Indonesia).

This is a very useful guide when objectively assessing the feeding management of young stock because poorly fed heifers may look healthy and relatively well grown, but if their first (or even second) incisor teeth have erupted they are likely to be much older than at first glance.

## 16.5 Energy and protein requirements for heifers

Table 16.2 shows the energy requirements (for maintenance and growth) of heifers growing at different rates at various live weights. The growth rates for 500 kg heifers assume a contribution of 0.4 kg/d from the growing foetus.

**Table 16.2** Energy and protein requirements for growing heifers

(Source: National Research Council 1989)

Live weight (kg)	Energy requirement MJ ME or (kg TDN/day)				Crude protein (%)
	Growth rate (kg/day)				
	0.4	0.5	0.6	0.7	
100	28 (1.8)	30 (2.0)	33 (2.2)	36 (2.4)	17
200	42 (2.8)	45 (3.0)	48 (3.2)	51 (3.4)	16
300	50 (3.3)	60 (4.0)	64 (4.2)	68 (4.5)	15
400	75 (4.9)	79 (5.2)	84 (5.5)	89 (5.9)	13
500	91 (6.0)	95 (6.3)	99 (6.5)	103 (6.8)	13

Growing heifers require a constant source of protein for optimum bone and muscle growth. Table 16.2 also lists crude protein requirements at different live weights.

## 16.6 Feeding heifers to achieve target live weights

Recommendations for grazing and feeding systems will differ between regions. Rather than depend on recipes, producers should regularly weigh their young stock, then vary feeding strategies according to their growth rates. Growth should average 0.6 to 0.7 kg/d, although that can vary between 0.5 and 1.0 kg/d, depending on available pasture and the supply and cost of suitable supplements.

As fresh forage is the cheapest feed, it should constitute the bulk of the diet, with hay, silage or concentrates used to overcome forage shortages. Fresh forages or conserved hay or silage must be of sufficient quality (at least 10 MJ of ME or 64% Total Digestible Nutrients, TDN) to satisfy the requirements for growth and maintenance.

Until calves reach 200 kg in weight, they are not able to maintain the growth rates needed to reach target weights on diets of either average quality forages or even top quality silage. Their capacity is limited and they simply cannot eat enough dry matter from the forages to meet their nutrient requirements for rapid growth. Forages must be good quality (at least 11 MJ of ME or 70% TDN) if used as the sole feed for heifers less than 12 months of age.

Forage quality and allocation should allow for continuous growth throughout the first two years. Uniform growth is not necessary and may be impracticable with seasonality of quality forage supplies. Yearling heifers have some ability for compensatory gain following periods of mild undernutrition, so long as they have not been grossly underfed. However, heifers should not be allowed to lose weight or to grow very slowly for long periods of time (ie no more than one month).

Ideally growing heifers should be continuously fed concentrates to supplement the fresh forage, the quantity offered depending on target growth rates and the nutrients provided from the forage.